

ALPINE VASCULAR FLORA OF HASLEY BASIN, ELK MOUNTAINS,
COLORADO, USA

RANDY V. SEAGRIST AND KEVIN J. TAYLOR
Rocky Mountain Biological Laboratory, Gothic, CO 81224

ABSTRACT

The alpine habitat of Hasley Basin in the Elk Mountains of central Colorado was surveyed for its vascular flora in the summers of 1994, 1995, and 1996. A total of 209 species from 35 families and 109 genera were collected, including ten Colorado endemics and one species endemic to the Southern Rocky Mountains.

Vascular plant diversity surveys of specific geographic areas are an important prerequisite for a variety of systematic and ecological research activities. Such surveys aid ecological researchers in understanding the basic natural history of those areas (Kass 1988). The resulting documentation of the geographic distributions of particular plant species is necessary for monographic research in plant systematics. These surveys are also the basis for research in phytogeography, from the initial definition of floristic regions (Takhtajan 1986; McLaughlin 1989) to biogeographic studies that analyze the historical and evolutionary basis for present plant distributions (Weber 1965; Raven and Axelrod 1974; Taylor 1977; Billings 1978; Harper et al. 1978; Crovello 1981; Humphries and Parenti 1986; Hadley 1987). Floristic surveys are also vital for the location of populations of rare and endangered species (O'Kane 1988) and can function as baseline data to monitor both the disappearance of native plants and the encroachment of alien species (Snow 1995).

Many regions of Colorado and the United States have never been systematically surveyed for their plant diversity (Weber 1990; Hartman 1992). Whenever an area is systematically surveyed for the first time, botanical knowledge usually increases significantly. As an example, surveys by the Rocky Mountain Herbarium from 1974 to 1989 discovered 306 species new to the state of Wyoming and 51 taxa new to science (Hartman 1992). Similar surveys in Colorado from 1979 to 1989 found 179 plant species new to the state (Weber 1979, 1981, 1982, 1983, 1984, 1985, 1989).

This research surveyed the alpine vascular flora of Hasley Basin, a high basin in the Elk Mountains of central Colorado. Although nearby areas such as the Crested Butte Quadrangle (Langenheim 1955), the Gunnison Basin (Barrell 1969), the Ruby Range (Hartman and Rottman 1987), and the Gothic area (Buck and Frase 1993) have been previously studied, Hasley Basin itself has never been systematically surveyed. The primary objective of this research was to document the occurrence, distribu-

tion, and relative abundance of vascular plant species found in this relatively isolated alpine basin.

Study area. Hasley Basin is a high alpine basin located west of the Continental Divide in the Elk Mountains of central Colorado. The Elk Mountains are located in Gunnison County west of the Sawatch Range, south of the Colorado River, and north of both the Gunnison River and the San Juan Mountains. The Elks contain six peaks over 4268 m and are one of the more topographically rugged ranges in the Southern Rocky Mountains. Hasley Basin itself is located at 39 degrees 3 minutes 30 seconds North latitude and 107 degrees 2 minutes 30 seconds West longitude (Sections 24, 25, and 26, Township 11 South, Range 87 West, and Sections 19, 30, and 31, Township 11 South, Range 86 West). Located 20.9 km north and 4.8 km west of Crested Butte, CO, Hasley Basin lies in the Maroon Bells-Snowmass Wilderness Area, White River National Forest.

The basin is a glaciated valley drained by Hasley Creek and is geographically defined by ridges to the west, south, and east that are consistently over 3689 m in elevation. These ridges form a basin that is also U-shaped in areal view and is open towards the north. Six unnamed peaks on these ridges reach over 3808 m. Hasley Creek cuts through the center of the basin; to either side are located broad shelves that range in elevation from 3537 m to 3569 m. The shelves contain at least six glacially-derived kettle ponds (Prather 1982), some permanent and some ephemeral. Elevations in the basin range from 3232 m in the north near the confluence of Hasley Creek with the North Fork of the Crystal River to the basin's high point, an unnamed 3861 m peak on the western ridge. Geographically, Hasley Basin is adjacent in all directions to high basins and peaks, specifically Fravert Basin and Maroon Peak (4316 m) to the east, Lead King Basin and Snowmass Mountain (4296 m) to the north, Schofield Park and Treasure Mountain (4124 m) to the west, and Mt. Bellview (3817 m) to the south. The basin covers approximately 26 km².

The western ridge and basin are coterminous with the Elk Mountain Structure Zone, an area of

steeply tilted rock strata at the edge of the block uplifts which produced the Elk Mountains (Prather 1982). The western ridge consists of strata which have been tilted to a near vertical position, while the strata of the eastern ridge are nearly horizontal, similar to those found in the Maroon Bells to the east.

Hasley Basin contains several rock types (Mutschler 1970). The Snowmass Stock (of Oligocene age in origin) is a light gray granodiorite found in the northeast portion of the Basin. Sedimentary formations include the Mancos Shale (Cretaceous), a dark gray-black calcareous shale found on the western ridge; the Dakota Sandstone (Cretaceous), a white-gray orthoquartzite located on the western ridge; the Morrison Formation (Jurassic), also found on the western ridge and consisting of greenish to dark gray shale, siltstone, sandstone, limestone, and dolomite; the Maroon Formation (Pennsylvanian-Permian), a gray brown to dusky red arkosic, micaceous, calcareous siltstone and conglomerate, found throughout most of Hasley Basin and on all its ridges; and the Gothic Formation (Pennsylvanian), a brownish gray to pale reddish brown shale, siltstone, sandstone, conglomerate, and limestone, located on the western and southern ridges and within the basin itself. Hasley Basin also contains various talus and scree slopes, several rock glaciers, and recent stream and pond deposits.

Climatic data are lacking for the study site itself. However, some data exist from the Rocky Mountain Biological Laboratory, located 12.9 km south and 3.2 km east at an elevation of 2887 m. Here mean snowfall for the 23 years of the data is 1121 cm, with a maximum of 1641 cm during 1994–1995 and a minimum of 474 cm in 1976–1977 (Barr personal communication). The mean January temperature is -11°C . At RMBL, the maximum temperature ever recorded is 29°C , while the coldest is -40°C . More complete data exists from Crested Butte; however, this town is located 20.9 km south and 4.8 km east of Hasley Basin and at the lower elevation of 2703 m. Mean annual snowfall here is 424 cm, while mean annual precipitation is 71 cm, with two maxima occurring, one in January and the other during the period from July to September (Langenheim 1962). Mean January temperature is -10.2°C , while mean July temperature is 39.0°C (Langenheim 1962).

Based upon both the above data and the personal experience of the authors, the climate at Hasley Basin can be characterized as being cold in the winters with a large accumulation of snow and cool but dry in the summers. Most precipitation falls as winter snow; summer rains generally fall during violent but brief thunderstorms. At RMBL, the access road is generally closed from November to mid-May due to snow. Hasley Basin, at a much higher elevation, is snow-free for only two or at most three months of the year. Estimates for mean snowfall range as

high as 1.5 times greater than at RMBL (Barr personal communication).

The two primary years of the study were, in fact, noteworthy for their climatic extremes. The winter of 1993–1994 had a relatively low snowfall of only 954 cm (Barr personal communication). Consequently, Hasley Basin was largely snow-free by early June (Seagrist personal observation). This drought persisted throughout the summer. By mid-August 1994, most plants in the tundra had senesced and many late season species failed to flower at all (Seagrist personal observation). The winter of 1994–1995, however, had the heaviest snowfall of any year since 1973 (when RMBL's weather data begins), a total of 1641 cm. Hasley Basin was almost completely covered by snow as late as 15 July, with only a few south- and west-facing ridge crests beginning to melt free of snow (Seagrist and Taylor personal observation). However, by mid-August the Basin had become largely free of snow. It is possible that the weather extremes during the period of our study may have affected those plant species flowering and hence collected during the research.

METHODS

Collections of vascular plant species were made during June, July, and August in 1994, July, August, and September in 1995, and June, July, and August in 1996. Collections were confined to the alpine zone, defined here to mean all areas of the basin and its surrounding ridges located at and above the krummholz habitat (found in Hasley Basin at about 3354 m). Specimens were collected, placed within plastic bags to prevent drying, and carried back to the Rocky Mountain Biological Laboratory in nearby Gothic, CO. Here they were identified, pressed, dried, and mounted using standard herbarium techniques (Liesner n.d.). Identifications were done by the authors using Harrington (1954), Weber (1987), Weber and Wittmann (1996), and Welsh et al (1993). Nomenclature follows Weber and Wittmann (1996). Specimens were deposited at RMBL.

PLANT COMMUNITIES

Krummholz. The krummholz community is defined by the presence of wind-stunted *Picea engelmannii* Parry ex Engelm and *Abies bifolia* A. Murray. It is located at elevations ranging from 3354 m to 3476 m, both in the central interior of the basin and on all slopes of the basin's surrounding ridges. Other common species found here include *Heracleum sphondylium* L. ssp. *montanum* (Schleicher ex Gaudin), *Ligusticum porteri* Coulter & Rose, *Lomatium dissectum* (Nuttall) Mathias & Constance, *Pseudocymopterus montanus* (A. Gray) Coulter, *Mertensia ciliata* (James ex Torrey) G. Don, *Geranium richardsonii* Fischer & Troutweyler, *Veratrum tenuipetalum* Heller, *Poa cusickii* vasey

ssp. *edilis* (Scribner) Co. A., *Trisetum spicatum* L., and *Aconitum columbianum* Nuttall ex Torrey & Gray.

Riparian. Riparian habitat is found along Hasley Creek and its tributaries in the center of Hasley Basin. Elevations range from 3573 m at the base of the South Ridge to 3354 m on the north where Hasley Creek enters subalpine spruce-fir forest. Characteristic plant species include *Ligusticum filicinum* S. Watson, *Pseudocymopterus montanus*, *Arnica rydbergii* Greene, *Dugaldia hoopesii* (A. Gray) Rydberg, *Mertensia ciliata*, *Cardamine cordifolia* A. Gray, *Noccaea montana* (L.) F. R. Meyer, *Rhodiola integrifolia* Rafinesque, *Chamerion subdentatum* (Rydberg) Löve & Löve, *Aquilegia coerulea* James ex Torrey, *Phleum commutatum* Gaudin, *Trisetum spicatum*, *Psychrophila leptosepala* (De Candolle) W. A. Weber, *Delphinium barbeyi* (Huth) Huth, *Ranunculus adoneus* A. Gray, *Ranunculus alismifolius* Geyer ex Benth, *Trollius albiflorus* (A. Gray) Rydberg, *Salix drummondiana* Barratt, *Castilleja rhexifolia* Rydberg, and *Pedicularis groenlandica* Retzius.

Ponds. At least six glacially-derived ponds are located within Hasley Basin, five on the Western Shelf and one on the Eastern Shelf. The Western Shelf ponds sit at elevations of 3315 m, 3543 m, 3573 m, 3659 m, and 3713 m, while the Eastern Shelf pond (really a set of small adjacent ponds) is located at 3598 m. Common plant species located within or immediately adjacent to these ponds include *Noccaea montana*, *Rhodiola integrifolia*, *Carex aquatilis* Wahlenberg, *Juncus drummondii* E. Meyer, *Erythronium grandiflorum* Pursh, *Oreobroma pygmaea* (A. Gray) T. J. Howell, *Psychrophila leptosepala*, *Ranunculus adoneus*, *Ranunculus alismifolius*, *Ranunculus inamoenus* Greene, *Salix geeyeriana* Anderson, *Castilleja rhexifolia*, *Pedicularis bracteosa* Benth in Hooker ssp. *paysoniana* (Pennell) W. A., *Pedicularis groenlandica*, and *Pedicularis parryi* A. Gray.

Wet meadows. Wet meadows are located along Hasley Creek in the center of the basin and also adjacent to the scattered glacial ponds. These relatively lush meadows range in elevation from 3415 m to 3713 m. Characteristic plants include *Pseudocymopterus montanus*, *Boechera drummondii* (A. Gray) Löve & Löve, *Erysimum capitatum* (Douglas) Greene, *Noccaea montana*, *Campanula parryi* A. Gray, *Rhodiola integrifolia*, *Clematis rhodantha* (A. Gray) Rose, *Carex illota* L. H. Bailey, *Lupinus bakeri* Greene ssp. *amplus* (Greene) Fleak & Dunn, *Phacelia sericea* (R. Graham) A. Gray, *Juncus drummondii*, *Erythronium grandiflorum*, *Phleum alpinum* L., *Poa cusickii* ssp. *edilis*, *Bistorta bistortoides* (Pursh) Small, *Primula parryi* A. Gray, *Amonastrum narcissiflorum* L., *Aquilegia coerulea*, *Psychrophila leptosepala*, *Ranunculus adoneus*, *Ranunculus inamoenus*, *Trollius albiflorus* (A. Gray) Rydberg, *Acomastylis rossii* (R. Brown)

Greene ssp. *turbinata* (Rydberg) W. A. Weber, *Salix drummondiana*, *Besseyia alpina* (A. Gray) Rydberg, *Castilleja occidentalis* Torrey, *Castilleja rhexifolia*, and *Pedicularis groenlandica*.

Dry meadows. Dry meadows are the most widespread habitat found within Hasley Basin. They are ubiquitous above the krummholz zone (above 3354 m), within the basin, along the slopes of the surrounding ridges, and on the highest ridge crests up to 3861 m. Characteristic plant species include *Pseudocymopterus montanus*, *Antennaria media* Greene, *Antennaria rosea* Greene, *Cirsium hesperium* (Eastwood) Petrak, *Heterotheca villosa* (Pursh) Shinners, *Rydbergia grandiflora* (Torrey & Gray) Greene, *Eritrichum aretoides* (Chamisso) De Candolle, *Boechera drummondii*, *Erysimum capitatum*, *Smelowskia calycina* (Stephan ex Willdenow) C. A., *Noccaea montana*, *Silene acaulis* L. ssp. *subcaulescens* (F. N. Williams) Hitchcock & Maguire, *Frasera speciosa* Douglas ex Grisebach, *Hydrophyllum capitatum* Douglas ex Benth, *Festuca brachyphylla* Schultes ssp. *coloradensis* Fredrickson, *Trisetum spicatum*, *Polemonium viscosum* Nuttall, *Bistorta bistortoides*, *Claytonia megarhiza* (Parry ex A. Gray), *Anemone multifida* Poiret var. *globosa* (Nuttall) Torrey & Gray, *Acomastylis rossii* (R. Brown) Greene, ssp. *turbinata* (Rydberg) W. A. Weber, *Dryas octopetala* L. ssp. *hookeriana* (Juzepczok) Holten, *Ivesia gordonii* (Hooker) Torrey & Gray, *Pentaphragmoides floribunda* (Pursh) Löve, *Salix arctica* Pallas, *Salix brachycarpa* Nuttall, *Castilleja occidentalis*, and *Penstemon whippleanus* A. Gray.

RESULTS

The alpine vascular flora of Hasley Basin consists of 209 species, including 34 families, 107 genera, and 207 species of angiosperms, and 1 family, 2 genera, and 2 species of gymnosperms. The largest family is Asteraceae with 45 species, followed by Scrophulariaceae with 16 species, Poaceae with 14 species, Cyperaceae with 13 species, and Brassicaceae and Rosaceae with 12 species. Ten species are woody, the rest are herbaceous.

Eight species endemic to Colorado were found in Hasley Basin: *Ligularia amplexans* (A. Gray) W. A. Weber, *Ligularia holmii* (Greene) W. A. Weber, *Ligularia porteri* (Greene) W. A. Weber, *Ligularia soldanella* (A. Gray) W. A. Weber, *Townsendia rothrockii* A. Gray ex Rothrock and *Townsendia leptotes* (A. Gray) Osterhout (all in Asteraceae), plus *Polemonium confertum* A. Gray (Polemoniaceae) and *Castilleja puberula* Rydberg (Scrophulariaceae) (Weber and Wittmann 1992, 1996). *Clematis rhodantha* (A. Gray) Rose (Crassulaceae) is endemic to the Southern Rocky Mountains (Weber and Wittmann 1996).

Polemonium confertum A. Gray is a Colorado endemic species which has been located at only a few scattered locations in the central ranges of the

state. Prior to this study, it had previously been found at Rollins Pass, Buchanan Pass, Gray's Peak, Hoosier Ridge, and on Avery Peak (12.9 km south and 3.2 km east of Hasley Basin and adjacent to RMBL) (Grant 1989); the authors' work has extended the plant's range to include North Italian Mountain, West Hasley Ridge, Frigid Air Pass, Maroon Peak, and Pyramid Peak within the Elk Range and on the summit of East Buffalo Peak within the Mosquito Range (Seagrist and Taylor in press; Taylor personal observation). *Polemonium confertum* was always found by the authors in fellfields and along rocky alpine streams. It appears that this species may not be as rare as previously thought; it just grows in high elevation, hard-to-access habitats.

DISCUSSION

Hasley Basin seems to have a relatively diverse alpine flora when compared to similar areas in Colorado. Floristic data from comparable studies indicate that 289 species were collected from sixteen sites in the Sawatch Range (Hartman and Rottman 1988), 220 species from eight basins in the Ruby Range (Hartman and Rottman 1987), 197 species from three basins in the San Juan Mountains (Hartman and Rottman 1985b), and 167 species from the Mt. Bross massif in the Mosquito Range (Hartman and Rottman 1985a). Our total of 209 species compares favorably to previous research, especially when it is taken into account that most of the above studies collected from multiple basins or sites.

It is possible that we have undercollected the Cyperaceae and the Poaceae. Our collections indicate totals of 13 sedges and 14 grasses from Hasley Basin, as compared to 23 sedges and 19 grasses from the nearby Ruby Range (Hartman and Rottman 1987). However, two additional factors must be considered. The Ruby Range study collected from eight scattered locations within the range; we collected from only one basin. Consequently, the greater numbers of sedges and grasses could be due to greater geographic diversity within the Ruby Range study rather than undercollection on our part. It is also possible that the variable weather conditions found during the summers of 1994 and 1995 affected the results. The summer of 1994 was exceptionally dry, due to both low snowfall in the previous winter and to low rainfall during June and July. It was observed that vegetation in Hasley Basin had senesced due to drought by mid-August (Seagrist personal observation). Since many sedges and grasses flower in late summer (Weber 1987, 1996), this could have skewed our samples. In addition, the summer of 1995 was affected by exceptionally heavy snowfall during the previous winter. Hasley Basin still lay under deep snow as late as July 20 (Seagrist and Taylor personal observation) and isolated snow patches persisted into late August. This could also have affected the flowering of

sedges and grasses and could have negatively impacted our collection samples.

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Nomenclature follows Weber and Wittmann (1992, 1996).

Alsiniaceae

- Cerastium beeringianum* Chamisso & Schlechtendal ssp. *earlei* (Rydberg) Hulthen; dry meadow.
Cerastium strictum L. emend Haenke; dry meadow.
Eremogone congesta (Nuttall ex Torrey & Gray) Ikonnikov; dry meadow.
Eremogone fendleri (A. Gray) Ikonnikov; dry meadow.

Apiaceae

- Angelica grayi* (Coulter & Rose) Coulter & Rose; dry meadow.
Heracleum sphondylium L. ssp. *montanum* (Schleicher ex Gaudin) Briquet in Schinz & Thellung; krummholz.
Ligusticum tenuifolium Watson; riparian, wet meadow, pond.
Ligusticum porteri Coulter & Rose; pond, krummholz, wet meadow.
Lomatium dissectum (Nuttall) Mathias & Constance; dry meadow.
Oreoxis alpina (A. Gray) Coulter & Rose; dry meadow.
Oxypholis fendleri (A. Gray) Heller; wet meadow, riparian.
Pseudocymopterus montanus (A. Gray) Coulter & Rose; dry meadow, wet meadow, krummholz, riparian.

Asteraceae

- Agoseris aurantiaca* (Hooker) Greene; dry meadow.
Agoseris glauca (Pursh) Rafinesque; dry meadow.
Antennaria media Greene; dry meadow.
Antennaria rosea Greene; dry meadow.
Antennaria umbrinella Rydberg; dry meadow.
Arnica cordifolia Hooker; dry meadow.
Arnica mollis Hooker; pond, wet meadow.
Arnica parryi A. Gray; dry meadow.
Arnica rydbergii Greene; dry meadow, pond, krummholz, riparian.
Artemisia scopulorum A. Gray; dry meadow.
Chaenactis alpina (A. Gray) Jones; dry meadow.
Cirsium hesperium (Eastwood) Petrak; dry meadow.
Dugaldia hoopesii (A. Gray) Rydberg; krummholz, riparian, wet meadow, pond, dry meadow.
Erigeron compositus Pursh; dry meadow.
Erigeron coulteri T.C. Porter; dry meadow.
Erigeron elatior (A. Gray) Greene; riparian, krummholz.

Erigeron formosissimus Greene; krummholz, riparian, dry meadow.
Erigeron leiomerus A. Gray; dry meadow.
Erigeron melanocephalus A. Nelson; dry meadow, riparian, wet meadow.
Erigeron pinnatisectus (A. Gray) A. Nelson; dry meadow.
Erigeron simplex Greene; dry meadow.
Erigeron speciosus (Lindley) De Candolle; krummholz, riparian, dry meadow.
Erigeron vagus Payson; dry meadow.
Helianthella quinquenervis (Hooker) A. Gray; krummholz, riparian.
Heterotheca villosa (Pursh) Shinnery; dry meadow.
Ligularia amplexans (A. Gray) W.A. Weber; dry meadow; **endemic in Colorado**.
Ligularia holmii (Greene) W.A. Weber; dry meadow; **endemic in Colorado**.
Ligularia porteri (Greene) W.A. Weber; dry meadow; **endemic in Colorado**.
Ligularia soldanella (A. Gray) W.A. Weber; dry meadow; **endemic in Colorado**.
Packera cana (Hooker) Weber & Löve; krummholz, riparian.
Packera dimorphophylla (Greene) Weber & Löve; wet meadow, ponds, dry meadow.
Packera streptanthifolia (Greene) Weber & Löve; dry meadow.
Packera werneriiifolia (A. Gray) Weber & Löve; dry meadow.
Pyrrocoma clementis Rydberg; dry meadow, krummholz, riparian.
Rydbergia grandiflora (Torrey & Gray) Greene; dry meadow.
Senecio crassulus A. Gray; wet meadow, dry meadow, pond, krummholz, riparian.
Senecio fremontii Toerrey & Gray ssp. *blitoides* (Greene) W.A. Weber; wet meadows, ponds.
Senecio triangularis Hooker; wet meadow, dry meadow.
Solidago simplex Humboldt, Bonpland, & Kunth var. *nana*; dry meadow.
Taraxacum eriophorum Rydberg; dry meadow.
Taraxacum officinale G. H. Weber ex Wiggers, riparian.
Tonestus lyallii (A. Gray) A. Nelson; dry meadow.
Townsendia leptotes (A. Gray) Osterhout; dry meadow; **endemic in Colorado**.
Townsendia rothrockii A. Gray ex Rothrock; dry meadow; **endemic in Colorado**.
Wyethia amplexicaulis (Nuttall) Nuttall X *Wyethia arizonica* A. Gray; dry meadow.

Boraginaceae

Eritrichum aretioides (Chamisso) De Candolle; dry meadow.
Hackelia floribunda (Lehmann) I. M. Johnston; dry meadow.
Mertensia ciliata (James ex Torrey) G. Don; dry meadow, wet tundra, riparian.

Mertensia lanceolata (Pursh) A. De Candolle; krummholz, riparian.

Brassicaceae

Boechera drummondii (A. Gray) Löve & Löve; dry meadow, wet meadow, riparian.
Cardamine cordifolia A. Gray; krummholz, pond, wet meadow, riparian.
Draba aurea M. Vahl ex Hornemann; dry meadow.
Draba breweri S. Watson var. *cana* (Rydberg); dry meadow.
Draba crassa Rydberg; dry meadow.
Draba crassifolia R. Graham; dry meadow.
Draba fladnizensis Wulfen var. *pattersonii* (Schultz) Rollins; dry meadow.
Draba oligosperma Hooker; dry meadow.
Draba spectabilis Greene; dry meadow, wet meadow, pond.
Erysimum capitatum (Douglas) Greene; dry meadow, wet meadow.
Noccaea montana (L.) F.K. Meyer; dry meadow, wet meadow, riparian, pond.
Smelowskia calycina (Stephan ex Willdenow) C.A. Meyer; dry meadow.

Campanulaceae

Campanula parryi A. Gray; wet meadow.
Campanula rotundifolia L.; dry meadow.

Caprifoliaceae

Distegia involuocrata (Banks ex Sprengel) Cockerell; dry meadow.
Symphoricarpos rotundifolius A. Gray; dry meadow, krummholz.

Caryophyllaceae

Gastrollychnis kingii (S. Watson) W.A. Weber; dry meadow, wet meadow.
Silene acaulis (L.) ssp. *subacaulescens* (F.N. Williams) Hitchcock & Maguire; dry meadow.

Crassulaceae

Clementsia rhodantha (A. Gray) Rose; wet meadow; **endemic in southern Rocky Mountains**.
Rhodiola integrifolia Rafinesque; riparian, wet meadow, dry meadow.

Cyperaceae

Carex albo-nigra Mackenzie in Rydberg; wet meadow, pond, dry meadow.
Carex aquatilis Wahlenberg; pond.
Carex athrostachya Olney; wet meadow, pond.
Carex chalciolepis Holm; wet meadow, pond, dry meadow.
Carex crandallii Gandoger; wet meadow, pond.
Carex ebenea Rydberg; dry meadow.
Carex egglestonii Mackenzie; riparian, wet meadow.

Carex elynoides Holm; wet meadow, pond, dry meadow.

Carex foenea Willdenow; wet meadow, pond.

Carex illota L.H. Bailey; wet meadow.

Carex lachenalii Schkuhr; dry meadow, riparian, pond, wet meadow.

Carex nigricans C.A. Meyer; wet meadow, pond.

Carex vernacula L.H. Bailey; wet meadow, pond.

Fabaceae

Astragalus alpinus L.; dry meadow.

Astragalus molybdenus Barneby; dry meadow, wet meadow.

Astragalus robbinsii (Oakes) A. Gray var. *minor* (Hooker) Barneby; dry meadow.

Hedysarum occidentale Greene; dry meadow.

Lupinus argenteus Pursh; riparian, pond, wet meadow, dry meadow.

Lupinus bakeri Greene ssp. *amplus* (Greene) Fleak & Dunn; dry meadow, wet meadow.

Oxytropis deflexa (Pallas) De Candolle ssp. *deflexa*; dry meadow.

Oxytropis podocarpa A. Gray; dry meadow.

Oxytropis viscida Nuttall ex Torrey & Gray; dry meadow.

Gentianaceae

Frasera speciosa Douglas ex Grisebach; dry meadow.

Gentianopsis barbellata (Engelmann) Iltis; dry meadow.

Gentianopsis thermalis (Kuntze) Iltis; pond, wet meadow.

Pneumathe parryi (Engelmann) Greene; dry meadow.

Swertia perennis L.; pond, wet meadow.

Geraniaceae

Geranium richardsonii Fischer & Trautvetter; pond, wet meadow, krummholz.

Geranium viscosissimum Fischer & Meyer ssp. *nerosum* (Rydberg) W.A. Weber; dry meadow.

Grossulariaceae

Ribes montigenum McClatchie; dry meadow.

Helleboraceae

Aconitum columbianum Nuttall ex Torrey & Gray; krummholz.

Aquilegia coerulea James ex Torrey; dry meadow, riparian, wet meadow.

Delphinium barbeyi (Huth) Huth; wet meadow, riparian, pond.

Psychrophila leptosepala (De Candolle) W.A. Weber; wet meadow, riparian.

Trollius albiflorus (A. Gray) Rydberg; wet meadow, riparian.

Hydrophyllaceae

Hydrophyllum capitatum Douglas ex Benthams; dry meadow.

Phacelia sericea (R. Graham) A. Gray; dry meadow, wet meadow.

Juncaceae

Juncus drummondii E. Meyer; wet meadow, pond, dry meadow.

Luzula parvifolia (Ehrhart) Desvoux; dry meadow.

Lamiaceae

Agastache urticifolia (Benthams) Kurtze; dry meadow.

Liliaceae

Erythronium grandiflorum Pursh; wet meadow, riparian, krummholz.

Lloydia serotina (L.) Salisbury ex Reichenbach; dry meadow, wet meadow.

Linaceae

Adenolinum lewisii (Pursh) Löve & Löve, krummholz.

Melanthaceae

Anticlea elegans (Pursh) Rydberg; krummholz, dry meadow.

Veratrum tenuipetalum Heller; krummholz.

Onagraceae

Chamerion subdentatum (Rydberg) Löve & Löve; riparian.

Epilobium clavatum Trelease; wet meadows, ponds.

Epilobium saximontanum Haussknecht; krummholz, riparian.

Pinaceae

Abies bifolia A. Murray; krummholz.

Picea engelmannii Parry ex Engelmann; krummholz.

Poaceae

Deschampsia cespitosa (L.) P. Beauvois; wet meadow, pond, dry meadow.

Elymus lanceolatus (Scribner & Smith) Gould; krummholz, riparian, wet meadow.

Elymus scribneri (Vasey) Jones; dry meadow.

Elymus trachycaulus (Link) Gould ex Shinnars ssp. *andinus* (Scribner & Smith) Löve & Löve; wet meadow, pond, dry meadow.

Festuca brachyphylla Schultes ssp. *coloradensis* Fredricksen; dry meadow.

Pheleocommutatum Gaudin; dry meadow, riparian, pond, wet meadow.

Poa alpina L.; dry meadow.

Poa cusickii Vasey ssp. *epilis* (Scribner) W.A. Weber; dry meadow, wet meadow, pond, krummholz.

Poa fendleriana (Steudel) Vasey; wet meadow, dry meadow, riparian.

Poa glauca M. Vahl ssp. *rupicola* (Nash) W.A. Weber; dry meadow.

Poa juncifolia Scribner; dry meadow.

Poa nemoralis L. ssp. *interior* (Rydberg) W.A. Weber; dry meadow.

Poa tracyi Vasey; dry meadow.

Trisetum spicatum (L.) Richter ssp. *congonii* (Scribner & Merrill) Hultén; dry meadow, wet meadow, riparian, pond.

Polemoniaceae

Polemonium confertum A. Gray; **endemic in Colorado.**

Polemonium pulcherrimum Hooker ssp. *delicatum* (Rydberg) Brand; dry meadow, wet meadow, riparian.

Polemonium viscosum Nuttall; dry meadow.

Polygonaceae

Bistorta bistortoides (Pursh) Small; dry meadow, wet meadow, pond.

Eriogonum coloradense Small; dry meadow; **endemic in Colorado.**

Eriogonum umbellatum Torrey var. *aureum* (Gardner) Reveal; dry meadow.

Oxyria digyna (L.) J. Hill; dry meadow.

Rumex densiflorus Osterhout; krummholz, pond.

Portulacaceae

Claytonia lanceolata Pursh; dry meadow, riparian.

Claytonia megarhiza Parry ex (A. Gray) dry meadow.

Oreobroma pygmaea (A. Gray) T.J. Howell; pond, dry meadow.

Primulaceae

Androsace chamaejasme Host ssp. *carinata* (Torrey) Hultén; dry meadow.

Androsace septentrionalis L.; dry meadow, wet meadow.

Primula parryi A. Gray; wet meadow.

Ranunculaceae

Anemonastrum narcissiflorum (L.) Holub ssp. *zephyrum* (A. Nelson) W.A. Weber; dry meadow, wet meadow.

Anemone multifida Poirlet var. *globosa* (Nuttall) Torrey & Gray; dry meadow.

Anemone parviflora Michaux; dry meadow.

Ranunculus adoneus A. Gray; dry meadow, wet meadow, riparian.

Ranunculus alismifolius Geyer ex Bentham var. *montanus* S. Watson; wet meadow, riparian, pond.

Ranunculus eschscholtzii Schlechtendal; dry meadow, wet meadow, riparian.

Ranunculus inamoenus Greene; dry meadow, wet meadow, riparian.

Ranunculus uncinatus D. Don; wet meadow, ponds.

Rosaceae

Acomastylis rossii (R. Brown) Greene ssp. *turbinata* (Rydberg) W.A. Weber; dry meadow, wet meadow.

Dryas octopetala L. ssp. *hookeriana* (Juzepczuk) Hultén; dry meadow.

Fragaria vesca L. ssp. *bracteata* (Heller) Staudt; dry meadow, wet meadow, pond.

Ivesia gordonii (Hooker) Torrey & Gray; dry meadow.

Pentaphylloides floribunda (Pursh) Löve; dry meadow.

Potentilla concinna Richardson; dry meadow.

Potentilla diversifolia Lehmann; dry meadow, wet meadow, krummholz, pond, riparian.

Potentilla nivea L.; dry meadow.

Potentilla pulcherrima Lehmann; dry meadow.

Potentilla rubicaulis Lehmann; dry meadow.

Potentilla subjuga Rydberg; riparian.

Sibbaldia procumbens L.; dry meadow.

Salicaceae

Salix arctica Pallas ssp. *petraea* (Andersson) Löve et al.; dry meadow.

Salix brachycarpa Nuttall; dry meadow, wet meadow, pond, riparian.

Salix drummondiana Barratt; riparian, wet meadow, dry meadow.

Salix geyeriana Andersson; dry meadow, pond, wet meadow.

Saxifragaceae

Ciliaria austromontana (Wiegand) W.A. Weber; dry meadow.

Micranthes odontoloma (Piper) Heller; dry meadow.

Micranthes oregana (T.J. Howell) Small; wet meadow.

Micranthes rhomboidea (Greene) Small; dry meadow, wet meadow, riparian.

Scrophulariaceae

Besseyia alpina (A. Gray) Rydberg; dry meadow, wet meadow.

Castilleja linariifolia Bentham in De Candolle; dry meadow, wet meadow.

Castilleja miniata Douglas ex Hooker; dry meadow, riparian, wet meadow.

Castilleja occidentalis Torrey; dry meadow, wet meadow.

Castilleja puberula Rydberg; dry meadow.

Castilleja rhexifolia Rydberg; riparian, pond, dry meadow.

- Castilleja sulphurea* Rydberg; wet meadow, riparian.
- Mimulus guttatus* De Candolle; krummholz, riparian.
- Pedicularis bracteosa* Bentham in Hooker ssp. *paysoniana* (Pennell) W.A. Weber; wet meadow, pond, krummholz.
- Pedicularis groenlandica* Retzius; riparian, pond.
- Pedicularis parryi* A. Gray; dry meadow, pond.
- Pedicularis procera* A. Gray; dry meadow.
- Penstemon mensarum* Pennell; krummholz; **endemic**.
- Penstemon strictus* Bentham in De Candolle; dry meadow.
- Penstemon whippleanus* A. Gray; dry meadow, wet meadow, pond.
- Veronica nutans* Bongard; riparian, pond, wet meadow, dry meadow.

Valerianaceae

- Valeriana capitata* Pallas ex Link ssp. *acutiloba* (Rydberg) F.G. Meyer; dry meadow, wet meadow.
- Valeriana edulis* Nuttall; wet meadow.
- Valeriana occidentalis* Heller; wet meadow.

Violaceae

- Viola labradorica* Schrank; dry meadow, wet meadow, pond.
- Viola nuttallii* Pursh; pond, dry meadow.
- Viola praemorsa* Douglas ex Lindley ssp. *major* (Hooker) M.S. Baker; wet meadow.

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LITERATURE CITED

- BUCK, P. AND B. FRASE. 1993. Vascular plants of the Gothic area. Rocky Mountain Biological Laboratory, Gothic, CO.
- BARRELL, J. 1969. Flora of the Gunnison Basin. Natural Land Institute, Rockford, IL.
- BILLINGS, W. D. 1978. Alpine phytogeography across the Great Basin. Great Basin Naturalist Memoirs No. 2: 105-117.
- CRONQUIST, A. 1994. Intermountain Flora: Vascular Plants of the Intermountain West, Volume Five, Asterales. The New York Botanical Garden, Bronx, NY.
- CROVELLO, T. J. 1981. Quantitative biogeography: an overview. Taxon 30:563-575.
- GRANT, V. 1989. Taxonomy of the tufted alpine and sub-alpine Polemoniaceae (Polemoniaceae). Botanical Gazette 150:158-169.
- HADLEY, K. S. 1987. Vascular alpine plant distributions within the central and southern Rocky Mountains, U.S.A. Arctic and Alpine Research 19:242-251.
- HARPER, K. T., D. C. FREEMAN, W. K. OSTLER, AND L. G. KLIKOFF. 1978. The flora of Great Basin mountain ranges: diversity, sources, and dispersal ecology. Great Basin Naturalist Memoirs No.2:81-103.
- HARRINGTON, H. D. 1954. Manual of the plants of Colorado. Sage Books, Denver, CO.
- HARTMAN, E. K. AND M. L. ROTTMAN. 1985a. The alpine vascular flora of the Mt. Bross massif, Mosquito Range. Phytologia 57:133-151.
- AND ———. 1985b. The alpine vascular flora of three cirque basins in the San Juan Mountains, Colorado. Madroño 32:253-272.
- AND ———. 1987. Alpine vascular flora of the Ruby Range, West Elk Mountains, Colorado. Great Basin Naturalist 47:152-160.
- AND ———. 1988. The vegetation and alpine vascular flora of the Sawatch Range, Colorado. Madroño 35:202-225.
- HARTMAN, R. L. 1992. The Rocky Mountain Herbarium, associated floristic inventory, and the Flora of the Rocky Mountains project. Journal of the Idaho Academy of Science 28:22-43.
- HUMPHRIES, C. J. AND L. PARENTI. 1986. Cladistic biogeography. Clarendon Press, Oxford.
- KASS, R. J. 1988. A checklist of the vascular plants of the House Range, Utah. Great Basin Naturalist 48:102-116.
- KOMARKOVA, V. 1979. Alpine vegetation of the Indian Peaks area. J. Cramer, Berlin.
- LANGENHEIM, J. H. 1955. Flora of the Crested Butte Quadrangle, Colorado. Madroño 13:64-78.
- LIESNER, R. n.d. Field techniques used by Missouri Botanical Garden. Unpublished manuscript.
- MCLAUGHLIN, S. P. 1989. Natural floristic areas of the western United States. Journal of Biogeography 16: 239-248.
- MCNEAL, D. W., JR. 1976. Annotated check list of the alpine vascular plants of Specimen Mountain, Rocky Mountain National Park, Colorado. The Southwestern Naturalist 20:423-435.
- MUELLER-DOMBOIS, D. AND H. ELLENBERG. 1974. Aims and methods of vegetation ecology. John Wiley & Sons, New York, NY.
- MUTSCHLER, F. E. 1970. Geologic map of the Snowmass Mountain Quadrangle, Pitkin and Gunnison Counties, Colorado. United States Geological Survey, Washington, D.C.
- O'KANE, S. L. 1988. Colorado's rare flora. Great Basin Naturalist 48:434-484.
- PRATHER, T. 1982. Geology of the Gunnison country. B & B Printers, Gunnison, CO.
- RAVEN, P. H. AND D. I. AXELROD. 1974. Angiosperm biogeography and past continental movements. Annals of the Missouri Botanical Garden 61:539-673.
- SCHAACK, C. G. 1983. The alpine vascular flora of Arizona. Madroño 30:79-88.
- SEAGRIST, R. V. AND K. TAYLOR. 1996. Noteworthy collections: Colorado, *Polemonium confertum*. Madroño 43:57.
- . 1998. Alpine vascular flora of the Buffalo Peaks, Colorado. Madroño 45:319-325.
- SNOW, N. 1995. The vascular flora of southeastern Yellowstone National Park and the headwaters region of the Yellowstone River. Wasmann Journal of Biology 50/51:52-95.

- TAKHTAJAN, A. 1986. Floristic regions of the world. University of California Press, Berkeley, CA.
- TAYLOR, D. W. 1977. Floristic relationships along the Cascade-Sierran axis. *American Midland Naturalist* 97: 333-349.
- WEBER, W. A. 1965. Plant geography in the southern Rocky Mountains. In A. E. Wright and D. G. Frey, *The quaternary of the United States*. Princeton University Press, Princeton, N.J.
- . 1979. Additions to the flora of Colorado—VI. *Phytologia* 41:486-500.
- . 1981. Additions to the flora of Colorado—VII. *Brittonia* 33:325-331.
- . 1982. Additions to the flora of Colorado—VIII. *Phytologia* 51:376-380.
- . 1983. Additions to the flora of Colorado—IX. *Phytologia* 53:191-193.
- . 1984. Additions to the flora of Colorado—X. *Phytologia* 55:11-13.
- . 1985. Additions to the flora of Colorado—XI. *Phytologia* 58:385-388.
- . 1987. Colorado flora: western slope. Colorado Associated University Press, Boulder, CO.
- . 1989. Additions to the flora of Colorado—XII. *Phytologia* 67:429-437.
- . 1990. Colorado flora: eastern slope. Colorado Associated University Press, Boulder, CO.
- AND R. C. WITTMANN. 1992. Catalog of the Colorado flora: a biodiversity baseline. University Press of Colorado, Boulder, CO.
- AND R. C. WITTMANN. 1996. Colorado flora: western slope, 2nd ed. Colorado Associated University Press, Boulder, CO.
- WELSH, S. L., N. D. ATWOOD, S. GOODRICH, AND L. C. HIGGINS. 1993. *A Utah Flora*, Second Edition. Brigham Young University, Provo, UT.