FIRST FLOWERING DATE TRENDS IN CLAY COUNTY, MINNESOTA AND POLLINATION AND LIFE HISTORY CHARACTERISTICS OF HOARY PUCCOON (*LITHOSPERMUM CANESCENS)*

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Elise Marie Maxson

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Title

First flowering date trends in clay county, minnesota and pollination and life history characteristics of hoary puccoon *(Lithospermum canescens)*

By

Elise Marie Maxson

The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF SCIENCE

SUPERVISORY COMMITTEE:

Dr. Steven Travers
Chair

Dr. Gary Clambey

Dr. Jack Norland

Approved:

06/26/13
Date

Eakalak Khan
Department Chair

ABSTRACT

Plant species in Clay County, Minnesota have been changing their first flowering dates (FFDs) in response to climate changes. To document those shifts, in 2011 and 2012 I recorded phenological data for Clay County, Minnesota. I added that data to data which had been collected since 1910 for two locations in Minnesota and found that, on average, plants flowered 1 day later than their historical averages in 2011 and 16.1 days earlier in 2012.

I also performed experiments upon *Lithospermum canescens*, a native prairie forb which has shifted its first flowering date (FFD) significantly earlier than in the past century and which is underrepresented in tallgrass prairie restorations. I found that this species does not appear to be pollen limited, that the concurrently blooming plant species have changed noticeably since the early 1900s, and that this species is able to be grown by hand from seed (the first known attempt).

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Lastly, but most importantly, I thank my God for saving me and bringing me this far. It is because of Him that this thesis was begun and completed, and I could not have done it without His strength and mercy.

DEDICATION

I dedicate this master's thesis to my husband, Dale Maxson, and my mother, Gail Boehm. Without their unfailing support throughout the years I would not have been able to complete this goal, and without their wise perspectives I would not have made it to the end sane.

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CHAPTER 1. LITERATURE REVIEW-THE GENUS *LITHOSPERMUM*

Introduction

The genus *Lithospermum* is a taxon with a surprisingly large impact on human life. The plants of this genus are found in some of the earliest human cultural sites and may have played a role in the saving of innumerable human lives through the compounds found in its root fibers (Papageorgiou et al. 2008). Various *Lithospermum* species are valuable to native North American ecosystems as first colonizers of disturbed areas and/or to land managers and ecologists as indicators of the vegetative quality of native plant communities (Weller & Keeler 2000, cited in Molano-Flores 2001). The genus *Lithospermum* exhibits a broad range of morphological and genealogical characteristics and could therefore be useful for taxonomists researching character evolution (Cohen 2011). In addition, various *Lithospermum* species have unusual life history traits (including plasticity in first flowering date in the face of climactic changes) which, if researched more fully, could lead to a greater understanding of plant adaptive traits leading to better management of wild and domesticated plants in the decades to come. My goal in this literature review is to compile the scientific literature published on the genus *Lithospermum* in order to consolidate it and to shed light on areas that could benefit from future research.

Systematics

The genus *Lithospermum* includes approximately 40 species (taxonomists disagree on the exact number). The phylogenetic relationships of *Lithospermum* species have been characterized with molecular tools including ten chloroplast DNA regions in one study (Cohen 2011) and two chloroplast DNA regions and the nuclear ribosomal internal transcribed spacer in another

(Weigend et al. 2009). *Lithuspermum* species are clustered around Mexico and the southwest United States, but can be found on every continent except Australia and Antarctica (Cohen & Davis 2009). *Lithospermum* is a member of the tribe Lithospermaea, in the family Boraginaceae. As members of Boraginaceae, these plants have flowers which are generally perfect, in scorpoid inflorescences. The plants tend to be covered in hairs and have four ovules per ovary that can produce a maximum of four nutlets (Levin 1972). Plants in the tribe Lithospermeae are notoriously difficult to divide into genera and species (Cohen & Davis 2009, Govoni 1975) and the tribe Lithospermeae is considered the most primitive tribe in the family Boraginaceae, due to the diversity in its members' pollen characteristics (Liu et al. 2010, Gabel 1987).

Growth Form and Demographics

Many *Lithospermum* species are perennial (Weller 1985a, Ganders 1979) and at least one species (*L. caroliniense*) may live several hundred years (Weller 1985a) (the lifespans of other *Lithospermum* species are unrecorded). In general these species set small numbers of seed compared to their potential seed number (four) and germination of those seeds and seedling survival tends to be low (Weller 1985a, Weller & Keeler 2000, Westelaken & Maun 1985). In some species (e.g., *L. caroliniense*) ovule abortion is common; differences in pollen load do not change seed set significantly nor did removing ovules (Weller 1985a, Levin 1972). These findings are not surprising as fixed abortion rates and low seed production are common in Boraginaceae (cited in Weller 1985a, cited in Weller & Keeler 2000, Levin 1972). Interestingly, some *Lithospermum* studies found that changes in nutlet mass did not noticeably affect germination rates or seedling vigor, even in species where nutlet size varied widely (Weller 1985a, Salisbury & Preston 1949). Possibly because of that variability in reproductive output, large changes in *L. caroliniense* recruitment are common from year to year (Weller 1985a).

Additionally, one study has found that smaller populations (less than one hundred individuals) have lower fecundity levels than larger populations (more than one hundred individuals) (cited in Molano-Flores 2001). Despite low rates of fecundity, in at least one remnant prairie a fragmented *Lithospermum canescens* population retained high levels of genetic diversity decades after it was first disturbed (Kittelson & Handler 2006), possibly because these plants can be long lived (see above).

Members of *L. caroliniense* are able to flower their first year, although a very slow rate of first flowering was more commonly observed in two studies (Weller 1985a, Weller 1985b). *Lithospermum canescens* has been observed to flower in its second year (Kittelson & Handler 2006). In its first year of growth, *L. canescens* sends up one or more vegetative shoots from its below ground apical bud (personal observation). The duration of an open flower has been estimated at approximately four days (Parrish & Bazzaz 1979).

The genus *Lithospermum* is heterostylous; pollen and sexual organs are often noticeably dimorphic and occasionally trimorphic (Ganders 1979, Halsted 1889, Weller & Keeler 2000, Levin 1968). Unequal pollen flow between morphs and unequal pollen production has been measured repeatedly in this genus, with more total pollen coming from the pin morph, but more legitimate pollen (pollen capable of fertilizing ova) coming from thrum anthers (Weller & Keeler 2000, Levine 1968, Ganders 1979). Populations may have unequal ratios of plants per morph, and that inequality can vary from population to population (Westelaken & Maun 1985, Molano-Flores 2001, Levin 1968).

Stratification and scarification are required for germination in some species of *Lithospermum* (cited in Weller 1985a, Parkinson & DeBolt 2005, Westelaken & Maun 1985,

Blake 1935). No doubt, the pericarp of Lithospermaea renders scarification helpful, if not essential for *Lithospermum*. The pericarp of that tribe has four layers and is embedded with calcium carbonate and silicon dioxide (Pustovoytov et al. 2004). Depth of burial and supplemental watering in dry years also affected seedling emergence (Weller 1985b, Weller 1989, Chantre & Orioli et al 2009). Dormancy can last for more than two cold periods (Weller 1985b). Germination may be favored by hot, dry autumn weather, but long periods of drought affect *L. canescens, L. incisum* and *L. caroliniense* negatively (Blake 1935, cited in Blake 1935). *L. arvense* requires high summer temperatures to germinate (cited in Chantre & Orioli et al 2009).

Some species of *Lithospermum* exhibit early successional characteristics, such as colonization of burned sites and beach dunes, but those characteristics may vary from site to site (Weller 1985a, Humphrey 1984). *Lithospermum ruderale* requires disturbance or it is lost from the landscape (Humphrey 1984).

Lithospermum canescens and *L. caroliniense* have brittle, woody root structures (personal observation, Weller & Keeler 2000). At Palouse Prairie, in Idaho and Washington State, *Lithospermum incisum* has deeply penetrating taproots with few off-branches, and *L. ruderale* has widely spreading roots which penetrate five to six feet deep (Weaver 1958).

Reproduction

All species of *Lithospermum* exhibit heterostyly, distyly or tristyly and populations may exhibit cleistogamy as well as chasmogamy (Weller & Keeler 2000, Ganders 1979, Halsted 1889, Levin 1968, Smith 1879, Bessey 1880, Kittleson 2006; but see *L. incisum* notes in Halsted 1889). In addition, at least one species is capable of clonal reproduction, with clonal plants

growing up to one meter in width (Weller 1985a, Weller & Keeler 2000). At least one *Lithospermum* species may be semi-parasitic and can be propagated via cuttings (*L. canescens,* cited in Molano-Flores 2001). Self incompatibility is common in this genus, but some species are weakly self-compatible (Ganders 1979, Parrish & Bazzaz 1979, Levin 1972). In fact, in *L. caroliniense* populations as much as 27% of a cohort's seeds may come from cleistogamous flowers, and cleistogamous reproduction may increase when chasmogamic reproduction is low (Levin 1968, Levin 1972). However, in chasmogamic *L. caroliniense* flowers, pollen from the same morph is inhibited in the style, to ensuring outcrossing (Levin 1968).

Seeds of *Lithospermum caroliniense* do not disperse more than a few meters from the parent plant unless they are carried away by small mammals (Weller 1985a, Weller & Keeler 2000), and that lack of dispersal is probably common throughout *Lithospermum* due to the genus' large, heavy nutlets. In at least in one species large nutlet size is with higher germination rates than those associated with smaller nutlets; *Lithospermum caroliniense* establishes itself upon unstable sand dunes, and its large nutlet may result in nutlet burial by weather events as well as providing a larger taproot which could facilitate seedling survival in drought-prone areas (Weller 1985a). It is plausible that this characteristic could extend to other species growing in dry ecotypes, such as *L. canescens* and *L. incisum,* which grow on tallgrass prairies on well-drained soils (personal observation, Kittelson & Handler 2006). According to Weller (1985a) these heavy nutlets may play a role in the low seed set of this genus; diverting resources to a few nutlets is a potential adaptive value of abortion, however the specific reason and mechanism for ovule abortion is currently unknown.

The genus *Lithospermum* encompasses species with a wide variety of floral characteristics, from small (<10 mm) to large (>30 mm) corollas, which may be blue, yellow,

orange, white or any color in between. At least some species contain nectar (personal observation). Corolla lobes may be entire or laciniate, and corolla tubes also vary in depth (Weigend et al. 2009). Because of this variety, the pollination syndromes of these species vary between melittophily (bee pollination), psychophily (butterfly pollination), phalaenophily (moth pollination), ornithophily (bird pollination), or a combination of those four types. Reported pollinators of *L. caroliniense* are bumblebees, butterflies, sphinx moths and Ruby-throated hummingbirds (Weller 1985a, Weller & Keeler 2000). *Lithospermum canescens* and *L. caroliniense* attract "bees and butterflies" (Kittelson & Handler 2006, Levin 1968), long-tongued bees and *Vanessa cardui* (the painted lady, a butterfly; Molano-Flores 2001). Potential pollinators of *L. canescens* are insects including bees and moths (members of Anthophoridae, Apidae, Halictidae, and Lepidoptera; Parrish & Bazzaz 1979). Weller has recorded large annual variations in seed production and pollen load in *L. caroliniense*, which may have been due to the different responses of the species' main pollinators (bumblebees and butterflies) to the weather (Weller 1985a). In one study, potential pollinators visited *L. canescens* flowers most often from nine a.m. to after five p.m. when temperatures were between 21 to 24 C° (Parrish & Bazzaz 1979).

Osmia illinoensis (a solitary bee) has been seen collecting pollen from *L. canescens* and nectar on *Lithospermum* species, and Weller has observed solitary bees removing pollen from *L. caroliniense* stigmas (Robertson 1925, Weller 1985a, Crosswhite & Crosswhite 1966). Crosswhite and Crosswhite list *Osmia atriventris* as a pollinator of *Lithospermum* species. (Crosswhite & Crosswhite 1966). The larvae of *Ethmia longimaculla* (a moth) have been found eating *L. caroliniense* plants, and the larvae of the moth *Haploa reversa* have been found

predating *L. canescens* plants (Westelaken & Maun 1985, Molano-Flores 2001, personal observation).

Anthropological and Medical Aspects

Human beings have long been fascinated with themselves, specifically with their ancient history and their bodies. *Lithospermum* plays a role in both of those arenas. The seeds of *Lithospermum* species have been found in fossil layers from the Miocene period (5 to 23 million years before present) in South Dakota (specifically *Lithospermum dakotense*), a packrat midden in Texas from the Wisconsin Glacial Episode (10 to 110 thousand years before present) and anthropological sites as early as the Neolithic time period (Baczyńska & Lityńska-Zając 2005, Pustovoytov et al. et al. 2010, Gabel 1987, Van Devender et al. 1978). *Lithospermum* seeds have been found in about one third of all Mediterranean and Near Eastern anthropologic sites (cited in Pustovoytov et al. 2010). In addition, *Lithospermum officinale* seeds have been found in 13 Polish archaeological sites during routine archaeological investigations – two in Neolithic, four in Bronze Age, two in Roman period and two in Middle Age sites (Baczyńska & Lityńska-Zając 2005).

The carbon-14 found in biogenic carbonate in *Lithospermum* seeds can potentially be used for dating fossil and archeological sites, especially since the carbonate and silicon dioxide found in the seed's pericarp protect it from microbe chemicals (Pustovoytov et al. 2004, Pustovoytov et al. 2010). In addition, *Lithospermum* nutlets often persist intact in ancient sites because of the silica content in their seed coats (cited in Baczynsak & Lityńska-Zając 2005).

The seeds found in archeological sites are likely both naturally occuring (from weeds) and intentionally placed there by human inhabitants of the sites (Pustovoytov et al. 2004,

Baczyńska & Lityńska-Zając 2005). For example, at least two burial sites in Poland have been found in which *Lithospermum* nutlets were deliberately applied to corpses, presumably for perceived medicinal or magical purposes (Baczyńska & Lityńska-Zając 2005).

If ancient humans were using *Lithospermum* species for medicine, their intellectual offspring followed suit. Ancient herbalists from Pliny the Elder to people of the Ming Dynasty included two Boraginaceae species, *Anchusa tinctoria* and *Lithospermum erythrorhizon*, in their writings and in their medicinal preparations (Papageorgiou et al. 2008, Baczyńska & Lityńska-Zając 2005). *Lithospermum erythrorhizon* contains shikonin which is a "wound-healing, anti-inflammatory, antimicobial, antioxidant, antithrombotic and antitumor" chemical (Papageogiou 2008, Huang 2010). Shikonin and its chiral partner alkannin are found in about 150 species, but are primarily obtained from *L. erythrorhizon* and *Alkanna tinctoria* (another member of Boraginaceae) (Papageogiou 2008). This chemical pair has been used for centuries for its medicinal purposes, and they continue to be used in the medical community today (Papageogiou 2008). *Lithospermum radix* contains a chemical which causes apoptosis in human tumor cells, *L. ruderale* and *L.officinale* produce chemicals used for thyroid diseases, and *L. officinale* chemicals regulate hormone secretion in the pituitary gland and strengthen capillary vessels (cited in Baczyńska & Lityńska-Zając 2005).

Conclusion

Lithospermum is a genus that is found on every continent except Australia and Antarctica and contains approximately 40 species. Some of those species, such as *Lithospermum caroliniense*, have life history characteristics that are well documented, but most species have little or no information published about them; therefore, nothing conclusive can be said about

them other than to assume that characteristics found in the entire Boraginaceae family or Lithospermaea tribe, such as ovule number and inflorescence type, are found in each *Lithospermum* species.

From the life history characteristics that have been recognized, we can say that most *Lithospermum* species are perennial with low germination and seedling survival rates. Heterostyly is common in this genus, and plants set seeds enclosed in tough pericarps which are composed partially of calcium carbonate and silicon dioxide, which impact seed dispersal (Weller 1985a, Weller & Keeler 2000) and allow the seeds to persist for hundreds of years (Baczyńska & Lityńska-Zając 2005, Pustovoytov et al. et al. 2010, Gabel 1987, Van Devender et al. 1978). At least some *Lithospermum* species have root systems that penetrate deeply into the soil (Weller & Keeler 2000, Weaver 1958). This genus has exhibited cleistogamy (Weller & Keeler 2000, Ganders 1979, Halsted 1889, Levin 1968, Smith 879, Bessey 1880, Kittleson 2006) and clonal reproduction (Weller 1985a, Weller & Keeler 2000) and may be able to be propagated via cuttings (cited in Molano-Flores 2001). Flowers may be blue, yellow, white or any combination of those colors, and corolla tube length is variable (Weigend et al. 2009). At least one species, *L. erythrorhizon* has a compound in it that has been used medically for centuries (Papageorgiou et al. 2008, Baczyńska & Lityńska-Zając 2005).

Lithospermum canescens, the species included on in some of the studies below (see chapters 3 and 4), has not been the focus of many studies. Some studies on tallgrass prairie plants include one or two mentions of it in vegetative surveys, but only three other studies have been published based on research performed specifically on *L. canescens* (Kittleson & Handler 2006, Molano-Flores 2001, Parrish & Bazzaz 1979). These studies concentrated on the genetic makeup and fecundity of *L. canescens* and found the following: the populations maintained high

levels of genetic diversity generations after habitat fragmenting events (Kittleson & Handler 2006); populations of *L. canescens* may have skewed flower morphology ratios (Molano-Flores 2001; and that potential pollinators visited the *L. canescens* flowers most frequently from nine a.m. to after five p.m. (Parrish & Bazzaz 1979). Some life history characteristics, such as the fact that the species can bloom as early as two years old and that the flowers last approximately four days have also been reported (Kittelson & Handler 2006 , Parrish & Bazzaz). It is pollinated by "bees and butterflies" (Kittleson & Handler, Levin 1968, Molano-Flores 2001) and possibly moths (Parrish & Bazzaz 1979). *Haploa reversa* (the reversed haploa, a moth) larvae predate *L. canescens* plants (Molano-Flores 2001). Because of the paucity of studies, and the importance of this species on the landscape (Molano-Flores 2001), it is important to study *Lithospermum canescens* further in order to characterize life history details as well as to determine the research possibilities of the species.

Literature Cited

Baczyńska, B. & Lityńska-Zając, M. Application of *Lithospermum officinale* L. in early Bronze Age medicine. *Vegetation History and Archaeobotany* **14**, 77-80 (2005).

Bessey, C. E. The supposed dimorphism of *Lithospermum longiflorum* (*L. Angustifolium* Michx. of Gray's Synoptical Flora.). *The American Naturalist* **14**, 417–421 (1880).

Blake, A. K. Viability and germination of seeds and early life history of prairie plants. *Ecological Monographs* **5**, 408–460 (1935).

Chantre, G., Sabbatini, M. & Orioli, G. Effect of burial depth and soil water regime on the fate of *Lithospermum arvense* seeds in relation to burial time. *Weed Research* **49**, 81–89 (2009).

Cohen, J. A. phylogenetic analysis of morphological and molecular characters of *Lithospermum* L. (Boraginaceae) and related taxa: evolutionary relationships and character. *Cladistics* **27**, 559-580 (2011).

Cohen, J. & Davis, J. I. Nomenclatural changes in *Lithospermum* (Boraginaceae) and related taxa following a reassessment of phylogenetic relationships. *Brittonia* **61**, 101-111 (2009).

Crosswhite, F. S. & Crosswhite, C. D. Insect Pollinators of *Penstemon* Series *Graciles* (Scrophulariaceae) with notes on *Osmia* and other Megachilidae. *American Midland Naturalist* **76**, 450 (1966).

Gabel, M. L. A fossil *Lithospermum* (Boraginaceae) from the Tertiary of South Dakota. *American Journal of Botany* **74**, 1690–1693 (1987).

Ganders, F. Heterostyly in *Lithospermum cobrense* (Boraginaceae). *American Journal of Botany* **66**, 746-748 (1979).

Govoni, D. N. Evidence for divergence in *Lithospermum incisum* Lehm. in the western Great Plains. *Taxon* **24**, 431–441 (1975).

Halsted, B. Notes upon *Lithospermum*. *Botanical Gazette* **14**, 202-203 (1889).

Humphrey, L.D. Patterns and mechanisms of plant succession after fire on *Artemisia*-grass sites in southeastern Idaho. *Plant Ecology* **57**, 91–101 (1984).

Kittelson, P. M. & Handler, S. D. Genetic diversity in isolated patches of the tallgrass prairie forb, *Lithospermum canescens* (Boraginaceae). *The Journal of the Torrey Botanical Society* **133**, 513–518 (2006).

Levin, D. A. The breeding system of *Lithospermum caroliniense*: adaptation and counteradaptation. *American Naturalist* **102**, 427–441 (1968).

Levin, D. A. Plant density, cleistogamy, and self-fertilization in natural populations of *Lithospermum caroliniense*. *American Journal of Botany* **59**, 71–77 (1972).

Liu, J.-X., Li, J.-Y., Zhang, Y.-L. & Ning, J.-C. Pollen morphology of the tribe Lithospermeae of Boraginoideae in China and its taxonomic significance. *Plant Systematics and Evolution* **290**, 75-83 (2010).

Molano-Flores, B. What can happen to heterostylous species in prairie restorations? The case of *Lithospermum canescens* (Boraginaceae). *Proceedings of the 17th N.A. Prairie Conference* (2001) at <http://images.library.wisc.edu/EcoNatRes/EFacs/NAPC/NAPC17/reference/econatres.napc17.bmolanoflores.pdf>.

Papageorgiou, V. P., Assimopoulou, N. & Ballis, C. Alkannins and shikonins: a new class of wound healing agents. *Current Medicinal Chemistry* **15**, 3248-67 (2008).

Parrish, J. & Bazzaz, F. Difference in pollination niche relationships in early and late successional plant communities. *Ecology* **60**, 597–610 (1979).

Pustovoytov, K., Riehl, S., Hilger, H. H. & Schumacher, E. Oxygen isotopic composition of fruit carbonate in Lithospermeae and its potential for paleoclimate research in the Mediterranean. *Global and Planetary Change* **71**, 258-268 (2010).

Pustovoytov, K., Riehl, S. & Mittmann, S. Radiocarbon age of carbonate in fruits of *Lithospermum* from the early Bronze Age settlement of Hirbet ez-Zeraqn (Jordan). *Vegetation History and Archaeobotany* **13**, 207-212 (2004).

Robertson, C. Heterotropic bees. *Ecology* **6**, 412-436 (1925).

Salisbury, E. & Preston, G. Note on fruit size and viability in *Lithospermum officinale*. *Kew Bulletin* **4**, 153–155 (1949).

Smith, E. F. Trimorphism in *Lithosperum canescens*. *Botanical Gazette* **4**, 168-169 (1879).

Van Devender, T. R., Freeman, C. E. & Worthington, R. D. Full-glacial and recent vegetation of Livingston Hills, Presidio County, Texas. *The Southwestern Naturalist* **23**, 289–301 (1978).

Weaver, J. E. Classification of root systems of forbs of grassland and a consideration of their significance. *Ecology* **39**, 394–401 (1958).

Weigend, M., Gottschling, M., Selvi, F. & Hilger, H. H. Marbleseeds are gromwells-systematics and evolution of *Lithospermum* and allies (Boraginaceae tribe Lithospermeae) based on molecular and morphological data. *Molecular Phylogenetics and Evolution* **52**, 755-68 (2009).

Weller, S. G. The effect of disturbance scale on sand dune colonization by *Lithospermum caroliniense*. *Ecology* **70**, 1244–1251 (1989).

Weller, S. Establishment of *Lithospermum caroliniense* on sand dunes: the role of nutlet mass. *Ecology* **66**, 1893-1901 (1985).

Weller, S. & Keeler, K. Clonal growth of *Lithospermum caroliniense* (Boraginaceae) in contrasting sand dune habitats. *American Journal of* **87**, 237-242 (2000).

Weller, S. G. Pollen flow and fecundity in populations of *Lithospermum caroliniense*. *American Journal of Botany* **67**, 1334 (1980).

Westelaken, I. L. & Maun, M. Reproductive capacity, germination and survivorship of *Lithospermum caroliniense* on Lake Huron sand dunes. *Oecologia* **66**, 238–245 (1985).

CHAPTER 2. FIRST FLOWERING DATE TRENDS IN CLAY COUNTY, MINNESOTA

Introduction

For many decades studies have shown that humans are causing widespread changes to occur in global and local climate patterns and these changes have noticeably affected many thousands of species worldwide, including insects, mammals, birds and plants (Parmesan 2006). Specifically, these climactic changes have caused species to change the timing of their life cycle events. Of these, plants may be the easiest to study phenologically (Parmesan 2006), due to their sedentary tendencies, long-time association with humans and the obviousness of certain parts of their life cycles. Throughout the years, researchers have found that phenological changes vary over time primarily because of local climate changes. Phenological responses also vary greatly from species to species, although there is evidence that phenological changes may be similar within higher order taxonomic groups (Mazer et al. 2013). It is important to determine which plant species change their phenology and how so that the effects of future climate changes can be monitored comparatively and, hopefully, anticipated in order to provide guidance for land managers and for future research.

The goals of this study are to 1) monitor current flowering phenology patterns of plant in Clay County Mineesota and 2) compare current phenological patterns to historical patterns for the same species in the same location.

Materials and Methods

In 2011, field observations were made at two locations in Clay County, Minnesota (Figure 2.1): 1) The Nature Conservancy's Bluestem Prairie Scientific and Natural Area

(Bluestem Prairie) and 2) the Jarvis parcel in the Fish and Wildlife Service's Detroit Lakes Wetland Management District (Jarvis).

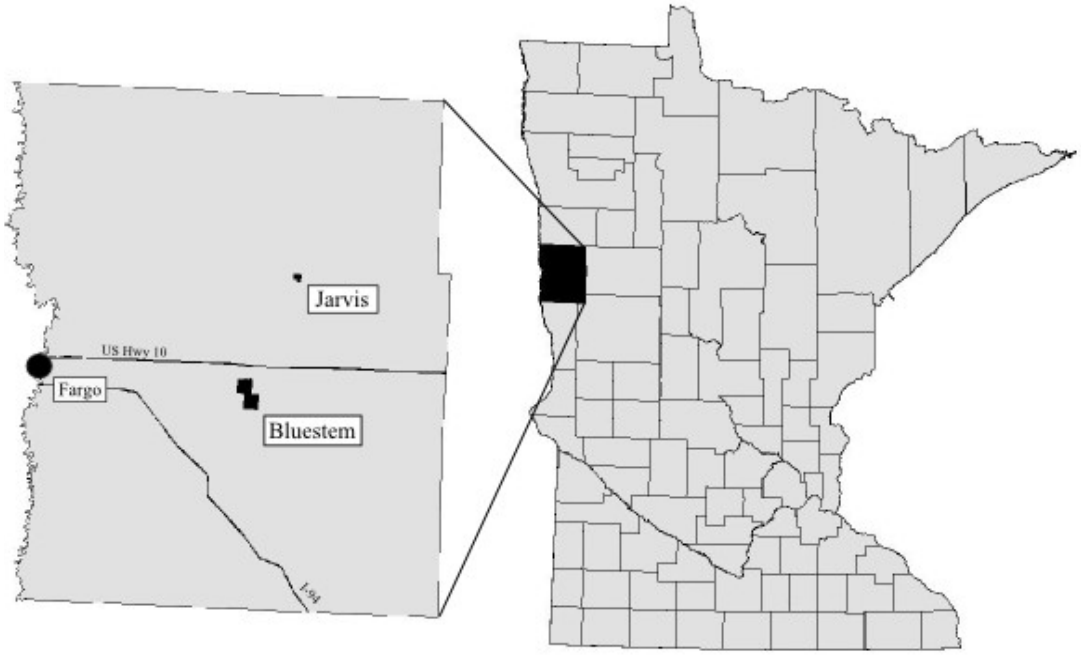

Figure 2.1. Bluestem Prairie Scientific and Natural Area and the Jarvis parcel, both of which are in Clay County, Minnesota. GIS data from the Minnesota DNR MIS Bureau, the Minnesota Department of Transportation, Survey and Mapping and the Minnesota DNR Division of Ecological Services Scientific and Natural Areas Program.

Bluestem Prairie Scientific and Natural Area (Bluestem Prairie) is located six and a half kilometers southeast of Glyndon, Minnesota (Lat/Lon: 46.87°N 96.48°W) (Figure 2.2). My study site at Bluestem Prairie was about 10.5 hectares in size. The predominant soil types are fine sands, with occasional loamy sands, sandy loams and clay loams. My study sites are on or directly adjacent to one of the Lake Agassiz beach ridges; therefore plant communities present include dry-mesic and mesic prairies and wetlands. Woodland species are also present in certain areas on Bluestem Prairie. Both Bluestem Prairie and Jarvis (see below) are classified as Northern Dry Prairies according to the Minnesota Department of Natural Resources' Native Plant

Communities classification system. Between 1977 and 2012 my study site at Bluestem was burned eleven times (an average of once per 3.2 years), had no herbicide applications and was not seeded with native plants.

The Jarvis parcel (Jarvis) is located 45 kilometers east of Hitterdal, Minnesota (Lat/Lon: 46.95°N 96.39°W) (Figure 2.3). I censused an area that was approximately 5 hectares in size. The main soil types are loams. Like Bluestem Prairie, Jarvis is in the tallgrass prairie ecosystem, and the communities that I sampled ranged from dry prairie to mesic prairie. Unlike Bluestem Prairie, Jarvis is not located on a beach ridge and has numerous prairie potholes. Jarvis was acquired in 1970 from a farmer who had used the area as pasture land. Since then it has not been grazed or seeded. The Jarvis parcel has been burned three times since 1995, (in 1995, 2000 and 2010), and had tree removal treatments applied in 2008 and 2012. No herbicide has been applied to the study site since the FWS obtained it in 1970.

In 2011, I initiated censuses of flowering plants at the Jarvis parcel of the Detroit Lakes Wetland Management District and The Nature Conservancy's Bluestem Prairie during the week of April 24th, which was the week herbaceous plants began blooming for that growing season. A census of each site consisted of walking the same route each time and recording the identity of all prairie and woodland plant species in flower. The route surveyed at Bluestem was approximately 3 kilometers long, and the route surveyed at Jarvis was also approximately 3 kilometers long.

These censuses were performed weekly between April and September on Bluestem Prairie, and intermittently between April and August on the Jarvis parcel. In total, I censused Bluestem Prairie approximately twenty times and the Jarvis parcel approximately five times over

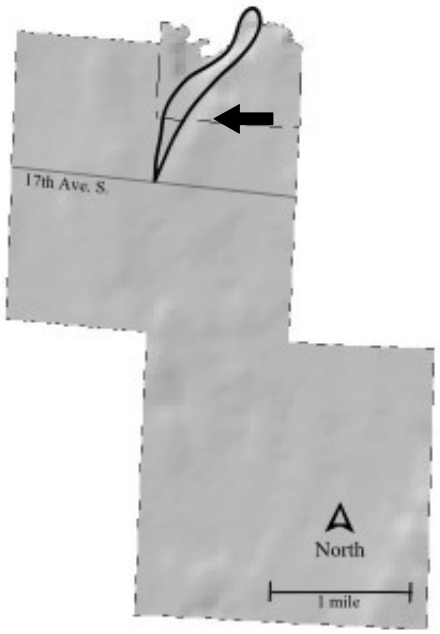

Figure 2.2. Survey route taken on Bluestem Prairie in 2011 and 2012. GIS data from the Minnesota DNR MIS Bureau, the Minnesota Department of Transportation, Survey and Mapping and the Minnesota DNR Division of Ecological Services Scientific and Natural Areas Program.

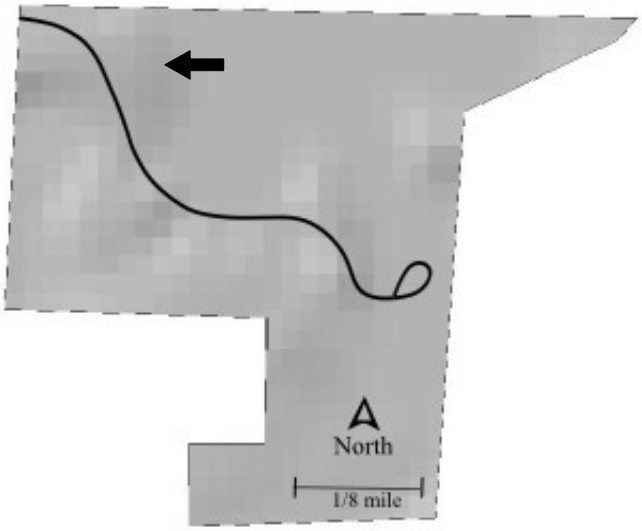

Figure 2.3. Survey route taken on the Jarvis parcel in 2011. GIS data from the Minnesota DNR MIS Bureau, the Minnesota Department of Transportation, Survey and Mapping and the Minnesota DNR Division of Ecological Services Scientific and Natural Areas Program.

the length of the growing season. In addition, as I performed a pollen limitation experiment on Bluestem Prairie and the Jarvis parcel (chapter 3) I recorded newly blooming species when I saw them. This tripled the plant observations I made while censusing each site. Flowering species were first identified from memory, if possible, and then were checked against wildflower field guides. If the species was not recognized initially, field guides were used to determine its identity.

In 2012, I surveyed flowering prairie and woodland plants at Bluestem Prairie using the same methods as in 2011. I began this census March 25th (the beginning of flowering in 2012) and ended the first week of August. In total, I surveyed the Bluestem Prairie plants 18 times. I also recorded newly blooming species as I found them opportunistically while performing a pollen limitation study on Bluestem Prairie (chapter 3). I visited the Jarvis parcel once in the spring, but did not visit it again in 2012 due to time constraints. I did not record any flowering data for the Jarvis parcel in 2012. In addition to regular censuses I made additional observations occasionally between the censuses.

Climate information for this study was collected by Steven Travers (personal communication) from the NOAA Weather Station near Ada Minnesota. Cumulative Annual Growing Degree Units were calculated by summing the degrees above 0º C and below 32.2º C for each day of the year.

The first flowering dates (FFD) for applicable species in 2011 and 2012 were compared to the mean FFD for the same species observed by O. A. Stevens between 1910 and 1960 (Travers & Dunnell 2009). In order to standardize the comparisons among years and varying sample sizes I calculated the deviation from the mean by calculating a z-score for each species in

2011 and 2012. The formula for the z-score was the following: ($z = (\chi-\mu)/\sigma$) where χ = the FFD in either 2011 or 2012, μ = the mean FFD between 1910 and 1960, and σ = the standard deviation of the mean FFD between 1910 and 1960 (Zar 2010). Comparisons were only made if there were a minimum of 2 values for the 1910 to 1960 mean. In order to compare the mean FFD values for the recent five years compared to the period between 1910 and 1960 I combined observations made by Dunnell and Travers (2010) with my observations from 2011 and 2012. In 2011 and 2012 I observed species flowering that were not included in the comparisons because they were not reported by Stevens. There were a total of eleven species that I observed but did not compare in 2011 and 2012.

In order to examine possible trends across the growing season in tendency to shift flowering time, each species' z-score was plotted against the FFD of that species surveyed in 2011 and 2012 from the same year (Table 2.2).

The mean z-scores for 2011 and 2012 and the ΔFFD (from 1910-1961 to 2007-2012) were compared among the lifeforms of the plants. The lifeforms included graminoid, forb, shrub and tree. Lifeform type was assigned based upon the vegetative characteristics of each species. For example, if the species had one main, persistent, woody stem and was capable of growing taller than three meters it was considered a tree. Mean FFD for each lifeform in 2011 and 2012 was compared with one-way ANOVAs, as was the ΔFFD (current FFD – average FFD from 1910 to 1961). A Tukey-Kramer HSD test was run comparing the ΔFFDs among lifeforms and mean FFDs also. These tests were performed with the statistical program JMP (SAS Institute Inc. 1989-2007).

Mean z-scores and ΔFFD values were calculated for eighteen families in 2011 and seventeen families in 2012. Only families with more than one surveyed species were included. Means among families were compared with a one-way ANOVA using the statistical program JMP (SAS Institute Inc. 1989-2007), and the ΔFFDs were compared among families in the same manner. The mean FFD and ΔFFD values among families were compared with a Tukey-Kramer HSD test with JMP (SAS Institute Inc. 1989-2007).

Results

Long term weather data from the Fargo area (see Dunnell and Travers 2010) indicate that in general the climate at the study sites has shifted to warmer temperatures and more Annual Growing Degree Units (AGDUs) than in the past century. In particular, 2011 was 1.2ºC warmer, had 4.6 inches more precipitation, had prior winter snow accumulation of 52.7 more inches than average historically, accumulated 20.9 more inches of snow from January to May, froze 12.0 days earlier and had 446 more Annual Growing Degree Units in comparison to the average values for 1910-1961. In contrast, compared with the data from 1910-1961, 2012 was warmer by 4.9ºC, accumulated comparable precipitation (0.8 inches more in 2012), had a prior winter snowfall of 10.9 inches less than in the early 20th century, had 1.5 inches less snowfall from January to March, froze 12.0 days earlier and accumulated 896 more AGDUs. Compared to 2007-2012's average climate indicators, 2011 was slightly cooler than average (by 0.6ºC), slightly drier (1.0 inches less precipitation), was following a winter that was snowier than average (by 39.9 inches), had more spring snow (by 8.6 inches), had its first freeze sooner (by 18.8 days) and had 79 more AGDUs in it. In comparison to 2007-2012's averages, 2012 was 3.1ºC warmer and had 5.8 fewer inches of precipitation drier, followed a winter with 23.8 fewer inches of snow, had 3.7 fewer inches of snow from January through May, the first freeze of fall

came 16.8 days earlier and it had 529 more AGDUs. In sum, 2011 was warmer than historical and had about the same mean temperature as the average for the last five years. It was also a lot snowier than both periods, had an earlier freeze than usual and had many more AGDUs than the first half of the 20th century and the average for recent years. The year 2012 was much warmer than both the beginning of the last century and this century, had precipitation levels similar to historical levels but much less than the average for this century, had less snowfall than both measures, froze earlier than the early 20th and 21st centuries and accumulated more AGDUs than historical and recent averages.

Table 2.1. Climate information for Ada, in Clay County, Minnesota from 1910 to 2012.

Year(s)	Average Annual Temperature (Celcius)	Average Annual Precipitation (in)	Prior Winter Snowfall (in)	Snowfall January – May (in)	First Freeze of Fall (DOY)	Annual Growing Degree Units
1910-1961 (mean)	5.02	19.37	35.78	22.45	267.98	5287
2007-2012 (mean)	6.81	25.95	48.65	34.7	274.83	5654
2010	6.36	29.5	46.6	20.8	274	5862
2011	6.17	24	88.5	43.3	256	5733
2012	7.96	20.2	24.9	21	257	6183

In 2011, 65 plant species were observed that had been observed by Stevens prior to 1962. In 2012, 67 species were observed that had also been observed by Stevens. Thirty-six of the 96 species in Table 2.2 were observed in both 2011 and 2012. The earliest blooming species in 2011 was *Capsella bursapastoris* with an FFD of 98 (April 8th), and the last blooming flower of that season was *Allium stellatum* which bloomed on the 245th day of the year (September 2nd). In

2012 the first blooming species was *Populus tremuloides* which bloomed on the 75th day of the year (March 15th), and *Liatris aspera* was the last blooming plant with an FFD of 227 (August 14th) (neither *P. tremuloids* or *L. aspera* were recorded in 2011).

In 2011, the z-scores ranged from -7.8 to 7.8 standard deviations and the average was 0.6. In 2012, the z-scores ranged from -12.0 to 7.1 standard deviations and the average was -1.8. A negative z-score indicates a shift earlier in phenology. The by-species shift in mean FFD (ΔFFD) between recent (2007-2012) and historical (1910-1961) records ranged from -33.9 to 78.7 days with a mean of -2.4 days. The ΔFFD shift from historical records vs. 2011 was 1.0 day and the shift from historical records vs. 2012 was -16.1 days.

Regression analysis indicates that the z-score per species was significantly positively related to FFD in both 2011 and 2012 (Figures 2.4 and 2.5). The equation of the fitted line for the relationship between z-score and FFD for 2011 is z-score = -3.913 + 0.29FFD and the equation for 2012 is z-score = -7.665 + 0.042FFD. The r-squared values are 0.108 and 0.402, respectively, with f-ratios of 7.475 and 44.765 and p-values of 0.0008 and <0.0001. The sample sizes for 2011 and 2012 were 64 and 70 species respectively. Observations were unusable for calculations if the species had had too few observations prior to 2011 or 2012 for an accurate standard error to be calculated. The most notable distinctions between the two years are the y-intercepts in each data set's best fit line (-3.913 and -7.665) and the differences in the f-ratios (7.475 and 44.765). The positive f-ratios indicate that the variance in the means of the sample are not due to random chance, and that is especially true for the 2012 data set. The fact that the y-intercept is lower in 2012 versus 2011 indicates that in 2012 species bloomed earlier overall than in 2011.

Table 2.2. Characteristics of native plant species found in Clay County, including family name, scientific and common names, lifeform and first flowering date (FFD) information from 1910 to 2012, including z-scores and mean shift in first flowering date from the 1910-1961 period to the 2007-2012 period.

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Aceraceae	*Acer saccharinum*	silver maple	tree	103	3.30	78	-18.30	99.2	51	1.2	96.4	5	5.4	-2.8
Aceraceae	*Acer negundo*	boxelder	tree			83	-24.45	115.4	47	1.3	104.5	4	8.4	-10.9
Apiaceae	*Cicuta maculata*	spotted water hemlock	herb	192	6.32	191	5.87	177.8	6	2.2	187.0	4	3.4	9.2
Apiaceae	*Osmorhiza longistylis*	sweet cicily	herb	143	-2.73			150.9	9	2.9	152.0	2	9.0	1.1
Apiaceae	*Pastinaca sativa*	wild parsnip	herb			158	-7.11	168.3	3	1.5	158.0	1	n/a	-10.3
Apiaceae	*Zizia aptera*	meadow zizia	herb			118	-8.77	142.6	8	2.8	137.7	3	9.8	-5.0
Apiaceae	*Zizia aurea*	meadow parsnip	herb			122	-15.13	146.8	22	1.6	140.8	4	6.5	-6.0
Apocynaceae	*Apocynum hypericifolium*	Indian hemp	herb			162	-5.50	173.9	14	2.2	162.0	1	n/a	-11.9
Asclepiadaceae	*Asclepias incarnata*	swamp milkweed	herb	192				187.0	2	1.0	192.0	1	n/a	5.0

Table 2.2. Characteristics of native plant species found in Clay Country (continued).

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Asclepiadaceae	*Asclepias ovalifolia*	oval-leaf milkweed	herb	165	-0.87			167.8	5	3.2	175.0	3	5.8	7.2
Asclepiadaceae	*Asclepias speciosa*	showy milkweed	herb	192	2.34			181.7	3	4.4	192.0	1	n/a	10.3
Asclepiadaceae	*Asclepias syriaca*	common milkweed	herb			165	-6.73	176.4	9	1.7	178.3	3	6.7	1.9
Asteraceae	*Achillea millefolium*	common yarrow	herb	165	-0.69	138	-13.08	166.5	8	2.2	158.8	5	5.7	-7.7
Asteraceae	*Ratibida columnifera*	upright prairie coneflower	herb	192	1.73	172	-3.80	185.8	8	3.6	184.4	5	5.2	-1.3
Asteraceae	*Taraxacum officinale*	common dandelion	herb	103	-23.86	86	-40.11	128.0	49	1.0	166.8	5	71.6	38.8
Asteraceae	*Antennaria aprica*	small-leaf pussytoes	herb			116	-0.97	120.7	6	4.8	116.0	1	n/a	-4.7
Asteraceae	*Aster nova-angliae*	New England aster	herb			191	-15.58	224.9	17	2.2	191.0	1	n/a	-33.9
Asteraceae	*Cirsium altissimum*	tall thistle	herb	192	-3.83			215.0	2	6.0	192.0	1	n/a	-23.0
Asteraceae	*Gaillardia aristata*	common gaillardia	herb	171	-0.15			171.8	5	5.2	168.5	4	3.7	-3.3

Table 2.2. Characteristics of native plant species found in Clay Country (continued).

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Asteraceae	*Helianthus maximiliani*	Maximilian sunflower	herb			192	-8.12	210.5	16	2.3	194.5	2	2.5	-16.0
Asteraceae	*Liatris aspera*	tall blazing star	herb			227	4.18	217.6	5	2.2	214.3	3	11.7	-3.3
Asteraceae	*Liatris punctata*	dotted blazing star	herb			215	-0.67	217.0	2	3.0	220.0	2	5.0	3.0
Asteraceae	*Liatris pycnostachya*	prairie blazing star	herb			226	13.77	202.8	5	1.7	218.0	2	8.0	15.2
Asteraceae	*Solidago canadensis*	Canada goldenrod	herb			216	-1.12	218.5	13	2.2	219.5	2	3.5	1.0
Asteraceae	*Tragopogon dubius*	yellow salsify	herb	161	1.87			158.5	17	1.4	161.3	4	3.1	2.8
Betulaceae	*Corylus americana*	American hazelnut	tree	103	0.07	78	-9.16	102.8	11	2.7	96.4	5	5.4	-6.4
Betulaceae	*Betula papyrifera*	paper birch	tree			79	-35.61	125.6	33	1.3	97.5	2	18.5	-28.1
Boraginaceae	*Lithospermum canescens*	hoary puccoon	herb	138	-0.47	116	-7.67	139.4	7	3.1	129.0	6	3.5	-10.4
Boraginaceae	*Lithospermum incisum*	narrow-leaved puccoon	herb	153	4.49	158	6.34	140.9	7	2.7	148.6	5	3.5	7.7

Table 2.2. Characteristics of native plant species found in Clay Country (continued).

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Brassicaceae	*Capsella bursapastoris*	shepherd's purse	herb	98	-7.28	80	-13.40	119.4	15	2.9	91.3	4	6.8	-28.2
Brassicaceae	*Erysimum chieranthoides*	wormseed wallflower	herb			227	3.18	148.3	3	24.7	227.0	1	n/a	78.7
Campanulaceae	*Campanula rotundifolia*	bluebell bellflower	herb	167	-1.83	216	5.24	179.7	3	6.9	179.3	4	12.7	-0.4
Campanulaceae	*Lobelia spicata*	palespike lobelia	herb	192	2.08	191	1.80	184.7	3	3.5	193.3	3	1.9	8.7
Caprifoliaceae	*Symphoricar-pos occidentalis*	western snowberry	shrub			173	-1.99	179.4	9	3.2	174.0	2	1.0	-5.4
Caryophyllaceae	*Cerastium arvense*	field chickweed	herb	134	-0.25	116	-8.09	134.6	12	2.3	126.4	5	4.3	-8.2
Commelinaceae	*Tradescantia bracteata*	longbract spiderwort	herb	167	6.26	157	2.64	149.7	10	2.8	162.0	2	5.0	12.3
Cyperaceae	*Carex pennsylvanica*	Pennsylvania sedge	grasslike	127	2.75	98	-9.98	120.7	15	2.3	112.5	2	14.5	-8.2
Euphorbiaceae	*Euphorbia esula*	leafy spurge	herb	140	-13.42			163.7	3	1.8	140.0	1	n/a	-23.7

Table 2.2. Characteristics of native plant species found in Clay Country (continued).

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Fabaceae	*Medicago sativa*	alfalfa	herb	165	2.40	125	-15.17	159.5	15	2.3	145.0	2	20.0	-14.5
Fabaceae	*Melilotus alba*	white sweetclover	herb	178	3.84	126	-30.31	172.2	13	1.5	152.0	2	26.0	-20.2
Fabaceae	*Amorpha canescens*	leadplant	shrub			178	-3.22	185.7	7	2.4	184.3	4	4.1	-1.5
Fabaceae	*Amorpha fruticosa*	desert false indigo	shrub	173	3.41			154.8	6	5.3	173.0	1	n/a	18.2
Fabaceae	*Melilotus officinalis*	yellow sweetclover	herb	161	1.39			159.0	23	1.4	164.5	2	3.5	5.5
Fabaceae	*Trifolium pratense*	red clover	herb	165	4.01			159.2	9	1.4	165.0	1	n/a	5.8
Fabaceae	*Trifolium repens*	white clover	herb	167	9.98			153.0	12	1.4	167.0	1	n/a	14.0
Fabaceae	*Vicia americana*	American vetch	herb	139	-7.26			150.0	22	1.5	145.7	3	7.7	-4.4
Hydrophyllaceae	*Hydrophyllum virginianum*	eastern waterleaf	herb	148	0.96			147.0	33	1.1	145.8	4	2.3	-1.2

Table 2.2. Characteristics of native plant species found in Clay Country (continued).

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Iridaceae	*Sisyrinchium angustifolium*	narrowleaf blue-eyed grass	herb			126	-5.62	141.5	11	2.8	139.0	5	4.5	-2.5
Lamiaceae	*Leonurus cardiaca*	common motherwort	herb			165	-3.38	185.7	3	6.1	165.0	1	n/a	-20.7
Lamiaceae	*Monarda fistulosa*	wild bergamot	herb	195	n/a	192	n/a	202.0	1	n/a	193.5	2	1.5	-8.5
Lamiaceae	*Prunella vulgaris*	common selfheal	herb	178	5.67			169.5	2	1.5	178.0	1	n/a	8.5
Liliaceae	*Allium stellatum*	autumn onion	herb	245	9.06	216	0.74	213.4	7	3.5	221.4	5	6.7	8.0
Liliaceae	*Maianthemum canadense*	Canada mayflower	herb	143	-1.00	95	-17.00	146.0	2	3.0	119.0	2	24.0	-27.0
Liliaceae	*Trillium cernuum*	nodding wake robin	herb	143	1.34	124	-4.39	138.6	7	3.3	137.6	5	4.0	-1.0
Liliaceae	*Zigadenus elegans*	mountain death camas	herb	178	2.79	162	-8.84	174.2	6	1.4	172.0	5	2.8	-2.2
Liliaceae	*Lilium philadelphicum*	wood lily	herb	192	9.04			174.5	4	1.9	181.3	4	4.3	6.8

Table 2.2. Characteristics of native plant species found in Clay Country (continued).

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Liliaceae	*Uvularia grandiflora*	largeflower bellwort	herb			124	-2.69	130.1	7	2.3	130.0	3	3.1	-0.1
Liliaceae	*Convallaria majalis*	European lily of the valley	herb			122	-7.04	140.8	5	2.7	122.0	1	n/a	-18.8
Linaceae	*Linum sulcatum*	grooved flax	shrub			191	4.00	179.0	2	3.0	191.0	1	n/a	12.0
Oleaceae	*Syringa vulgaris*	common lilac	herb	139	0.08	124	-13.29	138.9	44	1.1	128.3	3	5.4	-10.6
Onagraceae	*Oenothera biennis*	common evening primrose	herb	201	2.93			193.6	13	2.5	199.0	2	2.0	5.4
Onagraceae	*Oenothera nuttallii*	Nuttall's evening primrose	herb			191	2.69	177.0	6	5.2	195.5	4	1.8	18.5
Orchidaceae	*Cypripedium candidum*	white lady's slipper	herb	165	2.82			152.7	3	4.4	152.5	4	4.3	-0.2
Oxalidaceae	*Oxalis violacea*	violet wood sorrel	herb	140	-0.92	121	-13.61	141.4	16	1.5	134.2	6	3.2	-7.2
Oxalidaceae	*Oxalis stricta*	common yellow oxalis	herb	160	1.31			155.3	6	3.6	148.0	4	11.0	-7.3

Table 2.2. Characteristics of native plant species found in Clay Country (continued).

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Papaveraceae	*Sanguinaria canadensis*	bloodroot	herb			94	-9.91	116.7	16	2.3	102.7	3	6.3	-14.0
Polygalaceae	*Polygala senega*	Seneca snakeroot	herb	160	2.41			152.3	3	3.2	160.0	1	n/a	7.7
Ranunculaceae	*Anemone canadensis*	Canada anemone	herb	160	1.34	139	-10.47	157.6	13	1.8	152.8	4	5.1	-4.9
Ranunculaceae	*Anemone cylindrica*	candle anemone	herb	171	-0.74	165	-2.74	173.2	5	3.0	171.3	4	2.3	-1.9
Ranunculaceae	*Anemone patens*	pasque flower	herb	108	2.75	83	-2.98	96.0	3	4.4	100.7	6	4.1	4.7
Ranunculaceae	*Caltha palustris*	yellow marsh marigold	herb	140	4.29	109	-4.88	125.5	4	3.4	123.5	6	5.1	-2.0
Ranunculaceae	*Ranunculus abortivus*	littleleaf buttercup	herb	134	2.54	116	-1.99	123.9	10	4.0	128.2	5	4.4	4.3
Ranunculaceae	*Ranunculus rhomboideus*	prairie buttercup	herb	127	2.58	94	-7.03	118.1	14	3.4	112.3	6	5.6	-5.8
Ranunculaceae	*Actaea rubra*	baneberry	herb			122	-17.01	141.3	25	1.1	135.0	2	13.0	-6.3
Ranunculaceae	*Aquilegia canadensis*	wild columbine	herb	148	2.09			144.7	14	1.6	145.5	2	2.5	0.8

Table 2.2. Characteristics of native plant species found in Clay Country (continued).

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Rosaceae	*Potentilla arguta*	tall cinquefoil	tree	171	-2.13	156	-7.45	177.0	9	2.8	171.3	4	5.5	-5.8
Rosaceae	*Prunus americana*	American plum	shrub	139	8.34	99	-28.23	129.9	50	1.1	125.8	5	8.1	-4.1
Rosaceae	*Rosa arkansana*	prairie wild rose	tree	167	0.95	152	-10.84	165.8	14	1.3	163.0	5	4.5	-2.8
Rosaceae	*Prunus armeniaca*	apricot	shrub			96	-13.64	124.7	16	2.1	96.0	1	n/a	-28.7
Rosaceae	*Prunus pumila*	sandcherry	shrub			116	-4.27	139.5	2	5.5	116.0	1	n/a	-23.5
Rosaceae	*Spiraea alba*	white meadowsweet	herb	192	2.46			180.8	5	4.6	192.0	1	n/a	11.2
Rosaceae	*Fragaria virginiana*	wild strawberry	herb	139	6.72	122	-3.90	128.3	4	1.6	126.8	4	5.5	-1.5
Rubiaceae	*Galium boreale*	northern bedstraw	tree	165	3.34	152	-5.34	160.0	13	1.5	161.7	3	4.9	1.7
Salicaceae	*Populus deltoides*	cottonwood	tree	126	7.50	88	-20.86	116.0	42	1.3	108.0	5	6.5	-8.0
Salicaceae	*Populus tremuloides*	quaking aspen	herb			75	-12.98	110.8	17	2.8	94.3	3	9.7	-16.4

Table 2.2. Characteristics of native plant species found in Clay Country (continued).

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Saxifragaceae	*Heuchera richardsonii*	Richardson's alumroot	herb	158	-0.54	143	-3.71	160.6	9	4.7	155.3	4	5.3	-5.3
Scrophulariaceae	*Castilleja coccinea*	scarlet Indian paintbrush	herb	140	-10.00			160.0	2	2.0	140.0	1	n/a	-20.0
Scrophulariaceae	*Castilleja sessiliflora*	downy painted cup	herb	167	3.42			151.7	3	4.5	157.0	4	3.7	5.3
Scrophulariaceae	*Pedicularis canadensis*	Canadian lousewort	herb	139	-2.29			146.0	3	3.1	136.2	5	3.3	-9.8
Scrophulariaceae	*Penstemon albidus*	white penstemon	herb	160	0.81			157.0	4	3.7	158.5	4	4.4	1.5
Scrophulariaceae	*Penstemon gracilis*	lilac penstemon	herb	167	-2.42			174.5	12	3.1	164.5	4	4.6	-10.0
Scrophulariaceae	*Penstemon grandiflorus*	large beardtongue	grasslike	167	0.48			165.3	4	3.7	163.5	4	4.2	-1.8
Sparganiaceae	*Sparganium eurycarpum*	broadfruit burreed	tree			162	-2.85	171.0	4	3.2	162.0	1	n/a	-9.0
Ulmaceae	*Ulmus americana*	American elm	herb			79	-23.59	110.0	49	1.3	100.3	4	7.6	-9.8
Verbenaceae	*Verbena hastata*	swamp vervain	herb	192	11.00	191	10.00	181.0	2	1.0	191.5	2	0.5	10.5

Table 2.2. Characteristics of native plant species found in Clay Country (continued).

Family	Scientific Name	Common Name	Lifeform	2011		2012		1910-1961			2007-2012			Δ FFD
				FFD (DOY)	z-score (Sd)	FFD (DOY)	z-score (Sd)	mean FFD (DOY)	N	SE	mean FFD (DOY)	N	SE	(# Days)
Violaceae	*Viola pedatifida*	prairie violet	herb			127	-2.45	137.0	7	4.1	131.8	5	3.3	-5.2
Violaceae	*Viola sororia*	common blue violet	tree	138	10.00			128.0	2	1.0	138.0	1	n/a	10.0

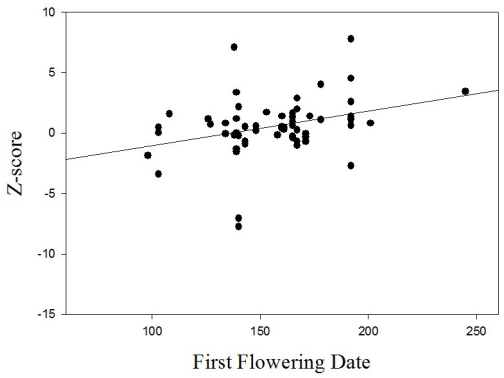

Figure 2.4. First flowering dates (FFDs) of individual species plotted against their z-score for 2011 ($z = (X-\mu)/\sigma$). (The line graphed is a line of best fit.)

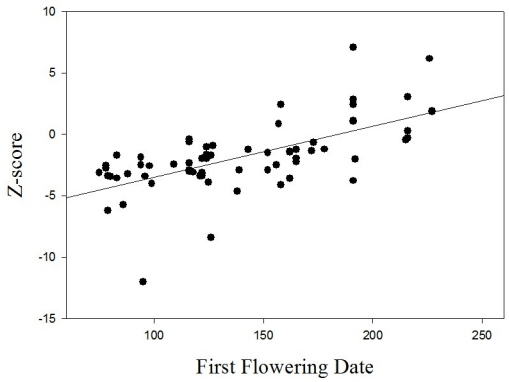

Figure 2.5. First flowering dates (FFDs) of individual species plotted against their z-score for 2012 ($z = (X-\mu)/\sigma$). (The line graphed is a line of best fit.)

The number of species which represented each lifeform varied from 2 to 78, (Table 2.3) with the herb lifeform as the most commonly observed and the grasslike lifeform as the least common. For the grasslike lifeform, there was no mean z-score in 2011, in 2012 the score was -2.0 and the average ΔFFD was -8.6. Herbs had a mean z-score of 0.6 in 2011, an average z-score of -1.5 in 2012, and the mean ΔFFD was -1.1. The 2011 average z-score for shrubs was 0.7, the 2012 score was -2.0 and the average ΔFFD was -2.1. Trees had a mean z-score of 0.7 in 2011 and -3.6 in 2012, with a mean ΔFFD of -12.8. Among the lifeforms, the mean z-scores

were similar for 2011 and 2012 (0.6 to 0.7 and -1.5 to -3.6 respectively) but varied quite a bit in mean ΔFFD, from -1.1 for herbs to -12.8 for trees.

A single factor ANOVA test indicated that there were significant differences among lifeforms in FFD. The ANOVA results from comparing 2011 FFDs among the different lifeforms resulted in an f-ratio of 4.27, a p-value of 0.008 and the degrees of freedom were 3 and 64. From the ANOVA comparing the FFDs from 2012 based upon lifeform, the f-ratio was 7.77, the p-value was 0.0002 and the degrees of freedom were 3 and 66. The ΔFFD ANOVA had 3 and 95 as the degrees of freedom, an f-ratio of 1.939 and a p-value of 0.128. The f-ratios of the 201an1 d 2012 ANOVAs tell us that there are differences between the mean FFDs of the lifeforms that cannot be explained by chance, and the p-values support the significance of the tests. However, the ANOVA run on the ΔFFDs did not show significant differences between the lifeform means.

According to the Tukey-Kramer HSD test run on the data, in 2011 the tree lifeform had a significantly different FFD compared to the herb and shrub lifeforms, which were not significantly different from each other. The grasslike lifeform was not significantly different from any of the other lifeforms. The results were the same for 2012 (Figure 2.7). In addition, looking at the graphs of the results of the ANOVA tests (Figure 2.6), we can see that in 2011 the tree lifeform was significantly different from both the shrub and the herb lifeforms. It was not significantly different from the grasslike lifeform, but the grasslike lifeform had an N of 2, which made its SE values quite high. It is possible that if there were more data points for the grasslike lifeform, the tree lifeform would be significantly different from it, but there is currently no way to tell. Regarding the ANOVA test run on the ΔFFDs (Figure 2.8), while the p-value was not significant at an alpha value of 0.05, results of the Tukey-Kramer HSD test comparing the

ΔFFDs between lifeforms show us that the means of herb lifeform and tree lifeform are significantly different.

Table 2.3. Mean z-scores and their standard error values from 2011 and 2012 and average ΔFFD between (1910-1961) and (2007-2012) for plants found in Clay County, grouped by lifeform.

Lifeform	2011 z-score			2012 z-score			Δ FFD		
	N	$\bar{x}$	SE	N	$\bar{x}$	SE	N	$\bar{x}$	SE
grasslike	1	n/a	n/a	2	-2.00	0.58	2	-8.62	0.38
herb	56	0.56	0.34	51	-1.50	0.44	78	-1.09	1.67
shrub	4	0.69	0.33	5	-1.96	0.46	7	-2.06	5.19
tree	4	0.70	0.28	9	-3.58	0.36	9	-12.80	3.24

For plant families, mean z-scores for 2011 varied from -1.1 (Scrophulariaceae) to 1.8 (Liliaceae). 2012's average z-scores ranged from -4.5 (Fabaceae) to 2.0 (Campanulaceae). The mean ΔFFD from 1910 to 2012 was lowest in Betulaceae (-17.3) and Salicaceae (-12.2) and highest in Brassicaceae (25.3) and Onagraceae (11.9). The families that have shifted earlier include (from largest change to smallest change): Betulaceae, Salicaceae, Rosaceae,Oxalidaceae, Aceraceae, Lamiaceae, Scrophulariaceae, Liliaceae, Asteraceae, Apiaceae, Ranunculaceae and Boraginaceae. The families that have shifted later are (from largest change to smallest change): Brassicaceae, Onagraceae, Asclepiadaceae, Campanulaceae, Violaceae and Fabaceae.

The f-ratio and p-value from the ANOVA comparing the FFDs among plant families for 2011 were 2.16 and 0.03, respectively (Figure 2.9). The results of the Tukey-Kramer HSD test for 2011 indicate that Onagraceae, Asclepiadaceae, Liliaceae, Campanulaceae, Lamiaceae, Apiaceae, Fabaceae, Asteraceae, Rosaceae, and Scrophulariaceae had significantly different means from Aceraceae, Betulaceae and Brassicaceae. Rununculaceae and Salicaceae had means that were significantly different from Onagraceae, Asclepiadaceae and Liliaceae. The f-ratio and

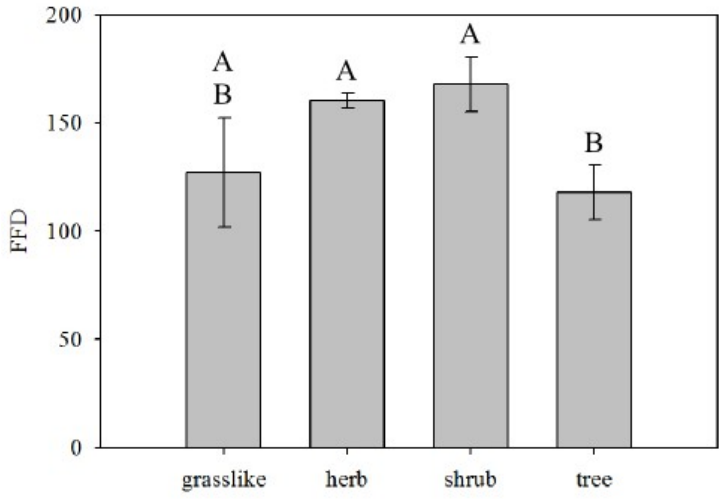

Figure 2.6. Least square mean First Flowering Day (1SE) for plants at Bluestem Prairie in 2011 by lifeform. Single factor ANOVA: F = 4.27, P = 0.01, DF = 3, 64.

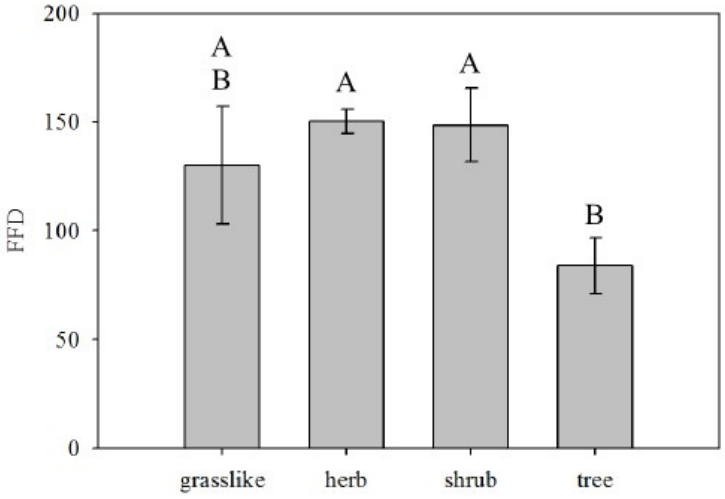

Figure 2.7. Least square mean First Flowering Day (1SE) for plants at Bluestem Prairie in 2012 by lifeform. Single factor ANOVA: F = 7.77, P = 0.0002, DF = 3, 66.

p-value statistics from the ANOVA comparing 2012 FFDs among plant families were 2.15 and 0.03, respectively. The results of the Tukey-Kramer HSD test for 2012 show that Campanulaceae, Onagraceae and Asteraceae had significantly different means from Salicaceae,

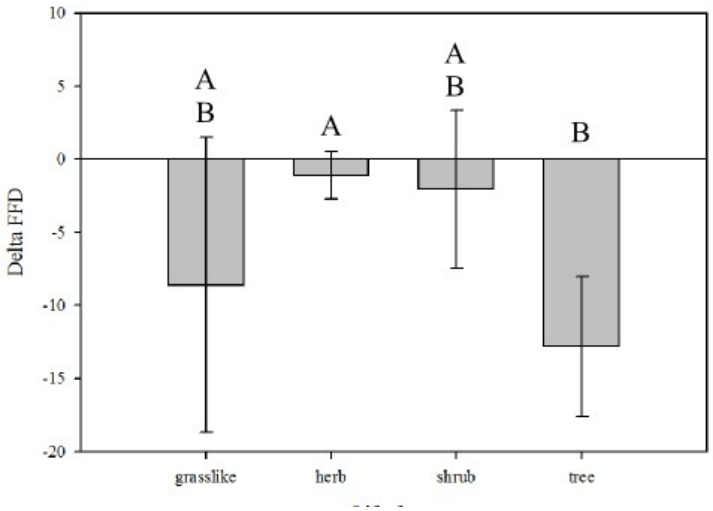

Figure 2.8. Least square mean ΔFirst Flowering Day (1SE) for plants surveyed in 2011 and 2012 by lifeform. Single factor ANOVA: F = 1.94, P = 0.13, DF = 3, 95.

Aceraceae and Betulaceae (Figure 2.10). Also, Rosaceae and Ranunculaceae had means that are significantly different from the means of Campanulaceae and Asteraceae. The results of the oneway ANOVA that was run on the ΔFFDs from 1910-1961 and 2007-2012 were an f-ratio of 0.84, and a p-value of 0.67 and the degrees of freedom were 17 and 77 (Figure 2.11). According to the Tukey-Kramer HSD test run on the means of the ΔFFD for those families, Brassicaceae was the only family significantly different from any of the rest.

Table 2.4. Mean z-scores, ΔFFD and associated standard error values and confidence intervals for plants growing in Clay County, grouped by plant family.

Family	2011 mean z score				2012 mean z score				mean ΔFFD			
	N	$\bar{x}$	SE	CI	N	$\bar{x}$	SE	CI	N	$\bar{x}$	SE	CI
Betulaceae	1	n/a	0.00	n/a	2	-4.48	1.72	3.37	2	-17.28	10.86	21.28
Salicaceae	1	n/a	n/a	n/a	2	-3.18	0.04	0.07	2	-12.19	4.24	8.31
Rosaceae	5	1.04	0.67	1.32	6	-2.96	0.29	0.57	7	-7.87	5.18	10.15
Oxalidaceae	2	0.15	0.38	0.75	1	n/a	n/a	n/a	2	-7.27	0.06	0.12
Aceraceae	1	n/a	n/a	n/a	2	-3.06	0.50	0.98	2	-6.84	4.06	7.97
Lamiaceae	1	n/a	n/a	n/a	1	n/a	n/a	n/a	2	-6.08	14.58	28.58
Scrophulariaceae	6	-1.08	1.28	2.51	0	n/a	n/a	n/a	6	-5.79	3.78	7.41
Liliaceae	5	1.78	0.96	1.88	6	-3.53	1.79	3.52	7	-4.91	4.95	9.70
Asteraceae	6	-0.89	0.70	1.38	10	-3.17	1.08	2.12	13	-2.49	4.88	9.56
Apiaceae	2	0.83	1.74	3.42	4	-2.01	1.49	2.91	5	-2.21	3.38	6.63
Ranunculaceae	7	0.83	0.31	0.60	7	-2.03	0.36	0.71	8	-1.39	1.52	2.99
Boraginaceae	2	0.76	0.94	1.84	2	-0.25	2.65	5.19	2	-1.34	9.09	17.81
Fabaceae	7	0.86	0.51	0.99	3	-4.51	2.10	4.11	8	0.36	4.68	9.17
Violaceae	1	n/a	n/a	n/a	1	n/a	n/a	n/a	2	2.40	7.60	14.90
Campanulaceae	2	0.07	1.13	2.21	2	2.03	0.99	1.95	2	4.13	4.54	8.90
Asclepiadaceae	3	0.48	1.14	2.23	1	n/a	n/a	n/a	4	6.11	1.78	3.49
Onagraceae	1	n/a	n/a	n/a	1	n/a	n/a	n/a	2	11.94	6.56	12.85
Brassicaceae	1	n/a	0.00	n/a	2	-0.81	2.65	5.19	2	25.26	53.41	104.68

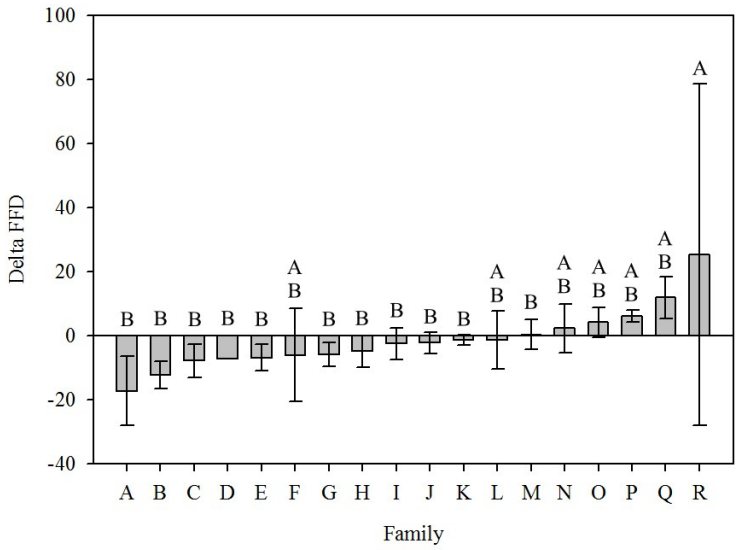

Figure 2.9. ΔFFD from 1910 – 1961 to 2007 – 2012 (1 SE) by plant family. A=Betulaceae, B=Salicaceae, C=Rosaceae, D=Oxalidaceae, E=Aceraceae, F=Lamiaceae, G=Scrophulariaceae, H=Liliaceae, I=Asteraceae, J=Apiaceae, K=Ranunculaceae, L=Boraginaceae, M=Fabaceae, N=Violaceae, O=Campanulaceae, P=Asclepiadaceae, Q=Onagraceae, R=Brassicaceae. (Oxalidaceae has no SE bar because the SE value was too small to be visible when graphed.)

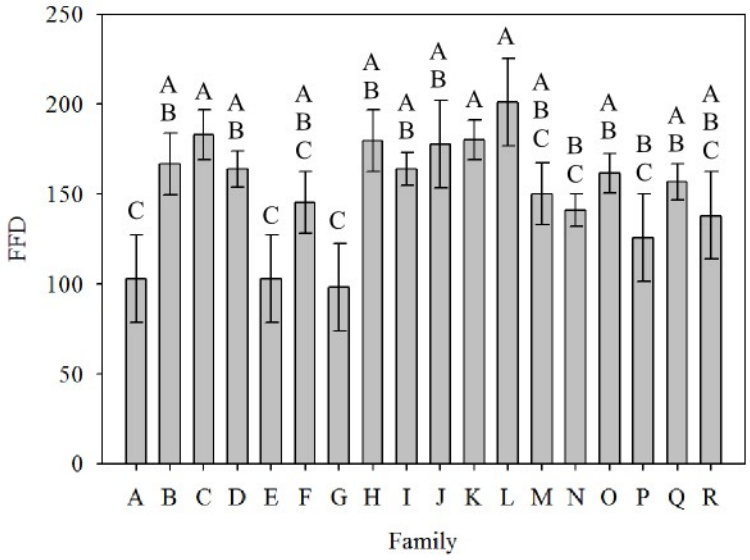

Figure 2.10. Least square means of First Flowering Day (1SE) for 2011 by plant family. Single factor ANOVA: F = 2.159, P = 0.026, DF = 17, 53. A=Aceraceae, B=Apiaceae, C=Asclepiadaceae, D=Asteraceae, E=Betulaceae, F=Boraginaceae, G=Brassiceae, H=Campanulaceae, I=Fabaceae, J=Lamiaceae, K=Liliaceae, L=Onagraceae, M=Oxalidaceae, N=Ranunculaceae, O=Rosaceae, P=Salicaceae, Q=Scrophulariaceae, R=Violaceae.

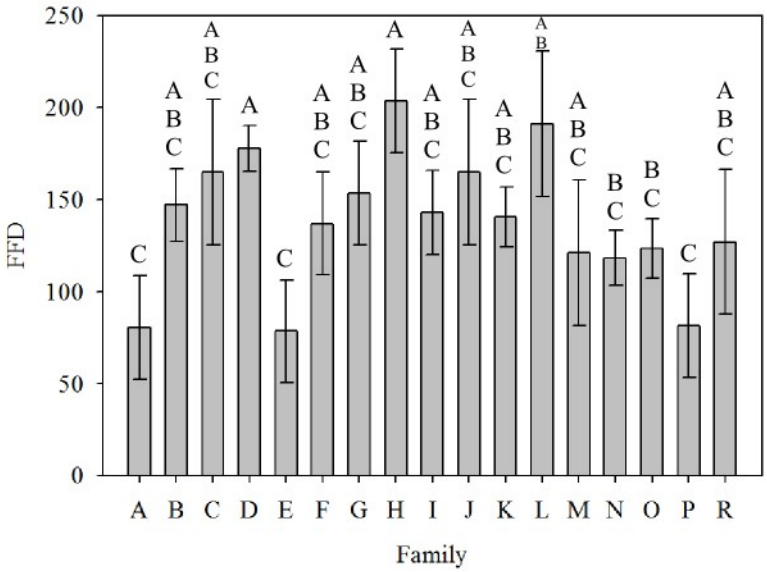

Figure 2.11. Least square means of First Flowering Day (1SE) for 2012 by plant family. Single factor ANOVA: F = 2.15, P = 0.03, DF = 17, 52. A=Aceraceae, B=Apiaceae, C=Asclepiadaceae, D=Asteraceae, E=Betulaceae, F=Boraginaceae, G=Brassiceae, H=Campanulaceae, I=Fabaceae, J=Lamiaceae, K=Liliaceae, L=Onagraceae, M=Oxalidaceae, N=Ranunculaceae, O=Rosaceae, P=Salicaceae, R=Violaceae.

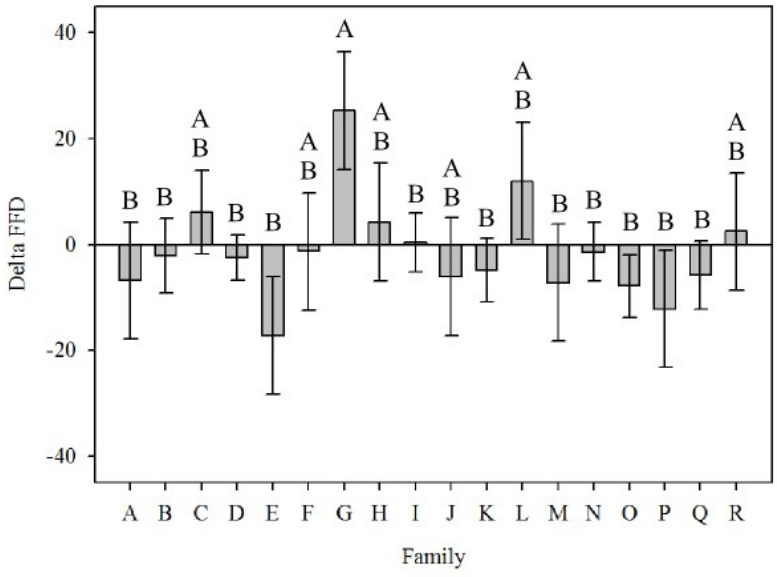

Figure 2.12. Least square mean ΔFirst Flowering Day (1SE) for plant families surveyed in 2011 and 2012. Single factor ANOVA: F = 0.84, P = 0.65, DF = 17, 77. A=Aceraceae, B=Apiaceae, C=Asclepiadaceae, D=Asteraceae, E=Betulaceae, F=Boraginaceae, G=Brassiceae, H=Campanulaceae, I=Fabaceae, J=Lamiaceae, K=Liliaceae, L=Onagraceae, M=Oxalidaceae, N=Ranunculaceae, O=Rosaceae, P=Salicaceae, Q=Scrophulariaceae, R=Violaceae.

Discussion

The combination of climactic data and plant flowering data from 1910 to 2012 indicates that recent years have been warmer and, correspondingly, flowering has been earlier. Overall in Clay County, 2011 was warmer and wetter than historical measures and 2012 was much warmer than historical norms. These local climatic changes are consistent with global patterns of climate change. In particular, the average global temperature has increased by 0.13 degrees Celsius per decade since 1955 in response to anthropogenic forcings and greenhouse gas accumulation (IPCC 2007). It appears that the effect of these climactic changes are longer growing seasons and earlier flowering dates for many plant species. For example, 2011 had 446 more Annual Growing Degree Units (AGDUs) than historical, and 2012 had 896 more. In response, plants flowered an average of 1 day later than the historical average in 2011 and 16.1 days earlier in 2012. This is a bit surprising, since both 2011 and 2012 were warmer than the historical mean and had more AGDUs, even though 2011 had 450 AGDUs less than 2012. However, it is possible that the wetness of 2011 and the winter before delayed blooming (but see Mazer et al. 2013). Also, it appears from the regression analysis of 2011 FFDs vs. z-score (Figure 2.4) that late-blooming plants may have pushed the average FFD back. Delayed blooming in late summer/early fall species (Figures 2.4 and 2.5) because of climate change has been found in other studies (Sherry 2007, Menzel 2000, Cook et al. 2012). One explanation of these observations is the late responses of species that require vernalization in order to flower; warmer winters may not sufficiently vernalize these species. These findings, specifically that the shifts in FFD rely upon temperature and the fact that those shifts are more dramatic in warmer years, are supported by the findings of numerous studies regarding the effects of climate change upon plant species (Cook et al. 2012, Menzel 2000, Beaubien & Freeland 2000, Miller-Rushing &

Primack 2008), as well as the significance of the data in this study. For example, when linear regressions of the data were calculated, the y-intercept for 2012 was 3.75 standard deviations less than that for 2011, which was -3.91. The p-values and f-ratios for these regressions are highly significant, indicating strong relationships for both years. Alternatively, late season species may be more dependent on vegetative growth for high reproductive output and therefore increase fitness by growing longer before flowering (cite Matt and Barrett). Because of the results of this study and others, it is to be expected that if climactic trends continue towards warmer years, most plants in Clay County will continue to bloom earlier and earlier while plants that bloom in the late summer and early fall will continue to bloom later and later, as freezing temperatures allow.

Of the lifeforms represented in this study, trees have had the most plastic response to changes in climactic conditions. This is consistent with the findings of other studies which have followed the flowering responses of tree species in relation to climactic changes (Beaubien & Freeland 2000, Chmielewski & Rötzer 2001). We found that from 2011 to 2012, trees had mean z-scores varying from 0.7 to -3.6. They are also the lifeform with the largest shift from historical vs. recent FFDs with a mean change of -12.8 days., a shift that was significantly different from the the shifts of the shrub and herb lifeforms (Figure 2.8.). A possible reason for the highly plastic nature of the trees' response to climatic variables is the fact that they are often the first species to bloom on the landscape and therefore may have phenological cues which respond more to temperature versus day length compared to other lifeforms. In addition, trees have an incentive to bloom early in the year , before leaf-out, in order to facilitate airborn pollen dispersal (Clambey, personal communication) . Whatever the reasons behind the proportionally higher response trees exhibit, it can be expected that they will continue to respond to changes in

temperature more than the other lifeforms present in the study if climactic conditions continue to prove as changeable as they have recently.

Just as there were definite trends in the responses of lifeforms to changes in the local climate, there were also differences in the means of plant family responses to climactic changes. However, according to the results of the ANOVA tests run, those means are not significantly differnt based upon the f-values (2.16 and 2.15, respectively). However, those tests were significant based upon p-values (0.026 and 0.027, respectively), and the Tukey-Kramer HSD test run on each of the ANOVA tests, including the ΔFFD (from historical to the present), for the families showed significant differences between some of the families (Figure 2.12). Most significant changes in mean family FFD were for families which have shifted earlier; the exception is Brassicaceae, but that family is only represented by two species in the data set from 1910 to 2012 and it is therefore difficult to draw meaningful conclusions from that family's data. In addition, in 2011 and 2012 the families which were most likely to have significantly different means from most of the other families were Aceraceae, Betulaceae, Brassicaceae (in 2011) and Salicaceae (in 2012). Aside from Brassicaceae, those families contain early-blooming trees which probably impacted their mean FFDs to a large degree (see above). Also, Mazer et al. (2013) have found that families differ significantly in FFD within and among numerous study sites. It is worth noting that in general families had more positive z-scores in 2011 compared to 2012. Also, certain families had a much larger shift in FFD when comparing historical data to data from this century.

It is important to keep in mind that these data represent a small (two-year) expanse of time and relationships are probably not fully discernible from that short length of time. Since this is the case, we can assume that the data gathered in this portion of Clay County are accurate,

if not statistically significant, and those changes documented will continue to be progress as climate change continues along its course.

Literature Cited

Beaubien, E. & Freeland, H. Spring phenology trends in Alberta, Canada: links to ocean temperature. *International Journal of Biometeorology* 53–59 (2000).

Chmielewski, F.-M. & Rötzer, T. Response of tree phenology to climate change across Europe. *Agricultural and Forest Meteorology* **108**, 101–112 (2001).

Clambey, G. Personal communication. June 26, 2013.

Cook, B. I., Wolkovich, E. M. & Parmesan, C. Divergent responses to spring and winter warming drive community level flowering trends. *Proceedings of the National Academy of Sciences of the United States of America* **109**, 9000–9005 (2012).

IPCC, 2007: Summary for policymakers. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovern mental Panel on Climate Change* Solomon, S., Qin, D., Manning, M., Chen, Z., Mar quis, M., Averyt, K. B., Tignor, and Miller, H. L. (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

JMP, Version 7. SAS Institute Inc., Cary, NC, 1989-2007.

Mazer, S. J., Travers S. E., Cook B. I., Davies T. J., Bolmgren K., B. Kraft N. J., Inouye D. W., McGill B., & Salamin N. Flowering date of taxonomic families predicts phenological sensitivity to temperature: implications for forecasting the effects of climate change on unstudied taxa. *American Journal of Botany. In press.*

Menzel, A. Trends in phenological phases in Europe between 1951 and 1996. *International Journal of Biometeorology* **44**, 76–81 (2000).

Miller-Rushing, A. J. & Primack, R. B. Global warming and flowering times in Thoreau's Concord: a community perspective. *Ecology* **89**, 332–41 (2008).

Parmesan, C. Ecological and evolutionary responses to recent climate change. *Annual Review of Ecology, Evolution, and Systematics* **37**, 637–669 (2006).

Sherry, R., Zhou X., Gu S., Arnone J., Schimel D. S., Verburg P. S., Wallace L. L. & Luo Y., Divergence of reproductive phenology under climate warming. *Proceedings of the National Academy of Sciences of the United States of America* **104**, 198–202 (2007).

Travers, S. E. & Dunnell, K. L. First-flowering dates of plants in the Northern Great Plains. *Ecology* **90**, 2332 (2009).

Zar, J. 2010. *Biostatistical Analysis (5th edition)*. Pearson Inc.

CHAPTER 3. POLLEN LIMITATION AND POLLINATOR VISITATION IN *LITHOSPERMUM CANESCENS*

Introduction

Phenological studies in recent years have indicated that some plant species are shifting their phonological patterns in response to climate change (citations). An important implication of these patterns is that changing phenology may have fitness consequences by disrupting evolved mutualisms with pollinators and therefore reproductive success. I conducted an experiment to examine reproductive patterns in a prairie species known to have shifted its flowering earlier in the past century.

Lithospermum canescens (hoary puccoon) is a member of the Boraginaceae family, and is found in the open areas of west central and east central United States and into southern Canada and northern Mexico (USDA 2013) (Figure 3.1). It can grow to eighteen inches tall, but has a tendency to sprawl. It has a distylous, five petaled yellow/orange flower with a floral tube of ~1 cm and is pollinated by Lepidopterans (Bishop, personal communication). It may exhibit cleistogamy (personal observation), although that has not been verified. *Lithospermum canescens* can set up to four nutlets per flower and its nutlets have a hard seed coat, from which it derives its genus name. Its species name and the term 'hoary' come from the whitish appearance it receives from the small hairs which cover the plant. 'Puccoon' is a reference to the plants' use as dyestuff (Freckmann Herbarium).

Lithospermum canescens has shifted its First Flowering Date (FFD) significantly in the last century (Travers & Dunnell 2009). Other studies have shown that such shifts in phenology could result in asynchrony between plants and their traditional pollinators (Parmesan 2007, cited

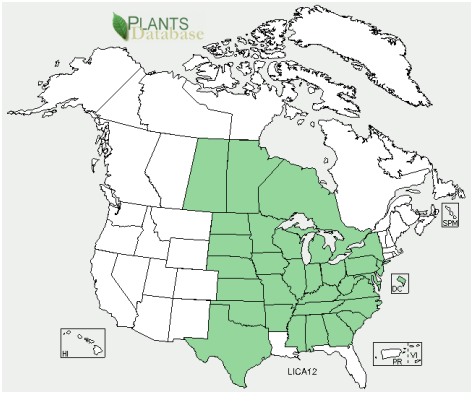

Figure 3.1. The species distribution of *Lithospermum canescens* (USDA 2013).

in Miller-Rushing 2008). It is important to establish whether or not these asynchronies are occurring in Clay County in order to, if possible, take steps to mitigate their effects. *Lithospermum canescens*, as a plant with a specialist pollinator syndrome, has the potential to be an excellent indicator species to determine if asynchronies are occurring. This species is also under represented in the prairie restorations in the surrounding area, and can therefore be used as an example of what is happening in plant species that are similarly underrepresented. In order to determine whether or not there is a plant/pollinator mismatch, we ran a pollen-limitation study upon *L. canescens*.

Materials and Methods

In 2011 and 2012 I conducted manipulative experiments in populations of *Lithospermum canescens* at two sites to directly measure natural levels of seed production and to indirectly measure pollen deposition and its complement, pollen limitation on reproduction.

Pollen Limitation Experiment

In spring 2011, I flagged 90 plants each at Bluestem Prairie and Jarvis (see Chapter 2) once the plants began to flower. At both sites the plant community in which the study plants

were found was tallgrass prairie. I chose plants to include in the study at each site as they bloomed and assigned them to a treatment based on the order in which I found them. Each marked plant received one of three experimental treatments for all of the flowers on each plant: open-pollinated (O), extra pollen (X) or bagged (B) (see Figure 3.2).

The bagged treatment was expected to prevent pollination by any animal or insect vectors and was designed to test for possible seed production in the absence of pollen. On bagged plants, one to nineteen flowers per plant were bagged at the beginning of the flowering season using 6 by 6 inch bags made out of bridal veil (white tulle). Wire markers were twisted around the stem of bagged plants to indicate the date they were bagged, with different colored wire indicating different dates. The bags were secured to the plant with plastic coated wire.

The extra pollen treatment (X) was designed to determine how many seeds are produced per flower if there is no limit to the amount of pollen received. Flowers on the plants in this treatment were pollinated by hand with mixed pollen from adjacent *L. canescens* individuals. I attempted to pollinate as many flowers per plant as possible at any one time by hand. Between 1 and 3 flowers per plant were pollinated each day and I pollinated plants a total of seven days. Pollen was collected in the morning from non-study plants by removing mature anthers and mixing them in a vial. This mixed pollen was then applied to the stigma of the focal *L. canescens* flower with a fine paintbrush. If the flower morphology was pin, the pollen was brushed onto the stigma without removing the corolla. If the flower morphology was thrum, the corolla and attached stamens were carefully removed to prevent selfing and outcross pollen was then brushed on to the stigma. Flowers that were hand-pollinated were marked on the flower pedicel with a Sharpee marker to distinguish them from the untreated flowers on the same inflorescence and were left open to further insect pollination.

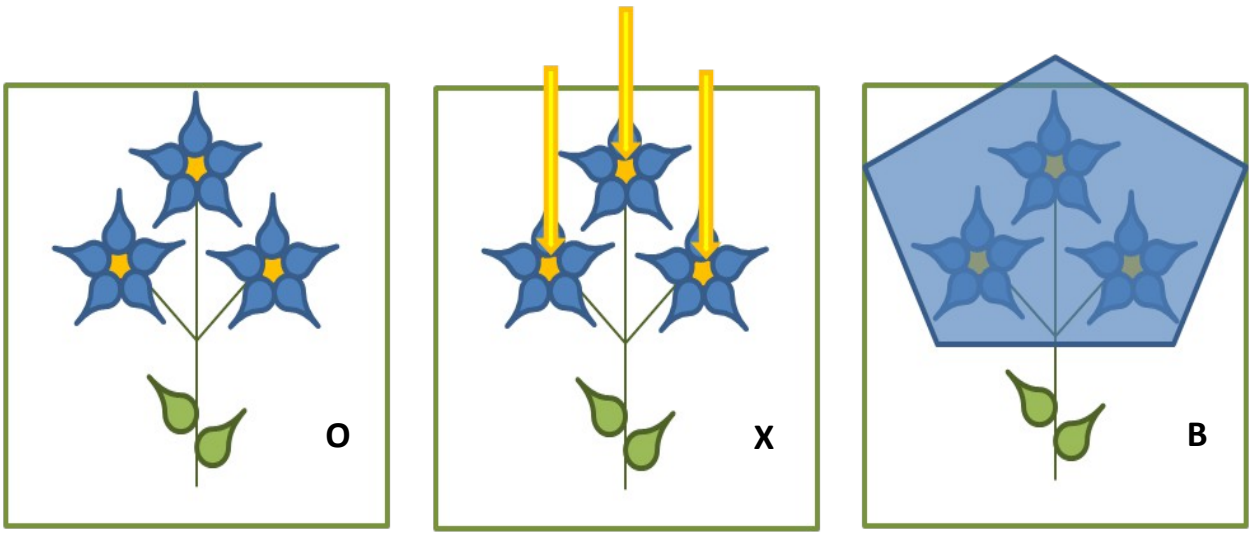

Figure 3.2. The pollen limitation treatments for *Lithospermum canescens*. Treatment O was open-pollinated, treatment X had pollen hand-administered and treatment B was bagged to exclude pollinators. The arrows in the second square represent the hand-administered pollen, and the blue polygon in the third square symbolizes the bag which excludes pollinators.

Plants in the open treatment were left undisturbed and served as a control to assess natural levels of seed production in this species. In this treatment, I monitored the flowers opening during a given week by placing colored wire around the stem of the inflorescence between the last unopened and the first opened flowers once a week. Different colors were used to indicate the different dates that those flowers opened to indicate the timing of maturity of flowers on open treatment plants. In 2011 my experiment lasted for six weeks, from first bloom to last bloom. I treated approximately 5 to 40 flowers per plant, depending upon treatment type.

After all study plants were finished setting seed (in August) I collected the plants and refrigerated them until they could be analyzed. *L. canescens* flowers each have four ovules and can produce up to four seeds. I counted the number of viable seeds produced by examining the nutlet scars left behind after the nutlets had fallen (approximately two to three weeks after the flower was pollinated). Seed set can be determined effectively with this technique (Forrest &

Thomson 2009, and see below). These scars are visible to the naked eye and were considered to represent a viable seed if the nutlet had reached full size before falling off. If the nutlet remained on the plant, it was considered viable if it resisted crushing and had reached a size of 1.5 to 2 mm in length.

In 2012, I repeated the experiment at Bluestem Prairie but not at Jarvis. Only the open-pollinated (O) and bagged (B) treatments were administered at the beginning of the season; the hand-pollination treatment (X) was initiated near the end of the blooming season (June 15th) after a pilot experiment to determine the signals of stigma maturation. After pollinators were observed accessing flowers that had been bagged with tulle, flowers in the bagged treatment were subsequently (after May 9th) covered with cages made of wire and tulle which were firmly staked to the ground. The wire cages were pyramidal with a base of one square foot.

I conducted the last part of the experiment on plants fifty meters to the west of my first experiments on a parcel at Bluestem that had been burned by the Nature Conservancy earlier in the spring (April 2012), which caused a delay in blooming. These plants (at the burned site) were marked after plants in the first community (at the unburned site) had finished blooming. Fifty three additional plants were marked at the burned site for the open (O) treatment.

The hand-pollinated plants (X) were located in the burned unit. Plants were bagged when they had at least three buds remaining. Once two or three flowers (three flowers open on one inflorescence at the same time was unusual) were open, pollen was administered to them in the same manner as in 2011. Red wire was placed below the oldest open flower and blue wire was placed above the youngest open flower to indicate where the pollinated treatment began and ended. After the flowers were hand pollinated, the wire and tulle cages were replaced over the

plants to ensure that there were no other pollination events. I conducted hand pollination of each plant once.

Plants were collected after *Lithospermum canescens* stopped blooming (beginning the week of July 8th) to evaluate seed set. The unburned site pollen limitation experiment took place from April 25th to June 11th and the burned site experiments took place from June 6th to June 25th.

After the seed set data was collected, one-way ANOVA tests were run to compare seed set from site to site and from year to year based upon treatment type. Four ANOVAs were performed using JMP statistical software (SAS Institute Inc. 1989-2007); one comparing seed set among treatments for the *L. canescens* population at Bluestem and Jarvis in 2011, one comparing seed set among the treatment types on Bluestem in 2012, one comparing seed set on Bluestem in 2011 and 2012 and one test comparing the seed set on Bluestem in the burned and unburned areas in 2012.

Background Community Flowering

In order to assess the environmental context in which *L. canescens* was blooming, I monitored the flowering patterns of other species within the flowering period for the experimental *Lithospermum canescens* population at the unburned site in 2012. A single transect was used that was 100 meters long and located within the *L. canescens* population. Once a week from April 30th to June 21st I walked the length of the transect and recorded the species and number of individual flowers within 3 meters on each side of the transect line. If the blooms were too small to distinguish individual flowers from one another I recorded the entire inflorescence. The transect data were recorded weekly during the entire *L. canescens* blooming period at the unburned site. Species surveyed along the transect included hoary puccoon

(*Lithospermum canescens*), pasque flower (*Pulsatilla patens*), pussy toes (*Antennaria aprica*), field chickweed (*Cerastium arvense*), prairie buttercup (*Ranunculus rhomboideus*), prairie smoke (*Geum triflorum*), fringed puccoon (*Lithospermum incisum*), ragwort (*Senecio plattensis*), gaura (*Gaura coccinea*), and thimbleweed (*Anemone virginiana*). Other species were recorded, but these were the most abundant and therefore they are the species that were included in the analysis.

Flower Persistence, Anther Dehiscence, and Nectar Production in *L. canescens*

I conducted an experiment to determine the lifespan of individual *Lithospermum canescens* flowers by observing how long they remained open after being treated with one of two treatments. (This experiment was performed in the burned area at Bluestem Prairie.) One treatment was an unpollinated treatment, in which the flowers were caged for the duration of their open period. The other treatment was a hand-pollinated treatment in which the plants were caged except when I administered outcross pollen with a paintbrush (I pollinated each flower once on the day that it opened). At the beginning of the experiment all open flowers were pinched off, leaving the oldest bud. If subsequent flowers opened on the same inflorescence as the flower being observed they were pinched off as well, leaving one open flower on the inflorescence. The flowers were observed each day to determine if they were open or closed, and those data were analyzed to find the average lifespan of a flower under each treatment. In total I processed eighty *L. canescens* plants for this experiment, forty per treatment (however, there were three mortalities: one in the open treatment and two in the caged treatment). After data on flower length were collected, a Student's t-test was run on the data with JMP statistical software (SAS Institute Inc. 1989-2007).

To determine another *L. canescens* flower characteristic, I ran a short experiment in the burned area of Bluestem Prairie to determine when this species' anthers dehisced. On June 13th and 25th, sequential flowers from ten inflorescences were examined to ascertain when anther dehiscence occurred. First the flower corolla was separated from its sepals and the floral tube was split with a sharpened piece of wire. The inside of the tube was then examined with a hand lens, and pollen abundance was rated on a scale of 0 (no pollen present) to 3 (abundant pollen present). Two values were collected, one for pollen abundance on the anthers and the other for pollen abundance on the corolla tube. From these values I was able to determine when the anthers dehisced, which was when pollen was first visible on the flower parts, and when pollen was most abundant.

The amount of nectar produced and the time of day of nectar production were determined over the course of two days (June 26th and 27th) in the burned area of Bluestem Prairie. To collect nectar, flower corollas were carefully plucked from the sepals, and a 20 µl capillary tube was used to collect the nectar which was squeezed out of the flower, as well as any nectar left on the sepals. The length of the nectar in the capillary tube was then measured with digital calipers. There were three treatments: plants that had never been bagged (A), plants that had been bagged for all of their blooming period but whose cages were removed for twelve hours to determine if there was a difference in when pollinators visited the plants (B) and bagged plants which did not have their cages removed until nectar was gathered (C). On the evening of the first day of the study, nectar was gathered from ten plants from treatment A and nine plants from treatment C. The cages were removed from eight plants (treatment B) for the next day's measurements. The next morning, nectar levels were taken from the eight plants from treatment B, ten plants from treatment A and five plants from treatment C. Eight more plants were uncovered for the

evening's measurements (treatment B). Nectar levels were measured in those flowers that evening. Data from this experiment were analyzed with an ANOVA test which compared nectar production by treatment and time using JMP statistical software (SAS Institute Inc. 1989-2007).

Verification of the Nutlet Scar Technique

In order to ensure that counting the seed scars left by nutlets was an accurate indication of viable nutlet production I conducted one final experiment on ten separate plants. Each branch of the plants were marked with wire to track each specific branch's nutlet production throughout the season. The plants were visited on a weekly basis, and viable nutlets per flower were counted. On a weekly basis from May 31st to June 26th I revisited the experimental plants and counted the viable nutlets present at each developing flower. The viability of nutlets was determined by nutlet size and color; viable nutlets are stony-looking and greyish and are greater than 1.5mm in length (Figure 3.3). Nutlet scars were counted immediately after all of the nutlets had dropped from each *L. canescens* stem. It was obvious when a nutlet had stopped developing, and when a fully sized nutlet was not viable (nutlets were a papery white and could be crushed with little effort, versus the viable nutlets which were durable and grey in color). A regression analysis was run on this data using JMP statistical software (SAS Institute Inc. 1989-2007).

Figure 3.3. A *Lithospermum canescens* seed without its pericarp (left) and another *L. canescens* seed enclosed in its pericarp (right); the latter, enclosed seed is called a nutlet.

Results

Pollen Limitation Experiment

In 2011, average seed set did not vary significantly between Bluestem and Jarvis with one exception: seed set was significantly higher at Bluestem (1.1 nutlets/flower) than at Jarvis (0.8 nutlets/flower) in the open treatment (Figure 3.4). Average seed set in 2011 varied significantly among pollination treatments; specifically, the bagged (B) treatment resulted in mean seed sets of 0.2 seeds per flower for Bluestem and 0.2 for Jarvis. The hand pollinated (X) treatment yielded average values of 0.5 for Bluestem and 0.6 for Jarvis. In the open (O) treatment, Bluestem had an average of 1.1 seeds set per flower and Jarvis had an average of 0.8. The lowest seed set for all treatments and sites was 0.2 seeds/flower (B treatment, Jarvis) and the highest was 1.1 seeds/flower (O treatment, Bluestem). The ANOVA test comparing the seed set among the treatments on Bluestem and Jarvis in 2011 resulted in an f-ratio of 170.2 and a p-value of <0.0001, with degrees of freedom of 5 and 8219. The results of the effect test on the difference between the sites were an f-ratio of 1.4 and a p-value of 0.24 with 1 degree of freedom. The results of the effects test for treatment were an f-ratio of 206.9 and a p-value of <0.0001 with 4 degrees of freedom. (Bluestem Prairie had higher seed set than Jarvis, which explains why the interaction term is significant.) When looking at the graph that resulted from the 2011 Bluestem ANOVA, we can see that all three treatments are significantly different from each other. The same is true of the Jarvis results from 2011.

In 2012, only Bluestem was used as a study site. Average seed set differed significantly from treatment to treatment in every case except one; the hand pollinated and bagged treatments were not significantly different. The bagged treatment averaged 0.5 seeds per flower, the hand

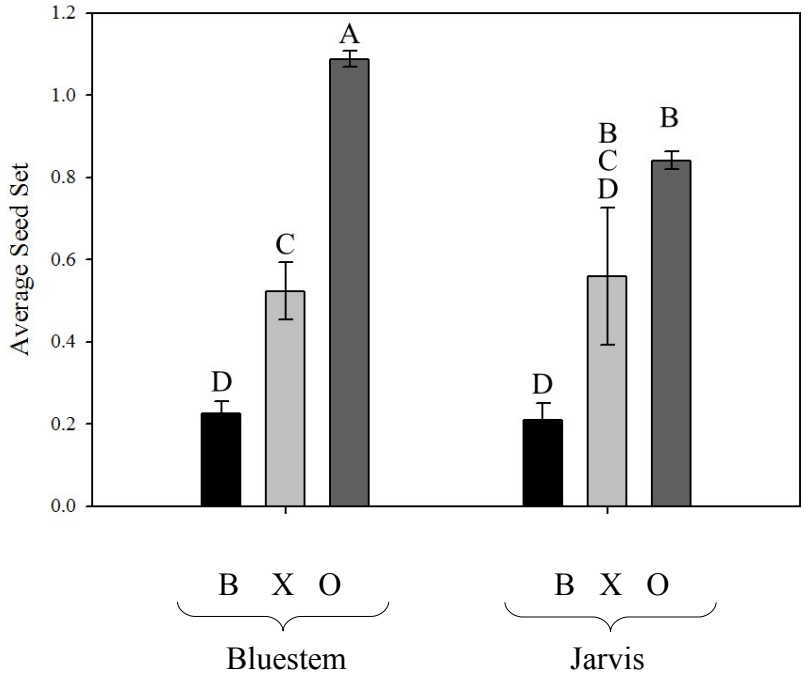

Figure 3.4. Least square means of average seed set in 2011 at Jarvis and Bluestem Prairie (1SE) by treatment. Nested ANOVA: F = 170.2, P = <0.0001, DF = 5, 8219. Effects test for treatment: F = 206.3, P = <0.0001, DF = 4. Effects test for site: F = 1.4, P = 0.24, DF = 1. B=bagged treatment, C=caged treatment, X=hand-pollinated treatment, O=open treatment.

pollinated treatment had 0.7 seeds/flower and the open treatment yielded a seed set of 1.1 (Figure 3.5). The caged and bagged seed sets were also significantly different. The lowest seed set recorded for 2012 was 0.1 in the caged treatment, and the highest was 1.1 in the open treatment. The ANOVA test results from the comparison of seed set among treatments from Bluestem in 2012 were an f-ratio of 45.61 and a p-value of <0.0001. On Bluestem in 2012, the bagged (B) and hand-pollinated (X) treatments were not significantly different, but the caged treatment (C) was significantly lower than the all of the other treatments with a mean seed set of 0.07 seeds/flower and the open treatment (O) was significantly higher than the other treatments with a mean seed set of 1.07.

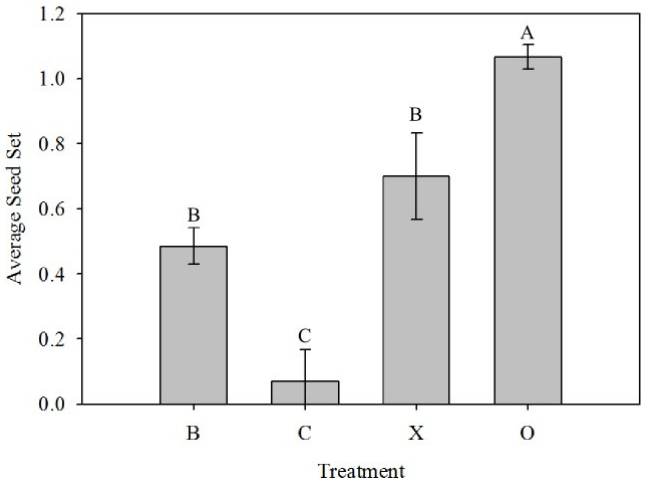

Figure 3.5. Least square means for seed set (1SE) on Bluestem Prairie by treatment for 2012. Single factor ANOVA:d F = 45.61, P = <0.0001, DF = 3, 1456. B=bagged treatment, C=caged treatment, X=hand-pollinated treatment, O=open treatment.

The main differences between Bluestem's seed set in 2011 and 2012 were in the bagged treatment; seed set for this treatment in 2011 was an average of 0.2 seeds/flower and in 2012 it was 0.5 seeds per flower, a difference of 0.3 seeds/flower. The open treatment in 2011 and 2012 resulted in an average seed set of 1.1 seeds/flower. The hand pollinated treatment in 2011 yielded 0.5 seeds per flower and in 2012 seed set for this treatment was 0.7 seeds per flower, a difference of 0.2. The results from the nested ANOVA performed on this data were an f-value of 119.43, and a p-value of <0.0001 and the degrees of freedom were 6 and 6518. The results of the effects test for treatment were an f-ratio of 143.3 and a p-value of <0.0001, with 5 degrees of freedom. The results of the effects test on year were an f-ratio of 0.03 and a p-value of 0.57 with 1 degree of freedom.

Seed set in the burned area versus the unburned area was not significantly different (Figure 3.7); therefore the plants from each area were treated as one population. An ANOVA

test was run comparing the burned and unburned areas; the resulting f-ratio was 0.08, the p-value was 0.79 and the degrees of freedom were 1 and 868.

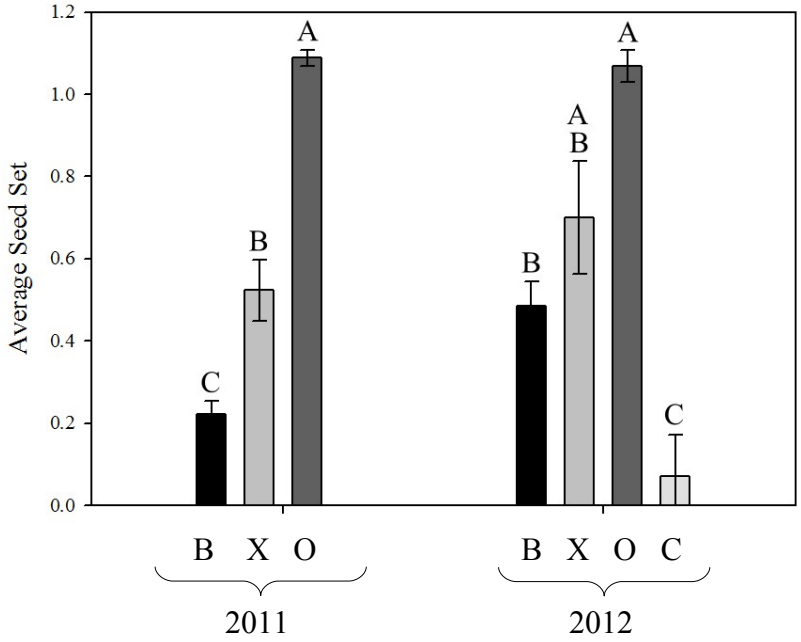

Figure 3.6. Least square means of average seed set in 2011 and 2012 at Bluestem Prairie (1SE) by treatment. Nested ANOVA: F = 119.43, P = <0.0001, DF = 6, 6518. Effects test for treatment: F = 143.3, P = <0.0001, DF = 5. Effects test for year: F = 0.3, P = 0.57, DF = 1. B=bagged treatment, C=caged treatment, X=hand-pollinated treatment, O=open treatment.

Background Community Flowering

Figures 3.8. and 3.9. include the ten most common species along the survey transect. Maximum bloom number varied based upon species, as did blooming duration and bloom distribution. Compared to the other species, *L. canescens* is the third most prolific producer of blooms with a bloom number comparable to ragwort (*Senecio plattensis*), gaura (*Gaura coccinea*) and fringed puccoon (*L. incisum*). The species with the highest bloom number, field chickweed (*Cerastium arvense*), had many times more blooms than the other species found along

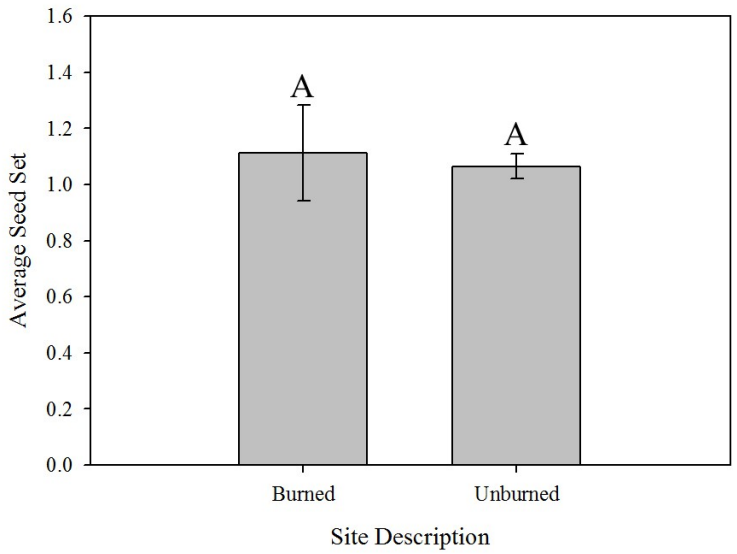

Figure 3.7. Least square means for seed set (1SE) on Bluestem Prairie by burned vs. unburned sites. Single factor ANOVA; F = 0.08, P = 0.79, DF = 1, 868.

the transect. Field chickweed is a generalist pollinated species, as are four other graphed species. Of the other five species, 20% are pollinated by moths (including *L. canescens*), 20% are pollinated by bees and 10% are pollinated by bees and moths. Only one species besides *L. canescens* appears to have had a bimodal distribution of blooms, which is pussy toes (*Antennaria aprica*). There appears to be a spike in bloom abundance at the beginning of *L. canescens'* bloom period which ends around day 135, that spike is followed by a paucity of blooms which lasts until about day 150. Because *L. canescens* is moth pollinated, it may be competing with other moth pollinated species and generalist pollinated species during those periods of bloom abundance. Of the surveyed species, the most abundant moth and generalist pollinated species include pasque flower, pussy toes, fringed puccoon, ragwort, gaura and thimbleweed. In short, all of the species which were the most common in the survey period have the capability to compete with *L. canescens* except one species, and that species (prairie buttercup) is butterfly pollinated and therefore is also a potential competitor.

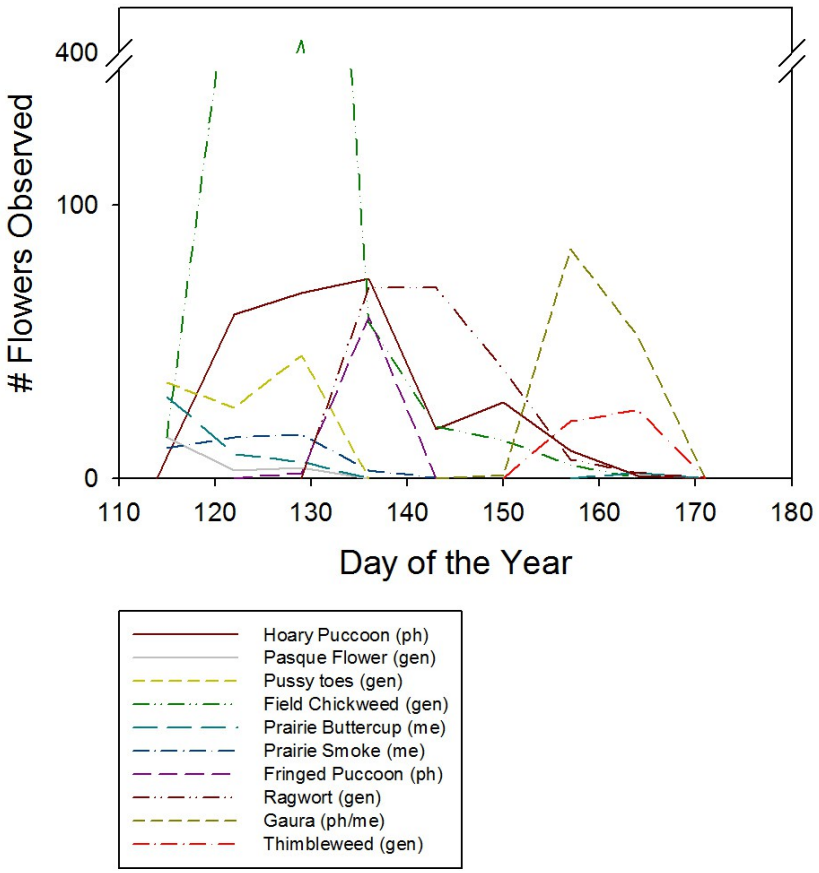

Figure 3.8. Flower abundance for species sampled at Bluestem Prairie during the duration of *L. canescens*' blooming period. Letters in parenthesis indicate pollination syndrome of the species surveyed. Gen=pollinated by a number of animal/insect types, me=melittophily (bee pollination), ph=phalaenophily (moth pollination). The break in the y axis is between 150 and 400 flowers observed.

Following the first plant community graph is a graph of a theoretical historical scenario (Figure 3.10). The bloom distribution of nine of the plants which shared *L. canescens'* bloom period were placed at their historical FFD. The result is a series of species bloom periods that stretches not from day 115 to day 171, as they did in 2012, but from day 97 to day 180. Out of the eight species found blooming alongside of *L. canescens* (there is no historical data for Prairie Smoke), only three historically bloomed concurrently. Three species bloomed before it and two species bloomed after. Of the three species which (theoretically) bloomed at the same time as *L.*

canescens, two are generalists and one is pollinated by moths. Two of the species which flower before have a generalist pollinator syndrome, and one is bee pollinated. One of the two remaining species is pollinated by generalists, and the other is pollinated by bees and moths. There are three gaps in the estimated historical plant community graph in which none of the focal species are blooming.

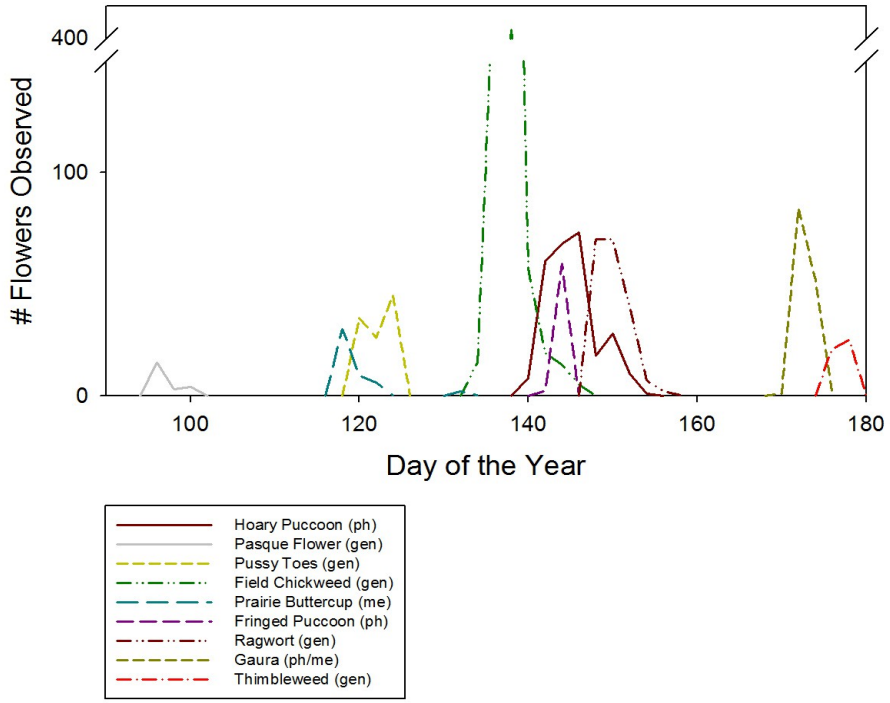

Figure 3.9. Flower abundance curves for species surveyed during *L. canescens*' blooming time spaced according to their historical FFD. (Prairie smoke was not included, due to its absence in the historical data set.) Letters in parenthesis indicate pollination syndrome of the species surveyed. Gen=pollinated by a number of animal/insect types, me=melittophily (bee pollination), ph=phalaenophily (moth pollination).

Flower Maturation

Results from 2012's hand pollinated plants show that seed set is significantly (p-value: 0.01) lower for the oldest flowers versus the middle and youngest flowers (Figure 3.11). The f-

ratio for that test was 4.8 and the degrees of freedom were 2 and 69. There is no significant difference between the seed set of the middle and youngest flowers. This indicates that stigmas are most receptive in the middle and youngest flowers, and receptivity declines once the flowers reach a certain age (approximately 12 days old – see results of flower duration experiment below).

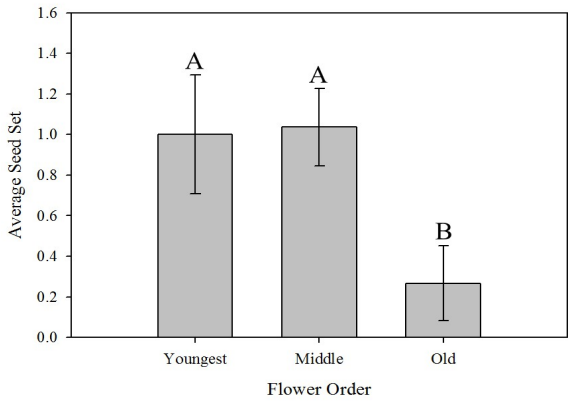

Figure 3.10. Least square means for average seed set (1SE) on Bluestem Prairie for hand pollinated flowers of differing ages. Single ANOVA: F = 4.8, P = 0.01, DF = 2, 69.

Flower Duration

In the flower duration experiment, unpollinated (treatment 1) flowers were open for significantly less time than hand pollinated (treatment 2) flowers. The t test ran on flower duration resulted in a p-value of <0.0001, a standard error difference of 0.3 and the degrees of freedom were 54 and 73. The flowers were open for a maximum of 9 days in treatment 1 and 5 days for treatment 2, and for a minimum of 1.5 days for both treatments. The average flower duration for treatment 1 was 4.8 days and 3.3 days for treatment 2.

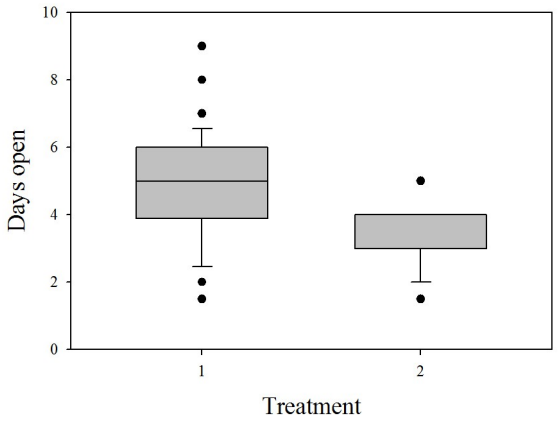

Figure 3.11. Box plot showing flower duration based upon treatment type. The middle line in the box equals the mean and the upper and lower limits to the box are the quantiles. Error bars indicate the 95% confidence limit, and dots represent outliers. Treatment 1: flowers that were caged to exclude pollinators. Treatment 2: flowers that were hand pollinated. Treatment 1's confidence interval is 2.98-3.553 and treatment 2's confidence interval is 4.27-5.36. Thirty nine flowers were tested for treatment 1, and thirty eight flowers were tested for treatment 2. Error bars represent +/- 1 SE from the mean.

Anther Dehiscence

Regarding pollen availability, pollen abundance was lowest for buds (0) and highest for flowers that had just opened (1) (Figure 3.12). Both buds and newly opened flowers had pollen abundances that differed significantly from all of the other flower stages. The 2nd and 3rd flowers did not significantly differ in pollen abundance. This pattern is typical of flowers that are protandrous.

Nectar Production

Nectar production for both the afternoon and the morning was significantly higher for the bagged treatment versus the open treatment. Also, nectar production was significantly higher for the morning versus the afternoon. Results did not vary significantly based on treatment type.

The nested ANOVA test run on the data resulted in a p-value of 0.01, an f-ratio of 3.93 and degrees of freedom of 3 and 51. The effects test for time resulted in an f-ratio of 6.95 and a p-value of 0.01 with 2 degrees of freedom. The results of the effects test for treatment were an f-ratio of 1.96 and a p-value of 0.15 with 1 degree of freedom. Average nectar production for the afternoon bagged treatment was 0.03 µl, and the average produced for the afternoon open treatment was 0.00 µl. Mean nectar production in the morning bagged treatment was 0.12 µl and the average for the morning open treatment was 0.05 µl. The minimum for each time period and treatment was 0.00 µl.

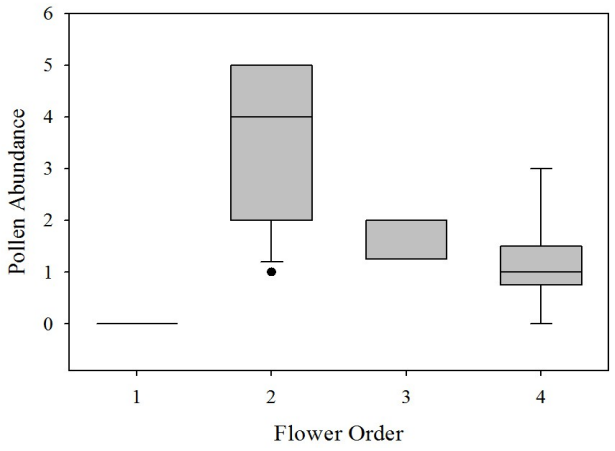

Figure 3.12. Box plot of pollen abundance measured by flower order. 1 indicates that the flower was still a bud, 2 is a newly opened flower, 3 is the second oldest flower and 4 is the oldest. The pollen abundance scale goes from 0 (no pollen visible) to 6 (the highest amount possible of pollen visible). Twenty seven plants were surveyed.

Verification of the Nutlet Scar Technique

There was a strong positive relationship between the number of nutlets which matured and the number of nutlet scars counted for the same flower. Regression analysis produced an r square value of 0.91, indicating that there is a strong relationship between nutlet scars and

number of nutlets, so predictability is high (Visible Scars = -0.933 + 0.964Nutlets, F = 128.95, P = <0.0001, SE = 0.08). All of these parameters lead us to believe that judging seed set based upon the scars left after the nutlets fall is valid.

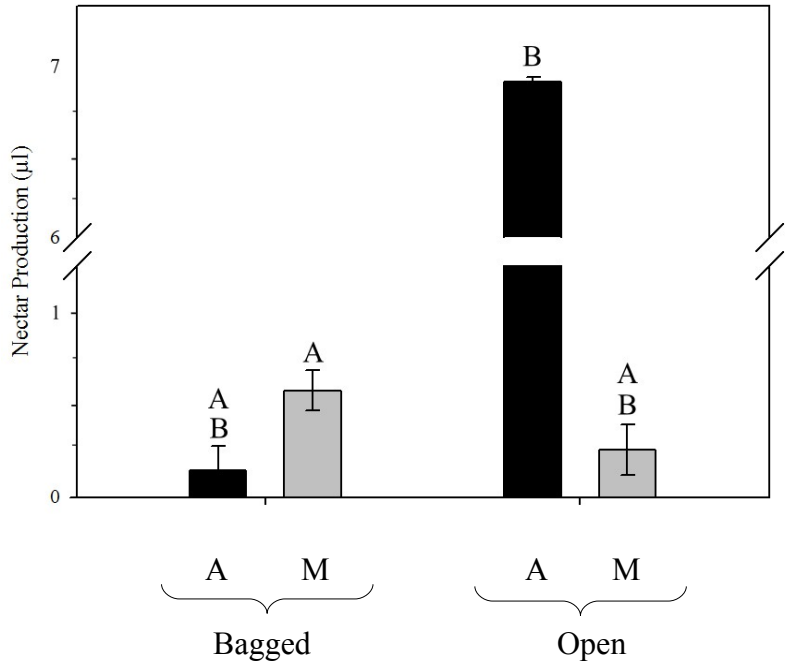

Figure 3.13. Least square means of nectar production (1SE) by treatment and time. Nested ANOVA: F = 3.9, P = 0.01, DF = 3, 51. Effects test for time: F = 6.95, P = 0.0, DF = 2. Effects test for treatment: F = 1.96, P = 0.15, DF = 1. A = Afternoon, M = Morning.

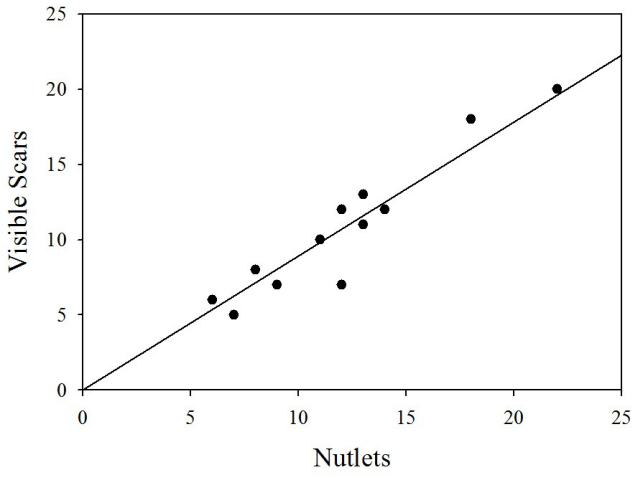

Figure 3.14. Number of nutlets produced per plant compared to the scars visible per plant. x = -0.933 + 0.964y, F = 128.95, P = <0.0001.

Discussion

The results of the experimental manipulation of pollen availability suggest several things about pollen limitation in this species and about the influence of growing season and plant community on reproductive success. For example, it appears that *Lithospermum canescens* is not pollen limited. Each of the treatments resulted in significantly different seed set at both Jarvis and Bluestem in 2011, and the open treatment (1.1) and caged (0.1) treatment were significantly different from each other and from the hand-pollinated and bagged treatments (these treatments were not significantly different from each other, with seed sets of 0.7 and 0.5, respectively) at Bluestem in 2012. The results of 2011's seed set on Jarvis were: O = 0.8, X = 0.6 and B = 0.2. The results for the 2011 Bluestem treatments were: O = 1.1, X = 0.5 and B = 0.2. The fact that in all cases the open-pollinated treatment resulted in a significantly higher seed set than the hand-pollinated treatment supports the hypothesis that *Lithospermum canescens* plants in these populations are not pollen limited.

Seed set for *Lithospermum canescens* was higher in 2012 versus 2011, even though this species had an earlier FFD in 2012 (116 vs. 138). Higher seed set in the hand pollinated treatment (X) (from 0.5 to 0.7 seeds/flower) may be explained by an improvement in pollination methods from 2011 to 2012, but that does not explain the increase in seed set in the bagged (B) treatment (from 0.2 seeds set/flower to 0.5 seeds set/flower). A potential explanation for that increase is the fact that bags were only used during part of the season for this treatment and bagged seed set could have been higher during the first half of the season, but that is not supported by seed set results from the open treatment. Seed set for the open (O) treatment from each year was quite comparable (1.00 in 2011 vs. 1.06 in 2012). Whatever the reasons for the increases in seed set in the X and B treatments, the fact remains that in all treatments seed set stayed at the same levels or increased from 2011 to 2012. This leads me to conclude, at least from this study, that there is no pollen limitation occurring in the *Lithospermum canescens* population I studied. Of course, it is possible that pollen limitation is occurring due to the absence of a plant or pollinator that is no longer on the landscape (Parrish & Bazzaz 1979), but that is impossible to ascertain that from this study. Also, judging from the projected historical plant community, plant species are blooming differently in relationship to each other (i.e. species are now blooming together with different species than they were historically), which may have resulted in changes in the way pollinators behave on the landscape (Sherry et al. 2007). Whether or not that is the case, no pollen-limitation was discernible on the bases of local climactic variables during this study. As an aside, part of the 2012 population of *L. canescens* had a delayed blooming period due to a prescription fire that burned half the site. Despite this delay, the seed set for this half of the population was statistically the same as the unburned half, which supports the hypothesis that *L. canescens* is not suffering from pollen limitation. Thus, this

species appears able to withstand the potential climate uncertainties facing it in the near future, both because of that lack of pollen limitation and because it has shown that it has the ability to adapt its blooming period from one year to another, and studies have shown that that plasticity can result in higher fitness in species (Cleland 2012, Mazer et. al 2013.

It is probable that the conclusions drawn above for the Bluestem *L. canescens* population hold true for Jarvis, even though that site was not included in the 2012 study. This inference is based upon the fact that two of the three treatments (B and X) performed in 2011 were not significantly different from Bluestem to Jarvis. The O treatment was significantly different, but I believe that the lower seed set at Jarvis for this treatment can be explained by the overwhelming presence of white sweet clover (*Melilotus alba)* on half of the study site, which surpassed *Lithospermum canescens* in growth during its blooming period and eventually reached a height surpassing two meters, effectively cutting off sunlight for over half of the *L. canescens* plants sampled (*M. alba* was found to negatively affect the growth of other plant species by Spellman & Wurtz in 2011).

Regarding the bagged treatment, it is important to point out a valuable fact which came to light in 2012, namely, that Lepidopteran pollinators were able to access *L. canescens* blooms through the plastic tulle (bridal veil) that the plants were bagged with. Not only was a moth observed accessing a *L. canescens* flower through the bag (Bishop, personal communication), but the seed set for bagged flowers was significantly different when compared to the seed set of flowers that had had cages built of wire and tulle placed around them (0.49 seeds/flower vs. 0.07 seeds/flower). As bagging flowers with bags made of plastic tulle is a common practice in pollen-limitation studies (Németh & Smith-Huerta 2003, Scott 2007, McCall 1996), I hope that

this information will be useful for studies involving pollinators with long proboscises in the future.

Literature Cited

Bishop, B. Personal communication. May 31, 2012.

Cleland, E., Allen, J., Crimmins, T. & Dunne, J. Phenological tracking enables positive species responses to climate change. *Ecology* **93**, 1765–1771 (2012).

JMP, Version 7. SAS Institute Inc., Cary, NC, 1989-2007.

Mazer, S. J., Travers S. E., Cook B. I., Davies T. J., Bolmgren, Kraft N. J. B., Inouye D. W., McGill B., & Salamin N. Flowering date of taxonomic families predicts phenological sensitivity to temperature: implications for forecasting the effects of climate change on unstudied taxa. *In press.*

McCall, C. Gender specialization and distyly in Hoary Puccoon, *Lithospermum croceum* (Boraginaceae). *American Journal of Botany* **83**, 162 (1996).

Németh, M. & Smith-Huerta, N. Pollen deposition, pollen tube growth, seed production, and seedling performance in natural populations of *Clarkia unguiculata* (Onagraceae). *International Journal of Plant Sciences* **164**, 153–164 (2003).

Parrish, J. & Bazzaz, F. Difference in pollination niche relationships in early and late successional plant communities. *Ecology* **60**, 597–610 (1979).

Scott, L. Reproductive ecology of *Rudbeckia fulgida* Ait. var. s*ullivantii* (C. L. Boynt and Beadle) Cronq. (Asteraceae) in northeastern Illinois. *The Journal of the Torrey Botanical Society* **134**, 362–368 (2007).

Sherry, R., Zhou X., Gu S., Arnone J., Schimel D. S., Verburg P. S., Wallace L. L.& Luo Y., Divergence of reproductive phenology under climate warming. *Proceedings of the National Academy of Sciences of the United States of America* **104**, 198–202 (2007).

Spellman, B. T. & Wurtz, T. L. Invasive sweetclover (*Melilotus alba*) impacts native seedling recruitment along floodplains of interior Alaska. *Biological Invasions* **13**, 1779–1790 (2011).

USDA, NRCS. 2013. The PLANTS database (http://plants.usda.gov, 4 March 2013). National Plant Data Team, Greensboro, NC 27401-4901 USA.

CHAPTER 4. GERMINATION OF *LITHOSPERMUM CANESCENS*

Introduction

*Lithospermum canescens*is a species that is underrepresented in local prairie restorations, mainly because of its seed characteristics (they shatter readily in the middle of the summer, when few companies and agencies are out collecting), and the fact that it is a difficult species to propagate (which is not an unusual trait in prairie forbs, see Blake 1935). However, *L. canescens*is a valuable part of the tallgrass prairie ecosystems where it is found. Tallgrass prairies are highly diverse systems comprised of hundreds of plant species which have undergone centuries of coevolution. Because of this coexistence, tallgrass prairie species have become adapted to specific pollinator niches, and the loss of one species on the prairie landscape affects the other species in its community (Parrish &Bazzaz, 1979). Sadly, even in remnant prairies, forbs such as *L. canescen* are especially at risk (McLachlan &Knispel 2005).

In addition to its value to native plant communities, *L. canescens* has the potential to be an excellent research species. It has a scirpoid inflorescence in which flowers mature sequentially. Also, it is perennial and individual plants are able to be easily monitored from year to year. Lastly, its reproductive strategy with distylous morphology and obligate outcrossing make this species valuable for pollination studies. In order to increase *L. canescens'* value as a research species by artificially extending its bloom season and in the hopes of finding a method of propagation which could be used by others, I attempted to propagate *L. canescens* in the winter of 2011-2012.

Materials and Methods

There are no records of *Lithospermum canescens* being grown from seed or cuttings in an artificial setting. However, development of propagation techniques would be informative and

promote the use of Lithospermum as a research tool and beneficial to prairie restoration efforts in the upper Midwest Our objectives were to: 1) develop propagation methods to facilitate reintroduction efforts, and 2) produce an experimental population for a pollen limitation study. I developed propagation methods based on *L. ruderal* methods of propagation (Green 1950).

I began by stratifying the seeds I had collected the summer of 2011 from the Jarvis parcel of the Fish and Wildlife Service's Detroit Lakes Wetland Management District. The seeds (~800) were mixed with dampened, sterilized sand and placed in a freezer at ~4°C on October 10th, 2011 in a paper bag. I established four cohorts from these seeds by removing collections of seeds and planting them at four different times. To prepare for germination, seeds were soaked for three to six hours in tap water at room temperature. The seed coats were removed via scarification with sand paper. After the scarification, the seeds were soaked in tap water for another twenty four hours, then taken up to the greenhouse and planted in Sunshine Mix 1 growing medium (Sun Gro Horticulture) which had been thoroughly saturated with water. The seeds were sprinkled over seed trays, then covered with ~1/8" of growing medium. Seeds were watered at least once a week with a water/chamomile tea solution (one teabag soaked in 4 liters of water for one day) to inhibit fungus formation. The seedlings were initially fed with Peters Professional Water Soluble Mix 20-20-20 fertilizer (The Scotts Company LLC) mixed in water once every two weeks, then as the seedlings began to show symptoms of nutrient deficiencies they were watered with a solution of Happy Frog Jump Start Organic Fertilizer (FoxFarm Soil and Fertilizer Company), which contained the micronutrients the plants were lacking, as well as mycorrhizal organisms.

Seedling cohorts were begun December 1st, 2011, December 14th, 2011, January 13th, 2012 and January 30th 2012. Cohorts were staggered in an attempt to spread out their blooming season, with a month between cohorts two and three to allow for the natural *L. canescens*

blooming period to take place. Sample sizes in each cohort were: 211, 255, 196 and 146 seeds for cohorts 1 through 4 respectively. Each cohort was started in its own seed tray. Once a seedling had germinated and had one set of true leaves, that individual was transplanted to its own 4" or 6" diameter plastic pot, which had been filled with Sunshine Mix 1 potting soil (Sun Gro Horticulture). Each pot was labeled with the cohort the seedling belonged to. A seed was considered germinated if it produced a seedling at the cotyledon stage.

Initially this study was designed solely to see if *Lithospermum canescens* could be propagated by hand from seed. Because of that, no specific data were collected during the first two months of the study until February 1. Beginning in February, I counted and recorded the number of seedlings in each cohort once a week until the third week of March when greenhouse equipment malfunctioned and high temperatures killed all of the seedlings. Because the cohorts were started at different times each cohort was observed for a different total number of weeks (Cohort 1= 7 weeks, cohort 2= 6 weeks, cohort 3 = 4 weeks and cohort 4 = 3 weeks).

Germinated plants were placed into two categories: plants with cotyledons present and plants with true leaves present. Each week, the total number of plants with cotyledons present and plants with true leaves present were counted for each cohort. New plants with true leaves present were not distinguished from previously germinated plants with true leaves present, mainly because growth rate was quite slow for most individuals.

The mean number of plants in each category of development each week was calculated for each cohort at the end of the study. I also calculated the mean number of plants in each category across cohorts (n=4) that were present each week. I used oneway ANOVA to test for differences among weeks in the mean number of plants in each development category. I used a

Tukey-Kramer HSD test to compare means among seedlings with cotyledons by cohort, seedlings with true leaves by cohort, seedlings with cotyledons by week and seedlings with true leaves by day of the experiment. All analyses were done with JMP statistical software (SAS Institute Inc. 1989-2007).

Results

Consistent with findings in other closely related species, germination was low. Germination rate (percentage of seeds planted per cohort that sprouted cotyledons) for each of the four cohorts were 11.8%, 7.1%, 4.6 and 2.1%, respectively from cohorts 1 through 4.. According to the Tukey-Kramer HSD test, the mean number of plants with true leaves in the 1st and 2nd cohort did not differ significantly, nor did the mean number of plants with true leaves in the 3rd and 4th cohorts (Figure 4.1). However, the mean number of plants with true leaves was significantly different between the 1st and 2nd cohorts and the 3rd and 4th cohorts. None of the cohorts with sufficient numbers to be tested had means which varied significantly among plants with cotyledons.

Throughout the study, the mean number of plants with true leaves did not vary significantly based upon day of the experiment according to the Tukey-Kramer HSD test, and neither did the means of the seedlings with cotyledons (Figure 4.2). However, the oneway ANOVA for the plants with true leaves by day of the experiment resulted in a p-value of 0.94 (and an f-value of 0.23 with 5 and 21 degrees of freedom), which means that those findings are not significant. The ANOVA test on plants with cotyledons yielded another non-significant p-value of 0.332, and an f-value of 0.29, with 5 and 16 degrees of freedom. The mean number of plants with true leaves varied from 6 to 14.7 and the average number of plants with cotyledons present ranged from 1 to 6 throughout the duration of the experiment. These results support

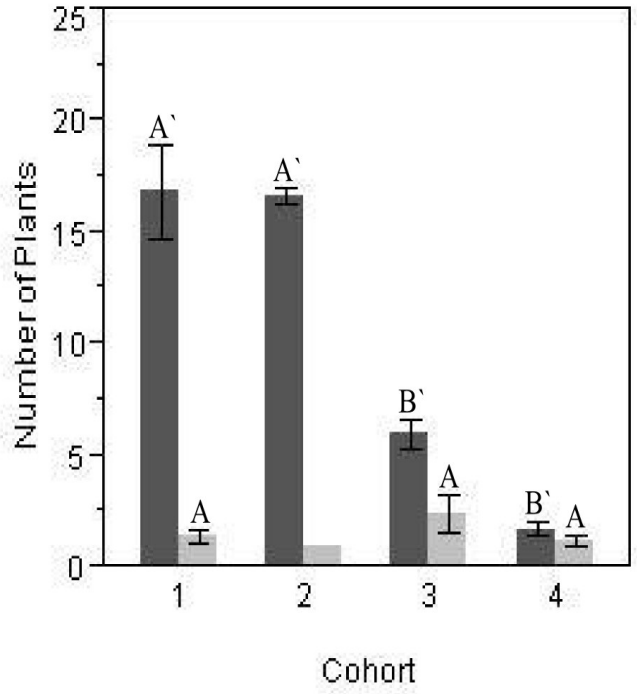

Figure 4.1. The average number of *L. canescens* seedlings with true leaves present (dark grey) and seedlinds with cotyledons present (light grey) produced in each cohort (1SE) throughout the entire study. (Due to insufficient data for standard error calculation, error bars are missing from the cotyledons present bar in the 2nd cohort.).

observations made in the greenhouse that, despite the periodic germination of new plants, some seedlings with cotyledons never grew true leaves and both categories of seedlings inexplicably died throughout the length of the experiment, which meant that numbers of plants with true leaves present stayed roughly the same throughout the experiment.

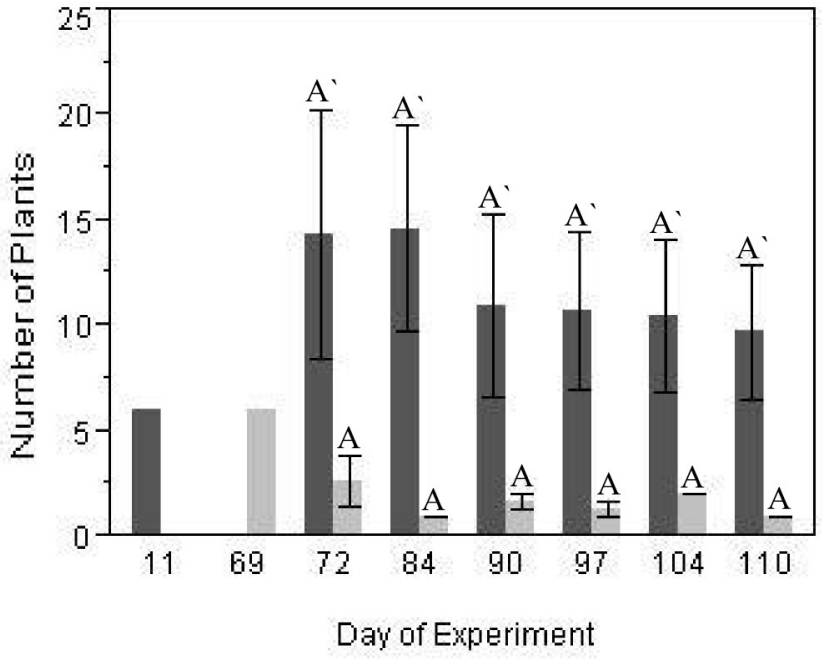

Figure 4.2. The average number of all *L. canescens* seedling with true leaves (dark grey) and seedlings with cotyledons (light grey) throughout the experiment (averaged across cohorts). Error bars represent +/- 1 standard error from the mean. Single factor ANOVA on seedlings true leaves present: F = 0.23, P = 0.94, DF = 5, 21. Single factor ANOVA on cotyledons presents: F = 1.35, P = 0.32, DF = 5, 16. (Due to insufficient data for standard error calculation, error bars are missing from the first two bars.)

Discussion

Both germination and seedling survival were very low for this study. The overall low germination levels may be explained by greenhouse conditions, which were very different from the conditions under which *L. canescens* usually germinates. According to a comprehensive prairie seedling study undertaken by A. K. Blake (1935), *Lithospermum* germination was quite high in hot, dry summer conditions. Blake also found that plants of various species which set seed in certain abiotic conditions (e.g, hot and dry) had lower germination rates in dissimilar conditions (e.g, cool and humid). The greenhouse that my plants were grown in was humid and subject to cold drafts due to its placement at the top of a campus building in a region that has

quite cold winters. It is also possible that, despite efforts to the contrary, a nutrient or microorganism was missing in the soil medium that *L. canescens* requires for survival. It has also been suggested that *L. canescens* is at least partially parasitic on other plants (cited in Molano-Flores 2001) or may exhibit germination polymorphism (Clambey, personal communication). Lastly, it is possible that as a perennial *L. canescens* has evolved a low rate of annual seedling germination. Its nutlets are quite durable, and it's possible that one of *L. canescens'* reproduction strategies is a bet-hedging one, and more viable nutlets are produced than are needed to germinate in the next year. (As an example of this strategy, see Tamm 1972 and Bierzychudek 1982.) This has been found to be the case with most non-weedy prairie plant species, which produce large amounts of seeds with low percentages of viability (Blake 1935) and low seedling production (Blake 1935, Weaver 1950).

Sadly, *Lithospermum canescens'* low germination rate in an artificial setting may be detrimental to its future. Often species that are relatively easy to propagate are the species chosen to be used in prairie restorations (personal observation). Because of this, none of the land management agencies or native seed suppliers in Clay County collect or propagate *L. canescens* seeds (personal observation). This absence of propagation could quickly result in *Lithospermum canescens'* absence on the landscape as more remnant prairies are plowed for agriculture and others areas are restored to native vegetation in Clay County.

Literature Cited

Bierzychudek, P. Life histories and demography of shade-tolerant temperate forest herbs: a review. *New Phytologist* **90**, 757-776 (1982).

Blake, A. K. Viability and germination of seeds and early life history of prairie plants. *Ecological Monographs* **5**, 408–460 (1935).

Clambey, G. Personal communication. June 26, 2013.

JMP, Version 7. SAS Institute Inc., Cary, NC, 1989-2007.

McLachlan, S. M. & Knispel A. L. Assessment of long-term tallgrass prairie restoration in Manitoba, Canada. *Biological Consevation.* 124, 75-88 (2005).

Molano-Flores, B. What can happen to heterostylous species in prairie restorations? The case of *Lithospermum canescens* (Boraginaceae). *Proceedings of the 17th N.A. Prairie Conference* (2001). at <http://images.library.wisc.edu/EcoNatRes/EFacs/NAPC/NAPC17 /reference/econatres.napc17.bmolanoflores.pdf>

Tamm, C. Survival and flowering of perennial herbs. The behaviour of *Primula veris* on permanent plots. *Oikos* (1972).

Parrish, J. &Bazzaz, F. Difference in pollination niche relationships in early and late successional plant communities. *Ecology* **60**, 597–610 (1979).

Weaver, J. E. Stabilization of Midwestern grassland. *Ecological Monographs* **20**, 251–270 (1950).

APPENDIX A. PLANT PHENOLOGIES FROM CLAY COUNTY MINNESOTA 1910-1938

First flowering dates of plant species found in Clay County Minnesota, including family name, scientific and common names, life-form and first flowering date (FFD) information from 1910 to 1938.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Acer ginnala	Aceraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.
Acer negundo	Aceraceae	92	114	112	.	121	103	125	127	103	120	126	110	117	120	122	100	112	115	122	114	104	105	113	112	118	125	124	121	104
Acer saccharinum	Aceraceae	79	110	98	102	104	92	107	102	84	103	107	92	96	108	96	88	105	100	91	92	93	95	104	104	102	100	108	105	84
Acer saccharum	Aceraceae	.	.	.	.	.	.	.	.	.	.	.	.	126	.	137	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acerates viridiflora	Asclepiadaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Achillea millefolium	Asteraceae	165	166	.	165	.	166	.	175	154	.	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acnida altissima	Amaranthaceae	214	.	.	.	.	.	.	.	.	.	.	.	.	.	226	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Actaea rubra	Ranunculaceae	.	.	.	145	.	.	.	.	.	144	.	.	.	.	.	143	.	.	.	.	.	.	.	.	.	.	.	.	138
Actinella acaulis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aesculus glabra	Hippocastana-ceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agastache anethiodora	Lamiaceae	195	206	.	.	.	.	.	201	.	.	.	.	.	.	.	185	.	.	.	.	.	.	.	.	.	.	.	.	.
Agoseris glauca	Asteraceae	158	.	.	158	.	168	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrimonia striata	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agropyron repens	Poaceae	173	166	.	176	.	185	.	176	.	.	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Agropyron smithii	Poaceae	174	169	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agropyron trachyeainlng	Poaceae	174	166	.	175	.	.	.	176	.	.	.	169	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostemma githago	Caryophyllaceae	173	.	.	.	.	.	.	198	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostis alba	Poaceae	174	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostis scabra	Poaceae	.	.	.	.	.	.	.	186	.	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alisma subcordatum	Alismataceae	176	.	.	.	.	.	.	.	.	.	.	164	.	.	.	199	.	.	.	.	.	.	.	.	.	.	.	.	.
Allionia hirsuta	Nyctaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	199	.	.	.	.	.	.	.	.	.	.	.	.	.
Allionia nyctaginea	Nyctaginaceae	169	156	.	165	160	.	.	.	.	.	.	.	.	.	.	175	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium schoenopra-sum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium stellatum	Liliaceae	221	.	.	214	.	.	212	.	.	205	217	.	.	.	226	199	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium textile	Liliaceae	132	125	.	154	.	.	.	.	154	144	145	.	133	.	.	.	.	.	.	.	.	.	.	.	139	.	.	.	.
Allium tricoccum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	176	184	.	.	178	.	.	.	.	.	.	.	.	.	.	172	.	.
Alopecurus aepualis	Poaceae	149	156	.	158	.	152	.	167	.	.	164	.	.	.	.	.	163	.	.	.	.	.	.	.	.	.	.	.	.
Alopecurus pratensis	Poaceae	.	.	.	.	.	.	.	145	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Amaranthus albus	Amaranthaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Amaranthus graecizans	Amaranthaceae	167	156	.	.	.	.	.	175	.	.	.	.	.	.	.	.	.	.	157	166	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Amaranthus retroflexus	Amaranthaceae	182	184	.	186	.	.	.	201	.	.	.	175	.	165	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ambrosia artemisia	Asteraceae	208	.	205	.	.	.	.	221	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ambrosia psilostochys	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ambrosia trifida	Asteraceae	175	.	191	181	.	.	212	201	.	202	213	186	.	185	.	199	.	.	.	200	.	.	.	.	.	.	.	.	.
Amelanchier alnifolia	Rosaceae	120	.	126	126	.	.	.	136	124	136	137	127	128	136	145	115	126	135	.	133	.	.	131	.	126	138	135	132	119
Ammannia coccinea	Lythraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Amorpha canescens	Fabaceae	190	.	.	181	.	.	.	.	.	.	.	.	182	177	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Amorpha fruticosa	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	166	.	.	.	.	.	.	.	.	.
Amphicarpa bracteata	Fabaceae	213	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Andropogon furcatus	Poaceae	208	.	.	.	.	.	212	.	224	.	206	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Andropogon scoparius	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Androsace occidentalis	Primulaceae	98	117	.	116	129	111	.	.	.	.	.	120	.	.	.	.	.	.	126	125	122	.	118	125	.	133	133	132	.
Anemone canadensis	Ranunculaceae	149	147	153	154	156	.	.	164	.	.	164	.	.	.	.	157	.	.	.	.	.	.	.	.	.	.	.	.	.
Anemone cylindrica	Ranunculaceae	166	.	.	.	.	.	.	175	.	.	.	167	182	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anemone patens	Ranunculaceae	88	.	97	103	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Anemone quinquefolia	Ranunculaceae	120	133	.	144	.	.	.	.	.	130	.	127	.	.	137	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anemone virginiana	Ranunculaceae	161	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Antennaria aprica	Asteraceae	101	.	.	.	.	.	.	.	.	130	.	120	.	.	.	.	.	.	126	.	.	.	.	.	.	.	.	.	.
Antennaria microphylla	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthemis cotula	Asteraceae	184	.	.	181	.	166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Antirrhinum majus	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aplopappus lanceolatus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aplopappus spinulosus	Asteraceae	.	192	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Apocynum androsaemifoium	Apocynaceae	173	.	.	.	166	.	.	.	.	.	.	169	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	.	.
Apocynum hypericifolium	Apocynaceae	175	166	.	169	.	192	.	.	.	.	173	167	.	.	.	.	.	.	.	173	.	.	.	161	.	.	.	.	.
Aquilegia canadensis	Ranunculaceae	149	140	.	155	.	.	.	146	.	144	.	.	.	.	.	.	.	.	147	.	.	.	.	.	.	.	.	.	.
Arabis divaricarpa	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arabis hirsuta	Brassicaceae	149	.	.	.	.	.	.	.	.	.	173	.	.	.	.	.	.	.	.	161	.	.	.	.	.	.	.	.	.
Aralia nudicaulis	Araliaceae	.	140	.	.	.	.	.	.	.	144	.	.	.	.	.	153	.	.	147	149	.	.	156	.	.	.	.	.	.
Arctium minus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	202	.	.	.	208	.	.	.	215	.	.	.	.	.	.	.	.	.
Arenaria laterifolia	Caryophyllaceae	148	140	131	144	.	133	.	146	.	.	151	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Aretium tomentosum	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arisaema atrorubens	Araceae	120	133	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arnica fulgens	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia absinthium	Asteraceae	223	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia biennis	Asteraceae	236	.	.	.	.	.	.	.	.	.	248	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia caudata	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	229	.	.	.	236	.	.	.	.	.
Artemisia dracunculoides	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia frigida	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia gnaphalodes	Asteraceae	236	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	236	.	.	.	.	.
Asarum canadense	Aristolochia-ceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asclepias incarnata	Asclepiadaceae	188	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asclepias ovalifolia	Asclepiadaceae	167	156	.	169	.	.	.	174	.	.	173	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asclepias speciosa	Asclepiadaceae	.	190	.	180	.	.	.	.	.	.	.	.	.	.	.	175	.	.	.	.	.	.	.	.	.	.	.	.	.
Asclepias syriaca	Asclepiadaceae	175	166	.	181	.	.	.	.	.	.	.	176	.	176	.	.	.	.	.	180	.	.	.	.	.	.	.	.	.
Asclepias verticillata	Asclepiadaceae	186	.	191	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Asparagus officinalis	Liliaceae	148	.	158	.	.	155	.	175	.	.	.	146	.	.	.	.	.	.	151	160	.	.	.	151	.	.	.	.	.
Aster brachyactis	Asteraceae	.	.	.	.	.	.	.	.	257	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aster ericoides	Asteraceae	.	.	222	.	223	.	.	235	.	.	228	.	.	.	.	.	.	.	.	239	.	.	.	.	.	.	.	.	.
Aster laevis	Asteraceae	.	224	233	.	.	.	.	241	.	.	237	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aster nova.angliae	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	233	226	236
Aster paniculatus	Asteraceae	.	221	.	.	223	.	.	235	.	.	237	.	.	.	.	.	.	.	.	239	.	.	.	.	.	.	.	.	.
Aster punicens	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus bisulcatus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus canadensis	Fabaceae	181	.	.	.	176	192	.	195	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus caryocarpus	Fabaceae	101	.	.	.	.	.	.	.	.	.	.	136	133	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus flexuosus	Fabaceae	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus hypoglottis	Fabaceae	130	.	135	145	144	133	.	.	.	144	150	136	.	146	148	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus missouriensis	Fabaceae	101	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus pectinatus	Fabaceae	.	.	.	.	.	.	.	.	151	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus plattensis	Fabaceae	101	125	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus racemosus	Fabaceae	.	.	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Astragalus striatus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus triphyllus	Fabaceae	101	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Atriplex confert	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Atriplex hastata	Chenopodiaceae	223	.	.	.	.	.	.	221	.	.	.	.	.	.	226	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Atriplex patula	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Atriplex rosea	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	229	.	.	.	236	.	.	.	.	.
Avena fatua	Poaceae	173	.	.	181	.	.	.	.	.	.	.	.	.	176	.	190	.	.	.	.	.	.	.	.	.	.	.	.	.
Bahia oppositifolia	Asteraceae	.	.	.	.	.	.	.	.	180	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Beckmannia syzigachne	Poaceae	164	166	.	.	.	.	.	175	.	.	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berberis thunbergii	Berberidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148	.	.	.	.	.	.	.	151	.	139
Berteroa incana	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Betula papyrifera	Betulaceae	.	.	.	.	.	.	.	.	.	.	130	125	121	130	136	110	.	120	128	127	122	128	.	129	124	137	131	.	119
Bidens acuta	Asteraceae	236	224	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bidens cernua	Asteraceae	236	224	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bidens frondosa	Asteraceae	236	224	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bidens vulgata	Asteraceae	226	224	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	229	.	.	.	.	.	.	.	.	.
Boltonia latisquama	Asteraceae	208	212	214	214	212	.	212	221	.	.	220	.	.	.	.	.	.	.	.	208	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Bouteloua curtipendula	Poaceae	.	.	.	.	.	.	.	.	.	.	.	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bouteloua gracilis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brassica arvensis	Brassicaceae	148	145	151	150	146	146	.	151	160	152	157	146	.	149	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brassica juncea	Brassicaceae	168	153	.	.	.	.	.	175	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brauneria angustifolia	Asteraceae	.	173	179	180	.	.	.	.	.	.	.	.	.	177	.	.	.	.	.	.	.	180	.	.	.	.	.	.	.
Bromus ciliatus	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bromus inermis	Poaceae	.	159	.	170	162	174	.	175	.	.	167	167	.	.	.	167	.	.	.	164	.	.	.	.	160	.	.	.	.
Bromus tectorum	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Buchloe dactyloides	Poaceae	.	.	.	.	.	.	.	.	.	.	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Calamagrostis inexpansa	Poaceae	.	.	.	181	.	.	.	.	.	.	.	.	182	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Calamovilfa longifolia	Poaceae	.	.	.	.	.	.	.	.	.	205	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Calla palustris	Araceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caltha palustris	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Camelina sativa	Brassicaceae	160	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campanula rapunculoides	Campanulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campanula rotundifolia	Campanulaceae	.	168	179	.	.	192	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campsis radicans	Bignoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Capsella bursapastoris	Brassicaceae	98	.	97	.	129	.	.	.	.	.	.	.	.	.	.	.	.	115	.	110	122	.	.	117	.	.	.	.	126
Caragana arborescens	Fabaceae	.	.	.	.	143	133	.	.	.	140	145	138	.	143	.	.	128	.	135	144	.	.	.	.	.	.	140	.	129
Caragana fruticosa	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	139	149	.	.	.	.	.	.	.	.	.
Caragana pygmaea	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	149	.	.	.	.	149
Cardamine bulbosa	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardaria draba	Brassicaceae	.	.	154	.	151	160	.	173	161	.	.	.	.	146	.	.	.	.	152	.	.	149	.	.	.	.	.	.	.
Cardaria pubescens	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carduus crispus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex aquatilis	Cyperaceae	.	.	132	.	.	128	.	.	.	.	.	.	.	.	.	137	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex assiniboinensis	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex blanda	Cyperaceae	148	.	.	.	.	149	.	149	.	139	.	134	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex brevior	Cyperaceae	.	140	151	.	.	.	.	.	.	139	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex deweyana	Cyperaceae	140	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex eleocharis	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex filifolia	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex gravida	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex laeviconica	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex lanuginosa	Cyperaceae	127	145	.	.	.	133	.	.	.	144	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Carex pennsylvanica	Cyperaceae	97	117	118	123	129	.	.	129	.	130	129	120	.	125	130	115	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex praegracilis	Cyperaceae	.	.	.	.	.	133	.	.	.	137	.	141	.	.	.	137	149	.	147	.	.	.	.	.	.	.	.	.	.
Carex rosea	Cyperaceae	.	140	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex sprengelii	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex vulpinoidea	Cyperaceae	.	.	.	.	.	168	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Castilleja coccinea	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Castilleja sessiliflora	Scrophulariaceae	158	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Catalpa bignoniodes	Bignoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Catalpa speciosa	Bignoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	172	190	187	.	.	.	180	.	180	171	.	171	.	.	.	.
Caulophyllum thalictroides	Berberidaceae	.	.	.	137	.	.	.	149	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Celastrus scandens	Celastraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Celtis occidentalis	Ulmaceae	.	.	.	.	.	.	.	.	.	.	.	124	126	128	136	.	.	127	129	128	122	.	130	.	124	.	133	128	.
Centaurea cyanus	Asteraceae	174	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centaurea maculosa	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centaurea repens	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Cerastium arvense	Caryophyllaceae	130	132	.	.	.	133	.	.	.	137	150	128	.	.	148	.	.	.	.	.	.	.	.	.	.	142	.	.	131
Cerastium nutans	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cerastium vulgatum	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chamaerhodos erecta	Rosaceae	.	.	.	.	.	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chenopodium album	Chenopodiaceae	169	156	.	181	177	174	.	175	.	.	.	.	.	180	.	172	.	.	.	.	.	.	.	.	.	.	.	.	.
Chenopodium gigantosper-mum	Chenopodiaceae	195	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chenopodium glaucum	Chenopodiaceae	215	.	.	.	.	.	.	.	.	.	237	.	.	.	.	.	.	.	.	229	.	.	.	239	.	.	.	.	.
Chenopodium leptophyllum	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chenopodium rubrum	Chenopodiaceae	.	.	.	.	.	.	.	235	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	228	.	.	.	.
Chenopodium strictum	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	231	229	.	237	226	.
Chrysanthe-mum coccineum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chrysanthe-mum leucanthemum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chrysanthe-mum uliginosum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	252	252	.	260	255	253	.	251	251	252	263	255	256	260
Chrysopsis villosa	Asteraceae	.	168	.	.	.	.	.	.	.	.	191	.	.	.	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Chrysotham-nus graveolens	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cichorium intybus	Asteraceae	183	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cicuta maculata	Apiaceae	173	.	.	181	.	185	.	.	.	.	.	178	.	.	.	.	.	.	.	.	.	180	170	.	.	.	.	.	.
Cinna latifolia	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Circaea latifolia	Onagraceae	.	.	.	.	.	.	.	.	.	.	.	202	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cirsium altissimum	Asteraceae	221	.	.	.	.	.	.	.	209	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cirsium arvense	Asteraceae	187	.	.	181	.	.	.	195	.	.	.	.	.	177	205	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cirsium undulatum	Asteraceae	180	.	.	181	.	192	191	187	.	.	181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cirsium vulgare	Asteraceae	199	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clematis virginiana	Ranunculaceae	221	.	.	203	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	192	.	.	.	.	.	.	.	.	.
Cleome serrulata	Capparaceae	.	.	.	.	.	.	.	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Collomia linearis	Polemoniaceae	.	.	.	.	.	.	.	.	163	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Comandra pallida	Santalaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	139	.	.	.	.
Conringia orientalis	Brassicaceae	156	154	.	154	.	148	.	.	154	.	.	141	133	.	131	151	.	.	.	.	.	.	.	.	.	.	.	.	.
Convallaria majalis	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Convolvulus arvensis	Convolvulaceae	174	.	.	.	.	.	.	186	.	.	.	.	.	172	.	.	.	.	.	167	.	.	.	.	.	173	.	.	.
Convolvulus repens	Convolvulaceae	169	158	.	.	.	.	.	173	.	.	173	164	.	168	.	163	163	.	.	.	.	.	.	.	.	173	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Convolvulus sepium	Convolvulaceae	175	.	.	.	163	.	.	201	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	161	.	.	.	.	.
Coreopsis tinctoria	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	213	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cornus alba	Cornaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cornus baileyi	Cornaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cornus racemosa	Cornaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cornus stolonifera	Cornaceae	.	.	.	155	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Corydalis aurea	Fumariaceae	113	.	131	137	.	.	.	.	.	.	143	.	.	.	145	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Corylus americana	Betulaceae	81	105	98	102	.	.	.	.	.	.	.	.	.	111	.	.	.	.	.	.	97	.	.	.	.	.	101	.	.
Cotoneaster acutifolius	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	150	155	.	152	154	154	145	.	.	.	.
Crataegus chrysocarpa	Rosaceae	127	140	.	137	.	.	.	145	.	144	.	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crataegus mollis	Rosaceae	127	.	.	.	.	.	.	141	134	.	.	.	.	.	152	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crepis runcinata	Asteraceae	158	.	.	.	.	.	.	.	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crocus vernus	Iridaceae	79	.	.	97	105	90	.	128	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cryptantha bradburiana	Boraginaceae	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cryptotaenia canadensis	Apiaceae	148	.	.	.	.	185	.	178	.	.	.	169	.	.	.	163	.	.	.	163	.	.	.	.	.	.	.	.	.
Cuscuta campestris	Cuscutaceae	.	.	.	.	.	.	212	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cuscuta coryli	Cuscutaceae	.	.	.	.	.	.	215	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Cuscuta gronovii	Cuscutaceae	215	212	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cynoglossum officinale	Boraginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	156	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyperus erythrorhizos	Cyperaceae	215	.	.	.	.	.	.	.	.	.	.	231	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyperus schweinitzii	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cypripedium candidum	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	144
Cypripedium parviflorum	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cypripedium pubescens	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylis glomerata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	171	184	172	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dalea alopecurioides	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Daphne cneorum	Thymelaeaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Daucus carota	Apiaceae	150	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Delphinium bicolor	Ranunculaceae	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Delphinium virescens	Ranunculaceae	170	.	.	181	174	192	.	186	.	.	.	.	.	.	.	175	.	.	.	.	.	.	.	169	.	.	.	.	.
Descurainia pinnata	Brassicaceae	141	145	148	145	161	148	.	171	.	.	151	141	133	.	148	143	.	.	.	155	.	.	.	.	.	.	.	.	.
Descurainia richardsonii	Brassicaceae	175	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Descurainia sophia	Brassicaceae	161	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	138	.	.
Desmodium acuminatum	Fabaceae	181	.	.	.	.	.	.	.	.	.	.	202	.	181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Desmodium canadense	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	202	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dictamnus albus	Rutaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Digitaria ischaemum	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Digitaria sanguinalis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dirca palustris	Thymelaeaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	137	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Disporum trachycarpa	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Distichlis stricta	Poaceae	.	.	.	.	.	.	.	175	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Draba nemorosa	Brassicaceae	113	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dracocephalum parviflorum	Lamiaceae	169	184	.	168	166	.	.	174	.	.	.	169	.	.	.	.	.	.	.	166	.	.	.	.	.	.	.	.	.
Echinochloa crusgalli	Poaceae	199	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Echinocystis lobata	Cucurbitaceae	208	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	210	.	.	.	.	206	.	.	.	.
Elaeagnus angustifolia	Elaeagnaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elaeagnus argentea	Elaeagnaceae	.	.	.	146	.	.	.	149	.	.	158	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Eleocharis acicularis	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eleocharis compressa	Cyperaceae	.	145	.	.	.	137	.	.	.	.	151	.	.	146	.	143	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eleocharis palustris	Cyperaceae	131	140	146	.	.	.	.	.	.	144	143	141	.	.	.	181	.	.	.	.	.	.	.	.	.	.	143	.	.
Ellisia nyctelea	Hydrophylla-ceae	128	133	141	140	141	.	.	145	132	141	145	141	138	.	152	.	.	.	135	142	.	.	136	136	.	147	142	141	140
Elsholtzia stauntonii	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elymus canadensis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	186	182	193	.	199	.	.	.	.	.	.	.	.	.	.	.	.	.
Elymus macounii	Poaceae	177	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elymus virginicus	Poaceae	181	.	.	.	.	.	.	195	.	.	.	.	184	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobium adenocaulon	Onagraceae	214	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobium angustifolium	Onagraceae	.	.	.	180	.	.	.	189	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Equisetum arvense	Equisetaceae	.	.	.	.	.	.	.	.	.	.	.	.	129	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis cilianensis	Poaceae	199	.	.	.	.	.	.	.	.	.	.	.	.	177	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis hypnoides	Poaceae	195	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis pectinacea	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erigeron caespitosus	Asteraceae	157	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Erigeron canadensis	Asteraceae	169	193	194	193	.	.	212	198	.	202	.	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erigeron glabellus	Asteraceae	.	.	.	.	.	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erigeron philadelphicus	Asteraceae	148	.	.	.	161	152	.	167	.	.	162	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erigeron strigosus	Asteraceae	.	.	.	.	.	.	.	.	.	.	175	.	.	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriogonum flavum	Polygonaceae	.	173	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriogonum multiceps	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum angustifolium	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erucastrum gallicum	Brassicaceae	165	161	.	.	.	.	.	.	.	.	.	.	.	.	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.
Erysimum asperum	Brassicaceae	157	.	148	154	.	.	.	.	148	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148	.
Erysimum chieranthoides	Brassicaceae	99	.	.	170	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erysimum parviflorum	Brassicaceae	.	156	.	171	.	.	.	175	.	.	173	169	.	.	.	.	.	.	.	166	.	.	.	.	.	.	.	.	.
Erythronium albidum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euonymus alatus	Celastraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euonymus atropurpurea	Celastraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	165
Euonymus nanus	Celastraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Eupatorium maculatum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eupatorium rugosum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	250	.	.	.	.	.
Euphorbia esula	Euphorbiaceae	161	.	.	.	.	.	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia glyptosperma	Euphorbiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia serpyllifolia	Euphorbiaceae	167	156	.	.	153	.	.	170	.	.	.	.	.	.	.	.	.	.	.	171	.	.	.	163	.	.	151	.	.
Festuca elatior	Poaceae	166	.	.	165	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca obtusa	Poaceae	.	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Forsythia ovata	Oleaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	103	.	.	.
Fragaria americana	Rosaceae	.	.	.	126	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fragaria virginiana	Rosaceae	.	126	127	.	.	133	.	.	.	.	.	127	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fraxinus lanceolata	Oleaceae	.	133	127	.	.	.	.	136	.	137	133	127	124	125	140	110	119	131	128	.	.	.	130	.	125	138	134	126	119
Fraxinus nigra	Oleaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fritillaria atropurpurea	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fumaria officinalis	Fumariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gaillardia aristata	Asteraceae	.	168	165	.	170	192	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Galinsoga ciliata	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium aparine	Rubiaceae	141	147	146	151	149	146	.	149	.	144	164	.	.	.	154	.	.	.	147	149	.	.	.	146	.	152	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Galium boreale	Rubiaceae	158	156	157	164	.	159	.	167	.	.	164	.	.	.	.	157	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium triflorum	Rubiaceae	92	.	.	.	.	.	.	.	.	.	145	128	.	.	.	.	145	.	132	.	.	.	.	.	.	.	.	.	.
Gaura coccinea	Onagraceae	.	168	165	.	.	193	.	187	154	.	.	.	.	.	.	157	.	.	.	.	.	.	.	.	.	.	.	.	.
Geranium carolinianum	Geraniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	161	.	.	.	.	.
Geranium maculatum	Geraniaceae	149	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	.	.	.	157	.	.	.	.	.	.	.	.	.
Geum aleppicum	Rosaceae	173	.	.	.	170	.	.	.	.	.	.	169	.	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geum canadense	Rosaceae	173	.	.	.	.	.	.	.	.	.	.	169	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geum rivale	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gleditsia triacanthos	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glyceria borealis	Poaceae	177	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glyceria grandis	Poaceae	168	.	.	162	.	.	.	175	.	.	173	169	.	.	.	175	.	.	.	.	.	.	.	.	.	.	.	.	.
Glycyrrhiza lepidota	Fabaceae	173	166	182	177	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gratiola ?	Scrophularia-ceae	162	.	.	.	.	.	.	.	.	.	.	.	181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Grindelia squarrosa	Asteraceae	182	166	.	.	.	.	212	216	.	205	.	.	.	.	226	215	.	.	.	208	.	.	.	.	.	.	.	.	.
Gutierrezia sarothrae	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gymnoeladus dioica	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Habenaria bracteata	Orchidaceae	.	140	.	144	.	.	.	.	.	.	.	.	.	.	.	.	.	.	147	.	.	.	.	.	.	.	.	.	.
Habenaria hyperborea	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Habenaria leucophaea	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hackelia americana	Boraginaceae	161	.	.	.	.	.	.	.	.	.	.	164	156	176	.	.	156	.	.	166	.	.	.	161	.	.	157	.	.
Haplopappus grindelioides	Asteraceae	.	.	.	.	.	.	.	.	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hedeoma drummondii	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hedeoma hispida	Lamiaceae	.	156	153	.	170	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helenium autumnale	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthus annuus	Asteraceae	.	.	.	.	.	.	.	.	.	190	.	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthus maximiliani	Asteraceae	199	212	.	214	212	.	212	208	216	202	.	202	.	195	.	.	.	.	.	212	.	.	.	.	.	.	.	.	.
Helianthus petiolaris	Asteraceae	195	.	.	181	.	193	.	.	173	185	.	186	.	.	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.
Helianthus rigidus	Asteraceae	.	.	.	214	.	.	212	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthus tuberosus	Asteraceae	.	.	.	226	.	.	.	235	228	226	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Heliopsis helianthoides	Asteraceae	172	166	.	171	170	181	212	186	.	.	173	171	.	177	.	.	.	.	.	176	.	.	.	.	171	.	.	.	.
Hemerocallis fulva	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Heracleum lanatum	Apiaceae	158	163	.	149	.	.	.	174	.	146	.	169	.	.	.	163	.	.	.	.	.	.	.	.	.	.	.	.	.
Hesperis matronalis	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Heuchera richardsonii	Saxifragaceae	163	.	153	.	170	.	.	186	.	.	175	.	.	.	.	157	.	.	.	.	.	.	.	.	.	.	.	.	144
Hibiscus trionum	Malvaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	185	.	.	.	.
Hieracium canadense	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hierochloa odorata	Poaceae	120	132	127	.	136	.	.	145	.	137	.	134	.	146	.	129	.	.	.	.	.	.	.	.	.	.	.	.	.
Hippophae rhamnoides	Elaeagnaceae	.	.	.	.	.	.	.	.	.	.	133	.	.	.	.	.	.	.	130	.	.	136	.	.	127	.	135	.	.
Hordeum jubatum	Poaceae	163	163	.	.	179	.	.	175	.	.	.	167	.	.	.	.	.	.	.	171	.	.	.	.	.	.	.	.	.
Hosta lancifolia	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Houstonia longifolia	Rubiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Humulus lupulus	Cannabaceae	.	.	.	181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hydrangea paniculata	Hydrangeaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hydrophyllum virginianum	Hydrophyllaceae	148	140	146	144	149	146	.	155	.	145	.	.	.	.	163	.	.	.	147	.	.	.	.	.	.	.	146	150	.
Hymenopappus filifolius	Asteraceae	.	.	.	.	.	.	.	.	193	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypoxis hirsuta	Liliaceae	158	.	.	.	.	.	.	.	.	.	.	.	.	146	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	144
Hystrix patula	Poaceae	.	.	.	.	.	.	.	.	.	.	.	184	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Impatiens capensis	Balsaminaceae	.	.	.	.	.	.	.	.	.	.	.	201	184	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Iva axillaris	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Iva xanthifolia	Asteraceae	231	.	227	224	236	.	.	230	228	.	236	230	.	229	.	.	.	.	.	229	.	.	.	227	.	.	233	226	.
Juglans cinerea	Juglandaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	138	145	.	146	140	145	140
Juglans nigra	Juglandaceae	.	.	.	.	.	.	.	.	.	.	.	.	145	.	.	.	.	.	144	159	159	155	.	151	.	.	147	150	155
Juncus balticus	Juncaceae	.	.	.	.	.	.	.	167	.	.	151	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus interior	Juncaceae	.	.	.	.	.	.	.	.	.	.	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus nodosus	Juncaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus torreyi	Juncaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juniperus scopulorum	Cupressaceae	.	.	.	.	.	.	.	.	.	.	128	120	118	130	130	116	.	.	127	132	.	131	130	133	126	137	135	133	121
Juniperus virginiana	Cupressaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	112	.	.	125	115	.	118	122	125	122	125	125	.	104
Kochia scoparia	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Koeleria cristata	Poaceae	.	166	.	.	.	.	.	175	.	.	173	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kuhnia eupatorioides	Juncaceae	.	.	.	206	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lactuca biennis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lactuca canadensis	Asteraceae	181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lactuca ludoviciana	Asteraceae	179	.	.	.	.	.	.	196	.	.	.	186	.	185	.	199	.	.	.	.	.	180	.	.	.	.	.	.	.
Lactuca pulchella	Asteraceae	181	184	.	181	.	.	.	195	173	.	185	.	.	.	.	.	.	.	.	184	.	180	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Lactuca scariola	Asteraceae	189	198	202	193	.	.	.	.	.	.	219	186	198	188	.	.	.	.	.	202	.	.	.	.	.	.	.	.	.
Laportea canadensis	Urticaceae	189	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lappula echinata	Boraginaceae	150	156	.	149	149	.	.	.	154	.	128	154	.	.	148	.	163	.	.	.	.	.	.	.	.	.	.	.	.
Lappula redowski	Boraginaceae	132	145	.	.	.	.	.	170	.	.	150	141	.	146	148	.	.	.	.	149	.	.	.	.	.	.	143	.	.
Lathyrus latifolius	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lathyrus ochroleucus	Fabaceae	162	140	.	158	.	156	.	146	.	.	.	.	.	.	.	153	.	.	147	163	.	.	.	.	.	.	.	.	.
Lathyrus palustris	Fabaceae	182	.	.	.	.	168	.	.	.	.	.	167	.	.	.	153	163	.	.	.	.	.	.	.	.	.	.	.	.
Lathyrus venosus	Fabaceae	163	.	.	164	166	156	.	174	.	.	.	169	.	.	.	163	163	.	.	166	.	.	.	.	.	.	.	.	.
Leersia oryzoides	Poaceae	226	.	.	.	.	.	.	.	.	.	.	231	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leonurus cardiaca	Lamiaceae	197	.	.	.	.	.	.	.	.	.	.	.	184	176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepidium densiflorum	Brassicaceae	138	143	140	149	163	132	.	160	.	155	151	141	.	.	.	143	.	.	154	.	.	.	.	145	.	.	143	.	.
Lepidium ramosissimum	Brassicaceae	.	.	.	.	.	.	.	181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lesquerella?	Brassicaceae	101	120	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leucocrinum montanum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liatris aspera	Asteraceae	223	.	212	213	.	.	218	.	.	.	.	.	.	.	222	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liatris punctata	Asteraceae	.	.	.	214	.	.	.	.	.	.	220	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Liatris pycnostachya	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	205	.	.	.	.	.	.	.	.	.	.	.	.	206	.	.	.	.
Lilium philadelphi-cum	Liliaceae	.	173	179	.	170	.	.	.	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.
Lilium pumilum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Limonium ?	Plumbaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Limosella aquatica	Scrophulariaceae	.	.	.	.	.	.	.	205	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linaria vulgaris	Scrophulariaceae	.	173	179	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linum lewisii	Linaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linum rigidum	Linaceae	.	168	161	.	.	195	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linum sulcatum	Linaceae	.	.	.	.	.	.	.	.	.	.	.	.	182	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.
Linum usitatissimum	Linaceae	169	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lithospermum canescens	Boraginaceae	128	132	.	145	.	.	.	.	.	144	150	.	.	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.
Lithospermum incisum	Boraginaceae	131	.	.	.	149	.	.	.	.	.	.	.	133	146	148	.	.	.	.	.	.	.	.	.	139	.	.	.	.
Lobelia siphilitica	Campanulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lobelia spicata	Campanulaceae	.	.	.	.	.	.	.	.	.	.	.	178	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lolium perenne	Poaceae	164	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lolium persicum	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lomatium foeniculaceum	Apiaceae	.	.	.	.	.	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Lomatium orientale	Apiaceae	92	.	.	.	.	.	.	.	.	.	.	.	.	.	122	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lonicera dioica	Caprifoliaceae	.	140	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	144	.	.	.	.	145	.	.	146	.	147
Lonicera maacki	Caprifoliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	153	.	.	.	.	.
Lonicera tatarica	Caprifoliaceae	.	133	140	146	.	138	.	149	.	.	.	141	.	.	.	.	.	.	141	.	.	.	.	139	.	152	143	.	137
Lotus americanus	Fabaceae	158	.	.	.	.	.	.	.	.	.	.	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lupinus argenteus	Fabaceae	.	.	.	.	.	.	.	.	158	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lupinus pusillus	Fabaceae	.	.	.	.	.	.	.	.	158	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lycopus americanus	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lycopus asper	Lamiaceae	215	.	.	.	.	.	212	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lycoris squamigera	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lygodesmia juncea	Asteraceae	.	173	.	.	.	.	.	.	.	.	182	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia ciliata	Primulaceae	173	.	.	.	.	185	.	.	.	.	.	.	.	.	.	175	.	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia longifolia	Primulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia thyrsiflora	Primulaceae	.	.	.	.	.	.	.	.	.	.	180	149	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lythrum alatum	Lythraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lythrum salicaria	Lythraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Lythrum salicaria	Lythraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Maianthemum canadense	Liliaceae	149	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Malus baccata	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	131	.	.	.	.	.	139	129
Malus sylvestris	Rosaceae	.	.	.	.	139	.	.	.	.	139	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Malva rotundifolia	Malvaceae	171	156	.	181	177	.	.	.	.	.	.	169	.	176	.	.	.	.	.	174	.	158	165	.	.	.	.	.	.
Mamillaria vivipara	Cactaceae	.	.	.	.	.	.	.	.	163	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Matricaria matricarioides	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Medicago falcata	Fabaceae	.	156	154	157	156	.	.	.	161	.	164	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Medicago lupulina	Fabaceae	152	.	.	.	.	.	.	.	.	.	.	.	.	165	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Medicago sativa	Fabaceae	167	159	162	160	150	134	.	167	.	.	167	.	.	162	.	.	163	.	.	166	.	158	.	.	162	.	.	.	.
Melilotus alba	Fabaceae	174	170	.	176	.	181	.	181	.	.	.	.	.	.	.	172	173	.	.	166	.	.	165	.	166	.	.	.	.
Melilotus officinalis	Fabaceae	164	171	.	165	.	153	.	173	.	.	167	162	156	.	.	157	156	.	.	163	.	.	156	.	150	166	.	.	.
Menispermum canadense	Menisperma-ceae	175	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.	163	.	.	166	.	.	.	.	.	.	.	.	.
Mentha arvensis	Lamiaceae	182	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mentzelia decapetala	Loasaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Menyanthes trifoliata	Menyanthaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.
Mertensia lanceolata	Boraginaceae	101	124	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Mertensia virginica	Boraginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mimulus ringens	Scrophularia-ceae	175	184	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Monarda fistulosa	Lamiaceae	.	.	202	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Monolepis nuttalliana	Chenopodiaceae	.	139	.	.	.	.	.	.	.	.	.	133	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	143
Morus alba	Moraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148	.	.	.	.
Muhlenbergia mexicana	Poaceae	226	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Muhlenbergia racemosa	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	199	.	.	.	.	.	.	.	.	.	.	.	.	.
Muhlenbergia richardsonis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Musineon divaricatum	Apiaceae	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nepeta cataria	Lamiaceae	183	.	.	.	.	.	.	201	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nepeta hederacea	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	.	147	.	.	.	.	.	.	.	.	.	.	.
Neslia paniculata	Brassicaceae	175	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oenothera biennis	Onagraceae	199	.	184	183	.	200	196	201	.	.	185	195	.	188	211	.	.	.	.	187	.	.	.	.	.	.	.	.	.
Oenothera caespitosa	Onagraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oenothera nuttallii	Onagraceae	199	166	.	181	.	.	.	.	165	.	180	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oenothera serrulata	Onagraceae	.	168	167	.	.	192	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Onosmodium occidentale	Boraginaceae	.	166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	169	.	.
Opuntia fragilis	Cactaceae	.	.	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Opuntia polycantha	Cactaceae	.	.	186	179	.	198	.	.	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	201
Orobanche fasciculata	Orobanchaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orthocarpus luteus	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oryzopsis asperifolia	Poaceae	.	133	.	.	.	.	.	.	.	130	.	127	.	.	141	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oryzopsis hymenoides	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oryzopsis racemosa	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Osmorhiza longistylis	Apiaceae	148	147	.	158	149	146	.	.	.	.	164	143	.	.	163	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ostrya virginiana	Betulaceae	.	133	.	.	.	.	.	.	.	.	.	125	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis europea	Oxalidaceae	.	152	157	158	162	146	.	167	161	.	162	169	155	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis stricta	Oxalidaceae	143	.	.	.	.	.	.	160	.	.	162	.	155	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis violacea	Oxalidaceae	130	140	143	145	144	133	.	149	.	144	150	141	.	.	.	.	.	.	.	.	.	.	.	.	.	.	143	.	.
Oxytropis campestris	Fabaceae	.	.	.	.	.	.	.	.	150	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxytropis lambertii	Fabaceae	.	.	153	155	.	.	.	.	.	.	.	.	.	.	.	.	156	.	.	.	.	.	.	.	.	.	.	148	.
Oxytropis splendens	Fabaceae	.	.	.	.	.	.	.	.	.	.	180	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Panicum capillare	Poaceae	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	199	.	.	.	.	.	.	.	.	.	.	.	.	.
Panicum leibergii	Poaceae	.	.	.	.	.	.	.	.	.	.	173	.	.	.	.	157	.	.	.	.	.	.	.	.	.	.	.	.	.
Panicum virgatum	Poaceae	186	.	.	.	.	.	.	198	.	.	.	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Papaver orientale	Papaveraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parietaria pennsylvanica	Urticaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parnassia glauca	Saxifragaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parnassia palustris	Saxifragaceae	.	.	.	.	185	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Paronychia sessiliflora	Caryophyllaceae	.	173	.	179	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parthenocissus vitacea	Vitaceae	.	.	.	.	.	.	.	.	.	.	.	.	184	176	.	.	.	.	.	185	.	.	.	.	.	.	.	.	.
Pastinaca sativa	Apiaceae	168	166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pedicularis canadensis	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	144	.	.	.	.	.	.	.	.	.
Pedicularis lanceolata	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Penstemon albidus	Scrophulariaceae	.	168	153	155	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Penstemon angustifolius	Scrophulariaceae	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Penstemon cristatus	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Penstemon gracilis	Scrophulariaceae	175	166	204	.	170	.	.	186	.	.	173	167	.	.	.	.	.	.	.	.	.	171	.	.	.	.	.	.	.
Penstemon grandiflorus	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Penthorum sedoides	Crassulaceae	189	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Petalostemum candidum	Fabaceae	.	.	.	180	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Petalostemum purpureum	Fabaceae	190	.	186	180	.	.	.	198	.	.	.	.	.	.	.	199	.	.	.	.	.	.	.	.	171	.	.	.	.
Petalostemum villosum	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Petasites sagittatus	Asteraceae	.	.	.	.	.	.	.	.	.	130	.	127	.	.	136	.	.	.	126	.	.	.	.	.	.	.	.	.	.
Phacelia leucophylla	Hydrophyllaceae	.	.	.	.	.	.	.	.	166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phalaris arundinacea	Poaceae	166	.	.	.	.	.	.	.	.	.	175	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Philadelphus coronarius	Hydrangeaceae	.	.	.	.	.	.	.	.	.	.	.	175	.	.	.	167	173	.	.	171	.	.	.	.	.	.	.	.	.
Phleum pratense	Poaceae	.	.	.	.	.	181	.	183	.	.	.	169	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phlox andicola	Polemoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phlox divaricata	Polemoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phlox hoodii	Polemoniaceae	101	123	.	121	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phlox subulata	Polemoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Phragmites communis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phryma leptostachya	Verbenaceae	197	.	.	.	.	.	.	.	.	.	.	.	.	.	211	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physalis heterophylla	Solanaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physalis lanceolata	Solanaceae	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physalis virginiana	Solanaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physaria brassicoides	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physostegia parviflora	Lamiaceae	208	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pinus banksiana	Pinaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.
Pinus scopulorum	Pinaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	151	155	.	.	.	.	.	.	.	.	.
Pinus sylvestris	Pinaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	146	151	.	.	.	.	.	.	.	.	.
Plantago eriopoda	Plantaginaceae	131	.	.	.	.	.	.	.	.	.	.	141	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago lanceolata	Plantaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago major	Plantaginaceae	172	.	.	.	.	174	.	175	.	.	.	171	.	172	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago purshii	Plantaginaceae	168	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago rugelii	Plantaginaceae	175	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa annua	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	176	191	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Poa compressa	Poaceae	.	166	.	170	168	178	.	183	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa palustris	Poaceae	169	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa pratensis	Poaceae	.	153	157	160	153	162	.	167	161	.	158	151	.	.	.	157	.	.	157	.	.	.	.	.	150	.	.	.	.
Polanisia graveolens	Capparaceae	199	.	.	.	.	.	.	.	.	.	.	.	.	177	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polemonium reptans	Polemoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygala alba	Polygalaceae	.	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygala senega	Polygalaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonatum commutatum	Liliaceae	174	.	.	164	166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	166	.	.	.	.	.	.	.	.	.
Polygonum achoreum	Polygonaceae	144	.	.	.	.	153	.	160	.	.	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum aviculare	Polygonaceae	151	.	.	.	.	.	.	.	.	.	171	154	.	.	.	157	.	.	157	171	.	.	.	.	.	.	.	.	.
Polygonum coccineum	Polygonaceae	175	190	.	.	.	.	.	.	.	.	.	186	.	.	.	199	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum convolvulus	Polygonaceae	175	.	.	.	.	.	.	178	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum lapathifolium	Polygonaceae	195	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum pennsylvani-cum	Polygonaceae	199	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum persicaria	Polygonaceae	205	.	.	.	.	.	.	.	.	.	.	.	208	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum ramosissimum	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Populus balsamifera	Salicaceae	.	.	.	.	.	.	.	.	.	.	126	110	118	121	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Populus deltoides	Salicaceae	92	117	.	.	121	108	125	129	105	120	.	110	118	121	124	100	112	117	123	114	104	106	114	.	120	.	127	122	107
Populus tremuloides	Salicaceae	85	107	.	108	.	.	.	116	99	111	120	.	.	116	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Portulaca oleracea	Portulacaceae	171	.	.	.	.	.	.	.	.	.	.	.	.	183	.	213	.	.	.	173	.	.	.	.	.	.	.	.	.
Potentilla anserina	Rosaceae	131	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	147	.	.
Potentilla arguta	Rosaceae	171	.	.	.	174	193	.	186	.	.	180	167	.	177	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla concinna	Rosaceae	.	123	.	135	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla fruticosa	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	161	.	.	.	.	.	.	.	.	.
Potentilla norvegica	Rosaceae	162	166	.	170	166	168	.	167	.	.	173	.	.	166	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla paradoxa	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla pennsylvanica	Rosaceae	175	166	.	.	.	.	.	186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla pentandra	Rosaceae	168	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prenanthes alba	Asteraceae	.	.	.	.	.	.	.	.	228	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prenanthes racemosa	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	239	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prinsepia sinensis	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	130	129	126	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Prunella vulgaris	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.
Prunus americana	Rosaceae	117	125	125	126	136	122	140	136	124	136	137	127	128	136	145	115	124	137	130	133	129	128	132	133	126	139	135	135	119
Prunus armeniaca	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus pennsylvanica	Rosaceae	.	.	129	.	.	.	.	139	.	.	143	.	.	139	152	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus pumila	Rosaceae	.	.	.	145	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus tomentosa	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus triloba	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus virginiana	Rosaceae	.	.	140	144	143	133	.	145	134	141	145	138	.	143	.	.	130	.	131	.	.	.	138	139	135	.	135	.	.
Psoralea argophylla	Fabaceae	175	189	.	181	.	.	.	201	173	.	181	.	182	177	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.
Psoralea esculenta	Fabaceae	.	.	.	.	.	.	.	.	168	.	175	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Psoralea lanceolata	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Puccinellia airoides	Poaceae	.	.	.	181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pycnanthe-mum virginianum	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pyrethrum coccineum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pyrola elliptica	Pyrolaceae	173	.	.	.	.	.	.	.	.	.	.	.	.	181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pyrus communis	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Quercus macrocarpa	Fagaceae	.	.	.	143	.	.	.	.	.	.	.	138	.	.	.	.	135	.	139	147	149	.	134	137	134	147	141	142	140
Ranunculus abortivus	Ranunculaceae	99	112	126	123	.	.	.	132	124	.	129	.	.	139	.	115	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus acris	Ranunculaceae	170	156	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus aquatilis	Ranunculaceae	158	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus cymbalaria	Ranunculaceae	132	147	.	.	.	.	.	167	.	.	159	141	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus flabellaris	Ranunculaceae	144	.	.	144	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus glaberrimus	Ranunculaceae	.	.	.	108	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus hispidus	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus macounii	Ranunculaceae	150	153	.	.	.	152	.	167	.	.	162	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus pennsylvani-cus	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus recurvatus	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus repens	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus rhomboideus	Ranunculaceae	94	117	118	108	.	107	127	.	103	.	.	120	.	124	122	.	.	.	.	.	.	.	110	.	.	.	.	.	.
Ranunculus sceleratus	Ranunculaceae	.	147	146	154	.	152	.	149	.	.	143	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus septentrionalis	Ranunculaceae	158	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	156	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Ratibida columnifera	Asteraceae	184	168	.	180	180	199	.	195	.	.	185	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhamnus cathartica	Rhamnaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	135	.	144	.	.	.	.	149	143	.	.	150	140
Rhamnus davurica	Rhamnaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	.	.	.	.	.
Rheum sp.	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhus glabra	Anacardiaceae	.	.	.	181	.	.	.	195	.	.	.	176	.	196	175	186	181	.	.	181	.	.	.	.	.	.	.	.	.
Rhus rydbergii	Anacardiaceae	162	.	.	.	.	.	.	.	.	.	.	169	.	.	.	178	.	.	.	.	.	.	.	161	.	.	.	.	.
Ribes americanum	Grossulariaceae	127	140	131	.	139	128	.	145	.	.	.	.	.	.	.	129	.	.	.	.	.	.	.	.	.	.	.	.	.
Ribes missouriense	Grossulariaceae	.	133	132	123	.	.	.	139	.	.	143	134	.	139	145	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ribes odoratum	Grossulariaceae	.	.	125	130	.	.	.	.	.	.	.	.	.	.	145	120	128	.	135	.	.	131	130	.	.	.	137	133	122
Ribes vulgare	Grossulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	123	135	139	112	128	.	129	131	.	.	130	130	127	.	135	.	126
Ribes hirtellum	Grossulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ribes nigrum	Grossulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	143	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ribes setosus	Grossulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	131	124	122
Ricinus communis	Euphorbiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Robinia pseudoacacia	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Rorippa armoracia	Brassicaceae	.	143	148	158	156	158	.	.	.	152	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rorippa austriaca	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rorippa islandica	Brassicaceae	162	164	.	.	.	181	.	174	.	.	164	169	.	176	.	.	.	.	.	.	.	.	156	.	.	.	.	.	.
Rorippa sinuata	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rosa arkansana	Rosaceae	167	162	162	165	162	168	.	.	.	.	171	164	.	.	.	.	173	.	.	173	.	.	.	.	.	.	.	.	.
Rosa blanda	Rosaceae	162	159	.	165	.	155	.	174	.	.	167	.	.	.	.	.	156	.	.	163	.	.	.	.	.	.	.	.	.
Rosa hugonis	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus strigosus	Rosaceae	.	.	.	.	.	.	.	151	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus occidentalis	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	150	.	.	.	.	.	.	.	.	.	.
Rubus pubescens	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus strigosus	Rosaceae	.	.	.	.	.	.	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rudbeckia laciniata	Asteraceae	208	.	205	.	.	.	.	211	.	202	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rudbeckia serotina	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	171	.	.	171	.	.	.	.
Rumex acetosella	Polygonaceae	166	.	167	.	.	.	.	.	.	.	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex crispus	Polygonaceae	168	166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	161	.	.	.	.	.
Rumex mexicanus	Polygonaceae	158	153	159	.	160	158	.	.	.	155	162	154	.	.	.	.	.	.	.	.	.	.	.	161	.	.	.	.	.
Rumex occidentalis	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex persicarioides	Polygonaceae	182	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Rumex venosus	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sagittaria cuneata	Alismataceae	169	.	.	171	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix interior	Salicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix amygdaloides	Salicaceae	.	.	.	.	.	128	.	136	.	.	140	.	.	139	.	.	.	.	132	.	.	.	.	.	.	.	.	135	.
Salix cordata	Salicaceae	92	112	.	.	115	106	.	.	117	.	.	108	.	120	.	99	114	.	122	118	.	.	114	.	.	.	.	.	.
Salix discolor	Salicaceae	76	107	.	107	.	.	.	126	103	114	126	106	.	118	122	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix interior	Salicaceae	175	144	.	.	.	128	.	.	.	144	151	.	.	.	152	.	.	.	147	.	.	.	.	.	.	.	.	135	.
Salix petiolaris	Salicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	118	.	126	.	.	.	.	.	.	.	.	.	.
Salix vitellina	Salicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	130	130	110	.	.	128	132	.	.	.	125	.	.	131	126	119
Salsola kali	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	186	182	185	.	199	.	.	.	.	.	.	.	.	.	.	182	.	.
Salvia lanceolata	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sambucus canadensis	Caprifoliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sambucus pubens	Caprifoliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	141	139	142	.	.	134	139	.	.	137	135	125
Sanguinaria canadensis	Papaveraceae	92	112	118	109	129	.	127	125	110	117	126	.	.	123	121	115	.	.	.	.	.	.	.	.	.	.	.	.	.
Sanicula marylandica	Apiaceae	161	.	.	158	166	.	.	.	.	.	.	.	.	.	.	.	156	.	.	.	.	.	.	.	.	.	.	.	.
Saponaria vaccaria	Caryophyllaceae	173	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schedonnardus paniculatus	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schizachne purpurascens	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Scilla siberica	Liliaceae	.	.	.	.	.	.	.	128	.	.	121	.	117	120	122	106	114	117	125	.	.	.	.	.	.	.	.	.	.
Scirpus acutus	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	143	.	.
Scirpus americanus	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus atrovirens	Cyperaceae	181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus fluviatilis	Cyperaceae	.	.	.	162	.	.	.	.	.	.	162	167	.	.	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus heterochaetus	Cyperaceae	.	.	.	.	.	.	.	.	.	.	151	.	.	.	.	157	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus paludosus	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	182	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus validus	Cyperaceae	.	.	.	.	.	.	.	175	.	.	.	169	.	.	.	.	.	.	.	166	.	.	.	.	.	.	.	.	.
Scolochloa festucacea	Poaceae	.	.	.	.	.	.	.	167	.	.	164	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scolochloa festucacea	Poaceae	.	.	.	.	.	.	.	167	.	.	164	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scrophularia leporella	Scrophulariaceae	.	166	.	154	.	193	.	.	.	.	.	.	.	.	.	.	.	.	.	164	.	.	.	161	.	.	.	148	.
Scutellaria galericulata	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scutellaria lateriflora	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scutellaria parvula	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Secale cereale	Poaceae	.	.	.	162	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio aureus	Asteraceae	149	140	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio canus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Senecio congestus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio integerrimus	Asteraceae	158	.	.	155	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio pauperculus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio plattensis	Asteraceae	141	.	.	154	.	.	.	.	.	147	151	141	.	.	.	137	.	.	142	.	.	.	144	.	.	.	.	.	.
Setaria glauca	Poaceae	188	.	.	.	.	.	.	201	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Setaria verticillata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Setaria viridis	Poaceae	175	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shepherdia argentea	Elaeagnaceae	92	.	108	.	113	106	117	121	94	111	123	106	114	118	113	98	110	114	117	108	102	103	111	111	117	119	126	122	100
Silene antirrhina	Caryophyllaceae	169	.	.	168	.	174	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Silene cserei	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Silene noctiflora	Caryophyllaceae	170	.	.	.	.	.	.	.	.	.	175	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Silphium perfoliatum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sisymbrium altissimum	Brassicaceae	157	156	.	161	.	.	.	174	154	.	167	.	.	165	.	.	.	.	.	.	.	.	149	.	.	.	143	.	.
Sisymbrium loeslii	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sisyrinchium angustifolium	Iridaceae	131	134	135	.	149	133	.	.	.	.	.	141	.	.	162	.	.	.	.	.	.	.	.	.	139	.	.	.	144
Sium suave	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	178	184	193	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Smilacina racemosa	Liliaceae	.	148	.	158	.	.	.	146	.	.	.	.	.	.	.	.	156	.	.	163	.	.	156	.	.	.	.	.	.
Smilacina stellata	Liliaceae	127	140	146	.	.	128	.	145	.	142	145	134	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Smilax herbacea	Smilacaceae	148	140	.	158	149	146	.	.	.	145	.	.	.	.	163	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum nigrum	Solanaceae	.	.	.	.	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum rostratum	Solanaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum triflorum	Solanaceae	.	171	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago canadensis	Asteraceae	199	224	222	219	212	221	.	221	223	.	224	.	.	.	230	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago gigantea	Asteraceae	208	206	205	193	.	.	.	.	209	207	.	202	.	203	224	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago graminifolia	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago missouriensis	Asteraceae	223	.	.	.	.	.	.	.	.	.	.	.	.	198	224	.	.	.	.	203	.	.	.	.	.	.	.	.	.
Solidago mollis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago nemoralis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago riddellii	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago rigida	Asteraceae	223	221	209	224	221	.	.	221	.	.	220	.	.	.	226	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sonchus arvensis	Asteraceae	.	.	.	.	.	.	202	195	.	185	.	178	176	176	197	176	175	.	.	184	.	.	.	.	.	.	179	.	.
Sonchus asper	Asteraceae	.	.	.	186	.	.	.	.	.	.	.	.	.	172	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sonchus oleraceus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Sorbus aucuparia	Rosaceae	145	140	.	149	.	.	.	151	.	.	.	.	.	.	.	137	.	.	140	.	.	.	.	147	.	.	.	.	.
Sorghastrum nutans	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	206	.	.	.	.
Sparganium eurycarpum	Sparganiaceae	163	.	.	.	.	.	.	175	.	.	.	169	.	177	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spartina gracilis	Poaceae	181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spartina pectinata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	186	182	.	.	199	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphaeralcea coccinea	Malvaceae	157	.	165	179	.	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphenopholis obtusata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spiraea alba	Rosaceae	182	.	.	.	.	185	.	195	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spiraea arguta	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spiraea thunbergii	Rosaceae	.	.	.	139	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spiranthes cernua	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sporobolus asper	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sporobolus cryptandrus	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sporobolus heterolepis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	198	.	199	.	.	.	.	.	.	.	.	.	.	.	.	.
Sporobolus neglectus	Poaceae	226	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stachys palustris	Lamiaceae	175	171	.	181	170	188	.	190	.	.	.	178	.	180	.	175	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Stellaria longifolia	Caryophyllaceae	136	140	.	.	.	.	.	146	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stellaria media	Caryophyllaceae	.	153	.	.	.	.	.	170	.	.	167	145	153	153	.	157	169	.	157	.	.	.	.	.	.	.	161	.	165
Stipa comata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stipa spartea	Poaceae	.	.	.	.	.	.	.	175	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stipa viridula	Poaceae	156	168	.	171	.	.	.	175	.	.	173	.	.	.	.	157	.	.	.	.	.	.	.	161	.	173	.	.	.
Strophostyles leiosperma	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Suaeda depressa	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Symphoricarpos occidentalis	Caprifoliaceae	173	166	.	.	.	200	.	186	.	.	182	176	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Syringa amurensis	Oleaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	189	.	170	.	.	.	.	.	.	.	.	.	.	.	.
Syringa persica	Oleaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Syringa villosa	Oleaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	147	.	.	.	.	.
Syringa vulgaris	Oleaceae	.	133	140	143	140	132	.	145	.	139	145	138	.	143	154	.	133	148	139	144	.	144	137	139	132	145	141	143	137
Tamarix pentandra	Tamaricaceae	.	.	.	.	.	.	.	.	.	.	.	167	.	164	.	.	.	.	.	171	.	.	.	163	150	.	.	.	.
Tanacetum vulgare	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Taraxacum officinale	Asteraceae	99	.	118	121	127	114	126	129	124	130	139	126	128	132	139	120	129	133	131	131	122	128	129	131	128	137	133	132	122
Teucrium occidentale	Lamiaceae	183	184	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thalesia uniflora	Orobanchaceae	161	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Thalictrum dasycarpum	Ranunculaceae	162	.	.	.	170	185	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thalictrum venulosum	Ranunculaceae	.	137	141	150	.	133	.	.	.	145	151	141	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thelypodium integrifolium	Brassicaceae	.	.	.	.	.	.	.	.	191	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thermopsis rhombifolia	Fabaceae	.	.	.	.	.	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thlaspi arvense	Brassicaceae	80	110	111	103	129	106	122	123	98	101	143	106	111	.	122	99	.	106	.	91	.	138	.	104	125	.	.	.	86
Tilia americana	Tiliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	206	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Townsendia exscapa	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tradescantia bracteata	Commelinaceae	148	140	.	.	155	133	.	.	.	.	158	156	.	.	162	151	.	.	.	.	.	.	.	.	.	.	.	.	.
Tradescantia occidentalis	Commelinaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tragopogon dubius	Asteraceae	168	.	.	.	164	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	158	.	.	155	163	.	156	.
Trifolium hybridum	Fabaceae	158	.	.	162	163	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium pratense	Fabaceae	154	162	.	158	156	159	.	167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium repens	Fabaceae	145	153	158	153	156	152	.	.	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Triglochin maritima	Juncaginaceae	.	.	.	.	.	.	.	.	.	.	180	141	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Triglochin palustris	Juncaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trillium cernuum	Liliaceae	127	137	132	137	.	.	.	145	.	.	.	.	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Trillium grandiflorum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	126	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Typha latifolia	Typhaceae	168	.	.	.	.	.	.	.	.	.	173	.	.	.	.	.	176	.	.	.	.	.	.	.	168	.	.	.	.
Ulmus americana	Ulmaceae	86	112	101	105	110	99	117	123	100	109	120	106	112	119	113	95	109	111	117	106	99	101	110	108	114	119	123	121	100
Ulmus fulva	Ulmaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	127	.
Ulmus pumila	Ulmaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Urtica procera	Urticaceae	175	.	.	.	179	.	.	195	.	.	.	176	.	180	.	199	.	.	.	192	.	.	.	.	.	.	.	.	.
Utricularia vulgaris	Lentibulariaceae	149	.	.	.	.	.	.	178	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Uvularia grandiflora	Liliaceae	120	.	.	126	.	.	.	132	.	134	.	127	.	.	137	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Uvularia sessifolia	Liliaceae	120	126	131	137	.	.	.	145	.	.	.	.	.	.	137	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Verbascum thapsus	Scrophularia-ceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Verbena bracteata	Verbenaceae	168	166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Verbena hastata	Verbenaceae	182	.	.	.	180	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Verbena stricta	Verbenaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Verbena urticifolia	Verbenaceae	199	.	.	.	.	.	.	201	.	.	.	.	.	.	211	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vernonia fasciculata	Asteraceae	208	.	.	.	.	.	212	216	209	.	206	.	.	193	.	199	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica peregrina	Scrophulariacea	136	.	.	144	.	.	.	145	.	.	.	.	145	.	.	131	.	141	147	137	151	.	134	136	.	152	.	143	.
Viburnum affine	Caprifoliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Viburnum lentago	Caprifoliaceae	149	147	146	155	.	146	.	.	.	.	.	.	.	.	163	.	.	.	147	.	.	.	147	145	.	.	.	.	.
Viburnum opulus	Caprifoliaceae	158	.	.	.	.	.	.	.	.	.	.	.	.	153	.	.	.	.	148	157	.	156	143	.	145	.	149	.	.
Vicia americana	Fabaceae	148	145	155	154	150	148	.	165	.	146	145	149	.	150	.	151	.	.	145	149	.	.	.	.	.	.	151	.	.
Vicia angustifolia	Fabaceae	.	.	.	.	.	188	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vicia sparsifolia	Fabaceae	.	.	.	.	.	.	.	.	154	.	.	.	.	146	157	146	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola adunca	Violaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola conspersa	Violaceae	114	126	.	.	.	.	.	.	.	130	.	122	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola eriocarpa	Violaceae	116	126	126	123	.	.	.	139	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola nuttallii	Violaceae	101	124	.	121	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola papilionacea	Violaceae	120	126	126	126	.	.	.	132	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola pedatifida	Violaceae	128	137	.	.	149	133	.	.	.	144	.	.	.	.	148	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola rugulosa	Violaceae	99	126	126	123	.	.	127	139	.	130	129	127	.	.	.	115	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola sororia	Violaceae	.	.	.	.	.	.	.	.	.	.	129	127	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vitis riparia	Vitaceae	162	.	.	.	.	.	.	.	.	.	.	.	156	.	.	.	.	.	.	163	.	.	156	.	.	162	.	.	.
Xanthium echinatum	Asteraceae	215	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	213	.	.	.	.	.	.	.	.	.
Xanthium italicum	Asteraceae	226	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	213	.	.	.	.	.	.	.	.	.
Yucca glauca	Agavaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zanthoxylum americanum	Rutaceae	.	129	.	137	.	.	.	136	.	.	.	136	.	.	154	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zephyranthes	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Scientific Name	Family	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Zigadenus elegans	Liliaceae	.	.	.	.	174	.	.	.	.	.	180	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.	.	.	.
Zizania aquatica	Poaceae	226	.	.	.	.	.	.	.	.	.	.	210	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zizia aptera	Apiaceae	141	.	.	.	.	.	.	.	.	.	.	141	.	.	148	137	.	.	.	.	.	.	149	.	.	.	.	.	.
Zizia aurea	Apiaceae	127	140	146	144	149	142	.	145	.	146	143	.	.	.	148	143	.	.	147	.	.	.	.	.	.	.	.	.	.

APPENDIX B. PLANT PHENOLOGIES FROM CLAY COUNTY MINNESOTA 1939-2012

First flowering dates of plant species found in Clay County Minnesota, including family name, scientific and common names, life-form and first flowering date (FFD) information from 1940 to 2012.

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Acer ginnala	Aceraceae	.	.	.	.	.	.	.	.	144	140	.	.	140	.	158	135	157	146	141	149	156	.	.	.	152	.		
Acer negundo	Aceraceae	124	115	110	113	119	97	105	122	114	.	134	119	113	123	118	105	131	116	.	.	128	.	.	121	114	100		83
Acer saccharinum	Aceraceae	108	99	92	97	103	80	85	109	106	100	111	112	106	95	99	97	110	106	92	92	105	.	.	107	104	90	103	78
Acer saccharum	Aceraceae	.	.	.	.	.	137	.	.	.	.	.	.	.	.	.	120	142	.	.	.	139	135	.	.	.	.		
Acerates viridiflora	Asclepiadaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Achillea millefolium	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	170	.	.	.	.	.	.	.	155	168	168	.	165	138
Acidanthera ?	Iridaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	261	.	.	.	.	.		
Acnida altissima	Amaranthaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Actaea rubra	Ranunculaceae	143	130	.	146	143	149	146	143	138	131	153	137	143	147	143	132	147	137	137	140	141	.	.	148	.	.		122
Actinella acaulis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148	.	.	.	.	.	.	145	.	.	.	.		
Aesculus glabra	Hippocastanaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	142	149	.	.	.	.		
Agastache anethiodora	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Agoseris glauca	Asteraceae	.	.	.	.	.	.	.	144	.	.	.	.	.	.	.	.	159	.	.	.	.	.	.	161	.	.		
Agrimonia striata	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Agropyron repens	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	163	177	176	.	169	175	.	165	169	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Agropyron smithii	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Agropyron trachyeainlng	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Agrostemma githago	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Agrostis alba	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Agrostis scabra	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Alisma subcordatum	Alismataceae	.	.	.	.	.	.	.	.	172	.	.	.	.	.	192	.	.	.	.	.	.	.	.	.	.	.		
Allionia hirsuta	Nyctaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Allionia nyctaginea	Nyctaginaceae	.	.	.	.	.	.	.	.	.	.	170	.	163	171	170	.	.	188	179	.	.	.	.	.	.	.		
Allium schoenoprasum	Liliaceae	.	.	153	.	.	.	.	.	.	.	.	.	.	.	162	149	.	.	147	.	155	.	.	.	.	.		
Allium stellatum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	205	225	216	.	245	216
Allium textile	Liliaceae	.	.	.	.	.	.	.	.	.	127	.	.	.	.	.	134	.	.	.	.	.	143	.	.	152	.		
Allium tricoccum	Liliaceae	.	.	.	.	.	.	.	.	.	.	189	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Alopecurus aepualis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Alopecurus pratensis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	151	.	.	.	134	.	.	.	.	.	.	.		
Amaranthus albus	Amaranthaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Amaranthus graecizans	Amaranthaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	169	.	.	.	161	.	.	.	.		
Amaranthus retroflexus	Amaranthaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	190	185	190	196	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Ambrosia artemisia	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	221	.	.	221	.	.	.	.	.	.	.	.		
Ambrosia psilostochys	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Ambrosia trifida	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	206	204	.	.	.	.	.	.	.	.		
Amelanchier alnifolia	Rosaceae	133	122	116	129	.	133	144	136	.	.	146	131	119	136	138	119	142	127	127	.	134	139	.	139	136	113		
Ammannia coccinea	Lythraceae	.	.	197	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Amorpha canescens	Fabaceae	.	.	.	.	.	.	.	.	.	.	196	.	.	.	.	.	.	.	.	186	.	188	177	194	188	.		178
Amorpha fruticosa	Fabaceae	.	.	.	136	.	.	.	.	153	.	165	.	143	.	.	166	.	.	.	.	.	.	.	.	.	.	173	
Amphicarpa bracteata	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Andropogon furcatus	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	214	.	.	.	.	.	.	.		
Andropogon scoparius	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Androsace occidentalis	Primulaceae	.	.	113	122	127	.	111	.	122	.	141	122	.	.	.	.	.	.	.	.	.	130	.	120	119	105		
Anemone canadensis	Ranunculaceae	.	.	.	.	.	.	.	170	.	.	.	.	157	.	159	.	163	.	.	.	.	156	151	161	.	.	160	139
Anemone cylindrica	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	.	.	174	175	.	171	165
Anemone patens	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	106	107	106	94	108	83
Anemone quinquefolia	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	133	.	.	.	.	.		
Anemone virginiana	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	180	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Antennaria aprica	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	114	.	.	.	.	133	.	.	.	.	.		116
Antennaria microphylla	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Anthemis cotula	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Antirrhinum majus	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	173	.	.	.	.		
Aplopappus lanceolatus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	214	.	.	.	.		
Aplopappus spinulosus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Apocynum androsaemi-foium	Apocynaceae	.	.	.	.	.	.	.	.	.	165	.	.	.	.	.	.	.	.	.	.	.	162	.	.	.	.		
Apocynum hypericifolium	Apocynaceae	.	.	.	.	.	.	.	.	.	.	182	.	.	.	177	169	170	184	.	.	.	177	.	.	.	.		162
Aquilegia canadensis	Ranunculaceae	.	135	143	.	.	.	.	.	143	.	.	.	.	.	153	.	.	.	137	147	.	149	.	.	143	.	148	
Arabis divaricarpa	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	131	.	.	.	.	.	.	.	.	.	.		
Arabis hirsuta	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Aralia nudicaulis	Araliaceae	.	.	.	.	.	.	.	161	143	149	161	139	.	160	.	140	.	.	.	.	153	.	.	.	.	.		
Arctium minus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	208	.	.	.	.	206	.	.	.	.		
Arenaria laterifolia	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	156	.	.	.	.	.	.	.	.	.		
Aretium tomentosum	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	210	.	.	.	.	.	.	.	.	.		
Arisaema atrorubens	Araceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Arnica fulgens	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	147	.	.	.	.	.	.	.	.	.	.	.	.	
Artemisia absinthium	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Artemisia biennis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	233	.	.	.	
Artemisia caudata	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Artemisia dracunculoides	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Artemisia frigida	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Artemisia gnaphalodes	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Asarum canadense	Aristolochiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	127	
Asclepias incarnata	Asclepiadaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	186	.	.	.	.	.	.	192	
Asclepias ovalifolia	Asclepiadaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	185	175	.	165	
Asclepias speciosa	Asclepiadaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	192	
Asclepias syriaca	Asclepiadaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	176	174	.	184	.	.	.	.	.	185	185	.		165
Asclepias verticillata	Asclepiadaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Asparagus officinalis	Liliaceae	.	.	.	158	.	.	.	.	.	.	.	.	.	.	163	142	154	149	.	153	155	.	.	.	.	.	.	
Aster brachyactis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Aster ericoides	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Aster laevis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	225	.	.	.	.	234	.	.	.	.		
Aster nova.angliae	Asteraceae	.	203	219	229	227	223	.	.	222	.	232	.	.	229	231	212	239	.	217	224	.	221	.	.	.	.		191
Aster paniculatus	Asteraceae	.	.	.	231	.	.	.	.	.	.	.	.	.	.	.	247	.	.	.	210	.	234	.	.	.	.		
Aster punicens	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	225	.	.	.	.	214	.	.	.	.		
Astragalus bisulcatus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Astragalus canadensis	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	201	.	.	.	193	.	.	.	.	.	.	.		
Astragalus caryocarpus	Fabaceae	.	.	119	.	.	.	.	.	129	127	.	.	.	.	.	.	.	.	.	.	.	132	.	.	.	.		
Astragalus flexuosus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Astragalus hypoglottis	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	134	.	.	134	.	.	.	.	.	.	.		
Astragalus missouriensis	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	138	.	.	.	.		
Astragalus pectinatus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Astragalus plattensis	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Astragalus racemosus	Fabaceae	.	.	.	.	152	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Astragalus striatus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	.	.	.	159	.	.	.	.	.	.	.		
Astragalus triphyllus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Atriplex confert	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Atriplex hastata	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	210	.	.	.	.	.	.	.	.	.		
Atriplex patula	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	226	231	217	230	213	.	.	.	.	.	.	.		
Atriplex rosea	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Avena fatua	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	185	.	.	.	.	.	.	.		
Bahia oppositifolia	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Beckmannia syzigachne	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	170	.	.	.	.	.	.	.	.	.	.	.		
Berberis thunbergii	Berberidaceae	.	.	131	.	142	.	.	.	139	132	153	150	124	142	.	122	147	135	129	137	150	147	.	.	.	.		
Berteroa incana	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	149	.	.	147	.	.	.	.	.	155	.		
Betula papyrifera	Betulaceae	130	118	114	124	.	124	139	.	120	.	141	123	116	126	132	116	137	118	.	.	.	130	.	.	116	.		79
Bidens acuta	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Bidens cernua	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	210	.	.	.	.	.	.		
Bidens frondosa	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	210	.	.	.	.	.	.		
Bidens vulgata	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Boltonia latisquama	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	227	217	221	.	.	.	.	.	.	.	.		
Bouteloua curtipendula	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	186	.	.	.	.	.	.		
Bouteloua gracilis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	186	.	.	.	.	.	.		
Brassica arvensis	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	144	.	159	137	.	148	.	.	153	.	.	.	.	.		
Brassica juncea	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Brauneria angustifolia	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Bromus ciliatus	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Bromus inermis	Poaceae	.	.	.	.	.	.	.	.	157	.	.	.	161	163	166	149	162	165	.	.	.	.	.	.	.	.		
Bromus tectorum	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	155	.	155	.	.	.	.	.		
Buchloe dactyloides	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Calamagrostis inexpansa	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Calamovilfa longifolia	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Calla palustris	Araceae	.	.	.	.	.	.	.	.	.	.	.	.	139	139	.	.	.	.	.	.	.	.	.	.	.	.		
Caltha palustris	Ranunculaceae	133	.	.	.	.	117	.	124	.	.	.	.	.	.	.	.	.	.	.	128	.	.	127	132	124	109	140	109
Camelina sativa	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Campanula rapunculoides	Campanulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	175	175	.	.	178	.	180	.	172	.	.		
Campanula rotundifolia	Campanulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	159	.	175	.	167	216
Campsis radicans	Bignoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	215	204	205	212	.	.	.	.	.	.	.	.		
Capsella bursapastoris	Brassicaceae	.	.	.	.	.	.	.	135	131	125	.	.	.	124	.	111	129	.	.	.	.	.	.	107	.	80	98	80
Caragana arborescens	Fabaceae	144	.	131	140	.	.	121	151	137	.	.	136	122	142	141	122	148	130	131	.	.	.	.	.	.	.		
Caragana fruticosa	Fabaceae	.	.	.	140	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Caragana pygmaea	Fabaceae	152	.	.	.	.	.	146	.	145	.	158	.	.	151	155	134	156	149	142	145	150	149	.	.	.	.		
Cardamine bulbosa	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	156	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Cardaria draba	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	175	147	.	.	.	.	.	.	.	.	
Cardaria pubescens	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	144	159	.	.	.	.	.	.	.	.	.	.	
Carduus crispus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	191	.	.	.	.	.	.	.	.	
Carex aquatilis	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Carex assiniboinensis	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Carex blanda	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	153	.	.	.	.	.	.	.	
Carex brevior	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	156	.	.	.	.	.	
Carex deweyana	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	.	.	.	.	.	.	.	
Carex eleocharis	Cyperaceae	.	.	119	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Carex filifolia	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Carex gravida	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Carex laeviconica	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Carex lanuginosa	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Carex pennsylvanica	Cyperaceae	.	116	119	.	.	.	.	.	.	.	.	.	.	.	.	114	.	.	.	.	.	.	.	.	.	.	127	98
Carex praegracilis	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Carex rosea	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Carex sprengelii	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.	.	.	.	.	.	.	.	
Carex vulpinoidea	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Castilleja coccinea	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	162	158	.	.	.	.	140	

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Castilleja sessiliflora	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	143	151	158	152	.	167	
Catalpa bignoniodes	Bignoniaceae	183	170	181	.	.	.	.	.	.	.	.	.	.	.	185	170	172	182	185	177	181	178	.	.	.	.		
Catalpa speciosa	Bignoniaceae	179	168	178	.	.	.	.	.	.	.	.	.	.	.	.	165	.	170	179	165	.	176	.	192	188	.		
Caulophyllum thalictroides	Berberidaceae	.	.	131	.	.	.	.	142	.	.	.	139	.	.	.	.	.	.	.	133	.	.	.	.	.	.		
Celastrus scandens	Celastraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	162	.	.	.	.		
Celtis occidentalis	Ulmaceae	132	121	113	124	.	124	114	135	.	119	142	.	117	127	.	115	141	.	.	.	134	.	.	.	.	109		
Centaurea cyanus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Centaurea maculosa	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	196	.	.	.	.	.	.	.	.	.		
Centaurea repens	Asteraceae	.	.	191	.	.	.	.	.	.	.	.	.	.	.	185	174	180	186	193	.	.	.	.	.	.	.		
Cerastium arvense	Caryophyllaceae	.	.	.	.	.	.	.	.	129	127	.	.	128	.	.	.	.	.	.	.	.	.	.	132	134	116	134	116
Cerastium nutans	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	.	.	.	.	.	.		
Cerastium vulgatum	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	139	148	.	.	.	.	.	.	.	.	.		
Chamaerhodos erecta	Rosaceae	.	.	.	.	.	.	.	.	.	.	170	.	.	166	.	.	.	.	.	.	.	171	.	.	.	.		
Chenopodium album	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	185	149	.	.	168	.	.	.	.	.	.	.		
Chenopodium gigantospermum	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Chenopodium glaucum	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	149	.	.	.	.	.	.	.	.	.	.		
Chenopodium leptophyllum	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Chenopodium rubrum	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Chenopodium strictum	Chenopodiaceae	228	.	229	226	.	.	.	.	.	.	.	.	.	227	226	234	.	230	227	230	.	.	.	.	.	.		
Chrysanthemum coccineum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	156	163	157	.	.	.	.		
Chrysanthemum leucanthemum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	142	161	.	152	155	153	156	.	.	.	.		
Chrysanthemum uliginosum	Asteraceae	258	257	249	260	259	256	.	259	249	259	250	257	253	254	.	262	258	.	258	254	251	252	.	.	.	.		
Chrysopsis villosa	Asteraceae	.	.	.	.	.	.	.	.	.	.	196	.	.	.	.	.	.	.	195	.	.	.	.	.	175	.		
Chrysothamnus graveolens	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cichorium intybus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	201	
Cicuta maculata	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	177	.	188	.	192	191
Cinna latifolia	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	.	.	.	.	.	.	.	.	.	.		
Circaea latifolia	Onagraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	.	.	191	.	.	.	.	.	.	.		
Cirsium altissimum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	192	
Cirsium arvense	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	182	.	185	184	.	.	184	186	178	177	.	.	.	.	.		
Cirsium undulatum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	188	.	.	184	174	.	.	193	.	.	.	.	.	.	.		
Cirsium vulgare	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	208	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Clematis virginiana	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	199	.	.	210	190	182	197	185	202	563	221	.	.	.	.	.		
Cleome serrulata	Capparaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	181	186	188	.	.	.	.		
Collomia linearis	Polemoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Comandra pallida	Santalaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148	134	156	.	.	.	.	.	.	.	.	137		
Conringia orientalis	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	153	.	.		
Convallaria majalis	Liliaceae	.	.	.	.	143	146	.	.	.	.	.	136	.	.	.	133	.	.	.	146	.	.	.	.	.	.		122
Convolvulus arvensis	Convolvulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	177	188	.		
Convolvulus repens	Convolvulaceae	.	.	.	.	.	.	.	.	.	.	.	159	157	.	170	169	175	.	179	.	.	.	.	.	.	.		
Convolvulus sepium	Convolvulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Coreopsis tinctoria	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cornus alba	Cornaceae	.	.	.	.	.	.	.	.	.	.	.	.	133	151	151	134	154	150	.	149	147	150	.	.	.	.		
Cornus baileyi	Cornaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	135	142	.	.	.	.	.	.	.		
Cornus racemosa	Cornaceae	.	.	.	.	.	.	.	.	.	165	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cornus stolonifera	Cornaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	154	.	.	.	.	.	.	.	.	.		
Corydalis aurea	Fumariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Corylus americana	Betulaceae	111	.	104	108	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	106	105	90	103	78

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Cotoneaster acutifolius	Rosaceae	.	.	.	.	.	.	.	.	141	135	155	.	124	151	159	134	152	143	142	137	151	149	.	.	.	.		
Crataegus chrysocarpa	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148	.	.		
Crataegus mollis	Rosaceae	.	.	.	.	.	.	125	.	141	130	.	.	124	.	142	125	148	.	.	.	.	.	.	.	.	.		
Crepis runcinata	Asteraceae	.	.	152	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Crocus vernus	Iridaceae	.	.	.	.	.	.	.	.	.	.	.	.	106	.	103	.	.	.	.	.	.	.	.	.	.	.		
Cryptantha bradburiana	Boraginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.	.	.		
Cryptotaenia canadensis	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	172	.	.	.	.	.	.	.	.	.	.	.		
Cuscuta campestris	Cuscutaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cuscuta coryli	Cuscutaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cuscuta gronovii	Cuscutaceae	.	.	194	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cynoglossum officinale	Boraginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cyperus erythrorhizos	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Cyperus schweinitzii	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	184	.	.	.	.	.	.	.	.		
Cypripedium candidum	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	156	.	.	.	.	158	151	147	147	.	165	
Cypripedium parviflorum	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	160	139
Cypripedium pubescens	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Dactylis glomerata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.	.		
Dalea alopecurioides	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Daphne cneorum	Thymelaeaceae	.	.	.	.	.	.	119	.	132	125	.	131	.	137	135	118	141	129	.	.	.	.	.	.	.	.		
Daucus carota	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Delphinium bicolor	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Delphinium virescens	Ranunculaceae	.	.	.	.	.	.	.	.	168	.	.	182	.	.	.	.	.	.	172	.	.	.	.	.	.	.		
Descurainia pinnata	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	159	144	.	.	137	.	151	.	.	140	.	.		
Descurainia richardsonii	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Descurainia sophia	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	137	.	153	149	132	148	.	136	.	.	.	.	.	.	.		
Desmodium acuminatum	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	.	.	.	.	.	.	.	.	.	.		
Desmodium canadense	Fabaceae	.	.	.	.	.	.	.	.	.	.	203	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Dictamnus albus	Rutaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	159	135	158	.	144	151	150	155	.	.	.	.		
Digitaria ischaemum	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	213	216	.	.	211	.	.	.	.	.		
Digitaria sanguinalis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	210	.	.	226	.	.	.	.	.	.		
Dirca palustris	Thymelaeaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		98
Disporum trachycarpa	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	144	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Distichlis stricta	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	172	.	.	.	.	.	.	.	.	.	.	.	.	.	
Draba nemorosa	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	143	.	.	.	.	.	
Dracocephalum parviflorum	Lamiaceae	.	.	.	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Echinochloa crusgalli	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	191	.	181	.	.	.	.	.	.	.	.	.	.	
Echinocystis lobata	Cucurbitaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	208	.	.	.	.	.	.	.	.	.	.	.	.	
Elaeagnus angustifolia	Elaeagnaceae	.	.	.	.	.	.	158	.	.	.	.	.	155	.	.	149	167	.	165	.	.	.	.	.	.	.	.	
Elaeagnus argentea	Elaeagnaceae	.	.	.	.	.	.	.	.	.	.	.	144	.	154	.	.	163	151	.	.	.	.	.	.	.	.	.	
Eleocharis acicularis	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Eleocharis compressa	Cyperaceae	.	.	.	.	.	.	.	151	.	.	.	.	.	.	151	.	.	.	.	.	.	.	.	.	.	.	.	
Eleocharis palustris	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	153	.	149	.	.	.	.	142	.	.	.	.	.	.	
Ellisia nyctelea	Hydrophyllaceae	145	132	.	139	.	142	.	151	137	134	154	136	126	144	140	125	146	137	144	.	139	140	.	.	.	.	.	
Elsholtzia stauntonii	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Elymus canadensis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	178	.	.	.	.	.	.	.	
Elymus macounii	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Elymus virginicus	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Epilobium adenocaulon	Onagraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	201	

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Epilobium angustifolium	Onagraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	191	.	.	.	.	.	.		
Equisetum arvense	Equisetaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Eragrostis cilianensis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	186	187	188	.	.	.	.	.	.	.	.		
Eragrostis hypnoides	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Eragrostis pectinacea	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	192	188	.	.	.	.	.	.	.	.		
Erigeron caespitosus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Erigeron canadensis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	201	199	210	.	200	.	.	.	.	.	.	.		
Erigeron glabellus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	156	.	145	.	162	.	.	.	.	.		
Erigeron philadelphicus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	161	.	145	.	162	.	.	161	.	108		
Erigeron strigosus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Eriogonum flavum	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Eriogonum multiceps	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Eriophorum angustifolium	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Erucastrum gallicum	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Erysimum asperum	Brassicaceae	139	.	.	.	.	.	.	.	.	.	.	.	144	.	.	.	.	.	.	.	.	.	.	148	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Erysimum chieranthoides	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		227
Erysimum parviflorum	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	162	.	.	.	.	.		
Erythronium albidum	Liliaceae	.	.	.	.	.	.	.	130	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Euonymus alatus	Celastraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	165	158	150	.	.	.	.		
Euonymus atropurpurea	Celastraceae	.	.	.	.	.	.	.	.	.	.	.	.	163	.	176	.	.	.	.	.	.	.	.	.	.	.		
Euonymus nanus	Celastraceae	.	.	145	.	.	.	.	.	145	141	.	143	137	.	.	134	158	150	150	.	.	.	.	.	.	.		
Eupatorium maculatum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	196	.	.	.	.	.	.	.	.	.	.		
Eupatorium rugosum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Euphorbia esula	Euphorbiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	.	.	.	.	.	.	.	.	.	.	.	140	
Euphorbia glyptosperma	Euphorbiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Euphorbia serpyllifolia	Euphorbiaceae	.	.	.	.	.	.	.	.	.	.	165	.	.	.	166	.	.	153	.	.	.	.	.	.	.	.		
Festuca elatior	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	161	162	.	.	.	.	.	.	.	.	.	.	.	.		
Festuca obtusa	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Forsythia ovata	Oleaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		83
Fragaria americana	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Fragaria virginiana	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	132	.	114	139	122

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Fraxinus lanceolata	Oleaceae	130	120	114	.	.	.	118	135	124	119	142	126	116	137	.	115	138	123	.	.	134	.	.	.	115	.		
Fraxinus nigra	Oleaceae	.	.	.	.	.	.	.	.	.	.	.	.	116	.	.	.	.	.	.	.	.	.	.	.	.	.		
Fritillaria atropurpurea	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	145	.	.	.	.		
Fumaria officinalis	Fumariaceae	.	.	144	151	152	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Gaillardia aristata	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	164	.	.	.	.	.	158	175	170	.	171	
Galinsoga ciliata	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	197	.	.	.	.	.	.		
Galium aparine	Rubiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	153	.	.	148	149	.		
Galium boreale	Rubiaceae	.	.	.	.	.	.	.	.	.	.	170	.	.	.	.	149	.	.	159	.	162	158	.	168	.	.	165	152
Galium triflorum	Rubiaceae	.	.	119	.	134	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	133	.	.	.	.	.		
Gaura coccinea	Onagraceae	.	.	.	.	.	.	.	.	.	.	170	.	.	166	158	.	.	.	159	.	.	.	151	166	170	.		
Geranium carolinianum	Geraniaceae	.	.	.	.	.	.	.	.	.	148	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Geranium maculatum	Geraniaceae	.	.	.	.	.	.	.	161	149	149	161	.	.	.	.	.	.	.	.	.	162	.	.	.	.	.		
Geum aleppicum	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Geum canadense	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	180	.	.	.	.	.	.	.	.	.	.	.		
Geum rivale	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	146	144	.	.	.	.	.	.	.	.	.	.	.	.	.		
Gleditsia triacanthos	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	169	159	160	165	161	160	.	.	.	.		
Glyceria borealis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Glyceria grandis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Glycyrrhiza lepidota	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	184	.	.	.	.	.	.	.	.	.	.		
Gratiola ?	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Grindelia squarrosa	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	205	204	210	.	209	.	.	.	.	.	.	.		
Gutierrezia sarothrae	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Gymnoeladus dioica	Fabaceae	.	.	.	169	.	.	.	.	.	.	.	.	.	.	.	.	.	165	165	.	157	.	.	.	.	.		
Habenaria bracteata	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	152	.	.	.	.	.	.	.	.	.	.	.	.		
Habenaria hyperborea	Orchidaceae	.	.	.	.	.	.	.	.	.	.	196	.	.	.	172	.	.	.	.	.	.	.	.	.	.	.		
Habenaria leucophaea	Orchidaceae	.	.	.	.	.	.	.	.	.	.	196	.	.	.	.	.	.	.	.	.	196	.	.	.	.	.		
Hackelia americana	Boraginaceae	.	.	.	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	163	.	.	.	.	.	.	.		
Haplopappus grindelioides	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Hedeoma drummondii	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	174	.	.	.	.		
Hedeoma hispida	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	162	.	.	.	.	.		
Helenium autumnale	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Helianthus annuus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Helianthus maximiliani	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	205	.	217	233	209	220	.	.	197	.	.	.		192
Helianthus petiolaris	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	.	184	197	173	.	.	.	.	.	.		
Helianthus rigidus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Helianthus tuberosus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Heliopsis helianthoides	Asteraceae	.	.	.	.	.	.	.	.	.	.	182	.	.	.	177	.	.	.	179	.	.	.	.	.	.	.		
Hemerocallis fulva	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	175	.	.	.	.	.	.	.	.	.	.		
Heracleum lanatum	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	167	.	.	.	.	.	.	.	.	.	.	.		
Hesperis matronalis	Brassicaceae	.	.	.	.	.	.	.	.	147	141	.	.	136	153	159	136	156	152	.	146	150	150	.	150	148	.		
Heuchera richardsonii	Saxifragaceae	.	.	152	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	145	.	.	.	.	168	152	.	158	143
Hibiscus trionum	Malvaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	191	178	.	.	.	.	.	.	.	.	.	.		
Hieracium canadense	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Hierochloa odorata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	120	.	.	.	.	.	.	.	.	.	.		
Hippophae rhamnoides	Elaeagnaceae	132	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Hordeum jubatum	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	170	.	175	.	.	.	.	.	.	.	.	.		
Hosta lancifolia	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	249	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Houstonia longifolia	Rubiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	.	.	.	.	.	.	.	.	.		
Humulus lupulus	Cannabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Hydrangea paniculata	Hydrangeaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	221	227	217	232	225	.	.	.	.		
Hydrophyllum virginianum	Hydrophyllaceae	154	135	142	147	147	153	146	.	142	143	157	143	141	152	151	138	156	148	137	149	150	.	.	148	148	139	148	
Hymenopappus filifolius	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Hypoxis hirsuta	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	156	.	145	.	.	.	146	149	152	.		
Hystrix patula	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	180	.	.	.	.	.	.	.	.	.	.	.		
Impatiens capensis	Balsaminaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Iva axillaris	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	152	.	.	.	.	.	.	.	.	.		
Iva xanthifolia	Asteraceae	228	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	223	230	.	.	.	.	.	.	.	.		
Juglans cinerea	Juglandaceae	144	130	129	141	.	.	129	.	141	131	153	.	122	145	144	124	152	.	.	.	.	.	.	.	.	.		
Juglans nigra	Juglandaceae	.	142	148	.	.	.	.	.	145	.	.	.	142	.	.	.	155	150	.	.	153	.	.	159	.	.		
Juncus balticus	Juncaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Juncus interior	Juncaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Juncus nodosus	Juncaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Juncus torreyi	Juncaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Juniperus scopulorum	Cupressaceae	131	122	125	134	.	130	142	133	124	.	140	130	117	127	134	117	139	123	.	130	.	130	.	.	.	.		
Juniperus virginiana	Cupressaceae	124	119	111	117	.	.	106	122	115	.	.	118	110	123	125	115	134	.	.	119	.	.	.	.	.	.		
Kochia scoparia	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	212	217	216	206	220	.	.	.	.	.	.		

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Koeleria cristata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Kuhnia eupatorioides	Juncaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lactuca biennis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lactuca canadensis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lactuca ludoviciana	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	190	.	.	.	.		
Lactuca pulchella	Asteraceae	.	.	.	.	.	.	.	.	181	.	.	188	.	.	.	.	.	.	200	.	.	.	.	.	205	.		
Lactuca scariola	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	205	.	.	200	196	.	201	200	.	.	.	.	.	.	.		
Laportea canadensis	Urticaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	185	.	.	.	.	.	.	206	.	.	.	.		
Lappula echinata	Boraginaceae	.	.	.	.	.	.	.	151	.	.	.	.	.	.	149	144	152	.	137	.	155	156	.	.	.	.		
Lappula redowski	Boraginaceae	.	.	.	.	.	.	152	151	.	.	.	.	.	.	.	.	.	.	137	.	155	.	.	.	.	.		
Lathyrus latifolius	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	190	186	.	189	.	.	.	.	.	.	.	.	.		
Lathyrus ochroleucus	Fabaceae	.	.	.	.	.	.	.	161	.	141	.	.	.	160	.	.	.	.	.	.	.	.	.	.	.	.		
Lathyrus palustris	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	167	.	.	.	.	.	.	.	.	.		
Lathyrus venosus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	164	.	.	.	162	.	.	.	.	.		
Leersia oryzoides	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

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Leonurus cardiaca	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		165
Lepidium densiflorum	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	152	.	145	.	.	.	.	.	.	.		
Lepidium ramosissimum	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	161	.	.	.	.	.	.	.	.	.	.		
Lesquerella ?	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Leucocrinum montanum	Liliaceae	.	.	.	.	137	.	.	148	140	128	150	136	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Liatris aspera	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	191	225	.	.		227
Liatris punctata	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	225	.	.		215
Liatris pycnostachya	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	205	197	.	.	.	.	201	.	.	.	210	.		226
Lilium philadelphicum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	171	181	181	.	192	
Lilium pumilum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	165	.	.	.	.	.	.	.	.	.	.		
Limonium ?	Plumbaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	206	.	.	.	.		
Limosella aquatica	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Linaria vulgaris	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Linum lewisii	Linaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148	.	164	.	.	.	.	.	.	.	.	.		
Linum rigidum	Linaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Linum sulcatum	Linaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		191
Linum usitatissimum	Linaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lithospermum canescens	Boraginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	143	127	136	134	123	138	116

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Lithospermum incisum	Boraginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	148	147	137	153	158
Lobelia siphilitica	Campanulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lobelia spicata	Campanulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	186	.	190	.	.	197	.	192	191
Lolium perenne	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	168	.	.	.	193	.	.	.	.	.	.	.		
Lolium persicum	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	182	.	.	.	.	.	.	.	.		
Lomatium foeniculaceum	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lomatium orientale	Apiaceae	.	.	.	.	.	.	.	124	.	.	.	.	.	.	.	.	124	.	.	.	.	.	.	.	.	.		
Lonicera dioica	Caprifoliaceae	150	.	141	151	148	.	144	.	144	140	157	141	130	149	151	134	154	144	.	.	148	.	.	.	.	.	
Lonicera maacki	Caprifoliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lonicera tatarica	Caprifoliaceae	151	132	.	146	149	149	136	.	141	134	.	136	125	145	147	125	151	139	.	139	144	147	.	.	148	.		
Lotus americanus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lupinus argenteus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lupinus pusillus	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lycopus americanus	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		192
Lycopus asper	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Lycoris squamigera	Liliaceae	266	.	.	.	.	247	234	.	224	222	241	233	226	232	232	225	237	232	240	230	233	227	.	.	.	.		
Lygodesmia juncea	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	.	.	.	.	.	.	.	194	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Lysimachia ciliata	Primulaceae	.	.	.	.	.	.	.	.	182	.	189	182	.	190	188	184	196	.	191	195	189	185	.	.	.	.		
Lysimachia longifolia	Primulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	196	.	.	.	.	.	.	.	.	.	.		
Lysimachia thyrsiflora	Primulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	.	.	.	.		
Lythrum alatum	Lythraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	181	.	.	.	.	.		
Lythrum salicaria	Lythraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	178	.	180	186	.	183	.	.	.	.		
Lythrum salicaria	Lythraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	175	.	178	.	.	177	.	.	.	.	.		
Maianthemum canadense	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	143	.	.	.	.	.	.	.	.	.	.	.	.	.	143	95
Malus baccata	Rosaceae	138	125	125	138	.	.	.	.	.	.	.	134	121	.	140	121	.	129	129	.	139	142	.	.	.	.		
Malus sylvestris	Rosaceae	.	125	125	138	142	138	120	141	136	127	150	134	121	138	138	120	146	129	128	.	136	141	.	139	.	.		
Malva rotundifolia	Malvaceae	.	.	.	.	.	.	.	.	159	171	.	.	.	177	.	.	.	.	.	.	.	.	.	.	.	.		
Mamillaria vivipara	Cactaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Matricaria matricarioides	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	149	.	.	.	.	.	.	.	.	.	.		
Medicago falcata	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	169	.	.	.	.	.	.	.	.	.		
Medicago lupulina	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	160	163	167	163	160	161	169	.	.	.	.	.	164	.	.		
Medicago sativa	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	165	151	.	.	.	.	.	.	.	.	.	.	165	125
Melilotus alba	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	170	.	167	.	.	.	.	177	.	.	.	.	178	126
Melilotus officinalis	Fabaceae	.	147	.	.	.	.	.	.	.	.	.	.	154	.	159	149	161	157	155	.	155	162	.	.	168	.	161	

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Menispermum canadense	Menispermaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	176	.	.	.	.	.	.	.	.	.	.	.	.	
Mentha arvensis	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	188	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Mentzelia decapetala	Loasaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Menyanthes trifoliata	Menyanthaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Mertensia lanceolata	Boraginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.	.	.	.	.	.	.	.	.	
Mertensia virginica	Boraginaceae	.	121	.	.	137	131	.	.	.	122	.	130	120	137	134	120	140	129	.	.	138	.	.	.	.	.		
Mimulus ringens	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Monarda fistulosa	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	192
Monolepis nuttalliana	Chenopodiaceae	.	.	.	139	.	140	.	.	.	.	.	.	.	.	139	120	143	.	129	.	137	142	.	.	.	.		
Morus alba	Moraceae	.	.	145	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	143	.	.	.	.	.		
Muhlenbergia mexicana	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Muhlenbergia racemosa	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Muhlenbergia richardsonis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Musineon divaricatum	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.	.	.	.	.	.	.		
Nepeta cataria	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Nepeta hederacea	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Neslia paniculata	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Oenothera biennis	Onagraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	204	.	184	.	.	.	.	197	.	.	.	201	
Oenothera caespitosa	Onagraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Oenothera nuttallii	Onagraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	171	200	195	.	196		191
Oenothera serrulata	Onagraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	171	.	175	.	.		
Onosmodium occidentale	Boraginaceae	.	.	.	.	.	.	.	.	.	.	203	.	.	.	.	.	.	.	.	181	.	162	.	178	175	.		
Opuntia fragilis	Cactaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Opuntia polycantha	Cactaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Orobanche fasciculata	Orobanchaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Orthocarpus luteus	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Oryzopsis asperifolia	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Oryzopsis hymenoides	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Oryzopsis racemosa	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	.	.	.	.	.	.	.	.	.	.		
Osmorhiza longistylis	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	.	.	.	161	.	.	143	
Ostrya virginiana	Betulaceae	.	.	.	.	.	.	110	.	.	.	.	.	.	.	134	120	145	130	127	136	134	139	.	.	133	112		
Oxalis europea	Oxalidaceae	.	.	.	.	.	.	.	.	.	.	165	.	.	.	160	.	.	.	139	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Oxalis stricta	Oxalidaceae	.	.	.	.	.	.	.	.	.	.	165	.	.	.	.	.	.	.	147	.	.	.	.	164	152	116	160	
Oxalis violacea	Oxalidaceae	.	.	.	.	.	.	.	.	.	.	.	139	.	.	.	140	146	130	145	.	.	.	130	140	141	133	140	121
Oxytropis campestris	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	138	.	.	.	.		
Oxytropis lambertii	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	152	.		
Oxytropis splendens	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Panicum capillare	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Panicum leibergii	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	172	.	.	.	.	.	.	.	.	.	.	.		
Panicum virgatum	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	175	.	.		
Papaver orientale	Papaveraceae	.	.	.	.	.	.	.	.	.	160	.	.	159	159	159	148	161	.	151	.	159	.	.	.	.	.		
Parietaria pennsylvanica	Urticaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Parnassia glauca	Saxifragaceae	.	.	.	.	.	.	.	.	.	.	.	198	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Parnassia palustris	Saxifragaceae	.	.	.	.	.	.	.	.	.	.	.	198	.	.	.	.	.	.	.	.	.	.	213	.	.	.		
Paronychia sessiliflora	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Parthenocissus vitacea	Vitaceae	.	.	.	.	.	.	.	.	.	.	186	.	.	.	.	.	196	.	183	.	.	.	.	.	.	.		
Pastinaca sativa	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.	.	.	.	.	.	.	.		158
Pedicularis canadensis	Scrophulariaceae	.	.	152	.	.	142	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	130	144	141	127	139	

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Pedicularis lanceolata	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Penstemon albidus	Scrophulariaceae	.	.	152	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	146	167	161	.	160	
Penstemon angustifolius	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.		
Penstemon cristatus	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Penstemon gracilis	Scrophulariaceae	.	.	.	.	.	.	.	.	168	.	172	.	.	175	.	.	.	.	167	.	.	.	151	172	168	.	167	
Penstemon grandiflorus	Scrophulariaceae	.	.	.	.	.	.	.	.	168	.	.	.	157	.	.	174	.	.	.	.	162	.	151	168	168	.	167	
Penthorum sedoides	Crassulaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Petalostemum candidum	Fabaceae	.	.	.	.	.	.	.	.	.	.	196	.	.	.	.	204	.	.	.	186	.	.	180	.	.	.		
Petalostemum purpureum	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	196	.	.	.	.	.	.	184	.	.	.		
Petalostemum villosum	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Petasites sagittatus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Phacelia leucophylla	Hydrophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Phalaris arundinacea	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	180	.	.	.	.	.	.	.	.	.		
Philadelphus coronarius	Hydrangeaceae	.	.	.	.	.	.	.	.	.	160	.	.	.	172	174	160	172	.	.	.	.	168	.	.	.	.		
Phleum pratense	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Phlox andicola	Polemoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	138	.	.	.	.		
Phlox divaricata	Polemoniaceae	.	.	.	.	.	.	.	.	.	127	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Phlox hoodii	Polemoniaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.	.	.	140	.	.	.	.		
Phlox subulata	Polemoniaceae	.	.	.	.	148	.	.	.	139	136	153	134	123	.	.	.	.	.	.	.	.	.	.	.	.	.		
Phragmites communis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Phryma leptostachya	Verbenaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	.	.	.	.	.	.	.	.	.	.		
Physalis heterophylla	Solanaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Physalis lanceolata	Solanaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	166	.	.	.	.	.	.	.	.	.	.	.	.		
Physalis virginiana	Solanaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	165	246	.	.	.	.	.	.	.	.	.	.		
Physaria brassicoides	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148	.	.	.	.	.	.	137	.	.	.	.		
Physostegia parviflora	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Pinus banksiana	Pinaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Pinus scopulorum	Pinaceae	.	147	151	.	.	.	.	.	.	.	.	.	142	.	.	.	.	.	.	.	.	.	.	.	.	.		
Pinus sylvestris	Pinaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	152	.	.	.	.	.		
Plantago eriopoda	Plantaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	154	.	.	.	.	153	.	.	.	.		
Plantago lanceolata	Plantaginaceae	.	166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Plantago major	Plantaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	181	.	.	184	.	.	.	.	.	.	.	.		
Plantago purshii	Plantaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Plantago rugelii	Plantaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	186	.	.	.	.	.		
Poa annua	Poaceae	.	.	.	.	.	144	.	.	.	.	.	.	.	.	170	134	158	.	.	.	.	.	.	.	.	.		
Poa compressa	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	170	.	.	.	.	.	.	.	.	.	.	.		
Poa palustris	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Poa pratensis	Poaceae	.	.	.	.	.	.	.	.	.	.	163	.	.	158	.	134	158	.	147	.	.	151	.	.	.	.		
Polanisia graveolens	Capparaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Polemonium reptans	Polemoniaceae	.	.	.	.	.	.	.	.	.	125	.	134	.	.	140	124	144	131	.	.	139	141	.	.	.	.		
Polygala alba	Polygalaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Polygala senega	Polygalaceae	.	.	152	.	.	.	.	.	.	.	.	.	.	.	.	.	158	.	.	.	.	.	.	.	.	.	160	
Polygonatum commutatum	Liliaceae	.	.	.	.	.	.	.	.	.	.	176	160	163	167	174	160	169	168	165	.	.	.	.	.	.	.		
Polygonum achoreum	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	180	176	149	181	.	.	.	.	.	.	.	.	.		
Polygonum aviculare	Polygonaceae	.	.	.	.	.	.	.	.	.	160	.	159	.	180	.	160	.	.	.	.	.	.	.	.	.	.		
Polygonum coccineum	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	203	.	.	.	.		
Polygonum convolvulus	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Polygonum lapathifolium	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	205	.	.	.	.	.	.	.	.	.	.	.		
Polygonum pennsylvanicum	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Polygonum persicaria	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Polygonum ramosissimum	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	205	.	.	.	.	.	.	203	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Populus balsamifera	Salicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Populus deltoides	Salicaceae	124	115	110	113	.	115	105	124	115	115	134	120	113	123	118	105	132	115	.	.	.	.	.	113	113	100	126	88
Populus tremuloides	Salicaceae	.	.	.	.	.	.	.	.	110	108	130	.	108	.	102	99	125	111	.	.	128	.	.	.	106	102		75
Portulaca oleracea	Portulacaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	183	185	186	192	186	206	.	.	.	.	.	.	.		
Potentilla anserina	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Potentilla arguta	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	168	.	.	177	.	.	.	.	.	.	.	.	177	181	.	171	156
Potentilla concinna	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.	.	.	.	.	.	.	.		
Potentilla fruticosa	Rosaceae	179	.	146	.	.	.	147	.	141	165	.	154	152	166	163	139	172	.	149	.	157	161	.	.	.	.		
Potentilla norvegica	Rosaceae	.	.	.	.	.	.	.	.	181	.	.	.	.	171	176	.	.	188	.	.	.	.	.	.	.	.		
Potentilla paradoxa	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	187	.	.	.	.	.	.	.	.	.	.	.		
Potentilla pennsylvanica	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	179	.	.	.	.	.	.	.		
Potentilla pentandra	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Prenanthes alba	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Prenanthes racemosa	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Prinsepia sinensis	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	119	141	.	.	.	.	140	.	.	.	.		

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Prunella vulgaris	Lamiaceae	.	.	.	.	.	.	.	.	168	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	178	
Prunus americana	Rosaceae	133	122	116	132	135	129	117	136	132	122	146	130	119	132	137	118	142	125	.	.	134	139	.	138	138	115	139	99
Prunus armeniaca	Rosaceae	130	118	.	.	.	117	111	124	128	119	141	127	117	126	132	115	137	.	.	.	132	.	.	.	.	.		96
Prunus pennsylvanica	Rosaceae	.	122	118	139	.	137	118	137	.	119	.	130	119	134	138	119	145	.	127	.	.	.	.	.	.	.		
Prunus pumila	Rosaceae	.	.	.	.	134	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		116
Prunus tomentosa	Rosaceae	.	.	.	.	.	.	.	.	.	.	141	127	117	126	132	114	137	118	.	.	131	130	.	.	.	111		
Prunus triloba	Rosaceae	140	.	.	.	.	.	.	.	130	.	146	131	120	134	138	119	145	125	.	.	135	140	.	.	140	.		
Prunus virginiana	Rosaceae	144	130	135	146	.	147	127	.	139	131	153	137	124	145	147	125	149	134	133	140	142	144	.	.	.	.		
Psoralea argophylla	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	174	.	.	195	.	.	176	.	203	188	.		
Psoralea esculenta	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Psoralea lanceolata	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Puccinellia airoides	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	.	.	.	.	.	.	.	.	.	.	.		
Pycnanthemum virginianum	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	192
Pyrethrum coccineum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	152	.	154	.	.	.	.	.	.	.	.		
Pyrola elliptica	Pyrolaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	.	.	.	.	.	.	.	.	.	.		
Pyrus communis	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.	.		

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Quercus macrocarpa	Fagaceae	.	.	134	146	.	148	129	.	139	131	153	137	124	145	144	125	147	134	137	.	147	144	.	.	.	.		
Ranunculus abortivus	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	.	.	.	132	139	120	134	116
Ranunculus acris	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Ranunculus aquatilis	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	.	.	.	.	.	.		
Ranunculus cymbalaria	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148	.	.	.	.	.		
Ranunculus flabellaris	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	135	.	.	.	.	.	.	.	.	.	.		
Ranunculus glaberrimus	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Ranunculus hispidus	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	151	.	.	.	.		
Ranunculus macounii	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	145	.	.	.	.	.	.	.		
Ranunculus pennsylvanicu	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Ranunculus recurvatus	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	.	.	.	.	.	.		
Ranunculus repens	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	136	154	146	137	146	150	140	.	.	.	.		
Ranunculus rhomboideus	Ranunculaceae	.	.	.	.	129	.	.	.	142	.	.	.	.	.	.	.	.	.	.	.	133	.	116	125	114	98	127	94
Ranunculus sceleratus	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	157	165	140	.	.	.	.	151	.	.	.	.	.		
Ranunculus septentrionalis	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	.	.	.	.	.	.		

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Ratibida columnifera	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	.	.	.	.	.	.	172	190	196	.	192	172
Rhamnus cathartica	Rhamnaceae	150	.	140	147	.	.	.	.	144	132	155	139	124	147	.	130	154	143	.	.	144	.	.	.	.	.		
Rhamnus davurica	Rhamnaceae	159	.	148	.	.	.	.	.	.	.	.	.	.	.	.	138	.	.	.	.	.	.	.	.	.	.		
Rheum sp.	Polygonaceae	.	.	145	.	.	.	.	.	.	.	.	146	.	153	153	137	156	.	143	.	156	150	.	.	.	.		
Rhus glabra	Anacardiaceae	.	.	.	.	.	.	.	.	181	.	187	176	.	.	179	.	.	.	.	.	.	.	.	194	.	.		
Rhus rydbergii	Anacardiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	172	.	.	.	.	.	.	.	.	.	.	.		
Ribes americanum	Grossulariaceae	.	.	.	.	.	138	125	.	138	.	.	.	.	.	.	.	.	.	.	.	.	.	.	139	.	128		
Ribes missouriense	Grossulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	138	133	114		
Ribes odoratum	Grossulariaceae	136	122	116	132	137	131	117	137	131	122	145	130	119	129	135	118	140	127	131	.	134	130	.	.	.	.		
Ribes vulgare	Grossulariaceae	.	.	.	129	.	.	.	135	129	.	.	126	.	132	134	119	140	127	.	137	135	135	.	.	.	.		
Ribes hirtellum	Grossulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	133	.	.	.	.	.	139	
Ribes nigrum	Grossulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Ribes setosus	Grossulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Ricinus communis	Euphorbiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	246	.	.	.	.	.		
Robinia pseudoacacia	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	142	.	164	160	167	157	.	.	153	155	.	.	.	.		
Rorippa armoracia	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Rorippa austriaca	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Rorippa islandica	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

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Rorippa sinuata	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	149	.	.	.	.	.	.	.	.	.	.	.		
Rosa arkansana	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	170	.	.	165	.	.	162	.	153	168	175	.	167	152
Rosa blanda	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	155	.	.	162	.	.	.	.		
Rosa hugonis	Rosaceae	.	.	.	.	.	.	158	.	.	.	169	158	146	163	164	140	162	154	154	156	157	157	.	.	.	.		
Rubus strigosus	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Rubus occidentalis	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	159	159	135	.	.	151	148	153	.	.	.	.	.		
Rubus pubescens	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	160	.	131	.	.	.	.	.	.	.	.	.	.		
Rubus strigosus	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Rudbeckia laciniata	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	208	.	213	.	.	.	.	.	.	.	.	.		
Rudbeckia serotina	Asteraceae	.	.	.	.	.	.	.	.	168	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Rumex acetosella	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Rumex crispus	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	.	.	165	.	.	.	.	.	.	.	.		
Rumex mexicanus	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	148	.	.	163	.	.	165	.	.	153	.	.	.	.	.		
Rumex occidentalis	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	151	.	.	.	.	.	.	.		
Rumex persicarioides	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Rumex venosus	Polygonaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Sagittaria cuneata	Alismataceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	189	174	183	.	179	.	.	.	.	.	.	.		
Salix interior	Salicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	155	.	.	.	.	.		

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Salix amygdaloides	Salicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Salix cordata	Salicaceae	.	.	.	.	.	.	.	.	.	113	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Salix discolor	Salicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Salix interior	Salicaceae	.	.	.	.	.	.	.	.	.	127	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Salix petiolaris	Salicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Salix vitellina	Salicaceae	131	.	.	126	.	.	114	135	124	119	142	126	118	127	131	115	139	.	.	.	134	.	.	.	.	.		
Salsola kali	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Salvia lanceolata	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Sambucus canadensis	Caprifoliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Sambucus pubens	Caprifoliaceae	138	122	125	137	142	.	118	137	136	125	146	131	120	136	139	120	146	.	.	.	.	.	.	.	.	.		
Sanguinaria canadensis	Papaveraceae	.	.	.	.	.	117	110	.	.	116	.	.	.	.	.	.	.	.	.	.	.	.	.	.	115	99		94
Sanicula marylandica	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	164	.	.	.	.		
Saponaria vaccaria	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Schedonnardus paniculatus	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Schizachne purpurascens	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	153	.	.	.	.	.	.		
Scilla siberica	Liliaceae	.	.	102	.	111	97	105	122	113	.	129	116	108	115	106	105	126	.	.	.	.	.	.	.	.	.		
Scirpus acutus	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Scirpus americanus	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Scirpus atrovirens	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus fluviatilis	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus heterochaetus	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	184	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus paludosus	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	179	.	.	.	.	.	.	.	.	.
Scirpus validus	Cyperaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	168	.	.	.	.	.	156	.	.	.	.	.	.	.
Scolochloa festucacea	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scolochloa festucacea	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scrophularia leporella	Scrophulariaceae	.	.	.	.	152	.	.	.	.	.	.	.	157	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scutellaria galericulata	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scutellaria lateriflora	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scutellaria parvula	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Secale cereale	Poaceae	.	.	.	.	.	.	.	.	.	.	165	.	.	.	163	149	.	.	.	.	.	155	.	.	.	.	.	.
Senecio aureus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	153	.	156	.	.	.	.	.	.
Senecio canus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio congestus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.	.	.	.	.	.	.	.	.
Senecio integerrimus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	138	.	.	.	.	.	.

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Senecio pauperculus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	144	.	.	.	.	.	.	.	.	.	.	.	.	.		
Senecio plattensis	Asteraceae	.	.	.	.	.	.	.	151	.	.	.	139	.	.	149	.	.	.	.	.	.	.	146	.	.	137		
Setaria glauca	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	191	.	190	.	.	.	.	.	.	.	.	.		
Setaria verticillata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	194	.	.	.	.	.	.	.	.		
Setaria viridis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	191	.	182	.	.	.	.	.	.	.	.	.		
Shepherdia argentea	Elaeagnaceae	.	113	108	111	119	95	101	121	112	110	132	.	111	117	112	104	127	114	.	.	.	.	.	131	117	101		
Silene antirrhina	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Silene cserei	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	170	149	.	.	155	173	.	.	.	.	.	.		
Silene noctiflora	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Silphium perfoliatum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Sisymbrium altissimum	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	142	.	.	.	.	.	.	.		
Sisymbrium loeslii	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	144	.	.	.	.	.	.	.	.	.	.	.		
Sisyrinchium angustifolium	Iridaceae	.	.	.	.	.	.	.	149	.	.	.	139	.	.	.	.	.	.	.	.	.	.	151	147	138	133		126
Sium suave	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Smilacina racemosa	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	153	.	.	.	.	.	.		
Smilacina stellata	Liliaceae	139	.	129	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	141	.	.	142	.	128		
Smilax herbacea	Smilacaceae	.	.	.	.	.	.	.	.	.	.	161	.	157	.	.	.	.	.	.	.	153	.	.	.	154	.		
Solanum nigrum	Solanaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

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Solanum rostratum	Solanaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Solanum triflorum	Solanaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Solidago canadensis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	216	209	220	.	.	.	.	223	.		216
Solidago gigantea	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	222	.	.	.	208	.	.	211	.	.	.	.		
Solidago graminifolia	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	210	.	.	.	.	.	.		
Solidago missouriensis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	201	.	.	.	205	.	.	.	.	225	216	.		
Solidago mollis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Solidago nemoralis	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Solidago riddellii	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	225	.	.	.	.		
Solidago rigida	Asteraceae	.	.	.	.	.	.	.	.	.	217	.	.	.	227	.	.	.	.	.	220	.	.	222	.	.	.		
Sonchus arvensis	Asteraceae	183	.	.	.	.	.	.	.	172	.	.	176	.	.	180	174	182	184	186	178	183	185	.	.	.	.		
Sonchus asper	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	186	193	.	.	.	.	.	.	.	.	.		
Sonchus oleraceus	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	195	.	193	.	.	.	.	.	.	.	.	.		
Sorbus aucuparia	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	154	132	152	135	134	143	144	151	.	.	.	.		
Sorghastrum nutans	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	214	.	.	.	.	.	.	.		
Sparganium eurycarpum	Sparganiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		162

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Spartina gracilis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Spartina pectinata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	191	204	.	.	.	.	.	.	.	.	.	.		
Sphaeralcea coccinea	Malvaceae	.	.	.	.	.	.	.	.	.	.	172	163	.	169	.	.	.	.	159	.	.	.	.	.	.	.		
Sphenopholis obtusata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Spiraea alba	Rosaceae	.	.	.	.	.	.	.	.	.	.	.	170	.	.	172	.	.	.	.	.	.	.	.	.	.	.	192	
Spiraea arguta	Rosaceae	138	125	120	.	135	137	119	.	.	125	.	131	120	134	138	118	143	125	.	.	136	139	.	.	.	.		
Spiraea thunbergii	Rosaceae	.	.	144	150	.	.	.	.	.	136	151	143	133	149	154	133	156	144	133	145	150	151	.	.	.	.		
Spiranthes cernua	Orchidaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Sporobolus asper	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Sporobolus cryptandrus	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	205	184	.	.	.	.	.	.	.	.		
Sporobolus heterolepis	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Sporobolus neglectus	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	213	205	.	.	.	.	.	.	.	.		
Stachys palustris	Lamiaceae	.	.	.	.	.	.	.	.	.	.	189	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Stellaria longifolia	Caryophyllaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	140	.	.	.	.	.	.	.	.	.	.		
Stellaria media	Caryophyllaceae	.	.	150	150	149	.	.	.	.	165	.	.	.	180	162	149	162	168	155	.	.	151	.	.	.	.		
Stipa comata	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	166	170	.	.	.	.	.	.	.	.	.	.	.		
Stipa spartea	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		

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Stipa viridula	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	166	.	.	.	.	.	.	.	.	.	.	.	.	.	
Strophostyles leiosperma	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Suaeda depressa	Chenopodiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Symphoricarpos occidentalis	Caprifoliaceae	.	.	.	.	.	.	.	.	.	.	182	.	.	.	.	174	.	.	.	.	.	.	.	.	175	.		173
Syringa amurensis	Oleaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Syringa persica	Oleaceae	.	125	135	.	.	.	136	.	138	.	155	.	.	.	.	.	152	137	137	.	144	147	.	.	.	.	.	
Syringa villosa	Oleaceae	.	.	.	167	153	.	.	167	.	149	168	.	147	153	163	142	158	153	145	136	151	155	.	.	.	.	.	
Syringa vulgaris	Oleaceae	142	131	125	141	142	.	122	148	138	130	152	136	123	145	141	122	148	134	134	137	141	146	.	.	.	122	139	124
Tamarix pentandra	Tamaricaceae	169	.	.	.	.	.	.	.	158	.	.	.	.	.	178	.	.	.	.	.	.	.	.	.	.	.	.	
Tanacetum vulgare	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	200	.	209	197	209	.	.	.	.	.	.	.	.	
Taraxacum officinale	Asteraceae	132	121	125	.	135	131	120	134	127	125	142	129	123	134	132	118	137	126	127	.	134	135	.	104	453	88	103	86
Teucrium occidentale	Lamiaceae	.	.	.	.	.	.	.	.	.	.	.	188	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Thalesia uniflora	Orobanchaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Thalictrum dasycarpum	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	177	.	171	.	175	.		
Thalictrum venulosum	Ranunculaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Thelypodium integrifolium	Brassicaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

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Thermopsis rhombifolia	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.	.	.	.	.	.	.	.		
Thlaspi arvense	Brassicaceae	110	.	.	106	.	.	.	.	111	.	.	121	110	124	134	97	129	115	96	.	110	83	.	132	.	.		
Tilia americana	Tiliaceae	191	.	.	.	.	.	.	.	.	.	.	.	166	191	191	190	192	.	191	193	191	.	.	.	.	.		
Townsendia exscapa	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	130	.	.	.	.		
Tradescantia bracteata	Commelinaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	149	.	145	.	.	.	.	.	.	.	.	167	157
Tradescantia occidentalis	Commelinaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	162	.	.	.	.	.		
Tragopogon dubius	Asteraceae	156	.	.	.	.	.	152	.	.	.	.	.	163	163	159	149	161	161	147	.	157	162	153	163	168	.	161	
Trifolium hybridum	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Trifolium pratense	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	164	.	.	.	155	.	158	.	.	.	.	.	165	
Trifolium repens	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	144	.	160	.	152	.	151	.	158	.	.	.	.	.	167	
Triglochin maritima	Juncaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	159	.	.	.	162	.	.	.	.	.		
Triglochin palustris	Juncaginaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	158	.	.	.	.		
Trillium cernuum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	145	143	133	143	124
Trillium grandiflorum	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		125
Typha latifolia	Typhaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	177	174	.	.	179	173	.	177	.	.	.	.		
Ulmus americana	Ulmaceae	117	107	107	112	118	88	98	117	112	109	131	118	110	112	106	100	127	113	.	.	113	.	.	114	107	101		79
Ulmus fulva	Ulmaceae	.	.	.	.	.	.	.	.	.	109	132	.	110	112	.	101	127	113	.	.	.	.	.	.	.	.		

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Ulmus pumila	Ulmaceae	118	107	110	112	.	.	101	117	.	109	101	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Urtica procera	Urticaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	192	.	.	.	.	.	.	.	.	.	.	
Utricularia vulgaris	Lentibulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Uvularia grandiflora	Liliaceae	.	.	.	.	.	.	.	135	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	132	134	.		124
Uvularia sessifolia	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Verbascum thapsus	Scrophulariaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Verbena bracteata	Verbenaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Verbena hastata	Verbenaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	192	191
Verbena stricta	Verbenaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	188	.	.	.	.	.	
Verbena urticifolia	Verbenaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	188	.	.	.	.	.	
Vernonia fasciculata	Asteraceae	.	.	.	.	.	.	.	.	.	.	205	.	.	.	205	204	.	.	.	.	.	.	.	.	.	.	.	
Veronica peregrina	Scrophulariacea	.	.	129	136	.	140	.	143	133	.	.	141	126	.	.	130	.	.	137	.	.	.	.	.	.	.	.	
Viburnum affine	Caprifoliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Viburnum lentago	Caprifoliaceae	.	.	.	.	.	.	.	.	.	141	.	.	.	.	.	.	.	.	.	.	.	.	.	158	159	.		
Viburnum opulus	Caprifoliaceae	.	.	.	.	.	.	.	.	.	.	.	148	.	154	160	139	.	.	.	155	.	157	.	.	.	.		
Vicia americana	Fabaceae	.	.	.	.	.	.	.	.	.	143	161	.	.	.	167	136	.	.	145	146	152	.	.	161	.	137	139	
Vicia angustifolia	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Vicia sparsifolia	Fabaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

Scientific Name	Family	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	2007	2008	2009	2010	2011	2012
Viola adunca	Violaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Viola conspersa	Violaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Viola eriocarpa	Violaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	124	.	.	.	.	.	.	.	.	.	.	115		
Viola nuttallii	Violaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	.	.	.	.	.	.	.	.	.	.	.		
Viola papilionacea	Violaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	134	115	.	127	.	.	.	.	.	.	129	.		
Viola pedatifida	Violaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	120	.	.	.	.	.	.	127	144	134	127		127
Viola rugulosa	Violaceae	.	121	.	.	.	.	110	.	.	.	.	.	.	.	134	117	.	117	.	.	128	.	.	.	.	.		
Viola sororia	Violaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	138	
Vitis riparia	Vitaceae	.	.	.	.	.	.	.	.	.	.	.	.	156	167	165	.	.	.	151	.	157	161	.	.	.	.		
Xanthium echinatum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	223	.	.	.	.	.	.	.	.	.		
Xanthium italicum	Asteraceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Yucca glauca	Agavaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Zanthoxylum americanum	Rutaceae	.	.	129	.	.	.	.	.	.	130	.	.	.	.	.	.	.	.	.	.	136	.	.	148	138	.		
Zephyranthes	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	190	.	.	.	.	.	.	.		
Zigadenus elegans	Liliaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	176	172	.	.	.	172	.	.	.	171	177	172	.	178	162
Zizania aquatica	Poaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Zizia aptera	Apiaceae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	131	.	.	.	.	.	156	.	148	147	.		118
Zizia aurea	Apiaceae	150	138	.	.	.	.	.	.	.	146	161	.	.	153	164	.	.	149	142	153	153	.	151	143	147	.		122