PLANT COMMUNITY CLASSIFICATION FOR ALPINE VEGETATION

ON BEAVERHEAD NATIONAL FOREST, MONTANA

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TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

INTRODUCTION

Much of what is generally considered the Northern Rocky Mountains floristic province is contained within the boundaries of Montana (McLaughlin 1989). Numerous mountain ranges occur in the western half of the state, many of these reaching elevations above timberline. The vegetation of grasslands, shrublands, forests, woodlands and riparian areas of western Montana have been described and classified (Hansen et al. 1991, Mueggler and Stewart 1980, Pfister et al. 1977). However, due to inaccessibility and its relatively low economic importance, few studies have described the alpine vegetation of the Northern Rocky Mountains. These include studies in Glacier National Park (Choate and Habeck 1967, Bamberg and Major 1968), the Big Snowy Mountains and Flint Creek Range (Bamberg and Major 1968) and the Beartooth Plateau (Johnson and Billings 1962). All of these studies were conducted at fewer than a half dozen sites. Recently, studies have been completed for alpine areas of central Idaho (Brunsfeld 1981, Caicco 1983, Moseley 1985).

Twenty-seven mountain ranges in Montana support significant alpine terrain. Of these, more than half are located in the southwest portion of the state, and nine are on Beaverhead National Forest. Southwest Montana is also the most floristically diverse region of the state (Lesica et al. 1984). Knowledge of alpine plant communities in this area would allow a more comprehensive portrayal of Northern Rocky Mountain alpine ecosystems. Our study had the following objectives:

(1) Develop a classification system for alpine communities on Beaverhead National Forest.

(2) Relate abiotic environmental factors such as climate, soils and landforms to the occurrence of these communities.

(3) Compare the communities occurring on Beaverhead National Forest to those described from other areas of western North America.

(4) Discuss management considerations for alpine vegetation systems.

STUDY AREA

Vegetation

Our study area encompassed eight alpine mountain ranges that occur, at least in part, on Beaverhead National Forest: Anaconda, Beaverhead, Gravelly, Madison, Pioneer, Snowcrest, Tendoy and Tobacco Root (Figure 1A,B). These ranges are all east of the Continental Divide. The area is semi-arid, and both upper and lower treelines occur in all of the ranges. Intermountain valleys are high, and the cold, frost-prone climate is unsuitable for the establishment of tree species that are not cold-adapted. Thus, Pseudotsuga menziesii and Pinus flexilis, not Pinus ponderosa, are climax dominants of lower treeline and extend through the montane to the middle of the subalpine. Pinus flexilis extends onto sites drier/warmer than can be tolerated by Pseudotsuga; it also shows a preference for the calcareous substrates of this area.

1

Figure 1. Map of the study area.
(●) indicates location of
sample plots.

MONTANA

1 in. = 17 mi.

0   10   20

WISDOM

Big Hole River

Beaverhead River

BUTTE

LIMA

DILLON

Jefferson River

Ruby River

SNOWCREST RANGE

VIRGINIA CITY

TOBACCO ROOT RANGE

Madison River
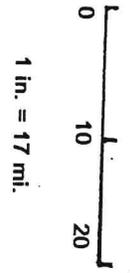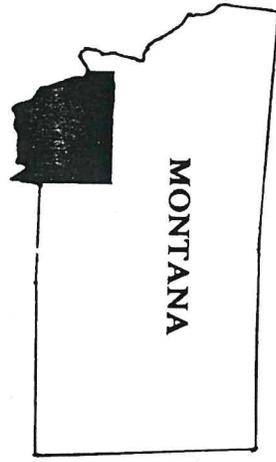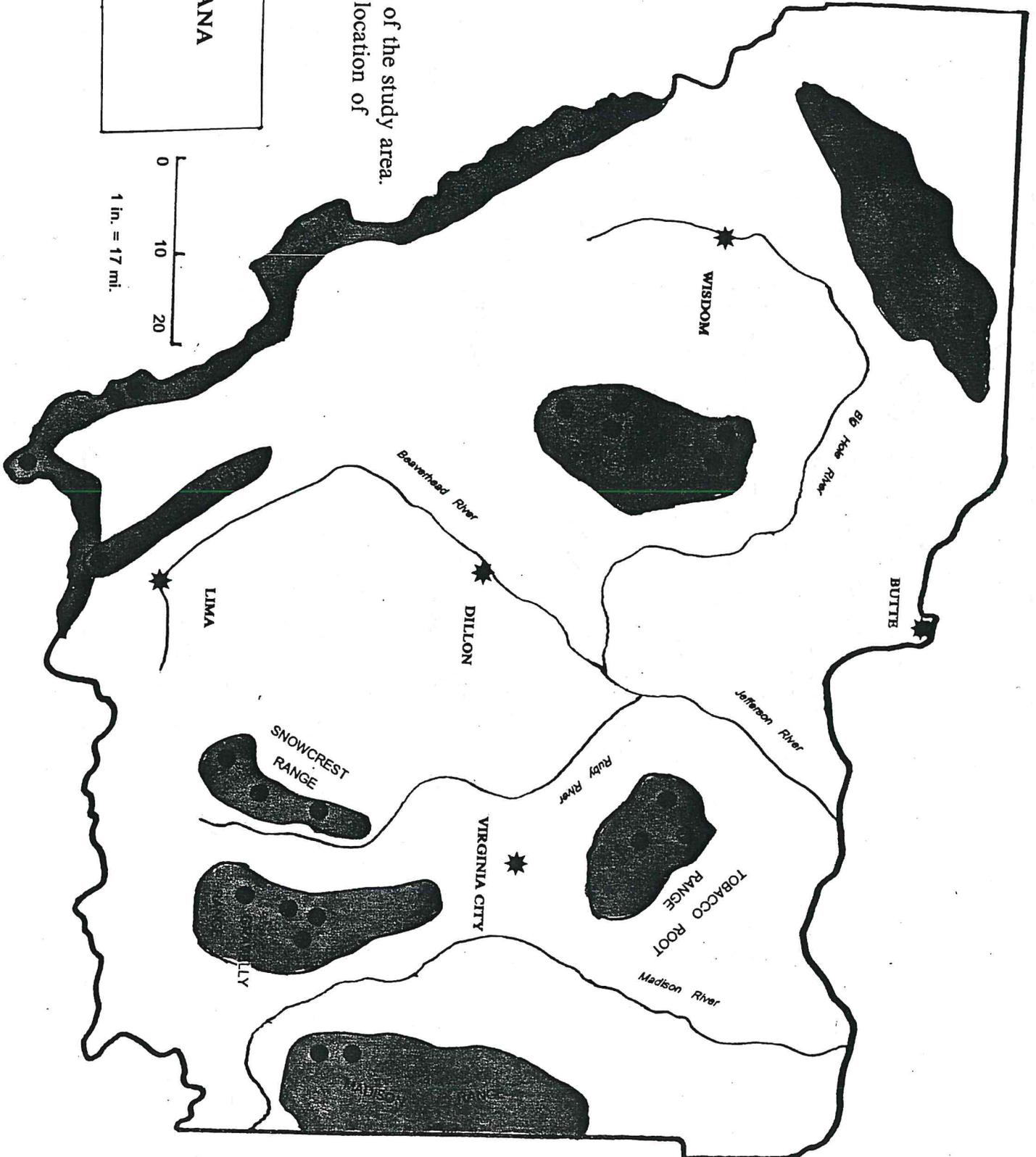
Figure 1B. Study area showing boundary of Beaverhead National Forest.
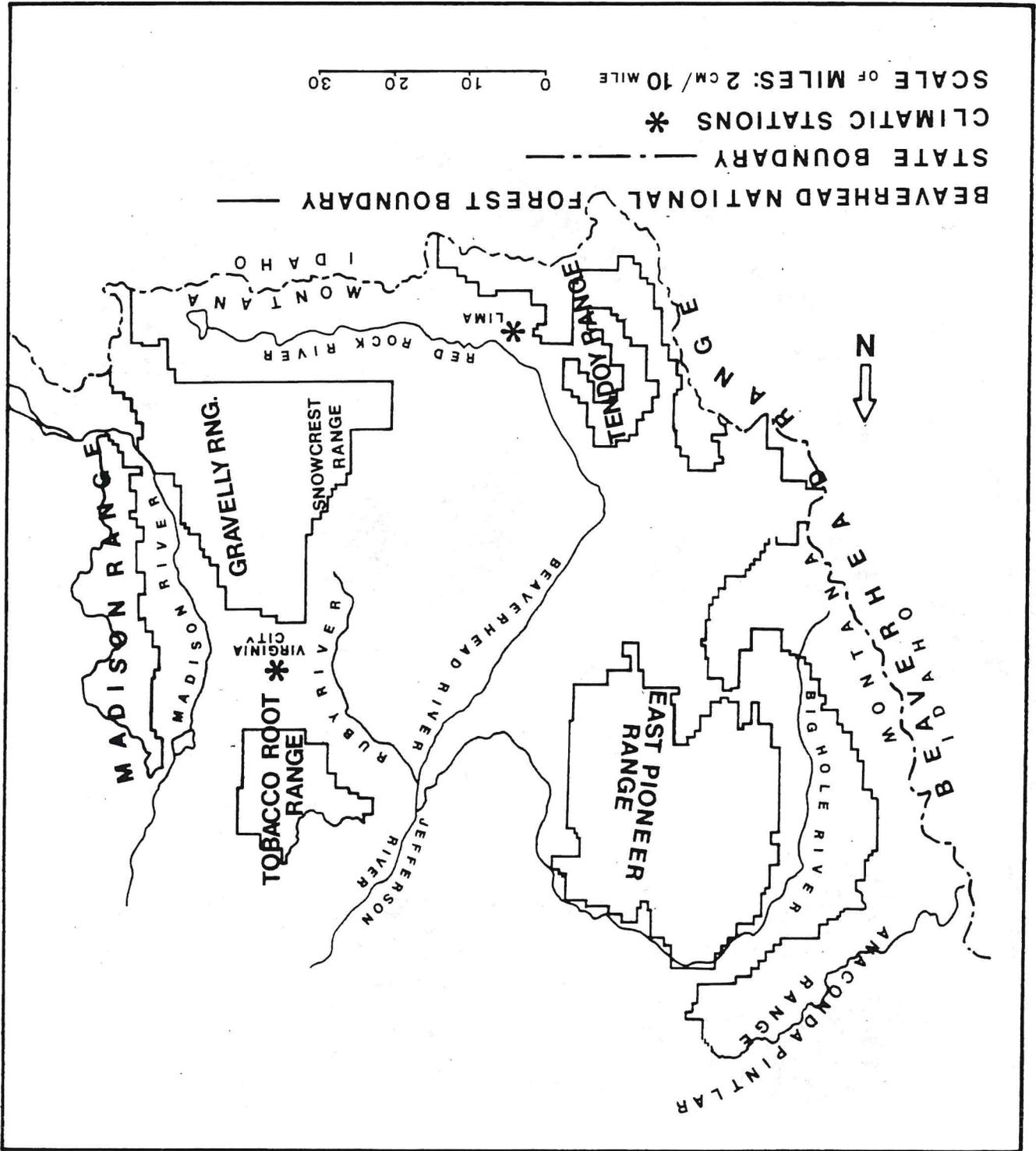
The upper subalpine is composed of <u>Abies</u> <u>lasiocarpa</u>, <u>Picea</u>, <u>Pinus</u> <u>contorta</u>, <u>Pinus</u> <u>albicaulis</u> and occasionally <u>P</u>. <u>flexilis</u> whose proportions depend primarily on successional status, aspect and, to a lesser degree, substrate. Above approximately 8,500 ft the forest canopy becomes progressively more open and dominated by <u>Pinus</u> <u>albicaulis</u>. Near timberline the belt of mostly continuous forest gives way to atolls of stunted and flagged trees interspersed among non-forest vegetation. The extent of true krummholz, trees not reaching much more than waist height due to ice particle abrasion of exposed surfaces, is very limited. Forest communities for this area are detailed by Pfister et al. (1977).

The non-forest communities at or just below timberline are shrub-steppe dominated by <u>Artemisia</u> <u>tridentata</u> ssp. <u>vaseyana</u>, grasslands dominated by <u>Festuca</u> <u>idahoensis</u> and <u>Deschampsia</u> <u>cespitosa</u>, and subalpine forb fields on the moister sites. Many of the plant associations comprising these high elevation steppes have been described by Mueggler and Stewart (1980).

Subalpine cirque basins often contain areas in which soil moisture is above that of the surrounding uplands for at least part of the year. These areas support wetland vegetation dominated by species of <u>Salix</u>, especially <u>S</u>. <u>planifolia</u> and <u>S</u>. <u>wolfii</u>, or by herbaceous species such as <u>Carex</u> <u>scopulorum</u>, <u>Eleocharis</u> <u>pauciflora</u>, <u>Juncus</u> <u>balticus</u> and <u>Caltha</u> <u>leptosepala</u>. Many of these subalpine wetlands are described by Hansen et al. (1991).

Climate

There are no long-term weather records for high-elevation sites in our study area. Walter-type climate diagrams (Walter and Lieth 1960) for Virginia City and Lima are presented in Figure 2. Although these stations are located at 5,776 ft and 6,275 ft respectively (Figure 1), they serve to illustrate the pattern of temperature and precipitation for the area. Precipitation in the alpine zone is undoubtedly higher, and temperatures are lower than at these valley stations. Clearly the seasonal march of precipitation and temperature is very similar for the two stations. Compared to Billing's (1988) diagrams for typical alpine areas in New Hampshire, California and Colorado, our study area pattern is closest to that of Niwot Ridge, Colorado with the notable exception of having a distinct precipitation bulge in May and June. This bulge also sets our study area apart from Sierra Nevada and Appalachian alpine. The relatively droughty conditions (where precipitation curve drops near to or below the temperature curve) portrayed by our valley stations would not obtain in the alpine where precipitation increases and the temperature curve would be depressed by about 5.7 to 6.8°F when extrapolated to the 9,500 ft contour. Such a depression would result in a total of six months with average temperatures below freezing. Some authors characterize alpine tundra as having a climate for which average temperature never exceeds 50°F (Billings 1988). However, the Sierra Nevadan alpine has at least three months exceeding this figure, and our lowest sites would exceed it in July and August.

Ross and Hunter (1976) present precipitation isopleth maps for Montana based on a large number of snow depth recording stations. These maps indicate that precipitation

4

Figure 2. Walter-type climatic diagrams for two stations in the study area, Virginia City and Lima, Montana. Lower case letters indicate the following: (a) station name, (b) station elevation (m), (c) mean annual temperature (°C), (d) mean annual precipitation (mm), (e) monthly march of precipitation, (f) monthly march of temperature (g) relatively humid season (vertical hatching, note axes explicitly scaled so that 10° = 20 mm precipitation), (h) period of relative drought, (i) period of mean daily minimum below 0° C (blackened), (j) months with absolute minimum below 0°C.

5
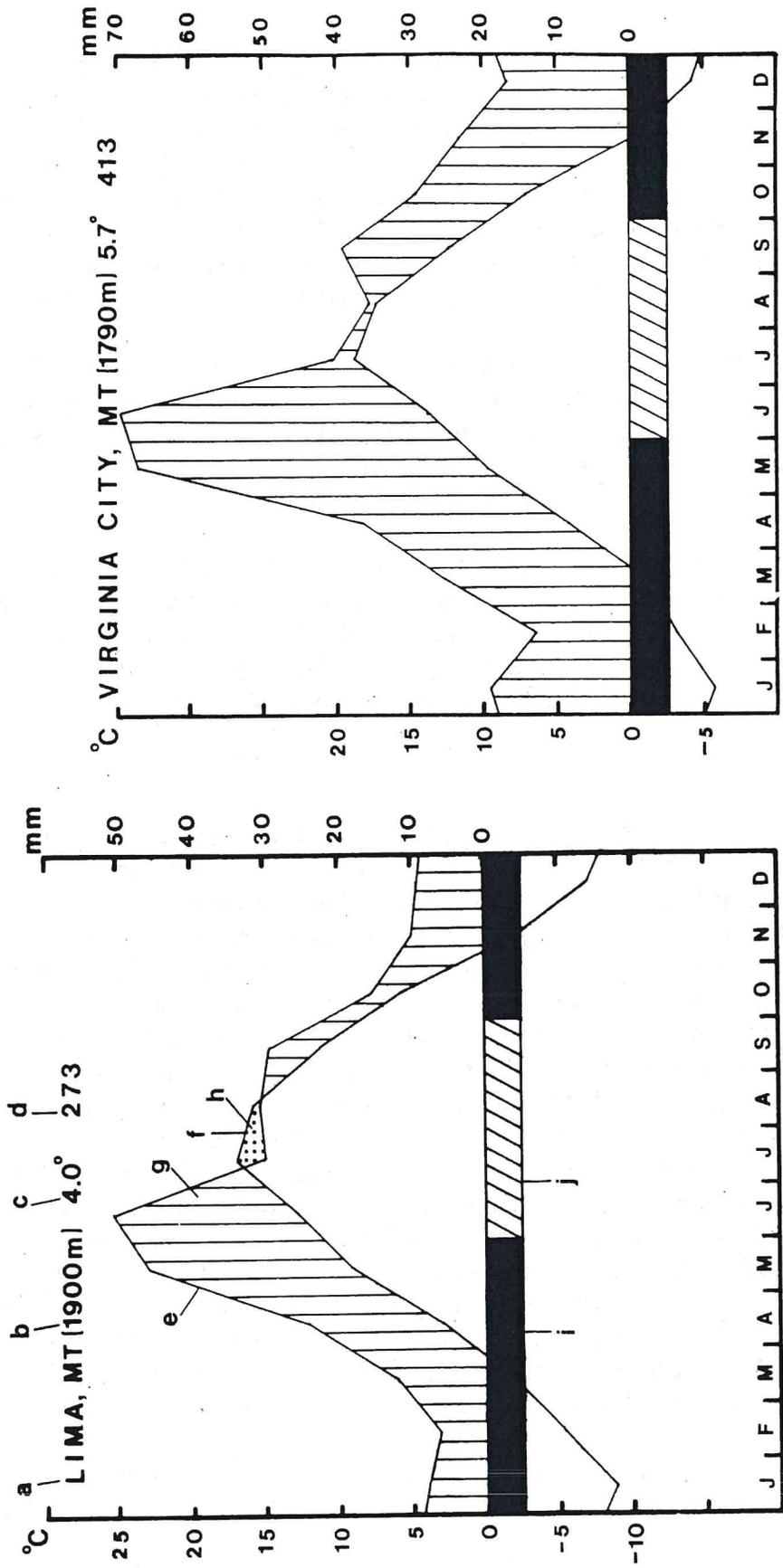
increases from west to east in the southwest part of the state. The crests of Beaverhead, Snowcrest and Tendoy ranges receive approximately 30 in of precipitation annually. The Gravelly Range receives 30-40 in, and the Anaconda, Pioneer and Tobacco Root ranges receive 40-60 in. The Madison Range at the west edge of our study area receives 50-70 in.

Geology and Soils

Representative types from the three major groups of parent materials, sedimentary, metamorphic and igneous, are found in mountain ranges of southwest Montana. Sedimentary and metamorphosed sedimentary rocks predominate in the south and west portions of the study area, while intrusive and metamorphic basement rocks become more common to the east and north (Ross et al. 1955). The crests of the southern Beaverhead, Gravelly, Snowcrest and Tendoy ranges are composed of Mesozoic and upper Paleozoic limestones, sandstones and quartzites. The southern end of the Beaverhead Range is composed of calcareous Beaverhead Conglomerate. The highest point in the Gravelly Range, Black Butte, is a remnant stock of Quaternary basalt. The high country of the Tobacco Root Range is composed of granite of the Tobacco Root Batholith. Most of the alpine terrain in the Pioneer Range is underlain by granite of the Pioneer Batholith; however, the high peaks at the very north end of the range form a contact between the intrusive and Paleozoic limestones and dolomites. Although the main part of the Anaconda Range is granitic, the east end where we sampled is underlain by precambrian quartzites and limestones. The southern end of the Madison Range is composed primarily of Precambrian gneiss and schist with some areas on the east flank underlain by Mesozoic limestone (Ross et al. 1955). A summary of the different parent materials for the plots in each mountain range are presented in Table 1.

Soils supporting alpine vegetation have been described for the Northern Rocky Mountains by Bamberg and Major 1968, Johnson and Billings (1962) Nimlos and McConnell (1962) and Thilenius and Smith (1985). Soils from our study sites on sedimentary parent material resembled those described by Bamberg and Major (1968), while sites with crystalline parent material had soils similar to those described by Johnson and Billings (1962) and Nimlos and McConnell (1962). In general, turf and meadow soils developed from sandstones, limestones and shales were finer textured than those derived from granite, quartzite or metamorphic basement rocks.

Indications of cryopedogenic processes were evident in all of the mountain ranges. Solifluction lobes and terraces were common on steep, moist north slopes. Frost boils, rock polygons and stone stripes were often apparent, especially in the Anaconda, Madison, Pioneer, Tendoy and Tobacco Root ranges. Development of these features has been described by Billings and Mooney (1959), Johnson and Billings (1962), Lewis (1970) and Washburn (1956).

6

Table 1. Distribution of sample plots by mountain range and parent material type. BH = Beaverhead Range, TD = Tendoy Range, SC = Snowcrest Range, GR = Gravelly Range, EP = East Pioneer, AP = Anaconda-Pintlar Range, TR = Tobacco Root Range, MA = Madison Range

	BH	TD	SC	GR	EP	AP	TR	MA	Total by PM
Parent Material									
Calcareous Types									
Limestone/Dolomite	16	01	04	08	05	02	00	03	39
Sandstone	00	00	12	05	00	00	00	00	17
Conglomerate	00	04	02	00	00	00	00	00	06
Mixed	00	01	01	00	02	00	00	00	04
Alluvium	01	00	00	00	00	00	00	00	01
Calcareous Subtotal	17	06	19	13	07	02	00	03	67
Noncalcareous Types									
Sandstone	00	00	00	02	00	00	00	00	02
Quartzite	00	02	00	02	05	05	00	00	14
Siltite	00	00	00	00	00	01	00	00	01
Extrusive Volcanics	00	00	00	08	00	00	00	00	08
Intrusive Volcanics	00	00	00	00	11	00	05	03	19
Metamorphosed Volcanic	00	00	00	00	00	00	12	09	21
Mixed	00	01	00	00	00	00	00	01	02
Alluvium	00	00	00	02	00	00	00	01	03
Noncalcareous Subtotal	00	03	00	14	16	06	17	14	70
Total by Mountain Range	17	09	19	27	23	08	17	17	137

METHODS

Stand Selection

We examined USGS topographic maps and aerial photography in order to determine the upper limit of trees. For most of the study area timberline occurs at approximately 9,500 ft, often higher on warm slopes and lower on north slopes. On the north side of the Anaconda Range at the north end of our study area, timberline occurs at approximately 9,200 ft. All of our sample plots were near or above these limits, and above both the majority of the high elevation Artemisia tridentata ssp. vaseyana dominated shrub steppe, as well as the majority of the scattered treeline stands. Other workers have consistently failed to consider A. tridentata- and A. arbuscula-dominated vegetation as alpine community types, even where this type occurred much above timberline. With one exception, we did not sample Artemisia-dominated communities. Most alpine terrain in our study area is far from major roads. Ease of access to an extensive alpine area was an important consideration in selecting sampling locations.

We sampled stands that appeared homogeneous in composition and structure. Generally, stands were representative of large areas of vegetation; however, wetlands were usually limited in extent. Efforts were made to avoid areas where site variables were not constant (e.g., change in slope or exposed rock) or where vascular plant cover was less than 10%.

Vegetation Sampling

Sample plots were 30 X 30 m with a 30 m tape laid down the middle of the plot perpendicular to the slope. In some cases we had to modify the shape of our macroplot in order to accommodate the shape of stands. We employed Daubenmire's (1959) concept of canopy cover in estimating species abundance. Canopy cover of bare soil, rock, litter, moss and lichens, total shrubs, total graminoids, total forbs, and all vascular plant species in the plot was assigned to one of the following cover classes:

Code	Class Range	Midpoint
0	0	0.0%
T	> 0 - < 1%	0.5%
P	= or > 1 - < 5%	3.0%
1	= or > 5 - < 15%	10.0%
2	= or > 15 - < 25%	20.0%
3	= or > 25 - < 35%	30.0%
4	= or > 35 - < 45%	40.0%
5	= or > 45 - < 55%	50.0%
6	= or > 55 - < 65%	60.0%
7	= or > 65 - < 75%	70.0%
8	= or > 75 - < 85%	80.0%

9	= or > 85 - < 95%	90.0%
F	= or > 95 - 100%	97.5%

At the start of our study we verified the accuracy of whole-plot estimates of canopy cover. We first made whole-plot estimates in the macroplot and then estimated cover in 25-50 randomly placed 50 X 20 cm microplots and used these data to obtain a second estimate of canopy cover for the macroplot. We conducted this test for three plots in alpine grassland and meadow vegetation. Canopy cover estimates from the microplots never differed by more than one cover class from the ocular estimates. In fact, class estimates matched for more than 80% of the species. Thus we concluded that whole-plot ocular estimation of species cover would be appropriate and considerably more efficient than using microplots.

We sampled stands in the Beaverhead, Gravelly, Snowcrest and Tendoy ranges on 18-30 July and 10-12 August, 1989. We sampled stands in the Anaconda, Madison, Pioneer and Tobacco Root ranges from 21 July to 2 August, 1991. Weather was drier than normal in southwest Montana during the winter and spring of 1989, while precipitation in 1991 was above normal.

Vascular plant nomenclature follows generally follows Hitchcock and Cronquist (1973). Nomenclature for willows (Salix spp.) follows Dorn (1984). The genus Poa is very difficult taxonomically, and a number of different treatments have been proposed for western North America. We have chosen to follow the treatment proposed by Arnow (1987). Poa incurva is combined under P. secunda; P. cusickii is combined under P. fendleriana; P. rupicola and P. interior are combined under P. glauca; P. grayana is considered synonymous with P. arctica.

Productivity

To estimate primary productivity we clipped current year's above-ground growth in three 20 X 50 cm microplots placed at 5, 15 and 25 meters along the upper side of the transect line. Clippings were pooled into three life-form classes (shrub, graminoid, forb) for each plot. Clippings were air-dried and then weighed to the nearest 1-gram. Due to the appreciable difference in precipitaion between the two sampling years, productivity estimates were probably lower than average for 1989 and higher for 1991.

Soils

For each plot we collected three soil samples from along the lower side of the transect line at the 5, 15 and 25 meter marks. Each 1-liter sample was collected from below the litter layer to a depth of 6 in. Percent coarse fragments was determined in the field by sieving through 2 mm screen and measuring volumetric displacement of the rock fragments remaining on the screen. Soil pH was determined by preparing 2:1 aqueous suspensions of sieved soil from each sample, allowing the suspension to equilibrate for 10 minutes and measuring pH with a portable Myron L DCH4 digital, temperature compensated meter. Means of the three

measurements from each plot were used to develop the Results narrative. Duff is the fermentation and humus sections of the organic layer. Litter is the surface layer of freshly fallen leaves and twigs.

For each plot we recorded percent slope and aspect with a hand-held clinometer and compass. We recorded elevation to the nearest 10 ft with a barometric altimeter that was calibrated at least once each day. We also took notes on parent material, topographic position, slope shape and erosion.

Data Analysis

Data were summarized using STRATA, USDA Forest Service Region One's ECODATA data reduction program. We used Two-way Indicator Species Analysis (TWINSPAN), a polythetic, divisive, hierarchical clustering technique, to group stands into community types (Gauch 1982). This classification was refined by tabular comparison (Becking 1957, Mueller-Dombois and Ellenberg 1974). For the most part, the two methods agreed closely as to the placement of stands within types. Detrended correspondence analysis (DCA) is a revised version of reciprocal averaging or correspondence analysis (Gauch 1982). We used DECORANA, the Cornell Ecology Program version of DCA (Hill 1979), as an indirect method of determining important environmental gradients controlling vegetative composition.

THE CLASSIFICATION

The results of uor study are delineation of 22 alpine vegetation community types. Brief descriptions of these associations and their habitats are presented below. Mean site variables and their standard deviations are presented in Appendix B, and constancy and average canopy cover for vascular plant species are presented in Appendix C.

Grassland Communities

Grassland communities occurred on gentle to steep slopes at the lower reaches of the alpine zone. They often continue downslope at subalpine elevations or merge into high-elevation sagebrush steppe. The deep soils and relatively warm climate make these some of the most productive sites in our study area. They are similar in graminoid composition to previously described high-elevation grasslands (Mueggler and Stewart 1980), but often contain alpine forb species, such as Polemonium viscosum and Trifolium haydenii, not commonly found in the subalpine zone. Alpine grasslands often grade into turf communities at higher elevations. Grassland communities are dominated by relatively robust grasses, while alpine turf associations are usually dominated by sedges and forbs of shorter stature. Grassland sites are often less wind-exposed than turf communities.

Festuca idahoensis/Potentilla diversifolia c.t.
(FESIDA/POTDIV; Idaho fescue/diverse-leaved cinquefoil)
(12 stands)

Environment- FESIDA/POTDIV was common below 9,900 ft in the Beaverhead, Gravelly, Snowcrest and Tendoy ranges in western portion of our study area. It was most common on warm slopes at the low limit of alpine vegetation (ca. 9,500 ft) where moderate to light snow cover melts off early in the growing season. It abutted subalpine forest dominated by Picea engelmannii, Pinus albicaulis and Pseudotsuga menziesii, or graded into shrublands dominated by Artemisia tridentata ssp. vaseyana below timberline. FESIDA/POTDIV merged with DESCES/POTDIV grassland on moister slopes and with CARELY turf at higher elevations on warm, dry, wind-impacted slopes. The BROPUM phase, dominated by Bromus pumpellianus was locally abundant on cool slopes in the Snowcrest Range.

Vegetation- Mean graminoid cover in FESIDA/POTDIV was 55%. Festuca idahoensis was the dominant graminoid with Agropyron caninum ranking second in abundance. Carex obtusata, Poa secunda, C. scirpoidea and P. arctica were locally common, the former two on warm aspects and the latter two on cooler slopes or level areas with deeper soils. Mean forb cover was 34%. Common forbs were Potentilla diversifolia, Phlox pulvinata and Polemonium viscosum. Polygonum bistortoides, Myosotis sylvatica and Cerastium arvense were frequent, and Geum triflorum and Trifolium haydenii were locally common. Mean cover of lichens and mosses was only 2%.

Bromus pumpellianus (BROPUM) phase- Two stands from cool slopes in the Snowcrest range were dominated by Bromus pumpellianus instead of Festuca idahoensis. Carex obtusata was abundant in one. These stands were otherwise compositionally similar to typical FESIDA/POTDIV.

Soils- Parent material was generally sedimentary, with calcareous limestones and sandstones predominating. Quartzite, calcareous conglomerate and volcanic andesite were also represented. Percent coarse fragments varied from 2-51% with a mean of 20%. Reaction of the soil was near-neutral (pH=6.7-7.5) with a mean pH of 7.2. Mean litter depth was 0.6 in, and mean duff depth was 0.3 in. Bare ground and gravel covered 11% of the surface.

Productivity- Graminoid productivity varied between 180 and 1,130 lbs/acre with a mean of 726 lbs/acre. Forb productivity varied between 160 and 1,270 lbs/acre with a mean of 778 lbs/acre. Mean total productivity for FESIDA/POTDIV was 1,504 lbs/acre. Productivity was highest on deep soils.

Other Studies- FESIDA/POTDIV could be considered a high-elevation phase of Mueggler and Stewart's (1980) Festuca idahoensis/Agropyron caninum habitat type. Although the dominant graminoids in the two types are similar, the important forbs are different. Potentilla gracilis, Geum triflorum and Achillea millefolium are the most abundant forbs in the lower-elevation type. Alpine grasslands similar to FESIDA/POTDIV were described for

east-central Idaho (Moseley 1985, Caicco 1983) where they were characterized by having the highest snow-deposition of all alpine communities (Moseley 1985).

<u>Deschampsia</u> <u>cespitosa</u>/<u>Potentilla</u> <u>diversifolia</u> c.t.
(DESCES/POTDIV; Tufted hairgrass/divers-leaved cinquefoil)
(6 stands)

Environment- This community type occurred from timberline up to over 10,000 ft in the Gravelly, Madison and Snowcrest ranges, but small examples can probably be found in all of the wetter ranges in our study area. It was confined to cool slopes, valley bottoms and depressions where soils were deep and remained moist until at least mid-summer. This community type occupied the most mesic situations in the lower alpine zone. Snow cover during winter protects the plants, and although snow release comes moderately early in the season, the sites are often fed by meltwater from upslope snowfields. DESCES/POTDIV was abundant on the old erosion terraces of the Gravelly Range and was often associated with slopes showing evidence of solifluction. This community type generally occurred in a matrix of drier grassland and moist or dry turf vegetation. It also graded into wetland communities, especially DESCES/CALLEP. In the Gravelly Range it sometimes occurred above shrublands dominated by <u>Artemisia</u> <u>tridentata</u> ssp. <u>vaseyana</u> or subalpine forests dominated by <u>Picea</u> <u>engelmannii</u>.

Vegetation- Graminoid cover in DESCES/POTDIV was high, averaging 78% and exceeded only by that of the CARSCO/CALLEP marsh community. <u>Deschampsia</u> <u>cespitosa</u> was the dominant graminoid, often forming large tussocks. <u>Carex</u> <u>atrata</u> and <u>Phleum</u> <u>alpinum</u> were also important. <u>Festuca</u> <u>idahoensis</u> was common in stands at lower elevations, and <u>Carex</u> <u>phaeocephala</u> and <u>Juncus</u> <u>balticus</u> were locally common. The latter may have increased under the influence of livestock grazing. Mean forb cover was 37%. <u>Potentilla</u> <u>diversifolia</u>, <u>Polygonum</u> <u>bistortoides</u> and <u>Senecio</u> <u>crassulus</u> were the most abundant forbs. <u>Cerastium</u> <u>arvense</u>, <u>Ranunculus</u> <u>eschscholtzii</u> and <u>Saxifraga</u> <u>oregana</u> were also common. <u>Mertensia</u> <u>ciliata</u> was abundant in one stand. Mean cover of lichens and mosses was 3%.

Soils- Parent materials for these stands were sandstone, limestone, quartzite and gneiss. This type had the lowest coarse fragment content, ranging from 0-19% with a mean of 8%. Bare ground and gravel covered 6% of the surface. Soil reaction varied from a low of 6.0 on soils derived from gneiss to 7.0 on soils derived from limestone and calcareous sandstone. Mean pH for the type was 6.5. Mean depths of litter and duff was 0.4 in and 0.8 in respectively. Generally soils supporting this community type were deep with dark, mollic-appearing epipedons and high moisture content throughout much of the growing season.

Productivity- Graminoid productivity varied between 850 and 2350 lbs/acre with a mean of 938 lbs/acre. Forb productivity ranged from 180 to 875 lbs/acre with a mean of 729 lbs/acre. Mean total productivity was 1667 lbs/acre and was highest on warmer aspects.

Other Studies- DESCES/POTDIV at lower elevations is very similar in environment and composition to Mueggler and Stewart's (1980) Festuca idahoensis/ Deschampsia cespitosa habitat type. Mueggler and Stewart's FEID/DECA probably also encompasses our moist turf community type, CARSCI/POTDIV. These authors state that productivity of their type probably ranges between 1200 and 1500 lbs/acre, somewhat lower than what we measured. Johnson and Billings (1962) described wet meadows dominated by D. cespitosa and Carex scopulorum in the Beartooth Mountains of south-central Montana, and Lesica (1991) reported that drier communities dominated by D. cespitosa and Geum rossii also occur in this range. Lewis (1970) described alpine meadow communities from the Uinta Mountains of Utah that were dominated by D. cespitosa, Polygonum bistortoides, and Geum rossii. These types differs by having G. rossii instead of P. diversifolia and by the greater prominence of Trifolium spp. Bonham and Ward (1970) and Komarkova and Webber (1978) described similar communities in Colorado with G. rossii and Trifolium parryi. This community type in Rocky Mountain National Park, Colorado did not have an abundance of T. parryi, and Willard (1979) believes that this species has increased under the influence of livestock grazing in unprotected areas outside the park. Meadows dominated by D. cespitosa are reported for the Cascade Range of Washington (Hamann 1972 as cited in Willard 1979). In North America, similar associations are best developed in the Rocky Mountains from southern Montana south.

Hesperochloa kingii/Oxytropis campestris c.t.
(HESKIN/OXYCAM; Spike fescue/field crazyweed)
(3 stands)

Environment- HESKIN/OXYCAM is a minor type occurring at 9,500-9,800 ft on moderate to steep slopes, generally with warm aspects. Extensive stands of this type occurred only in the Beaverhead and Tendoy ranges, the westernmost and driest part of our study area. Although not particularly windswept, these areas receive little precipitation and snowmelt occurs early. HESKIN/OXYCAM most often occurred in a mosaic of FESIDA/POTDIV grassland and CARELY turf communities. It generally occurred in stonier soils than other grassland types and at lower elevations than turf communities. Subalpine grasslands and shublands dominated by Artemisia tridentata ssp. vaseyana generally occurred at lower elevations.

Vegetation- Mean graminoid cover was 37%. Hesperochloa kingii (=Leucopoa kingii) was the dominant grass. Agropyron spicatum and Poa fendleriana were present in all three stands. Mean forb cover was 23%. Common forbs included Oxytropis campestris, Phlox hoodii, Erigeron compositus and Cymopterus bipinnatus. The subshrub Artemisia frigida was a minor component of all three stands, and the shrubs, A. tridentata and Chrysothamnus viscidiflorus were minor components in the lowest stand that bordered subalpine shrublands. Mean cover of lichens and mosses was less than 1%.

Soils- HESKIN/OXYCAM occurred only on soils derived from calcareous parent material, either limestone or Beaverhead conglomerate. Percent coarse fragments ranged from 33-65% with a mean of 51%. Bare ground and gravel covered 21% of the surface, and rock cover was averaged 9%. Soil reaction varied from 7.3-7.5, with a mean pH of 7.4. Mean depths of litter and duff were 0.3 and 0.2 respectively. This community occurred on the shallowest and stoniest soils of any grassland type.

Productivity- Graminoid productivity varied between 275 and 875 lbs/acre with a mean of 613 lbs/acre. Forb productivity ranged from 250 to 600 lbs/acre with a mean of 399 lbs/acre. Shrub productivity in the lowest stand was 253 lbs/acre. Mean total productivity was 1096 lbs/acre, appreciably less than that of the other two grassland types.

Other Studies- Although Hesperochloa kingii occurs throughout much of the western U.S., similar alpine grassland associations have only been described for the calcareous ranges of east-central Idaho (Caicco 1983, Moseley 1985) and northwest Utah (Preece 1950, Ream 1964). In Idaho, where this association is more common, two types based on differences in soil stability are recognized (Moseley 1985).

Turf Communities

We define turf as vegetation dominated by dwarf, fibrous-rooted graminoids, usually Carex spp. (Johnson and Billings 1962, Eddleman and Ward 1984). May and Webber (1984) have referred to these sites as dry meadow, which seems a contradiction in terms, as meadows have traditionally been conceived of as relatively moist (Daubenmire 1968). Forb-dominated sites have also been characterized as turf (Thilenius and Smith 1985). Turf communities are consistently associated with wind-scouring of winter snow, gentle terrain (ridgetops and slope shoulders), a dense, generally continuous plant cover, and appreciable soil development. As wind-exposure increases and soil becomes more stony and shallow, turf vegetation grades into cushion plant communities.

Carex elynoides c.t.
(CARELY; blackroot sedge)
(24 stands)

Environment- CARELY was the most frequently sampled c.t. It was found in all eight mountain ranges and is undoubtedly the most extensive alpine vegetation type in our study area. It was most extensive in the drier Tendoy, Beaverhead, and Snowcrest ranges. CARELY spanned a considerable range in elevation, 9,360 to 10,360 ft. All sites, because of topographic position and orientation, were inferred to be highly wind-impacted and blown free of winter snow. More than half the stands occurred on ridge crests or shoulders with less than 20% slope. Most of the remainder were on moderate to steep southwest- to west-facing slopes. This type often graded to grassland c.t's. or CARSCI/POTDIV c.t. of more

protected, moister sites and cushion plant dominated sites with yet greater wind impact. Mean exposed bare soil, gravel and rock (23%) was slightly greater than for grassland types; however, sites grading to cushion plant communities had as much as 70% substrate exposure.

Vegetation- CARELY was characterized by a short (< 4 in) usually dense ground cover of fibrous-rooted graminoids (ave. c.c. 46%) and forbs. Carex elynoides was strongly dominant (100 constant, 27% c.c.) followed in decreasing order by the turf-formers Carex rupestris and Festuca ovina. Our concept of this c.t. is broader than that of others. We did not separate C. rupestris or F. ovina dominated stands from those dominated by C. elynoides. Other common graminoids were Calamagrostis purpurascens, Poa glauca, and Hesperochloa kingii. Average forb cover was 31%, only slightly less than and composition largely overlapping that of grassland types. The dominance of Phlox pulvinata and Selaginella densa and the presence and occasional dominance of cushion plants set this type apart from grasslands. Forbs with high (>50%) constancy included Cymopterus bipinnatus, Besseya wyomingensis, Hymenoxys grandiflora, Oxytropis campestris, Potentilla diversifolia, and P. ovina.

Soils- Parent materials were predominantly calcareous limestones and sandstones, but quartzites and gneiss were also represented. Percent coarse fragments ranged from 8 to 75% with a mean of 33%, a figure intermediate between the grassland and cushion plant c.t's. Soil reactions were slightly more basic than those of grasslands with an average pH of 7.5 for calcareous materials and 6.4 for noncalcareous substrates. Mean litter and duff depths were, respectively, 0.4 and 0.3 in.

Productivity- A nearly ten-fold range in productivity was recorded for both graminoids (80 to 682 lbs/acre) and forbs (115 to 977 lbs/acre). Average productivities for graminoids, forbs and community total were respectively, 398, 398, and 796 lbs/acre. A cline of decreasing productivity occurred from solid turf conditions to near cushion plant conditions.

Other Studies- Carex elynoides turf communities are reported from similar environments in neighboring ranges in Idaho (Moseley 1985, Caicco 1983), calcareous sites in Montana (Bamberg and Major 1968), the Beartooth Plateau of Wyoming/Montana (Johnson and Billings 1962), throughout Colorado (Eddleman and Ward 1984, Willard 1979, Komarkova and Webber 1978), the Uinta Range of Utah (Lewis 1970) and south to New Mexico (Baker 1983) and the Great Basin of Nevada (Loope 1969). Johnson and Billings (1962) consider C. elynoides and G. rossii dominated turf to be the climax vegetation type of their study area. Similar vegetation is not reported for the cooler and moister ranges to the north and west of our study area.

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Carex scirpoidea/Potentilla diversifolia c.t.
(CARSCI/POTDIV; northern single-spike sedge/diverse-leaved cinquefoil)
(7 stands)

</div>

Environment- CARSCI/POTDIV is a moist turf type that was found in ranges with higher precipitation (Gravelly, Snowcrest, Anaconda-Pintlar and Madison). It occurred from 9,300 to 10,320 ft associated with gentle, not nearly so wind-impacted slopes as those of the CARELY c.t. Most of the sites had evidence of frost-sorting or solifluction lobes (slopes > 20%). We hypothesize these sites are turf because they occur in windswept positions (little winter snow accumulation), but they are also moist, being in runoff collecting positions or if on slopes then ones with low solar insolation (north-facing). CARSCI/POTDIV grades to CARELY on upper slopes and to wet meadows or snowbed communities of yet wetter sites. With the exception of wet meadow c.t.'s, CARSCI/POTDIV had less exposed soil and rock (4%) than any other graminoid dominated c.t.

Vegetation- We consider dominance of Carex scirpoidea, C. atrata, C. phaeocephala or C. obtusata in the graminoid layer to be diagnostic for this c.t. Graminoid canopy cover averaged 66%, of which 35% was C. scirpoidea. Carex elynoides, C. rupestris, Festuca ovina and Calamagrostis purpurascens were strongly represented. Agropyron caninum, Luzula spicata and Poa alpina had high constancy and low coverage. Average forb coverage (47%) was high, reflecting the favorable moisture status of these sites. Forbs with high constancy (> 50%) included those more typical of moist sites such as Lloydia serotina, Erigeron simplex, Polygonum bistortoides, P. viviparum and Zigadenus elegans. Other high-constancy forbs included Cerastium arvense, Hymenoxys grandiflora, Lupinus argentea, Pedicularis parryi, Solidago multiradiata, and most characteristically Potentilla diversifolia. Those more typical of dry turf or cushion plant communities included Arenaria obtusiloba, Oxytropis campestris and Phlox pulvinata.

Soils- Samples were about evenly divided between calcareous (limestone and conglomerate) and noncalcareous (basalt, granite and quartzite) substrates. Coarse fragment content ranged from 0 to 31% and averaged 9%. Soil reaction was strongly conditioned by substrate type, averaging 7.2 for calcareous and 5.8 for noncalcareous types; both values were distinctly lower than for the drier turf types. Average litter and duff depth were, respectively 0.6 and 0.4 in.

Productivity- The range in total productivity was relatively narrow, 1,127 to 1,426 lbs/acre (1283 lbs/acre average), with graminoids averaging 743 and forbs 540 lbs/acre. These high values relative to CARELY c.t. (ave. 796 lbs/acre) further substantiate the high moisture status of the CARSCI/POTDIV c.t.

Other Studies- Douglas and Bliss (1977) describe a Carex scirpoidea var. scirpoidea c.t. from the eastern North Cascades of Washington that is vegetationally and physiognomically very similar to CARSCI/POTDIV. However, their c.t. represents the dry, early snow-free end of an alpine continuum. Their c.t. was found on well-drained slopes of all aspects.

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Stand tables from Bamberg and Major (1968) show plots for the Big Snowy Mountains of Montana that conform to our conception of this c.t.

Carex scirpoidea/Geum rossii c.t.
(CARSCI/GEUROS; northern single-spike sedge/Ross' avens)
(13 stands)

Environment- We envision CARSCI/GEUROS as a geographic/substrate variant of CARSCI/POTDIV. It was a common community type in those relatively moist mountain ranges dominated by granitic or metamorphosed intrusive volcanics, the East Pioneers and Tobacco Roots. It was also found in the Madison Range, exclusively on gneiss. It spanned the full range of alpine elevations, from 9,300 to 10,320 ft. Sample sites were about evenly divided between low gradient slopes and steeper slopes. All aspects were represented. Most characteristic was some degree of enhanced effective moisture through increased snowpack or delayed snowmelt. CARSCI/GEUROS had ten times the amount of exposed soil/gravel and rock as CARSCI/POTDIV. Often CARSCI/GEUROS turf occurred as patches scattered among boulders which act as snow fences creating eddy currents and increased snowpack. CARSCI/GEUROS graded to drier turf types, usually CARELY, of more exposed positions and to DRY SLOPE or MOIST SLOPE c.t's. of steeper, unstable slopes.

Vegetation- Graminoid c.c. averaged only 37%, of which 24% was Carex scirpoidea. Carex phaeocephala, C. atrata and C. albonigra were also dominant in at least one stand. Common turf graminoids C. rupestris, C. elynoides and Festuca ovina had moderate coverages or high constancy but are much less important than in the CARSCI/POTDIV c.t. Other graminoids with high constancy were Luzula spicata, Poa alpina, P. secunda and Trisetum spicatum. The wettest sites had moderate coverages of Deschampsia cespitosa. CARSCI/GEUROS forb coverage averaged 51%, very similar to that of CARSCI/POTDIV. With the exception of Geum rossii, which was 100% constant and averaged 37% c.c. in this type, the two C. scirpoidea-dominated turf types had many forb species of high constancy or coverage in common e.g., Arenaria obtusiloba, Potentilla diversifolia, Phlox pulvinata, Polygonum bistortoides, Erigeron simplex, Lloydia serotina and Lupinus argenteus. Nonetheless, these two mesic turf types had fewer herbs in common (55) than were found in only one of the two types (63).

Soils- Coarse fragment content ranged from 6 to 39% and averaged 19%. pH values were low, averaging 5.9 and ranging from 5.5 to 6.3. This is a reflection of the fact that all soils were developed on intrusive igneous or metamorphosed forms thereof. Both litter and duff depths were shallow (0.2 in).

Productivity- The high degree of variability in productivity appears to be directly associated with the amount of substrate exposed. Total productivity ranged from 236 to 2669 lbs/acre and averaged 964 lbs/acre, 272 and 692 lbs/acre for graminoids and forbs, respectively.

Other Studies- The Carex scirpoidea var. scirpoidea c.t. described by Douglas and Bliss (1977) for the eastern North Cascades has strong floristic similarity with our CARSCI/GEUROS c.t., except their type lacks Geum rossii, However, their CARSCI c.t. represents drier portions of moisture/snowmelt gradients from a much wetter climatic regime. Conversely, Thilenius and Smith (1985) describe as the moistest of their Absaroka Range alpine sites a Geum rossii-Trifolium parryi c.t. whose environmental parameters resemble those of CARSCI/GEUROS but whose vegetation differs by having C. scirpoidea replaced by C. ebenea. Lewis (1970) described vegetation dominated by Carex scirpoidea, Geum rossii and Deschampsia cespitosa from Utah's Uinta Mountains. Well-drained sites were dominated by C. scirpoidea, while D. cespitosa dominated areas of impeded drainage.

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Dryas octopetala/Polygonum viviparum
DRYOCT/POLVIV; white dryas/viviparous bistort
(3 stands)

</div>

Environment- This minor type was found in both the wettest, (Anaconda and Madison) and driest (Tendoy) ranges. Small occurrences of this type were noted but not sampled in other mountain ranges. This vegetation was generally found on northerly-facing gentle to steep slopes. Evidence of disturbance, including solifluction, slumps and earthflows, were also common. Only trace amounts of rock were exposed but gravel ranged from 5 to 30%.

Vegetation- Mats of Dryas octopetala, ranging in cover from 30 to 80%, and Salix reticulata (5-20% c.c) provided the dominant aspect of this c.t. Graminoid canopy cover was low, not exceeding 5%, and composed of the common turf species Carex elynoides, C. rupestris, and Festuca ovina as well as Poa alpina. Average forb cover was also relatively low, 14%, with dominance shared among the diagnostic species for the type, Polygonum viviparum, P. bistortoides, Zigadenus elegans and Oxytropis viscida. Other forbs with high constancy, low coverage and some degree of fidelity to this type were Lloydia serotina, Senecio crassulus, Smelowskia calycina, Oxytropis campestris and Pedicularis cystopteridifolia. Two plots had moss and lichen coverages in excess of 50% adding to the impression of a smooth blanket of vegetation.

Soils- Parent materials were limestone and quartzite. Coarse fragment content ranged from 8 to 45% and averaged 30%. Soil reaction for calcareous sites ranged from 7.4 to 7.6; the lone quartzite sample was more than one unit lower, 6.15. Average litter and duff depth were, respectively 0.4 and 0.5 in.

Productivity- Of the two plots clipped, the one from the rocky site registered only 548 lbs/acre (46% shrub) whereas the one with only trace amounts of exposed rock and soil supported 1229 lbs/acre (97% shrub).

Other Studies- Vegetation similar to DRYOCT/POLVIV is common in the Canadian Rockies (Achuff and Corns 1982, Hrapko and LaRoi 1978). Canadian types have high diversity of

lichens and mosses and are considered successionally mature. Concentrating on calcareous substrates of several Montana ranges Bamberg and Major (1968) sampled many stands of what they termed zonal alpine vegetation, but did not explicitly group stands into community types. On the basis of their stand tables it appears DRYOCT/POLVIV is a major c.t. in Glacier National Park and Big Snowy Mountains. A very similar turf type occurs in the Flint Creek Range. In the Colorado Rockies, Willard (1979) described moist fellfield communities dominated by D. octopetala with significant P. viviparum cover and lichens and mosses, but lacking dwarf Salix spp.; she described dwarf willow communities as being confined to snowbed environments.

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Salix arctica/Polygonum bistortoides c.t.
(SALARC/POLBIS; Arctic willow/American bistort)
(2 stands)
</div>

Environment- Though our definition of this c.t. is based on only two plots, the fact that this type is recognized elsewhere in the Rocky Mountains allows us to compare and interpret our meager data. Sites occurred in the East Pioneer and Anaconda-Pintlar Ranges on lower to mid-slopes of gentle terrain. We interpret these sites as wetland/turf hybrids in terms of both environment and vegetation. Both sites were potentially in water-receiving positions; one community was intercalated between snowbeds upslope and drier turf c.t's. downslope, while the other was developed on an ephemeral spring with spongy ground throughout. Landscape positions of SALARC/POLBIS were much like those supporting SALRET/CALLEP but with a higher probability of wind scouring. Vegetation composition also indicated a drier environment than that of SALRET/CALLEP.

Vegetation- These stands were dominated by Salix arctica (50% c.c.) with reduced amounts of Dryas octopetala. Moss coverages in excess of 50% added to the visual impression of blanket vegetation. Graminoid cover averaged 15%, contributed mostly by Poa alpina and moist-site Carex spp., C. albonigra, C. phaeocephala or C. nova. Forb cover averaged 30%. The diagnostic forb, Polygonum bistortoides (10% c.c.), was among several with relatively high coverages, including P. viviparum, Geum rossii, Potentilla diversifolia, Aster alpigenus and Claytonia lanceolata.

Soils- Parent material included quartzite and granite-limestone mix from a contact zone. Coarse fragment content ranged from 19 to 33%. Soil reactions were slightly acid, averaging 6.50. Average litter and duff depth were 0.1 and 0.4, respectively.

Productivity- Total productivity ranged from 798 to 1,095 lbs/acre with shrub productivity constituting 32 to 81% of the total; graminoid and forb coverage were 148 and 295 lbs/acre, respectively.

Other Studies- Salix arctica dominates in some snowbed communities of the Canadian Rockies (Achuff and Corns 1982, Hrapko and LaRoi 1978). Potentilla diversifolia and

Polygonum viviparum were common species in their type; however, snowbed indicator species, such as Antennaria lanata, Phyllodoce glandulifera and Cassiope mertensiana were also common.   Johnson and Billings (1962) discuss small disturbance sites within moist Deschampsia meadows with vegetation very similar to SALARC/POLBIS (see Other Studies section SALRET/CALLEP for expanded discussion). In the Colorado Rockies Willard (1979) described snowbed vegetation dominated by S. arctica; her community type had high cover of Geum rossii, Polygonum spp., Festuca ovina, mosses and lichens and was more similar to that of our study area.

Cushion Plant Communities

Cushion plant communities occurred on extremely wind-exposed sites, often on ridge tops or saddles. Such sites have little winter snow cover and receive abundant direct insolation. As a result, these were the most xeric high-elevation sites and may be thought of as alpine deserts. Soils on these windy, unproductive sites were shallow, stony, low in organic matter and poorly developed, strongly reflecting the composition of the parent material. Wind deflation often resulted in a gravelly pavement. Cushion plants, with their low, compact growth form, were favored in this dry, windy, cold environment. Unlike most other habitats, graminoids were generally less abundant than forbs. Dryas octopetala, a low, mat-forming shrub dominated one of the community types.

Carex rupestris/Potentilla ovina c.t.
(CARRUP/POTOVI; Curly sedge/sheep cinquefoil)
(8 stands)

Environment- CARRUP/POTOVI occurred on exposed, windswept upper slopes, saddles and ridgetops, generally on soils developed from calcareous parent materials in the Beaverhead, Madison, Pioneer and Tendoy ranges. Elevations ranged from 9,500 to 10,400 ft. CARRUP/POTOVI generally graded into the CARELY or CARSCI/POTDIV turf communities in deeper soils on more protected slopes.

Vegetation- Mean graminoid cover was 11%. Dominant graminoids were Carex rupestris, Festuca ovina, and Hesperochloa kingii. Carex elynoides was common in some stands. Mean forb cover was 29%. Common forbs included Potentilla ovina, Arenaria obtusiloba, Oxytropis campestris and Phlox pulvinata. Eritrichium nanum, Bupleurum americanum, Cymopterus bipinnatus, Erigeron compositus and Senecio canus were uncommon but frequent. Trifolium haydenii, Selaginella densa and Silene acaulis were well represented. The shrub, Potentilla fruticosa, was present in one stand. Lichen and moss cover was less than 2%.

Soils- Parent material was quartzite in one stand and limestone in the remaining seven stands. Percent coarse fragments ranged from 40-66% with a mean of 57%. Bare ground and gravel

covered 67% of the surface. Soil pH varied from 6.9 to 8.2 with a mean of 7.8; pH from the seven plots on limestone varied from 7.5 to 8.2 with a mean of 7.9. Mean depths of litter and duff were both 0.1 in.

Productivity- Graminoid productivity varied from 35 to 253 lbs/acre with a mean of 112 lbs/acre. Forb productivity ranged from 89 to 759 lbs/acre with a mean of 277 lbs/acre. Mean total productivity was 389 lbs/acre. Cushion plant productivity is difficult to measure; thus, the forb estimates are only rough approximations. However, this community type was among the least productive in our study area.

Other Studies- Carex rupestris is a common dominant of windswept fellfields in the Rocky Mountains. Lewis (1970) describes cushion plant communities in the Uinta Mountains of Utah dominated by C. rupestris, Festuca ovina and cushion plants such as Silene acaulis and Trifolium nanum. Willard (1979) describes a dry turf association dominated by C. rupestris, Potentilla nivalis and Silene acaulis for Rocky Mountain National Park in Colorado, and Komarkova and Webber (1978) report a fellfield community dominated by C. rupestris and Kobresia myosuroides from just south on Niwot Ridge. Moseley (1985) describes similar limestone fellfields dominated by Potentilla ovina from east-central Idaho.

In our study area CARRUP/POTOVI is mainly confined to calcareous parent materials, and Potentilla ovina, one of the dominant forbs, is a calciphile at high elevations in our study area. In the limestone mountains to the north, most C. rupestris associations are also dominated by Dryas spp. (Bamberg and Major 1968, Achuff and Corns 1982). To the east and south of our study area, C. rupestris fellfield communities on crystalline parent material are often codominated by Geum rossii or Dryas octopetala (Bliss 1956, Johnson and Billings 1962, Willard 1979). This c.t. may be endemic to limestone ranges of southwest Montana and adjacent east-central Idaho.

<u>Geum rossii/Arenaria obtusiloba</u> c.t.
(GEUROS/AREOBT; Ross' avens/arctic sandwort)
(5 stands)

Environment- GEUROS/AREOBT was common on exposed, windswept upper slopes, saddles and ridgetops between 9,800 and 10,400 ft in the Pioneer and Tobacco Root ranges. This type occurred only on soils developed from crystalline parent material. This sparsely vegetated association usually graded into the CARSCI/GEUROS turf community in deeper soils on more protected slopes.

Vegetation- Mean graminoid cover was only 4%. Festuca ovina was the only common graminoid. Luzula spicata and Carex elynoides had low coverage but were frequent, and Carex rupestris and Trisetum spicatum were locally common. Mean cover of forbs was 30%. Geum rossii was the most common forb; Arenaria obtusiloba, Eritrichium nanum, Phlox pulvinata and Silene acaulis were common cushion plants. Selaginella densa and S. watsonii

were locally abundant. Trace amounts of the shrubs, <u>Ribes</u> <u>hendersonii</u> and <u>Dryas</u> <u>octopetala</u>, occurred in one stand. Cover of mosses and lichens was less than 1%.

Soils- Parent materials were granite and quartzite. Percent coarse fragments varied from 35-70% with a mean of 49%. Bare ground and gravel covered 47% of the surface. Soil pH ranged from 6.2 to 6.6 with a mean of 6.4. Mean depths of litter and duff were both less than 0.1 in.

Productivity- Graminoid productivity ranged from 0 to 118 lbs/acre with a mean of 41 lbs/acre. Forb productivity varied from 192 to 651 lbs/acre with a mean of 453 lbs/acre. Mean total productivity was 494 lbs/acre. Cushion plant productivity is difficult to measure; thus, the forb estimates are only rough approximations. The low total productivity resulted mainly from the small graminoid contribution.

Other Studies- Fellfields and cushion plant communities similar to GEUROS/AREOBT are common in the Rocky Mountains of southern Montana south to Colorado. Bamberg and Major (1968) describe a fellfield community from the Flint Creek Range of Montana that is dominated by <u>G. rossii</u>, <u>Carex</u> <u>elynoides</u>, <u>Lupinus</u> <u>argenteus</u> and <u>Potentilla</u> <u>concinna</u>. Cushion plant communities in the Beartooth Range of Montana and Wyoming are dominated by <u>G. rossii</u>, <u>Carex</u> <u>rupestris</u>, <u>Arenaria</u> <u>obtusiloba</u>, <u>Silene</u> <u>acaulis</u> and <u>Trifolium</u> <u>nanum</u> (Johnson and Billings 1962, Lesica 1991). Bliss (1956) describes ridgetop vegetation in the Medicine Bow Mountains of Wyoming dominated by <u>Carex</u> <u>rupestris</u> and cushion plants such as <u>Paronychia</u> <u>pulvinata</u>, <u>Selaginella</u> <u>densa</u>, <u>Arenaria</u> <u>obtusiloba</u>, <u>Phlox</u> <u>caespitosa</u> and <u>Trifolium</u> <u>dasyphyllum</u>. <u>Geum</u> <u>rossii</u> was present but of secondary importance. Similar associations with varying amounts of <u>Geum</u> <u>rossii</u> have been described from Wyoming's Absaroka Range (Thilenius and Smith 1985) and the Uinta Range in Utah (Lewis 1970). In the Rocky Mountains of Colorado, exposed ridges and fellfields are dominated by cushion plants, such as <u>Trifolium</u> <u>dasyphyllum</u>, <u>Paronychia</u> <u>pulvinata</u>, <u>Silene</u> <u>acaulis</u> and <u>Arenaria</u> <u>obtusiloba</u> as well as <u>Carex</u> <u>rupestris</u> and <u>Kobresia</u> <u>myosuroides</u> (Komarkova and Webber 1978, Willard 1979). <u>Geum</u> <u>rossii</u> is dominant in turf communities but is of secondary importance in cushion plant associations in these areas.

<u>Dryas</u> <u>octopetala</u>/<u>Carex</u> <u>rupestris</u> c.t.
(DRYOCT/CARRUP; Mountain avens/curly sedge)
(5 stands)

Environment- This sparsely vegetated community type occurred on broad ridge tops, shoulders, saddles and upper slopes at 9,200-9,700 ft in the Pioneer and Anaconda ranges. Distinct patterning was apparent, with <u>Dryas</u> <u>octopetala</u> forming mats surrounded by bare ground or rock pavement. Mats were either evenly spaced or aligned along the edge of stepped terraces or wind rows. Bamberg and Major (1968) report that <u>Dryas</u> mats in the Big Snowy Range of Montana demonstrated appreciable yearly downslope movement. However, wind rows at Siyeh Pass in Glacier Park were relatively stable. DRYOCT/CARRUP usually

occurred in a matrix of dry or moist turf communities such as CARELY or CARSCI/POTDIV. This community type is closely related to DRYOCT/POLVIV, and the two may intergrade. However, DRYOCT/POLVIV occurred on wetter sites, had higher total cover, and had more species, such as Salix reticulata, Polygonum spp., and Poa alpina, indicative of mesic conditions.

Vegetation- Mean cover of dwarf shrubs was 38%. Dryas octopetala was the only common species; Cassiope mertensiana, Potentilla fruticosa and Salix arctica each occurred in one stand. Mean graminoid cover was 13%. Common species included Carex rupestris and C. elynoides. Calamagrostis purpurascens, Festuca ovina and Poa secunda were locally distributed. Mean forb cover was only 15%, the second lowest value among all community types. Oxytropis campestris and Phlox pulvinata were common species found in most stands. Anemone drummondii, Arenaria obtusiloba, Douglasia montana, Geum rossii, Oxytropis viscida Potentilla diversifolia, Zigadenus elegans and Selaginella densa were common in some stands. Cover of mosses and lichens was less than 1%.

Soils- Parent materials were limestone, granite and quartzite, with limestone predominating. Percent coarse fragments ranged from 33 to 54% with a mean of 42%. Bare ground and gravel covered 40% of the surface. Soil pH ranged from 6.2 to 7.8 with a mean of 7.3. Mean depths of litter and duff were both 0.1 in. Soils were erodible and often unstable. Heavier soils derived from calcareous parent materials often showed evidence of frost churning.

Productivity- Our estimates are based on only three stands, and two of these occurred on barren soils derived from metamorphosed limestone. These soils likely have unusual chemical properties that deter plant establishment and growth. Consequently, our production estimates for this type are probably low. Shrub productivity varied from 44 to 651 lbs/acre with a mean of 157 lbs/acre. Graminoid productivity ranged from 15 to 89 lbs/acre with a mean of 33 lbs/acre. Forb productivity varied from 8 to 148 lbs/acre with a mean of 43 lbs/acre. Total productivity averaged 233 lbs/acre.

Other Studies- Achuff and Corns (1982) describe an alpine type from the Canadian Rockies dominated by Dryas octopetala and Kobresia myosuroides, but this community has many mesic site indicators and is more similar to our DRYOCT/POLVIV. Douglas and Bliss (1977) describe Dryas fellfields from the North Cascades of Washington. Besides D. octopetala, only a handful of other species, including Festuca ovina and Arenaria obtusiloba, were common. Associations dominated by D. octopetala, Carex rupestris, C. elynoides and C. scirpoidea occur in the Big Snowy and Flint Creek ranges of Montana (Bamberg and Major 1968). Dryas communities in Glacier Park, Montana appear compositionally intermediate between those in the Flint Creek Range and those of the Canadian Rockies (Bamberg and Major 1962, Choate and Habeck 1967). Johnson and Billings (1962) state that D. octopetala colonizes wind-eroded sites and is very limited on the Beartooth Plateau of south-central Montana and adjacent Wyoming. Communities dominated by D. octopetala and Carex rupestris from the Rocky Mountains of Colorado are associated with high levels of

calcium (Komarkova and Webber 1979, Willard 1978), but Eddleman and Ward (1984) found no such relationship. Festuca ovina, Geum rossii, Silene acaulis and Trifolium nanum are also common in the Colorado type.

Our two types DRYOCT/CARRUP and DRYOCT/POLVIV appear to be at the drier and wetter ends of a moisture gradient. The former type predominates in relatively dry mountain ranges of the Central and Northern Rockies and on the east side of the Cascades, while the latter type is more common in the Canadian Rockies and the wetter ranges of the Northern Rockies.

Slope Communities

The following two stand groupings, DRY SLOPES and MOIST SLOPES, are not named for dominant or diagnostic species. There were no species assemblages that characterized these sites; rather, composition derived from the flora of adjacent communities. However, member stands occupied similar, relatively unstable environments. Frequent natural disturbance, such as avalanche-scouring, slumping and erosion, prevent zonal vegetation types from establishing. Consequently, these sites were generally occupied by a sparse compliment of species from adjacent vegetation types adapted to the particular disturbance regimes. These sites were common and easily recognized by their sparse cover and usually steep topographic positions.

DRY SLOPES
(11 stands)

Environment- These species assemblages occurred in all ranges and were most abundant in the Tendoy and Tobacco Root Ranges. Elevations ranged from 9,580 to 10,530 ft. Slopes were almost uniformly steep, inclination averaging 50%, and their aspects, with but two exceptions, were southeast through west. None of the sites had less than 55% exposed soil, gravel and rock. The dominant aspect was of exposed gravel (39% average) with lesser amounts of exposed soil (18% average) and rock (25% average).

Vegetation- Vegetative cover of these sites was usually low (<20%); however, a few stands with higher cover inflated the averages. Average cover by life form was shrubs 1%, graminoids 10% and forbs 25%. Agropyron scribneri was the one species with both higher constancy and coverage in the Dry Slope type than the other c.t's.; this grass appeared to be associated with gravelly, unstable slopes. Other graminoids with greater than 50% constancy were Festuca ovina, Poa glauca, P. secunda and Trisetum spicatum. Forbs with at least 50% constancy were Achillea millefolium, Hymenoxys grandiflora, Lomatium cous, Phlox pulvinata, Potentilla diversifolia, Sedum lanceolatum and Smelowskia calycina. If present at all, moss and lichen cover did not exceed trace amounts.

24

Soils- Parent materials included limestone, calcareous sandstone, quartzite, granite, basalt and gneiss. Coarse fragment content ranged from 31 to 79%, averaging 55%. The relative lack of substrate weathering was reflected in high soil reactions for both calcareous and noncalcareous sites, 7.7 and 6.6 respectively. The only litter and duff was present immediately under vegetation canopies.

Production- Total production ranged from 207 to 964 lbs/acre, averaging 657 lbs/acre, with forb production (494 lbs/acre) far outstripping that of graminoids (163 lbs/acre). It is instructive to note that grass and forb coverage values of dry slopes approximate those of cushion plant communities, but dry slope production is twice as great. Greater dry slope production is due to a predominance of upright growth forms as opposed to cushion plants.

Other Studies- Diverse plant assemblages occurring on sparsely vegetated slopes have been reported for Washington's Cascades (Douglas and Bliss 1977). These authors found high beta diversity in this group of stands and that clustering and ordination techniques did not yield meaningful insight into community structure and classification. They found composition of sparsely vegetated slopes was most dependent on species comprising immediately adjacent communities. We hypothesize that similar, open, early seral stands occur in most mountain ranges, but their fate is the "no-fit" category and thus they go unreported in the literature.

Caicco (1983) and Moseley (1985) describe a Agropyron scribneri c.t. of east- and south-central Idaho that is floristically and environmentally similar to about half of our stands. Their sites are also characterized by unstable surfaces but occupy a variety of landscape positions, including snowbeds. Moseley (1985) describes a Hesperochloa kingii c.t., unstable phase, on gravelly soils that is similar to several of our plots from the Gravelly and Beaverhead Ranges. We speculate DRY SLOPES are environmentally similar to the "dry fellfield" of Colorado's Front Range described as having discontinuous or no winter snow cover, a growing season exceeding 3 months, wind-swept exposures and often severe soil erosion (Isard 1986, Eddleman and Ward 1984, May and Webber 1982). Because our sites were seldom cushion plant-dominated we infer our dry slopes to be less wind-swept than those of Colorado.

MOIST SLOPES
(8 stands)

Environment- This environmental type was observed in all study area ranges and sampled on the Gravelly, Snowcrest, Tendoy, Tobacco Root and Madison Ranges. Sites were moderate to steep, straight slopes with predominantly northerly exposures. This type usually extended from mid-slope positions to the slope shoulder where it frequently graded into turf or cushion plant communities. Elevations ranged from 9,480 to 10,000 ft. Besides having cooler slope exposures, MOIST SLOPES differ from DRY SLOPES by having even more exposed substrate (90% average) a much reduced fraction of which is rock (8% average) and much higher percent of which is exposed soil (53%) and gravel (29%). We speculate that these are

snowbed sites of varying degree due to their upper lee slope positions, cooler exposures and moist to wet soils. The steeper sites were abundantly rilled and also had evidence of sheet erosion; features to be expected with rapid snowmelt on steep, sparsely vegetated sites.

Vegetation- Vegetative cover was reduced, only 12% c.c. for graminoids and 29% c.c. for forbs. Sites with the longest persisting snowpack had less than 10% total canopy cover. Like the DRY SLOPES there were no characteristic species. Rather, the composition was apparently drawn from surrounding communities. Only four graminoids, <u>Deschampsia</u> <u>cespitosa</u>, <u>Agropyron</u> <u>caninum</u>, <u>Poa</u> <u>alpina</u> and <u>P</u>. <u>fendleriana</u> had more than 50% constancy but coverages seldom exceeded 5%. Moist-site graminoids with relatively high coverage were <u>Carex</u> <u>paysonis</u>, <u>C</u>. <u>haydenii</u> and <u>C</u>. <u>phaeocephala</u>. Forbs with at least 50% constancy were <u>Achillea</u> <u>millefolium</u>, <u>Agoseris</u> <u>glauca</u>, <u>Lupinus</u> <u>argenteus</u>, <u>Potentilla</u> <u>diversifolia</u>, <u>Senecio</u> <u>crassulus</u> and <u>Solidago</u> <u>multiradiata</u>. In addition to <u>L</u>. <u>argenteus</u> and <u>P</u>. <u>diversifolia</u>, other forbs that dominated at least two stands were <u>Aster</u> <u>foliaceus</u>, <u>Erigeron</u> <u>ursinus</u>, <u>Ranunculus</u> <u>eschscholtzii</u>, and <u>Sibbaldia</u> <u>procumbens</u>; the last three species were also often associated with snowbed communities. Only trace amounts of mosses and lichens were recorded.

Soils- Parent materials included gneiss, quartzite, sandstone, calcareous sandstone and limestone. Coarse fragment content ranged widely, from 5 to 71%, and averaged 31%. The two stands with lowest coarse fragments (5 and 6%) were probably snowmelt areas and had extensive pocket gopher (<u>Thomomys</u> <u>talpoides</u>) workings and soil erosion. Soil reaction for both calcareous (7.3) and noncalcareous (6.5) substrates tended to be lower than for DRY SLOPES. Trace amounts of litter and duff were found only under individual plants.

Productivity- Total production ranged from 391 to 1,104 lbs/acre; average total (646 lbs/acre) and component fraction averages (forbs, 479 lbs/acre; graminoids (167 lbs/acre) were very similar to DRY SLOPES values.

Other Studies- In terms of site parameters, low vegetation coverage and productivity values WET SLOPES are like <u>Sibbaldia-Selaginella</u> snowbed communities described for Colorado's Front Range (May and Webber 1982, Eddleman and Ward 1984, Isard 1986) but differ by lacking <u>Selaginella</u> <u>densa</u> and lichens, described as dominant ground cover in Colorado types. See discussion under DRY SLOPES.

Snowbed Communities

Prevailing winds from the southwest and west interact with topography to cause snow to accumulate in consistent patterns behind small ridges, on upper lee slopes and in depressions. Plants in these snow accumulation areas are well protected during the winter and generally receive more moisture than surrounding zonal vegetation. In addition, late snow release results in a shortened growing season and soils that often remain cold during much of this season. The depth of accumulated snow determines the interplay among these

factors and results in a relatively large number of communities associated with this habitat. They vary from sparsely vegetated forb-dominated communities to dense graminoid sods and moist dwarf shrub types. Different types may intergrade in an intricate mosaic related to broken topography or form concentric patterns on more even terrain (Holway and Ward 1963, Johnson and Billings 1962). In extreme cases, late persisting snow precludes most vascular plant growth. We did not sample these "snow barrens."

<u>Carex nigricans</u> c.t.
(CARNIG; Black alpine sedge)
(4 stands)

Environment- CARNIG was found between 9,500 and 10,000 ft in the Anaconda, Madison, Pioneer and Tobacco Root ranges, the wettest ranges in our study area. This distinctive community occurred on nearly level sites at the base of slopes and in valley bottoms where blowing snow is deposited and meltoff does not occur until well into the growing season. CARNIG occupied sites with perennially moist or wet soil and with the shortest snow-free season of any snowbed c.t. In 1991, many of our stands had just begun to green-up in late July. CARNIG usually occurs in a matrix of small patches of wetland or other snowbed communities. DESCES/CALLEP, CARSCO/CALLEP, JUNDRU/ANTLAN and PHYEMP/ANTLAN were often adjacent.

Vegetation- Mean graminoid cover was 83%. <u>Carex nigricans</u> was the absolute dominant with mean cover of 76%. Other frequent but less abundant graminoids were <u>Juncus drummondii</u>, <u>Phleum alpinum</u> and <u>Carex paysonis</u>. Forbs had a mean cover of 21%. The most common species were <u>Caltha leptosepala</u>, <u>Antennaria lanata</u> and <u>Erigeron peregrinus</u>. No forb species occurred in all four stands, and only one, <u>A. lanata</u> occurred in three out of four. The dwarf shrubs <u>Phyllodoce empetriformis</u> and <u>P. glanduliflora</u> were present in small amounts in two stands, and <u>Salix arctica</u> was common in one stand. Mean cover of mosses and lichens was less than 1%.

Soils- Parent materials were limestone, granite and gneiss. Percent coarse fragments were always less than 10% with a mean of 3%. Bare ground and gravel covered only 2% of the surface. pH was 6.5 at the limestone site and varied between 5.8 and 6.2 when parent materials were crystalline. Mean pH for the type was 6.2. Mean depths of litter and duff were 0.4 in and 0.2 in respectively. Soils in late July, 1992 were always wet and cold.

Productivity- Due to retarded phenology in 1991, we measured productivity in only two stands. Graminoid productivity had a mean of 375 lbs/acre, and forb productivity had a mean of 275 lbs/acre. Mean total productivity was 650 lbs/acre. Mean productivity of dwarf shrubs was 22 lbs/acre. <u>Carex nigricans</u> was not fully mature when we clipped plots in these stands; thus, our estimates of graminoid and total productivity are low.

Other Studies- Communities dominated by Carex nigricans have been described for Banff and Jasper national parks in Alberta Canada (Achuff and Corns 1982, Hrapko and LaRoi 1978). Composition is similar to our CARNIG c.t., although Luzula wahlenbergii (=L. piperi) was a common component of the Canadian types. Carex nigricans communities are more widely distributed in the Canadian Rockies, often occurring on slopes as well as level areas. Communities similar to CARNIG are also common in the North Cascades of Washington (Douglas 1972, Douglas and Bliss 1977). Luetkea pectinata and bryophytes were common in the Cascade type. Rottman and Hartman (1985) report an association dominated by C. nigricans occurring in the center of sorted stone polygons in the San Juan Mountains of Colorado. Sibbaldia procumbens, Artemisia scopulorum and Juncus drummondii were other common species. Carex nigricans snowbed communities appear to be most common to the north and west of our study area.

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Juncus drummondii/Antennaria lanata c.t.
(JUNDRU/ANTLAN; Drummond's rush/woolly pussytoes)
(3 stands)

</div>

Environment- Small examples of JUNDRU/ANTLAN were common in depressions in valleys and cirque basins between 9,600 and 10,000 ft in the Madison Range. This community was always associated with areas of late snowmelt; however, meltoff probably occurs earlier than in communities dominated by Carex nigricans. JUNDRU/ANTLAN was often part of vegetation mosaic resulting from uneven snow deposition. Commonly associated communities were moist turf, wetland and other snowbed associations such as CARSCI/GEUROS, CARSCO/CALLEP, CARNIG and PHYEMP/ANTLAN.

Vegetation- Mean graminoid cover was 30%. Dominant graminoids were Juncus drummondii, Poa fendleriana and Carex paysonis. Carex pyrenaica was locally common. Mean cover of forbs was 37%, and common species included Antennaria lanata, Sibbaldia procumbens and Erigeron peregrinus. Arnica latifolia was common in one stand. The shrub, Vaccinium scoparium, was also common in this same stand. Mean cover of mosses and lichens was 2%.

Soils- Parent materials were gneiss and granite. Percent coarse fragments varied from 6-17% with a mean of 13%. Bare ground and gravel covered 50% of the surface. Soil pH ranged from 6.0 to 6.1 with a mean of 6.1. Mean depths of litter and duff were both 0.1 in. Although they occurred in topographically low positions, these relatively barren and unproductive communities were apparently underlain by shallow and perhaps excessively well-drained soils.

Productivity- Graminoid productivity varied between 200 and 270 lbs/acre with a mean of 237 lbs/acre. Forb productivity ranged from 150-860 lbs/acre with a mean of 460 lbs/acre. Productivity of dwarf shrubs in one stand was 30 lbs/acre. Mean total productivity was 726 lbs/acre. Highest productivity occurred on the deepest soils.

Other Studies- Antennaria lanata is a common component of snowbed communities in the North Cascades and Canadian Rockies, but codominant species are Carex nigricans or dwarf shrubs such as Cassiope or Phyllodoce spp. rather than Juncus drummondii (Achuff and Corns 1982, Hrapko and LaRoi 1978, Douglas and Bliss 1977). Snowbed communities dominated by Juncus drummondii with Carex pyrenaica and Sibbaldia procumbens occur in the Rocky Mountains of Colorado (Komarkova and Webber 1978, Willard 1979); however, Antennaria lanata is not listed for the Colorado associations. Lesica (1991) reports communities very similar to JUNDRU/ANTLAN from the eastern edge of the Beartooth Mountains in south-central Montana. It appears that Juncus drummondii dominates snowbed communities in the central Rocky Mountains, while Antennaria lanata occupies a similar niche in the Canadian Rockies and the North Cascades. The two species codominate snowbed associations in the crystalline ranges of southern Montana.

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Phyllodoce empetriformis/Antennaria lanata c.t.
(PHYEMP/ANTLAN; Mountain-heather/woolly pussytoes)
(4 stands)

</div>

Environment- PHYEMP/ANTLAN was locally common on gentle to moderate, protected slopes between 9,200 and 10,100 ft in the Anaconda, Madison and Pioneer ranges. The type was associated with crystalline parent materials in the wetter ranges in our study area. These sites are undoubtedly well covered by snow during the winter, and meltoff probably occurs relatively late in the season, although not as late as in the CARNIG c.t. In addition to other snowbed associations such as CARNIG and JUNDRU/ANTLAN, PHYEMP/ANTLAN is often adjacent to moist turf communities such as SALARC/POLBIS and CARSCI/GEUROS. A typical toposequence on a lee slope might be CARSCI/GEUROS on the lower slope, PHYEMP/ANTLAN at the base of the slope, with CARNIG in the bottom.

Vegetation- Dwarf shrubs provide the dominant aspect with mean cover of 55%. Phyllodoce empetriformis and Vaccinium scoparium were common in all four stands, while P. glanduliflora and Cassiope mertensiana were common in two of the stands. Mean graminoid cover was low, 20%. Carex paysonis, Juncus drummondii and Poa fendleriana were common graminoids occurring in all or most stands. Forb cover was 35%; Antennaria lanata, Polygonum bistortoides and Sibbaldia procumbens were consistently present, though only A. lanata occurred with greater than 5% cover. Mean cover of mosses and lichens was less than 1%.

Soils- Parent materials were granite and quartzite. Percent coarse fragments varied from 0-14% with a mean of 7%. Cover of bare ground and gravel was 15% with 8% cover of rock. Soil reaction ranged from 6.0-6.4 with a mean pH of 6.1. Mean depths of litter and duff were both 0.1 in. Soils underlying PHYEMP/ANTLAN were relatively deep and generally still moist in late July.

Productivity- We measured productivity in only two stands, and the species of heather proved difficult to clip accurately. Thus, our production estimates are only rough approximations. Mean shrub productivity was 166 lbs/acre. Graminoid productivity had a mean of 133 lbs/acre, and forb productivity had a mean of 104 lbs/acre. Mean total productivity was 403 lbs/acre.

Other Studies- Mountain-heather communities similar to PHYEMP/ANTLAN have been reported for Banff and Jasper national parks in the Canadian Rockies by Achuff and Corns (1982) and Hrapko and LaRoi (1978). The Canadian types had similar composition, but Phyllodoce glanduliflora and Cassiope empetriformis were the dominant heather species. Mountain-heather communities from the North Cascades of Washington are more similar to our PHYEMP/ANTLAN (Douglas 1972, Douglas and Bliss 1977). While Douglas (1972) combines all Phyllodoce- and Cassiope-dominated associations into one community type, Douglas and Bliss (1977) designate separate community type dominated by P. empetriformis, P. glanduliflora and C. mertensiana. In the North Cascades, where snowpack is much higher than most areas of the northern Rockies, these communities are not confined to areas of late snow release. Apart from these studies, Choate and Habeck's (1967) mention of similar type at Logan Pass in Glacier National Park in northwest Montana is the only reference to heather-dominated communities. Thus, mountain-heather associations appear to be confined to the mountains north and west of our study area.

Cassiope mertensiana/Carex paysonis c.t.
(CASMER/CARPAY; Merten's moss-heather/Payson's sedge)
(3 stands)

Environment- CASMER/CARPAY is uncommon in the study area, occurring at the base of gentle, north- or east-facing slopes at 9,400-9,600 ft in the Anaconda and Tobacco Root ranges. This type probably also occurs in the Pioneer Range. These cool, protected sites have deep snow during the winter, and release comes somewhat late in the growing season. They often showed signs of frost-churning and solifluction, suggesting that they receive additional upslope moisture. In addition to other snowbed associations such as CARNIG and JUNDRU/ANTLAN, CASMER/CARPAY is often adjacent to moist turf communities such as SALARC/POLBIS and CARSCI/GEUROS. CASMER/CARPAY is often adjacent to other snowbed associations such as CARNIG or moist turf communities such as SALARC/POLBIS or CARSCI/GEUROS. CASMER/CARPAY probably experiences earlier snow release than the other mountain-heather community, PHYEMP/ANTLAN.

Vegetation- Mean canopy cover of shrubs was 60%. Cassiope mertensiana and Salix arctica were the dominant shrubs. Phyllodoce glanduliflora was present in one stand. Mean graminoid cover was 23%, with Carex paysonis the dominant. Poa alpina and Carex scirpoidea were also common, and Poa fendleriana and Deschampsia cespitosa were well represented in one stand. Mean forb cover was 30%. Geum rossii and Potentilla diversifolia were common species, and Erigeron simplex and Polygonum bistortoides were frequent.

Antennaria lanata and Juncus drummondii were notable by their absence or low cover. Mean cover of lichens and mosses was less than 1%.

Soils- Parent materials were quartzite, gneiss and granite. Percent coarse fragments varied from 9-35% with a mean of 23%. Bare ground and gravel covered 11% of the surface, while rock was 8%. Soil pH ranged from 5.8-6.2 with a mean of 6.0. Mean depth of litter was 0.2 in, and mean depth of duff was 0.1 in. Soils were moderately deep and moist to wet in late July.

Productivity- We measured productivity in only one stand, and Cassiope was difficult to clip accurately. Thus, our production estimates are only rough approximations. Shrub productivity was 237 lbs/acre, graminoid productivity was 267 lbs/acre, and forb productivity was 712 lbs/acre. Total productivity was 1216 lbs/acre.

Other Studies- Associations dominated by Cassiope mertensiana have been reported for the Canadian Rockies, the Cascade Range and northwest Montana. Phyllodoce spp. were often codominants. See discussion under PHYEMP/ANTLAN c.t.

Juncus parryi/Erigeron ursinus c.t.
(JUNPAR/ERIURS; Parry's rush/bear fleabane)
(2 stands)

Environment- Examples of JUNPAR/ERIURS were locally common near the base of gentle slopes with warm aspects. Both of our stands were between 9,500 and 9,800 ft in the Gravelly Range. Although snow is expected to accumulate on these sites, this type is perhaps least affected by late meltoff of all the snowbed communities. FESIDA/POTDIV grassland was the common adjacent plant community. JUNPAR/ERIURS is similar in physiognomy and habitat to JUNDRU/ANTLAN.

Vegetation- Mean graminoid cover was 35%. Dominant graminoids were Juncus parryi and Festuca idahoensis, and Poa glauca was uncommon but frequent. Mean cover of forbs was 25%. Common species included Erigeron ursinus, E. peregrinus, E. simplex, Antennaria umbrinella and Lewisia pygmaea. Mean cover of mosses and lichens was 2%.

Soils- Parent materials in the two stands were andesite and quartzite. Mean percent coarse fragments was 25%. Bare ground and gravel covered 47% of the surface, indicating that this was the most barren of our snowbed communities. Mean soil pH was 5.6. Mean depths of litter and duff were 0.3 and 0.1 in respectively. This sparsely vegetated community type is similar to JUNDRU/ANTLAN, but the soils were even more stony and acidic.

Productivity- Mean graminoid productivity was 439 lbs/acre, and mean forb productivity was 253 lbs/acre. Mean total productivity was 692 lbs/acre. Productivity is probably affected more by the shallow, poorly developed soils than late snow release.

31

Other Studies- Holway and Ward (1963) report snow accumulation areas in the Colorado Rocky Mountains dominated by Carex pyrenaica and Juncus parryi. Willard (1979) states that Juncus parryi is ecologically similar to J. drummondii but generally occurs at lower elevations. In our study area, JUNPAR/ERIURS was associated with alpine grasslands, while JUNDRU/ANTLAN was associated with turf communities. Thus, it seems likely that these two community types occupy similar topographic positions, but the latter occupies cooler, moister habitats.

Salix glauca c.t.
(SALGLA; Glaucus willow)
(1 stand)

Environment- The single stand of SALGLA occurred on a moderate to steep upper, north-facing slope, just in the lee of a divide ridge at 9,900 ft in the Snowcrest Range. We observed but did not sample other examples of this type in the Gravelly Range. This site was a definite snow catchment area. Adjacent associations were CARELY turf and MOIST SLOPES.

Vegetation- Salix glauca had canopy cover of 60%; no other shrubs were present. Trace amounts of Poa alpina and Agropyron caninum were present, but total graminoid cover was only 1%. Forb cover was 60%. Common species included Aster alpigenus, Hedysarum sulphurescens, Senecio crassulus and Synthyris pinnatifida. Lichens and mosses covered 7% of the ground surface.

Soils- Parent material was calcareous sandstone. Percent coarse fragments was very different for different microsites but averaged 30% for the stand. Bare ground and gravel covered 6% of the surface. Soil pH was 7.6. Depths of litter and duff were 1.0 and 0.5 in respectively. The high surface organic matter probably reflects low rates of decomposition due to low insolation and late snowmelt.

Productivity- Our estimates are based on only three plots in one stand and should be considered only rough approximations. Salix glauca produced 759 lbs/acre. Graminoid productivity was 12 lbs/acre, and forb productivity was 759 lbs/acre. Total productivity was 1,530 lbs/acre.

Other Studies- Achuff and Corns (1982) describe three community types dominated by Salix glauca from the Canadian Rockies. These associations contain other shrubs (i.e., Salix, Betula, Potentilla) and better developed graminoid cover. Salix glauca associations were observed near timberline in the Front Range of Montana, south of Glacier National Park (Cooper and Lesica, pers. obs.). Associations dominated by Salix glauca occur on gentle lee slopes on the east end of the Beartooth Range (Lesica 1991). Common understory species in these communities were Carex paysonis, Deschampsia cespitosa, Geum rossii and Lupinus argenteus. In the Beartooth Range of Montana and the Rocky Mountains of Colorado, Salix

planifolia and S. glauca dominated associations found on cool moist slopes having late snow release (Johnson and Billings 1962, Komarkova and Webber 1978).

Wetland Communities

Community types described under this heading include bogs and fens, that would be considered wetlands under federal convention (Federal Interagency Committee for Wetland Delineation 1989). We also include those environments referred to as moist or mesic meadow, meltwater meadows, wet meadow and Deschampsia meadows, the greater portion of which would probably not meet federal wetland qualification. Any assessment of site hydrological conditions is problematical. We assessed the degree of saturation or inundation using landscape position and soil moisture at the time of sampling. In environments where mottling or gleying might be expected, these conditions were not observed. Where Deschampsia cespitosa was dominant there were some consistent vegetational and environmental differences for distinguishing grasslands from moist meadow.

Deschampsia cespitosa/Caltha leptosepala c.t.
DESCES/CALLEP;tufted hairgrass/elkslip marshmarigold
(5 stands)

Environment- This c.t. was well represented in the Gravelly Range and also sampled in the Beaverhead and Madison Ranges; it was noted, but not sampled, in four of the other five mountain ranges. It occurred at elevations as high as 10,100 ft but was much more common at lower elevation collecting (either snow or percolating water) positions. Sampled sites occupied flat to concave benches and slopes that did not exceed 15% slope and were north-through northeast-facing. Small patches of this c.t. were noted on steeper slopes below persistent snowbanks. At time of sampling all soil profiles were saturated to the surface. Solifluction lobes were prominent even on the most gentle slopes. Only trace amounts of gravel and rock were exposed, however bare soil exposure was as high as 20%, especially where pocket gopher (Thomomys talpoides) workings were extensive.

Vegetation- The high coverage of moss (72% average) contributed strongly to the lush appearance of this c.t. Only trace amounts of Salix spp. were found. Graminoid cover varied considerably, averaging 38%. Deschampsia cespitosa was clearly the dominant graminoid; other moist site graminoids occurring with at least 5% coverage were Carex atrata, C. nigricans, C. haydenii, Juncus drummondii and J. balticus. Though D. cespitosa clumps provided a recognition factor for this c.t., forb cover (68% average) far outstripped that of the graminoids. Caltha leptosepala dominated (48% c.c.) the forb layer. Other forbs with high coverage but not necessarily high constancy were Aster foliaceus, Claytonia lanceolata, Erigeron peregrinus, Pedicularis groenlandica, Polygonum bistortoides, P. viviparum, Senecio cymbalarioides and Veronica wormskjoldii.

33

Soils- Parent materials included alluvium, limestone, sandstone, basalt and gneiss. Coarse fragment content was consistently low, averaging only 3%, with traces of gravel and rock found on the surface. Soil reaction for calcareous substrates averaged 7.5 while that for noncalcareous was only 5.8. Litter and duff depth averaged 0.6 and 0.4 in, respectively.

Productivity- Total productivity ranged widely, from 621 to 3,197 lbs/acre with a mean of 1,820 lbs/acre. Graminoid productivity accounted for only 13 to 42% of the total. These productivity figures are likely underestimates as at least two sites were sampled prior to culmination of growth.

Other Studies- Mueggler and Stewart (1980) describe Deschampsia cespitosa/Carex spp. for subalpine meadows of western Montana. It has high productivity but little contribution by forbs. Our DESCES/CALLEP c.t. can be interpreted as a alpine extension of the Deschampsia series. A more broadly defined Deschampsia cespitosa vegetation type (appreciable Carex scopulorum) has been described for the Beartooth Range of Montana-Wyoming by Johnson and Billings (1962). They state Caltha leptosepala indicates a transition to C. scopulorum bog. Deschampsia cespitosa meadows extend southward at least to Colorado (Willard 1979, Bonham and Ward 1970, May and Webber 1982 and Eddleman and Ward 1984) and Utah (Lewis 1970) but apparently lack the mesic to hydric forbs that characterize the DESCES/CALLEP c.t. Their types are apparently intermediate between our DESCES/POTDIV and DESCES/CALLEP c.t's.

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Carex scopulorum/Caltha leptosepala c.t.
CARSCO/CALLEP; Holm's Rocky Mountain sedge/elkslip marsh marigold
(5 stands)

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Environment- This c.t. was extensive in the Gravelly and Madison Ranges, sampled in the Tobacco Roots, noted in the East Pioneer and to be expected in the other ranges based on broad distribution of the dominant species. Saturated soil, often with standing water throughout the growing season, was the dominant feature. These sites span the range from wet meadow to fen and occur in shallow undrained depressions, low-gradient subirrigated positions and also adjacent to first order streams or rivulets. From the high values for basal area (8% average) and abundant moss (60% average) and litter (30% average), it follows that there was seldom more than a trace amount of exposed soil/gravel or rock.

Vegetation- Only trace amounts of Salix spp. were present. Without exception, the graminoid component, dominated by the diagnostic species Carex scopulorum or C. lenticularis, was extremely dense (88% c.c. average), though not exceeding 8-12 in in height. Other graminoids with high constancy or coverage were C. haydenii, Deschampsia cespitosa, Juncus drummondii, J. mertensiana and Poa alpina. The forb component, notably lacking in diversity, was dominated by several wet-site species, most commonly Caltha leptosepala (35% c.c. average), Pedicularis groenlandica, Polygonum bistortoides, Senecio cymbalarioides, Trollius laxus and Veronica wormskjoldii.

Soils- All parent materials were characterized as alluvium, mostly volcanic-derived. No coarse fragments were found in any of the profiles (0-20 cm depth). Four of the five sites had fibrous peat at least 6 in deep. Soil reaction for the one calcareous site (pH = 5.9) was the lowest of any calcareous site sampled; however, the soils derived from volcanic alluvium showed no trend of lower pH values (6.0 average) than other wet/moist sites. The only slightly acid values indicate minerotrophic sites having more in common with fens than bogs (as this c.t. has been termed in the literature). Litter depths averaged 0.7 in; we did not discriminate duff from peat.

Productivity- Average productivity for the c.t., 2,277 lbs/acre, was higher, particularly in the graminoid component, 1,720 lbs/acre, than that of any other study area c.t. However, the range, 1,426 to 4,123 lbs/acre, overlaps with a number of moist/wet site types. We speculate that these values are underestimates, as sampling invariably occurred prior to phenological optima. A protected site at 10,230 ft in the Madison range bears citing because total productivity, 4,123 lbs/acre, was much higher than values for comparable c.t.'s appearing in the literature (May and Webber 1982, Scott and Billings 1964, Briggs and MacMahon 1983).

Other Studies- Virtually identical alpine marsh communities and environmental parameters are described for the Beartooth Range (Johnson and Billings, Medicine Bow (Scott and Billings 1964) and Teton Ranges (Spence and Shaw 1981) of Wyoming and Colorado's Front Range (Willard 1979 and May and Webber 1982). Caltha leptosepala is the dominant forb in many alpine marshes of Utah's Uinta Mountains, but the dominant graminoids are Carex aquatilis or C. saxatilis, rather than C. scopulorum (Briggs and MacMahon 1983, Lewis 1970). Hansen et al. (1991) describe a similar type from subalpine and alpine areas of Montana, but subalpine stands have a different forb composition. Similar communities have not been described north and west of our study area.

<div align="center">

Salix reticulata/Caltha leptosepala c.t.
SALRET/CALLEP; snow willow/ marsh marigold
(2 stands)

</div>

Environment- Sampled in only the Tendoy and Gravelly ranges, SALRET/CALLEP appears to be a minor type, environmentally and floristically related c.t. SALARC/POLBIS. The relative paucity of this c.t. can be explained, at least in part, by lack of appropriate habitat, gentle to steep north-facing slopes. Slopes with this aspect and possessing a soil mantle are not common in the predominantly north-south trending ranges of the study area. Slopes with northerly aspects did occur as spur ridges but often they were merely boulder fields. Both stands carpeted active solifluction slopes and were subirrigated from late-persisting snowfields lying above. Ostensibly these sites could be as wet as CARSCO/CALLEP, differing by lacking stagnant water and possessing both unstable substrates and possibly long-persisting snowpacks.

Vegetation- The prevailing aspect of this c.t. was a lush green carpet of dwarf shrub species (average c.c. 70%), among which S. reticulata (= S. nivalis) was dominant, but S. rotundifolia (= S. dodgeana) and S. arctica also figure prominently. The graminoid component was sparse, not exceeding 20% c.c. with Carex haydenii, C. nova, C. scirpoidea, Deschampsia cespitosa, Luzula spicata and Poa alpina having at least 5% c.c. in one or more stands. Averaging 21% c.c., Caltha leptosepala was a diagnostic species (only forb with 100% constancy) and it, along with Silene acaulis, were the only forbs with more than 10% coverage.

Soils- Both stands were developed on limestone but were notably low in coarse fragment content (< 10%). Despite the wet conditions, soil reaction was typical for calcareous substrates (7.5 average). Litter and duff depths were less than 0.5 in.

Productivity- The wide range in productivity, 517 to 1,670 lbs/acre, despite the similarity of site parameters, is partly explained by the fact that the low-productivity site had experienced snow release just prior to sampling. The higher figure would be more typical for the c.t. The shrub fraction of total production was 56 and 78%.

Other Studies- Stands dominated by Caltha leptosepala and Trollius laxus with a significant contribution by Salix arctica and S. reticulata are occasionally found in alpine seepage areas in the Canadian Rockies (Achuff and Corns 1982). Johnson and Billings (1962) describe for the Beartooth Range small areas of soil frost disturbance dominated by Salix arctica or S. reticulata and Trifolium parryi. They infer these sites to be in an early stage of recolonization and describe no more extensive communities with dwarf Salix spp. dominant. Our sites are like those of the Beartooth Range but disturbance (solifluction and congeliturbation) has apparently occurred on a much larger scale. Willard (1979) describes alpine marshes in Colorado Rockies dominated by Carex scopulorum and Caltha leptosepala with Salix arctica a common species (see discussion under CARSCO/CALLEP). In her Colorado study area S. reticulata is apparently rare.

DISCUSSION

Ordinations and Environmental Gradients

Beta diversity of the data set was high because a broad diversity of environments, parent materials and mountain ranges were represented. We reduced the unacceptably high beta diversity by compartmentalizing the data set into dry and moist portions prior to DECORANA runs (Gauch 1982). Assignment of plots to dry and moist groups was based on analysis of abiotic variables and precedents set by previous alpine vegetation studies. Grassland, turf, cushion plant and slope communities formed the dry portion, and snowbed and wetland communities formed the wet portion.

36

The best separation of types in ordination space was obtained with Axis 1 and Axis 3 (Fig. 3). There was a moderate degree of correspondence between Axis 1 and site moisture. Carex scopulorum-dominated sites, subjectively assessed as wettest, clustered at the left end (Fig. 3). Immediately adjacent to C. scopulorum sites on Axis 1 were Deschampsia cespitosa- and Caltha leptosepala-dominated sites. These positions correspond well with their respective places on moisture gradients inthe field. Snowbed communities ordinated to the right of these wetland types. CARNIG, the wettest snowbed type was furthest toward the wet end of Axis 1, while the three drier types dominated by Juncus spp. and Antennaria lanata ordinated at the dry end of Axis 1.

We were unable to determine a correspondence between Axis 2 and any known environmental gradient. The distinctive composition of Juncus parryi and Erigeron ursinus-dominated plots (assessed as snowbed sites) set them apart on Axis 2 and compressed the remaining variability. The merely wet sites are clustered near the center of Axis 2 whereas the snowbed sites (with exception of JUNPAR/ERIURS c.t.) are clustered near the axis origin. Snowbed sites occurred in a jumble on Axis 2. The ordination did not even recover the fact that Carex nigricans-dominated snowbed sites clearly were the last to become snow-free, though they were positioned as the wettest of snowbed sites on Axis 1. There was a tendency for communities dominated by shrubs to have lower values on Axis 3, but otherwise this axis does not seem to correspond to known environmental gradients.

"Dry Sites"

The best separation of types was obtained using Axis 1 and Axis 3. Axis 1 roughly corresponds to a gradient of wind-exposure/soil depth, with shallow stony soils of exposed sites on the left end and deep soils with less exposure on the right (Fig. 4). Axis 3 appears to correspond to a moisture gradient. Dry grassland communities occur near the bottom, while moister turf communities are found near the top (Fig. 4). Moist dwarf shrub-dominated types occur in the upper left corner, while grassland communities are found in the lower right (Fig. 4). Cushion plant and turf communities are found in the center of the ordination space, and there is a good deal of overlap among them. Plots of slope communities are scattered throughout much of the ordination space rather than clustering together or with any other types. This result is expected since these "communities" are simply assemblages of species on disturbed sites drawn from adjacent vegetation types. Axis 2 did not appear to correspond to any known environmental gradient.

The results of the DECORANA analysis suggest that moisture and soil depth are important environmental factors determining vegetation of the drier communities. These two variables are often correlated when the entire range of environments is considered because wind-exposure results in soil deflation as well as removal of snow. When only dry sites are considered, this covariation becomes less pronounced. In general, moist sites with stony soil support dwarf willow or mountain avens communities, moist sites with deeper soil support

Figure 3. Detrended correspondence analysis ordination of "wet site" alpine communities. Community abbreviations are defined in the text. Axis scales are in units of average standard deviations of species turnover X 100.
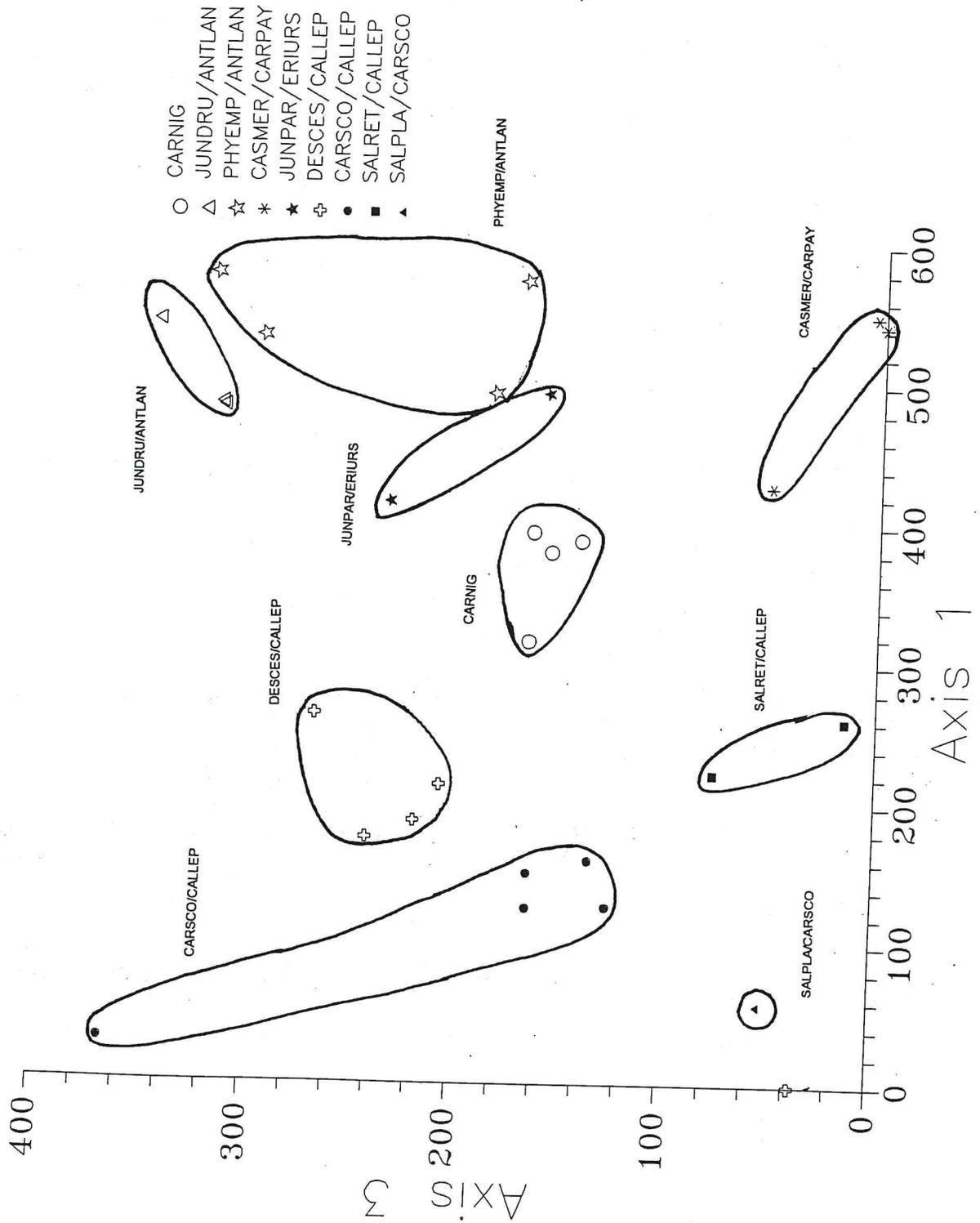
Figure 4. Detrended correspondence analysis ordination of "dry site" alpine communities. Community abbreviations are defined in the text. Axis scales are in units of average standard deviations of species turnover X 100.
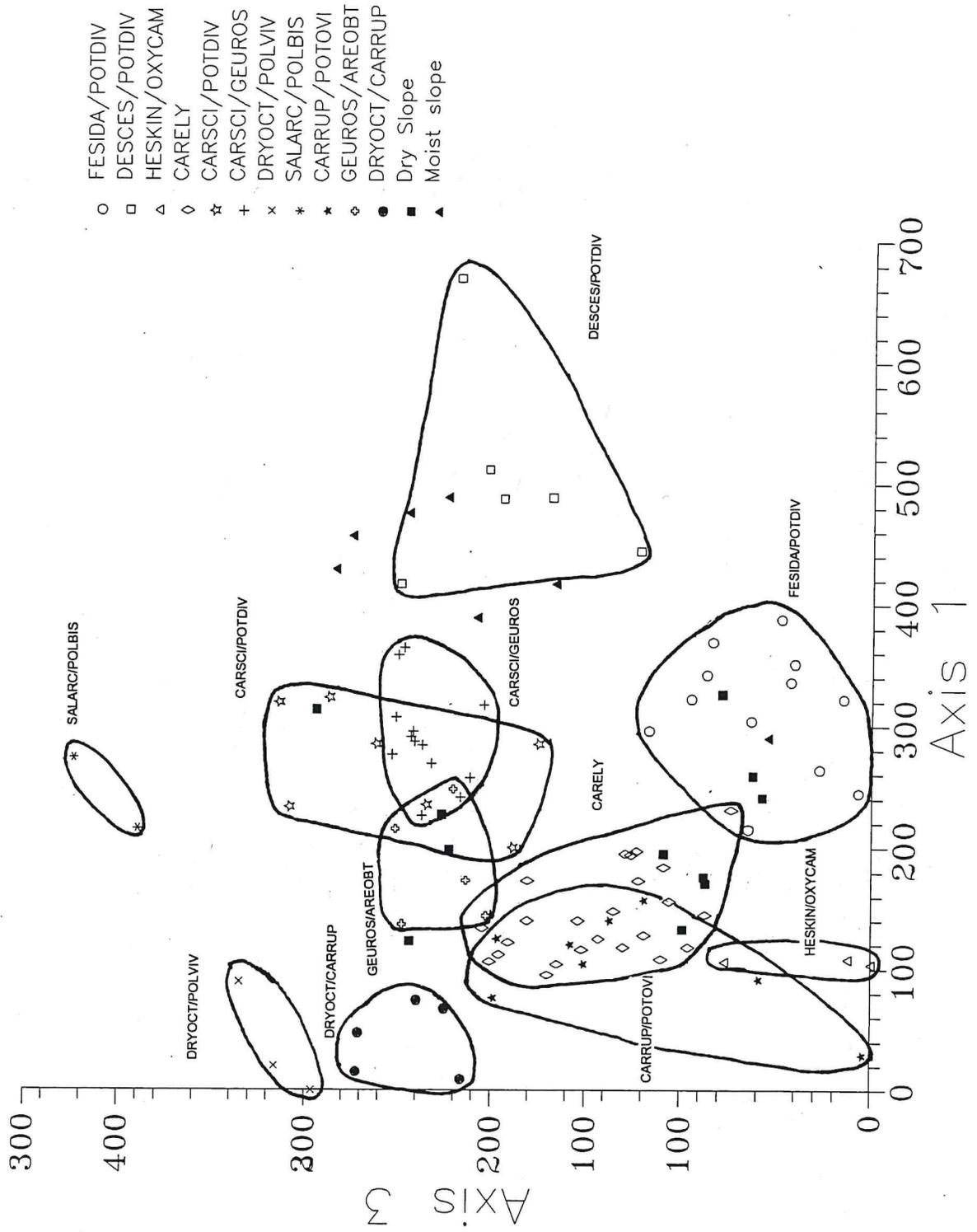
sedge-dominated turf, dry sites with deep soil support grasslands, and dry stony sites are dominated by cushion plants. For wetland and snowbed sites, moisture and timing of snow-release are the overridingly important environmental gradient because these sites are not wind-exposed, and soils are generally deep. Wind-exposure, moisture and timing of snow-release have generally been considered the most important environmental factors determining vegetation above timberline (Billings 1988, Bliss 1963, Eddleman and Ward 1984, Isard 1986, Johnson and Billings 1962, Willard 1979). May and Webber (1982) also identified disturbance as an important environmental gradient in the Colorado alpine. Our slope communities are structured by disturbance, and the commonness of these communities suggests that disturbance is also important in our study area.

Management Considerations

Alpine environments are among the most severe on earth. Low temperatures, nearly constant high winds, and high insolation are among the factors that shape the alpine environment and limit plant growth (Billings 1988, Bliss 1985, Brown et al. 1978). The growing seasons in the alpine is short, often only 8-12 weeks. Temperatures during the growing season are cool, and frost can occur on any night. As a result, plants are limited in the amount of photosynthate they can accrue. Furthermore, the frequent hard freeze-thaw cycles make frost-churning a common phenomenon, especially in moist sites. Frost churning and needle ice damage vegetation and limit recruitment. High windspeeds can damage plants through desiccation. Wind-driven soil and ice particles can destroy plant tissue, especially when young. Wind redistributes snow cover. Ridge tops and upper windward slopes are dry and exposed to severe winter temperatures, while lee slopes and depressions are cold and wet with a reduced growing season. Wind diminishes the formation of a boundary layer around plant parts, further exacerbating low summer temperatures. Solar radiation at high elevations is intense. Intense radiation coupled with high winds promote summer drought and high levels of evaporation. High levels of ultraviolet radiation can damage plant tissues.

The harsh environmental conditions above timberline make growth and the accumulation of biomass a slow process. Furthermore, soil formation takes much longer at high elevations because of the retarded pace of biological processes. As a result, recovery from disturbance is generally slow (Billings 1973, Willard and Marr 1971). Alpine tundra ecosystems evolved almost completely without the disruptive effects of humans. Only in the past 150 years have these systems been exposed to such large-scale disturbances as livestock grazing, mining and road-building. Unfortunately, few controlled studies have been done on the effects of these encroachments in alpine landscapes.

Livestock Grazing

Grazing has two primary effects on plant communities, removal of plant biomass and trampling. By selecting certain plants over others, grazers alter the competitive balance among species and eventually alter the composition of communities. Although both sheep

and cattle graze above timberline in our study area, in most areas of the Rocky Mountains sheep are the principle domestic animal in the alpine zone (Johnson 1962, Thilenius 1975). Consequently most observations relating to the effects of livestock on alpine ranges refer to sheep. In general, cushion plants, such as Arenaria obtusiloba and Silene acaulis, and low sedges, such as Carex rupestris and C. elynoides, tend to increase with grazing pressure, while robust graminoids, such as Deschampsia cespitosa and Poa glauca, and forbs, such as Agoseris spp. and Potentilla diversifolia, tend to decrease (Johnson 1962, Lewis 1970). At low elevations, grazing tends to have the same effect as drought, decreasing mesic site indicators and increasing xeric site species (Weaver 1954). The same appears to be true in the alpine. Unfortunately there have been no controlled quantitative studies to verify the little anecdotal evidence available.

In our study area, sheep grazing was common on the gentle alpine terrain of the Gravelly Range. We commonly observed cattle or evidence of cattle above treeline in the Snowcrest and Beaverhead and Pioneer ranges. We were surprised to find evidence of heavy livestock use near 11,000 ft in the Beaverhead Range.

There were no exclosures above treeline in our study area, so we have little knowledge of the effects of livestock grazing on plant species composition. Cushion plants were more common in some turf communities than others, but these differences could be due to soils or moisture regime rather than overgrazing. Poa pratensis, an introduced grass considered an indicator of present or past disturbance, occurred in some grassland, turf and wetland stands, mainly in ranges that had been subject to long-term livestock grazing (e.g., Gravelly and Snowcrest ranges) and in moist or wet community types. Juncus balticus was codominant with Deschampsia cespitosa in one wetland site in the Snowcrest Range. It is native but is thought to increase under grazing in wet meadows (Hansen et al. 1991). These observations suggest that it is the moist and wet sites that are most susceptible to alteration of species composition from grazing.

In drier portions of our study area, such as the Beaverhead and Snowcrest ranges, surface water is uncommon above timberline. As a result, cattle use tends to be concentrated in areas near water. We observed the effects of livestock trampling mainly in wetland communities. Streams where use had been heavy had increased turbidity, and banks had been compacted and eroded.

Trampling can destroy plants and result in the loss of soil. Plant communities occupying wet habitats are more easily damaged than mesic communities (Willard and Marr 1970), and continued disturbance often results in significant erosion (Billings 1973). Plants in wet sites are more succulent and susceptible to being broken, and the soil is more prone to compaction (Willard and Marr 1970). Turf communities are not as easily disturbed, but repeated trampling will result in the loss of soil, and recovery may take hundreds of years (Willard and Marr 1971). Wind erosion and frost action enlarge areas that have been denuded by trampling (Willard and Marr 1971). In general, wet communities are more

susceptible to adverse effects of trampling, but drier areas will take longer to recover once damage has occurred.

Thilenius (1975, 1979) has written guidelines for livestock grazing in the alpine zone; the following synopsis is taken from his report. Cattle tend to aggregate in lower portions of cirque basins where water and lush vegetation are concentrated. These sites suffer damage under untended cattle grazing. Wet sites, including snowbed communities, dry sites, and steep slopes (40°+) should not be grazed. Livestock should not be allowed to remain in any area for very long. Thus, intensive range-riding or herding is needed for non-destructive use of alpine ranges by livestock. Grazing and trampling by horses used for recreation can also cause damage when use is concentrated

Vehicle Use

There are fewer roads above timberline in Montana than in other Rocky Mountain states. Nonetheless, vehicle use, including motorcycle and all-terrain vehicles, was apparent in the alpine zone of the Beaverhead, Snowcrest, Gravelly, Pioneer and Tobacco Root ranges. Road construction and vehicle use are among the most damaging activities in alpine environments (Brown et al. 1978, Thilenius 1975). Repeated vehicle use destroys plants and causes soil erosion and compaction. Damage is generally proportional to (1) wetness of the site, (2) frequency of use, and (3) weight of the vehicles (Thilenius 1975). Four-wheel drive vehicles are banned from the alpine zone in some states (Thilenius 1975).

At the north end of the Pioneer Range, some areas have soils derived from highly metamorphosed limestone that are relatively barren and easily erodible. These areas also are the site of mining activity, and roads have been built to the mines. These roads provide access to fragile alpine landscapes for four-wheel drive and all-terrain vehicles. Some of these roads remain open, while others have been closed. However, we observed a three-wheel all-terrain vehicle driving on a steep, barren, eroding trail behind a locked gate. We also observed unauthorized all-terrain vehicles in the Italian Peaks area of the Beaverhead Range, an area closed to all motor vehicles. Use of vehicles for recreation in the alpine zone is causing damage that will take tens or perhaps hundreds of years to recover (Marr and Willard 1971).

Mining

Mines are very damaging to alpine communities, causing destruction of vegetation, soil erosion, and water pollution (Brown et al. 1978, Thilenius 1975). Evidence of mining activity is common in the Pioneer and Tobacco Root ranges. Mine shafts, building sites, tailings heaps, dumps and roads scar the landscape in many areas. In most cases activity ceased decades ago; nonetheless, the damage is still apparent at the majority of these sites.

Geographic Affinities of Alpine Plant Communities

With the possible exception of CARRUP/POTOVI and JUNPAR/ERIURS, none of the plant communities we described are endemic to our study area. Rather, the mountain ranges of southwest Montana appear to be a meeting ground for associations that are best developed in the mountains to the south, west and northwest. Many of these plant associations are apparently at the edge of their range in southwest Montana. The unique geographic position of these ranges and the presence of calcareous and crystalline parent materials result in the great diversity of plant communities.

Alpine grasslands dominated by Hesperochloa kingii (HESKIN/OXYCAM) have been reported in the Rocky Mountains only from east-central Idaho and northwest Utah (Brunsfeld 1981, Caicco 1983, Moseley 1985, Preece 1950, Ream 1964). Alpine associations dominated by F. idahoensis (FESIDA/POTDIV) are common only in Idaho and southwest Montana. These communities may be considered forms of high-elevation grasslands that persist in the alpine zone on well-developed soils derived from calcareous sedimentary parent materials.

Moist turf communities in our study area show affinities with both the Southern Rockies and east-central Idaho. Carex scirpoidea and Geum rossii are common associates in the Southern Rocky Mountains and in the eastern portion of our study area (CARSCI/GEUROS). In the warmer and drier western ranges of our area and adjacent Idaho, G. rossii is replaced by Potentilla diversifolia (CARSCI/POTDIV).

Plant associations dominated by Carex elynoides, Deschampsia cespitosa, Geum rossii and Carex scopulorum occur in the Rocky Mountains from southern Montana south at least to Colorado (Johnson and Billings 1962, Komarkova and Webber 1978, Lewis 1970, Willard 1979). All of these community types in our study area with the exception of CARELY turf (e.g., DESCES/POTDIV, CARSCI/GEUROS, GEUROS/AREOBT, DESCES,CALLEP, CARSCO/CALLEP, SALPLA/CARSCO) are most common on or confined to soils derived from crystalline parent material. Crystalline parent materials predominate in the Southern Rocky Mountains, and all of the vegetation studies from this area have been done in ranges formed by intrusives. Thus, it is not possible to determine if the range of these communities is determined climatically or edaphically or both.

Communities similar to the JUNDRU/ANTLAN c.t. are found throughout much of the Rocky Mountains and the Cascade Range. All of the other common snowbed communities found in our study area (CARNIG, PHYEMP/ANTLAN, CASMER/CARPAY) are best developed or confined to the wetter mountains to the north and west (Achuff and Corns 1982, Douglas 1972, Douglas and Bliss 1977, Hrapko and LaRoi 1978). Rottman and Hartman (1985) report an association dominated by Carex nigricans from the San Juan Mountains, one of the more mesic ranges in Colorado. Otherwise this snowbed association has not been reported from the Southern Rockies. In our study area, these communities were found only in the wetter ranges. Clearly, these mesic to hydric snowbed associations are dependent on

reliable, late-persisting snow cover found principally in the Cascades, the Northern Rockies and Canadian Rockies.

Dryas spp. are a common, often dominant, component of alpine vegetation throughout the Western Cordillera. In the Canadian Rockies and Cascade Range, D. octopetala generally forms communities with wet- or mesic-site indicators such as Salix reticulata, Polygonum viviparum and Lupinus lepidus (Achuff and Corns 1982, Douglas and Bliss 1977). In the southern Rockies, D. octopetala occurs in more xeric communities with Carex rupestris and cushion plants such as Silene acaulis, Trifolium nanum and Arenaria obtusiloba (Willard 1979). Our study area occupies an intermediate position in this continuum, and both xeric and mesic Dryas associations were present. DRYOCT/POLVIV was found on moist terraces and mesic slopes, while DRYOCT/CARRUP occurred in shallower soils of exposed ridges and upper slopes.

Carex rupestris is a common component of fellfields and dry turf throughout much of the Rocky Mountains. The common D. octopetala/C. rupestris type has already been mentioned. In the Southern Rockies, C. rupestris also commonly occurs with Geum rossii on soils derived from crystalline parent material. On calcareous soils in our study area and adjacent Idaho, a similar community occurs (CARRUP/POTOVI) but Potentilla ovina replaces G. rossii.

The above geographic analysis indicates the suite of plant communities found above timberline in southwest Montana has been formed by an interplay of geography, climate and soil parent material. Plant associations gradually change character over the length of the Western Cordillera as individual species wax and wane in importance. In general, communities adapted to cool, wet climates and calcareous soils predominate in the Canadian Rockies and northern Montana. Communities adapted to more xeric, less snowy environments are common in the Central and Southern Rocky Mountains. Our study area in southwest Montana occurs in the tension zone between these two distinct phytogeographic zones.

ACKNOWLEDGMENTS

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Appendix A. Vascular plant species encountered above timberline during the course of the study in 1989 and 1991. Nomenclature generally follows Hitchcock and Cronquist (1973). Nomenclature for <u>Salix</u> follows Dorn (1984), and <u>Poa</u> nomenclature follows Arnow (1987).

APIACEAE
Angelica roseana
Bupleurum americanum
Cymopterus bipinnatus
Ligusticum tenuifolium
Lomatium cous
Lomatium cusickii

ASTERACEAE
Achillea millefolium
Agoseris glauca
Antennaria alpina
Antennaria anaphaloides
Antennaria aromatica
Antennaria corymbosa
Antennaria lanata
Antennaria microphylla
Antennaria umbrinella
Arnica alpina
Arnica diversifolia
Arnica fulgens
Arnica latifolia
Arnica longifolia
Arnica mollis
Arnica rydbergii
Artemisia dracunculus
Artemisia frigida
Artemisia tridentata
Artemisia scopulorum
Aster alpigenus
Aster foliaceus
Aster integrifolius
Chaenactis alpina
Chrysothamnus viscidiflorus
Cirsium scariosum
Erigeron asperugineus
Erigeron caespitosus
Erigeron compositus
Erigeron humilis
Erigeron leiomerus

Erigeron peregrinus
Erigeron radicatus
Erigeron rydbergii
Erigeron simplex
Erigeron tweedyi
Erigeron ursinus
Haplopappus acaulis
Haplopappus lanuginosus
Haplopappus lyallii
Haplopappus suffruticosus
Haplopappus uniflorus
Hieracium gracile
Hymenoxys acaulis
Hymenoxys grandiflora
Microseris nigricans
Saussurea weberi
Senecio canus
Senecio crassulus
Senecio cymbalarioides
Senecio fremontii
Senecio hydrophyllus
Senecio streptanthifolius
Senecio triangularis
Solidago multiradiata
Taraxacum ceratophorum
Taraxacum lyratum
Taraxacum officinale
Townsendia condensata
Townsendia montana
Townsendia parryi

BORAGINACEAE
Cryptantha sp.
Eritrichium nanum
Mertensia alpina
Mertensia ciliata
Mertensia oblongifolia
Mertensia perplexa
Myosotis sylvatica

BRASSICACEAE
Arabis drummondii
Arabis lemmonii
Arabis lyallii
Arabis nuttallii
Braya humilis
Draba apiculata
Draba crassifolia
Draba incerta
Draba lanceolata
Draba lonchocarpa
Draba nemorosa

BRASSICACEAE (cont.)
Draba oligosperma
Draba ventosa
Draba sp.
Lesquerella alpina
Lesquerella sp.
Physaria saximontana
Smelowskia calycina
Thlaspi parviflorum

CAMPANULACEAE
Campanula rotundifolia
Campanula scabrella
Campanula uniflora

CARYOPHYLLACEAE
Arenaria capillaris
Arenaria congesta
Arenaria nuttallii
Arenaria obtusiloba
Arenaria rossii
Arenaria rubella
Cerastium arvense
Cerastium beeringianum
Lychnis apetala
Silene acaulis
Silene parryi
Silene repens
Stellaria calycantha
Stellaria longipes
Stellaria umbellata

CRASSULACEAE
Sedum lanceolatum
Sedum rosea

CYPERACEAE
Carex albonigra
Carex atrata
Carex elynoides
Carex haydenii
Carex illota
Carex lenticularis
Carex leporinella
Carex microptera
Carex nardina
Carex nigricans
Carex nova
Carex obtusata
Carex pachystachya
Carex paysonis
Carex petasata
Carex phaeocephala
Carex pyrennaica
Carex rossii
Carex rupestris
Carex scirpoidea
Carex scopulorum

ERICACEAE
Cassiope mertensiana
Phyllodoce empetriformis
Phyllodoce glanduliflora
Phyllodoce intermedia
Vaccinium scoparium

FABACEAE
Astragalus aboriginum
Astragalus adsurgens
Astragalus alpinus
Astragalus bourgovii
Astragalus kentrophyta
Astragalus miser
Hedysarum sulphurescens
Lupinus argenteus
Lupinus lepidus

Oxytropis campestris
Oxytropis deflexa
Oxytropis viscida
Trifolium haydenii
Trifolium longipes
Trifolium nanum
Trifolium parryi

GENTIACEAE
Frasera speciosa
Gentiana affinis
Gentiana algida
Gentiana amarella
Gentiana calycosa
Gentiana prostrata

GROSSULARIACEAE
Ribes hendersonii
Ribes lacustre

HYDROPHYLLACEAE
Phacelia hastata
Phacelia sericea

HYPERICACEAE
Hypericum formosum

JUNCACEAE

JUNCACEAE (cont.)
Juncus balticus
Juncus drummondii
Juncus mertensianus
Juncus parryi
Luzula campestris
Luzula hitchcockii
Luzula spicata

LILIACEAE
Allium brevistylum
Allium cernuum
Allium schoenoprasum
Erythronium grandiflorum
Lloydia serotina

Zigadenus elegans

LINACEAE
Linum perenne

ONAGRACEAE
Epilobium alpinum
Epilobium latifolium

PINACEAE
Abies lasiocarpa
Larix lyallii
Picea engelmannii
Pinus albicaulis

PLANTAGINACEAE
Plantago tweedyi

POACEAE
Agropyron caninum
Agropyron scribneri
Agropyron spicatum
Agrostis humilis
Agrostis variabilis
Alopecurus alpinus
Bromus pumpellianus
Calamagrostis purpurascens
Deschampsia cespitosa
Danthonia intermedia
Festuca idahoensis
Festuca ovina
Hepserocloa kingii
Koeleria cristata
Phleum alpinum
Poa alpina
Poa arctica
Poa fendleriana
Poa glauca
Poa leptocoma
Poa nervosa
Poa pratensis
Poa reflexa
Poa secunda
Stipa occidentalis

Trisetum spicatum

POLEMONIACEAE
Collomia debilis
Gilia spicata
Phlox hoodii
Phlox multiflora
Phlox pulvinata
Polemonium viscosum

POLYGONACEAE
Eriogonum flavum
Eriogonum ovalifolium
Eriogonum umbellatum
Oxyria digyna
Polygonum bistortoides
Polygonum viviparum
Polygonum watsonii
Rumex paucifloius

PORTULACACEAE
Claytonia lanceolata
Lewisia pygmaea
Montia chamissoi

PRIMULACEAE
Androsaceae filiformis
Androsaceae septentrionalis
Dodecatheon pulchellum
Douglasia montana

RANUNCULACEAE
Anemone drummondii
Anemone multifida
Anemone parviflora
Caltha leptosepala
Delphinium occidentale
Ranunculus eschscholtzii
Ranunculus pygmaeus
Thalictrum sp.
Trollius laxus

ROSACEAE
Dryas octopetala

Geum rossii

ROSACEAE (cont.)
Geum triflorum
Ivesia gordonii
Potentilla breviflora
Potentilla concinna
Potentilla diversifolia
Potentilla fruticosa
Potentilla glandulosa
Potentilla hippiana
Potentilla nivea
Potentilla ovina
Potentilla quinquefolia
Sibbaldia procumbens

SALICACEAE
Salix arctica
Salix brachycarpa
Salix glauca
Salix planifolia
Salix reticulata
Salix rotundifolia

SAXIFRAGACEAE
Heuchera cylindrica
Heuchera parvifolia
Lithophragma bulbifera
Saxifraga adsurgens
Saxifraga arguta
Saxifraga bronchialis
Saxifraga caespitosa
Saxifraga flagellaris
Saxifraga occidentalis
Saxifraga oppositifolia
Saxifraga oregana
Saxifraga rhomboidea
Saxifraga tempestiva

SELAGINELLACEAE
Selaginella densa
Selaginella watsonii

SCROPHULARIACEAE
Besseya wyomingensis
Castilleja crista-gali
Castilleja cusickii
Castilleja miniata
Castilleja nivea
Castilleja pallescens
Castilleja pulchella
Castilleja rhexifolia
Chionophila tweedyi
Pedicularis contorta
Pedicularis cystopteridifolia
Pedicularis groenlandica
Pedicularis parryi
Penstemon attenuatus
Penstemon montanus
Penstemon procerus
Sythyris pinnatifida
Veronica cusickii
Veronica wormskjoldii

VALERIANACEAE
Valeriana edulis

VIOLACEAE
Viola adunca
Viola nuttallii

Appendix B. Mean site variables (±SD) for 23 plant community types in the study area.

COMMUNITY TYPE NAMES

SITE VARIABLES	FESIDA/POTDIV N = 12	DESCES/POTDIV N = 6	HESKIN/OXYCAM N = 3	CARELY N = 24	CARSCI/POTDIV N = 7	CARSCI/GEUROS N = 13	DRYOCT/POLVIV N = 3
COMMUNITY SIZE (AC)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
SLOPE SHAPE	2.7 (1.8)	2.2 (1.6)	2.0 (.0)	1.9 (1.2)	1.3 (.5)	2.5 (1.6)	2.0 (1.0)
ASPECT (DEGREES)	180.4 (129.6)	257.7 (131.6)	163.3 (97.5)	162.7 (101.3)	126.4 (103.3)	212.7 (107.2)	233.3 (197.9)
SLOPE (%)	35.5 (21.6)	20.2 (21.1)	42.0 (13.2)	24.0 (16.9)	19.6 (12.9)	28.2 (15.5)	29.3 (18.4)
ELEVATION (MSL)	9640.8 (161.7)	9666.7 (329.8)	9650.0 (183.8)	9839.0 (256.2)	9785.7 (363.3)	9880.0 (224.0)	9560.0 (330.4)
BARE/GRAVEL COVER-%	10.9 (19.1)	6.2 (8.3)	21.0 (1.7)	13.0 (14.0)	3.7 (3.6)	14.6 (15.1)	16.0 (15.7)
ROCK COVER (%)	1.9 (2.7)	.3 (.5)	8.7 (9.8)	10.0 (17.6)	1.4 (1.1)	21.2 (18.5)	1.0 (.0)
ORGANIC COVER (%)	86.0 (23.6)	91.8 (6.2)	62.3 (18.5)	68.6 (27.4)	97.0 (8.0)	61.4 (25.2)	89.0 (13.5)
BASAL VEG COVER (%)	7.1 (3.6)	6.5 (3.8)	5.3 (4.0)	6.2 (6.0)	8.0 (3.4)	9.9 (5.4)	5.3 (4.0)
WOODY COVER (%)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.3 (.6)
LITTER COVER (%)	63.6 (31.5)	58.3 (34.3)	56.7 (23.1)	53.8 (28.2)	62.9 (26.3)	50.0 (23.5)	43.3 (40.4)
BASAL AREA (SQ FT)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
AVERAGE DBH (IN)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
TREE COVER (%)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.1 (.4)	.4 (.5)	.3 (.6)
SHRUB COVER (%)	.0 (.0)	.0 (.0)	3.7 (5.5)	1.8 (8.1)	.6 (1.1)	.1 (.3)	66.7 (25.2)
GRAMINOID COVER (%)	55.0 (18.8)	76.7 (12.1)	36.7 (5.8)	46.2 (18.1)	65.7 (17.2)	37.7 (22.8)	4.7 (4.7)
FORB COVER (%)	34.2 (15.6)	36.7 (17.5)	23.3 (5.8)	31.2 (16.5)	47.1 (18.9)	50.8 (18.0)	14.3 (9.8)
DOMINANT AGE (YRS)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	2.1 (5.7)	.0 (.0)	.0 (.0)
STAND AGE (YRS)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
GRASS PROD (LBS/AC)	726.5 (302.6)	938.2 (839.4)	613.3 (306.3)	398.7 (171.6)	636.9 (297.8)	230.1 (234.5)	27.3 (29.7)
FORB PROD (LBS/AC)	778.3 (420.3)	728.8 (361.1)	398.7 (178.7)	398.0 (201.9)	462.9 (239.4)	585.6 (526.6)	86.7 (130.7)
SHRUB PROD (LBS/AC)	.1 (.3)	.0 (.0)	84.3 (146.1)	.1 (.3)	8.4 (22.3)	.0 (.0)	482.7 (630.5)
DUFF DEPTH (IN)	.3 (.2)	.8 (.8)	.2 (.1)	.3 (.2)	.4 (.2)	.2 (.2)	.5 (.6)
LITTER DEPTH (IN)	.6 (.4)	.4 (.3)	.3 (.3)	.4 (.3)	.6 (.3)	.2 (.3)	.4 (.3)
FUEL DEPTH (FT)	.3 (.1)	.3 (.3)	.4 (.2)	.2 (.1)	.1 (.1)	.1 (.1)	.0 (.1)

COMMUNITY TYPE NAMES

SITE VARIABLES	SALARC/POLBIS N = 2	CARRUP/POTOVI N = 8	GEUROS/AREOBT N = 5	DRYOCT/CARRUP N = 5	CARNIG N = 4	JUNDRU/ANTLAN N = 3	PHYEMP/ANTLAN N = 4
COMMUNITY SIZE (AC)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
SLOPE SHAPE	2.5 (2.1)	2.1 (1.2)	2.0 (.7)	2.2 (1.3)	3.0 (1.6)	2.7 (.6)	3.5 (.6)
ASPECT (DEGREES)	205.0 (198.0)	128.9 (75.5)	197.0 (105.9)	127.0 (95.0)	228.8 (122.9)	173.3 (152.7)	106.2 (73.6)
SLOPE (%)	9.0 (1.4)	17.0 (13.4)	15.6 (16.6)	24.8 (15.3)	7.8 (4.6)	13.0 (8.9)	27.0 (11.5)
ELEVATION (MSL)	9540.0 (254.6)	9875.0 (309.0)	****** (225.0)	9504.0 (181.9)	9585.0 (280.0)	9793.3 (195.0)	9570.0 (347.7)
BARE/GRAVEL COVER-%	12.5 (12.0)	66.6 (28.1)	47.2 (11.5)	39.8 (37.4)	1.8 (.5)	50.0 (10.0)	15.2 (17.1)
ROCK COVER (%)	6.5 (4.9)	15.6 (20.2)	26.0 (15.2)	12.2 (10.7)	8.8 (14.2)	4.0 (5.2)	7.8 (4.5)
ORGANIC COVER (%)	80.0 (4.2)	8.4 (7.4)	20.6 (12.1)	37.8 (31.8)	92.7 (9.5)	55.3 (19.7)	67.0 (19.9)
BASAL VEG COVER (%)	3.0 (.0)	2.5 (.9)	4.0 (3.5)	4.4 (3.1)	10.0 (.0)	5.3 (4.0)	6.5 (4.0)
WOODY COVER (%)	.5 (.7)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
LITTER COVER (%)	21.5 (26.2)	5.9 (6.9)	16.6 (10.4)	32.8 (31.7)	75.0 (12.9)	30.0 (10.0)	55.0 (31.1)
BASAL AREA (SQ FT)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
AVERAGE DBH (IN)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
TREE COVER (%)	.5 (.7)	.0 (.0)	.0 (.0)	.0 (.0)	.3 (.6)	.3 (.6)	.5 (.6)
SHRUB COVER (%)	50.0 (28.3)	.0 (.0)	.4 (.5)	38.0 (26.8)	3.0 (4.7)	6.7 (11.5)	55.0 (17.3)
GRAMINOID COVER (%)	15.0 (7.1)	10.7 (6.5)	4.0 (3.5)	13.2 (9.3)	82.5 (9.6)	30.0 (.0)	20.0 (8.2)
FORB COVER (%)	30.0 (14.1)	28.7 (12.5)	30.0 (20.0)	15.2 (13.8)	21.0 (23.4)	36.7 (15.3)	35.0 (25.2)
DOMINANT AGE (YRS)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
STAND AGE (YRS)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
GRASS PROD (LBS/AC)	148.0 (125.9)	70.1 (89.6)	41.2 (49.4)	32.6 (39.7)	374.5 (511.2)	237.0 (30.0)	133.0 (247.0)
FORB PROD (LBS/AC)	295.5 (293.4)	173.2 (251.0)	452.8 (223.4)	43.0 (63.6)	274.5 (473.0)	459.7 (364.2)	103.5 (119.5)
SHRUB PROD (LBS/AC)	503.0 (209.3)	.0 (.0)	.0 (.0)	156.8 (278.7)	22.2 (44.5)	29.7 (51.4)	166.3 (212.5)
DUFF DEPTH (IN)	.4 (.3)	.1 (.1)	.0 (.0)	.1 (.1)	.2 (.1)	.1 (.1)	.1 (.1)
LITTER DEPTH (IN)	.1 (.1)	.1 (.2)	.0 (.0)	.1 (.1)	.4 (.3)	.1 (.1)	.1 (.0)
FUEL DEPTH (FT)	.0 (.0)	.1 (.1)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)

SITE VARIABLES	CASMER/CARPAY N = 3	JUNPAR/ERIURS N = 2	SALGLA N = 1	DRY SLOPE N = 11	MOIST SLOPE N = 7	DESCES/CALLEP N = 5	CARSCO/CALLEP N = 5
COMMUNITY SIZE (AC)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
SLOPE SHAPE	2.7 (1.5)	1.0 (.0)	2.0 (.0)	1.5 (.7)	2.1 (2.0)	2.6 (2.2)	1.8 (1.8)
ASPECT (DEGREES)	63.3 (53.0)	202.5 (38.9)	360.0 (.0)	179.1 (83.2)	164.3 (108.2)	89.2 (148.5)	130.4 (178.0)
SLOPE (%)	14.3 (9.5)	16.0 (7.1)	33.0 (.0)	49.7 (12.8)	44.0 (18.3)	9.4 (8.3)	1.4 (1.1)
ELEVATION (MSL)	9513.3 (100.6)	9680.0 (183.8)	9910.0 (.0)	9824.5 (326.0)	9740.0 (193.1)	9772.0 (246.2)	9594.0 (390.4)
BARE/GRAVEL COVER-%	11.0 (9.0)	46.5 (47.4)	6.0 (.0)	56.7 (24.4)	82.0 (9.3)	5.2 (8.3)	.2 (.4)
ROCK COVER (%)	8.0 (10.4)	2.0 (1.4)	10.0 (.0)	24.6 (18.5)	8.3 (8.6)	.8 (1.3)	.2 (.4)
ORGANIC COVER (%)	81.7 (25.1)	48.0 (49.5)	76.0 (.0)	10.5 (9.2)	5.9 (7.6)	89.6 (11.1)	98.6 (7.7)
BASAL VEG COVER (%)	7.7 (4.0)	3.0 (.0)	3.0 (.0)	2.9 (2.5)	1.9 (1.1)	4.4 (3.1)	8.6 (3.1)
WOODY COVER (%)	.3 (.6)	.0 (.0)	.0 (.0)	.1 (.3)	.0 (.0)	.0 (.0)	.0 (.0)
LITTER COVER (%)	66.7 (15.3)	30.0 (28.3)	3.0 (.0)	7.3 (8.6)	4.0 (7.1)	13.2 (15.4)	30.0 (29.2)
BASAL AREA (SQ FT)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
AVERAGE DBH (IN)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)
TREE COVER (%)	.7 (.6)	.0 (.0)	.0 (.0)	.1 (.3)	.0 (.0)	.0 (.0)	.0 (.0)
SHRUB COVER (%)	60.0 (20.0)	.0 (.0)	60.0 (.0)	1.2 (3.0)	.1 (.4)	.4 (.5)	.8 (1.3)
GRAMINOID COVER (%)	23.3 (23.1)	35.0 (21.2)	1.0 (.0)	10.8 (6.6)	12.3 (7.8)	38.0 (14.8)	88.0 (4.5)
FORB COVER (%)	30.0 (26.5)	25.0 (7.1)	60.0 (.0)	25.5 (11.3)	29.0 (15.9)	68.0 (19.2)	52.0 (23.9)
DOMINANT AGE (YRS)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.1 (.4)	.0 (.0)	.0 (.0)
STAND AGE (YRS)	.0 (.0)	.0 (.0)	.0 (.0)	.0 (.0)	.1 (.4)	.0 (.0)	.0 (.0)
GRASS PROD (LBS/AC)	89.0 (154.2)	448.5 (439.1)	12.0 (.0)	139.6 (106.7)	119.0 (137.0)	458.2 (491.3)	1719.6 (*****)
FORB PROD (LBS/AC)	237.3 (411.1)	253.0 (32.5)	759.0 (.0)	462.4 (335.2)	327.9 (347.2)	997.4 (813.1)	577.2 (289.5)
SHRUB PROD (LBS/AC)	79.0 (136.8)	.0 (.0)	759.0 (.0)	.0 (.0)	.0 (.0)	16.6 (35.5)	.0 (.0)
DUFF DEPTH (IN)	.1 (.1)	.3 (.4)	.5 (.0)	.0 (.1)	.0 (.0)	.4 (.3)	2.5 (4.2)
LITTER DEPTH (IN)	.2 (.2)	.1 (.1)	1.0 (.0)	.0 (.1)	.0 (.0)	.6 (.5)	.7 (.4)
FUEL DEPTH (FT)	.0 (.0)	.2 (.1)	.8 (.0)	.1 (.1)	.2 (.2)	.2 (.2)	.2 (.3)

SITE VARIABLES	SALNIV/CALLEP N = 2	SALPLA/CARSCO N = 1
COMMUNITY SIZE (AC)	.0 (.0)	.0 (.0)
SLOPE SHAPE	3.0 (2.8)	1.0 (.0)
ASPECT (DEGREES)	357.5 (3.5)	10.0 (.0)
SLOPE (%)	28.0 (9.9)	1.0 (.0)
ELEVATION (MSL)	9905.0 (219.1)	9320.0 (.0)
BARE/GRAVEL COVER-%	3.0 (1.4)	.0 (.0)
ROCK COVER (%)	5.5 (6.4)	.0 (.0)
ORGANIC COVER (%)	95.0 (7.1)	100.0 (.0)
BASAL VEG COVER (%)	10.0 (.0)	10.0 (.0)
WOODY COVER (%)	.0 (.0)	.0 (.0)
LITTER COVER (%)	35.0 (35.4)	10.0 (.0)
BASAL AREA (SQ FT)	.0 (.0)	.0 (.0)
AVERAGE DBH (IN)	.0 (.0)	.0 (.0)
TREE COVER (%)	.0 (.0)	.0 (.0)
SHRUB COVER (%)	70.0 (.0)	70.0 (.0)
GRAMINOID COVER (%)	15.0 (7.1)	40.0 (.0)
FORB COVER (%)	30.0 (28.3)	40.0 (.0)
DOMINANT AGE (YRS)	.0 (.0)	.0 (.0)
STAND AGE (YRS)	.0 (.0)	.0 (.0)
GRASS PROD (LBS/AC)	86.5 (47.4)	869.0 (.0)
FORB PROD (LBS/AC)	329.0 (383.3)	178.0 (.0)
SHRUB PROD (LBS/AC)	678.0 (384.7)	1335.0 (.0)
DUFF DEPTH (IN)	.4 (.1)	9.9 (.0)
LITTER DEPTH (IN)	.4 (.0)	.5 (.0)
FUEL DEPTH (FT)	.1 (.0)	.0 (.0)

Appendix A. Vascular plant constancy and (mean canopy cover).

COMMUNITY TYPE NAMES

SPECIES ABBREVIATIONS	FESIDA/POTDIV N = 12	DESCES/POTDIV N = 6	HESKIN/OXYCAM N = 3	CARELY N = 24	CARSCI/POTDIV N = 7	CARSCI/GEUROS N = 13	DRYOCT/POLVIV N = 3
***** TREES *****							
ABILAS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
LARLYA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)
PICENG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PINALB	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	30.8(1.1)	.0(.0)
***** SHRUBS *****							
ARTFRI	.0(.0)	.0(.0)	100.0(2.2)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARTTSV	.0(.0)	.0(.0)	33.3(10.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASMER	8.3(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CHRVIS	.0(.0)	.0(.0)	33.3(.5)	4.2(.5)	.0(.0)	.0(.0)	.0(.0)
DRYOCT	.0(.0)	.0(.0)	.0(.0)	4.2(3.0)	.0(.0)	.0(.0)	100.0(60.0)
HAPSUF	.0(.0)	.0(.0)	.0(.0)	8.3(.5)	.0(.0)	.0(.0)	.0(.0)
PHYEMP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	7.7(.5)	.0(.0)
PHYGLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTFRU	.0(.0)	.0(.0)	.0(.0)	4.2(3.0)	28.6(6.5)	.0(.0)	.0(.0)
RIBHEN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
RIBLAC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALARC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALDOO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALGLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALIXX	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALNIV	8.3(.5)	.0(.0)	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	100.0(11.0)
SALPLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
VACSCO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
***** GRASSES *****							
AGRCAN	58.3(4.6)	.0(.0)	33.3(.5)	29.2(4.6)	85.7(.9)	.0(.0)	.0(.0)
AGRHUM	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
AGROST	.0(.0)	.0(.0)	.0(.0)	.0(.0)	14.3(.5)	23.1(.5)	.0(.0)
AGRSCR	.0(.0)	.0(.0)	33.3(.5)	16.7(3.5)	.0(.0)	7.7(3.0)	.0(.0)
AGRSPI	.0(.0)	.0(.0)	100.0(3.0)	4.2(.5)	.0(.0)	7.7(.5)	.0(.0)
AGRVAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ALOALP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
BROPUM	33.3(15.7)	.0(.0)	.0(.0)	12.5(.5)	28.6(1.8)	.0(.0)	.0(.0)
CALPUR	.0(.0)	.0(.0)	33.3(3.0)	45.8(9.2)	42.9(7.8)	15.4(.5)	33.3(.5)
CARALB	.0(.0)	.0(.0)	.0(.0)	.0(.0)	14.3(.5)	15.4(6.5)	33.3(.5)
CARATR	25.0(.5)	66.7(12.7)	.0(.0)	.0(.0)	14.3(.5)	7.7(20.0)	.0(.0)
CARELY	50.0(3.8)	.0(.0)	33.3(3.0)	100.0(27.1)	71.4(30.6)	46.2(2.6)	100.0(2.2)
CAREXX	8.3(.5)	50.0(7.8)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARHAY	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARILL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARLEN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARLEP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARMIC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARNAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)
CARNIG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARNOV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CAROBT	33.3(40.0)	.0(.0)	.0(.0)	8.3(1.8)	28.6(3.0)	.0(.0)	.0(.0)
CARPAC	8.3(.5)	16.7(40.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARPAY	.0(.0)	16.7(20.0)	.0(.0)	.0(.0)	.0(.0)	15.4(.5)	.0(.0)
CARPET	25.0(3.7)	16.7(10.5)	.0(.0)	8.3(.5)	14.3(.5)	.0(.0)	.0(.0)
CARPHA	.0(.0)	16.7(10.0)	.0(.0)	.0(.0)	14.3(.5)	76.9(5.8)	33.3(.5)
CARPYR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARROI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARROS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARRUP	33.3(1.1)	.0(.0)	33.3(.5)	62.5(15.6)	28.6(5.3)	23.1(14.3)	33.3(3.0)

5.7

Table of species frequency and mean cover values (format: frequency % (mean cover %)). Rotated data table.

GRAMINOIDS / GRASSES

Species	1	2	3	4	5	6	7
CARSCI	8.3(40.0)	.0(.0)	.0(.0)	20.8(2.0)	85.7(35.5)	84.6(23.7)	.0(.0)
CARSCO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	28.6(11.5)	15.4(.5)	.0(.0)
DANINT	8.3(.5)	16.7(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DANTHO	41.7(.5)	33.3(30.0)	.0(.0)	.0(.0)	28.6(1.8)	23.1(14.3)	.0(.0)
DESCES	91.7(27.5)	100.0(28.4)	66.7(1.8)	20.8(4.3)	28.6(3.0)	7.7(10.0)	33.3(.5)
FESIDA	8.3(3.0)	33.3(30.0)	100.0(26.7)	58.3(10.0)	42.9(3.0)	84.6(4.9)	66.7(.5)
FESOVI	25.0(7.0)	33.3(1.8)	.0(.0)	54.2(5.0)	100.0(8.3)	.0(.0)	33.3(.5)
HESKIN	.0(.0)	16.7(50.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
JUNBAL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
JUNCUS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
JUNDRU	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
JUNMER	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
JUNPAR	8.3(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
KOECRI	8.3(.5)	.0(.0)	33.3(.5)	8.3(.5)	.0(.0)	.0(.0)	.0(.0)
LUZCAM	8.3(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
LU2HIT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
LU2PAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
LU2SPI	16.7(.5)	50.0(1.3)	.0(.0)	8.3(.5)	57.1(.5)	92.3(1.1)	.0(.0)
LUZULA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PHLALP	.0(.0)	66.7(1.1)	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)
POAALP	41.7(1.0)	33.3(6.5)	100.0(2.2)	20.8(1.5)	71.4(2.9)	46.2(3.3)	100.0(3.0)
POAARC	8.3(20.0)	33.3(1.8)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)
POAFEN	25.0(1.3)	16.7(.5)	33.3(3.0)	20.8(.5)	28.6(.5)	7.7(3.0)	.0(.0)
POAGLA	25.0(4.5)	.0(.0)	.0(.0)	66.7(2.0)	28.6(.5)	15.4(1.8)	33.3(.5)
POALEP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)
POANER	.0(.0)	16.7(3.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POAPRA	16.7(3.0)	.0(.0)	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)
POAREF	.0(.0)	16.7(.5)	.0(.0)	.0(.0)	.0(.0)	15.4(.5)	.0(.0)
POARUP	.0(.0)	16.7(.5)	100.0(4.5)	12.5(.5)	.0(.0)	53.8(.9)	.0(.0)
POASEC	8.3(10.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POAXXX	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
STIOCC	.0(.0)	16.7(.5)	100.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
STIPAX	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TRISPI	8.3(.5)	33.3(.5)	.0(.0)	12.5(.5)	28.6(.5)	84.6(1.0)	33.3(.5)

***** FORBS *****

Species	1	2	3	4	5	6	7
ACHMIL	83.3(2.2)	66.7(1.8)	33.3(.5)	33.3(2.9)	57.1(6.0)	15.4(1.8)	33.3(.5)
AGOGLA	50.0(1.3)	16.7(3.0)	66.7(.5)	45.8(1.4)	42.9(.5)	30.8(1.1)	.0(.0)
ALLBRE	8.3(.5)	16.7(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ALLCER	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ALLSCH	.0(.0)	16.7(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANDFIL	8.3(.5)	16.7(.5)	.0(.0)	4.2(.5)	14.3(.5)	15.4(.5)	33.3(.5)
ANDSEP	8.3(.5)	33.3(.5)	.0(.0)	4.2(.5)	28.6(.5)	.0(.0)	.0(.0)
ANEDRU	8.3(.5)	.0(.0)	.0(.0)	20.8(.5)	14.3(.5)	.0(.0)	.0(.0)
ANEMON	8.3(.5)	.0(.0)	.0(.0)	4.2(.5)	14.3(.5)	.0(.0)	.0(.0)
ANEMUL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANENUT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANEPAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	14.3(3.0)	30.8(.5)	33.3(.5)
ANGROS	16.7(.5)	.0(.0)	.0(.0)	4.2(3.0)	.0(.0)	.0(.0)	.0(.0)
ANTALP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANTANA	.0(.0)	.0(.0)	.0(.0)	8.3(.5)	14.3(.5)	15.4(.5)	33.3(.5)
ANTARO	16.7(.5)	.0(.0)	.0(.0)	8.3(1.8)	14.3(.5)	15.4(.5)	.0(.0)
ANTCOR	8.3(.5)	.0(.0)	.0(.0)	4.2(20.0)	14.3(.5)	15.4(.5)	.0(.0)
ANTENN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANTLAN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANTMIC	16.7(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	7.7(.5)	7.7(.5)
ANTUMB	8.3(.5)	.0(.0)	.0(.0)	12.5(.5)	42.9(.5)	23.1(.5)	23.1(.5)
ARABIS	.0(.0)	.0(.0)	.0(.0)	4.2(3.0)	.0(.0)	.0(.0)	.0(.0)
ARADRU	.0(.0)	.0(.0)	.0(.0)	29.2(.9)	.0(.0)	.0(.0)	.0(.0)
ARALEM	50.0(.5)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0)	33.3(.5)
ARALYA	33.3(.5)	.0(.0)	.0(.0)	.0(.0)	42.9(.5)	76.9(5.1)	33.3(3.0)
ARANUT	.0(.0)	.0(.0)	33.3(10.0)	33.3(4.1)	42.9(4.5)	—	33.3(3.0)
ARECAP	—	—	—	—	—	—	—
ARECON	—	—	—	—	—	—	—
ARENUT	—	—	—	—	—	—	—
AREOBT	—	—	—	—	—	—	—

Species abundance/frequency data table (frequency %, mean cover value in parentheses):

Species	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
AREROS	33.3(.5)	.0(.0)	42.9(.5)	4.2(.5)	.0(.0)	.0(.0)	.0(.0)
ARERUB	.0(.0)	15.4(.5)	14.3(.5)	4.2(.5)	.0(.0)	.0(.0)	.0(.0)
ARNALP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARNDIV	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0)	.0(.0)
ARNFUL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARNLAT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARNLON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARNMOL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARNRYD	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARTDRA	.0(.0)	7.7(10.0)	.0(.0)	8.3(1.8)	.0(.0)	.0(.0)	16.7(.5)
ARTSCO	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0)	.0(.0)
ASTABO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTADS	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0)	.0(.0)
ASTALG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	16.7(.5)
ASTALP	33.3(.5)	.0(.0)	42.9(2.2)	4.2(.5)	.0(.0)	.0(.0)	.0(.0)
ASTBOU	.0(.0)	23.1(1.3)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTFOL	.0(.0)	15.4(3.0)	.0(.0)	20.8(.5)	.0(.0)	.0(.0)	8.3(.5)
ASTINT	.0(.0)	.0(.0)	14.3(.5)	4.2(.5)	.0(.0)	.0(.0)	.0(.0)
ASTKEN	33.3(.5)	.0(.0)	.0(.0)	8.3(.5)	.0(.0)	.0(.0)	8.3(.5)
ASTMIS	.0(.0)	.0(.0)	.0(.0)	41.7(2.3)	.0(.0)	.0(.0)	.0(.0)
ASTRAG	33.3(.5)	.0(.0)	14.3(.5)	54.2(1.1)	.0(.0)	.0(.0)	.0(.0)
BESWYO	33.3(.5)	.0(.0)	42.9(1.3)	.0(.0)	33.3(.5)	.0(.0)	50.0(2.2)
BUPAME	66.7(.5)	15.4(.5)	28.6(.5)	.0(.0)	.0(.0)	.0(.0)	41.7(1.0)
CALLEP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CAMPAR	.0(.0)	15.4(.5)	.0(.0)	4.2(.5)	.0(.0)	.0(.0)	.0(.0)
CAMROT	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)	8.3(.5)
CAMSCA	.0(.0)	15.4(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CAMUNI	.0(.0)	15.4(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASCRI	.0(.0)	15.4(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	8.3(.5)
CASCUS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASMIN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASNIV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASPAL	33.3(.5)	7.7(.5)	42.9(1.3)	4.2(.5)	66.7(.5)	16.7(3.0)	16.7(.5)
CASPUL	.0(.0)	7.7(.5)	.0(.0)	12.5(.5)	.0(.0)	.0(.0)	.0(.0)
CASRHE	.0(.0)	7.7(.5)	.0(.0)	8.3(.5)	.0(.0)	.0(.0)	75.0(.5)
CASTIL	.0(.0)	7.7(.5)	14.3(.5)	.0(.0)	.0(.0)	66.7(6.0)	.0(.0)
CERARV	.0(.0)	7.7(.5)	71.4(1.0)	37.5(.8)	.0(.0)	.0(.0)	8.3(3.0)
CHAALP	33.3(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CHITWE	.0(.0)	15.4(6.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CIRSCA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	16.7(1.8)
CLALAN	33.3(.5)	.0(.0)	28.6(1.8)	12.5(1.3)	100.0(1.3)	33.3(.5)	16.7(.5)
CRYPTA	33.3(.5)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)	16.7(.5)	.0(.0)
CYMBIP	.0(.0)	.0(.0)	.0(.0)	54.2(2.4)	.0(.0)	.0(.0)	.0(.0)
DELOCC	.0(.0)	.0(.0)	.0(.0)	12.5(.5)	.0(.0)	.0(.0)	.0(.0)
DODCON	.0(.0)	.0(.0)	.0(.0)	8.3(.5)	.0(.0)	.0(.0)	8.3(.5)
DODECA	.0(.0)	46.2(1.3)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)	.0(.0)
DODPUL	33.3(.5)	7.7(.5)	42.9(1.3)	12.5(.5)	.0(.0)	.0(.0)	.0(.0)
DOUMON	.0(.0)	.0(.0)	28.6(.5)	8.3(1.8)	.0(.0)	.0(.0)	.0(.0)
DRAAPI	33.3(.5)	23.1(.5)	.0(.0)	.0(.0)	33.3(.5)	16.7(1.8)	.0(.0)
DRABAX	33.3(.5)	15.4(.5)	.0(.0)	.0(.0)	33.3(.5)	.0(.0)	.0(.0)
DRACRA	.0(.0)	38.5(.5)	.0(.0)	.0(.0)	66.7(1.8)	.0(.0)	.0(.0)
DRAINC	.0(.0)	7.7(.5)	.0(.0)	.0(.0)	.0(.0)	16.7(.5)	.0(.0)
DRALAN	.0(.0)	.0(.0)	.0(.0)	16.7(.5)	.0(.0)	.0(.0)	.0(.0)
DRALON	33.3(.5)	.0(.0)	.0(.0)	16.7(.5)	.0(.0)	.0(.0)	.0(.0)
DRANEM	.0(.0)	.0(.0)	.0(.0)	20.8(2.9)	.0(.0)	.0(.0)	.0(.0)
DRAOLI	.0(.0)	.0(.0)	.0(.0)	45.8(.5)	.0(.0)	.0(.0)	.0(.0)
EPIALP	33.3(.5)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0)	.0(.0)
ERICAE	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	16.7(.5)
ERICOM	.0(.0)	.0(.0)	.0(.0)	33.3(1.4)	.0(.0)	16.7(.5)	.0(.0)
ERIFLA	.0(.0)	.0(.0)	.0(.0)	8.3(.5)	.0(.0)	16.7(.5)	.0(.0)
ERIGER	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERIHUM	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERINAN	.0(.0)	15.4(.5)	.0(.0)	.0(.0)	66.7(.5)	.0(.0)	8.3(.5)
ERIOVA	.0(.0)	7.7(.5)	.0(.0)	.0(.0)	66.7(.5)	.0(.0)	.0(.0)
ERIPER	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERIRAD	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)

Species	1	2	3	4	5	6
ERIRYD	33.3(.5)	30.8(1.1)	14.3(.5)	16.7(1.8)	.0(.0)	25.0(2.2)
ERISIM	33.3(.5)	76.9(3.7)	85.7(2.9)	12.5(.5)	33.3(1.8)	.0(.0)
ERITWE	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERIUMB	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERIURS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERYGRA	33.3(.5)	.0(.0)	28.6(1.8)	33.3(.5)	16.7(30.0)	50.0(.5)
FORBPE	.0(.0)	7.7(3.0)	.0(.0)	.0(.0)	16.7(.5)	.0(.0)
FRASPE	33.3(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
GENAFF	.0(.0)	100.0(36.9)	.0(.0)	.0(.0)	16.7(.5)	8.3(3.0)
GENALG	.0(.0)	.0(.0)	57.1(1.1)	.0(.0)	.0(.0)	.0(.0)
GENAMA	33.3(3.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
GENCAL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	8.3(10.0)
GENPRO	.0(.0)	30.8(.5)	.0(.0)	8.3(.5)	.0(.0)	.0(.0)
GEUROS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
GEUTRI	33.3(3.0)	.0(.0)	14.3(3.0)	8.3(.5)	.0(.0)	.0(.0)
GILSPI	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
HAPACA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	8.3(.5)
HAPLYA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
HAPUNI	.0(.0)	15.4(.5)	.0(.0)	12.5(.5)	.0(.0)	8.3(.5)
HEDSUL	33.3(3.0)	.0(.0)	.0(.0)	8.3(5.3)	.0(.0)	.0(.0)
HEUCYL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
HEUPAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	66.7(.5)
HIEGRA	.0(.0)	69.2(.8)	71.4(1.0)	8.3(.5)	.0(.0)	.0(.0)
HYMACA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	8.3(.5)
HYMGRA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
HYPFOR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	8.3(.5)
IVEGOR	.0(.0)	61.5(2.4)	.0(.0)	54.2(1.4)	.0(.0)	.0(.0)
LESALP	.0(.0)	15.4(.5)	.0(.0)	4.2(.5)	.0(.0)	16.7(.5)
LESQUE	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
LEWPYG	.0(.0)	84.6(6.9)	.0(.0)	4.2(.5)	16.7(.5)	8.3(.5)
LIGTEN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	16.7(.5)
LINLEW	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	33.3(1.1)
LITBUL	.0(.0)	53.8(1.6)	100.0(2.2)	33.3(1.1)	16.7(.5)	25.0(2.2)
LLOSER	.0(.0)	.0(.0)	42.9(3.0)	37.5(2.4)	33.3(.5)	.0(.0)
LOMCOU	100.0(1.3)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	50.0(.5)
LOMCUS	.0(.0)	.0(.0)	71.4(8.8)	45.8(1.4)	.0(.0)	.0(.0)
LUPARG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
LUPLEP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
LYCAPE	.0(.0)	.0(.0)	14.3(3.0)	4.2(.5)	.0(.0)	.0(.0)
MERALP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	16.7(3.0)	16.7(.5)
MERCIL	.0(.0)	7.7(.5)	28.6(.5)	33.3(3.0)	16.7(30.0)	.0(.0)
MEROBL	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0)
MERPER	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
MICNIG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	16.7(3.0)	8.3(.5)
MONCHA	.0(.0)	7.7(.5)	28.6(1.8)	20.8(.5)	.0(.0)	.0(.0)
MYOARV	.0(.0)	.0(.0)	57.1(3.5)	79.2(3.5)	.0(.0)	75.0(.8)
MYOSYL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	50.0(.5)	41.7(2.5)
OXYCAM	66.7(1.8)	7.7(.5)	28.6(.5)	25.0(2.5)	.0(.0)	.0(.0)
OXYDIG	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	8.3(.5)
OXYVIS	66.7(5.3)	7.7(.5)	42.9(3.7)	4.2(3.0)	.0(.0)	8.3(.5)
PEDCON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(1.8)	33.3(.5)
PEDCYS	66.7(1.8)	7.7(.5)	57.1(2.9)	4.2(.5)	16.7(.5)	.0(.0)
PEDGRO	.0(.0)	.0(.0)	.0(.0)	25.0(1.3)	.0(.0)	.0(.0)
PEDICU	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)	50.0(1.8)
PEDPAR	.0(.0)	7.7(.5)	42.9(2.2)	4.2(.5)	16.7(.5)	.0(.0)
PEDPUL	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0)
PENARI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	8.3(.5)
PENATT	.0(.0)	7.7(.5)	.0(.0)	4.2(.5)	33.3(5.3)	.0(.0)
PENMON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	41.7(1.5)
PENPRO	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0)
PENRYD	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PENSTE	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PHAHAS	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	33.3(.5)	.0(.0)
PHASER	.0(.0)	.0(.0)	.0(.0)	12.5(3.7)	33.3(.5)	8.3(3.0)
PHLHOO	.0(.0)	.0(.0)	.0(.0)	8.3(5.3)	66.7(10.0)	25.0(2.2)
PHLMUL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)

Species						
PHLPUL	66.7(.5)	92.3(7.3)	71.4(8.7)	87.5(12.2)	66.7(.5)	16.7(.5) / 66.7(10.9)
PHYSAX	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
PLATWE	66.7(5.3)	69.2(4.6)	100.0(6.1)	25.0(1.8)	.0(.0)	16.7(.5) / 58.3(7.1)
POLBIS	100.0(16.8)	.0(.0)	14.3(20.0)	29.2(6.7)	.0(.0)	100.0(7.7) / 91.7(9.7)
POLVIS	.0(.0)	.0(.0)	42.9(1.3)	4.2(10.0)	.0(.0)	16.7(.5) / .0(.0)
POLVIV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	16.7(10.0) / .0(.0)
POLWAT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
POLYGO	100.0(.5)	84.6(5.0)	85.7(14.3)	62.5(3.4)	.0(.0)	.0(.0) / 83.3(13.6)
POTCON	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0) / .0(.0)
POTDIV	100.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
POTENT	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0) / .0(.0)
POTGLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
POTHIP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)	.0(.0) / .0(.0)
POTNIV	.0(.0)	.0(.0)	14.3(.5)	4.2(.5)	.0(.0)	.0(.0) / .0(.0)
POTOVI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
POTQUI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	66.7(1.8)	.0(.0) / 16.7(.5)
RANESC	.0(.0)	7.7(.5)	.0(.0)	4.2(.5)	.0(.0)	66.7(3.5) / .0(.0)
RANPYG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / 8.3(.5)
RUMPAU	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(1.8) / 66.7(3.0)
SAUWEB	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SAXADS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	16.7(.5) / 33.3(1.8)
SAXARG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SAXBRO	.0(.0)	7.7(.5)	14.3(.5)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SAXCES	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SAXFLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SAXOCC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SAXOPP	33.3(.5)	7.7(3.0)	42.9(.5)	4.2(.5)	.0(.0)	50.0(5.3) / 8.3(3.0)
SAXORE	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.8) / 66.7(.8)
SAXRHO	.0(.0)	23.1(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SAXTEM	33.3(.5)	15.4(1.2)	28.6(.5)	41.7(.5)	.0(.0)	16.7(.5) / 16.7(.5)
SEDLAN	33.3(.5)	53.8(.5)	28.6(1.8)	41.7(1.8)	100.0(.5)	66.7(8.5) / 16.7(1.8)
SEDROS	66.7(.5)	.0(.0)	.0(.0)	12.5(.5)	33.3(.5)	.0(.0) / .0(.0)
SENCAN	.0(.0)	.0(.0)	28.6(.5)	12.5(.5)	.0(.0)	16.7(3.0) / 41.7(1.5)
SENCRA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SENCYM	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SENECI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SENFRE	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SENHYD	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SENHYR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SENSTR	.0(.0)	.0(.0)	28.6(.5)	20.8(.5)	33.3(.5)	.0(.0) / .0(.0)
SENTRI	.0(.0)	30.8(.5)	14.3(3.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SIBPRO	.0(.0)	46.2(.9)	28.6(.5)	16.7(1.1)	.0(.0)	.0(.0) / .0(.0)
SILACA	.0(.0)	.0(.0)	.0(.0)	16.7(1.8)	.0(.0)	.0(.0) / 8.3(.5)
SILPAR	.0(.0)	.0(.0)	.0(.0)	16.7(1.1)	.0(.0)	.0(.0) / 8.3(.5)
SILREP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / 8.3(.5)
SMECAL	.0(.0)	30.8(.5)	14.3(3.0)	33.3(2.0)	33.3(.5)	16.7(3.0) / 8.3(3.0)
SOLIDA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)	.0(.0) / 41.7(1.5)
SOLMUL	33.3(3.0)	7.7(3.0)	85.7(11.2)	25.0(1.8)	.0(.0)	16.7(.5) / .0(.0)
STECAL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
STELLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	16.7(.5) / 8.3(.5)
STELON	.0(.0)	7.7(.5)	.0(.0)	.0(.0)	.0(.0)	16.7(3.0) / 8.3(3.0)
STEUMB	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
SYNPIN	33.3(.5)	38.5(1.5)	14.3(10.0)	29.2(.9)	.0(.0)	33.3(1.8) / 33.3(1.1)
SYNPLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	8.3(3.0) / 8.3(3.0)
TARAXA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
TARCER	.0(.0)	7.7(.5)	14.3(.5)	4.2(.5)	.0(.0)	.0(.0) / 25.0(.5)
TARLYR	.0(.0)	.0(.0)	.0(.0)	4.2(.5)	.0(.0)	.0(.0) / .0(.0)
TAROFF	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
THAFEN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(1.8)	.0(.0) / .0(.0)
THLPAR	.0(.0)	.0(.0)	14.3(.5)	4.2(.5)	.0(.0)	16.7(.5) / .0(.0)
TOWCON	.0(.0)	.0(.0)	14.3(.5)	4.2(.5)	.0(.0)	.0(.0) / .0(.0)
TOWMON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
TOWPAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / .0(.0)
TRIHAY	.0(.0)	.0(.0)	.0(.0)	4.2(4.5)	.0(.0)	16.7(.5) / 8.3(.5)
TRILON	33.3(.5)	.0(.0)	.0(.0)	12.5(4.5)	.0(.0)	33.3(5.3) / 25.0(11.0)
TRINAN	.0(.0)	7.7(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0) / 8.3(3.0)

	1	2	3	4	5	6	7
TRIPAR	.0(.0)	33.3(10.0)	.0(.0)	.0(.0)	14.3(10.0)	7.7(.5)	.0(.0)
TROLAX	.0(.0)	16.7(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
VALEDU	16.7(1.8)	.0(.0)	.0(.0)	8.3(1.8)	14.3(.5)	.0(.0)	.0(.0)
VERCUS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
VERONI	.0(.0)	16.7(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
VERMOR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
VIOADU	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
VIONUT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ZIGELE	25.0(4.5)	.0(.0)	.0(.0)	29.2(3.6)	71.4(4.8)	.0(.0)	66.7(3.0)
***** FERNS *****							
SELDEN	8.3(.5)	.0(.0)	33.3(.5)	70.8(9.1)	14.3(.5)	30.8(3.5)	.0(.0)
SELWAT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	53.8(14.7)	.0(.0)

COMMUNITY TYPE NAMES

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*********************************************************************************
SPECIES      * SALARC/POLBIS * CARRUP/POTOVI * GEUROS/AREOBT * DRYOCT/CARRUP * CARNIG   * JUNDRU/ANTLAN * PHYEMP/ANTLAN *
ABBREVIATIONS*   N = 2       *    N = 8      *    N = 5      *    N = 5      *  N = 4   *    N = 3      *    N = 4      *
*********************************************************************************
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ABBREVIATIONS	SALARC/POLBIS N=2	CARRUP/POTOVI N=8	GEUROS/AREOBT N=5	DRYOCT/CARRUP N=5	CARNIG N=4	JUNDRU/ANTLAN N=3	PHYEMP/ANTLAN N=4
TREES							
ABILAS	50.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)	.0(.0)
LARLYA	.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PICENG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PINALB	50.0(.5)	.0(.0)	20.0(.5)	.0(.0)	.0(.0)	33.3(.5)	50.0(.5)
SHRUBS							
ARTFRI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARTTSV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASMER	.0(.0)	.0(.0)	.0(.0)	20.0(10.0)	50.0(.0)	.0(.0)	.0(.0)
CHRVIS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	50.0(20.2)
DRYOCT	50.0(10.0)	.0(.0)	20.0(.5)	100.0(36.0)	.0(.0)	.0(.0)	.0(.0)
HAPSUF	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PHYEMP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	50.0(.5)	.0(.0)	100.0(30.0)
PHYGLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	50.0(40.0)
POTFRU	.0(.0)	12.5(.5)	20.0(.5)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)
RIBHEN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
RIBLAC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALARC	100.0(50.0)	.0(.0)	20.0(.5)	20.0(.5)	25.0(10.0)	.0(.0)	25.0(3.0)
SALDOO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALGLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALIXX	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALNIV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALPLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
VACSCO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(10.0)	100.0(7.8)
GRASSES							
AGRCAN	50.0(.5)	.0(.0)	.0(.0)	20.0(.5)	.0(.0)	33.3(.5)	.0(.0)
AGRHUM	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
AGROST	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
AGRSCR	.0(.0)	50.0(.5)	20.0(3.0)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)
AGRSPI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
AGRVAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	25.0(.5)
ALOALP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
BROPUM	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CALPUR	.0(.0)	37.5(1.3)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	25.0(.5)
CARALB	50.0(3.0)	.0(.0)	20.0(.5)	40.0(3.0)	.0(.0)	.0(.0)	.0(.0)
CARATR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	25.0(20.0)	.0(.0)	.0(.0)
CARELY	100.0(.5)	37.5(3.7)	40.0(1.8)	60.0(5.3)	.0(.0)	.0(.0)	.0(.0)
CAREXX	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARHAY	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	66.7(1.8)	.0(.0)
CARILL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARLEN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARLEP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARMIC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARNAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARNIG	50.0(3.0)	.0(.0)	.0(.0)	20.0(.5)	100.0(77.5)	33.3(3.0)	25.0(10.0)
CARNOV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CAROBT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARPAC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARPAY	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	100.0(2.2)	100.0(10.2)
CARPET	.0(.0)	.0(.0)	.0(.0)	.0(.0)	50.0(6.5)	.0(.0)	.0(.0)
CARPHA	50.0(.5)	.0(.0)	20.0(.5)	.0(.0)	25.0(.5)	66.7(.5)	25.0(.5)
CARPYR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(10.0)	25.0(.5)
CARROI	.0(.0)	.0(.0)	.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARROS	.0(.0)	.0(.0)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)	25.0(3.0)
CARRUP	50.0(.5)	62.5(9.2)	20.0(20.0)	100.0(3.9)	.0(.0)	.0(.0)	.0(.0)

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CARSCI
CARSCO
DANINT
DANTHO
DESCES
FESIDA
FESOVI
HESKIN
JUNBAL
JUNCUS
JUNDRU
JUNMER
JUNPAR
KOECRI
LUZCAM
LUZHIT
LUZPAR
LUZSPI
LUZULA
PHLALP
POAALP
POAARC
POAFEN
POAGLA
POALEP
POANER
POAPRA
POAREF
POARUP
POASEC
POAXXX
STIOCC
STIPAX
TRISPI

*****  FORBS  *****

ACHMIL
AGOGLA
ALLBRE
ALLCER
ALLSCH
ANDFIL
ANDSEP
ANEDRU
ANEMON
ANEMUL
ANENUT
ANEPAR
ANGROS
ANTALP
ANTANA
ANTARO
ANTCOR
ANTENN
ANTLAN
ANTM1C
ANTUMB
ARABIS
ARADRU
ARALEM
ARALYA
ARANUT
ARECAP
ARECON
ARENUT
AREOBT
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Species	C1	C2	C3	C4	C5	C6	C7
AREROS	.0(.0)	.0(.0)	.0(.0)	40.0(.5)	.0(.0)	25.0(.5)	50.0(.5)
ARERUB	.0(.0)	.0(.0)	.0(.0)	40.0(.5)	.0(.0)	12.5(.5)	.0(.0)
ARNALP	.0(.0)	.0(.0)	.0(.0)	20.0(.5)	.0(.0)	12.5(.5)	.0(.0)
ARNDIV	.0(.5)	.0(.5)	.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARNFUL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARNLAT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARNLON	.0(.5)	.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARNMOL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARNRYD	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARTDRA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARTSCO	.0(.0)	.0(.0)	.0(.0)	.0(.5)	.0(.0)	.0(.0)	.0(.0)
ASTABO	50.0(3.0)	33.3(10.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTADS	50.0(3.0)	33.3(.0)	25.0(.0)	40.0(.0)	20.0(.0)	.0(.0)	.0(.0)
ASTALG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	50.0(10.0)
ASTALP	.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTBOU	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTFOL	.0(.0)	.0(.5)	.0(.0)	40.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTINT	25.0(3.0)	33.3(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTKEN	25.0(3.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTMIS	.0(.5)	.0(.0)	.0(.0)	20.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTRAG	50.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
BESWYO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
BUPAME	.0(.0)	.0(.0)	.0(.0)	40.0(.5)	40.0(.5)	.0(.0)	.0(.0)
CALLEP	.0(.5)	.0(.0)	50.0(15.2)	.0(.0)	.0(.0)	75.0(.5)	.0(.0)
CAMPAR	25.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CAMROT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CAMSCA	25.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CAMUNI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASCRI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASCUS	.0(.5)	.0(.0)	.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASMIN	25.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASNIV	.0(.0)	.0(.0)	.0(.0)	100.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASPAL	.0(.5)	.0(.0)	25.0(.5)	.0(.5)	20.0(.5)	25.0(.5)	50.0(.5)
CASPUL	.0(.0)	.0(.0)	25.0(20.0)	.0(.0)	.0(.0)	12.5(.5)	.0(.0)
CASRHE	25.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(.0)	.0(.0)	.0(.0)
CASTIL	.0(.5)	.0(.0)	25.0(.0)	.0(.5)	.0(.5)	.0(.5)	.0(.5)
CERARV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CHAALP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	50.0(.5)
CHITWE	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	50.0(3.0)
CIRSCA	50.0(1.8)	.0(.0)	.0(.0)	20.0(3.0)	.0(.0)	.0(.0)	.0(.0)
CLALAN	25.0(.5)	.0(.0)	.0(.0)	.0(.5)	.0(.0)	.0(.0)	.0(.0)
CRYPTA	50.0(5.3)	.0(.0)	.0(.0)	20.0(.0)	.0(.0)	62.5(.0)	.0(.0)
CYMBIP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	12.5(.0)	50.0(3.0)
DELOCC	.0(.0)	.0(.0)	.0(.0)	20.0(.0)	.0(.0)	12.5(1.0)	.0(.0)
DODCON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DODECA	.0(.5)	.0(.0)	.0(.5)	.0(.0)	.0(.0)	.0(.0)	50.0(.5)
DODPUL	50.0(1.8)	.0(.0)	.0(.0)	.0(.0)	60.0(1.3)	.0(.0)	50.0(.5)
DOUMON	25.0(.5)	.0(.0)	25.0(.5)	40.0(.0)	20.0(.0)	12.5(.5)	.0(.0)
DRAAPI	50.0(5.3)	.0(.0)	.0(.0)	20.0(.0)	.0(.0)	37.5(.5)	.0(.0)
DRABAX	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	25.0(.5)	.0(.0)
DRACRA	50.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	87.5(.5)	50.0(.5)
DRAINC	.0(.0)	.0(.0)	.0(.0)	40.0(.0)	40.0(.0)	25.0(.5)	.0(.0)
DRALAN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DRALON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DRANEM	.0(.0)	.0(.0)	.0(.0)	.0(.5)	40.0(.5)	.0(.0)	.0(.0)
DRAOLI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
EPIALP	.0(.5)	.0(.0)	.0(.0)	.0(.0)	20.0(10.0)	.0(.5)	.0(.0)
ERICAE	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(.5)	.0(.5)	.0(.0)
ERICOM	25.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.5)	.0(.0)
ERIFLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.5)	.0(.0)
ERIGER	.0(.0)	.0(.0)	.0(.0)	40.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERIHUM	.0(.0)	.0(.0)	.0(.0)	40.0(.5)	80.0(1.8)	75.0(.9)	50.0(.5)
ERINAN	50.0(.5)	100.0(3.7)	50.0(.5)	20.0(.5)	20.0(.5)	50.0(.5)	.0(.0)
ERIOVA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERIPER	.0(.5)	.0(.0)	.0(.5)	.0(.5)	.0(.0)	.0(.0)	.0(.0)
ERIRAD	50.0(.0)	.0(.0)	.0(.0)	40.0(.0)	.0(.0)	50.0(.5)	.0(.0)

65

Species codes (left column, top to bottom):

ERIRYD
ERISIM
ERITWE
ERIUMB
ERIURS
ERYGRA
FORBPE
FRASPE
GENAFF
GENALG
GENAMA
GENCAL
GENPRO
GEUROS
GEUTRI
GILSPI
HAPACA
HAPLYA
HAPUNI
HEDSUL
HEUCYL
HEUPAR
HIEGRA
HYMACA
HYMGRA
HYPFOR
IVEGOR
LESALP
LESQUE
LEWPYG
LIGTEN
LINLEW
LITBUL
LLOSER
LOMCOU
LOMCUS
LUPARG
LUPLEP
LYCAPE
MERALP
MERC1L
MEROBL
MERPER
MICNIG
MONCHA
MYOARV
MYOSYL
OXYCAM
OXYDIG
OXYVIS
PEDCON
PEDCYS
PEDGRO
PEDICU
PEDPAR
PEDPUL
PENARI
PENATT
PENMON
PENPRO
PENRYD
PENSTE
PHAHAS
PHASER
PHLHOO
PHLMUL

Species									
PHLPUL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PHYSAX	.0(.0)	12.5(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PLATWE	.0(.0)	75.0(8.7)	100.0(3.9)	80.0(5.9)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POLB1S	100.0(10.0)	.0(.0)	.0(.0)	40.0(1.8)	.0(.0)	.0(.0)	100.0(2.2)	.0(.0)	.0(.0)
POLVIS	100.0(5.3)	12.5(.5)	40.0(.5)	40.0(1.8)	50.0(3.0)	.0(.0)	.0(.0)	100.0(2.4)	.0(.0)
POLVIV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POLWAT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POLYGO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTCON	50.0(3.0)	37.5(1.3)	20.0(1.3)	60.0(4.5)	50.0(1.8)	100.0(.5)	.0(.0)	25.0(.5)	.0(.0)
POTDIV	.0(.0)	.0(.0)	60.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTDIV	.0(.0)	.0(.0)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTENT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTGLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTHIP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	75.0(1.3)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTNIV	.0(.0)	100.0(1.1)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTNIV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTQUI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTVI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
RANESC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
RANPYG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)	.0(.0)	25.0(.5)	.0(.0)
RUMPAU	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)	.0(.0)	25.0(.5)	.0(.0)	.0(.0)
SAUWEB	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SAXADS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SAXARG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SAXBRO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SAXCES	.0(.0)	.0(.0)	20.0(.5)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SAXFLA	.0(.0)	12.5(.5)	.0(.0)	60.0(1.3)	.0(.0)	.0(.0)	.0(.0)	25.0(.5)	.0(.0)
SAXOCC	.0(.5)	3.0	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SAXOPP	50.0(.5)	12.5(.5)	60.0(.5)	20.0(1.3)	.0(.0)	.0(.0)	.0(.0)	25.0(.5)	.0(.0)
SAXORE	50.0(.5)	12.5(.5)	20.0(.5)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SAXRHO	.0(.0)	.0(.0)	.0(.0)	40.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SAXTEM	100.0(.5)	62.5(.5)	60.0(.5)	.0(.0)	25.0(.5)	33.3(.5)	.0(.0)	25.0(.5)	.0(.0)
SEDLAN	.0(.0)	12.5(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SEDROS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SENCAN	.0(.0)	.0(.0)	20.0(.5)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SENCRA	50.0(.5)	25.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SENCYM	.0(.0)	.0(.0)	.0(.0)	.0(.0)	25.0(.5)	.0(.0)	25.0(.5)	.0(.0)	.0(.0)
SENECI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	25.0(3.0)	.0(.0)	25.0(.5)	.0(.0)	.0(.0)
SENFRE	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	25.0(.5)	.0(.0)	.0(.0)
SENHYD	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SENHYR	.0(.0)	25.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	25.0(.5)	.0(.0)	.0(.0)
SENSTR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SENTRI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	100.0(7.7)	75.0(1.3)	.0(.0)
SIBPRO	100.0(.5)	3.0	.0(.0)	40.0(1.8)	50.0(1.8)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SILACA	.0(.0)	12.5(3.0)	80.0(4.8)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SILPAR	.0(.0)	.0(.0)	60.0(1.3)	40.0(1.8)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SILREP	50.0(.5)	25.0(.5)	.0(.0)	40.0(.5)	60.0(1.3)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SMECAL	.0(.0)	25.0(.5)	.0(.0)	40.0(1.8)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SOLIDA	.0(.0)	50.0(.5)	.0(.0)	40.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SOLMUL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
STECAL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
STELLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
STELON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
STEUMB	.0(.0)	.0(.0)	.0(.0)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SYNPIN	50.0(3.0)	.0(.0)	40.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SYNPLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TARAXA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TARCER	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TARLYR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TAROFF	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	25.0(.5)	.0(.0)
TARPAR	.0(.0)	25.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
THAFEN	.0(.0)	25.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
THLPAR	.0(.0)	37.5(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TOWCON	.0(.0)	25.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TOWMON	.0(.0)	12.5(3.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TOWPAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TRIHAY	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TRILON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TRINAN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)

TRIPAR	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)
TROLAX	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)
VALEDU	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)
VERCUS	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)
VERONI	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)
VERMOR	.00(.0)	.00(.0)	.00(.0)	.00(.0)	50.00(.5)	25.00(.5)
VIOADU	.00(.0)	.00(.0)	.00(.0)	.00(.0)	25.00(.5)	.00(.0)
VIONUT	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)	.00(.0)
ZIGELE	50.00(.5)	37.50(1.5)	.00(.0)	20.00(3.0)	5.00(.5)	.00(.0)
***** FERNS *****						
SELDEN	.00(.0)	25.00(11.5)	40.00(10.0)	20.00(10.0)	.00(.0)	.00(.0)
SELWAT	.00(.0)	.00(.0)	40.00(16.5)	.00(.0)	.00(.0)	.00(.0)

COMMUNITY TYPE NAMES

SPECIES ABBREVIATIONS	CASMER/CARPAY N = 3	JUNPAR/ERIURS N = 2	SALGLA N = 1	DRY SLOPE N = 11	MOIST SLOPE N = 7	DESCES/CALLEP N = 5	CARSCO/CALLEP N = 5
***** TREES *****							
ABILAS	33.3(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
LARLYA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PICENG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PINALB	66.7(.5)	.0(.0)	.0(.0)	18.2(.5)	14.3(.5)	.0(.0)	.0(.0)
***** SHRUBS *****							
ARTFRI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARTTSV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CASMER	100.0(46.7)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CHRVIS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DRYOCT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
HAPSUF	.0(.0)	.0(.0)	.0(.0)	36.4(2.9)	.0(.0)	.0(.0)	.0(.0)
PHYEMP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
PHYGLA	33.3(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POTFRU	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
RIBHEN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
RIBLAC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALARC	66.7(35.0)	.0(.0)	.0(.0)	9.1(.5)	14.3(.5)	.0(.0)	20.0(.5)
SALDOD	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALGLA	.0(.0)	.0(.0)	100.0(60.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
SALIXX	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(.5)	.0(.0)
SALNIV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(.5)	20.0(10.0)
SALPLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
VACSCO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
***** GRASSES *****							
AGRCAN	.0(.0)	50.0(.5)	100.0(.5)	36.4(1.1)	57.1(3.5)	.0(.0)	.0(.0)
AGRHUM	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
AGROST	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
AGRSCR	.0(.0)	.0(.0)	.0(.0)	63.6(3.9)	28.6(1.8)	.0(.0)	.0(.0)
AGRSPI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
AGRVAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ALOALP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(3.0)
BROPUM	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CALPUR	.0(.0)	.0(.0)	.0(.0)	9.1(.5)	.0(.0)	.0(.0)	.0(.0)
CARALB	.0(.0)	.0(.0)	.0(.0)	9.1(.5)	.0(.0)	.0(.0)	.0(.0)
CARATR	33.3(.5)	.0(.0)	.0(.0)	27.3(.5)	.0(.0)	.0(.0)	.0(.0)
CARELY	.0(.0)	50.0(.5)	.0(.0)	27.3(.5)	.0(.0)	60.0(4.5)	.0(.0)
CAREXX	.0(.0)	50.0(.5)	.0(.0)	9.1(.5)	.0(.0)	20.0(.5)	20.0(.5)
CARHAY	.0(.0)	50.0(.5)	.0(.0)	.0(.0)	42.9(4.5)	20.0(10.0)	60.0(3.0)
CARILL	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(10.0)	20.0(10.0)
CARLEN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(90.0)	20.0(90.0)
CARLEP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARMIC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)
CARNAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARNIG	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(3.0)	20.0(3.0)
CARNOV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(.5)
CAROBT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARPAC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARPAY	100.0(10.2)	.0(.0)	.0(.0)	9.1(.5)	14.3(3.0)	.0(.0)	.0(.0)
CARPET	.0(.0)	50.0(.5)	.0(.0)	9.1(.5)	28.6(.5)	.0(.0)	.0(.0)
CARPHA	33.3(.5)	.0(.0)	.0(.0)	9.1(.5)	14.3(.5)	.0(.0)	.0(.0)
CARPYR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARROI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARROS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CARRUP	.0(.0)	.0(.0)	.0(.0)	9.1(3.0)	.0(.0)	.0(.0)	.0(.0)

Species						
CARSCI	66.7(11.5)	50.0(3.0)	.0(.0)	18.2(5.3)	.0(.0)	20.0(.5)
CARSCO	.0(.0)	.0(.0)	.0(.0)	9.1(.5)	.0(.5)	80.0(67.5)
DANINT	.0(.0)	50.0(.5)	.0(.0)	.0(.0)	.0(.5)	.0(.0)
DANTHO	33.3(10.0)	.0(.0)	3.0(.0)	.0(.0)	.0(.0)	.0(.0)
DESCES	.0(.0)	50.0(20.0)	.0(.0)	27.3(7.7)	100.0(18.2)	100.0(28.6)
FESIDA	66.7(.5)	50.0(.5)	57.1(6.6)	54.5(2.2)	.0(.0)	.0(.0)
FESOVI	.0(.0)	.0(.0)	42.9(.5)	36.4(1.8)	.0(.0)	.0(.0)
HESKIN	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
JUNBAL	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
JUNCUS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(50.0)	.0(.0)
JUNDRU	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	60.0(2.2)
JUNMER	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	60.0(2.2)
JUNPAR	.0(.0)	100.0(25.0)	.0(.0)	18.2(.5)	40.0(20.0)	.0(.0)
KOECRI	.0(.0)	.0(.0)	.0(.0)	.0(.0)	40.0(.5)	.0(.0)
LUZCAM	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
LUZHIT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(.5)
LUZPAR	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
LUZSPI	33.3(.5)	.0(.0)	14.3(.5)	36.4(.5)	.0(.0)	.0(.0)
LUZULA	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	20.0(.5)
PHLALP	.0(.0)	.0(.0)	14.3(.5)	45.5(1.5)	80.0(1.1)	40.0(6.5)
POAALP	100.0(1.3)	.0(.0)	57.1(.5)	.0(.0)	60.0(1.3)	60.0(3.7)
POAARC	33.3(10.0)	50.0(.5)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
POAFEN	.0(.0)	100.0(.5)	42.9(2.2)	54.5(.9)	20.0(.5)	.0(.0)
POAGLA	.0(.0)	.0(.0)	14.3(3.0)	.0(.0)	.0(.0)	.0(.0)
POALEP	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
POANER	.0(.0)	.0(.0)	14.3(.5)	9.1(.5)	40.0(.5)	.0(.0)
POAPRA	33.3(.5)	.0(.0)	14.3(.5)	54.5(.5)	40.0(.5)	.0(.0)
POAREF	.0(.0)	100.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POARUP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
POASEC	33.3(.5)	.0(.0)	14.3(20.0)	9.1(.5)	.0(.0)	20.0(.5)
POAXXX	.0(.0)	100.0(.0)	.0(.0)	54.5(2.9)	.0(.0)	.0(.0)
STIOCC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
STIPAX	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
TRISPI	33.3(.5)	.0(.0)	42.9(3.7)	63.6(.5)	20.0(.5)	.0(.0)

***** FORBS *****

Species						
ACHMIL	.0(.0)	50.0(.5)	71.4(2.9)	72.7(1.1)	20.0(.5)	.0(.0)
AGOGLA	.0(.0)	100.0(.0)	57.1(1.1)	36.4(1.1)	.0(.0)	.0(.0)
ALLBRE	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ALLCER	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ALLSCH	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANDFIL	.0(.0)	.0(.0)	14.3(.5)	27.3(.0)	.0(.0)	.0(.0)
ANDSEP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	20.0(.0)
ANEDRU	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANEMON	.0(.0)	.0(.0)	.0(.0)	9.1(.5)	.0(.0)	.0(.0)
ANEMUL	.0(.0)	50.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANENUT	.0(.0)	100.0(1.8)	.0(.0)	9.1(.5)	.0(.0)	.0(.0)
ANEPAR	.0(.0)	.0(.0)	.0(.0)	9.1(.5)	.0(.0)	.0(.0)
ANGROS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANTALP	33.3(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
ANTANA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANTARO	.0(.0)	50.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ANTCOR	.0(.0)	100.0(.0)	42.9(.5)	27.3(.5)	.0(.0)	.0(.0)
ANTENN	66.7(1.8)	.0(.0)	14.3(.5)	27.3(.0)	.0(.0)	.0(.0)
ANTLAN	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
ANTMIC	.0(.0)	.0(.0)	28.6(.5)	.0(.0)	.0(.0)	.0(.0)
ANTUMB	.0(.0)	.0(.0)	14.3(.5)	9.1(.5)	.0(.0)	.0(.0)
ARABIS	33.3(.5)	100.0(.0)	28.6(.5)	36.4(.5)	.0(.0)	.0(.0)
ARADRU	.0(.0)	.0(.0)	14.3(.5)	9.1(3.0)	.0(.0)	.0(.0)
ARALEM	.0(.5)	.0(.0)	28.6(.5)	.0(.0)	.0(.0)	.0(.0)
ARALYA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARANUT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARECAP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARECON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARENUT	.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
AREOBT	100.0(.5)	.0(.0)	14.3(.5)	18.2(1.8)	.0(.5)	.0(.0)

Species						
AREROS	.0(.0)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARERUB	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
ARNALP	.0(.0)	.0(.0)	.0(.0)	9.1(.5)	.0(.0)	50.0(.5)
ARNDIV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	100.0(10.0)	.0(.0)
ARNLAT	.0(.0)	.0(.0)	14.3(3.0)	.0(.0)	.0(.0)	.0(.0)
ARNLON	.0(.0)	.0(.0)	14.3(3.0)	.0(.0)	.0(.0)	.0(.0)
ARNMOL	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
ARNRYD	.0(.0)	.0(.0)	14.3(3.0)	.0(.0)	.0(.0)	.0(.0)
ARTDRA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ARTSCO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTABO	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTADS	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTALG	20.0(30.0)	20.0(60.0)	.0(.0)	9.1(3.0)	.0(.0)	66.7(5.3)
ASTALP	20.0(.5)	.0(.0)	.0(.0)	9.1(.5)	.0(.0)	.0(.0)
ASTBOU	.0(.0)	.0(.0)	28.6(6.5)	9.1(20.0)	.0(.0)	.0(.0)
ASTFOL	.0(.0)	.0(.0)	.0(.0)	18.2(.5)	100.0(.5)	.0(.0)
ASTINT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ASTKEN	.0(.0)	.0(.0)	28.6(.5)	27.3(.5)	.0(.0)	.0(.0)
ASTMIS	.0(.0)	.0(.0)	.0(.0)	27.3(.5)	.0(.0)	.0(.0)
ASTRAG	.0(.0)	.0(.0)	28.6(.5)	36.4(.5)	.0(.0)	.0(.0)
BESWYO	.0(.0)	.0(.0)	.0(.0)	36.4(.5)	.0(.0)	.0(.0)
BUPAME	100.0(35.2)	100.0(48.0)	.0(.0)	.0(.0)	100.0(.5)	.0(.0)
CALLEP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CAMPAR	.0(.0)	.0(.0)	14.3(3.0)	18.2(.5)	.0(.0)	.0(.0)
CAMROT	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CAMSCA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
CAMUNI	.0(.0)	.0(.0)	.0(.0)	18.2(.5)	.0(.0)	.0(.0)
CASCRI	.0(.0)	.0(.0)	14.3(.5)	9.1(.5)	.0(.0)	.0(.0)
CASCUS	20.0(.5)	60.0(10.2)	14.3(.5)	9.1(.5)	100.0(.5)	.0(.0)
CASMIN	.0(.0)	.0(.0)	.0(.0)	18.2(.5)	.0(.0)	.0(.0)
CASNIV	.0(.0)	.0(.0)	14.3(3.0)	.0(.0)	.0(.0)	.0(.0)
CASPAL	.0(.0)	.0(.0)	14.3(.5)	9.1(.5)	.0(.0)	.0(.0)
CASPUL	.0(.0)	.0(.0)	28.6(.5)	18.2(.5)	.0(.0)	.0(.0)
CASRHE	.0(.0)	.0(.0)	.0(.0)	54.5(.9)	.0(.0)	.0(.0)
CASTIL	.0(.0)	.0(.0)	.0(.0)	18.2(1.8)	.0(.0)	.0(.0)
CERARV	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	33.3(.5)
CHAALP	.0(.0)	.0(.0)	14.3(.5)	36.4(.5)	.0(.0)	.0(.0)
CHITWE	.0(.0)	.0(.0)	14.3(.5)	9.1(.5)	.0(.0)	.0(.0)
CIRSCA	.0(.0)	.0(.0)	28.6(.5)	18.2(.5)	.0(.0)	.0(.0)
CLALAN	.0(.0)	.0(.0)	14.3(.5)	18.2(1.8)	.0(.0)	.0(.0)
CRYPTA	.0(.0)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
CYMBIP	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DELOCC	40.0(3.0)	40.0(.5)	.0(.0)	.0(.0)	100.0(.5)	.0(.0)
DODCON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DODECA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DOOPUL	20.0(.5)	20.0(.5)	.0(.0)	.0(.0)	.0(.0)	50.0(.5)
DOUMON	.0(.0)	.0(.0)	14.3(.5)	9.1(.5)	.0(.0)	.0(.0)
DRAAPI	.0(.0)	.0(.0)	14.3(.5)	9.1(.5)	.0(.0)	.0(.0)
DRABAX	.0(.0)	.0(.0)	.0(.0)	18.2(.5)	.0(.0)	.0(.0)
DRACRA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DRAINC	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DRALAN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DRALON	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
DRANEM	.0(.0)	40.0(1.8)	14.3(.5)	36.4(.5)	.0(.0)	.0(.0)
DRAOLI	.0(.0)	.0(.0)	14.3(.5)	9.1(.5)	.0(.0)	.0(.0)
EPIALP	.0(.0)	.0(.0)	14.3(.5)	81.8(.5)	.0(.0)	.0(.0)
ERICAE	.0(.0)	.0(.0)	.0(.0)	18.2(.5)	.0(.0)	.0(.0)
ERICOM	20.0(.5)	.0(.0)	14.3(.5)	.0(.0)	.0(.0)	.0(.0)
ERIFLA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERIGER	.0(.0)	.0(.0)	.0(.0)	18.2(.5)	.0(.0)	.0(.0)
ERIHUM	.0(.0)	.0(.0)	.0(.0)	18.2(.5)	.0(.0)	.0(.0)
ERINAN	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERIOVA	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERIPER	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)	.0(.0)
ERIRAD	20.0(30.0)	40.0(20.0)	.0(.0)	.0(.0)	.0(.0)	50.0(20.0)

71

Species						
ERIRYD						
ERISIM						
ERITWE						
ERIUMB						
ERIURS						
ERYGRA						
FORBPE						
FRASPE						
GENAFF						
GENALG						
GENAMA						
GENCAL						
GENPRO						
GEUROS						
GEUTRI						
GILSPI						
HAPACA						
HAPLYA						
HAPUNI						
HEDSUL						
HEUCYL						
HEUPAR						
HIEGRA						
HYMACA						
HYMGRA						
HYPFOR						
IVEGOR						
LESALP						
LESQUE						
LEWPYG						
LIGTEN						
LINLEW						
LITBUL						
LLOSER						
LOMCOU						
LOMCUS						
LUPARG						
LUPLEP						
LYCAPE						
MERALP						
MERCIL						
MEROBL						
MERPER						
MICNIG						
MONCHA						
MYOARV						
MYOSYL						
OXYCAM						
OXYDIG						
OXYVIS						
PEDCON						
PEDCYS						
PEDGRO						
PEDICU						
PEDPAR						
PEDPUL						
PENARI						
PENATT						
PENMON						
PENPRO						
PENRYD						
PENSTE						
PHAHAS						
PHASER						
PHLHOO						
PHLMUL						

PHLPUL
PHYSAX
PLATWE
POLBIS
POLVIS
POLVIV
POLMAT
POLYGO
POTCON
POTDIV
POTENT
POTGLA
POTHIP
POTNIV
POTOVI
POTQUI
RANESC
RANPYG
RUMPAU
SAUWEB
SAXADS
SAXARG
SAXBRO
SAXCES
SAXFLA
SAXOCC
SAXOPP
SAXORE
SAXRHO
SAXTEM
SEDLAN
SEDROS
SENCAN
SENCRA
SENCYM
SENECI
SENFRE
SENHYD
SENHYR
SENSTR
SENTRI
SIBPRO
SILACA
SILPAR
SILREP
SMECAL
SOLIDA
SOLMUL
STECAL
STELLA
STELON
STEUMB
SYNPIN
SYNPLA
TARAXA
TARCER
TARLYR
TAROFF
THAFEN
THLPAR
TOWCON
TOWMON
TOWPAR
TRIHAY
TRILON
TRINAN

TRIPAR

TROLAX

VALEDU

VERCUS

VERONI

VERMOR

VIOADU

VIONUT

ZIGELE

***** FERNS *****

SELDEN   33.3(10.0)

SELMAT

74

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************************************************************************
SPECIES        * SALNIV/CALLEP * SALPLA/CARSCO *
ABBREVIATIONS  *     N =  2    *     N =  1    *
************************************************************************
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SPECIES ABBREVIATIONS	SALNIV/CALLEP N = 2	SALPLA/CARSCO N = 1
***** TREES *****		
ABILAS	.0(.0)	.0(.0)
LARLYA	.0(.0)	.0(.0)
PICENG	.0(.0)	.0(.0)
PINALB	.0(.0)	.0(.0)
***** SHRUBS *****		
ARTFRI	.0(.0)	.0(.0)
ARTTSV	.0(.0)	.0(.0)
CASMER	.0(.0)	.0(.0)
CHRVIS	.0(.0)	.0(.0)
DRYOCT	50.0(3.0)	.0(.0)
HAPSUF	.0(.0)	.0(.0)
PHYEMP	.0(.0)	.0(.0)
PHYGLA	.0(.0)	.0(.0)
POTFRU	.0(.0)	.0(.0)
RIBHEN	.0(.0)	.0(.0)
RIBLAC	.0(.0)	.0(.0)
SALARC	50.0(10.0)	.0(.0)
SALDOO	50.0(3.0)	.0(.0)
SALGLA	.0(.0)	.0(.0)
SALIXX	.0(.0)	.0(.0)
SALNIV	100.0(70.0)	.0(.0)
SALPLA	.0(.0)	100.0(70.0)
VACSCO	.0(.0)	.0(.0)
***** GRASSES *****		
AGRCAN	.0(.0)	.0(.0)
AGRHUM	.0(.0)	.0(.0)
AGROST	.0(.0)	.0(.0)
AGRSCR	.0(.0)	.0(.0)
AGRSPI	.0(.0)	.0(.0)
AGRVAR	.0(.0)	.0(.0)
ALOALP	.0(.0)	.0(.0)
BROPUM	.0(.0)	.0(.0)
CALPUR	.0(.0)	.0(.0)
CARALB	.0(.0)	.0(.0)
CARATR	50.0(.5)	.0(.0)
CARELY	.0(.0)	.0(.0)
CAREXX	.0(.0)	.0(.0)
CARHAY	100.0(5.3)	.0(.0)
CARILL	.0(.0)	.0(.0)
CARLEN	.0(.0)	.0(.0)
CARLEP	50.0(3.0)	.0(.0)
CARMIC	.0(.0)	.0(.0)
CARNAR	.0(.0)	.0(.0)
CARNIG	.0(.0)	100.0(.5)
CARNOV	50.0(10.0)	.0(.0)
CAROBT	.0(.0)	.0(.0)
CARPAC	.0(.0)	.0(.0)
CARPAY	.0(.0)	.0(.0)
CARPET	.0(.0)	.0(.0)
CARPHA	.0(.0)	.0(.0)
CARPYR	.0(.0)	.0(.0)
CARROI	.0(.0)	.0(.0)
CARROS	.0(.0)	.0(.0)
CARRUP	.0(.0)	.0(.0)

75

	Col 1	Col 2
CARSCI	50.0(3.0)	100.0(.0)
CARSCO	.0(.0)	100.0(30.0)
DANINT	.0(.0)	.0(.0)
DANTHO	50.0(3.0)	100.0(20.0)
DESCES	.0(.0)	.0(.0)
FESIDA	.0(.0)	.0(.0)
FESOVI	.0(.0)	.0(.0)
HESKIN	.0(.0)	.0(.0)
JUNBAL	.0(.0)	.0(.0)
JUNCUS	.0(.0)	.0(.0)
JUNDRU	.0(.0)	.0(.0)
JUNMER	.0(.0)	100.0(.5)
JUNPAR	.0(.0)	.0(.0)
KOECRI	.0(.0)	.0(.0)
LUZCAM	.0(.0)	.0(.0)
LUZHIT	.0(.0)	.0(.0)
LUZPAR	.0(.0)	100.0(3.0)
LUZSPI	50.0(10.0)	.0(.0)
LUZULA	.0(.0)	.0(.0)
PHLALP	100.0(5.3)	.0(.0)
POAALP	.0(.0)	.0(.0)
POAARC	.0(.0)	.0(.0)
POAFEN	.0(.0)	.0(.0)
POAGLA	.0(.0)	.0(.0)
POALEP	.0(.0)	.0(.0)
POANER	.0(.0)	.0(.0)
POAPRA	.0(.0)	.0(.0)
POAREF	.0(.0)	100.0(3.0)
POARUP	.0(.0)	.0(.0)
POASEC	.0(.0)	.0(.0)
POAXXX	.0(.0)	.0(.0)
STIOCC	.0(.0)	.0(.0)
STIPAX	.0(.0)	.0(.0)
TRISPI	.0(.0)	.0(.0)

***** FORBS *****

	Col 1	Col 2
ACHMIL	.0(.0)	.0(.0)
AGOGLA	.0(.0)	.0(.0)
ALLBRE	.0(.0)	.0(.0)
ALLCER	.0(.0)	.0(.0)
ALLSCH	.0(.0)	.0(.0)
ANDFIL	.0(.0)	.0(.0)
ANDSEP	.0(.0)	.0(.0)
ANEDRU	.0(.0)	.0(.0)
ANEMON	.0(.0)	.0(.0)
ANEMUL	50.0(.5)	.0(.0)
ANENUT	.0(.0)	.0(.0)
ANEPAR	50.0(.5)	.0(.0)
ANGROS	.0(.0)	.0(.0)
ANTALP	50.0(.5)	.0(.0)
ANTANA	.0(.0)	.0(.0)
ANTARO	.0(.0)	.0(.0)
ANTCOR	.0(.0)	.0(.0)
ANTENN	.0(.0)	.0(.0)
ANTLAN	.0(.0)	.0(.0)
ANTMIC	.0(.0)	.0(.0)
ANTUMB	.0(.0)	.0(.0)
ARABIS	.0(.0)	.0(.0)
ARADRU	.0(.0)	.0(.0)
ARALEM	.0(.0)	.0(.0)
ARALYA	.0(.0)	.0(.0)

76

Species		
AREROS	.0(.0)	.0(.0)
ARERUB	.0(.0)	.0(.0)
ARNALP	.0(.0)	.0(.0)
ARNDIV	.0(.0)	.0(.0)
ARNFUL	.0(.0)	.0(.0)
ARNLAT	.0(.0)	.0(.0)
ARNLON	.0(.0)	.0(.0)
ARNMOL	.0(.0)	.0(.0)
ARNRYD	.0(.0)	.0(.0)
ARTDRA	.0(.0)	.0(.0)
ARTSCO	.0(.0)	.0(.0)
ASTABO	.0(.0)	.0(.0)
ASTADS	.0(.0)	.0(.0)
ASTALG	.0(.0)	.0(.0)
ASTALP	.0(.0)	.0(.0)
ASTBOU	.0(.0)	.0(.0)
ASTFOL	50.0(.5)	100.0(10.0)
ASTINT	.0(.0)	.0(.0)
ASTKEN	.0(.0)	.0(.0)
ASTMIS	.0(.0)	.0(.0)
ASTRAG	.0(.0)	.0(.0)
BESWYO	.0(.0)	.0(.0)
BUPAME	.0(.0)	.0(.0)
CALLEP	100.0(21.5)	.0(.0)
CAMPAR	.0(.0)	.0(.0)
CAMROT	.0(.0)	.0(.0)
CAMSCA	.0(.0)	.0(.0)
CAMUNI	.0(.0)	.0(.0)
CASCRI	.0(.0)	.0(.0)
CASCUS	.0(.0)	.0(.0)
CASMIN	.0(.0)	.0(.0)
CASNIV	.0(.0)	.0(.0)
CASPAL	.0(.0)	.0(.0)
CASPUL	.0(.0)	.0(.0)
CASRHE	.0(.0)	.0(.0)
CASTIL	.0(.0)	.0(.0)
CERARV	100.0(1.8)	.0(.0)
CHAALP	.0(.0)	.0(.0)
CHITWE	50.0(.5)	.0(.0)
CIRSCA	.0(.0)	.0(.0)
CLALAN	.0(.0)	.0(.0)
CRYPTA	.0(.0)	.0(.0)
CYMBIP	.0(.0)	.0(.0)
DELOCC	.0(.0)	.0(.0)
DODCON	.0(.0)	.0(.0)
DODECA	.0(.0)	.0(.0)
DODPUL	.0(.0)	.0(.0)
DOUMON	.0(.0)	.0(.0)
DRAAPI	.0(.0)	.0(.0)
DRABAX	.0(.0)	.0(.0)
DRACRA	.0(.0)	.0(.0)
DRAINC	.0(.0)	.0(.0)
DRALAN	.0(.0)	.0(.0)
DRALON	.0(.0)	.0(.0)
DRANEM	.0(.0)	.0(.0)
DRAOLI	.0(.0)	.0(.0)
EPIALP	.0(.0)	100.0(10.0)
ERICAE	.0(.0)	.0(.0)
ERICOM	.0(.0)	.0(.0)
ERIFLA	.0(.0)	.0(.0)
ERIGER	.0(.0)	.0(.0)
ERIHUM	50.0(.5)	.0(.0)
ERINAN	.0(.0)	.0(.0)
ERIOVA	.0(.0)	.0(.0)
ERIPER	.0(.0)	.0(.0)
ERIRAD	.0(.0)	.0(.0)

77

ERIRYD
ERISIM
ERITHE
ERIUMB
ERIURS
ERYGRA
FORBPE
FRASPE
GENAFF
GENALG
GENAMA
GENCAL
GENPRO
GEUROS
GEUTRI
GILSPI
HAPACA
HAPLYA
HAPUNI
HEDSUL
HEUCYL
HEUPAR
HIEGRA
HYMACA
HYMGRA
HYPFOR
IVEGOR
LESALP
LESQUE
LEWPYG
LIGTEN
LINLEW
LITBUL
LLOSER
LOMCOU
LOMCUS
LUPARG
LUPLEP
LYCAPE
MERALP
MERCIL
MEROBL
MERPER
MICNIG
MONCHA
MYOARV
MYOSYL
OXYCAM
OXYDIG
OXYVIS
PEDCON
PEDCYS
PEDGRO
PEDICU
PEDPAR
PEDPUL
PENARI
PENATT
PENMON
PENPRO
PENRYD
PENSTE
PHAHAS
PHASER
PHLHOO
PHLMUL

Species				
PHLPUL	.0(	.0)	.0(	.0)
PHYSAX	.0(	.0)	.0(	.0)
PLATHE	50.0(	.5)	100.0(	3.0)
POLBIS	50.0(	.5)	.0(	.0)
POLVIS	50.0(	.5)	.0(	.0)
POLVIV	.0(	.0)	.0(	.0)
POLWAT	.0(	.0)	.0(	.0)
POLYGO	50.0(	.5)	.0(	.0)
POTCON	.0(	.0)	100.0(	3.0)
POTDIV	.0(	.0)	.0(	.0)
POTENT	.0(	.0)	.0(	.0)
POTGLA	50.0(	.5)	.0(	.0)
POIHIP	.0(	.0)	.0(	.0)
POTNIV	50.0(	.5)	.0(	.0)
POTOVI	50.0(	.5)	.0(	.0)
POTQUI	.0(	.0)	.0(	.0)
RANESC	.0(	.0)	.0(	.0)
RANPYG	.0(	.0)	.0(	.0)
RUMPAU	.0(	.0)	.0(	.0)
SAUWEB	.0(	.0)	.0(	.0)
SAXADS	.0(	.0)	.0(	.0)
SAXARG	.0(	.0)	.0(	.0)
SAXBRO	.0(	.0)	.0(	.0)
SAXCES	.0(	.0)	.0(	.0)
SAXFLA	.0(	.0)	.0(	.0)
SAXOCC	50.0(	.5)	.0(	.0)
SAXOPP	50.0(	.5)	.0(	.0)
SAXORE	50.0(	.5)	.0(	.0)
SAXRHO	.0(	.0)	.0(	.0)
SAXTEM	.0(	.0)	.0(	.0)
SEDLAN	.0(	.0)	.0(	.0)
SEDROS	.0(	.0)	.0(	.0)
SENCAN	50.0(	.5)	.0(	.0)
SENCRA	.0(	.0)	.0(	.0)
SENCYM	.0(	.0)	100.0(	3.0)
SENECI	.0(	.0)	.0(	.0)
SENFRE	.0(	.0)	.0(	.0)
SENHYD	.0(	.0)	.0(	.0)
SENHYR	.0(	.0)	.0(	.0)
SENSTR	.0(	.0)	.0(	.0)
SENTRI	.0(	.0)	.0(	.0)
SIBPRO	50.0(	10.0)	.0(	.0)
SILACA	50.0(	.5)	.0(	.0)
SILPAR	.0(	.0)	.0(	.0)
SILREP	.0(	.0)	.0(	.0)
SMECAL	.0(	.0)	100.0(	.0)
SOLIDA	.0(	.0)	.0(	.0)
SOLMUL	50.0(	.5)	.0(	.5)
STECAL	.0(	.0)	.0(	.0)
STELLA	50.0(	.5)	.0(	.0)
STELON	50.0(	.5)	.0(	.0)
STEUMB	.0(	.0)	.0(	.0)
SYNPIN	50.0(	.5)	.0(	.0)
SYNPLA	.0(	.0)	.0(	.0)
TARAXA	.0(	.0)	.0(	.0)
TARCER	50.0(	.5)	.0(	.0)
TARLYR	.0(	.0)	.0(	.0)
TAROFF	.0(	.0)	.0(	.0)
THAFEN	.0(	.0)	.0(	.0)
THLPAR	.0(	.0)	.0(	.0)
TOWCON	.0(	.0)	.0(	.0)
TOWMON	.0(	.0)	.0(	.0)
TOWPAR	50.0(	3.0)	.0(	.0)
TRIHAY	.0(	.0)	.0(	.0)
TRILON	.0(	.0)	.0(	.0)
TRINAN	.0(	.0)	.0(	.0)

TRIPAR	.0(.0)	100.0(.0)
TROLAX	.0(.0)	100.0(20.0)
VALEDU	.0(.0)	.0(.0)
VERCUS	.0(.0)	.0(.0)
VERONI	.0(.0)	.0(.0)
VERMOR	.0(.0)	100.0(3.0)
VIOADU	.0(.0)	.0(.0)
VIONUT	.0(.0)	.0(.0)
ZIGELE	50.0(.5)	.0(.0)

***** FERNS *****

SELDEN	.0(.0)	.0(.0)
SELWAT	.0(.0)	.0(.0)