

# THE VEGETATION AND ALPINE VASCULAR FLORA OF THE SAWATCH RANGE, COLORADO

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## ABSTRACT

The Sawatch Range, located in central Colorado, is part of the Southern Rocky Mountains. Extending over 130 km in a north-south direction and 65 km in an east-west direction, the range is the highest and one of the most extensive in the state. No previous floristic work has been done on its tundra. Sixteen study areas distributed throughout the entire range were analyzed over four field seasons. A vascular flora of 289 taxa in 118 genera and 35 families is reported. Two taxa are recent new records for the state. Eight taxa are Colorado endemics. Sixteen taxa are limited to calcareous substrates within the range. The phytogeographic distribution of the flora is primarily alpine (38.1%) and western North American (31.5%). According to Sorensen's Index of Similarity, the floristic inventory of the Sawatch Range shows an overall consistency among the tundra vascular floras of the Mosquito and West Elk Ranges, Indian Peaks area of the Front Range, and the San Juan Mountains.

The Sawatch Range of central Colorado (Fig. 1), a segment of the Southern Rocky Mountains, extends over 130 km in a north-south direction between the valleys of the Eagle River on the north and Tomichi Creek on the south. The Arkansas River valley forms the eastern boundary of the 65 km wide range (Chronic and Chronic 1972); the Gunnison Basin, Taylor Park, and the Elk Mountains form the boundary on the west. Much of the 8450 sq. km area included within the Sawatch Range lies above timberline. The range lies between 38°30' and 39°40'N latitude and 106°10' and 106°50'W longitude. The Continental Divide follows the range for more than two-thirds of its length (Stark 1934). The Sawatch Range is the highest range in the state. It contains four of the state's five highest peaks and 15 of the state's 54 peaks that are over 4270 m.

The topography of the range is rugged and variable with a maximum relief of over 2135 m from the summits of the highest peaks to the floor of the Arkansas River valley (Stark and Barnes 1935). Extensive Pleistocene alpine and valley glaciers carved numerous cirques and scoured broad glacial troughs on both sides of the range. However, the rounded summit of Mt. Elbert, Colorado's highest mountain at 4401 m, extended beyond the upper limit of glaciation (Stark and Barnes 1935). Glacial erosional forms in the present alpine landscape include cirques, tarns, basins, hanging tributary valleys, and broad U-shaped valleys. Depositional landforms of gla-

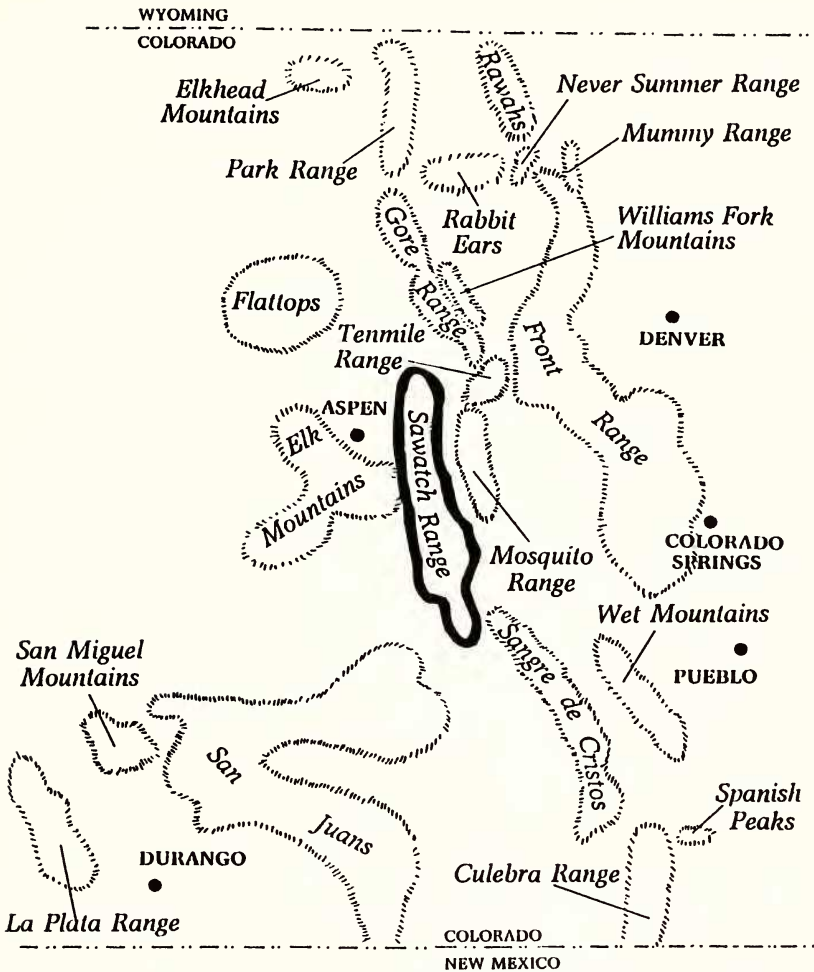


FIG. 1. Map showing the location of the Sawatch Range in the Southern Rocky Mountains of Colorado. (Courtesy of U.S.G.S.)

cial origin consist of both terminal and lateral moraines, some of which reach heights up to 305 m (Westgate 1905).

The Sawatch Range is composed primarily of coarse schists and gneisses intruded by pre-Cambrian granites, and of metamorphosed limestone and quartzite. Paleozoic sediments, including limestones, sandstones, and shales, dip away from the crystalline core on both sides of the range. Tertiary igneous intrusive rocks include stocks of quartz monzonite porphyry and various porphyritic dikes and sills. Extrusive rocks are highly localized: rhyolite occurs in the Independence Pass area in the north, and volcanic breccia occurs in

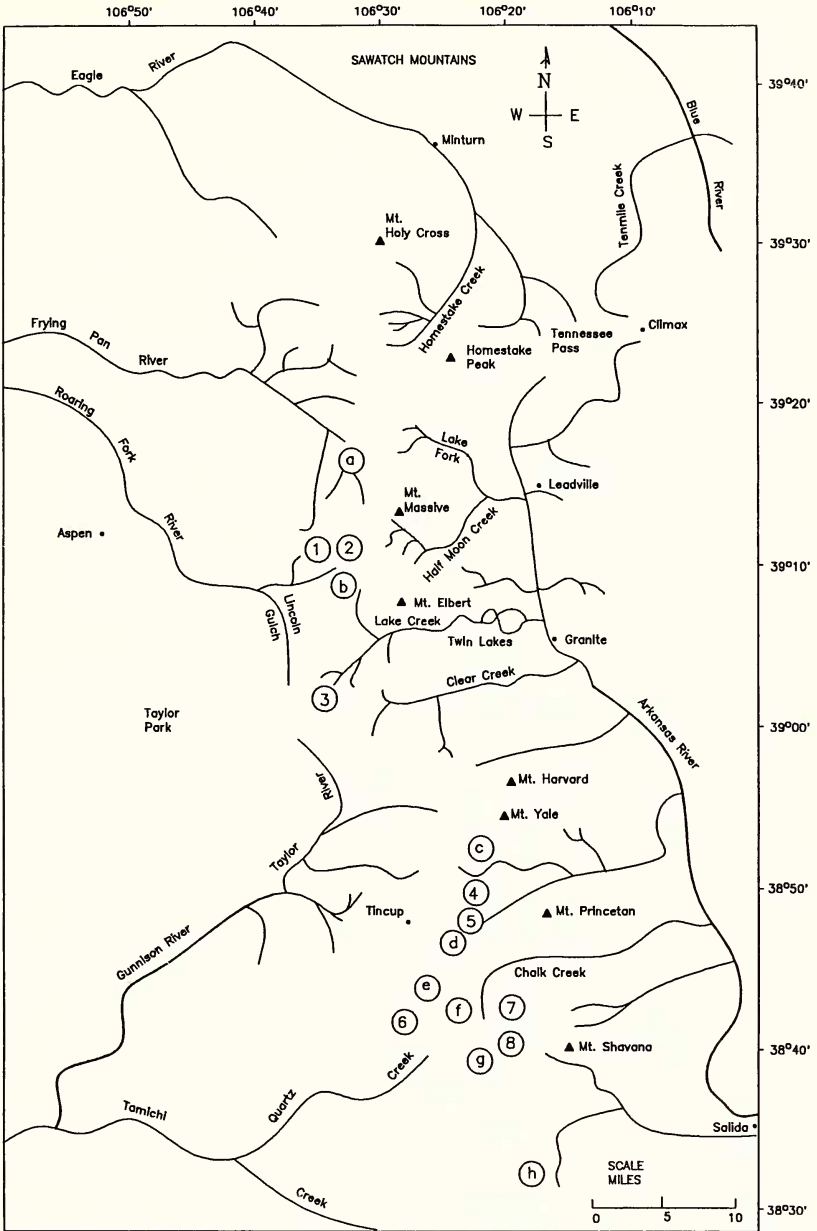
the southern part of the range near Tomichi Creek (Stark and Barnes 1932, 1935, Stark 1934, Brock and Barker 1972, Tweto 1974, Van Loenen 1985).

Climatic data from the Sawatch Range are non-existent. However, one can extrapolate data from a climograph for timberline elevation of 3446 m at Climax, Colorado, located 16 km east of the Sawatch Range (Arno and Hammerly 1984). Mean average temperature is  $-1.0^{\circ}\text{C}$  and mean average precipitation is 149 cm. The climate of the Sawatch Range is typical of high mountainous areas in Colorado. Summer thunderstorms, often accompanied by hail, occur almost daily. Snowfall begins in September with major accumulations by mid-October and continuing until late May or early June. Daytime temperatures in the summer are temperate but frost may occur any night (Dings and Robinson 1957).

Our investigation is the first floristic study of the alpine tundra of the Sawatch Range. An ecological study by Loder (1964) was limited to an area on Cottonwood Pass. The primary objective of this study was to inventory the vascular flora of the alpine tundra of the Sawatch Range, thus filling in a noticeable gap in the tundra flora of the central mountainous area of Colorado. The importance of this range in expanding our knowledge of the Colorado tundra is amplified by the pivotal position the range occupies between the drier north-south oriented ranges to the east and the more moist east-west oriented ranges to the west. This study is part of our comprehensive floristic inventory of all of the tundra areas of the major mountain ranges in Colorado.

#### METHODS

This study was conducted over four field seasons: 1982, 1984, 1985, and 1986. The entire 1986 season, from 10 June through 10 October, was devoted to intensive field work in the range. The authors follow the definition of alpine tundra as the area above the subalpine forest on all peaks, ridges, and in basins that rise above the general level of tree-limit at an elevation of about 3477 m in Colorado; however, scattered krummholz conifers may extend as isolated patches or cushions into the alpine tundra zone (Marr 1961, Zwinger and Willard 1972, Arno and Hammerly 1984). In the Sawatch Range tree-limit is found to vary from 3629 m in the lower portions of the basins to 3782 m on the highest slopes. Sixteen alpine areas including eight passes and eight cirque basins distributed throughout the length of the Sawatch Range were selected for study (Fig. 2). The passes are basically saddles flanked by convex slopes and are relatively homogeneous in habitats and associated community types. Patterned ground forms, including sorted stripes, polygons, and frost boils, are common. Cirque basins which include basin



Drawn by: Dale Boody & Associates, Canon City, Colorado 3-30-87

FIG. 2. Map of the Sawatch Range, Colorado, showing study areas. Letters indicate passes; numbers indicate basins.

TABLE 1. LOCATION, ORIENTATION, AND ELEVATION OF STUDY AREAS IN THE SAWATCH RANGE, COLORADO.

Map reference	Location—pass	Orientation	Elevation (m)
a	Hagerman	e./w.	3637
b	Independence	e./w.	3689
c	Cottonwood	nnw./sse.	3698
d	Tincup	wnw./ese.	3707
e	Cumberland	n./s.	3663
f	Altman	nne./ssw.	3642
g	Hancock	n./s.	3691
h	Monarch	n./s.	3629

Map reference	Location—basin	Orientation	Elevational range (m)
1	Linkins Lake	se.	3660–3721
2	Mt. Champion	e.	3614–3798
3	Peekaboo	ne.	3538–3752
4	Mineral	se.	3733–3904
5	Emma Burr	e.	3736–3813
6	Fairview Peak	ne.	3599–3691
7	Billings Lake	se.	3569–3736
8	Island Lake	n.	3630–3691

floors, adjacent slopes, headwalls, and ridge tops, on the other hand, contain a greater diversity of habitats and community types. Cirque basins in the Sawatch Range tend to have a broader and more shallow morphology resulting in a more gradual drainage gradient than cirque basins in other mountain ranges of the state (Hartman and Rottman 1985a,b, 1987). Table 1 gives the orientation and elevation of the passes and the orientation and elevational ranges of the basin study areas.

A total of 825 communities representative of nine community types found in the Sawatch Range were inventoried in the study. The community types include dry, moist, and wet meadows, shrub tundra, krummholz, fellfield, rock-predominating (ledges, rock crevices, and talus), rivulet, and snowbank. Care was taken to ensure that the number of communities inventoried was proportionate to the predominance of the community type in each study area.

Identification of questionable taxa were verified by R. D. Dorn, R. L. Hartman, R. A. Price, R. C. Rollins, and W. A. Weber. A complete voucher set for all taxa inventoried in the Sawatch Range is deposited in the herbarium of the University of Colorado—Denver, where the authors are associated. In addition duplicates of most specimens are deposited in COLO. Nomenclature, for the most part, follows Nelson and Hartman (1987). The Colorado endemics, alternative names for taxa in the checklist, and 22 taxa not found in

Nelson and Hartman (1987) and indicated by an asterisk after the authority follow Weber (1987) and Wittmann et al. (1988).

#### VEGETATION

*Meadow communities.* The dry meadow community type is most common in the tundra of the Sawatch Range, unlike the moist meadow type which predominates in the ranges to the west and southwest in Colorado (Langenheim 1962, Webber et al. 1976, Rottman and Hartman 1985, Hartman and Rottman 1987). Dry meadows predominate on passes, on convex mountain slopes, and on the upper slopes of cirque basins. The predominance of dry meadows in the Sawatch correlates with the Mosquito Range adjacent to the Arkansas River valley on the east (Hartman and Rottman 1985a). We anticipated finding different dominants in the dry meadows on passes than in those in basins; however, *Kobresia bellardii*, *Dryas octopetala* var. *hookeriana*, *Geum rossii* var. *turbinatum*, *Carex elynoides*, and *Salix reticulata* subsp. *nivalis* occur in both. The only slight difference found is that *Kobresia bellardii*, the most frequent dominant on the passes, is replaced by *Dryas octopetala* var. *hookeriana* in the basins. The listed dominants appear to vary with local microenvironments which are not exposure correlated. Among the graminoid taxa, grasses exceed sedges only in dry meadows. Closed turf communities dominated by *Kobresia bellardii* or *Carex elynoides* have a low species richness.

Moist meadow dominants occur in three size classes: an erect tall form such as *Deschampsia caespitosa*, a short caespitose form represented by *Carex nigricans*, and a prostrate semi-shrub form typical of *Sibbaldia procumbens* and *Salix reticulata* subsp. *nivalis*. Moist meadows on the passes are restricted to swales where *Deschampsia caespitosa* is dominant and on the concave bases of pass slopes where either *Sibbaldia procumbens* or *Salix reticulata* subsp. *nivalis* predominate. In the basins this community type occupies the mid- to lower slopes and borders the basin floor where it may interdigitate with shrub tundra or wet meadow. *Deschampsia*-dominated moist meadow communities in the basins are associated with a wide variety of tall forb taxa including *Erigeron peregrinus* subsp. *callianthemus*, *Potentilla diversifolia*, and *Senecio crassulus*. *Carex nigricans* and *Sibbaldia procumbens* are often co-dominant where basin slope and floor interface.

Wet meadows, although relatively infrequent on passes, occur on flat areas underlain by sporadic permafrost (Ives 1974). These areas are often adjacent to small ponds. Dominants include *Caltha leptosepala*, *Carex scopulorum*, *C. nigricans*, and *Juncus drummondii*. This same community type in basins usually is adjacent to ponds, lakes, or drainages. *Carex scopulorum*, *Caltha leptosepala*, *Carex*

*nigricans*, and *Deschampsia caespitosa* are the most frequent dominants. There is a conspicuous difference in species richness between wet meadow hummock communities. Because of the persistence of old leaf bases in hummocks dominated by *Carex scopulorum*, virtually no other taxa can compete. Hummocks dominated by *Carex nigricans* are moderately species-rich.

*Shrub tundra.* Shrub tundra is far more extensive in the Sawatch Range, than in other mountain ranges studied (Rottman and Hartman 1985, Hartman and Rottman 1985a, 1987), often to the extent that almost the entire basin floor is covered with this community type. *Salix brachycarpa* and *S. glauca* subsp. *glauca* var. *villosa* dominate in drier or well-drained areas on both passes and in basins where they are associated with dry or moist meadow herbaceous understory taxa. *Salix planifolia* is dominant primarily in hydric sites, especially in basins where it may be co-dominant with *Betula glandulosa*. Wet and moist meadow herbaceous taxa are associated with these stands. Basin elevations for shrub tundra were observed from 3538–3904 m.

*Krummholz community.* The krummholz community type occurs as isolated patches or cushions primarily on slopes of both passes and basins. The overwhelming dominant is *Picea engelmannii*; however, *Pinus aristata* is found on Cumberland Pass and *Pinus contorta* var. *latifolia* occurs in Peekaboo Basin. The herbaceous understory component of this community is represented by both alpine and subalpine taxa. The latter are able to extend into the tundra in this community type because of the greater snow accumulation particularly on the leeward side of the cushion and the lower evapotranspiration rate as a result of overstory shading during the growing season.

*Fellfield community.* Fellfield community sites are characterized by a high proportion of finely-weathered rock material (up to 80%), coarse-textured soils, and little organic material (Willard 1963). Fellfield communities are far more prevalent on the passes where *Paronychia pulvinata*, *Trifolium nanum*, *Minuartia obtusiloba*, and *Silene acaulis* var. *subacaulescens* form the dominants. This community type in the basins is found primarily on wind-swept ridges. The dominants listed for the passes also occur in the basins; however, *Dryas octopetala* var. *hookeriana* is the most frequent dominant in the latter. The typical cushion plant-dominated fellfield communities found in the Sawatch Range are similar to those of the Front Range (Komarkova 1976, Eddleman and Ward 1984). In the Mosquito Range this community type appears to be restricted to mountain tops and wind-swept ridges (Hartman and Rottman 1985a). In the east-west-trending mountains of the state, the Elk Mountains

(Langenheim 1962), West Elk Mountains (Hartman and Rottman 1987), and San Juan Mountains (Webber et al. 1976, Hartman and Rottman 1985b), this community type is poorly represented.

*Rock-predominating community types.* Bedrock ledges, rock crevices, and talus habitats are combined into one category of minor importance in terms of community development. Composed of either fractured bedrock outcrops or talus, these habitats are characterized by minimal soil accumulation available for the growth of vascular plant taxa. As a result, community structure is replaced by a diverse assortment of various opportunistic taxa that can tolerate the limitations of the habitat substrates. In some instances, however, bedrock outcrops in the basins are capped by krummholz or dry meadow communities.

*Rivulet community.* Small rivulets converge to form the major drainages of most basins. Taxa bordering the rivulets are primarily subalpine plants capable of extending upward to high elevations in the tundra because of enhanced moisture availability. Some of the subalpine taxa that can dominate rivulet communities are *Senecio triangularis*, *Aconitum columbianum*, *Cardamine cordifolia*, *Mimulus guttatus*, and *Saxifraga odontoloma*. Shrub tundra communities often border the rivulets.

*Snowbank community.* Snowbanks may persist late into August in the basins. These areas are subject to shortened growing seasons, often permitting only vegetative growth of taxa found in the area in front of the receding snowbank. *Carex pyrenaica* is a good indicator dominant of this community type. Other taxa worthy of note are *Ranunculus adoneus*, *Sibbaldia procumbens*, and *Salix arctica*. *Carex incurviformis* appears to be restricted to this community. A widespread early-melting snowbank community dominated by *Vaccinium caespitosum*, *Carex pyrenaica*, and *Stereocaulon* sp. assumes a deceptively dry appearance as the season progresses.

#### FLORA

*Comparative floristics.* The alpine flora of the Sawatch Range consists of 289 taxa representing 109 genera of angiosperms, four genera and five species of gymnosperms, and five genera and five species of pteridophytes. Our total of 289 taxa compared to the estimated 300 vascular plant taxa in the alpine tundra of Colorado (Bliss 1962) attests to the thoroughness of this study in the Sawatch Range. The largest family is Asteraceae with 47 taxa, followed by Cyperaceae, Poaceae, Brassicaceae, Ranunculaceae, Caryophyllaceae, Rosaceae, and Scrophulariaceae with 34, 23, 21, 16, 15, 14, and 14 taxa, respectively. Comparing these leading families with those of other Colorado alpine floras, the greatest similarity is to the Mosquito



Range to the east (Hartman and Rottman 1985a), the only difference being the addition of Ranunculaceae which exceeds Rosaceae and Scrophulariaceae in the Sawatch alpine. In the Ruby Range of the West Elk Mountains (Hartman and Rottman 1987), San Juan Mountains (Hartman and Rottman 1985b), and Indian Peaks area of the Front Range (Komarkova 1976), Saxifragaceae is among the leading families. Similarities between alpine floristic inventories of the Sawatch Range and the above ranges were analyzed by using Sorensen's Index of Similarity (Mueller-Dombois and Ellenberg 1974). The greatest similarity, 73.3%, again occurs between the Sawatch and Mosquito ranges; however, similarities to the West Elk (73.1%), Indian Peaks area of the Front Range (72.6%), and San Juan Mountains (72.5%) show an overall consistency among the tundra floras of the various ranges. Differences between the inventories at the individual taxon level are in many cases striking, and relate primarily to apparent distributional ranges of the plants or to substrate and microenvironmental dissimilarities.

Rare taxa with restricted occurrences in the Colorado tundra may reflect local environmental conditions or distributional ranges. The following taxa in the Sawatch Range are considered rare or infrequent by Weber (1987): *Anemone parviflora*, *Asplenium viride*, *Astragalus aboriginum*, *Carex arctogena*, *Draba streptobrachia*, *Gentianella tenella*, *Physaria alpina*, *Ranunculus pygmaeus* var. *pygmaeus*, *Saxifraga adscendens* subsp. *oregonensis*, and *Ligularia taraxacoides*. From our experiences in the various tundras of the state we would add *Arabis lemmonii*, *Astragalus molybdenus*, *Draba incerta*, *Erigeron vagus*, and *Ligularia porteri* to this list. *Carex vernacula*, *Erigeron grandiflorus*, and *Ligularia soldanella*, all of which Weber (1987) considers rare, are infrequent in the Sawatch Range. Two new state records recently were reported for the Sawatch Range from Mt. Champion basin. These are *Draba apiculata* var. *apiculata* (Price et al. 1985) and *Antennaria aromatica* (O'Kane et al. 1988).

*Phenology.* Our 1986 field season extended from 10 June through 10 October, and permitted some interesting phenological observations. Complete snow release in a fellfield on Independence Pass was observed 11 June with 14 taxa in prime anthesis while all other communities on the pass were snow-covered. By 2 July the pass was completely snow-free and vegetative growth was in progress. *Thlaspi montanum* var. *montanum* and *Smelowskia calycina* var. *americana* (fellfield constituents) were in fruit on 10 July. By 5 September this pass and all others were showing the typical reddish-brown coloration of autumn. In the basins, however, a number of extremely dwarfed moist meadows, dominated by *Geum rossii* var. *turbinatum*, *Sibbaldia procumbens*, and *Erigeron melanocephalus*, often found

adjacent to talus or at the interface of slopes and basin floor were in prime anthesis in late August and early September. Ronning (1968) and Owen (1976) have suggested that both stature and late anthesis may relate to either cold soil temperatures or late snow release. On 10 September the entire range was blanketed by the first snow. Seasonal snow accumulations were in evidence by 3 October. At this time some snow depth measurements were made on Independence Pass in communities studied earlier in the season. Even at this early date it was possible to correlate relative snow accumulation, wind patterns of snow distribution, and community types. Snow depths ranged from 2.4–12.6 cm in fellfield communities to a maximum of 10.7–30.0 cm in moist meadows. Shrub tundra communities were intermediate with 12.6 cm on the windward side and 20.8 cm on the leeward side. Obviously these values cannot reflect the total snow accumulation that will occur; however, we feel that the relative ratios of snow depth to community type are maintained throughout the winter and spring seasons.

*Calcareous substrates.* Although the Sawatch Range is primarily metamorphic in composition, three of our study areas contain localized occurrences of limestone and dolomite. The following taxa were found only on these calcareous substrates: *Anemone parviflora*, *Asplenium viride*, *Astragalus aboriginum*, *A. molybdenus*, *Juncus albescens*, *J. castaneus*, *Ligularia taraxacoides*, *Oreochrysum parryi*, *Oxytropis podocarpa*, *O. viscida*, *Physaria alpina*, *Potentilla ovina*, *Pyrracoma uniflora*, and *Senecio canus*. Some of these taxa were reported also for limestone substrates in the Mosquito Range (Hartman and Rottman 1985a), Elk Mountains (Langenheim 1962), and Montana (Bamberg and Major 1968). Schroeter (1926), Nordhagen (1955), Curry (1962), and Bamberg and Major (1968) consider *Dryas octopetala* var. *hookeriana* to be an indicator of calcareous rock or soil, but Murdock (1951), Johnson and Billings (1962), and Willard (1963) fail to substantiate this substrate specificity. In the Sawatch Range the occurrence of *Dryas octopetala* var. *hookeriana* does not appear to be substrate specific and, as suggested by Willard (1963), the var. *hookeriana* may be a Southern Rocky Mountain ecotype with low calcium requirements. As previously mentioned, shrub tundra forms extensive stands both on passes and in basins in the range; however, in our calcareous study sites this community type is extremely limited, perhaps reflecting the porosity and downward percolation of water characteristic of limestone-dolomite areas.

*Phytogeography.* Table 2 shows the phytogeographic distribution of the alpine flora of the Sawatch Range compared to other ranges in Colorado. Four elements are recognized, each of which may be combined with more specific geographical subelements (Komarkova

TABLE 2. COMPARISON OF THE ALPINE FLORA AND GEOGRAPHIC SUBELEMENTS IN THE SAWATCH RANGE WITH OTHER MOUNTAIN RANGES IN COLORADO. Unit abbreviations are cited in the annotated checklist. <sup>1</sup>Hartman and Rottman (1985a), <sup>2</sup>Hartman and Rottman (1985b), <sup>3</sup>Hartman and Rottman (1987), <sup>4</sup>Komarkova (1976).

Element	Abbreviation	Sawatch Range	Mosquito <sup>1</sup> Range	San Juan <sup>2</sup> Mountains	West Elk <sup>3</sup> Mountains	Indian Peaks <sup>4</sup> Front Range
Boreal montane	BM	25.6%	18.3%	19.8%	24.1%	27.5%
Montane	M	11.4	8.4	6.0	16.8	2.4
Arctic alpine	AA	24.9	30.6	31.5	23.6	28.7
Alpine	A	38.1	42.7	42.7	35.5	41.4
Geographic Subelement						
Circumpolar	C	19.4	20.6	22.9	17.7	25.9
North American	NA	13.8	8.9	10.2	12.3	9.6
Western North American	WNA	31.5	30.0	25.9	32.3	28.2
Rocky Mountains	RM	13.1	13.1	13.7	14.5	11.2
Southern Rocky Mountains	SRM	11.4	10.7	11.6	11.8	9.9
Colorado	CO	2.8	4.6	4.1	1.4	3.2
North American-Asiatic	NAA	6.6	11.2	9.6	8.6	10.8
North American-European	NAE	1.4	0.9	2.0	1.4	1.2

1976). The Rocky Mountains subelement includes the Northern Rocky Mountain province south to the Laramie Basin in Wyoming. The Southern Rocky Mountains subelement includes southern Wyoming, Colorado, New Mexico, and Arizona. The Colorado subelement contains taxa endemic to Colorado. Phytogeographic determinations for taxa are based upon distributions given by Porsild (1957), Weber (1965), Munz and Keck (1970), Komarkova (1976), Cronquist et al. (1977), Porsild and Cody (1980), and Moss (1983).

The largest part of the vascular flora of the Sawatch Range is made up of Alpine (38.1%) and Western North American (31.5%) taxa. The Circumpolar subelement (19.4%), which is primarily linked with the Arctic-Alpine element, is another important component of the flora. The North American-Asiatic subelement (6.6%), although smaller in the Sawatch Range than in the other ranges compared, still indicates a stronger affinity to the Asiatic alpine flora than to the European alpine flora. The Alpine element is consistently the highest in all ranges compared, with the Arctic-Alpine element second in all but the Sawatch Range and West Elk Mountains where the Boreal-Montane is better represented. The proximity of the Mosquito Range to the Sawatch Range makes comparisons of these two particularly significant. For the most part there is a greater correlation between subelements of the two than between elements.

Colorado endemics found in this study include *Alsinanthe macrantha*, *Draba streptobrachia*, *Ligularia soldanella*, *Luzula subcapitata*, *Penstemon hallii*, *P. harbourii*, *Physaria alpina*, and *Potentilla subjuga* var. *subjuga*. Fewer Colorado endemics occur in the Sawatch Range than in the more northerly Indian Peaks area, and in the Mosquito Range, which is due east of the northern part of the Sawatch.

#### ANNOTATED CATALOGUE OF VASCULAR PLANT TAXA

The terms used in the annotated catalogue to describe occurrence/abundance are a combination of abundance classes and constancy values. In estimating abundance, standard abundance classes were used: very abundant, abundant, frequent, occasional, and rare (Daubenmire 1968). As data from multiple samples of a particular community type accumulated, it was possible to analyze the inventoried taxa and their abundance ratings on the basis of constancy of occurrence between samples of communities. The percentage values of the constancy classes used were taken from Mueller-Dombois and Ellenberg (1974): very abundant (81–100% constancy), abundant (60.1–80% constancy), frequent (40.1–60% constancy), occasional (20.1–40% constancy), and rare (1.5–20% constancy). The abbreviations used for community types for each taxon are: dry meadow (dm); moist meadow (mm); wet meadow (wm); shrub tundra (st);

krummholz (kr); fellfield (ff); rock-predominating including bedrock ledges, rock crevices, and talus (rp); rivulet (rv); and snowbank (sn). In the phytogeographic citation for each taxon, the element precedes the subelement, the two being separated by a slash (Table 2). Bracketed nomenclature follows Weber (1987) and Wittmann et al. (1988). Twenty-two taxa that are indicated by an asterisk (\*) after the authority are not found in Nelson and Hartman (1987) and follow the nomenclature of W. A. Weber (1987) and Wittmann et al. (1988).

## PTEROPHYTA

## Selaginellaceae

*Selaginella densa* Rydb. var. *densa*. Abundant; dm, mm, st, kr, ff, rp, sn; A/WNA.

## Adiantaceae

*Cryptogramma acrostichoides* R. Br. Rare; rp; BM/NAA.

## Aspleniaceae

*Asplenium viride* Huds. [*A. trichomanes-ramosum* L.]. Rare; rp; AA/C.

*Cystopteris fragilis* (L.) Bernh. var. *fragilis*. Occasional; st, rp; AA/C.

*Woodsia oregana* D. C. Eat. var. *oregana*. Occasional; dm, rp; BM/NA.

## CONIFEROPHYTA

## Cupressaceae

*Juniperus communis* L. var. *depressa* Pursh [*J. communis* L. subsp. *alpina* (Neilr.) Celak.]. Rare; kr; BM/C.

## Pinaceae

*Abies lasiocarpa* (Hook.) Nutt. var. *lasiocarpa*. Rare; kr; BM/WNA.

*Picea engelmannii* Parry ex Engelm. Occasional; kr; BM/WNA.

*Pinus aristata* Engelm.\* Rare; kr; BM/WNA.

*Pinus contorta* Dougl. ex Loud. var. *latifolia* Engelm. ex Wats. [*P. contorta* Dougl. subsp. *latifolia* (Engelm.) Critch.]. Rare; kr; BM/WNA.

## ANTHOPHYTA—DICOTYLEDONEAE

## Adoxaceae

*Adoxa moschatellina* L. Rare; mm; BM/C.

## Apiaceae

*Angelica grayi* (Coul. & Rose) Coul. & Rose. Frequent; dm, mm, st, rp; A/SRM.

*Cymopterus lemmonii* (Coul. & Rose) Dorn [*Pseudocymopterus montanus* (A. Gray) Coul. & Rose]. Occasional; dm, mm, st, kr; M/SRM.

*Ligusticum tenuifolium* Wats. [*L. filicinum* Wats. var. *tenuifolium* (Wats.) Math. & Const.]. Rare; mm; BM/WNA.

*Oreoxis alpina* (A. Gray) Coul. & Rose. Very abundant; dm, mm, wm, st, kr, ff, rp, sn; A/SRM.

*O. bakeri* Coul. & Rose.\* Frequent; dm, mm, wm, st, ff, rp; A/SRM.

*Oxypolis fendleri* (A. Gray) Heller. Rare; rv; M/SRM.

*Podistera eastwoodiae* (Coul. & Rose) Math. & Const.\* Rare; dm; A/SRM.

## Asteraceae

- Achillea millefolium* L. var. *lanulosa* (Nutt.) Piper [*A. lanulosa* Nutt.]. Frequent; dm, mm, wm, st, kr, ff, rp; A/WNA.
- Agoseris aurantiaca* (Hook.) Greene var. *aurantiaca*. Occasional; dm, mm, rp; BM/WNA.
- A. glauca* (Pursh) Raf. var. *dasycephala* (Torr. & A. Gray) Jeps. Rare; dm; M/WNA.
- A. glauca* (Pursh) Raf. var. *laciniata* (D. C. Eat.) Smiley. Occasional; dm, mm, kr; BM/NA.
- Antennaria aromatica* Evert. Rare; ff; M/RM. #6671/2942 COLO.
- A. media* Greene. Abundant; dm, mm, wm, st, kr, ff, rp, sn; AA/NAE.
- A. rosea* Greene. Occasional; mm, st, kr; BM/NA.
- A. umbrinella* Rydb. Rare; dm; A/WNA.
- Arnica cordifolia* Hook. Rare; rp; BM/WNA.
- A. mollis* Hook. Rare; mm, rp; BM/NA.
- A. rydbergii* Greene. Occasional; dm, kr; BM/WNA.
- Artemisia campestris* L. subsp. *borealis* (Pall.) Hall & Clem. var. *borealis*. Occasional; dm, mm, kr, ff, rp; AA/C.
- A. scopulorum* A. Gray. Very abundant; dm, mm, wm, st, kr, ff, rp, sn; A/RM.
- Chaenactis alpina* (A. Gray) Jones. Occasional; ff, rp; M/WNA.
- Cirsium scopulorum* (Greene) Ckll. Occasional; dm, rp; A/RM.
- C. tweedyi* (Rydb.) Petr. Occasional; mm, wm, rp; BM/NA.
- Erigeron compositus* Pursh. Occasional; dm, rp; BM/NA.
- E. coulteri* Porter. Rare; dm; BM/WNA.
- E. grandiflorus* Hook. Occasional; dm, mm, st, sn; AA/WNA.
- E. leiomerus* A. Gray. Occasional; dm, mm, ff, rp; M/RM.
- E. melanocephalus* (A. Nels.) A. Nels. Abundant; dm, mm, wm, rp, sn; A/SRM.
- E. peregrinus* (Banks ex Pursh) Greene subsp. *callianthemus* (Greene) Cronq. var. *callianthemus* [*E. peregrinus* (Banks ex Pursh) Greene subsp. *callianthemus* (Greene) Cronq.]. Occasional; dm, mm, wm, st, kr; BM/WNA.
- E. pinnatisectus* (Gray) A. Nels. Abundant; dm, mm, st, ff, rp; A/SRM.
- E. simplex* Greene. Very Abundant; dm, mm, wm, st, kr, ff, rp, sn; A/WNA.
- E. ursinus* D. C. Eat. Rare; dm; M/WNA.
- E. vagus* Pays.\* Rare; dm; A/WNA.
- Haplopappus pygmaeus* (Torr. & A. Gray) A. Gray [*Tonestus pygmaeus* (Torr. & A. Gray) A. Nels.]. Frequent; dm, kr, ff, rp; A/RM.
- Heterotheca fulcrata* (Greene) Shinnars. Occasional; dm, rp; M/RM.
- Hieracium gracile* Hook. var. *gracile* [*Chlorocrepis tristis* (Willd. ex Spreng.) A. Löve & D. Löve subsp. *gracile* (Hook.) W. A. Weber]. Occasional; dm, mm, st, rp; A/WNA.
- Hymenoxys grandiflora* (Torr. & A. Gray ex A. Gray) K. Parker [*Rydbergia grandiflora* (Torr. & A. Gray) Greene]. Frequent; dm, mm, st, kr, ff, rp; A/RM.
- Ligularia amplexans* (A. Gray) W. A. Weber.\* Occasional; mm, wm, rp; M/RM.
- L. holmii* (Greene) W. A. Weber.\* Abundant; dm, mm, ff, rp, sn; A/RM.
- L. porteri* (Greene) W. A. Weber.\* Rare; rp; A/RM.
- L. soldanella* (A. Gray) W. A. Weber. Occasional; ff, rp; A/CO.
- L. taraxacoides* (A. Gray) W. A. Weber.\* Rare; rp; A/SRM.
- Oreochrysum parryi* (A. Gray) Rydb.\* Rare; dm; M/SRM.
- Pyrrocotula uniflora* (Hook.) Greene. Occasional; dm, mm, st, sn; M/WNA.
- Senecio atratus* Greene. Rare; rp; A/SRM.
- S. canus* Hook. [*Packera cana* (Hook.) W. A. Weber & A. Löve]. Occasional; dm, rp; M/WNA.
- S. crassulus* A. Gray. Occasional; dm, mm, wm, st, rp; BM/WNA.
- S. dimorphophyllus* Greene var. *dimorphophyllus* [*Packera dimorphophylla* (Greene) W. A. Weber & A. Löve]. Frequent; mm, wm, st, rp, rv, sn; M/RM.
- S. fremontii* Torr. & A. Gray var. *blitoides* (Greene) Cronq. [*S. fremontii* Torr. & A. Gray subsp. *blitoides* (Greene) Cronq.]. Occasional; rp; A/SRM.

- S. integerrimus* Nutt. var. *integerrimus*. Occasional; mm; M/WNA.  
*S. triangularis* Hook. Occasional; mm, wm, st, rv; BM/WNA.  
*S. werneriaefolius* (A. Gray) A. Gray [*Packera wernerifolia* (A. Gray) W. A. Weber & A. Löve]. Abundant; dm, mm, kr, ff, rp, sn; A/WNA.  
*Solidago spathulata* DC. var. *nana* (A. Gray) Cronq. Frequent; dm, mm, st, kr, ff, rp; A/WNA.  
*Taraxacum ceratophorum* (Ledeb.) DC. [*T. ovinum* Greene]. Occasional; kr, ff, rp, sn; AA/C.

## Betulaceae

- Betula glandulosa* Michx. Occasional; wm, st, kr; BM/NA.

## Boraginaceae

- Eritrichium nanum* (Vill.) Schrad. var. *elongatum* (Rydb.) Cronq. [*Eritrichium aretioides* (Cham.) DC.]. Frequent; dm, mm, st, ff, rp; AA/NAA.  
*Mertensia ciliata* (James ex Torr.) G. Don. Occasional; mm, wm, st, rp, rv; BM/WNA.  
*M. lanceolata* (Pursh) A. DC.\* Occasional; dm, mm, st; A/SRM.  
*M. viridis* (A. Nels.) A. Nels. [*M. lanceolata* (Pursh) A. DC. var. *viridis* A. Nels.]. Very abundant; dm, mm, wm, st, kr, ff, rp, rv; A/WNA.

## Brassicaceae

- Arabis drummondii* A. Gray [*Boechea drummondii* (A. Gray) A. Löve & D. Löve]. Rare; st, kr; BM/NA.  
*A. lemmonii* Wats. [*Boechea lemmonii* (Wats.) W. A. Weber]. Rare; rp; A/WNA.  
*Cardamine cordifolia* A. Gray var. *cordifolia*. Occasional; mm, st, rp, rv; BM/WNA.  
*Descurainia richardsonii* (Sweet) O. E. Schulz var. *richardsonii*. Rare; st, rp; BM/NA.  
*Draba apiculata* C. L. Hitchc. var. *apiculata*. Rare; rp; A/RM. #6025/2296 COLO.  
*D. aurea* Vahl ex Hornem. var. *aurea*. Abundant; dm, mm, st, kr, ff, rp; AA/C.  
*D. cana* Rydb. Occasional; dm, mm, st, rp; AA/C.  
*D. crassa* Rydb. Occasional; rp; A/RM.  
*D. crassifolia* Grah. var. *crassifolia*. Very abundant; dm, mm, wm, st, kr, ff, rp, sn; AA/NAE.  
*D. fladnizensis* Wulf. Rare; dm, st; AA/C.  
*D. incerta* Pays. Rare; rp; A/RM.  
*D. lonchocarpa* Rydb. var. *lonchocarpa*. Frequent; dm, mm, rp; AA/NA.  
*D. oligosperma* Hook. Occasional; dm, mm, rp; AA/WNA.  
*D. spectabilis* Greene var. *spectabilis*. Rare; dm, kr; M/RM.  
*D. streptobrachia* Price. Rare; dm, ff; A/CO.  
*D. streptocarpa* A. Gray var. *streptocarpa*. Occasional; ff, rp; A/SRM.  
*Erysimum nivale* (Greene) Rydb. [*E. capitatum* (Dougl.) Greene]. Frequent; dm, mm, st, ff, rp; A/SRM.  
*Physaria alpina* Roll. Rare; rp; A/CO.  
*Rorippa curvipes* Greene var. *alpina* (Wats.) Stuckey. Rare; wm, rv; A/RM.  
*Smelowskia calycina* (Steph. ex Willd.) C. A. Mey. var. *americana* (Regel & Herd.) Drury & Roll. [*S. calycina* (Steph. ex Willd.) C. A. Mey.]. Abundant; dm, mm, st, kr, ff, rp; AA/NAA.  
*Thlaspi montanum* L. var. *montanum* [*Noccaea montana* (L.) F. K. Mey.]. Very abundant; dm, mm, wm, st, kr, ff, rp, sn; AA/C.

## Campanulaceae

- Campanula rotundifolia* L. Rare; dm, rp; BM/C.  
*C. uniflora* L. Frequent; dm, mm, st, ff, rp; A/C.

## Caryophyllaceae

- Alsianthe macrantha* (Rydb.) W. A. Weber. Rare; rp; A/CO.  
*Arenaria congesta* Nutt. var. *congesta* [*Eremogone congesta* (Nutt. ex Torr. & A. Gray) Ikonn.]. Occasional; dm, rp; M/WNA.  
*A. fendleri* A. Gray var. *fendleri* [*Eremogone fendleri* (A. Gray) Ikonn.]. Abundant; dm, mm, st, kr, ff, rp; A/SRM.  
*Cerastium arvense* L. [*Alsine media* L.]. Occasional; dm, mm, st, ff, rp; BM/C.  
*C. beeringianum* Cham. & Schlecht. [*C. beeringianum* Cham. & Schlecht. subsp. *earlei* (Rydb.) Hulten]. Occasional; dm, rp; A/RM.  
*Gastrolychnis kingii* (Wats.) W. A. Weber.\* Rare; dm, rp; A/SRM.  
*Minuartia austromontana* S. J. Wolf & Packer [*Alsianthe stricta* (Sw.) Reichenb.]. Rare; mm, ff, rp; AA/NA.  
*M. obtusiloba* (Rydb.) House [*Lidia obtusiloba* (Rydb.) A. Löve & D. Löve]. Very abundant; dm, mm, st, kr, ff, rp, sn; AA/NAA.  
*M. rubella* (Wahlenb.) Hiern [*Tryphane rubella* (Wahlenb.) Reichenb.]. Frequent; dm, mm, st, ff, rp; AA/C.  
*Paronychia pulvinata* A. Gray. Occasional; dm, ff, rp; A/SRM.  
*Sagina saginoides* (L.) Karst. Frequent; dm, mm, wm, rp, sn; AA/C.  
*Silene acaulis* (L.) Jacq. var. *subcaulescens* (F. N. Williams) Fern. & St. John [*S. acaulis* subsp. *subcaulescens* (F. N. Will.) C. L. Hitchc. & Maguire]. Very abundant; dm, mm, st, kr, rp, sn; AA/NAA.  
*S. drummondii* Hook. var. *drummondii* [*Gastrolychnis drummondii* (Hook.) A. Löve & D. Löve]. Occasional; dm, wm, kr; BM/NA.  
*Stellaria longipes* Goldie var. *longipes*. Frequent; dm, mm, st, kr, rp; BM/NA.  
*S. umbellata* Turcz. ex Kar. & Kir. Frequent; dm, mm, st, rp, sn; A/NAA.

## Crassulaceae

- Sedum integrifolium* (Raf.) A. Nels. subsp. *integrifolium* [*Rhodiola integrifolia* Raf.]. Abundant; dm, mm, wm, rp, rv; AA/NAA.  
*S. lanceolatum* Torr. var. *lanceolatum* [*Amerosedum lanceolatum* (Torr.) A. Löve & D. Löve]. Frequent; dm, mm, st, kr, ff, rp; A/RM.  
*S. rhodanthum* A. Gray [*Clementsia rhodantha* (A. Gray) Rose]. Occasional; mm, wm, st, rp, rv; A/RM.

## Ericaceae

- Arctostaphylos uva-ursi* (L.) Spreng. subsp. *uva-ursi* [*A. adenotricha* (Fern. & Macbr.) A. Löve, D. Löve & Kapoor]. Rare; dm, st; BM/NA.  
*Gaultheria humifusa* (Grah.) Rydb. Rare; mm; BM/WNA.  
*Kalmia microphylla* (Hook.) Heller var. *microphylla*. Rare; wm; BM/WNA.  
*Vaccinium caespitosum* Michx. [*V. caespitosum* Michx.]. Very abundant; dm, mm, wm, st, kr, rp, sn; BM/NA.  
*V. myrtillus* L. subsp. *oreophilum* (Rydb.) A. Löve, D. Löve & Kapoor. Rare; dm, mm, rp; BM/C.  
*V. scoparium* Leib. ex Cov. Rare; kr; BM/WNA.

## Fabaceae

- Astragalus aboriginum* Richards. Rare; dm; BM/WNA.  
*A. molybdenus* Barneby.\* Rare; dm; AA/C.  
*A. tenellus* Pursh. Rare; dm, mm; BM/WNA.  
*Oxytropis deflexa* (Pall.) DC. var. *sericea* Torr. & A. Gray. Occasional; dm, mm, st, rp; BM/C.  
*O. parryi* A. Gray. Rare; st; A/WNA.  
*O. podocarpa* A. Gray. Occasional; dm, ff, rp; AA/C.  
*O. sericea* Nutt. var. *sericea*. Rare; dm, st; BM/NA.  
*O. viscida* Nutt. var. *viscida*. Rare; mm; A/WNA.



*Trifolium dasyphyllum* Torr. & A. Gray var. *dasyphyllum*. Abundant; dm, mm, st, kr, ff, rp; A/RM.

*T. nanum* Torr. Abundant; dm, mm, st, kr, ff, rp; A/RM.

*T. parryi* A. Gray var. *parryi*. Frequent; dm, mm, wm, st, rp; A/RM.

#### Gentianaceae

*Frasera speciosa* Dougl. ex Griseb. Rare; dm; BM/WNA.

*Gentiana algida* Pall. [*Gentianodes algida* (Pall.) A. Löve & D. Löve]. Occasional; dm, mm, st; AA/NAA.

*G. calycosa* Griseb. [*Pneumonanthe parryi* (Engelm.) Greene]. Rare; dm, mm; A/WNA.

*G. prostrata* Haenke ex Jacq. [*Chondrophylla prostrata* (Haenke ex Jacq.) J. P. Anderson.]. Occasional; dm, mm, st; AA/NAA.

*Gentianella amarella* (L.) Borner [*G. acuta* (Michx.) Hiit.]. Occasional; dm, mm, st, ff, rp; BM/C.

*G. tenella* (Rottb.) Borner [*Comastoma tenellum* (Rottb.) Toyokuni]. Rare; mm; AA/C.

*Gentianopsis barbellata* (Engelm.) Iltis. Rare; dm, ff; A/SRM.

*G. detonsa* (Rottb.) Ma var. *elegans* (A. Nels.) N. Holmgren [*G. thermalis* (Kuntze) Iltis]. Occasional; mm; A/RM.

*Swertia perennis* L. Occasional; mm, wm, st; A/C.

#### Grossulariaceae

*Ribes montigenum* McClat. Occasional; st, kr, rp; BM/WNA.

#### Hydrophyllaceae

*Phacelia glandulosa* Nutt. Rare; rp; BM/WNA.

*P. hastata* Dougl. ex Lehm. var. *hastata*. Rare; dm, rp; M/NA.

*P. sericea* (Grah. ex Hook.) A. Gray var. *sericea*. Frequent; dm, mm, st, kr, ff; A/WNA.

#### Onagraceae

*Epilobium anagallidifolium* Lam. Frequent; wm, st, rp, rv, sn; AA/C.

*E. hornemannii* Reichenb. subsp. *hornemannii*. Rare; wm, st; AA/C.

#### Polemoniaceae

*Phlox pulvinata* (Wherry) Cronq. [*P. condensata* (A. Gray) E. Nels.]. Abundant; dm, st, ff, rp; A/SRM.

*Polemonium pulcherrimum* Hook. var. *pulcherrimum* [*P. pulcherrimum* Hook. subsp. *delicatum* (Rydb.) Brand]. Rare; st, kr; M/SRM.

*P. viscosum* Nutt. Abundant; dm, mm, st, kr, ff, rp; A/WNA.

#### Polygonaceae

*Eriogonum jamesii* Benth. var. *xanthum* (Stokes) Reveal.\* Rare; dm, st; A/WNA.

*Oxyria digyna* (L.) Hill. Frequent; mm, rp, rv; AA/C.

*Polygonum bistortoides* Pursh [*Bistorta bistortoides* (Pursh) Small]. Very abundant; dm, mm, wm, st, kr, ff, rp; A/WNA.

*P. douglasii* Greene var. *douglasii*. Rare; ff; BM/NA.

*P. viviparum* L. var. *viviparum* [*Bistorta vivipara* (L.) S. Gray]. Abundant; dm, mm, wm, st, kr, ff, rp; AA/C.

#### Portulacaceae

*Claytonia megarhiza* (A. Gray) Parry ex Wats. var. *megarhiza* [*C. megarhiza* (Parry ex A. Gray) Wats.]. Frequent; ff, rp; A/RM.

*Lewisia pygmaea* (A. Gray) B. L. Robins. [*Oreobroma pygmaea* (A. Gray) Howell].  
Frequent; dm, mm, st, kr, rp, sn; A/WNA.

#### Primulaceae

*Androsace septentrionalis* L. Abundant; dm, mm, wm, st, kr, ff, rp; AA/C.

*Primula angustifolia* Torr.\* Frequent; dm, mm, ff, rp, sn; A/SRM.

*P. parryi* A. Gray. Frequent; mm, wm, rp, rv, sn; A/RM.

#### Ranunculaceae

*Aconitum columbianum* Nutt. var. *columbianum*. Rare; mm, rv; BM/WNA.

*Anemone multifida* Poir. var. *multifida* [*A. multifida* Poir. var. *globosa* (Nutt.) Torr. & A. Gray]. Occasional; dm, st, kr, rp; BM/NA.

*A. narcissiflora* L. subsp. *zephyra* (A. Nels.) A. Löve, D. Löve & Kapoor [*Anemonastrum narcissiflorum* (L.) Holub. subsp. *zephyrum* (A. Nels.) W. A. Weber]. Frequent; dm, mm, wm, st, kr, ff, sn; A/SRM.

*A. parviflora* Michx. Rare; mm, rp; BM/NAA.

*A. patens* L. [*Pulsatilla patens* (L.) Mill. subsp. *multifida* (Pritz.) Zamels]. Rare; rp; BM/NA.

*Aquilegia caerulea* James. Frequent; dm, mm, st, kr, rp; M/RM.

*Caltha leptosepala* DC. subsp. *leptosepala* var. *leptosepala* [*Psychrophila leptosepala* (DC.) W. A. Weber]. Occasional; mm, wm, st, rv, sn; A/WNA.

*Delphinium barbeyi* (Huth) Huth. Rare; mm; M/SRM.

*Ranunculus adoneus* A. Gray. Infrequent; mm, sn; A/WNA.

*R. eschscholtzii* Schlecht. var. *eschscholtzii*. Frequent; dm, mm, wm, rp, rv, sn; AA/NAA.

*R. inamoenus* Greene var. *alpeophilus* (A. Nels.) Benson [*R. inamoenus* Greene]. Rare; mm; M/WNA.

*R. maccauleyi* A. Gray.\* Rare; mm; A/SRM.

*R. pedatifidus* J. E. Sm. var. *affinis* (R. Br.) Benson [*R. pedatifidus* J. E. Sm.]. Rare; dm; AA/C.

*R. pygmaeus* Wahlenb. var. *pygmaeus*. Rare; wm; AA/C.

*Thalictrum alpinum* L. var. *hebetum* Boivin [*T. alpinum* L.]. Frequent; dm, mm, wm, st, rp, sn; A/WNA.

*Trollius laxus* Salisb. [*T. albiflorus* (A. Gray) Rydb.]. Occasional; mm, st; BM/WNA.

#### Rosaceae

*Dryas octopetala* L. var. *hookeriana* (Juz.) Breit. [*D. octopetala* L. subsp. *hookeriana* (Juz.) Hulten]. Frequent; dm, mm, st, kr, ff, rp; A/RM.

*Fragaria vesca* L. var. *bracteata* (Heller) R. J. Davis [*F. vesca* L. subsp. *bracteata* (Heller) R. J. Davis]. Rare; dm, kr; BM/NA.

*Geum rossii* (R. Br.) Ser. var. *turbinatum* (Rydb.) C. L. Hitchc. [*Acomastylis rossii* (R. Br.) Greene subsp. *turbinata* (Rydb.) W. A. Weber]. Very abundant; dm, mm, wm, st, kr, ff, rp, rv, sn; AA/NA.

*Potentilla concinna* Richards. var. *concinna*. Rare; dm, st; M/WNA.

*P. diversifolia* Lehm. var. *diversifolia*. Very abundant; dm, mm, wm, st, kr, ff, rp, sn; A/WNA.

*P. fruticosa* L. [*Pentaphylloides floribunda* (Pursh) A. Löve]. Occasional; dm, st, rp; BM/C.

*P. hookeriana* Lehm. subsp. *hookeriana* var. *hookeriana* [*P. hookeriana* Lehm.]. Frequent; dm, st, ff, rp; AA/NAA.

*P. nivea* L. Occasional; dm, ff, rp; AA/C.

*P. ovina* Macoun var. *decurrens* (Wats.) Welsh & B. C. Johnston. Rare; dm; M/RM.

*P. ovina* Macoun var. *ovina*. Rare; dm; M/WNA.

*P. pulcherrima* Lehm. Occasional; dm, mm, st, ff, rp; BM/WNA.

- P. rubricaulis* Lehm. Occasional; dm, kr, ff, rp; AA/NA.  
*P. subjuga* Rydb. var. *subjuga*. Frequent; dm, ff, rp; A/CO.  
*Sibbaldia procumbens* L. Abundant; dm, mm, wm, st, rp, sn; AA/C.

## Salicaceae

- Salix arctica* Pall. [*S. arctica* Pall. subsp. *petraea* (Anderss.) A. Löve, D. Löve & Kapoor]. Abundant; dm, mm, wm, st, ff, rp, sn; A/WNA.  
*S. brachycarpa* Nutt. subsp. *brachycarpa* var. *brachycarpa* [*S. brachycarpa* Nutt.]. Frequent; dm, mm, st, kr, rp; BM/NA.  
*S. glauca* L. subsp. *glauca* var. *villosa* (Hook.) Anderss. Occasional; mm, st, kr; BM/WNA.  
*S. planifolia* Pursh subsp. *planifolia* var. *planifolia* [*S. planifolia* Pursh]. Occasional; mm, wm, st, ff; BM/NA.  
*S. reticulata* L. subsp. *nivalis* (Hook.) A. Löve, D. Löve & Kapoor. Very abundant; dm, mm, wm, st, kr, ff, rp, sn; A/WNA.

## Saxifragaceae

- Heuchera parvifolia* Nutt. ex Torr. & A. Gray [*H. parvifolia* Nutt. ex Torr. & A. Gray var. *nivalis* (Rosend.) A. Löve, D. Löve & Kapoor]. Abundant; dm, mm, st, kr, ff, rp; M/RM.  
*Micranthes oregana* (Howell) Small.\* Occasional; mm, wm, st, rv; M/WNA.  
*Saxifraga adscendens* L. subsp. *oregonensis* (Raf.) Breit. [*Muscaria adscendens* (L.) Small]. Occasional; rp; AA/NAE.  
*S. bronchialis* L. subsp. *austromontana* (Wieg.) G. N. Jones [*Ciliaria austromontana* (Wieg.) W. A. Weber]. Frequent; dm, mm, st, kr, ff, rp; A/WNA.  
*S. caespitosa* L. var. *minima* Blank. [*Muscaria delicatula* Small]. Rare; rp; AA/C.  
*S. cernua* L. Occasional; rp; AA/C.  
*S. debilis* Engelm. ex A. Gray [*S. hyperborea* R. Br. subsp. *debilis* (Engelm. ex A. Gray) A. Löve, D. Löve & Kapoor]. Frequent; dm, rp; AA/NA.  
*S. flagellaris* Willd. ex Sternb. subsp. *flagellaris* [*Hirculus platysepalus* (Trautv.) W. A. Weber subsp. *crandallii* (Gand.) W. A. Weber]. Frequent; dm, mm, st, kr, ff, rp; A/SRM.  
*S. odontoloma* Piper [*Micranthes odontoloma* (Piper) Heller]. Occasional; wm, st, rv; BM/WNA.  
*S. rhomboidea* Greene var. *rhomboidea* [*Micranthes rhomboidea* (Greene) Small]. Very abundant; dm, mm, st, kr, ff, rp, rv, sn; A/WNA.  
*S. rivularis* L. var. *flexuosa* (Sternb.) Engl. & Irmsch. [*S. rivularis* L.]. Rare; rp; AA/C.

## Scrophulariaceae

- Besseyia alpina* (A. Gray) Rydb. Frequent; dm, mm, ff, rp; A/SRM.  
*Castilleja miniata* Dougl. ex Hook. Rare; dm, rp; BM/WNA.  
*C. occidentalis* Torr.\* Very abundant; dm, mm, wm, st, kr, ff, rp, rv, sn; A/RM.  
*C. rhexifolia* Rydb. Occasional; mm, wm, st, rv; BM/WNA.  
*Chionophila jamesii* Benth. Frequent; dm, mm, ff, rp, sn; A/SRM.  
*Mimulus guttatus* DC. subsp. *guttatus*. Rare; rv; BM/NA.  
*Pedicularis bracteosa* Benth. ex Hook. var. *paysoniana* (Penn.) Cronq. [*P. bracteosa* Benth. subsp. *paysoniana* (Penn.) W. A. Weber]. Rare; st; M/RM.  
*P. groenlandica* Retz. var. *surrecta* (Benth. ex Hook.) A. Gray [*P. groenlandica* Retz.]. Frequent; mm, wm, st, rp, rv, sn; AA/NA.  
*P. parryi* A. Gray subsp. *parryi*. Occasional; dm, mm, st, kr; A/RM.  
*P. scopulorum* A. Gray.\* Occasional; mm, wm, st; A/RM.  
*Penstemon hallii* A. Gray. Rare; dm, ff; A/CO.  
*P. harbourii* A. Gray. Rare; rp; A/CO.  
*P. whippleanus* A. Gray. Occasional; st, kr, rp; M/RM.  
*Veronica nutans* Bong.\* Frequent; dm, mm, wm, st, kr, rp, rv; AA/NA.

## Valerianaceae

- Valeriana acutiloba* Rydb. var. *acutiloba* [*V. capitata* Pall. ex Link subsp. *acutiloba* (Rydb.) F. G. Mey.]. Rare; dm; AA/NAA.  
*V. edulis* Nutt. ex Torr. & A. Gray var. *edulis*. Rare; dm, rp; BM/WNA.

## Violaceae

- Viola adunca* Sm. var. *bellidifolia* (Greene) Harrington [*V. labradorica* Schrank]. Occasional; dm, mm, wm, st, kr, rp; BM/NA.

## ANTHOPHYTA—MONOCOTYLEDONEAE

## Cyperaceae

- Carex albonigra* Mack. [*C. albo-nigra* Mack. in Rydb.]. Frequent; dm, mm, wm, st, kr, ff, rp; AA/WNA.  
*C. aquatilis* Wahlenb. var. *aquatilis* [*C. aquatilis* Wahlenb. subsp. *stans* (Drejer) Hulten]. Occasional; mm, wm, rv; AA/C.  
*C. arapahoensis* Clokey.\* Rare; dm, mm; A/SRM.  
*C. arctogena* H. Sm. [*C. capitata* L. subsp. *arctogena* (H. Smith) Böcher]. Rare; mm; BM/NA.  
*C. aurea* Nutt. Rare; mm; BM/NA.  
*C. bipartita* Bellardi ex All. var. *bipartita* [*C. lachenalii* Schkuhr]. Rare; mm; AA/C.  
*C. brevipes* W. Boott. Rare; dm, kr; BM/NA.  
*C. capillaris* L. subsp. *capillaris*. Rare; mm; AA/C.  
*C. ebenea* Rydb. Abundant; dm, mm, wm, st, kr, rp, rv, sn; A/RM.  
*C. elynoides* Holm. Very abundant; dm, mm, st, kr, ff, rp, sn; A/WNA.  
*C. foenea* Willd. Occasional; dm, mm, st, kr, ff; BM/NA.  
*C. haydeniana* Olney. Occasional; dm, mm, wm, rp; A/WNA.  
*C. heteroneura* W. Boott var. *chalciolepis* (Holm) F. J. Herm. [*C. chalciolepis* Holm]. Abundant; dm, mm, wm, st, kr, ff, rp, sn; A/WNA.  
*C. heteroneura* W. Boott var. *epapillosa* (Mack.) F. J. Herm. [*C. epapillosa* Mack. in Rydb.]. Rare; dm, mm; M/WNA.  
*C. illota* Bailey. Rare; mm, wm; A/WNA.  
*C. incurviformis* Mack. [*C. maritima* Gunn.]. Rare; rp, sn; A/WNA.  
*C. misandra* R. Br. Rare; mm, st; AA/C.  
*C. nardina* Fries var. *hepburnii* (Boott) Kukenth. [*C. nardina* Fries subsp. *hepburnii* (Boott) A. Löve, D. Löve & Kapoor]. Rare; mm, wm; A/SRM.  
*C. nelsonii* Mack. Rare; mm; A/SRM.  
*C. nigricans* C. A. Mey. Frequent; mm, wm, st, rp, rv; AA/NA.  
*C. norvegica* Retz. Rare; dm, mm, rp; AA/NAE.  
*C. nova* Bailey. Frequent; mm, wm, st, rp, rv; BM/WNA.  
*C. obtusata* Lilj. Rare; mm, st; BM/C.  
*C. perglobosa* Mack.\* Rare; rp, sn; A/SRM.  
*C. phaeocephala* Piper. Frequent; dm, mm, st, kr, rp, sn; A/WNA.  
*C. praeceptorum* Mack. Rare; mm, wm; A/WNA.  
*C. pseudoscirpoidea* Rydb. Frequent; dm, mm, st, kr, ff, rp; A/WNA.  
*C. pyrenaica* Wahlenb. [*C. praegracilis* Boott]. Occasional; mm, rp, sn; A/C.  
*C. rupestris* All. var. *drummondii* (Dewey) Bailey [*C. rupestris* All. subsp. *drummondiana* (Dewey) Holub]. Frequent; dm, mm, st, kr, ff, rp; A/RM.  
*C. saxatilis* L. [*C. saxatilis* L. subsp. *laxa* (Trautv.) Kalela]. Rare; mm; AA/C.  
*C. scopulorum* Holm var. *scopulorum*. Frequent; mm, wm, st, rp, rv; A/WNA.  
*C. vernacula* Bailey. Occasional; mm, wm, rp, rv; A/WNA.  
*Eleocharis pauciflora* (Lightf.) Link [*E. quinquefolia* (F. X. Hartm.) Schwartz]. Rare; mm; A/C.  
*Kobresia bellardii* (All.) Degl. ex Loisel. [*K. myosuroides* (Vill.) Fiori & Paoli]. Frequent; dm, mm, st, kr, ff, rp; AA/C.

## Juncaceae

- Juncus albescens* (Lange) Fern. Rare; mm; AA/NA.  
*J. balticus* Willd. var. *montanus* Engelm. [*J. arcticus* Willd. subsp. *ater* (Rydb.) Hul-  
 ten]. Rare; mm; M/WNA.  
*J. biglumis* L. Rare; mm, wm, rp; AA/C.  
*J. castaneus* Sm. subsp. *castaneus* var. *castaneus*. Rare; mm; AA/C.  
*J. drummondii* E. Mey. var. *drummondii*. Very abundant; dm, mm, wm, st, kr, rp,  
 rv, sn; A/WNA.  
*J. mertensianus* Bong. Occasional; mm, wm, rv; A/NAA.  
*J. parryi* Engelm. Rare; mm; M/WNA.  
*J. triglumis* L. Rare; mm; AA/C.  
*Luzula parviflora* (Ehrh.) Desv. [*L. parviflora* (Ehrh. ex Hoffm.) Lejeune]. Rare; mm,  
 rv; BM/C.  
*L. spicata* (L.) DC. Very abundant; dm, mm, wm, st, kr, ff, rp, sn; A/RM.  
*L. subcapitata* (Rydb.) Harr. Rare; mm, wm; A/CO.

## Liliaceae

- Lloydia serotina* (L.) Sweet subsp. *serotina*. Abundant; dm, mm, wm, st, kr, ff, rp,  
 sn; AA/C.  
*Zigadenus elegans* Pursh subsp. *elegans* [*Anticlea elegans* (Pursh) Rydb.]. Occasional;  
 dm, mm, st, rp; AA/NA.

## Poaceae

- Agropyron latiglume* (Scribn. & Sm.) Rydb. [*Elymus trachycaulus* (Link) Gould ex  
 Shinnery subsp. *andinus* (Scribn. & Sm.) A. Löve & D. Löve]. Occasional; dm,  
 st, rp; AA/NA.  
*A. scribneri* Vasey [*Elymus scribneri* (Vasey) Jones]. Frequent; dm, kr, ff, rp; A/WNA.  
*Agrostis borealis* Hartm. [*A. mertensii* Trin.]. Rare; dm, mm; AA/C.  
*A. humilis* Vasey. Rare; mm, st; A/WNA.  
*A. variabilis* Rydb. Rare; dm; A/WNA.  
*Calamagrostis canadensis* (Michx.) Beauv. Rare; st; BM/NAA.  
*C. purpurascens* R. Br. var. *purpurascens*. Occasional; dm, kr, ff, rp; AA/NAA.  
*Danthonia intermedia* Vasey. Occasional; dm, st, rp; BM/NAA.  
*Deschampsia caespitosa* (L.) Beauv. var. *caespitosa* [*D. caespitosa* (L.) P. Beauv. subsp.  
*alpicola* (Rydb.) A. Löve, D. Löve & Kapoor]. Abundant; dm, mm, wm, st, rp,  
 rv, sn; BM/C.  
*Festuca ovina* L. var. *brevifolia* (R. Br.) Wats. [*F. minutiflora* Rydb.]. Very abundant;  
 dm, mm, wm, st, kr, ff, rp, sn; AA/C.  
*F. ovina* L. var. *rydbergii* St. Yves [*F. brachyphylla* subsp. *coloradensis* Fred.]. Oc-  
 casional; dm, st, kr, ff; M/NA.  
*Helictotrichon mortonianum* (Scribn.) Henr. Occasional; dm, mm, ff, rp; A/SRM.  
*Phleum alpinum* L. [*P. commutatum* Gaud.]. Frequent; dm, mm, wm, st, rp, sn;  
 AA/C.  
*Poa alpina* L. var. *alpina*. Abundant; dm, mm, wm, st, kr, rp, sn; AA/C.  
*P. cusickii* Vasey. Rare; dm; M/RM.  
*P. epilis* Scribn. [*P. cusickii* Vasey subsp. *epilis* (Scribn.) W. A. Weber]. Frequent;  
 dm, mm, wm, st, kr, rp; BM/WNA.  
*P. fendleriana* (Steud.) Vasey. Occasional; dm, mm, st; BM/NA.  
*P. grayana* Vasey [*P. arctica* R. Br.]. Occasional; dm, mm, st, rp; A/RM.  
*P. interior* Rydb. [*P. nemoralis* L. subsp. *interior* (Rydb.) W. A. Weber]. Rare; dm;  
 BM/NA.  
*P. reflexa* Vasey & Scribn. ex Vasey. Occasional; mm, st, kr; A/WNA.  
*P. rupicola* Nash ex Rydb. [*P. glauca* M. Vahl subsp. *rupicola* (Nash) W. A. Weber].  
 Abundant; dm, mm, st, kr, ff, rp; A/WNA.

*P. sandbergii* Vasey [*P. secunda* C. Presl]. Rare; dm, mm; BM/NA.  
*Trisetum spicatum* (L.) Richt. var. *spicatum* [*T. spicatum* (L.) Richt. subsp. *congdonii* (Scribn. & Merr.) Hulten]. Very abundant; dm, mm, wm, st, kr, ff, rp, sn; AA/C.

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## LITERATURE CITED

- ARNO, S. F. and R. P. HAMMERLY. 1984. Timberline: mountain and arctic forest frontiers. The Mountaineers, Seattle.
- BAMBERG, S. A. and J. MAJOR. 1968. Ecology of the vegetation and soils associated with calcareous parent materials in three alpine regions of Montana. *Ecol. Monog.* 38:127-167.
- BLISS, L. C. 1962. Adaptations of arctic and alpine plants to environmental conditions. *Arctic* 15:117-144.
- BROCK, M. R. and F. BARKER. 1972. Geologic map of the Mount Harvard quadrangle, Chaffee and Gunnison counties, Colorado. Map GQ-952.
- CHRONIC, J. and H. CHRONIC. 1972. Prairie, peak and plateau: a guide to the geology of Colorado. *Colo. Geol. Surv. Bull.* 32.
- CRONQUIST, A., A. H. HOLMGREN, N. H. HOLMGREN, J. L. REVEAL, and P. K. HOLMGREN. 1977. Intermountain flora. Vol. 6. Columbia Univ. Press, New York.
- CURRY, R. R. 1962. Geobotanical correlations in the alpine and subalpine regions of the Tenmile Range, Summit County, Colorado. M.S. thesis, Univ. Colorado, Boulder.
- DAUBENMIRE, R. 1968. Plant communities: a textbook of plant synecology. Harper and Row, New York.
- DINGS, M. G. and C. S. ROBINSON. 1957. Geology and ore deposits of the Garfield quadrangle, Colorado. U.S.G.S. Prof. Paper 289.
- EDDLEMAN, L. F. and R. T. WARD. 1984. Phytoedaphic relationships in alpine tundra, north-central Colorado, U.S.A. *Arctic and Alpine Research* 16:343-359.
- HARTMAN, E. L. and M. L. ROTTMAN. 1985a. The alpine vascular flora of the Mt. Bross massif, Mosquito Range, Colorado. *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. The alpine vascular flora of the Ruby Range, West Elk Mountains, Colorado. *Great Basin Naturalist* 47:152-160.
- IVES, J. D. 1974. Permafrost. In J. D. Ives and R. G. Barry, eds., *Arctic and alpine environments*, p. 159-194. Methuen, London.
- JOHNSON, P. L. and W. D. BILLINGS. 1962. The alpine vegetation of the Beartooth Plateau in relation to cryopedogenic processes and patterns. *Ecol. Monog.* 32: 105-135.
- KOMARKOVA, V. 1976. Alpine vegetation of the Indian Peaks area, Colorado Rocky Mountains. Ph.D. dissertation, Univ. Colorado, Boulder.
- LANGENHEIM, J. H. 1962. Vegetation and environmental patterns in the Crested Butte area, Gunnison County, Colorado. *Ecol. Monog.* 32:249-285.
- LODER, C. W. 1964. Alpine tundra of Cottonwood Pass, Colorado. M.A. thesis, Western State College, Gunnison, CO.
- MARR, J. W. 1961. Ecosystems of the east slope of the Front Range in Colorado. *Univ. Colorado Studies, Series in Biology* 8.
- MOSS, E. H. 1983. *Flora of Alberta: a manual of flowering plants, ferns, and fern*

- allies found growing without cultivation in the province of Alberta, Canada. Univ. Toronto Press, Toronto.
- MUELLER-DOMBOIS, D. and H. ELLENBERG. 1974. Aims and methods of vegetation ecology. John Wiley & Sons, New York.
- MUNZ, P. A. 1968. Supplement to a California flora. Univ. California Press, Berkeley.
- and D. D. KECK. 1970. A California flora. Univ. California Press, Berkeley.
- MURDOCK, J. R. 1951. Alpine plant succession near Mt. Emmon, Uinta Mountains, Utah. M.S. thesis, Brigham Young Univ., Provo, UT.
- NELSON, B. E. and R. L. HARTMAN. 1987. Rocky Mountain Herbarium checklist—flora of Wyoming. Univ. of Wyoming, Laramie.
- NORDHAGEN, R. 1955. Kobresieto-Dryadion in northern Scandinavia. *Svensk. Bot. Tidskr.* 49:63–87.
- O'KANE, S., E. L. HARTMAN, and M. L. ROTTMAN. 1988. Noteworthy collections: Colorado. *Madroño* 35:72.
- OWEN, H. E. 1976. Phenological development of herbaceous plants in relationship to snowmelt date. In H. W. Steinhoff and J. D. Ives, eds., *Ecological impacts of snowpack augmentation in the San Juan Mountains, Colorado*, p. 323–342. Final Report, San Juan Ecology Project, Colorado State Univ., Fort Collins.
- PORSILD, A. E. 1957. Illustrated flora of the Canadian Arctic Archipelago. *Nat. Mus. of Canada Bull.* 146.
- and W. J. CODY. 1980. Vascular plants of continental Northwest Territories, Canada. *Nat. Mus. of Nat. Sci., Ottawa*.
- PRICE, R. A., M. L. ROTTMAN, and E. L. HARTMAN. 1985. Noteworthy collections: Colorado. *Madroño* 32:191.
- RONNING, O. I. 1968. Features of the ecology of some Arctic Svalbard (Spitsbergen) plant communities. *Arctic and Alpine Research* 1:29–44.
- ROTTMAN, M. L. and E. L. HARTMAN. 1985. Tundra vegetation of three cirque basins in the northern San Juan Mountains, Colorado. *Great Basin Naturalist* 45:87–93.
- SCHROETER, C. 1926. *Das pflanzenleben der Alpen*. Verlag, Zurich.
- STARK, J. T. 1934. Reverse faulting in the Sawatch Range. *Bull. Geol. Soc. Amer.* 45:1001–1016.
- and F. F. BARNES. 1932. The structure of the Sawatch Range. *Amer. J. Sci., Ser. 5, Vol. 24*:471–480.
- and ———. 1935. Geology of the Sawatch Range, Colorado. *Colo. Sci. Soc. Proc.* 13:467–479.
- TWETO, O. 1974. Geologic map and sections of the Holy Cross quadrangle, Eagle, Lake, Pitkin and Summit counties, Colorado. *Misc. Invest. Ser. Map* 1-830.
- VAN LOENEN, R. E. 1985. Geologic map of the Mount Massive wilderness, Lake County, Colorado. *Misc. Field Stud. Map* MF-1792-A.
- WEBBER, P. J., J. C. EMERICK, D. C. E. MAY, and V. KOMARKOVA. 1976. The impact of increased snowfall on alpine vegetation. In H. W. Steinhoff and J. D. Ives, eds., *Ecological impacts of snowpack augmentation in the San Juan Mountains, Colorado*, p. 201–254. Final Report, San Juan Ecology Project, Colorado State Univ., Fort Collins.
- WEBER, W. A. 1965. Plant geography in the Southern Rocky Mountains. In H. E. Wright and D. C. Frey, eds., *The Quaternary of the United States*, p. 453–468. Princeton Univ. Press, Princeton, NJ.
- . 1987. *Colorado flora: western slope*. Colorado Associated Univ. Press, Boulder.
- WESTGATE, L. G. 1905. The Twin Lakes glaciated area, Colorado. *J. Geol.* 13:285–312.
- WILLARD, B. E. 1963. Phytosociology of the alpine tundra of Trail Ridge, Rocky Mountain National Park, Colorado. Ph.D. dissertation, Univ. Colorado, Boulder.

- WITTMANN, R. C., W. A. WEBER, and B. C. JOHNSTON. 1988. Flora of Colorado: computer-generated catalog. Univ. Colorado, Boulder.
- ZWINGER, A. H. and B. E. WILLARD. 1972. Land above the trees. Harper and Row, New York.

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## ERRATUM

Part of the address of Mountain West Publishing was inadvertently omitted when the announcement below appeared in *Madroño* 35(2):125. The announcement is repeated here with the complete address.

### ANNOUNCEMENT

#### New Publication

DORN, ROBERT D. 1988. *Vascular Plants of Wyoming*, illustrated by JANE L. DORN. Mountain West Publishing, Cheyenne, WY. vi + 340 pp., paperbound. [Keys to 120 families, 650 genera, 2369 species, 39 subspecies, and 690 varieties; 93 new combinations, 1 new species, 4 new varieties, and 1 new name; section of taxonomic notes. Available postpaid for \$13.00 from Mountain West Publishing, Box 1471, Cheyenne, WY 82003.]

### ANNOUNCEMENT

#### NEW PUBLICATION

POWELL, A. M. 1988. *Trees and Shrubs of Trans-Pecos Texas*, Big Bend Natural History Association, P.O. Box 68, Big Bend National Park, TX 79834, 536 pp., illus., ISBN 0-912001-14-3, \$19.95 (paperbound). Includes keys, descriptions, distributions, and illustrations of about 450 species of woody plants native to the Texas mountain and desert region west of the Pecos River. (Also available, Chihuahuan Desert Research Institute, P.O. Box 1334, Alpine, TX 79831, \$17.95 to members, \$19.95 to non-members.)