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Classification of City of Rocks National Reserve vegetation data to support the vegetation mapping program

City of Rocks National Reserve

Natural Resource Technical Report NPS/UCBN/NRTR—2010/313

ON THE COVER
City of Rocks National Reserve Landscape
Photo courtesy of the Upper Columbia Basin Network

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Step 1: Finding the best classification strategy for the CIRO data

Methods

In our initial work we have tried to find the best possible classification method given the general cluster structure of data collected to support the Upper Columbia Basin Network (UCBN) Vegetation Mapping Program at the City of Rocks National Reserve (CIRO). The data consisted of 190 plots and 312 plant species. Seven classification methods were compared:

(1) average linkage (Sokal and Michener 1958),
(2) complete linkage (McQuitty 1960),
(3) flexible β = -0.25 (Lance and Williams 1967),
(4) k-means analysis (MacQueen 1967),
(5) partitioning around medoids, i.e. PAM (Kauffman and Rousseeuw 1990),
(6) single linkage (Sneath 1957), and
(7) variance minimization linkage, i.e. Ward's method (Ward 1963).

PAM and k-means analysis are non-hierarchical methods while the other five are hierarchical agglomerative methods. Each k-means classification was the lowest sum of squares solution from 100 randomized starts. Steinhaus/Bray-Curtis dissimilarity (Bray and Curtis 1957) was used to quantify resemblance of sites for all methods except for k-means analysis (where Euclidean distance was used). Bray-Curtis dissimilarity generally outperforms Euclidean distance with typically sparse (few non-zero entries) vegetation datasets which may contain many plots with nothing in common (Beals 1984; McCune and Grace 2002). Over 90% of the cells in the CIRO data matrix contained zero entries. Within-dendrogram distances for hierarchical classifications were measured with Wishart's objective function (Wishart 1969) which prevents reversals (McCune and Grace 2002). Hierarchical agglomerative classifications were created using PC-ORD (McCune and Mefford 1999). Nonhierarchical classifications were created using the base and cluster (Maechler et al. 2005) libraries in R (R-core development team 2008).

The seven methods were compared using six classification evaluators:

(1) indicator species analysis (ISA) number of significant indicators (Dufrêne and Legendre 1997; McCune and Grace 2002),
(2) ISA average *p*-value (Dufrêne and Legendre 1997; McCune and Grace 2002),
(3) C-index (Hubert and Levin 1976),
(4) average silhouette width, i.e. ASW (Rousseeuw 1987),
(5) point biserial correlation, i.e. PBC (Brogden 1949), and
(6) partition analysis ratio; i.e. PARTANA (Roberts 2005, Aho et al. 2006a).

For further detail on these procedures see Aho et al. (2008). All evaluators were programmed by Aho et al. (2006a) using the R language except for ASW which exists in the R-library cluster (Maechler et al. 2005).

The evaluator scores of the seven classification methods were compared with respect to their forty-nine simplest clustering solutions (i.e. 2 to 50 clusters) of the CIRO data. Comparisons of methods were made for each evaluator. Distributions of residuals from ANOVAs which compared methods were highly non-normal necessitating a non-parametric approach. Because classification methods were blocked by number of clusters, Friedman's method for non-parametric repeated measures (blocking without replication) was used (Table 1.1). The tested hypotheses were:

H$_0$: $\tau_1 = \tau_2 = \tau_3 = \tau_4 = \tau_5 = \tau_6 = \tau_7 = \tau_8 = 0$

H$_A$: at least one $\tau_i \neq 0$.

Where τ_i is the *i*th treatment effect (i = 1, 2,…, 7).

Note that the Freidman's test statistic asymptotically approaches a χ^2 distribution with $r - 1$, i.e. (7 - 1) degrees of freedom (Table 1.1). Friedman's test was conducted using the library coin in R (Hothorn et al. 2008).

Classification methods were also compared to each other in a non-parametric pairwise fashion adjusted for simultaneous inference (Table 1.1). These comparisons use the Friedman's pooled variances and are based on the method of Kutner et al. (2005, pgs. 1138-1139). These analyses were run using the R package asbio (Aho 2009).

The tested hypotheses were:

H$_0$: $\tau_i = \tau_i'$.

H$_A$: $\tau_i \neq \tau_i'$.

Where τ_i is the *i*th treatment effect (i = 1, 2,…, 7).

Results

Classifications of the seven methods differed significantly from the perspective of all six evaluators ($df = 7$, $158 \leq \chi^2 \leq 239$, $p < 2.2\times10^{-16}$; Table 1.1). Flexible β = -0.25 created the strongest classifications. It had the highest evaluator score for five evaluators (Table 1.1). Ward's and average linkage classifications were also effective. Both had the highest evaluator score for four of the evaluators (Table 1.1). The best non-hierarchical method was PAM which had two highest evaluator scores (Table 1.1). In contrast, single linkage and *k*-means analysis created the weakest classifications. These methods did not have the highest evaluator score for any of the evaluators, and had the largest number of lowest evaluator scores (Table 1.1). Note that several methods can tie for best (or worst) method if they are statistically indistinguishable (Table 1.1).

Discussion/Conclusions

In general, methods which created spherical clusters (i.e. average linkage, flexible β = -0.25, complete linkage, and PAM, Ward) were favored by the evaluators. This was true for both the geometric evaluators, which are predisposed to favoring spherical clusters, and non-geometric evaluators (i.e. the indicator species analysis methods) which are not predisposed to favor a particular type of cluster geometry. As a result it appears as if a spherical cluster interpretation of the CIRO data (as opposed to a linear cluster interpretation) is the most valid one. In particular, we identified flexible β = -0.25 as the most appropriate classification method for the CIRO data.

Step 2: Finding the optimal number of clusters in the CIRO data

Methods

In step one, seven classification methods were compared and flexible β = -0.25 (Lance and Williams 1967) was found to be the best overall method for the CIRO data. In step two, we found the optimal numbers of clusters in the flexible β = -0.25 classification.

The same six evaluators used in step one were used as optimality criteria. The geometric evaluators (ASW, C-index, PARTANA, and PBC) index classification effectiveness based on cluster compactness and distinctness in multivariate space (cf. Dale 1991). The non-geometric evaluators (ISA number of significant indicators, and ISA average p-value) measure classification effectiveness with respect to indicator species. For instance, a clustering solution in which a species occurs predominantly in one cluster while being absent from others indicates a "real" cluster structure from the perspective of that species (Aho et al. 2008).

Forty-nine possible classification solutions were examined (2 to 50 clusters). Evaluator scores were centered and scaled, i.e. standardized (Eq. 2.1) to allow all evaluators to be displayed in a single figure

$$E_{jk} = \frac{X_{jk} - \overline{X}_k}{S_k}, \qquad (2.1)$$

where E_{jk} is the standardized evaluator score of the jth cluster from the kth evaluator (j = 2, 3,..., 50), (k = 1, 2, …,6); X_{jk} is the raw evaluator score of the jth cluster from the kth evaluator; $\overline{X}_k$ is the kth evaluator sample mean; and S_k is the kth evaluator sample standard deviation.

In addition, because some evaluators always tend to increase/decrease with number of clusters (Aho 2006a), linear models were used to identify and account for this trend (Eq. 2.2). Residuals (Eq. 2.3) from these models (now standardized values with respect to linear trends) were used as indicators of classification efficacy (See Fig. 2.1).

$$\hat{Y}_{jk} = X_{jk} b_1 + b_0 \qquad (2.2)$$

Where $\hat{Y}_{jk}$ is the predicted evaluator score of the jth cluster from the kth evaluator (j = 2, 3,..., 50), (k = 1, 2, …,6); X_{jk} is jth cluster number from the kth evaluator; and b_1 and b_0 are least squares estimates for the linear regression slope and Y-intercept.

$$e_{jk} = Y_{jk} - \hat{Y}_{jk} \qquad (2.3)$$

Where Y_{jk} are observed values and $\hat{Y}_{jk}$ are fitted values from the linear regression model in Eq. 2.2.

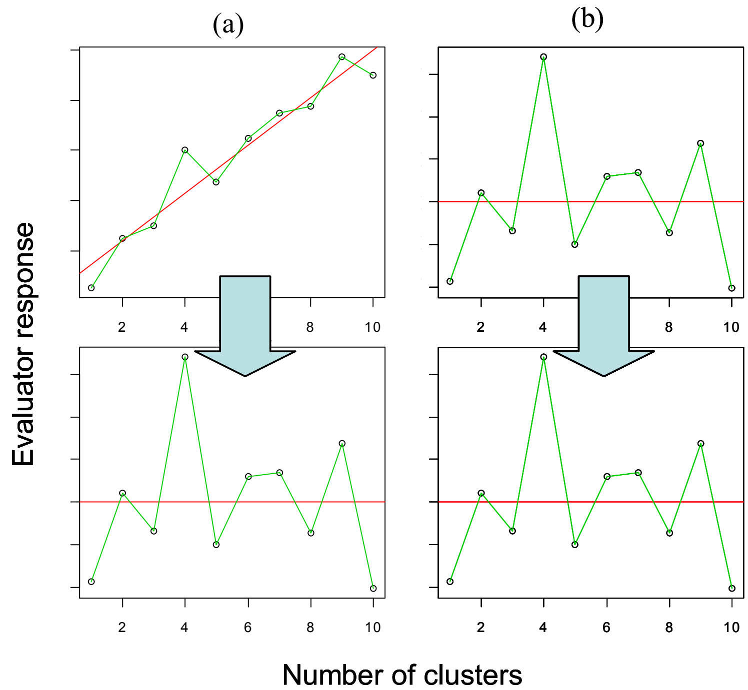


Figure 2.1. Converting evaluator scores (upper figures) to residuals from linear models (lower figures). This is demonstrated for evaluators with possible linear artifact (a), and without linear artifact (b). Note that while predicted optima for the evaluator with linear artifact (a) are radically adjusted, (b) is unchanged (from Aho 2006a).

Results

Five of six evaluators found solutions with only two, three or four clusters to be the worst possible solutions (Fig. 2.2, Table 2.1). Among non-geometric evaluators, ISA *p*-values were optimized at 12 clusters, while ISA significant indicator species were optimized at 37 clusters. Geometric evaluators generally found 15-18 clusters to be optimal (Table 2.1). An outlier outcome for the *C*-index evaluator at the extreme low value of two clusters caused this linear residuals to be large, and for this to be the largest positive residual for *C*-index (Table 2.1).

Averaging the scores of all six evaluators, the best solution was 12 clusters, although solutions of twenty-eight, and thirty-seven clusters (and particularly 15 clusters) were also favored (Fig. 2.3). Classifications with fewer than 8 clusters and more than 40 clusters were found to be particularly poor (Fig. 2.3).

NMDS ordinations (Kruskal and Wish 1978) were used to demonstrate the spread of sites in multivariate species space and the relationship of the clusters to each other in 15 cluster and 37 cluster solutions (Figs. 2.4-2.5).

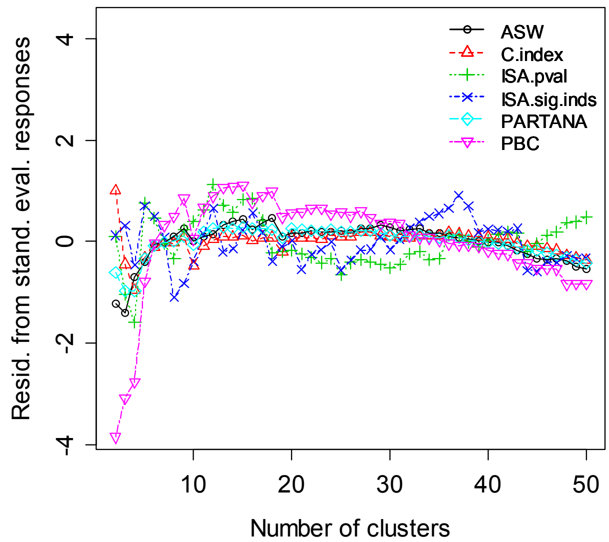


Figure 2.2. Scores of six evaluators with respect to 49 clustering solutions (2 to 50 Clusters) of the CIRO vegetation data.

Table 2.1. Tabular summary of Figure 2.2.

	best solution	**worst solution**
ASW	18	3
C-index	2	4
ISA avg. *p*-value	12	4
ISA # of sig. inds	37	8
PARTANA	15	4
PBC	15	2

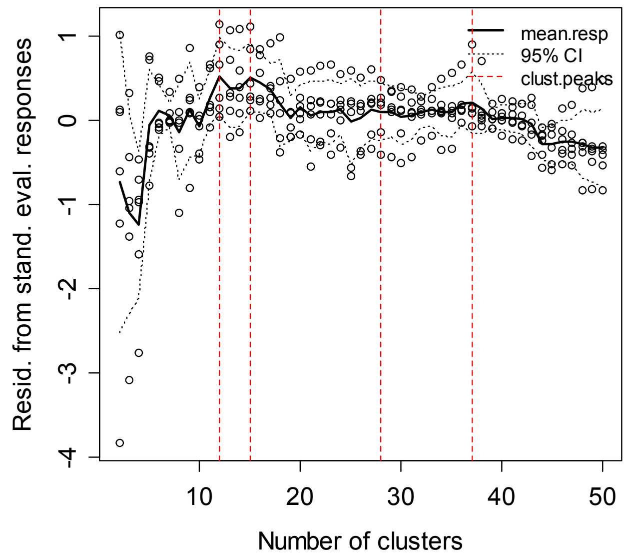
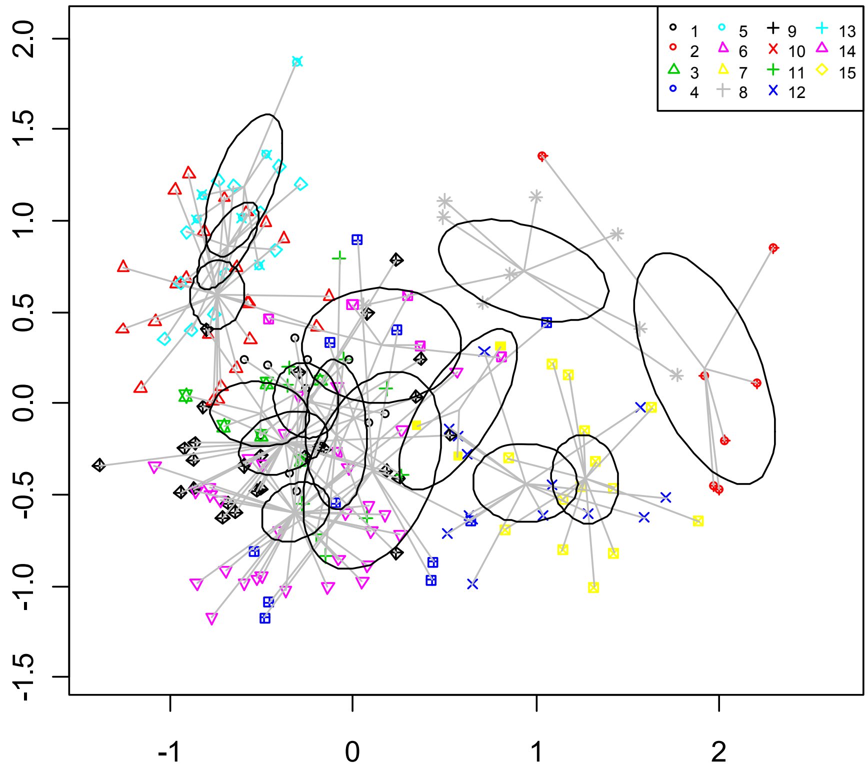


Figure 2.3. Scores of six evaluators with respect to 49 clustering solutions (2 to 50 clusters) of the CIRO vegetation data. Averages shown with a solid black line. Ninety-five percent confidence intervals around the mean shown with black dashed lines. Red dashed lines are at 12, 15, 28, and 37 clusters.

(a)



(b)

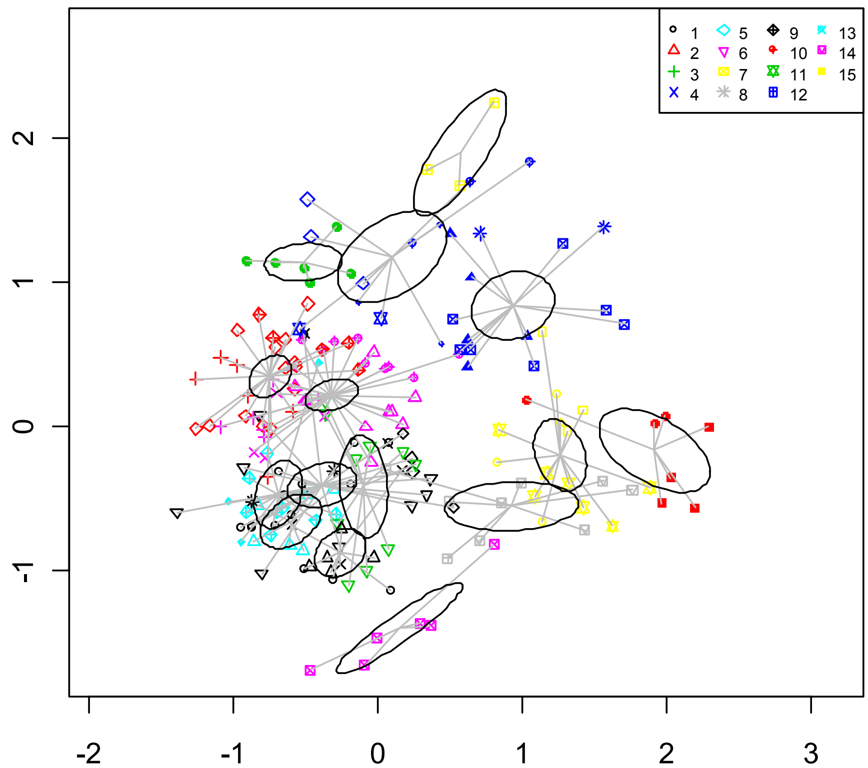


Figure 2.4. NMDS ordination of the CIRO vegetation data. Fifteen cluster solution overlaid. (a) Dimensions 1 and 2; (b) dimensions 1 and 3. Final stress for 3 dimensional solution = 18.34. Steinhaus dissimilarity used to create distance matrix. Ellipses are 95% confidence intervals around cluster centroids.

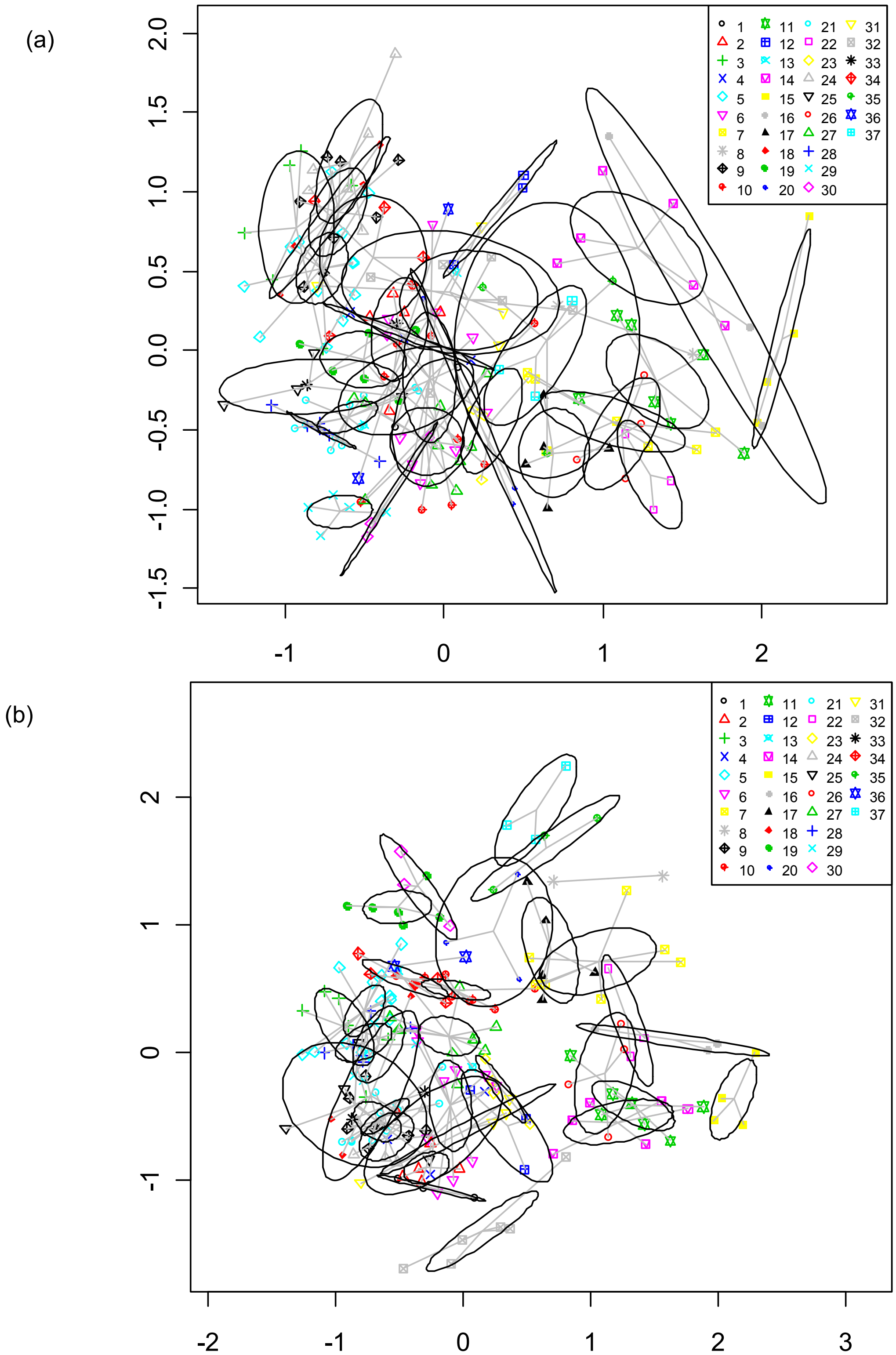


Figure 2.5. NMDS ordination of the CIRO vegetation data. Thirty-seven cluster solution overlaid. (a) Dimensions 1 and 2; (b) dimensions 1 and 3. Final stress for 3 dimensional solution = 18.34. Steinhaus dissimilarity used to create distance matrix. Ellipses are 95% confidence intervals around cluster centroids.

Step 3: Classification Description

Methods

In this step the 15 and 37 type classifications are described. These were both judged as optimal in our pruning analyses (Fig. 2.2, Table 2.1).
Classification descriptions follow the method used by Aho et al. (2005) in consulting work with the Montana Department of Environmental Quality. This work utilized relevé tables which described both cover and constancy of plant species within communities. Cover is the average percent ground cover of a species within a community. Constancy is defined is the percentage of time a species occurs in a particular community. Thus for species *j* within community *k* (which was sampled with n_k sites) constancy is calculated as:

$$Const_{jk} = \frac{O_{jk}}{n_k} \qquad (3.1)$$

Where O_{jk} is the number of sites within community *k* that species *j* occurs in and n_k is the number of sites which describe community *k*.
Aho (2006b, pg. 371) introduced a function to sort species based on a meaningful ordering of sites or groups of sites. The function is implemented in the R-package asbio (Aho 2009). In particular, in a summary relevé table, where sites are grouped based on the similarity of their species composition, species can be sorted with respect to their fidelity to the groups. Fidelity is the percentage of times a species occurs in a particular community compared to its occurrences in all other communities (Eq. 3.2). For species *j* within community *k* (sampled with n_k sites) fidelity is calculated as:

$$Fidel_{jk} = \frac{O_{jk}}{\sum_{k=1}^{g} O_{jk}} \qquad (3.2)$$

Where O_{jk} is the number of occurrences of the *j*th species in the *k*th community $k = (1, 2, \ldots, g)$.

The sorting method has five steps.

1) An unsorted relevé table is created with groups (communities) in columns and species in rows. Responses within the table are fidelities of species to groups.
2) Groups (columns) are ordered with respect to some sort of meaningful gradient (e.g. soil moisture, soil depth, etc.).
3) Fidelities of species to groups are multiplied by a vector, *v*, of length *g* (where *g* is the number of groups). The vector is uniformly distributed from 1 to -1.
4) The vector *v* is multiplied element-wise by each row.
5) The species (rows) in the relevé table are sorted with respect to the sums of this multiplication, i.e. their dot product (Aho 2006b). One will obtain γ sums where γ = the number of species in the dataset.

A lack of environmental data hindered relevé sorting with respect to a meaningful order of columns. Communities (columns) were ordered left to right in the relevé table from least to greatest total community abundance (lowest to highest total ground cover of vegetation). Species (rows) were sorted with respect to this ordering of columns.

Conventional statistical summaries of the 15 and 37 cluster classifications (Tables 3.1 and 3.3) are included along with 15 and 37 cluster sorted relevés (Tables 3.2 and 3.4).

Table 3.1. Summary statistics for the 15 cluster classification.

cluster	plots	Total Richness	Plot Richness (mean ± SE)	Plot Cover (mean ± SE)	Simpson[1] Diversity (mean ± SE)	Shannon-Wein[2] Diversity (mean ± SE)	Beta[3] Diverstiy
1	11	88	25.1 ± 1.1	48.2 ± 5	0.78 ± 0.02	0.02 ± 2.5	2.5
2	24	128	24 ± 1.6	51 ± 2.6	0.68 ± 0.03	0.03 ± 4.3	4.3
3	10	87	25.1 ± 2	59.2 ± 3.4	0.69 ± 0.04	0.04 ± 2.5	2.5
4	14	111	28.9 ± 1.2	88.5 ± 5.8	0.8 ± 0.03	0.03 ± 2.8	2.8
5	12	76	23 ± 1.7	37.5 ± 4.2	0.76 ± 0.03	0.03 ± 2.3	2.3
6	30	133	28.7 ± 0.8	70.6 ± 2.3	0.79 ± 0.01	0.01 ± 3.6	3.6
7	14	119	22.8 ± 1.5	93.3 ± 7.9	0.72 ± 0.02	0.02 ± 4.2	4.2
8	9	73	17 ± 1.4	59.6 ± 5.1	0.6 ± 0.05	0.05 ± 3.3	3.3
9	27	144	26 ± 1.3	53.2 ± 2.4	0.79 ± 0.02	0.02 ± 4.5	4.5
10	7	68	20.4 ± 2	95.8 ± 4.6	0.78 ± 0.03	0.03 ± 2.3	2.3
11	6	68	22.5 ± 1.7	84.9 ± 5.4	0.66 ± 0.02	0.02 ± 2	2
12	11	89	20.3 ± 1.8	79.9 ± 8	0.63 ± 0.07	0.07 ± 3.4	3.4
13	6	61	20.8 ± 1.8	32.7 ± 3.8	0.66 ± 0.09	0.09 ± 1.9	1.9
14	6	58	17.7 ± 2.4	54.3 ± 6.5	0.44 ± 0.1	0.1 ± 2.3	2.3
15	3	30	17.3 ± 3.3	45.7 ± 7.8	0.43 ± 0.18	0.18 ± 0.7	0.7

[1] $D = 1 - \sum_i p_i^2$ (Simpson 1964), [2] $H' = \sum_i p_i \ln p_i$ (MacArthur and MacArthur 1961), where p_i is the proportion of species *i* in the sampling unit, [3] $\beta_W = (\gamma / \alpha) - 1$ (Whittaker 1960), where γ is the total number of species in the landscape, and α is average plot richness.

Table 3.2. Summary relevé table for 15 community types. This table lists all species that occur with >20% constancy in at least one community[1]. The two character cipher[2] in each cell indicates the constancy and cover of the species in the community. Bolded cells indicate >30% constancy. Lightly shaded cells indicate 40%<constancy<70%. Dark shaded cells indicate ≥70% constancy.

	13	5	15	1	2	9	14	8	3	6	12	11	4	10	7
Erigeron tener	**3A**	**5A**	..	..	..	..	..	..	..	..	..	..	..	..	..
Packera cana	**3A**	**4A**	..	++	..	..	..	..	..	..	..	..	..	..	..
Balsamorhiza hookeri var. *hispidula*	**3A**	1A	..	..	++	..	..	..	..	..	..	..	..	..	..
Astragalus calycosus	1A	**4A**	..	2A	..	++	..	..	..	..	..	..	..	..	..
Haplopappus acaulis	**8A**	**4A**	..	..	2A	+A	..	..	..	..	..	..	..	..	..
Poa nervosa var. *wheeleri*	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..
Ribes montigenum	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..
Castilleja pallescens var. *inverta*	1A	**3A**	..	..	..	..	..	..	..	++	..	..	..	..	..
Erigeron pumilus ssp. *concinnoides* var.	**4A**	**5A**	..	..	++	++	..	..	..	++	..	..	..	..	..
Pediocactus simpsonii	**8A**	**7A**	..	..	1A	++	1A	..	..	++	..	..	..	..	..
Cryptantha humilis	1A	**4A**	..	1A	++	++	**3A**	..	..	..	..	..	..	..	..
Artemisia arbuscula	1A	**8D**	..	..	1A	+A	..	2C	..	..	..	..	..	..	..
Arenaria fendleri	**3A**	**4A**	..	..	1A	..	..	..	++	++	..	..	..	..	..
Penstemon humilis	**3A**	2A	..	2A	2A	++	..	1A	..	..	..	..	..	..	..
Phlox hoodii var. *canescens*	**9B**	**9B**	..	**5A**	1A	+A	..	..	++	2A	..	..	..	..	..
Artemisia nova	**9D**	2A	..	..	..	1A	..	2A	..	+A	++	..	..	..	..
Erigeron lonchophyllus	..	++	..	**6A**	++	1A	..	..	..	..	..	..	..	..	..
Antennaria dimorpha	1A	2A	..	1A	1A	..	..	..	++	++	..	..	..	..	..
Chaenactis douglasii	**3A**	..	..	**5A**	++	1A	**3A**	..	..	..	..	..	..	..	..
Juniperus osteosperma	..	1A	..	..	**4D**	++	..	..	..	..	..	..	..	..	..
Sedum lanceolatum	**6A**	**9A**	..	..	2A	++	..	2A	1A	1A	++	..	..	..	..
Penstemon attenuatus var. *militaris*	1A	1A	**6A**	..	..	++	..	..	..	+A	++	..	..	..	..
Elymus elymoides var. *elymoides*	**4A**	++	..	**3A**	+A	1A	**6A**	1A	..	..	..	..	..	..	..
Packera multilobata	**6A**	..	..	++	**3A**	++	**3A**	..	..	++	..	..	..	..	..
Astragalus beckwithii	..	..	..	**3A**	2A	++	1A	..	..	..	..	..	..	..	..
Hesperostipa comata var. *comata*	**3A**	++	..	**3B**	1A	+A	..	..	1A	++	..	..	..	..	..
Tetradymia canescens	..	2A	..	1A	..	++	..	..	..	++	..	..	..	..	..
Crepis modocensis ssp. *modocensis*	**4A**	2A	..	..	++	++	..	..	..	1A	..	..	..	..	..
Castilleja angustifolia var. *dubia*	**4A**	1A	..	..	1A	1A	..	..	..	++	..	..	..	..	..
Achnatherum hymenoides	1A	..	..	**5A**	1A	++	**3A**	..	..	++	+A	..	..	..	..
Leptodactylon pungens	..	2A	..	++	1A	+A	..	..	..	+A	..	1A	..	..	..
Abies lasiocarpa	..	..	**9E**	..	..	..	..	..	..	..	..	..	+B	..	..
Astragalus cibarius	1A	+A	..	**3A**	++	**3A**	1A	..	++	++	..	..	..	..	..
Pinus contorta var. *latifolia*	..	..	**6C**	..	..	..	..	..	..	..	+A	..	..	..	..
Koeleria macrantha	**3A**	**5B**	..	2A	2A	2A	**3A**	**4A**	++	1A	..	..	..	..	+A
Agropyron desertorum	..	..	..	**9D**	++	**3C**	1A	..	1C	..	..	..	..	..	++
Pseudoroegneria spicata	**9C**	**9C**	..	**3A**	**4A**	**6C**	1A	1A	**3B**	**3A**	+A	**4B**	..	..	..
Penstemon radicosus	**3A**	**4A**	..	..	+A	++	..	..	..	1A	..	1A	..	..	..
Vulpia octoflora	..	..	..	++	++	2A	..	..	++	..	..	..	..	..	..
Alyssum desertorum	1A	++	..	**8A**	**4A**	**6A**	**6A**	2A	2A	++	..	..	..	..	1A
Opuntia polyacantha	**4A**	..	..	**6A**	**7A**	**7A**	..	1A	**4A**	2A	..	1A	..	..	..
Lappula redowskii	..	..	..	**3A**	++	++	1A	..	..	..	..	..	..	..	++
Antennaria microphylla	..	**9C**	..	2A	2A	1A	1A	..	1A	**3A**	..	1A	..	..	++
Zigadenus paniculatus	..	++	..	**3A**	2A	2A	..	2A	++	++	..	1A	..	..	..
Allium acuminatum	..	..	..	**5A**	2A	**5A**	..	2A	++	1A	..	..	..	..	++
Heuchera parvifolia var. *utahensis*	..	**4A**	..	..	+A	++	..	..	++	++	++	1A	..	..	..
Bromus tectorum	**4A**	..	..	**6D**	**6A**	**7B**	**9E**	**3A**	**4B**	1A	..	..	..	..	2A
Purshia tridentata	1A	..	..	**4A**	**5A**	**7D**	1A	2A	2A	2A	..	..	..	..	++
Hackelia floribunda	..	..	**9A**	..	..	++	..	..	..	..	++	..	++	..	..
Eriogonum microthecum var. *laxiflorum*	**6A**	2A	..	**3A**	2A	2A	..	..	2A	**3A**	..	**4A**	..	..	..
Eriogonum umbellatum	1A	..	..	1A	+A	1A	..	..	1A	+A	++	..	..	..	..
Arabis holboellii var. *retrofracta*	**4A**	1A	..	++	**3A**	2A	..	..	1A	2A	++	**3A**	++	..	..
Castilleja flava	1A	**4A**	..	..	..	++	..	..	++	2A	..	..	..	..	..
Phlox longifolia	..	1A	..	2A	**4A**	**5A**	**3A**	..	++	**3A**	..	..	..	..	++
Hordeum jubatum	..	..	..	..	++	+A	..	2A	..	..	..	..	..	..	..
Cirsium undulatum	1A	++	..	**4A**	..	2A	1A	2A	++	++	2A	**3A**	..	..	..
Poa secunda	**9C**	**9C**	..	**9D**	**9C**	**8C**	**9B**	**7B**	**8C**	**5A**	**5A**	**9A**	2A	1A	2A

Table 3.2 (continued). Summary relevé table for 15 community types.

	13	5	15	1	2	9	14	8	3	6	12	11	4	10	7
Arnica cordifolia	..	..	3A	..	..	..	..	..	..	..	++	..	..	..	..
Descurainia richardsonii var. *brevipes*	..	..	..	++	2A	++	3A	..	..	++	..	..	..	..	1A
Agoseris glauca var. *dasycephala*	..	5A	3A	5A	4A	5A	..	..	7A	6A	2A	1A	1A	..	..
Descurainia pinnata var. *filipes*	..	..	..	++	2A	+A	1A	1A	..	++	..	..	..	..	1A
Erodium cicutarium	..	..	..	..	..	+A	3A	2A	..	..	..	..	..	..	..
Lomatium triternatum var. *platycarpum*	..	1A	..	++	1A	3A	..	..	5A	2A	..	1A	..	..	..
Grindelia squarrosa var. *serrulata*	..	..	..	..	..	++	1A	2A	..	..	..	..	..	..	..
Senecio integerrimus var. *exaltatus*	..	1A	..	2A	2A	2A	..	..	1A	2A	1A	3A	..	..	..
Chrysothamnus viscidiflorus ssp. *lanceolatus*	4A	8A	..	9D	6A	8C	6A	1A	9C	9C	1A	4A	2A	..	2A
Comandra umbellata var. *pallida*	1A	4A	..	+A	1A	4A	..	1A	2A	6A	++	..	..	..	..
Chrysothamnus nauseosus ssp. *albicaulis*	1A	1A	..	3A	++	2A	4C	..	1A	++	..	..	+A	..	3A
Artemisia tridentata ssp. *vaseyana*	..	4A	..	6A	7C	8D	1A	1A	1A	8D	3A	1A	2A	..	2A
Festuca idahoensis	..	4C	..	+A	2B	+A	..	2A	2C	4D	..	..	+A	..	..
Sisymbrium altissimum	..	..	..	3A	..	..	8C	1A	+A	..	..	..	..	..	1A
Iva axillaris	..	..	..	+A	..	+A	3B	3A	..	..	..	..	..	..	+A
Pinus monophylla	1A	1A	..	..	9D	2A	..	..	5B	4B	..	3A	2B	..	2A
Crepis acuminata	1A	1A	..	3A	1A	1A	..	..	1A	3A	++	3A	2A	..	..
Cercocarpus ledifolius	..	1A	..	..	5C	+A	..	..	..	2B	3B	9E	..	..	..
Lithospermum ruderale	1A	..	..	1A	++	3A	..	..	3A	1A	..	1A	1A	..	++
Tragopogon dubius	..	..	..	8A	++	2A	8A	2A	1A	++	..	..	++	1A	4A
Danthonia californica	..	..	..	..	..	..	..	2B	..	..	..	..	..	..	..
Achnatherum nelsonii	..	..	..	+A	2A	2B	..	..	2A	2C	3B	1B	..	..	+A
Ribes viscosissimum	..	..	9C	..	++	..	..	..	++	..	+A	..	2A	..	..
Balsamorhiza sagittata	4A	2A	..	2A	6B	4B	..	1A	6B	8C	4A	8D	4B	..	+A
Danthonia unispicata	1A	..	..	++	1A	1A	..	5C	..	++	++	1A	..	..	2B
Elymus lanceolatus	..	+A	..	9D	2A	5B	3A	3A	6B	3A	3A	1A	2A	1A	4B
Phacelia hastata	..	..	..	..	++	1A	..	..	4A	1A	++	..	..	..	..
Hackelia patens	1A	..	..	++	3A	2A	..	..	2A	4A	++	8B	2A	..	..
Poa bulbosa	1A	..	..	3A	2A	5B	3B	9E	3A	2B	1A	..	1A	1A	5C
Crepis intermedia	..	2A	..	..	1A	..	..	..	..	1A	1A	3A	1A	..	..
Eriogonum heracleoides	..	++	..	++	1A	3A	..	1A	1A	5A	2A	1A	++	..	..
Schoenocrambe linifolia	..	..	..	++	..	1A	..	..	..	1A	++	..	..	..	..
Lupinus argenteus var. *argentatus*	1A	3A	..	2B	2A	7A	..	2A	7A	8B	4A	1A	4A	..	2A
Pinus flexilis	..	++	3A	..	++	..	..	..	..	..	2C	1A	+A	..	..
Artemisia tridentata ssp. *tridentata*	..	..	..	1C	2A	1B	..	1A	9E	1B	..	..	1A	..	2C
Symphoricarpos oreophilus	..	4A	6B	6A	5A	4B	1A	2A	6B	9D	9C	9D	6D	..	3A
Collinsia parviflora	..	1A	6A	1A	6A	5A	..	1A	7A	5A	6A	6A	5A	..	2A
Collomia linearis	..	..	..	++	++	3A	..	..	3A	3A	..	..	1A	..	1A
Erysimum asperum	1A	++	..	++	1A	++	..	..	4A	4A	++	4A	++	..	..
Delphinium depauperatum	..	..	..	+A	3A	1A	..	..	7A	5A	1A	1A	1A	..	++
Bromus commutatus	..	..	..	..	..	+A	1A	3A	..	..	..	..	..	..	+A
Amelanchier alnifolia	..	2A	6A	..	+A	1A	..	2A	1A	1A	1A	3A	4A	..	..
Myosotis stricta	..	..	..	..	1A	++	..	2A	++	++	..	..	..	1A	1A
Packera streptanthifolia	..	++	..	..	+A	1A	..	..	..	2A	+A	3A	++	..	..
Leucopoa kingii	..	..	..	1A	+A	1A	1A	..	++	2C	2A	3A	1A	..	..
Mertensia oblongifolia	1A	3A	..	1A	1A	1A	..	..	4A	5A	4B	6B	3A	..	+A
Symphyotrichum ascendens	..	..	..	..	..	1A	3A	5A	..	..	++	..	..	..	2B
Leymus cinereus	..	..	..	++	1A	3A	1A	1A	4C	5C	4A	3C	2A	..	1A
Fritillaria atropurpurea	..	1A	..	++	++	..	..	..	2A	3A	++	3A	1A	..	..
Viola purpurea	..	..	9A	..	1A	1A	..	..	3A	5A	7A	9A	2A	..	++
Carex rossii	..	..	6A	..	..	..	..	..	..	+A	++	3A	1A	..	..
Artemisia ludoviciana var. *incompta*	..	..	..	..	++	2A	4A	4A	1A	+A	++	..	3A	..	3A
Pseudotsuga menziesii var. *glauca*	..	..	3A	..	..	..	..	..	..	..	3D	1A	..	..	..
Ribes cereum var. *pedicellare*	..	..	..	..	2A	++	..	..	++	3A	3A	6B	..	1A	1A
Lactuca serriola	..	..	..	++	..	..	3A	1A	..	..	..	..	++	..	1A
Microseris nutans	..	..	..	++	++	1A	..	4A	..	2A	++	1A	2A	..	3A
Taraxacum officinale	..	1A	3A	5A	++	2A	3A	4A	3A	3A	1A	1A	7A	4A	9A
Osmorhiza depauperata	..	..	9A	..	..	..	..	..	..	..	1A	..	2A	..	1A
Ceanothus velutinus	..	..	..	..	..	+A	..	..	..	++	3D	..	..	..	..
Viola vallicola var. *major*	..	++	3A	..	..	++	..	..	2A	1A	..	1A	2A	..	1A
Achillea millefolium var. *occidentalis*	..	1A	3A	++	1A	2A	3A	5A	2A	5A	1A	3A	4A	2A	9A

Table 3.2 (continued). Summary relevé table for 15 community types.

	13	5	15	1	2	9	14	8	3	6	12	11	4	10	7
Mahonia repens	..	..	**6A**	..	2A	1A	..	1A	1A	**4A**	**8B**	**4B**	**7C**	..	1A
Holodiscus dumosus	..	..	..	..	++	..	..	..	..	..	1A	**3A**	..	..	..
Lithophragma parviflorum	..	..	**3A**	++	++	++	..	..	++	1A	..	**4A**	2A	..	2A
Delphinium nuttallianum	..	++	..	..	..	++	1A	..	..	2A	..	1A	2A	..	1A
Lupinus leucophyllus	..	..	..	..	..	..	..	..	1A	..	..	..	++	..	..
Juniperus scopulorum	..	..	..	..	2A	1A	..	..	1A	1A	**3A**	..	**6D**	1A	2C
Melica bulbosa	..	..	..	..	..	1A	..	..	..	**4B**	++	1A	2A	..	1A
Prunus virginiana var. *melanocarpa*	..	..	..	..	..	+A	..	..	..	2A	**9D**	**3A**	2A	..	+A
Smilacina racemosa	..	..	**6A**	..	..	..	..	..	..	..	2B	..	**4B**	..	..
Poa pratensis	..	..	..	2A	..	**3C**	**3A**	**5C**	2A	**3B**	+A	..	**8D**	**7D**	**9E**
Claytonia perfoliata	..	..	..	..	++	..	..	..	..	..	1A	1A	2A	..	++
Stellaria jamesiana	..	..	**6A**	..	..	..	..	..	..	..	1A	..	1A	1A	1A
Mertensia ciliata	..	..	..	..	..	+A	..	..	..	+A	1A	1A	2A	..	..
Camelina microcarpa	..	..	..	..	..	++	1A	1A	..	..	..	..	..	..	2A
Senecio serra	..	..	**3A**	..	..	..	..	..	++	..	1A	..	**3A**	..	..
Agastache urticifolia	..	..	**3A**	..	..	+A	..	..	..	2A	**5A**	..	**6A**	..	2A
Nemophila breviflora	..	..	..	++	++	++	..	..	..	**3A**	1A	..	**9A**	..	2A
Galium aparine	..	..	..	..	+A	++	..	..	..	..	1A	..	2A	1A	1A
Helianthella uniflora	..	..	..	..	..	..	..	..	..	1A	1A	..	1B	..	++
Eucephalus elegans	..	..	..	..	..	..	..	..	..	2A	1A	**3A**	**3A**	..	..
Geranium viscosissimum var. *incisum*	..	..	..	..	..	..	..	..	+A	2A	..	..	2A	..	+A
Cirsium vulgare	..	..	..	..	..	..	**3A**	1A	++	..	..	..	..	**4A**	1A
Frasera speciosa	..	..	..	..	..	..	..	..	++	++	..	..	2A	..	..
Hydrophyllum capitatum var. *alpinum*	..	..	..	..	..	++	..	..	..	++	2A	1A	**6A**	..	1A
Rumex crispus	..	..	..	..	..	..	1A	**3A**	..	..	..	..	..	**5A**	1A
Ribes aureum	..	..	..	..	..	1A	..	..	..	++	++	..	..	**4B**	2A
Artemisia dracunculus	..	..	..	..	..	..	..	..	1A	..	..	..	1A	..	++
Populus tremuloides	..	..	**9B**	..	..	..	..	..	..	..	**3C**	..	**9D**	..	**3D**
Bromus carinatus	..	..	..	..	..	++	..	..	..	++	++	..	**3A**	..	++
Juncus balticus var. *montanus*	..	..	..	..	..	++	1A	**6B**	..	..	..	..	..	**8D**	**4D**
Delphinium occidentale	..	..	..	..	..	..	..	..	..	1A	+A	..	2A	..	1A
Stellaria longipes	..	..	..	..	++	..	..	..	..	..	..	..	++	**4A**	..
Cystopteris fragilis	..	..	..	..	..	..	..	..	..	++	1A	**4A**	2A	..	..
Rosa woodsii var. *ultramontana*	..	..	..	..	..	++	1A	**3A**	..	1A	..	..	+A	**8C**	**5A**
Thalictrum fendleri	..	..	**6A**	..	..	..	..	..	..	..	**3A**	1A	**9D**	..	2A
Arnica sororia	..	..	..	..	++	..	1A	..	..	..	..	1A	..	2B	2B
Acer glabrum var. *douglasii*	..	..	..	..	..	..	..	..	..	..	2B	..	**3B**	..	..
Elymus glaucus	..	..	..	..	..	..	1A	..	..	+A	2A	1A	**6A**	1A	2A
Cirsium arvense	..	..	**3A**	..	..	++	1A	..	..	..	..	1A	**3A**	**5A**	2A
Aster ascendens	..	..	..	..	..	..	..	2A	..	++	..	..	+A	..	2A
Valeriana acutiloba var. *pubicarpa*	..	..	..	..	..	..	..	..	..	++	+A	..	**3B**	1A	..
Geum macrophyllum var. *perincisum*	..	..	..	..	++	..	..	..	..	..	..	..	1A	**7A**	..
Viola adunca var. *adunca*	..	..	**3A**	..	..	..	..	..	..	..	..	..	2A	**4A**	1A
Iris missouriensis	..	..	..	..	..	++	1A	2A	..	++	..	..	++	**7C**	**6A**
Potentilla gracilis var. *pulcherrima*	..	..	..	..	..	..	1A	2A	..	..	..	..	..	2A	**4B**
Heracleum maximum	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..
Osmorhiza occidentalis	..	..	..	..	..	..	..	..	..	..	2C	1A	**5C**	1A	2A
Urtica dioica	..	..	..	..	..	..	..	..	..	..	+A	..	**3A**	**4A**	..
Verbascum thapsus	..	..	..	..	..	..	1A	..	..	..	..	..	1A	1A	2A
Maianthemum stellatum	..	..	..	..	..	..	..	..	..	..	..	..	**7A**	**5A**	1A
Cornus sericea	..	..	..	..	..	..	..	..	..	..	..	..	2B	..	+A
Aquilegia formosa	..	..	..	..	..	..	..	..	..	..	..	..	2A	1A	++
Mimulus guttatus	..	..	..	..	..	..	..	..	..	..	..	..	+A	2A	..
Veratrum californicum	..	..	..	..	..	..	..	..	..	..	..	..	2C	**4C**	1A
Ribes setosum	..	..	..	..	..	..	..	..	..	..	++	..	1A	**5B**	2A
Alopecurus aequalis	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..
Carex praegracilis	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..
Epilobium ciliatum	..	..	..	..	..	..	..	..	..	..	..	..	..	**4A**	..
Galium triflorum	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..
Salix boothii	..	..	..	..	..	..	..	..	..	..	..	..	..	**7D**	..
Salix exigua ssp. *exigua* var. *stenophylla*	..	..	..	..	..	..	..	..	..	..	..	..	..	**4D**	..

Table 3.2 (continued). Summary relevé table for 15 community types.

	13	5	15	1	2	9	14	8	3	6	12	11	4	10	7
Salix geyeriana	..	..	..	..	..	..	..	..	..	..	..	..	..	2D	..
Senecio pseudaureus	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..
Thermopsis rhombifolia	..	..	..	..	..	..	..	..	..	..	..	..	..	2B	..
Carex douglasii	..	..	..	..	..	..	..	..	..	..	++	..	..	..	2A
Carex nebrascensis	..	..	..	..	..	..	..	..	..	++	..	..	..	**8D**	2B
Salix lasiandra	..	..	..	..	..	..	..	..	..	..	..	..	..	2C	+A
Salix lutea	..	..	..	..	..	..	..	..	..	..	..	..	..	2C	1B
Trifolium pratense	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	1A
Phleum pratense	..	..	..	..	..	..	..	..	..	..	..	..	..	2C	2A
Arctium minus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A

[1]Lower constancy species not included in table were: *Aconitum columbianum, Achnatherum lettermanii, Achnatherum nevadense, Actaea rubra, Allium brandegeei, Alnus incana* ssp. *rugosa* var. *occidentalis, Amelanchier utahensis, Antennaria parvifolia, Antennaria stenophylla, Apocynum androsaemifolium, Arenaria congesta, Arabis drummondii, Arabis glabra, Arabis hirsuta, Arabis lignifera, Arabis microphylla, Arabis sparsiflora, Astragalus agrestis, Astragalus convallarius, Aster foliaceus, Astragalus lentiginosus* var. *salinus, Astragalus purshii* var. *purshii, Atriplex spinosa, Barbarea orthoceras, Bromus inermis, Caulanthus crassicaulis, Carex hoodii, Castilleja miniata, Carex microptera, Carex multicostata, Carduus nutans, Cardamine pensylvanica, Carex petasata, Castilleja tenuis, Carex vallicola, Ceratocephala testiculata, Chenopodium album, Chorispora tenella, Cirsium neomexicanum* var. *utahense, Claytonia lanceolata, Cryptantha ambigua, Cryptantha circumscissa, Cryptantha watsonii, Dactylis glomerata, Descurainia californica, Descurainia sophia, Draba nemorosa, Eleocharis palustris, Elymus trachycaulus* var. *latiglumis, Equisetum arvense, Equisetum laevigatum, Erigeron divergens, Fritillaria pudica, Galium bifolium, Gayophytum decipiens, Gayophytum diffusum, Gilia aggregata* var. *macrosiphon, Glyceria striata* var. *striata, Gutierrezia sarothrae, Hackelia micrantha, Heuchera cylindrica* var. *alpina, Heterotheca villosa, Hieracium cynoglossoides, Hordeum brachyantherum, Ionactis alpina, Juncus ensifolius* var. *brunnescens, Krascheninnikovia lanata, Lepidium campestre, Lepidium perfoliatum, Lithophragma glabrum, Linum lewisii, Lomatium dissectum* var. *eatonii, Lomatium foeniculaceum* var. *macdougalii, Lomatium nudicaule, Machaeranthera canescens, Maianthemum racemosum, Mentzelia albicaulis, Mentha arvensis, Medicago lupulina, Microsteris gracilis, Microsteris humilis, Montia linearis, Montia perfoliata, Muhlenbergia richardsonis, Oenothera caespitosa* var. *marginata, Osmorhiza berteroi, Paeonia brownii, Packera pseudaurea, Penstemon rydbergii, Plantago major, Plectritis macrocera, Populus alba, Potentilla arguta, Polygonum bistortoides, Poa bolanderi, Poa cusickii* var. *epilis, Polygonum douglasii* var. *douglasii, Polygonum douglasii* var. *latifolium, Potentilla glandulosa* var. *intermedia, Pteridium aquilinum, Ranunculus andersonii, Ranunculus macounii, Rorippa curvisiliqua, Rorippa nasturtium-aquaticum, Rudbeckia occidentalis, Salix bebbiana, Sambucus cerulea, Sambucus racemosa* var. *racemosa, Salix scouleriana, Sarcobatus vermiculatus, Solidago velutina, Sporobolus cryptandrus, Sphaeralcea grossulariifolia, Stellaria crispa, Stephanomeria minor* var. *myrioclada, Symphyotrichum falcatum, Trifolium gymnocarpon, Trifolium repens, Valeriana edulis, Veronica americana, Veronica serpyllifolia* var. *humifusa, Wyethia amplexicaulis, and Zigadenus venenosus* var. *venenosus*

[2]For each cell in the body of the table, constancy is indicated by the first symbol, while cover is indicated by the second symbol. For constancy: 0% = ".", 0-10% = +, 10-20% = 1, 20-30% = 2, 30-40% = 3, 40-50% = 4, 50-60% = 5, 60-70% = 6, 70-80% = 7, 80-90% 8, 90-100% = 9. For cover: 0% = ".", 0-0.01% = +, 0.01-1% = A, 1-2% = B, 2-5% = C, 5-25% = D, >25% = E.

Table 3.3. Summary statistics for the 37 cluster classification.

cluster	plots	Total Richness	Plot Richness (mean ± SE)	Plot Cover (mean ± SE)	Simpson[1] Diversity (mean ± SE)	Shannon-Wein[2] Diversity (mean ± SE)	Beta[3] Diverstiy
1	3	40	21 ± 1	42 ± 9.6	0.72 ± 0.01	1.7 ± 0.1	0.9
2	5	55	25.2 ± 1	53.7 ± 7.1	0.79 ± 0.02	1.9 ± 0.1	1.2
3	6	71	22.8 ± 4.3	51.2 ± 4.7	0.64 ± 0.03	1.4 ± 0.2	2.1
4	3	56	29 ± 1.7	45.2 ± 12.5	0.82 ± 0.03	2.1 ± 0.2	0.9
5	13	105	23.5 ± 2	53.8 ± 3.5	0.65 ± 0.04	1.6 ± 0.1	3.5
6	10	87	25.1 ± 2	59.2 ± 3.4	0.69 ± 0.04	1.7 ± 0.1	2.5
7	7	86	29.4 ± 1.8	88.2 ± 9.5	0.88 ± 0.01	2.4 ± 0.1	1.9
8	2	42	25 ± 1	69 ± 1.2	0.57 ± 0.05	1.3 ± 0.1	0.7
9	8	66	23 ± 2	36.1 ± 4.3	0.74 ± 0.04	1.8 ± 0.1	1.9
10	9	93	29.2 ± 1.2	74.6 ± 1.7	0.78 ± 0.02	2 ± 0.1	2.2
11	7	68	19.3 ± 1.5	77.2 ± 6.3	0.75 ± 0.02	1.7 ± 0.1	2.5
12	3	44	19.3 ± 3.4	57.9 ± 5.1	0.79 ± 0.02	1.9 ± 0.2	1.3
13	2	46	30 ± 3	62.5 ± 3	0.81 ± 0.05	2.2 ± 0.2	0.5
14	6	53	15.8 ± 1.4	60.5 ± 7.6	0.51 ± 0.04	1.2 ± 0.1	2.3
15	4	43	19 ± 3.4	96.9 ± 8.4	0.75 ± 0.04	1.7 ± 0.2	1.3
16	3	49	22.3 ± 0.9	94.2 ± 1.2	0.82 ± 0.02	2.1 ± 0.1	1.2
17	5	72	29.8 ± 2.2	96.6 ± 7.7	0.77 ± 0.04	2 ± 0.2	1.4
18	4	50	23 ± 3.5	40.2 ± 10.1	0.8 ± 0.04	2 ± 0.2	1.2
19	6	68	22.5 ± 1.7	84.9 ± 5.4	0.66 ± 0.02	1.6 ± 0	2
20	3	53	23.7 ± 5.3	87.7 ± 22	0.7 ± 0.05	1.7 ± 0.1	1.2
21	11	74	23.4 ± 2.3	52.3 ± 2.6	0.74 ± 0.03	1.8 ± 0.2	2.2
22	3	52	24.3 ± 1.9	126.5 ± 24.1	0.61 ± 0.03	1.3 ± 0.2	1.1
23	4	72	30 ± 1.3	65.1 ± 4	0.82 ± 0.02	2.1 ± 0.1	1.4
24	6	61	20.8 ± 1.8	32.7 ± 3.8	0.66 ± 0.09	1.6 ± 0.2	1.9
25	4	63	21.8 ± 3.7	46.9 ± 5.7	0.79 ± 0.06	2 ± 0.2	1.9
26	4	75	27.8 ± 2.8	96.5 ± 9.1	0.76 ± 0.04	1.9 ± 0.2	1.7
27	10	94	30.9 ± 1.2	74 ± 5.1	0.83 ± 0.01	2.1 ± 0.1	2
28	6	59	28.3 ± 1	64.4 ± 5.7	0.78 ± 0.01	1.9 ± 0	1.1
29	5	57	23.6 ± 1.8	63.7 ± 3.8	0.73 ± 0.05	1.8 ± 0.2	1.4
30	3	32	17 ± 2.6	75.8 ± 11.3	0.34 ± 0.12	0.9 ± 0.3	0.9
31	4	65	31.8 ± 2.2	57.9 ± 4.4	0.84 ± 0.02	2.3 ± 0.1	1
32	6	58	17.7 ± 2.4	54.3 ± 6.5	0.44 ± 0.1	1 ± 0.2	2.3
33	2	35	25 ± 3	28.4 ± 7.1	0.88 ± 0.03	2.4 ± 0.2	0.4
34	5	70	26.8 ± 3.1	43.3 ± 6.6	0.78 ± 0.04	2 ± 0.2	1.6
35	3	43	22 ± 2.3	96.8 ± 8	0.76 ± 0.02	2 ± 0	1
36	2	30	17.5 ± 3.5	49.2 ± 5.6	0.79 ± 0.04	2 ± 0	0.7
37	3	30	17.3 ± 3.3	45.7 ± 7.8	0.43 ± 0.18	1.1 ± 0.5	0.7

[1] $D = 1 - \sum_i p_i^2$ (Simpson 1964), [2] $H' = \sum_i p_i \ln p_i$ (MacArthur and MacArthur 1961), where p_i is the proportion of species *i* in the sampling unit, [3] $\beta_W = (\gamma / \alpha) - 1$ (Whittaker 1960), where γ is the total number of species in the landscape, and α is average plot richness.

Table 3.4. Summary relevé table for 37 community types. This table lists all species that occur with >20% constancy in at least one community[1]. The two character cipher[2] in each cell indicates the constancy and cover of the species in the community. Bolded cells indicate >30% constancy. Lightly shaded cells indicate 40%<constancy<70%. Dark shaded cells indicate ≥70% constancy.

	33	24	9	18	1	34	4	37	25	36	3	21	5	2	32	12	31	6	14	13	29	28	23	8	27	10	11	30	19	7	20	16	26	17	35	15	22
Cryptantha circumscissa	**4A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sporobolus cryptandrus	**4A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Erigeron tener	..	**3A**	**4A**	**7B**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Packera cana	..	**3A**	**4A**	2A	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Arenaria congesta	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Valeriana edulis	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Linum lewisii	..	1A	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Balsamorhiza hookeri v. hi.	..	**3A**	2A	..	..	..	..	..	..	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Elymus trachycaulus v. lat.	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gilia aggregata v. *macro.*	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sarcobatus vermiculatus	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Haplopappus acaulis	..	**8A**	**6A**	2A	..	**3A**	..	..	2A	..	**3A**	..	+A	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Achnatherum lettermanii	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Microsteris gracilis	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Erigeron pumilus ssp. conc.	..	**4A**	**6A**	**4A**	..	..	..	..	**4A**	..	1A	..	++	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Castilleja pallescens v. *inv.*	..	1A	**3A**	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..
Pediocactus simpsonii	..	**8A**	**6A**	**9A**	..	1A	..	..	2A	..	**3A**	..	++	..	1A	..	..	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Artemisia arbuscula	..	1A	**9D**	**4C**	..	**3A**	..	..	2A	..	1A	..	+A	..	..	**6D**	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Astragalus calycosus	..	1A	**4A**	2A	..	..	**3A**	..	..	..	..	..	..	**3A**	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cryptantha humilis	..	1A	**4A**	**4A**	..	..	**3A**	..	..	..	1A	++	..	1A	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Arenaria fendleri	..	**3A**	**4A**	2A	..	1A	..	..	..	..	..	..	1A	..	..	..	..	++	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Heterotheca villosa	..	..	..	..	..	**5A**	..	..	..	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Poa nervosa var. wheeleri	..	..	..	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ribes montigenum	..	..	..	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fritillaria pudica	..	..	..	..	..	**3A**	..	..	..	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pinus contorta v. *lat.*	..	..	..	..	..	..	..	**6C**	..	**4C**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Penstemon humilis	..	**3A**	2A	2A	..	1A	**6A**	..	..	..	**3A**	..	1A	1A	..	**3A**	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Arabis drummondii	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sedum lanceolatum	..	**6A**	**8A**	**9B**	..	**5A**	..	..	2A	**4A**	1A	..	++	..	..	**3A**	..	1A	1A	..	..	**6A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phlox hoodii v. *canescens*	..	**9B**	**9A**	**9C**	**3A**	..	**6A**	..	**4A**	..	1A	..	2A	**5A**	..	..	..	++	..	..	..	**8A**	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..
Chaenactis douglasii	**4A**	**3A**	..	..	**9A**	..	**3A**	..	..	..	..	++	++	**3A**	**3A**	..	..	..	..	**4A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Antennaria dimorpha	..	1A	**3A**	..	**3A**	..	**3A**	..	..	..	**4A**	..	++	..	..	..	..	++	..	..	..	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..
Sphaeralcea grossulariifolia	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Juniperus osteosperma	..	..	2A	..	..	1A	..	..	2A	..	**9D**	..	**3C**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Artemisia nova	..	**9D**	1A	**4A**	..	..	..	..	2A	..	..	..	..	..	..	..	**7C**	..	**3A**	..	..	..	..	..	..	1A	..	**3A**	..	..	..	..	..	..	..	..	..
Ionactis alpina	..	..	..	..	..	..	**6A**	..	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Packera multilobata	**4A**	**6A**	..	..	..	..	..	..	..	..	**8A**	..	2A	1A	**3A**	..	..	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Castilleja angustifolia v. *d.*	..	**4A**	2A	..	..	1A	..	..	2A	..	..	1A	1A	..	..	..	..	..	..	..	..	1A	..	..	++	1A	..	..	..	..	..	..	..	..	..	..	..
Aster foliaceus	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	**3C**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Astragalus purshii v. *pursh.*	..	1A	2A	..	..	..	..	..	..	..	1A	++	1A	1A	..	..	..	++	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Table 3.4 (continued). Summary relevé table for 37 community types.

	33	24	9	18	1	34	4	37	25	36	3	21	5	2	32	12	31	6	14	13	29	28	23	8	27	10	11	30	19	7	20	16	26	17	35	15	22
Penstemon attenuatus v. *mi.*	..	1A	1A	2A	..	..	..	6A	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	**3A**	..	..	..	..	..	..	..	..	..
Erigeron lonchophyllus	..	..	1A	..	**6A**	..	**3A**	..	..	..	1A	1A	++	**7A**	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Elymus elymoides v. *elym.*	..	**4A**	1A	..	**3A**	..	..	..	..	..	**3A**	1A	..	**5A**	**6A**	..	**7B**	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Vulpia octoflora	**4A**	..	..	..	..	..	..	..	..	..	..	**4A**	++	1A	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Crepis modocensis ssp. mo.	..	**4A**	2A	2A	..	..	..	..	..	..	..	..	1A	..	..	..	2A	..	..	..	..	**3A**	..	..	++	1A	..	..	..	..	..	..	..	..	..	..	..
Tetradymia canescens	..	..	..	**7A**	..	..	..	..	..	..	..	++	..	**3A**	..	..	..	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Zigadenus venenosus v. *ve.*	..	1A	1A	2A	**3A**	1A	..	..	..	..	..	2A	..	..	1A	..	**4A**	..	..	..	..	..	..	..	..	1A	1A	..	..	..	..	..	..	..	..	..	..
Agropyron desertorum	**4A**	..	..	..	**9D**	..	**9C**	..	..	..	1A	**7D**	..	**7A**	1A	..	..	1C	..	..	..	..	2A	..	..	..	1A	..	..	..	..	..	..	..	..	..	..
Astragalus cibarius	..	1A	1A	..	**6A**	..	**6A**	..	2A	..	1A	**4A**	++	..	1A	..	**4A**	++	..	..	..	..	2A	..	1A	..	..	..	..	..	..	..	..	..	..	..	..
Leptodactylon pungens	..	..	..	**7A**	**3A**	..	..	..	2A	..	1A	..	1A	..	..	..	..	..	..	..	..	1A	2A	..	..	..	..	..	1A	..	..	..	..	..	..	..	..
Astragalus beckwithii	..	..	..	..	**3A**	..	**3A**	..	..	..	**4A**	..	2A	**3A**	1A	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Alyssum desertorum	**9A**	1A	1A	..	**9A**	**3A**	**6A**	..	2A	..	**8A**	**8A**	2A	**7A**	**6A**	**3A**	**9A**	2A	1A	**4A**	..	..	2A	..	++	..	2A	..	..	..	..	..	..	..	..	..	..
Pseudoroegneria spicata	**9B**	**9C**	**9C**	**9D**	..	**5A**	**3A**	..	**9D**	**4A**	**3A**	**3A**	**5A**	**5B**	1A	**3A**	**9D**	**3B**	..	**4C**	..	**9C**	**4A**	..	**4A**	1A	..	..	**4B**	..	..	..	..	..	..	..	..
Hesperostipa comata v. *co.*	..	**3A**	1A	..	..	..	..	..	..	..	..	..	2A	**7C**	..	..	..	1A	..	..	1A	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lappula redowskii	..	..	..	..	**6A**	..	..	..	..	..	..	++	++	**3A**	1A	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..
Koeleria macrantha	..	**3A**	**7B**	2A	..	..	**3A**	..	..	..	**4A**	..	1A	**3A**	**3A**	**6A**	**9B**	++	**3A**	**4A**	..	**3A**	2A	..	++	1A	1A	..	..	..	..	..	..	..	..	..	..
Ceratocephala testiculata	..	..	..	..	**3A**	..	**3A**	..	..	..	1A	..	++	..	..	..	..	++	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..
Zigadenus paniculatus	**9A**	..	1A	..	**3A**	1A	**3A**	..	..	..	**3A**	**3A**	1A	**3A**	..	**6A**	2A	++	..	..	..	..	..	..	1A	1A	..	..	1A	..	..	..	..	..	..	..	..
Amelanchier utahensis	..	..	2B	..	..	..	..	..	2A	..	..	..	+A	..	..	..	**9B**	..	..	..	..	..	..	..	+B	..	..	..	..	..	..	..	..	..	..	..	..
Lomatium foeniculaceum v.	**4A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Opuntia polyacantha	**9B**	**4A**	..	..	..	**7B**	**6A**	..	**7A**	..	**8A**	**8A**	**7A**	**9A**	..	**3A**	**7A**	**4A**	..	**9A**	..	..	**4A**	..	**3A**	**3A**	..	..	1A	..	..	..	..	..	..	..	..
Antennaria microphylla	..	..	**8C**	**9D**	..	**3A**	**6A**	..	..	..	1A	1A	2A	1A	1A	..	2A	1A	..	..	1A	**9C**	..	..	**3A**	1A	..	..	1A	..	..	..	2A	..	..	..	..
Penstemon radicosus	..	**3A**	**3A**	**4A**	..	..	..	..	2A	..	..	..	+A	..	..	..	..	..	..	..	..	**4A**	2A	..	1A	1A	..	..	1A	..	..	..	..	..	..	..	..
Eriogonum microthecum v.	**9A**	**6A**	**3A**	..	..	**7A**	**3A**	..	**4A**	..	..	2A	1A	**5A**	..	..	2A	2A	..	..	1A	**8A**	..	..	2A	2A	..	..	**4A**	..	..	..	..	..	..	..	..
Astragalus lentiginosus v. *s.*	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Poa cusickii var. epilis	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Allium acuminatum	**9A**	..	..	..	**6A**	1A	**9A**	..	2A	..	**4A**	**5A**	1A	1A	..	**3A**	**4A**	++	1A	..	..	..	**7A**	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	**3A**
Achnatherum hymenoides	..	1A	..	..	**3A**	..	..	..	..	..	..	++	**3A**	**9A**	**3A**	..	..	..	..	..	..	..	..	..	++	..	..	..	..	..	**3A**	..	..	..	..	..	..
Gutierrezia sarothrae	..	1A	..	..	..	..	..	..	2A	..	..	..	+A	..	..	**3A**	**7A**	..	..	..	..	..	2B	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Abies lasiocarpa	..	..	..	..	..	..	..	**9E**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1C	..	..	..
Purshia tridentata	**9C**	1A	..	..	..	**7B**	**9C**	..	..	..	**3A**	**9D**	**5A**	**3A**	1A	**6A**	**9D**	2A	..	**9B**	1A	1A	**7C**	..	**3B**	1A	..	..	..	..	..	..	2A	..	..	..	..
Eriogonum umbellatum	**4A**	1A	..	..	..	..	**6A**	..	2A	..	..	..	+A	..	..	..	2A	1A	..	**4A**	..	1A	..	..	+A	..	..	..	..	..	**3A**	..	..	..	..	..	..
Heuchera parvifolia v. *u.*	..	..	2A	**7A**	..	1A	..	..	2A	..	..	..	..	..	..	..	..	++	..	..	..	1A	..	..	++	1A	..	..	1A	..	..	..	..	..	**3A**	..	..
Descurainia richardsonii v. *b.*	**4A**	..	..	..	..	1A	..	..	..	..	**4A**	..	2A	1A	**3A**	..	..	..	..	..	1A	..	..	..	..	..	1A	..	..	..	..	..	2A	..	..	..	..
Lomatium dissectum v. *e.*	..	1A	..	..	..	1A	..	..	..	..	..	+A	..	..	..	**3C**	**4A**	..	..	**4A**	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..
Bromus tectorum	**9B**	**4A**	..	..	**3A**	**3A**	**3A**	..	**4C**	..	**6A**	**8B**	**7B**	**9D**	**9E**	**6A**	**7B**	**4B**	1A	**4A**	1A	..	**4A**	..	+A	**3A**	..	..	..	..	..	..	**4A**	..	..	..	**3A**
Cirsium undulatum	**4A**	1A	1A	..	**6A**	..	**9A**	..	2A	**4A**	..	1A	..	..	1A	**3A**	2A	++	1A	**9A**	..	..	2A	..	++	..	..	**3A**	**3A**	..	**3A**	..	..	..	..	..	..
Descurainia pinnata v. *f.*	**4A**	..	..	..	..	..	..	..	2A	..	1A	..	**3A**	1A	1A	..	..	..	1A	..	..	..	..	..	++	..	2A	..	..	..	..	..	..	..	..	..	..
Castilleja flava	..	1A	2A	**7A**	..	..	..	..	2A	..	..	..	..	..	..	..	..	++	..	..	1A	**8A**	2A	..	1A	1A	..	..	..	..	..	..	..	..	..	..	..
Phlox longifolia	**9A**	..	2A	..	..	**5A**	**6A**	..	..	..	**3A**	**6A**	**4A**	1A	**3A**	..	**7A**	++	..	..	1A	**3A**	**4A**	..	**6A**	1A	..	..	..	..	..	..	2A	..	..	..	..
Erodium cicutarium	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	**3A**	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cryptantha ambigua	..	..	..	..	..	..	..	..	..	..	1A	1A	1A	..	..	..	..	++	..	**4A**	..	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..
Poa secunda	**9B**	**9C**	**9D**	**7C**	**9B**	**9B**	**9D**	..	**4A**	**9C**	**8C**	**9C**	**9C**	**9D**	**9B**	**9C**	**9C**	**8C**	**6A**	**9B**	1A	**6A**	**7B**	**4A**	**5A**	**6C**	**4A**	**3A**	**9A**	..	**6A**	**3A**	..	**3A**	**3A**	..	..

Table 3.4 (continued). Summary relevé table for 37 community types.

	33	24	9	18	1	34	4	37	25	36	3	21	5	2	32	12	31	6	14	13	29	28	23	8	27	10	11	30	19	7	20	16	26	17	35	15	22
Hordeum jubatum	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	3A	2A	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Iva axillaris	..	..	..	..	3B	..	..	..	2A	..	..	+A	..	..	3B	3A	..	..	3A	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	..
Arabis sparsiflora	..	..	..	2A	..	3A	..	..	..	..	1A	1A	++	..	..	..	2A	..	..	..	1A	..	..	..	1A	1A	..	..	1A	..	..	..	..	..	..	..	..
Plectritis macrocera	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	3A	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lomatium triternatum v. *p.*	..	..	2A	..	..	1A	3A	..	4A	..	3A	3A	++	..	..	..	2A	5A	..	..	1A	3A	4A	..	3A	..	..	..	1A	..	..	..	..	..	..	..	..
Arabis holboellii v. *r.*	..	4A	2A	..	3A	3A	..	..	..	..	4A	1A	3A	..	..	..	2A	1A	..	4A	..	..	4A	..	4A	2A	..	..	3A	..	3A	..	..	1A	..	..	..
Chrysothamnus visc. ssp.	9B	4A	7A	9A	9D	7A	9D	..	9A	4A	3A	9D	7B	9D	6A	3A	4A	9C	..	9A	9B	9B	7B	..	9D	9C	1A	..	4A	5A	3A	..	4A	..	..	..	3A
Pinus flexilis	..	..	..	2A	..	1A	..	3A	..	9D	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	1A	..	..	..	..	3A	..	..
Cirsium neomexicanum v. *u.*	..	..	..	..	3A	..	..	..	..	..	3A	++	++	..	1A	3A	2A	++	..	4A	..	..	..	..	..	..	..	3A	..	..	..	..	2A	..	..	..	..
Chrysothamnus naus. ssp. A	..	1A	..	4A	6C	..	3A	..	2A	..	1A	2A	++	1A	4C	..	7A	1A	..	..	..	..	2A	..	++	..	1A	..	..	1A	..	..	7C	..	..	..	3A
Artemisia tridentata ssp. v.	9C	..	4A	2A	9B	7A	3A	..	9D	4A	6C	9D	7C	5A	1A	3A	4A	1A	..	4A	9D	9D	9D	..	9D	4C	4A	6A	1A	4A	3A	..	..	1A	..	..	..
Festuca idahoensis	4A	..	3C	4D	..	1C	..	..	..	..	3A	..	2B	1A	..	3A	..	2C	1A	4A	1A	9D	..	..	2B	5C	..	..	..	..	..	..	..	1A	..	..	..
Symphyotrichum falcatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Agoseris glauca v. *d.*	..	..	6A	4A	3A	1A	6A	3A	4A	..	6A	6A	5A	5A	..	..	4A	7A	..	4A	7A	4A	7A	..	5A	8A	..	3A	1A	..	6A	..	..	3A	..	..	..
Sisymbrium altissimum	..	..	..	..	3A	..	..	..	..	..	..	..	..	5A	8C	..	..	+A	1A	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	3A
Danthonia californica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3C	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pinus monophylla	4A	1A	2A	..	..	9D	..	..	2A	..	9D	++	9E	..	..	..	7A	5B	..	4A	1A	6A	..	4B	6C	3A	1A	..	3A	4C	..	..	2A	..	..	..	6A
Comandra umbellata v. *p.*	..	1A	4A	2A	..	1A	3A	..	2A	..	1A	2A	1A	..	..	3A	7A	2A	..	9A	5A	9A	4A	..	7A	3A	..	..	..	..	3A	..	..	..	..	..	..
Hackelia floribunda	..	..	..	..	..	..	..	9A	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	3A	..	..
Cercocarpus ledifolius	4B	..	..	4A	..	9D	..	..	..	4C	1A	..	5C	..	..	..	..	..	..	4A	1A	6A	..	..	++	2C	..	6A	9E	..	3A	..	..	..	..	..	..
Phacelia hastata	4A	..	..	..	..	1A	..	..	..	..	..	++	++	..	..	..	..	4A	..	4A	1A	..	..	..	++	2A	..	..	..	..	3A	..	..	..	..	..	..
Solidago velutina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3A	..	..	..	4A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lomatium nudicaule	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Senecio integerrimus v. *e.*	..	..	1A	2A	..	1A	3A	..	2A	..	..	1A	3A	3A	..	..	7A	1A	..	..	..	3A	4A	..	2A	4A	..	..	3A	..	6A	..	..	..	..	..	..
Poa bulbosa	9C	1A	..	..	6A	3B	3B	..	4C	..	1A	3A	2A	1A	3B	9D	7C	3A	9E	9D	..	..	2A	..	3B	4B	8D	..	..	..	6A	3A	4B	3A	..	..	..
Symphyotrichum ascendens	..	..	..	..	..	..	..	..	2A	4A	..	++	..	..	3A	3A	2A	..	6A	..	..	..	..	..	..	..	2B	..	..	..	..	..	..	..	..	..	3B
Tragopogon dubius	..	..	..	..	6A	..	9A	..	..	..	..	1A	++	7A	8A	..	7A	1A	3A	..	..	..	7A	..	++	..	4A	..	..	1A	..	..	2A	..	..	2A	6A
Balsamorhiza sagittata	9B	4A	2A	2A	..	7A	6B	..	4A	..	3A	4A	7C	1A	..	3A	..	6B	..	9D	7C	9C	4A	4A	8C	7C	1A	9A	8D	4B	6B	..	..	5A	..	..	..
Crepis acuminata	..	1A	..	4A	..	3A	..	..	..	..	..	2A	1A	7A	..	..	..	1A	..	4A	5A	4A	2A	4A	4A	1A	..	..	3A	..	3A	..	..	3A	..	..	..
Elymus lanceolatus	9C	..	1A	..	6C	1A	9B	..	2A	4C	1A	5B	3A	9D	3A	3A	4A	6B	3A	4A	1A	3A	9C	..	3A	4A	4A	6A	1A	2A	3A	3A	7B	3A	..	..	3A
Heuchera cylindrica v. *a.*	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..
Grindelia squarrosa v. *s.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	3A	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hackelia micrantha	..	..	..	..	..	..	..	..	..	4A	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..
Erysimum asperum	..	1A	1A	..	..	3A	3A	..	2A	4A	1A	..	++	..	..	..	..	4A	..	..	7A	3A	2A	..	3A	4A	..	..	4A	1A	..	..	..	..	..	..	..
Lithospermum ruderale	..	1A	..	..	..	..	6A	..	..	..	..	4A	1A	..	..	..	4A	3A	..	..	..	..	4A	..	4A	1A	..	..	1A	1A	..	..	2A	1A	..	..	..
Collinsia parviflora	4A	..	1A	2A	3A	5A	3A	6A	4A	9A	8A	7A	6A	..	..	..	2A	7A	1A	..	7A	4A	4A	..	5A	3A	4A	3A	6A	4A	6A	..	2A	9A	6A	..	..
Danthonia unispicata	..	1A	..	..	..	3A	..	..	..	..	..	..	1A	1A	..	6D	4A	..	4B	..	..	..	2A	..	1A	1A	2C	..	1A	..	3A	..	2A	..	..	..	..
Artemisia tridentata ssp. tr.	..	..	..	..	..	1A	6D	..	..	..	1A	2A	2A	..	..	3A	..	9E	..	..	..	..	4C	..	+A	4C	..	..	..	1A	..	..	7D	1A	..	..	..
Myosotis stricta	..	..	..	..	..	..	..	..	..	..	1A	1A	1A	..	..	3A	..	++	1A	..	..	..	..	..	++	..	1A	..	..	..	..	..	2A	..	..	2A	..
Astragalus convallarius	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..
Delphinium depauperatum	..	..	..	..	..	5A	3A	..	..	..	1A	3A	3A	..	..	..	..	7A	..	..	1A	4A	..	..	4A	8A	1A	3A	1A	1A	3A	..	..	1A	..	..	..
Hackelia patens	4A	1A	..	..	..	5A	3A	..	2A	..	3A	1A	3A	..	..	..	..	2A	..	4A	3A	..	4A	..	6A	4A	..	..	8B	2A	3A	..	..	1A	..	..	..
Bromus commutatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	3A	..	..	3A	..	..	..	2A	..	..	..	1A	..	..	..	..	..	..	..	..	..	..

Table 3.4 (continued). Summary relevé table for 37 community types.

	33	24	9	18	1	34	4	37	25	36	3	21	5	2	32	12	31	6	14	13	29	28	23	8	27	10	11	30	19	7	20	16	26	17	35	15	22
Eriogonum heracleoides	..	..	1A	..	..	1A	3A	..	2A	..	..	3A	1A	..	..	3A	4A	1A	..	4A	5A	9A	2A	..	4A	3A	..	3A	1A	..	6A	..	..	1A	..	..	..
Crepis intermedia	..	..	2A	2A	..	1A	..	..	..	..	1A	..	++	..	..	..	..	..	..	..	1A	3A	..	..	1A	..	..	..	3A	2A	3A	..	..	..	3A	..	..
Machaeranthera canescens	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Polygonum douglasii v. *l.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lupinus argenteus v. *a.*	..	1A	3A	2A	..	..	6A	..	4A	4A	1A	8B	4A	1B	..	6A	7A	7A	..	9A	9B	8A	7B	..	8A	8B	1A	6A	1A	2A	6A	..	7A	9A	..	..	..
Leucopoa kingii	4A	..	..	..	..	..	3A	..	2B	4A	1A	..	+A	1A	1A	..	2A	++	..	..	7D	..	..	..	..	3A	..	3A	3A	1A	3B	..	..	1A	..	..	..
Achnatherum nelsonii	..	..	..	..	..	1A	3B	..	..	..	3A	..	3A	..	..	..	4C	2A	..	9C	..	1A	4C	..	5D	..	..	9C	1B	..	3C	..	2A	..	..	..	..
Symphoricarpos oreophilus	4A	..	3A	4A	..	7C	6A	6B	2B	9B	1A	4B	6A	9A	1A	3A	..	6B	1A	9B	9B	9C	7C	..	9D	9E	1A	9C	9D	5B	9D	..	4A	9D	6A	..	6B
Collomia linearis	..	..	..	..	..	1A	3A	..	..	..	..	4A	++	..	..	..	2A	3A	..	4A	5A	1A	7A	4A	4A	2A	..	..	..	..	..	..	2A	1A	..	..	3A
Ribes viscosissimum	..	..	..	..	..	..	..	9C	..	..	..	..	++	..	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	1A	3A	..	..
Amelanchier alnifolia	4A	..	2A	2A	..	1A	..	6A	2B	..	..	..	++	..	..	3A	..	1A	1A	..	..	3A	2C	4A	2A	1A	..	3A	3A	1A	..	..	..	9A	3A	..	..
Packera streptanthifolia	..	..	1A	..	..	1A	..	..	2A	4A	..	..	+A	..	..	..	2A	..	..	..	3A	1A	2A	..	1A	4A	..	..	3A	..	..	..	..	1A	..	..	..
Lepidium perfoliatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	1A	..	..	..	2A	..	..	..	1A	..	..	..	..	..	..	..	..	..	..
Penstemon rydbergii	..	..	..	..	..	..	..	..	..	..	..	++	..	..	..	..	..	++	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..
Mertensia oblongifolia	..	1A	2A	4A	..	1A	..	..	4B	4C	..	..	1A	3A	..	..	..	4A	..	..	3A	8A	4A	..	7A	3A	1A	3A	6B	2A	6B	..	..	5A	3B	..	..
Fritillaria atropurpurea	..	..	1A	2A	..	..	3A	..	..	..	..	..	++	..	..	..	..	2A	..	..	5A	6A	..	..	1A	3A	..	..	3A	..	3A	..	..	3A	..	..	..
Arnica cordifolia	..	..	..	..	..	..	..	3A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3A	..	..
Allium brandegeei	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3A
Leymus cinereus	..	..	..	..	..	3A	..	..	4A	4A	..	2A	++	1A	1A	..	..	4C	1A	9D	5D	..	4A	4A	4B	8C	..	3A	3C	2A	6A	..	2A	..	3A	..	3A
Hieracium cynoglossoides	..	..	..	..	..	..	3A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	3A	..	..	..	..	..	..	..	..	..	..	..
Lupinus leucophyllus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..
Artemisia ludoviciana v. *i.*	..	..	..	..	..	1A	..	..	2A	..	..	1A	..	..	4A	6A	2A	1A	3A	4A	1A	..	2A	4A	..	2A	2A	..	..	5A	3A	..	2A	..	..	..	6A
Schoenocrambe linifolia	..	..	..	..	..	..	..	..	2A	..	..	..	..	1A	..	..	..	..	..	4A	1A	..	2A	..	1A	3A	..	..	..	..	3A	..	..	..	..	..	..
Viola purpurea	..	..	..	..	..	1A	..	9A	2A	9A	..	++	2A	..	..	..	..	3A	..	4A	9A	..	2A	..	5A	6A	1A	9A	9A	5A	6A	..	..	..	3A	..	..
Achillea millefolium v. *o.*	..	..	1A	2A	3A	3A	..	3A	..	4A	..	2A	1A	..	3A	3A	7A	2A	6A	..	1A	4A	4A	4A	6A	5A	9A	..	3A	5A	3A	6A	9A	3A	..	..	9A
Arabis hirsuta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	..	..
Descurainia californica	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	1A	..	..	..	2A	..	..	..	..
Ribes cereum v. *pedic.*	..	..	..	..	..	5A	..	..	..	4A	..	..	1A	..	..	..	..	++	..	..	5A	1A	2A	..	2A	4B	..	3A	6B	..	..	3A	2A	..	6B	..	3A
Lactuca serriola	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	3A	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	1A	..	..	2A	..	..	..	3A
Taraxacum officinale	..	..	1A	2A	9A	..	3A	3A	..	..	..	2A	1A	3A	3A	..	4A	3A	6A	..	1A	3A	7A	4A	5A	3A	9B	..	1A	8B	..	3A	9A	5A	6A	4A	9A
Holodiscus dumosus	..	..	..	..	..	..	..	..	..	4A	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3A	..	..	..	..	..	3B	..	..
Carex rossii	..	..	..	..	..	..	..	6A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	1A	..	..	3A	..	3A	..	..	1A	..	..	..
Microseris nutans	..	..	..	..	3A	..	..	..	..	..	1A	1A	..	..	..	6A	2A	..	3A	..	..	3A	4A	..	3A	1A	4A	..	1A	..	3A	..	2A	5A	..	..	3A
Mahonia repens	..	..	..	..	..	3A	..	6A	..	4A	..	++	2A	..	..	3A	..	1A	..	4A	3B	4A	2A	9C	1A	6B	1A	9A	4B	8C	6A	..	2A	5B	9D	..	..
Lithophragma parviflorum	..	..	..	..	..	1A	3A	3A	2A	..	..	++	++	..	..	..	..	++	..	..	..	..	..	..	++	4A	1A	..	4A	2A	..	..	2A	3A	..	..	6A
Delphinium nuttallianum	..	..	..	2A	..	..	..	..	..	..	..	++	..	..	1A	..	..	..	..	..	5A	3A	2A	..	1A	1A	..	..	1A	1A	..	..	2A	5A	..	..	3A
Viola vallicola v. *major*	..	..	1A	..	..	..	..	3A	..	..	..	..	..	..	..	..	..	2A	..	..	..	..	2A	..	1A	3A	..	..	1A	2A	..	..	2A	3A	..	..	3A
Camelina microcarpa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	1A	..	..	..	2A	..	..	..	2A	..	..	..	..	..	..	..	..	..	3A
Carex vallicola	..	..	..	..	..	..	..	..	2C	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	1A	2A	..	..	..	..	3A	..	..	1A	..	..	..
Juniperus scopulorum	..	..	..	..	..	1A	..	..	..	4A	..	..	3A	..	..	..	2A	1A	..	..	..	3A	4A	9E	2C	..	..	..	..	8C	..	3A	4D	1A	9B	..	6A
Paeonia brownii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	++	2A	..	..	..	..	..	..	..	..	..	..	..
Pseudotsuga menziesii v. *g.*	..	..	..	..	..	..	..	3A	..	4C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	9E	..	..
Poa pratensis	..	..	..	..	3A	..	3A	..	..	..	..	1A	..	1A	3A	..	7D	2A	8C	..	1A	1A	9D	4A	6C	3A	9E	..	..	9D	3B	6D	9E	7D	..	7C	9E

Table 3.4 (continued). Summary relevé table for 37 community types.

	33	24	9	18	1	34	4	37	25	36	3	21	5	2	32	12	31	6	14	13	29	28	23	8	27	10	11	30	19	7	20	16	26	17	35	15	22
Helianthella uniflora	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	3A	..	4A	..	3B	1A	3A	..	1C	3A	..	..	..	..	..	..
Juncus balticus var.	..	..	..	..	..	..	..	..	..	..	..	++	..	..	1A	6A	..	..	6C	..	..	..	..	..	..	..	8D	..	..	..	..	6B	2A	..	..	9D	..
Astragalus agrestis	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	..	..	..
Artemisia dracunculus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	2A	..	..	..	..
Osmorhiza depauperata	..	..	..	..	..	..	..	9A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	3A	..	2A	3A	3B	..	3A
Rorippa curvisiliqua	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	1A	..	..	..	..	3A	..	..	..	..	..
Potentilla gracilis v. *pul.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	3A	..	..	..	..	..	..	..	8C	..	..	..	..	..	..	..	..	4A	..
Melica bulbosa	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..	4A	1A	..	2B	..	5A	7C	1A	..	1A	2A	3A	..	2A	3A	..	..	..
Claytonia perfoliata	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	4A	..	..	1A	..	1A	2A	..	..	..	..	6A	..	..
Stellaria jamesiana	..	..	..	..	..	..	..	6A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	..	1A	..	..	1A	..	..	2A	..	6A	2A	..
Arnica sororia	..	..	..	..	..	..	..	..	..	..	..	..	++	..	1A	..	..	..	..	..	..	..	..	..	..	..	4C	..	1A	..	..	..	..	..	..	4C	..
Geranium viscosissimum v.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+A	..	..	3A	..	..	..	1B	3A	..	..	..	4A	..	..	2A	1A	..	..	..
Cirsium vulgare	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3A	..	..	++	1A	..	..	..	..	..	..	..	..	..	..	..	..	3A	2A	..	..	4A	3A
Aster ascendens	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3A	..	..	..	..	..	++	..	4A	..	..	..	..	..	..	1A	..	..	3A
Prunus virginiana v. *m.*	..	..	..	..	..	..	..	..	..	4C	..	..	..	..	..	..	..	..	..	9B	5A	1A	..	4A	..	3A	..	9C	3A	2A	9E	..	2B	..	9C	..	..
Mertensia ciliata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	1C	..	..	4A	..	2A	..	3A	1A	2A	..	..	..	..	3A	..	..
Ceanothus velutinus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4D	..	..	..	..	..	1A	..	9E	..	..	3A	..	..	..	..	..	..
Apocynum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	..	..	..	..	1A	..	..	..	..	..	..	..
Chorispora tenella	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..
Equisetum arvense	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..
Polygonum bistortoides	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	..	..	..	..
Nemophila breviflora	..	..	..	..	..	1A	3A	..	..	..	..	..	++	..	..	..	..	..	..	4A	1A	..	..	9A	2A	6A	..	..	..	8A	3A	..	2A	9B	3B	..	6A
Agastache urticifolia	..	..	..	..	..	..	..	3A	2A	..	..	..	..	..	..	..	..	..	..	4A	5A	..	..	4A	1A	4A	1A	6A	..	5A	6B	..	2A	7B	6A	..	3A
Rumex crispus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	4A	..	..	..	..	..	..	..	1A	..	..	..	..	3A	..	..	..	7A	3A
Eucephalus elegans	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3A	1A	..	4A	..	4A	..	3A	3A	1A	..	..	..	5A	3A	..	..
Smilacina racemosa	..	..	..	..	..	..	..	6A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	..	..	..	..	4C	3A	..	..	5A	6C	..	..
Populus tremuloides	..	..	..	..	..	..	..	9B	..	4A	..	..	..	..	..	..	..	..	..	..	..	..	..	9D	..	..	1C	3B	..	9D	6D	..	2A	9E	..	..	9E
Heracleum maximum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	..	..	..	..	2B	..	..	..	..	..	..	..
Rosa woodsii v. *ul.*	..	..	..	..	..	..	..	..	..	..	..	++	..	..	1A	3A	..	..	3A	..	..	..	2A	..	++	3A	2A	..	..	1A	..	9C	9B	..	..	7A	6A
Thalictrum fendleri	..	..	..	..	..	..	..	6A	..	4A	..	..	..	..	..	..	..	..	..	..	..	..	..	9A	..	..	1A	..	1A	9D	3A	..	4A	9C	6B	..	..
Frasera speciosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	++	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	5A	..	..	..
Geum macrophyllum v. *pe.*	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	..	..	..	..	1A	..	9A	..	..	..	4A	..
Ribes aureum	..	..	..	..	..	..	..	..	2B	..	..	..	..	..	..	..	2A	..	..	..	..	1A	2A	..	..	..	..	..	..	..	3A	6C	4B	..	..	2A	6A
Salix scouleriana	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	..	..	..	..	1A	..	3C	..	..	..	..	..
Senecio serra	..	..	..	..	..	..	..	3A	..	..	..	..	..	..	..	..	..	++	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	5B	6A	..	..
Delphinium occidentale	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	1B	2A	2A	..	..	1A	..	..	..	5A	3A	..	..
Galium aparine	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	..	5A	..	3A	..	..	6A	..	6A
Iris missouriensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	2A	..	3A	..	..	..	..	..	..	2A	7B	..	..	..	..	3A	7A	1A	..	9D	3A
Arabis glabra	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	1A	1A	..	..	1A	..	3A	2A	..	..	..	..
Cystopteris fragilis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9A	++	..	..	..	4A	2A	..	..	..	..	6A	..	..
Hydrophyllum capitatum v.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	2A	4A	++	2A	1A	3A	1A	5A	3A	..	..	7A	3A	..	3A
Cornus sericea	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4A	..	..	..	..	..	2C	..	..	2C	..	..	..	..
Cirsium arvense	..	..	..	..	..	..	..	3A	..	..	..	++	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	5B	..	6A	4B	1A	..	4A	6A

Table 3.4 (continued). Summary relevé table for 37 community types.

	33	24	9	18	1	34	4	37	25	36	3	21	5	2	32	12	31	6	14	13	29	28	23	8	27	10	11	30	19	7	20	16	26	17	35	15	22
Elymus glaucus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	**9A**	..	**3A**	1A	**3A**	1A	**4A**	**3A**	**3A**	2B	**7A**	**3A**	..	**3A**
Viola adunca var. adunca	..	..	..	..	..	..	..	**3A**	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**4A**	..	..	..	..	..	1A	..	**3A**	2A	1A	..	**4A**	**3A**
Poa bolanderi	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	1A	..	..	..
Bromus carinatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	1A	..	..	..	**5A**	..	..	..	1A	**3A**	..	**3A**
Wyethia amplexicaulis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	1A	..	..	..
Osmorhiza occidentalis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**4A**	..	..	1A	..	1A	**8D**	**3D**	**3A**	**4A**	1A	**6C**	..	..
Stellaria longipes	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	**7A**	..
Maianthemum stellatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**9A**	..	..	..	..	..	**8B**	..	**6B**	**4B**	**3A**	..	**4A**	..
Urtica dioica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**4A**	..	..	..	..	..	**4A**	..	**9B**	..	1A	**3A**	..	..
Carex douglasii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1B	..	..	..	**3A**	..	**4A**	..	..	..	..
Stellaria crispa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	2A	..	..	..	..
Verbascum thapsus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	**3A**	2A	1A	..	..	**6A**
Acer glabrum v. *d.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**4A**	..	..	..	..	..	**5C**	..	..	..	..	**9D**	..	..
Osmorhiza berteroi	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**4A**	..	..	..	..	..	..	..	..	2A	..	..	..	**3A**
Aquilegia formosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**4A**	..	**3A**	2A	1A	..	..	..
Carex nebrascensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	++	..	**4B**	..	..	..	..	**6B**	..	..	..	**9E**	**3A**
Phleum pratense	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	..	..	2A	..	..	**4C**	..
Alnus incana ssp. rug.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1B	..	**3C**	..	1C	..	..	..
Actaea rubra	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	1A	..	..	..
Carex multicostata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	1A	..	..	..
Eleocharis palustris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	..	..	..	..	..
Mentha arvensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	..	..	..	..	..
Medicago lupulina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	..	..	..	..	..
Plantago major	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	..	..	..	..	..
Trifolium repens	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	..	..	..	..	..
Veronica americana	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	..	..	..	..	..
Valeriana acutiloba v. *pub.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	1A	..	**3A**	..	**7C**	**3A**	..	..
Aconitum columbianum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	**3A**	..	..	..	..	**3A**
Salix lasiandra	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**6C**	2B	..	..	..	..
Ribes setosum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**4A**	..	..	..	..	..	1A	..	**6C**	**4A**	..	**3A**	**4A**	**3A**
Veratrum californicum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**4C**	..	**3B**	2A	1A	..	**4C**	**3A**
Carex hoodii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	..
Glyceria striata v. *s.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	2A	..
Populus alba	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2C	..	..	..	..
Carex microptera	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	2A	1A	..	2A	..
Salix exigua ssp. e.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**6D**	..	..	..	2A	..
Dactylis glomerata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	..	**3A**
Salix lutea	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3C**	**4C**	..	..	2C	..
Salix boothii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**9D**	..	..	..	**4C**	..
Alopecurus aequalis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	..	..	..	2A	..
Carex praegracilis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	..	..	..	2A	..
Galium bifolium	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..
Galium triflorum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	..	..	..	2A	..

Table 3.4 (continued). Summary relevé table for 37 community types.

	33	24	9	18	1	34	4	37	25	36	3	21	5	2	32	12	31	6	14	13	29	28	23	8	27	10	11	30	19	7	20	16	26	17	35	15	22
Rudbeckia occidentalis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..
Salix geyeriana	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3C**	..	..	..	2D	..
Senecio pseudaureus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	..	..	..	2A	..
Mimulus guttatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1A	..	..	..	..	..	**4A**	..
Trifolium pratense	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**	2A	..	..	2A	**3A**
Veronica serpyllifolia var. h.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	2A	..
Maianthemum racemosum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3C**	..	..
Sambucus racemosa v. *r.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3C**	..	..
Arctium minus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..	..	..	**6A**
Barbarea orthoceras	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..
Cardamine pensylvanica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..
Epilobium ciliatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**7A**	..
Juncus ensifolius v. *b.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2B	..
Montia linearis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..
Ranunculus macounii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2A	..
Thermopsis rhombifolia	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**4C**	..
Claytonia lanceolata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**
Rorippa nasturtium-	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	**3A**

[1]Lower constancy species not included in table were: *Achnatherum nevadense*, *Antennaria parvifolia*, *Antennaria stenophylla*, *Arabis lignifera*, *Arabis microphylla*, *Atriplex spinosa*, *Bromus inermis*, *Caulanthus crassicaulis*, *Castilleja miniata*, *Carduus nutans*, *Carex petasata*, *Castilleja tenuis*, *Chenopodium album*, *Cryptantha watsonii*, *Descurainia sophia*, *Draba nemorosa*, *Equisetum laevigatum*, *Erigeron divergens*, *Gayophytum decipiens*, *Gayophytum diffusum*, *Hordeum brachyantherum*, *Krascheninnikovia lanata*, *Lepidium campestre*, *Lithophragma glabrum*, *Mentzelia albicaulis*, *Microsteris humilis*, *Montia perfoliata*, *Muhlenbergia richardsonis*, *Oenothera caespitosa* var. *marginata*, *Packera pseudaurea*, *Potentilla arguta*, *Polygonum douglasii* var. *douglasii*, *Potentilla glandulosa* var. *intermedia*, *Pteridium aquilinum*, *Ranunculus andersonii*, *Salix bebbiana*, *Sambucus cerulea*, *Stephanomeria minor* var. *myrioclada*, and *Trifolium gymnocarpon*

[2]For each cell in the body of the table, constancy is indicated by the first symbol, while cover is indicated by the second symbol. For constancy: 0% = ".", 0-10% = +, 10-20% = 1, 20-30% = 2, 30-40% = 3, 40-50% = 4, 50-60% = 5, 60-70% = 6, 70-80% = 7, 80-90% 8, 90-100% = 9. For cover: 0% = ".", 0-0.01% = +, 0.01-1% = A, 1-2% = B, 2-5% = C, 5-25% = D, >25% = E.

Step 4: Classification selection, refinement, and crosswalk to the NVC

The vegetation classes resulting from both the 15 cluster and 37 cluster classifications were compared to the hierarchical framework of vegetation classification described within the National Vegetation Classification Standard (NVCS; FGDC 2008) and to vegetation types currently described and archived in the National Vegetation Classification (NVC; NatureServe 2010) database. Vegetation classes resulting from the 37 cluster classification were more readily interpreted within the NVCS framework than classes resulting from the 15 cluster classification. This is likely a consequence of the 37 cluster classification being favored by indicator species evaluators and the floristic levels of the NVC being defined largely by characteristic species that are unique to each class within the lower levels of the hierarchy. We were therefore able to crosswalk the classes resulting from the 37 cluster classification to classes represented in the NVC, mostly at the Association level, in a very straightforward manner. Because the 15 cluster classification would require substantial refinement to yield Association-level classes and because each of the classes resulting from the 37 cluster classification represented unique, primarily Association-level vegetation types, we describe the 37 cluster classification here.

We considered refining several of the clusters to ensure that classes with all potential overstory/understory combinations were identified and represented to the extent possible with the given data set. Sample sizes were too small to justify splitting most of these clusters since subsequent divisions resulted in classes having inadequate data to support the quantitative class descriptions recommended by the FGDC (2008). Cluster 5 did have an adequate sample size and the highest beta diversity score, making it a suitable candidate for further refinement. Using the pruning analysis described in Step 2, we identified the optimal number of clusters within cluster 5 and ran the flexible $\beta = -0.25$ algorithm. The refinement of cluster 5 resulted in two subclasses, one with a sample size of two and the other with a sample size of 11. Since both clusters would have been assigned the same NVC name based on constancy and cover values, they likely represented variation within one Association. Consequently, the resulting subclasses were not considered to be unique and were not retained in the final class list. We did not pursue refining additional clusters because our attempt at refining cluster 5, the cluster with the greatest sample size, species richness, and beta diversity score, did not yield unique vegetation types.

We compiled a list of plant communities for CIRO based on the 37 cluster classification (Table 4.1). Plant communities were named according to the conventions outlined by the FGDC (2008). Constancy and mean cover were used as criteria to determine nominal taxa for each cluster or class. Generally, the species with the highest constancy and mean cover values were coincident within each cluster and only species having 100% constancy and mean cover within the top three or four ranks were used in the class name. A handful of classes contained species having high mean cover values, but less than 100% constancy. When mean cover values of these species indicated that they were likely co-dominants in the plant community, meaning cover values of these species approached or exceeded cover values of the next most dominant species having 100% constancy, we included these species in the class name. With the exception of one class, all species added to a class name under this set of circumstances were present in all but one plot in each of the respective clusters.

The resulting classes were compared with analogous NVC classes – usually at the Association level (NatureServe 2010). When the constancy and mean cover values for a class corresponded to a plant community currently described within the NVC, the name of that class was modified to match the name of the NVC class, if necessary. For classes that were not represented in NatureServe (2010) at the time of the report, we referred to the PLANTS National Database (USDA, NRCS 2010) as the taxonomic standard for species' names as they appear in the class list. We then crosswalked the classes to appropriate Alliances and Ecological Systems (Table 4.2). For Associations that occur in multiple ecological systems, we chose the most geographically appropriate System. Only one Ecological System, with an inappropriate geographic distribution, was identified in the NVC for a few of the Associations. Ecological Systems with inappropriate geographic distributions were included in the crosswalk only when more appropriate Systems had not previously been identified for a given Association.

Thirty-five of the thirty-seven plant communities identified using this data set were classified at the Association level; two were classified at the Alliance level. Of the two Alliance-level classes, the *Pinus flexilis* Woodland Alliance was identified as such because there were not enough data available to adequately characterize the understory and assign the plant community to an appropriate Association. The *Bromus tectorum* Semi-natural Herbaceous Alliance was not assigned an Association-level class because the NVC had not described Associations within this Alliance.

Twenty-five of the thirty-seven plant communities resulting from this classification were represented in the NVC at the time the class list was compiled (NatureServe 2010). Eleven classes were not listed in the NVC at the Association level, but were described within the range of variation of an appropriate NVC Alliance. Several of the Associations which had not been described below the Alliance level by the NVC were recognized at other park units within the Upper Columbia Basin Network. For example, a class typified by the co-dominance of green rabbitbrush (*Chrysothamnus viscidiflorus*) and crested wheatgrass (*Agropyron cristatum* or *A. desertorum*) had been described for Craters of the Moon National Monument and Preserve (Rust and Wolken 2008). Many of the Associations not previously described in the NVC were also typified by the dominance of *Poa pratensis* and/or *Poa bulbosa* in the herbaceous layer; plant communities characterized by the abundance of the species had not yet received much attention in the NCV (2010). Only one class, strongly dominated by *Poa bulbosa*, was not previously described as an Association or an Alliance by the NVC. Regardless of NCV status, variations of most of the plant communities identified by this classification process had been described in a previous classification effort at CIRO (Sanders et al. 1996).

Of the 25 plant communities for which an appropriate NVC class had been previously described, many fit the NVC description well, while others deviated somewhat from the standard description. Deviations generally occurred as a result of a given class occurring outside of the previously described geographic range, with less canopy cover than previously described, or with different shrub to herbaceous ratios than suggested by the NVC description. Of note, are *Ceanothus velutinus* Shrubland and *Pseudoroegneria spicata* - *Festuca idahoensis* Canyon Herbaceous Vegetation, which had either not been previously described in Idaho or within the region of Idaho where CIRO is located. Three forest classes, *Populus tremuloides* / *Thalictrum fendleri* Forest, *Populus tremuloides* / *Symphoricarpos oreophilus* / *Thalictrum fendleri* Forest, and *Pseudotsuga menziesii* / *Acer glabrum* Forest all had an average of less than 60% canopy cover, which would place them in woodland rather than forest classes. However, the plant community composition of these classes fit the NVC descriptions of the forest types well enough to justify identifying them as the corresponding NVC-described forest class. The *Artemisia tridentata* ssp. *vaseyana* / *Pseudoroegneria spicata* Shrubland class generally had slightly higher mean herbaceous cover than customary for a shrubland class and the *Purshia tridentata* / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation class had lower mean herbaceous cover than expected in a shrub herbaceous class; however, the species composition of these classes fit the respective NVC descriptions well and were named accordingly. Finally, the subspecies of *Artemisia tridentata* was not identified in the name of the *Artemisia tridentata* / *Chrysothamnus viscidiflorus* / *Poa secunda* Shrubland class as it appeared in the NatureServe (2010) database. In an effort to remain consistent with Natureserve (2010) we used the same name. Both the NVC description for this class and the summary data for this class at CIRO indicate that the appropriate taxon is *Artemisia tridentata* ssp. *tridentata*.

Table 4.1. Plant community class list for City of Rocks National Reserve. Within each physiognomic group, classes are listed in alphabetic order by National Vegetation Classification (NCV) scientific name. A colloquial name, the code used to denote the plant community in the dichotomous key, the NVC element code, the number of the classification cluster corresponding to the class, and the number of plots in the cluster are also included.

Scientific Name	Common Name	Key Code	NVC Code	Cluster #	N
	Forest and Woodland				
Abies lasiocarpa / Sparse Woodland	Subalpine fir / Sparse Woodland	ABLA / Sparse	N/A	37	3
Cercocarpus ledifolius / *Symphoricarpos oreophilus* Woodland	Curl-leaf Mountain-mahogany / Mountain Snowberry Woodland	CELE / SYOR	CEGL000970	19	6
Juniperus scopulorum - *Populus tremuloides* Woodland	Rocky Mountain Juniper - Quaking Aspen Woodland	JUSC - POTR	N/A	8	2
Pinus flexilis Woodland Alliance	Limber Pine Woodland Alliance	PIFL	A.540	36	2
Pinus monophylla - *Juniperus osteosperma* / Sparse Understory Woodland	Singleleaf Pinyon - Utah Juniper / Sparse Understory Woodland	PIMO - JUOS / Sparse	CEGL000829	3	6
Pinus monophylla / *Cercocarpus ledifolius* Woodland	Singleleaf Pinyon / Curl-leaf Mountain-mahogany Woodland	PIMO / CELE	CEGL000828	34	5
Pinus monophylla Woodland	Singleleaf Pinyon Woodland	PIMO	CEGL000825	5	13
Populus tremuloides / *Poa pratensis* Forest	Quaking Aspen / Kentucky Bluegrass Forest	POTR / POPR	N/A	22	3
Populus tremuloides / *Symphoricarpos oreophilus* / *Thalictrum fendleri* Forest	Quaking Aspen / Mountain Snowberry / Fendler's Meadowrue Forest	POTR / SYOR / THFE	CEGL000616	17	5
Populus tremuloides / *Thalictrum fendleri* Forest	Quaking Aspen / Fendler's Meadowrue Forest	POTR / THFE	CEGL000619	7	7
Pseudotsuga menziesii / *Acer glabrum* Forest	Douglas-fir / Rocky Mountain Maple Forest	PSME / ACGL	CEGL000418	35	3
	Shrubland and Shrub Herbaceous Vegetation				
Artemisia arbuscula / *Poa bulbosa* Shrub Herbaceous Vegetation	Dwarf Sagebrush / Bulbous Bluegrass Shrub Herbaceous Vegetation	ARAR / POBU	N/A	12	3
Artemisia arbuscula / *Poa secunda* Shrub Herbaceous Vegetation	Dwarf Sagebrush / Curly Bluegrass Shrub Herbaceous Vegetation	ARAR / POSE	CEGL001411	9	8
Artemisia nova / *Pseudoroegneria spicata* Shrubland	Black Sagebrush / Bluebunch Wheatgrass Shrubland	ARNO / PSSP	CEGL001424	24	6

Table 4.1 (continued). Plant community class list for City of Rocks National Reserve.

Scientific Name	Common Name	Key Code	NVC Code	Cluster #	N
Artemisia tridentata / *Chrysothamnus viscidiflorus* / *Poa secunda* Shrubland	Basin Big Sagebrush / Green Rabbitbrush / Curly Bluegrass Shrubland	ARTR / CHVI / POSE	CEGL000999	4	3
Artemisia tridentata ssp. *tridentata* / *Poa pratensis* Shrub Herbaceous Vegetation	Basin Big Sagebrush / Kentucky Bluegrass Shrub Herbaceous Vegetation	ARTRT / POPR	N/A	26	4
Artemisia tridentata ssp. *tridentata* / *Poa secunda* Shrubland	Basin Big Sagebrush / Curly Bluegrass Shrubland	ARTRT / POSE	CEGL001008	6	10
Artemisia tridentata ssp. *vaseyana* - *Purshia tridentata* / *Elymus lanceolatus* Shrubland	Mountain Big Sagebrush - Antelope Bitterbrush - Streambank Wheatgrass Shrubland	ARTRV - PUTR / ELLA	N/A	33	2
Artemisia tridentata ssp. *vaseyana* - *Purshia tridentata* / *Poa secunda* Shrubland	Mountain Big Sagebrush - Antelope Bitterbrush - Curly Bluegrass Shrubland	ARTRV - PUTR / POSE	N/A	21	11
Artemisia tridentata ssp. *vaseyana* - *Symphoricarpos oreophilus* Shrubland	Mountain Big Sagebrush - Mountain Snowberry Shrubland	ARTRV - SYOR	N/A	27	10
Artemisia tridentata ssp. *vaseyana* / *Festuca idahoensis* Shrub Herbaceous Vegetation	Mountain Big Sagebrush / Idaho Fescue Shrub Herbaceous Vegetation	ARTRV / FEID	CEGL001533	28	6
Artemisia tridentata ssp. *vaseyana / Leucopoa kingii* Shrubland	Mountain Big Sagebrush / Spike Fescue Shrubland	ARTRV / LEKI	CEGL001025	29	5
Artemisia tridentata ssp. *vaseyana* / *Poa pratensis* Sagebrush Shrubland	Mountain Big Sagebrush / Kentucky Bluegrass Sagebrush Shrubland	ARTRV / POPR	CEGL002528	23	4
Artemisia tridentata ssp. *vaseyana* / *Pseudoroegneria spicata* Shrubland	Mountain Big Sagebrush / Bluebunch Wheatgrass Shrubland	ARTRV / PSSP	CEGL001030	25	4
Ceanothus velutinus Shrubland	Tobacco-brush Shrubland	CEVE	CEGL002167	30	3
Chrysothamnus viscidiflorus / *Agropyron desertorum* Shrub Herbaceous Vegetation	Green Rabbitbrush / Crested Wheatgrass Shrub Herbaceous Vegetation	CHVI / AGDE	N/A	1	3
Chrysothamnus viscidiflorus / *Elymus lanceolatus* - *Poa secunda* Shrub Herbaceous Vegetation	Green Rabbitbrush / Streambank Wheatgrass - Curly Bluegrass Shrub Herbaceous Vegetation	CHVI / ELLA - POSE	N/A	2	5
Prunus virginiana - (*Prunus americana*) Shrubland	Chokecherry - (American Plum) Shrubland	PRVI	CEGL001108	20	3
Purshia tridentata / Pseudoroegneria spicata Shrub Herbaceous Vegetation	Antelope Bitterbrush / Bluebunch Wheatgrass Shrub Herbaceous Vegetation	PUTR / PSSP	CEGL001495	31	4
Salix boothii / Mesic Forbs Shrubland	Booth's Willow / Mesic Forbs Shrubland	SABO / Mesic Forbs	CEGL001180	16	3

Table 4.1 (continued). Plant community class list for City of Rocks National Reserve.

Scientific Name	Common Name	Key Code	NVC Code	Cluster #	N
Symphoricarpos oreophilus Shrubland	Mountain Snowberry Shrubland	SYOR	CEGL002951	10	9
	Herbaceous Vegetation				
Bromus tectorum Semi-natural Herbaceous Alliance	Cheatgrass Semi-natural Herbaceous Alliance	BRTE	A.1814	32	6
Carex nebrascensis Herbaceous Vegetation	Nebraska Sedge Herbaceous Vegetation	CANE	CEGL001813	15	4
Poa bulbosa Herbaceous Vegetation	Bulbous Bluegrass Herbaceous Vegetation	POBU	N/A	14	6
Poa pratensis - Juncus balticus Semi-natural Herbaceous Vegetation	Kentucky Bluegrass - Baltic Rush Herbaceous Vegetation	POPR - JUBA	N/A	11	7
Pseudoroegneria spicata - Balsamorhiza sagittata - Poa secunda Herbaceous Vegetation	Bluebunch Wheatgrass - Arrowleaf Balsamroot - Curly Bluegrass Herbaceous Vegetation	PSSP - BASA - POSE	CEGL001662	13	2
Pseudoroegneria spicata - Festuca idahoensis Canyon Herbaceous Vegetation	Bluebunch Wheatgrass - Idaho Fescue Canyon Herbaceous Vegetation	PSSP - FEID	CEGL001669	18	4

Table 4.2. Crosswalk of plant community classes to National Vegetation Classification Alliances and Ecological Systems.

Scientific Name	Common Name	Key Code	NVC Code	Cluster #	N
		Forest and Woodland			
Abies lasiocarpa / Sparse Woodland	N/A	*Abies lasiocarpa* Woodland Alliance	A.559	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	CES306.828
Cercocarpus ledifolius / *Symphoricarpos oreophilus* Woodland	CEGL000970	*Cercocarpus ledifolius* Woodland Alliance	A.586	Inter-Mountain Basins Curl-leaf Mountain-mahogany Woodland and Shrubland	CES304.772
Juniperus scopulorum - *Populus tremuloides* Woodland	N/A	*Juniperus scopulorum* Woodland Alliance	A.506	Rocky Mountain Foothill Limber Pine-Juniper Woodland	CES306.955
N/A	N/A	*Pinus flexilis* Woodland Alliance	A.540	Rocky Mountain Foothill Limber Pine-Juniper Woodland	CES306.955
Pinus monophylla - *Juniperus osteosperma* / Sparse Understory Woodland	CEGL000829	*Pinus monophylla* - (*Juniperus osteosperma*) Woodland Alliance	A.543	Inter-Mountain Basins Cliff and Canyon	CES304.779
Pinus monophylla / *Cercocarpus ledifolius* Woodland	CEGL000828	*Pinus monophylla* - (*Juniperus osteosperma*) Woodland Alliance	A.543	Great Basin Pinyon-Juniper Woodland	CES304.773
Pinus monophylla Woodland	CEGL000825	*Pinus monophylla* - (*Juniperus osteosperma*) Woodland Alliance	A.543	Great Basin Pinyon-Juniper Woodland	CES304.773
Populus tremuloides / *Poa pratensis* Forest	N/A	*Populus tremuloides* Forest Alliance	A.274	Rocky Mountain Aspen Forest and Woodland	CES306.813
Populus tremuloides / *Symphoricarpos oreophilus* / *Thalictrum fendleri* Forest	CEGL000616	*Populus tremuloides* Forest Alliance	A.274	Rocky Mountain Aspen Forest and Woodland	CES306.813
Populus tremuloides / *Thalictrum fendleri* Forest	CEGL000619	*Populus tremuloides* Forest Alliance	A.274	Rocky Mountain Aspen Forest and Woodland	CES306.813
Pseudotsuga menziesii / *Acer glabrum* Forest	CEGL000418	*Pseudotsuga menziesii* Forest Alliance	A.157	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	CES306.825
		Shrubland and Shrub Herbaceous Vegetation			
Artemisia arbuscula / *Poa bulbosa* Shrub Herbaceous Vegetation	N/A	*Artemisia arbuscula* ssp. *arbuscula* Shrub Herbaceous Alliance	A.1566	Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785
Artemisia arbuscula / *Poa secunda* Shrub Herbaceous Vegetation	CEGL001411	*Artemisia arbuscula* ssp. *arbuscula* Shrub Herbaceous Alliance	A.1566	Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785
Artemisia nova / *Pseudoroegneria spicata* Shrubland	CEGL001424	*Artemisia nova* Shrubland Alliance	A.1105	Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785

Table 4.2 (continued). Crosswalk of plant community classes to National Vegetation Classification Alliances and Ecological Systems.

Scientific Name	Common Name	Key Code	NVC Code	Cluster #	N
Artemisia tridentata / *Chrysothamnus viscidiflorus* / *Poa secunda* Shrubland	CEGL000999	*Artemisia tridentata* Shrubland Alliance	A.829	Inter-Mountain Basins Big Sagebrush Shrubland	CES304.777
Artemisia tridentata ssp. *tridentata* / *Poa pratensis* Shrub Herbaceous Vegetation	N/A	*Artemisia tridentata* (ssp. *tridentata*, ssp. *xericensis*) Shrubland Alliance	A.830	Inter-Mountain Basins Big Sagebrush Steppe	CES304.778
Artemisia tridentata ssp. *tridentata* / *Poa secunda* Shrubland	CEGL001008	*Artemisia tridentata* (ssp. *tridentata*, ssp. *xericensis*) Shrubland Alliance	A.830	Inter-Mountain Basins Big Sagebrush Shrubland	CES304.777
Artemisia tridentata ssp. *vaseyana* - *Purshia tridentata* / *Elymus lanceolatus* Shrubland	N/A	*Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance	A.831	Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785
Artemisia tridentata ssp. *vaseyana* - *Purshia tridentata* / *Poa secunda* Shrubland	N/A	*Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance	A.831	Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785
Artemisia tridentata ssp. *vaseyana* - *Symphoricarpos oreophilus* Shrubland	N/A	*Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance	A.831	Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785
Artemisia tridentata ssp. *vaseyana* / *Festuca idahoensis* Shrub Herbaceous Vegetation	CEGL001533	*Artemisia tridentata* ssp. *vaseyana* Shrub Herbaceous Alliance	A.1526	Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785
Artemisia tridentata ssp. *vaseyana* / *Leucopoa kingii* Shrubland	CEGL001025	*Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance	A.831	Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785
Artemisia tridentata ssp. *vaseyana* / *Poa pratensis* Sagebrush Shrubland	CEGL002528	*Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance	A.831	Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785
Artemisia tridentata ssp. *vaseyana* / *Pseudoroegneria spicata* Shrubland	CEGL001030	*Artemisia tridentata* ssp. *vaseyana* Shrubland Alliance	A.831	Inter-Mountain Basins Montane Sagebrush Steppe	CES304.785
Ceanothus velutinus Shrubland	CEGL002167	*Ceanothus* (*fendleri*, *velutinus*) Shrubland Alliance	A.787	Rocky Mountain Aspen Forest and Woodland	CES306.813
Chrysothamnus viscidiflorus / *Agropyron desertorum* Shrub Herbaceous Vegetation	N/A	*Chrysothamnus viscidiflorus* Shrub Herbaceous Alliance	A.1524	Inter-Mountain Basins Semi-Desert Shrub-Steppe	CES304.788
Chrysothamnus viscidiflorus / *Elymus lanceolatus* - *Poa secunda* Shrub Herbaceous Vegetation	N/A	*Chrysothamnus viscidiflorus* Shrub Herbaceous Alliance	A.1524	Inter-Mountain Basins Semi-Desert Shrub-Steppe	CES304.788
Prunus virginiana - (*Prunus americana*) Shrubland	CEGL001108	*Prunus virginiana* Shrubland Alliance	A.919	Rocky Mountain Lower Montane-Foothill Shrubland	CES306.822
Purshia tridentata / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation	CEGL001495	*Purshia tridentata* Shrub Herbaceous Alliance	A.1523	Inter-Mountain Basins Big Sagebrush Steppe	CES304.778
Salix boothii / Mesic Forbs Shrubland	CEGL001180	*Salix boothii* Temporarily Flooded Shrubland Alliance	A.972	Rocky Mountain Subalpine-Montane Riparian Shrubland	CES306.832

Table 4.2 (continued). Crosswalk of plant community classes to National Vegetation Classification Alliances and Ecological Systems.

Scientific Name	Common Name	Key Code	NVC Code	Cluster #	N
Symphoricarpos oreophilus Shrubland	CEGL002951	*Symphoricarpos oreophilus* Shrubland Alliance	A.2530	Rocky Mountain Lower Montane-Foothill Shrubland	CES306.822
		Herbaceous Vegetation			
N/A	N/A	*Bromus tectorum* Semi-natural Herbaceous Alliance	A.1814	Inter-Mountain Basins Semi-Desert Grassland	CES304.787
Carex nebrascensis Herbaceous Vegetation	CEGL001813	*Carex nebrascensis* Seasonally Flooded Herbaceous Alliance	A.1417	Rocky Mountain Alpine-Montane Wet Meadow	CES306.812
Poa bulbosa Herbaceous Vegetation	N/A	*Poa bulbosa* Herbaceous Alliance	N/A	Inter-Mountain Basins Semi-Desert Grassland	CES304.787
Poa pratensis - Juncus balticus Semi-natural Herbaceous Vegetation	N/A	*Poa pratensis* Semi-natural Seasonally Flooded Herbaceous Alliance	A.1382	Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland	CES306.821
Pseudoroegneria spicata - Balsamorhiza sagittata - Poa secunda Herbaceous Vegetation	CEGL001662	*Pseudoroegneria spicata* Herbaceous Alliance	A.1265	Columbia Basin Palouse Prairie	CES304.792
Pseudoroegneria spicata - Festuca idahoensis Canyon Herbaceous Vegetation	CEGL001669	*Pseudoroegneria spicata* Herbaceous Alliance	A.1265	Columbia Basin Foothill and Canyon Dry Grassland	CES304.993

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