

Vascular Plant Checklist of the Chimney Spring and Limestone Flats Prescribed Burning Study Areas Within Ponderosa Pine Experimental Forests in Northern Arizona



Catherine Scudieri, *School of Forestry, NAU, Flagstaff, AZ, USFS, Rocky Mountain Research Station, Flagstaff, AZ*; **James Fowler**, *Carolyn Hull Sieg, USFS, Rocky Mountain Research Station, Flagstaff, AZ*; **Laura Williams**, *Department of Biological Sciences, NAU, Flagstaff, AZ*; and **Sally Haase**, *USFS, Pacific Southwest Research Station, Riverside, CA*

Abstract—This paper presents a vascular plant species list for two sites that are part of a long-term study exploring the effects of varying fire intervals on forest characteristics including the abundance and composition of understory vegetation. The Chimney Spring study area is on the Fort Valley Experimental Forest near Flagstaff, AZ and the Limestone Flats study area is on the Long Valley Experimental Forest, 90 km (56 mi) southeast of Flagstaff. Since 1976 (Chimney Spring) and 1977 (Limestone Flats), three replicates of each of seven burn intervals (1, 2, 4, 6, 8, 10 years, plus unburned) have been maintained by the USFS Pacific Southwest Research Station. Each study area encompasses approximately 40 to 48 ha (99 to 119 acres) of dense ponderosa pine (*Pinus ponderosa*) forest. Our plant species list was generated through systematic sampling of the understory vegetation in 2006 and 2007 as well as surveys of the entire study areas for additional species. We documented a total of 147 species, with 96 species found at Chimney Spring and 123 species at Limestone Flats. There are eight introduced species on the list, with six introduced species found at Chimney Spring and seven found at Limestone Flats. All of the exotic species we found have been intentionally introduced to North America, either directly or indirectly, and are widespread throughout the United States so their presence at these sites is not surprising. This survey will serve as baseline information for these two sites when examining future floristic changes due to continued research on fuels management and prescribed fire.

In: Olberding, Susan D., and Moore, Margaret M., tech coords. 2008. Fort Valley Experimental Forest—A Century of Research 1908-2008. Proceedings RMRS-P-53CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 408 p.

Introduction

In 1976, a long-term prescribed burn study was initiated by the USFS, Rocky Mountain Forest and Range Experiment Station at the Chimney Spring study area on the Fort Valley Experimental Forest. A year later a similar study was begun at the Limestone Flats study area on the Long Valley Experimental Forest. These studies were designed to examine the effects of varying burn intervals on several forest characteristics including the abundance and composition of understory vegetation. At these study sites 1-ha (2.5 acres) plots have been burned at different frequencies ranging from every year to every ten years for the past 30 years using low-severity fall burns (Sackett and others 1996). At various intervals throughout the last 30 years, data on the abundance and composition of the understory vegetation has been collected as part of these long-term studies.

In 2006 and 2007 we continued the long-term sampling of the understory vegetation using the original sampling protocols for both sites augmented with additional sampling and survey methods. We have compiled a vascular plant species list for Chimney Spring and Limestone Flats from a combination of the recent sampling and surveys of the entire study areas in 2006 and 2007. Although this is a long-term study, historical data is not presented here because prior data was not collected at the same scale (entire site) as the data presented in this paper.

Methods

Study Area and History

Both study areas are within the Coconino National Forest in northern Arizona. These sites are dominated by dense stands of an almost exclusive *Pinus ponderosa* (ponderosa pine) overstory with a bunchgrass understory dominated by *Festuca arizonica* (Arizona fescue) and *Elymus elymoides* (squirreltail). Chimney Spring is located approximately 11 km (7 mi) northwest of Flagstaff, Arizona at an elevation of 2250 m (7380 ft) on basalt soils with an average annual precipitation of 56 cm (22 inches) (U.S. Department of Agriculture 1995, Western Regional Climate Center 2007). Limestone Flats is approximately 90 km (56 mi) southeast of Flagstaff at an elevation of 2100 m (6900 ft) on limestone/sandstone soils with an average annual precipitation of 66 cm (26 inches) (U.S. Department of Agriculture 1995, Western Regional Climate Center 2007).

Before 1876, surface fires were common at both sites with mean fire intervals averaging 2.5 years (Swetnam and Baisan 1996). Dendrochronological studies in this region document that this frequent fire regime was abruptly halted in the late 1800s primarily due to grazing, logging, and fire suppression (Dieterich 1980a, Dieterich 1980b, Fulé and others 1997, Swetnam and Baisan 1996). Neither site has experienced wildfire since that time. Livestock have been excluded from the study sites since before the studies began and the sites have never been logged with only a few downed and mistletoe-infested trees removed from the sites (Dieterich 1980b, Sackett 1980, Sutherland and others 1991).

Study Design

The same general study design is used at both Chimney Spring and Limestone Flats. The design includes seven different burn intervals: an unburned control and 1, 2, 4, 6, 8, and 10-year burn frequencies. Chimney Spring encompasses approximately 40 ha (99 acres) and Limestone Flats encompasses approximately 48 ha (119 acres). Each study area is divided into 21 1-ha (2.5 acres) plots, separated by 1-m (3-ft) wide firelines, with each plot randomly assigned one of the seven burn intervals with three replicates of each interval (Figure 1). Beginning in 1976 at Chimney Spring and in 1977 at Limestone Flats, the plots were burned using low-severity fall burns according to each assigned burn frequency.

The original sampling design for the understory vegetation at Chimney Spring used a total of 200 20- x 50-cm (8- x 20-inches) quadrats spaced at 1-m (3-ft) intervals within four permanent 5- x 26-m (16- x 85-ft) subplots in each plot. At Limestone Flats the original understory sampling design is different from that at Chimney Spring. Five permanent 21-m (70-ft) transects were installed in each plot with six 30- x 60-cm (1- x 2-ft) quadrats per transect spaced at 3-m (10-ft) intervals, for a total of 30 quadrats per plot.

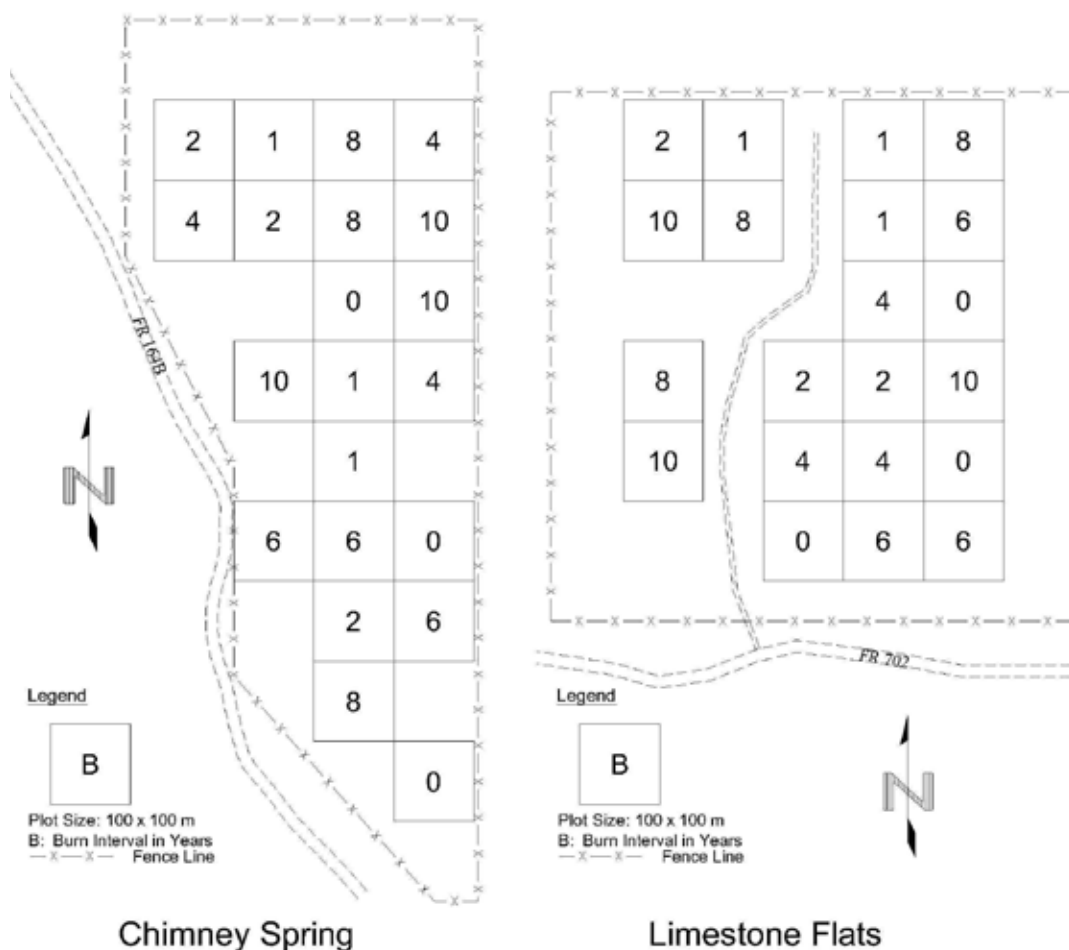


Figure 1. Plot layouts for the Chimney Spring and Limestone Flats study areas. Numbers indicate the assigned burn interval. Chimney Spring is located at 111° 41' 7.1" W and 35° 16' 0.4" N. Limestone Flats is located at 111° 19' 39" W and 34° 33' 37.9" N.

In 2006 and 2007 a list of the understory flora was compiled at both sites using the above sampling designs. In addition, in 2007 species composition was measured at both sites by systematically searching a 25- x 52-m (82- x 170-ft) subplot within each plot. In addition to the above sampling, both study areas were surveyed in 2006 and 2007 in their entirety for any species not previously found during the sampling. We walked the entire study area, for both sites, within the fence line several times throughout the growing season (from early spring to late fall) and collected any additional species that we had not previously observed.

Nomenclature and nativity are based on Flora of North America (Flora of North America Editorial Committee 1993+), Intermountain Flora (Cronquist and others 1972+), and Arizona Flora (Kearney and Peebles 1960) in that order of priority. The plant checklist format incorporates the guidelines from Palmer and others (1995). Species were verified at the Rocky Mountain Herbarium at the University of Wyoming in Laramie and at the Deaver Herbarium in Flagstaff, Arizona. We deposited voucher specimens at the USFS herbarium at the Rocky Mountain Research Station in Flagstaff, Arizona. Voucher specimens have been collected for nearly all species from both sites and we hope to complete our collection in 2008.

Results

The vascular plant species list was compiled from the sampling and survey methods described above for the Chimney Spring and Limestone Flats study areas (Appendix A). Table 1 provides a floristic summary of the species found at these study areas. We documented a total of 147 species, with 96 species found at Chimney Spring and 123 species at Limestone Flats. The species list consists of 40 families; 30 at Chimney Spring and 36 at Limestone Flats. There are 24 plant species unique to Chimney Spring and 51 species unique to Limestone Flats. At Chimney Spring, 73 (76 percent) species are forbs, 16 (17 percent) graminoids, and 7 (7 percent) woody species. At Limestone Flats the proportion of species in each functional group is similar with 93 (75 percent) forbs, 23 (19 percent) graminoids, and 7 (6 percent) woody species. Waif species were excluded from this list. There are eight introduced species on the list, with six introduced species found at Chimney Spring and seven found at Limestone Flats. The introduced species range in rate of occurrence from infrequent (difficult to find but found in several locations) to frequent (easily found in common habitats but not dominant) (Palmer and others 1995). *Linaria dalmatica* occurs frequently, *Medicago lupulina*, *Rumex acetosella*, *Taraxacum officinale*, *Tragapogon dubius*, and *Verbascum thapsus* occur occasionally, while *Bromus tectorum* and *Poa pratensis* occur infrequently at Chimney Spring and occasionally at Limestone Flats. The list contains three species that are endemic to northern Arizona: *Draba asprella*, *Hymenoxys jamesii*, and *Triteleia lemmoniae*.

Table 1. Floristic summary of the vascular plant species at the Chimney Spring and Limestone Flats Study Areas for 2006 and 2007.

Group	Species				
	Families	Genera	Native	Exotic	Total
Gymnosperm	2	3	5	0	5
Monocot	6	25	29	2	31
Dicot	32	91	105	6	111
Total	40	119	139	8	147

Discussion

A five-year study examining the effects of prescribed burning on ponderosa pine understory vegetation at sites near both study areas found similar proportions of forb, graminoid, and woody species: 72, 20, and 8 percent respectively (Fowler, data on file). Although that study had greater total species richness (269 vs. 147), it also sampled larger, more diverse habitats, so our survey methods have likely found most of the flora at these sites. We estimate that we have found at least 85 percent of the species at these sites. Short-lived annuals were likely among the under-represented species.

All of the exotic species we found have been intentionally introduced to North America, either directly or indirectly, through seeding programs, as seed contaminants, or in the case of *Linaria dalmatica*, as an ornamental plant (Dodge and others 2008, Fowler and others 2008, Mack and Erneberg 2002). These introduced species are widespread throughout the United States (the western U.S. for *Linaria dalmatica*) so their presence at these sites is not surprising. Although some of these species occur frequently at these study sites, their overall abundance is still quite low. The low abundance and richness of these exotic species at Chimney Spring and Limestone Flats is consistent with other studies that have examined the effects of low levels of disturbance, such as low-severity fire, on invasive species (Crawford and others 2001, Fowler and others 2008, Griffis and others 2001). We were unable to determine the nativity of *Lepidium virginicum* to northern Arizona due to conflicting information from authoritative sources.

This survey will serve as baseline information for these two sites when examining future floristic changes due to continued research on fuels management and prescribed fire practices in the absence of tree harvesting.

Acknowledgments

Funding for this project has been provided by the Joint Fire Sciences Program (06-2-1-36) and the USFS, both the Pacific Southwest and Rocky Mountain Research Stations. We would like to thank David Hammond, Glenn Rink, Michael Harrington, Daniel Laughlin, and Judy Springer for reviewing this paper. We would also like to thank our field crew for all their hard work, especially Bonni Corcoran, Gloria Burke, Anna Arias, Cat Yang, Jenn Watt, Amy Van Gundy, and Justin Bendell.

References

- Crawford, Julie A.; Wahren, C.-H.A.; Kyle, S.; Moir, W.H. 2001. Response of exotic plant species to fires in *Pinus ponderosa* forests in northern Arizona. *Journal of Vegetation Science*. 12: 261-268.
- Cronquist, Arthur; Holmgren, Arthur H.; Holmgren, Noel H.; Reveal, James L.; Holmgren, Patricia K. 1972+. *Intermountain Flora: Vascular Plants of the Intermountain West, USA*. Vols. 2A, 3A, 3B, 4, & 5. New York: The New York Botanical Garden.
- Daubenmire, R. 1959. A canopy-coverage method of vegetational analysis. *Northwest Science*. 33(1): 43-64.
- Dieterich, John H. 1980a. Chimney Spring forest fire history. Res. Pap. RM-220. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 8 p.
- Dieterich, John H. 1980b. The composite fire interval: A tool for more accurate interpretation of fire history. In: Stokes, M.A. and Dieterich, J.H. eds. *Proceedings of the Fire History Workshop, 1980 October 20-24, Tucson, AZ*. Gen. Tech. Rep. RM-81. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. pp. 8-14.
- Dodge, Rita S.; Fulé, Peter Z.; Sieg, Carolyn H. 2008. Dalmatian Toadflax (*Linaria dalmatica*) response to wildfire in a southwestern USA forest. *Ecoscience*. In Press.
- Flora of North America Editorial Committee, eds. 1993+. *Flora of North America North of Mexico*. New York: Oxford University Press. 13+ vols.
- Fowler, James F.; Sieg, Carolyn Hull; Dickson, Brett G.; Saab, Victoria. 2008. Exotic plant species diversity: Influence of roads and prescribed fire in Arizona ponderosa pine forests. *Rangeland Ecology and Management*. 61(3): 284-293.
- Fulé, Peter Z.; Covington, W. Wallace, and Moore, Margaret M. 1997. Determining reference conditions for ecosystem management of southwestern ponderosa pine forests. *Ecological Applications*. 7: 895-908.
- Griffis, Kerry L.; Crawford, Julie A.; Wagner, Michael R.; Moir, W.H. 2001. Understory response to management treatments in northern Arizona ponderosa pine forests. *Forest Ecology and Management*. 146: 239-245.
- Kearney, Thomas H.; Peebles, Robert H. 1960. *Arizona Flora*. 2nd ed. Berkeley: University of California Press. 1085 p.
- Mack, Richard N.; Erneberg, Marianne. 2002. The United States naturalized flora: largely the product of deliberate introductions. *Annals of the Missouri Botanical Garden*. 89: 176-189.

- Palmer, Michael W.; Wade, Gary L.; Neal, Paul. 1995. Standards for the writing of floras. *BioScience*. 45(5): 339-345.
- Sackett, Stephen S. 1980. Reducing natural ponderosa pine fuels using prescribed fire: Two case studies. Res. Note RM-392. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 6 p.
- Sackett, Stephen S.; Haase, Sally M.; Harrington, Michael H. 1996. Lessons learned from fire use for restoring southwestern ponderosa pine systems. In: Covington, Wallace; Wagner, Pamela K., tech. coords. Conference on adaptive ecosystem restoration and management: Restoration of Cordilleran conifer landscapes of North America: 1996 June 6-8; Flagstaff, AZ. Gen. Tech. Rep. RM-278. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. 54-61.
- Sutherland, Elaine Kennedy; Covington, W. Wallace; Andariese, Steve. 1991. A model of ponderosa pine growth response to prescribed burning. *Forest Ecology and Management*. 44(2-4): 161-173.
- Swetnam, Thomas W.; Baisan, Christopher H. 1996. Historical fire regime patterns in the southwestern United States since AD 1700. In: C. Allen ed. *Fire Effects in Southwestern Forests, Proceedings of the Second La Mesa Fire Symposium*, Los Alamos, N.M. 1994 March 29-31. Gen. Tech. Rep. RM-286. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. p.11-32.
- U.S. Department of Agriculture. 1995. *Terrestrial Ecosystem Survey of the Coconino National Forest*. U.S. Department of Agriculture, Forest Service, Southwestern Region.
- Western Regional Climate Center. April 30, 2007. Arizona historical climate summaries. <<http://www.wrcc.dri.edu/summary/Climsmaz.html>>. Accessed March 21, 2008.

Appendix A

Checklist of Vascular Plants of the Chimney Spring and Limestone Flats Study Areas

The annotational abbreviations used in this checklist are: native (N), exotic (E), uncertain (U), conservation concern (C). The conservation concern comment is based on Flora of North America Editorial Committee (1993+). The site location abbreviations are as follows: Chimney Spring (CS) and Limestone Flats (LF). The frequency of occurrence ratings follow guidelines set by Palmer and others (1995) and are: abundant, dominant or codominant in one or more common habitats; frequent, easily found in one or more common habitats but not dominant in any common habitat; occasional, widely scattered but not difficult to find; infrequent, difficult to find with few individuals or colonies but found in several locations; rare, very difficult to find and limited to one or very few locations or uncommon habitats. These ratings apply specifically to these two study sites and not the larger area. The species noted as Endemic are endemic to northern Arizona.

Apiaceae

Cymopterus lemmonii (J.M. Coult & Rose) Dorn. N, CS frequent, LF frequent

Asclepiadaceae

Asclepias asperula (Decne.) Woodson. Antelope horns, N, LF infrequent

Asteraceae

Achillea millefolium Linnaeus. Common yarrow, N, CS frequent, LF occasional

Ageratina herbacea (A. Gray) R.M. King & H. Robinson. N, LF infrequent

Agoseris parviflora (Nuttall) D. Dietrich. N, CS occasional, LF occasional

Amauriopsis dissecta (A. Gray) Rydberg. N, CS occasional, LF occasional

Antennaria marginata Greene. White-margin pussytoes, N, CS occasional, LF occasional

Antennaria parvifolia Nuttall. Small-leaf pussytoes, N, CS frequent, LF frequent

Antennaria rosulata Rydberg. Kaibab pussytoes, N, CS infrequent, LF infrequent

Artemisia carruthii Alph. Wood ex Carruth. N, CS occasional, LF occasional

Artemisia ludoviciana Nuttall subsp. *mexicana* (Willdenow) ex Sprengel D.D. Keck. N, CS occasional, LF occasional

Chrysothamnus viscidiflorus (Hooker) Nuttall. N, CS infrequent

Cirsium wheeleri (A. Gray) Petrak. N, CS frequent, LF frequent

Conyza canadensis (Linnaeus) Cronquist. N, LF occasional

Dieteria canescens (Pursh) Nuttall var. *canescens*. N, CS infrequent

Erigeron divergens Torrey & A. Gray. N, CS frequent, LF frequent

Erigeron flagellaris A. Gray. N, CS occasional

Erigeron formosissimus Greene var. *viscidus* (Rydberg) Cronquist. N, CS occasional, LF occasional
Erigeron speciosus (Lindley) de Candolle. N, LF occasional
Erigeron tracyi Greene. N, LF infrequent
Heliomeris multiflora Nuttall var. *nevadensis* (A. Nelson) W.F. Yates. N, CS occasional, LF occasional
Heterotheca villosa (Pursh) Shinnars var. *pedunculata* (Greene) V.L. Harms ex Semple. N, LF frequent
Hieracium fendleri Schultz-Bipontinus. N, CS occasional, LF frequent
Hymenopappus mexicanus A. Gray. N, LF occasional
Hymenoxys bigelovii (A. Gray) K.F. Parker. N, CS occasional, LF occasional
Hymenoxys jamesii Bierner. N, LF infrequent, Endemic, C
Laennecia schiedeana (Lessing) G.L. Nesom. N, CS frequent, LF occasional
Packera multilobata (Torrey & A. Gray) W.A. Weber & A. Löve. N, CS frequent
Packera neomexicana (A. Gray) W.A. Weber & A. Löve var. *neomexicana*. N, LF frequent
Pseudognaphalium macounii (Greene) Kartesz. N, CS frequent, LF occasional
Senecio actinella Greene. N, CS infrequent, LF occasional
Senecio eremophilus Richardson var. *kingii* Greenman. N, CS infrequent
Senecio wootonii Greene. N, CS infrequent
Solidago velutina de Candolle subsp. *sparsiflora*. N, CS frequent, LF frequent
Symphyotrichum falcatum (Lindley) G.L. Nesom var. *commutatum* (Torrey & A. Gray) G.L. Nesom. N, CS occasional, LF occasional
Taraxacum officinale F.H. Wiggers. Common dandelion, E, CS occasional, LF occasional
Townsendia exscapa (Richardson) Porter. N, LF infrequent
Tragopogon dubius Scopoli. Yellow salsify, E, CS occasional, LF occasional

Berberidaceae

Berberis repens Lindley. N, LF occasional

Boraginaceae

Lithospermum multiflorum Torr. ex A. Gray. N, CS infrequent, LF occasional

Brassicaceae

Boechera fendleri (S. Watson) W.A. Weber. N, CS infrequent
Draba asprella Greene. N, LF frequent, Endemic
Hesperidanthus linearifolius (A. Gray) Rydb. N, LF infrequent
Lepidium virginicum L. var. *virginicum*. U, LF occasional
Noccaea montana (L.) F.K. Mey. N, LF occasional
Pennellia longifolia (Benth.) Rollins. N, CS infrequent, LF infrequent

Caryophyllaceae

- Arenaria lanuginosa* (Michaux) Rohrbach var. *saxosa* (A. Gray) Zarucchi. N, CS occasional, LF occasional
Cerastium nutans var. *obtectum* Rafinesque. N, LF infrequent
Drymaria leptophylla (Chamisso & Schlechtendal) Fenzl ex Rohrbach var. *leptophylla*. N, CS occasional, LF infrequent
Silene antirrhina Linnaeus. N, LF infrequent
Silene laciniata (A. Gray) C.L. Hitchcock & Maguire subsp. *greggii* Cavanilles. N, LF occasional

Chenopodiaceae

- Chenopodium berlandieri* Moquin-Tandon. N, CS infrequent
Chenopodium fremontii S. Watson. N, CS infrequent, LF infrequent
Dysphania graveolens (Willdenow) Mosyakin. N, CS frequent, LF occasional

Commelinaceae

- Commelina dianthifolia* Delile. N, LF occasional
Tradescantia pinetorum Greene. N, LF infrequent

Convolvulaceae

- Ipomoea plummerae* Gray. N, CS occasional, LF infrequent

Cupressaceae

- Juniperus deppeana* Steudel var. *deppeana*. Alligator juniper, N, LF occasional
Juniperus monosperma (Engelmann) Sargent. One-seed juniper, N, LF infrequent
Juniperus scopulorum Sargent. Rocky Mountain juniper, N, LF infrequent

Cyperaceae

- Carex occidentalis* L.H. Bailey. N, CS frequent, LF frequent
Cyperus fendlerianus Boeckeler. N, CS infrequent, LF occasional

Ericaceae

- Pterospora andromedea* Nutt. Pinedrops, N, LF rare

Euphorbiaceae

- Chamaesyce serpyllifolia* (Pers.) Small. N, CS infrequent, LF infrequent
Euphorbia brachycera Engelm. N, CS infrequent, LF occasional
Tragia ramosa Torr. N, CS infrequent

Fabaceae

- Astragalus humistratus* A. Gray. N, CS frequent, LF infrequent
Astragalus tephrodes Gray var. *brachylobus* (Gray) Barneby. N, LF occasional
Cologania longifolia Gray. N, CS infrequent, LF infrequent
Dalea candida Michx. ex Willd. White prairie clover, N, LF infrequent
Dalea filiformis Gray. N, LF infrequent

Lathyrus lanszwertii Kellogg var. *leucanthus* (Rydb.) Dorn. N, LF occasional
Lotus wrightii (A. Gray) Greene. N, CS frequent, LF frequent
Lupinus argenteus Pursh var. *hillii* (Greene) Barneby. N, CS occasional, LF frequent
Medicago lupulina L. Black medick, E, LF occasional
Oxytropis lambertii Pursh. Purple locoweed, N, CS occasional, LF infrequent
Thermopsis rhombifolia (Nutt. ex Pursh) Richardson var. *ovata* (Robinson ex Piper) Egely. N, CS infrequent
Trifolium longipes Nutt. var. *rusbyi* (Greene) H. Harrington. N, CS occasional, LF infrequent
Vicia americana Muhl. ex Willd. N, CS frequent, LF occasional

Fagaceae

Quercus gambelii Nuttall. Gambel oak, N, CS infrequent, LF occasional

Geraniaceae

Geranium caespitosum E. James. N, CS occasional, LF occasional

Grossulariaceae

Ribes cereum Douglas. Wax currant, N, CS infrequent

Hydrophyllaceae

Nama dichotomum (Ruiz & Pavon) Choisy. N, CS occasional
Phacelia heterophylla Pursh var. *heterophylla*. N, LF infrequent

Iridaceae

Iris missouriensis Nuttall. Rocky Mountain iris, N, CS frequent

Lamiaceae

Prunella vulgaris L. var. *lanceolata* (W. Barton) Fern. N, LF infrequent

Liliaceae

Echeandia flavescens (Schultes & Schultes f.) Cruden. N, CS occasional, LF infrequent
Triteleia lemmoniae (S. Watson) Greene. N, LF infrequent, Endemic

Linaceae

Linum australe A. Heller. N, CS infrequent, LF occasional

Nyctaginaceae

Mirabilis linearis var. (Pursh) Heimerl var. *decipiens* (Standley) S.L. Welsh. N, CS infrequent

Onagraceae

Gayophytum racemosum Torr. & A. Gray. N, CS occasional, LF occasional
Gayophytum ramosissimum Torr. & A. Gray. N, LF infrequent
Oenothera laciniata Hill. N, LF occasional

Orchidaceae

Malaxis soulei L.O. Williams. N, LF occasional

Corallorhiza maculata (Rafinesque) Rafinesque var. *maculata*. N, CS infrequent

Oxalidaceae

Oxalis caerulea (Small) Kunth. N, CS infrequent, LF infrequent

Pinaceae

Pinus ponderosa Douglas ex Lawson & C. Lawson var. *scopulorum*

Engelmann. Rocky Mountain ponderosa pine, N, CS abundant, LF abundant

Pseudotsuga menziesii (Mirbel) Franco var. *glauca* (Mayr) Franco. Rocky Mountain Douglas-fir, N, CS infrequent

Plantaginaceae

Plantago patagonica Jacq. N, LF occasional

Poaceae

Agrostis scabra Willd. N, LF infrequent

Aristida arizonica Vasey. Arizona threeawn, N, LF occasional

Blepharoneuron tricholepis (Torr.) Nash. Pine dropseed, N, CS frequent, LF frequent

Bouteloua gracilis (Kunth) Lag. ex Griffiths. Blue gramma, N, CS frequent, LF occasional

Bromus ciliatus L. Fringed brome, N, CS occasional

Bromus tectorum L. Cheatgrass, E, CS infrequent, LF occasional

Dichanthelium oligosanthos (Schult.) Gould. N, LF infrequent

Elymus elymoides (Raf.) Swezey subsp. *brevifolius* (J.G. Sm.) Barkworth. Squirreltail, N, CS abundant, LF frequent

Eragrostis mexicana (Hornem.) Link subsp. *mexicana*. N, LF occasional

Festuca arizonica Vasey. Arizona fescue, N, CS abundant, LF abundant

Koeleria macrantha (Ledeb.) Schult. Junegrass, N, LF frequent

Muhlenbergia minutissima (Steud.) Swallen. N, CS infrequent, LF occasional

Muhlenbergia montana (Nutt.) Hitchc. Mountain muhly, N, CS frequent, LF frequent

Muhlenbergia ramulosa (Kunth) Swallen. N, CS occasional, LF infrequent

Muhlenbergia straminea Hitchc. Screwleaf muhly, N, CS infrequent, LF occasional

Muhlenbergia wrightii Vasey ex J.M. Coult. Spike muhly, N, CS occasional, LF infrequent

Panicum bulbosum Kunth. Bulb panicgrass, N, LF infrequent

Piptochaetium pringlei (Beal) Parodi. Pringle's speargrass, N, LF occasional

Poa fendleriana (Steud.) Vasey subsp. *longiligula* (Scribn. & T.A. Williams) Soreng. Muttongrass, N, CS abundant, LF abundant
Poa pratensis L. subsp. *pratensis*. Kentucky bluegrass, E, CS infrequent, LF occasional
Schizachyrium scoparium (Michx.) Nash var. *scoparium*. Little bluestem, N, CS infrequent, LF occasional
Vulpia octoflora (Walter) Rydb. var. *hirtella* (Piper) Henrard. N, LF occasional

Polemoniaceae

Gilia aggregata (Pursh) Sprengel var. *maculata* M.E. Jones. Skyrocket, N, LF infrequent
Microsteris gracilis (Hook.) Greene var. *humilior* (Hook.) Cronq. N, LF infrequent

Polygonaceae

Eriogonum alatum Torrey var. *alatum*. N, CS infrequent
Eriogonum racemosum Nuttall. N, CS occasional, LF infrequent
Polygonum sawatchense Small subsp. *sawatchense*. N, CS occasional, LF occasional
Rumex acetosella Linnaeus. Sheep sorrel, E, LF occasional

Portulacaceae

Lewisia brachycalyx Engelmann ex A. Gray. N, LF infrequent

Ranunculaceae

Thalictrum fendleri Engelmann ex A. Gray. N, CS occasional, LF occasional

Rhamnaceae

Ceanothus fendleri A. Gray. N, CS occasional, LF occasional

Rosaceae

Geum triflorum Pursh var. *ciliatum* (Pursh) Fassett. N, CS infrequent
Potentilla crinita A. Gray. N, CS frequent, LF frequent
Potentilla diversifolia Lehm. N, CS occasional, LF occasional
Potentilla hippiana Lehm. N, CS occasional, LF occasional
Potentilla subviscosa Greene. N, CS occasional
Rosa woodsii Lindl. var. *ultramontana* (S. Watson) Jeps. N, CS occasional

Rubiaceae

Houstonia wrightii A. Gray. N, CS infrequent, LF occasional

Saxifragaceae

Lithophragma tenellum Nutt. N, LF infrequent
Saxifraga rhomboidea Greene. N, LF infrequent

Scrophulariaceae

Castilleja miniata Douglas ex Hook. N, CS infrequent, LF infrequent

Linaria dalmatica (L.) Miller. Dalmatian toadflax, E, CS frequent

Mimulus rubellus A. Gray. N, CS infrequent

Pedicularis centranthera A. Gray. N, CS infrequent, LF occasional

Penstemon virgatus Gray. N, CS occasional, LF occasional

Verbascum thapsus L. Common mullein, E, CS occasional, LF occasional

Veronica peregrina L. var. *xalapensis* (H.B.K.) St. John & Warren. N, LF infrequent

Verbenaceae

Verbena macdougallii A.A. Heller. N, CS infrequent

The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.