



# Classification of the Plant Communities of Lake Roosevelt National Recreation Area, Washington

Natural Resource Report NPS/LARO/NRR—2017/1465



#### **ON THE COVER**

Images of Lake Roosevelt National Recreation Area (clockwise from upper right): *Ericameria nauseosa* / *Achnatherum hymenoides* Sparse Vegetation, *Purshia tridentata* / *Hesperostipa comata* Shrub Herbaceous Vegetation, *Carex vulpinoidea* - *Phalaris arundinacea* Herbaceous Vegetation, and *Pseudotsuga menziesii* / *Symphoricarpos albus* Forest.

Photograph by: Northwest Management, Inc.

---

# **Classification of the Plant Communities of Lake Roosevelt National Recreation Area, Washington**

Natural Resource Report NPS/LARO/NRR—2017/1465

Steven K. Rust

Northwest Institute on Plant Community Conservation  
P.O. Box 8662  
Boise, ID 83707

June 2017

U.S. Department of the Interior  
National Park Service  
Natural Resource Stewardship and Science  
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate comprehensive information and analysis about natural resources and related topics concerning lands managed by the National Park Service. The series supports the advancement of science, informed decision-making, and the achievement of the National Park Service mission. The series also provides a forum for presenting more lengthy results that may not be accepted by publications with page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available in digital format from the [Upper Columbia Basin Network website](#) and the [Natural Resource Publications Management website](#). To receive this report in a format that is optimized to be accessible using screen readers for the visually or cognitively impaired, please email [irma@nps.gov](mailto:irma@nps.gov).

Please cite this publication as:

Rust, S. K. 2017. Classification of the plant communities of Lake Roosevelt National Recreation Area, Washington. Natural Resource Report NPS/LARO/NRR—2017/1465. National Park Service, Fort Collins, Colorado.

# Contents

|                                           | Page |
|-------------------------------------------|------|
| Figures.....                              | v    |
| Tables.....                               | v    |
| Appendices.....                           | v    |
| Abstract.....                             | vii  |
| Introduction.....                         | 1    |
| Study Area .....                          | 3    |
| Methods.....                              | 5    |
| Results.....                              | 7    |
| Classification of Plant Communities ..... | 7    |
| Discussion.....                           | 15   |
| Literature Cited .....                    | 17   |



## Figures

|                                                                                                                                                                                                                              | Page |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>Figure 1.</b> The location of Lake Roosevelt National Recreation Area is shown in relation to land designations, major rivers and lakes, cities, and roads. Inset: location with respect to the State of Washington. .... | 4    |
| <b>Figure 2.</b> Ordination of Samples - Forest and Woodland. Forest and woodland samples are plotted by association in relation to DCA axes 1 and 2. ....                                                                   | 59   |
| <b>Figure 3.</b> Ordination of Samples - Shrubland and Shrub-steppe. Shrubland and shrub-steppe samples are plotted by association in relation to DCA axes 1 and 2. ....                                                     | 64   |
| <b>Figure 4.</b> Ordination of Samples - Herbaceous Vegetation. Herbaceous vegetation samples are plotted by association in relation to DCA axes 1 and 3. ....                                                               | 67   |

## Tables

|                                                      | Page |
|------------------------------------------------------|------|
| <b>Table 1.</b> Plant community classification. .... | 8    |

## Appendices

|                                                                              | Page |
|------------------------------------------------------------------------------|------|
| Appendix A. Dichotomous Key to the Classification.....                       | 25   |
| Appendix B. Classification crosswalk to ecological system and alliance ..... | 31   |
| Appendix C. Summary of classification literature.....                        | 39   |
| Appendix D. Synthesis tables .....                                           | 43   |
| Appendix E. Statistical summary.....                                         | 55   |



## **Abstract**

Work on the vegetation map for Lake Roosevelt National Recreation Area was initiated in May 2007. The National Recreation Area occurs in central and northeast Washington, within the Columbia Basin and Okanogan Highlands eco-regional sections. Given its geographic breadth, the National Recreation Area encompasses considerable geologic and climatic diversity. Vegetation within the area ranges from xeric shrub-steppe to coniferous forest. Initial plant community groups were identified using hierarchical cluster analysis. Plant community groups were successively partitioned to optimize within-group homogeneity, between-group difference, and the number of groups using indicator species analysis and multi-response permutation procedures. Decisions regarding the identification of plant associations within the data were informed by cross-walking candidate community groupings to the National Vegetation Classification. Classification and regression tree analysis (recursive partitioning) was employed in the development of dichotomous keys and the evaluation of cluster analysis results. Eighty-one plant communities are identified as occurring within Lake Roosevelt National Recreation Area. Fifty-nine percent of associations identified within the National Recreation Area are currently listed in the National Vegetation Classification. Associations described but not recognized by the National Vegetation Classification include: (1) semi-natural vegetation (12 associations) and (2) plant communities (21 associations) that have not been described previously at the association level. Plant associations that should be considered for inclusion in the National Vegetation Classification are listed. A dichotomous key to the classification is presented in Appendix A. Summaries of stand composition are provided.



## Introduction

The National Park Service Inventory and Monitoring Program Upper Columbia Basin Network (UCBN) are working in conjunction with the National Park Service Vegetation Mapping Program to complete vegetation maps for each of the national park units within the network. The National Park Service vegetation mapping protocol consists of the following major phases: preliminary collection and review of existing information; field data collection, management, and analysis; photo-interpretation and mapping; map validation; and accuracy assessment (The Nature Conservancy and Environmental Systems Research Institute 1994a). Work on the vegetation map for Lake Roosevelt National Recreation Area was initiated in May 2007. The objective of this document is to report on the field data analysis phase and provide a classification of the vegetation and a dichotomous key to the classification of plant communities. The plant community classification presented here will contribute photo-interpretation and mapping processes, map validation, and the accuracy assessment at Lake Roosevelt National Recreation Area.



## Study Area

Lake Roosevelt National Recreation Area occurs in central and northeast Washington, within the Columbia Basin and Okanogan Highlands eco-regional sections (McNab and Avers 1994) (Figure 1). The National Recreation Area spans three distinct physiographic provinces: the Okanogan Highlands, Kootenay Arc, and Columbia Plateau. Given the breadth of this geographic region, the National Recreation Area encompasses considerable geologic and climatic diversity.

Climatic variation within the National Recreation Area occurs primarily on a north-south axis. In the south summers are hot and dry. Mean minimum and maximum temperature, annual precipitation, and annual snow fall at the Coulee Dam (47.97N, 118.97W; elevation 290 m) are 4.4 °C, 15.8 °C 26.8 cm, and 39.6 cm, respectively. The dominant vegetation is xeric shrub-steppe. In the north (Northport, WA; 48.91N, 117.78W; elevation 395 m), mean minimum and maximum temperature, annual precipitation, and annual snow fall are 1.7 °C, 15.6 °C, 49.4 cm, and 135.4 cm, respectively. The dominant vegetation in the north is coniferous forest and woodland.

The geologic setting of the National Recreation Area is marked by a history of volcanism and glaciation. In the Columbia Basin rocks are predominantly Miocene flow basalts. In the north, within the Okanogan Highlands, Precambrian and Mesozoic metamorphic and intrusive rocks formed in the continental shelf are increasingly dominant. The area was shaped by glaciation during the Pleistocene. Repeated massive glacial floods scoured the area during the most recent age of continental ice, creating a landscape of deeply dissected canyons, coulees, and channeled scablands.

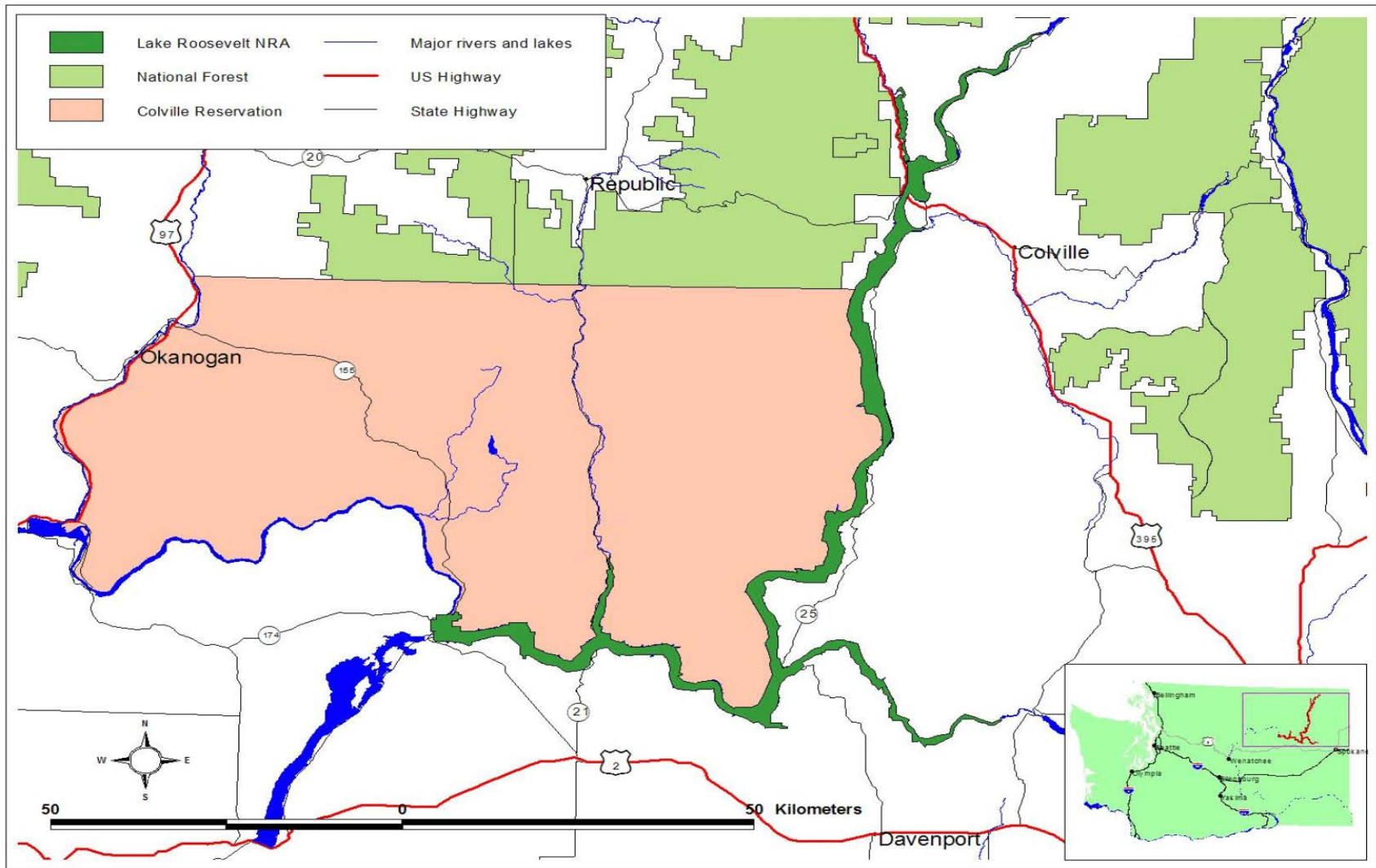


**Figure 1.** The location of Lake Roosevelt National Recreation Area is shown in relation to land designations, major rivers and lakes, cities, and roads. Inset: location with respect to the State of Washington.

## Methods

Classification analyses were conducted using 431 vegetation samples collected in 2007 (47 stand-level point observations were also considered). Field methods employed in the collection of these data are described by Northwest Management Inc. (2006). Analytical methods were employed in a manner consistent with the objective of identifying natural associations of existing vegetation (Jennings et al. 2006, Tart et al. 2005, The Nature Conservancy and Environmental Systems Research Institute 1994b).

The species composition data set consists of 431 samples by 400 species. Pseudo-species were identified to differentiate between tree species abundance in the forest overstory stratum versus abundance in the understory, shrub, or herbaceous strata. Species occurring in fewer than three samples were eliminated from analyses. No data transformations were employed. In analyses conducted at the sub-alliance level, noise in the species composition data was reduced by filtering to include only species from selected lifeforms.

Multivariate statistical analyses were conducted using PC-ORD (McCune and Mefford 2006). Plant community groups were identified through the use of hierarchical cluster analysis, indicator species analysis, multi-response permutation procedures (MRPP), and detrended correspondence analysis. Hierarchical cluster analysis was employed using relative Sorensens distance and flexible beta linkage ( $\beta = -0.25$ ). Through iterative analyses, plant community groups were successively partitioned to optimize within-group homogeneity, between-group difference, and the number of groups.

Indicator species analysis provides a quantitative assessment of the value of individual species to differentiate respective plant community groups. Monte Carlo tests of the significance of indicator values were conducted using 4,999 randomizations. Within each hierarchical cluster analysis iteration, the optimum number of groups was selected by evaluating the number of significant [ $p \leq 0.05$ ] indicator species and the overall significance of species indicator values (mean of  $p$ -values).

Values generated by MRPP (for an entire data set or pairs of groups within the data set) include measures of (1) separation between groups, (2) within-group homogeneity, and (3) compositional similarity of samples within a group. The method is based on comparison of the observed weighted mean within-group distance (observed delta) to distribution of all possible deltas (approximated by the Pearson type III distribution). The MRPP test statistic,  $T$ , describes separation among groups. The chance-corrected agreement statistic ( $A$ ) describes within group homogeneity. The MRPP probability value ( $p$ ) is an expression of the likelihood of achieving a delta less than the observed delta. Sorensens relative distance and the group weighting,  $C_i = n_i / \sum n_i$ , were used in all MRPP runs.

Environmental relations, within-group homogeneity, and between-group difference were evaluated graphically using detrended correspondence analysis (DCA). Though DCA has inherent problems regarding underlying assumptions and stability of results (McCune and Grace 2002), the method is considerably less time consuming than the alternative, nonmetric multidimensional scaling (NMS). In experimental runs conducted at the onset of the analysis DCA and NMS produced similar results.

In employment of DCA composition, data were relativized by sample, rare species were down-weighted, and rescaling occurred on 26 segments with a threshold of zero.

Final decisions regarding the naming of plant associations were informed by cross-walking candidate community groupings to the National Vegetation Classification (NatureServe 2007). Classification and regression tree analysis (recursive partitioning) was employed in the development of dichotomous keys and the evaluation of classification results using the `rpart` package in R (R Development Core Team 2007). Once the assignment of samples to associations was finalized, MRPP was used to test the null hypothesis of no difference in the composition of associations. The analyses were conducted on associations (with  $n \geq 2$  fixed area samples) grouped by physiognomic class.

Plant species nomenclature standards identified by the National Recreation Area were maintained for the analysis to reflect local and regional taxonomic distinctions. Plant nomenclature of the Integrated Taxonomic Information System (ITIS) as reflected by the PLANTS Database (USDA, NRCS 2007) is employed in the naming of plant associations. This is the National Vegetation Classification standard and is necessary to discriminate differences among associations currently reported within the National Vegetation Classification.

# Results

## Classification of Plant Communities

Eighty-one plant communities are identified as occurring within Lake Roosevelt National Recreation Area. Table 1 provides a summary of the associations described for the study area. Appendix A provides a crosswalk from association (as listed in Table 1) to ecological system and alliance (NatureServe 2007). Plant communities are named for the indicator (dominant or diagnostic) species of the vegetative strata present. The indicator species of the uppermost strata is listed first, followed by successively lower strata. Species that occur in the same strata (or are the same lifeform) are separated by a hyphen (-). Indicator species that occur in different strata (or are a different lifeform) are separated by a slash (/). Plant association names incorporate the physiognomic class in which the association is classified (e.g., Forest, Woodland, or Herbaceous) (FGDC 1997, 2006).

Forty-eight (59%) of the associations identified within the National Recreation Area are currently listed in the National Vegetation Classification (as indicated by an assigned element code, Table 1) (NatureServe 2007). Many of the plant associations identified in this classification have been described previously by others. A summary of previous classification work regarding vegetation that occurs within the study area is provided in Appendix B.

Thirty-three associations (41%) described in this classification are not recognized by the National Vegetation Classification or have not been described previously. These associations include: (1) semi-natural vegetation (12 associations, Table 1) that, due to the priority of conserving natural vegetation, has not been systematic reviewed nor incorporated into the National Vegetation Classification and (2) plant communities (21 associations) that have not been described previously at the association level.

Summary statistics for final tests of the significance of difference between associations are presented in Appendix C. In the analysis by physiognomic group, values for the MRPP test statistic (T) are -54.20, -25.10, and -23.93, respectively, for forest, shrubland, and herbaceous associations with the more negative value representing greater group separation among associations. Values for the chance-corrected agreement statistic (A) are 0.23, 0.36, and 0.36, respectively, for forest, shrubland, and herbaceous associations, with a greater value representing greater within group agreement (A=1 implies each sample is identical; values >0.1 and <0.3 are common in community ecology). Each test was significant with  $p \leq 0.0001$ . There are no associations in the sparse physiognomic class with sufficient number of samples for the analysis.

**Table 1.** Plant community classification. Plant communities observed at Lake Roosevelt National Recreation Area are listed alphabetically by National Vegetation Classification class with scientific name, common name, symbol, element code (abbreviated as "elcode"), the number of stands sampled on fixed area plots (N Plots), and total number of observations (N Total, the sum of fixed area plots and stand-level point observations). Physiognomic classes employed in names of plant associations currently listed in the National Vegetation Classification are used here, though the physiognomic class of the occurrence of any given association within the National Recreation Area may not actually correspond to the assigned class.

| Class | Association Name                                                 | Common Name                             | Symbol      | Elcode     | N Plots | N Total |
|-------|------------------------------------------------------------------|-----------------------------------------|-------------|------------|---------|---------|
| ∞     | <b>Forest and Woodland</b>                                       |                                         |             |            |         |         |
|       | <i>Acer platanoides</i> Planted Woodland                         | Norway maple                            | ACPL        |            | 1       | 1       |
|       | <i>Betula papyrifera</i> Forest                                  | paper birch                             | BEPA        | CEGL000520 |         | 2       |
|       | <i>Juniperus scopulorum</i> Woodland                             | Rocky Mountain juniper                  | JUSC2       | CEGL003550 | 1       | 1       |
|       | <i>Pinus ponderosa</i> / <i>Amelanchier alnifolia</i> Woodland   | ponderosa pine / Saskatoon serviceberry | PIPO/AMAL2  | CEGL000840 | 25      | 27      |
|       | <i>Pinus ponderosa</i> / <i>Bromus tectorum</i> Woodland         | ponderosa pine / cheatgrass             | PIPO/BRTE   |            | 22      | 22      |
|       | <i>Pinus ponderosa</i> / <i>Crataegus douglasii</i> Woodland     | ponderosa pine / black hawthorn         | PIPO/CRDO2  | CEGL000855 | 1       | 1       |
|       | <i>Pinus ponderosa</i> / <i>Festuca idahoensis</i> Woodland      | ponderosa pine / Idaho fescue           | PIPO/FEID   | CEGL000857 |         | 1       |
|       | <i>Pinus ponderosa</i> / <i>Hesperostipa comata</i> Woodland     | ponderosa pine / needle and thread      | PIPO/HECO26 | CEGL000879 | 3       | 4       |
|       | <i>Pinus ponderosa</i> / <i>Mahonia aquifolium</i> Woodland      | ponderosa pine / hollyleaved barberry   | PIPO/MAAQ2  |            | 4       | 4       |
|       | <i>Pinus ponderosa</i> / <i>Mahonia repens</i> Woodland          | ponderosa pine / creeping barberry      | PIPO/MARE11 | CEGL000187 | 5       | 6       |
|       | <i>Pinus ponderosa</i> / <i>Pseudoroegneria spicata</i> Woodland | ponderosa pine / bluebunch wheatgrass   | PIPO/PSSP6  | CEGL000865 | 11      | 11      |
|       | <i>Pinus ponderosa</i> / <i>Purshia tridentata</i> Woodland      | ponderosa pine / antelope bitterbrush   | PIPO/PUTR2  | CEGL000867 | 33      | 34      |
|       | <i>Pinus ponderosa</i> / <i>Shepherdia canadensis</i> Woodland   | ponderosa pine / russet buffaloberry    | PIPO/SHCA   |            | 7       | 7       |
|       | <i>Pinus ponderosa</i> / <i>Symphoricarpos albus</i> Forest      | ponderosa pine / common snowberry       | PIPO/SYAL   | CEGL000203 | 89      | 92      |

**Table 1 (continued).** Plant community classification. Plant communities observed at Lake Roosevelt National Recreation Area are listed alphabetically by National Vegetation Classification class with scientific name, common name, symbol, element code (abbreviated as "elcode"), the number of stands sampled on fixed area plots (N Plots), and total number of observations (N Total, the sum of fixed area plots and stand-level point observations). Physiognomic classes employed in names of plant associations currently listed in the National Vegetation Classification are used here, though the physiognomic class of the occurrence of any given association within the National Recreation Area may not actually correspond to the assigned class.

| Class                              | Association Name                                                                          | Common Name                                   | Symbol            | Elcode     | N Plots | N Total |
|------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------|------------|---------|---------|
| <b>Forest and Woodland (cont.)</b> | <i>Populus balsamifera</i> ssp. <i>trichocarpa</i> / Mixed Herbs Forest                   | black cottonwood / mixed forbs                | POBAT/MIXED FORBS | CEGL000675 |         | 1       |
|                                    | <i>Populus balsamifera</i> ssp. <i>trichocarpa</i> / <i>Salix exigua</i> Forest           | black cottonwood / narrowleaf willow          | POBAT/SAEX        | CEGL000676 |         | 1       |
|                                    | <i>Populus balsamifera</i> ssp. <i>trichocarpa</i> / <i>Symphoricarpos albus</i> Woodland | black cottonwood / common snowberry           | POBAT/SYAL        | CEGL000677 | 5       | 5       |
|                                    | <i>Populus tremuloides</i> / <i>Symphoricarpos albus</i> Forest                           | quaking aspen / common snowberry              | POTR5/SYAL        | CEGL000609 | 2       | 2       |
|                                    | <i>Pseudotsuga menziesii</i> / <i>Acer glabrum</i> Forest                                 | Douglas-fir / Rocky Mountain maple            | PSME/ACGL         | CEGL000418 | 9       | 9       |
|                                    | <i>Pseudotsuga menziesii</i> / <i>Physocarpus malvaceus</i> Forest                        | Douglas-fir / mallow ninebark                 | PSME/PHMA5        | CEGL000447 | 16      | 17      |
|                                    | <i>Pseudotsuga menziesii</i> / <i>Pseudoroegneria spicata</i> Woodland                    | Douglas-fir / bluebunch wheatgrass            | PSME/PSSP6        | CEGL000908 | 5       | 5       |
|                                    | <i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> Forest                         | Douglas-fir / common snowberry                | PSME/SYAL         | CEGL000459 | 14      | 16      |
|                                    | <i>Robinia pseudoacacia</i> Semi-natural Forest                                           | black locust                                  | ROPS              |            | 2       | 2       |
|                                    | <i>Ulmus americana</i> / <i>Bromus tectorum</i> Semi-natural Woodland                     | American elm / cheatgrass                     | ULAM/BRTE         |            |         | 1       |
| <b>Shrubland and Shrub-steppe</b>  | <i>Alnus incana</i> / Mesic Forbs Shrubland                                               | gray alder / mesic forbs                      | ALIN2/MESIC FORBS | CEGL001147 |         | 1       |
|                                    | <i>Alnus viridis</i> ssp. <i>sinuata</i> / Mesic Forbs Shrubland                          | Sitka alder / mesic forbs                     | ALVIS/MESIC FORBS | CEGL002633 |         | 1       |
|                                    | <i>Amelanchier alnifolia</i> / <i>Pseudoroegneria spicata</i> Shrubland                   | Saskatoon serviceberry / bluebunch wheatgrass | AMAL2/PSSP6       | CEGL001065 | 5       | 5       |
|                                    | <i>Artemisia tridentata</i> / <i>Bromus tectorum</i> Semi-natural Shrubland               | big sagebrush / cheatgrass                    | ARTR2/BRTE        |            | 1       | 1       |

**Table 1 (continued).** Plant community classification. Plant communities observed at Lake Roosevelt National Recreation Area are listed alphabetically by National Vegetation Classification class with scientific name, common name, symbol, element code (abbreviated as "elcode"), the number of stands sampled on fixed area plots (N Plots), and total number of observations (N Total, the sum of fixed area plots and stand-level point observations). Physiognomic classes employed in names of plant associations currently listed in the National Vegetation Classification are used here, though the physiognomic class of the occurrence of any given association within the National Recreation Area may not actually correspond to the assigned class.

| Class                                     | Association Name                                                                                                      | Common Name                                               | Symbol                 | Elcode     | N Plots | N Total |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|------------------------|------------|---------|---------|
| <b>Shrubland and Shrub-steppe (cont.)</b> | <i>Artemisia tridentata</i> / <i>Festuca idahoensis</i> Shrub Herbaceous Vegetation                                   | big sagebrush / Idaho fescue                              | ARTR2/FEID             | CEGL001530 | 2       | 2       |
|                                           | <i>Artemisia tridentata</i> / <i>Leymus cinereus</i> Shrub Herbaceous Vegetation                                      | big sagebrush / basin wildrye                             | ARTR2/LECI4            | CEGL001458 | 2       | 2       |
|                                           | <i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / <i>Hesperostipa comata</i> Shrubland                           | Wyoming big sagebrush / needle and thread                 | ARTRW8/HECO26          | CEGL001051 | 5       | 5       |
|                                           | <i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / <i>Pseudoroegneria spicata</i> Shrubland                       | Wyoming big sagebrush / bluebunch wheatgrass              | ARTRW8/PSSP6           | CEGL001009 | 6       | 6       |
|                                           | <i>Artemisia tripartita</i> ssp. <i>tripartita</i> / <i>Poa secunda</i> Shrubland                                     | threetip sagebrush / Sandberg bluegrass                   | ARTRT2/POSE            |            | 2       | 2       |
|                                           | <i>Betula occidentalis</i> / <i>Cornus sericea</i> Shrubland                                                          | water birch / redosier dogwood                            | BEOC2/COSE16           | CEGL001161 | 1       | 1       |
|                                           | <i>Chrysothamnus viscidiflorus</i> / <i>Bromus tectorum</i> Semi-natural Shrub Herbaceous Vegetation                  | yellow rabbitbrush / cheatgrass                           | CHVI8/BRTE             |            | 1       | 1       |
|                                           | <i>Crataegus douglasii</i> / Mesic Graminoids Shrub Herbaceous Vegetation                                             | black hawthorn / mesic graminoids                         | CRDO2/MESIC GRAMINOIDS |            | 2       | 3       |
|                                           | <i>Ericameria nauseosa</i> / <i>Bromus tectorum</i> Semi-natural Shrubland                                            | rubber rabbitbrush / cheatgrass                           | ERNA10/BRTE            | CEGL002937 | 7       | 7       |
|                                           | <i>Eriogonum niveum</i> / <i>Bromus tectorum</i> Dwarf-shrub Herbaceous Vegetation                                    | snow buckwheat / cheatgrass                               | ERNI2/BRTE             |            | 3       | 3       |
|                                           | <i>Philadelphus lewisii</i> / <i>Pseudoroegneria spicata</i> Shrubland                                                | Lewis' mock orange / bluebunch wheatgrass                 | PHLE4/PSSP6            |            | 1       | 1       |
|                                           | <i>Prunus virginiana</i> Shrubland                                                                                    | chokecherry                                               | PRVI                   |            |         | 2       |
|                                           | <i>Purshia tridentata</i> - <i>Salvia dorrii</i> / <i>Pseudoroegneria spicata</i> ssp. <i>spicata</i> Dwarf-shrubland | antelope bitterbrush - purple sage / bluebunch wheatgrass | PUTR2-SADO4/PSSP6      |            | 2       | 2       |

**Table 1 (continued).** Plant community classification. Plant communities observed at Lake Roosevelt National Recreation Area are listed alphabetically by National Vegetation Classification class with scientific name, common name, symbol, element code (abbreviated as "elcode"), the number of stands sampled on fixed area plots (N Plots), and total number of observations (N Total, the sum of fixed area plots and stand-level point observations). Physiognomic classes employed in names of plant associations currently listed in the National Vegetation Classification are used here, though the physiognomic class of the occurrence of any given association within the National Recreation Area may not actually correspond to the assigned class.

| Class                                     | Association Name                                                                       | Common Name                                 | Symbol                 | Elcode     | N Plots | N Total |
|-------------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------|------------------------|------------|---------|---------|
| <b>Shrubland and Shrub-steppe (cont.)</b> | <i>Purshia tridentata</i> / <i>Achnatherum hymenoides</i> Shrubland                    | antelope bitterbrush / Indian ricegrass     | PUTR2/ACHY             | CEGL001058 |         | 1       |
|                                           | <i>Purshia tridentata</i> / <i>Bromus tectorum</i> Semi-natural Shrubland              | antelope bitterbrush / cheatgrass           | PUTR2/BRTE             |            | 10      | 16      |
|                                           | <i>Purshia tridentata</i> / <i>Festuca idahoensis</i> Shrub Herbaceous Vegetation      | antelope bitterbrush / Idaho fescue         | PUTR2/FEID             | CEGL002674 | 4       | 4       |
|                                           | <i>Purshia tridentata</i> / <i>Hesperostipa comata</i> Shrub Herbaceous Vegetation     | antelope bitterbrush / needle and thread    | PUTR2/HECO26           | CEGL001498 | 12      | 12      |
|                                           | <i>Purshia tridentata</i> / <i>Pseudoroegneria spicata</i> Shrub Herbaceous Vegetation | antelope bitterbrush / bluebunch wheatgrass | PUTR2/PSSP6            | CEGL001495 | 6       | 7       |
|                                           | <i>Rhus glabra</i> / <i>Hesperostipa comata</i> Shrubland                              | smooth sumac / needle and thread            | RHGL/HECO26            |            | 3       | 3       |
|                                           | <i>Rosa gymnocarpa</i> Shrubland                                                       | dwarf rose                                  | ROGY                   |            | 1       | 1       |
|                                           | <i>Rosa woodsii</i> Shrubland                                                          | Woods' rose                                 | ROWO                   | CEGL001126 | 2       | 2       |
|                                           | <i>Salix alba</i> / <i>Poa pratensis</i> Semi-natural Shrubland                        | white willow / Kentucky bluegrass           | SAAL2/POPR             |            |         | 1       |
|                                           | <i>Salix exigua</i> / Barren Shrubland                                                 | narrowleaf willow / Barren                  | SAEX/BARREN            | CEGL001200 | 1       | 4       |
|                                           | <i>Salix exigua</i> / <i>Equisetum arvense</i> Shrubland                               | narrowleaf willow / field horsetail         | SAEX/EQAR              | CEGL001201 |         | 1       |
|                                           | <i>Symphoricarpos albus</i> Shrubland                                                  | common snowberry                            | SYAL                   | CEGL005890 | 15      | 15      |
|                                           | Active Dune Herbaceous Vegetation                                                      | herbaceous active dune                      | HERBACEOUS ACTIVE DUNE |            | 1       | 1       |
|                                           | <i>Agropyron cristatum</i> Semi-natural Herbaceous Vegetation                          | crested wheatgrass                          | AGCR                   |            | 1       | 1       |
| <b>Herbaceous Vegetation</b>              | <i>Bromus inermis</i> Semi-natural Herbaceous Vegetation                               | smooth brome                                | BRIN2                  |            | 1       | 2       |
|                                           | <i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation                              | cheatgrass                                  | BRTE                   | CEGL003019 | 18      | 19      |

**Table 1 (continued).** Plant community classification. Plant communities observed at Lake Roosevelt National Recreation Area are listed alphabetically by National Vegetation Classification class with scientific name, common name, symbol, element code (abbreviated as "elcode"), the number of stands sampled on fixed area plots (N Plots), and total number of observations (N Total, the sum of fixed area plots and stand-level point observations). Physiognomic classes employed in names of plant associations currently listed in the National Vegetation Classification are used here, though the physiognomic class of the occurrence of any given association within the National Recreation Area may not actually correspond to the assigned class.

| Class                                              | Association Name                                                                                          | Common Name                                                      | Symbol               | Elcode     | N Plots | N Total |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|----------------------|------------|---------|---------|
| <b>Herba-<br/>ceous<br/>Vegetation<br/>(cont.)</b> | <i>Carex vulpinoidea</i> - <i>Phalaris arundinacea</i> Herbaceous Vegetation                              | fox sedge - reed canarygrass                                     | CAVU2-PHAR3          |            | 4       | 4       |
|                                                    | <i>Centaurea diffusa</i> Semi-natural Herbaceous Vegetation                                               | diffuse knapweed                                                 | CEDI3                |            | 1       | 1       |
|                                                    | <i>Dactylis glomerata</i> Semi-natural Herbaceous Vegetation                                              | orchardgrass                                                     | DAGL                 |            | 1       | 1       |
|                                                    | <i>Dichanthelium oligosanthes</i> var. <i>scribnerianum</i> Herbaceous Vegetation                         | Scribner's rosette grass                                         | DIOLS                |            | 6       | 6       |
|                                                    | <i>Distichlis spicata</i> Herbaceous Vegetation                                                           | saltgrass                                                        | DISP                 | CEGL001770 |         | 1       |
|                                                    | <i>Eriogonum compositum</i> / <i>Poa secunda</i> Dwarf-shrub Herbaceous Vegetation                        | arrowleaf buckwheat / Sandberg bluegrass                         | ERCO12/POSE          | CEGL001784 | 1       | 1       |
|                                                    | <i>Festuca idahoensis</i> Herbaceous Vegetation                                                           | Idaho fescue                                                     | FEID                 | CEGL001897 | 2       | 2       |
|                                                    | <i>Festuca ovina</i> Semi-natural Herbaceous Vegetation                                                   | sheep fescue                                                     | FEOV                 |            | 3       | 4       |
|                                                    | Gravel Bar Herbaceous Vegetation                                                                          | gravel bar                                                       | GRAVEL BAR           |            | 2       | 2       |
|                                                    | <i>Hesperostipa comata</i> ssp. <i>comata</i> Herbaceous Vegetation                                       | needle and thread                                                | HECO26               |            | 4       | 5       |
|                                                    | <i>Juncus balticus</i> Herbaceous Vegetation                                                              | Baltic rush                                                      | JUBA                 | CEGL001838 | 3       | 3       |
|                                                    | <i>Leymus cinereus</i> Herbaceous Vegetation                                                              | basin wildrye                                                    | LECI4                | CEGL001479 | 1       | 1       |
|                                                    | <i>Phalaris arundinacea</i> Western Herbaceous Vegetation                                                 | reed canarygrass                                                 | PHAR3                | CEGL001474 | 8       | 8       |
|                                                    | <i>Poa pratensis</i> Semi-natural Herbaceous Vegetation                                                   | Kentucky bluegrass                                               | POPR                 |            | 7       | 7       |
|                                                    | <i>Pseudoroegneria spicata</i> - <i>Poa secunda</i> / <i>Balsamorhiza sagittata</i> Herbaceous Vegetation | bluebunch wheatgrass - Sandberg bluegrass / arrowleaf balsamroot | PSSP6-POSE/<br>BASA3 | CEGL001662 | 4       | 4       |

**Table 1 (continued).** Plant community classification. Plant communities observed at Lake Roosevelt National Recreation Area are listed alphabetically by National Vegetation Classification class with scientific name, common name, symbol, element code (abbreviated as "elcode"), the number of stands sampled on fixed area plots (N Plots), and total number of observations (N Total, the sum of fixed area plots and stand-level point observations). Physiognomic classes employed in names of plant associations currently listed in the National Vegetation Classification are used here, though the physiognomic class of the occurrence of any given association within the National Recreation Area may not actually correspond to the assigned class.

| Class                                | Association Name                                                                            | Common Name                                    | Symbol              | Elcode     | N Plots | N Total |
|--------------------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------|---------------------|------------|---------|---------|
| <b>Herbaceous Vegetation (cont.)</b> | <i>Pseudoroegneria spicata</i> / <i>Eriogonum heracleoides</i> Herbaceous Vegetation        | bluebunch wheatgrass / parsnipflower buckwheat | PSSP6/ERHE2         | CEGL001668 | 1       | 1       |
|                                      | <i>Schoenoplectus acutus</i> Herbaceous Vegetation                                          | hardstem bulrush                               | SCAC3               | CEGL001840 | 1       | 1       |
|                                      | <i>Secale cereale</i> Planted Herbaceous Vegetation                                         | cereal rye                                     | SECE                | CEGL004382 | 1       | 1       |
|                                      | <i>Sporobolus cryptandrus</i> Shrub Herbaceous Vegetation                                   | sand dropseed                                  | SPCR                | CEGL001514 | 1       | 1       |
|                                      | <i>Thinopyrum intermedium</i> Semi-natural Herbaceous Vegetation                            | intermediate wheatgrass                        | THIN6               | CEGL002935 | 7       | 9       |
| <b>Sparse Vegetation</b>             | <i>Ericameria nauseosa</i> / <i>Achnatherum hymenoides</i> Sparse Vegetation                | rubber rabbitbrush / Indian ricegrass          | ERNA10/ACHY         |            |         | 1       |
|                                      | Lacustrine Cut Bank Sparse Vegetation                                                       | lacustrine cut bank                            | LACUSTRINE CUT BANK |            |         | 3       |
|                                      | <i>Philadelphus lewisii</i> / <i>Pseudoroegneria spicata</i> Rock Outcrop Sparse Vegetation | Lewis' mock orange / bluebunch wheatgrass rock | PHLE4/PSSP6 ROCK    |            | 1       | 2       |
|                                      | <i>Pseudotsuga menziesii</i> / <i>Philadelphus lewisii</i> Talus Sparse Wooded Vegetation   | Douglas-fir / Lewis' mock orange               | PSME/PHLE4 TALUS    |            |         | 2       |



## Discussion

No specific modifications to associations currently listed within the National Vegetation Classification are identified. In some instances data from the National Recreation Area may support modification of existing associations to more specific classification subunits.

An example of this is the *Symphoricarpos albus* Shrubland association. Samples assigned to the association appear to represent a wide floristic range. The dominance of different bunchgrass species (including *Festuca idahoensis*, *Leymus cinereous*, and *Pseudoregneria spicata*) supports splitting the association. Observations from Lake Roosevelt National Recreation Area alone, however, are not sufficient to support recognition of separate associations.

Distinctive plant associations that should be considered for inclusion in the National Vegetation Classification include: *Pinus ponderosa* / *Shepherdia canadensis* Woodland, *Purshia tridentata* - *Salvia dorrii* / *Pseudoregneria spicata* Dwarf-shrubland, and *Rhus glabra* / *Hesperostipa comata* Shrubland. Associations that appear unique, are not listed in the National Vegetation Classification (NatureServe 2007), but require further regional review include: *Carex vulpinoidea* - *Phalaris arundinacea* Herbaceous Vegetation, *Crataegus douglasii* / Mesic Graminoids Shrub Herbaceous Vegetation, *Ericameria nauseosa* / *Achnatherum hymenoides* Sparse Vegetation, *Hesperostipa comata* Herbaceous Vegetation, and *Philadelphus lewisii* / *Pseudoregneria spicata* Shrubland.

MRPP pair-wise tests of the significance of difference between associations are sensitive to sample size. Associations with relatively few samples (e.g., n=2) often appear insignificantly different. Though some classification units were joined on the basis of the MRPP result, many are retained, though  $p > 0.05$ ,  $T > 0$ , or  $A < 0$  (Appendix C), on the basis of their apparent ecological significance.



## Literature Cited

- Anderson, J. E. 1991. Vegetation Studies Support the NPR Environmental Impact Statement, Final Report. Unpublished report prepared for Idaho National Engineering Laboratory by Department of Biological Sciences, Idaho State University, Pocatello. 171 pp.
- Blackburn, W. H., P. T. Tueller, and R. E. Eckert Jr. 1971. Vegetation and soils of the Rock Springs Watershed. Nevada Agricultural Experiment Station Bulletin R-83. Reno. 116 pp.
- Bowerman, T. S., J. Dorr, S. Leahy, K. Varga, and J. Warrick. 1997. Targhee National Forest ecological unit inventory. USDA Forest Service, Targhee National Forest, St. Anthony, ID. 789 pp.
- Carsey, K., G. Kittel, K. Decker, D. J. Cooper, and D. Culver. 2003. Field guide to the wetland and riparian plant associations of Colorado. Colorado Natural Heritage Program, Fort Collins, Co. 432 pp. plus appendices.
- Cogan, D., M. Reid, K. Schulz, and M. Pucherelli. 2004. Zion National Park, Utah 1999-2003. Vegetation Mapping Project. Technical Memorandum 8260-03-01. Remote Sensing and GIS Group Technical Service Center, Bureau of Reclamation, Denver, CO. Appendix F: Vegetation Association Descriptions for Zion.
- Cooper, S. V., K. E. Neiman, and D. W. Roberts. 1991. Forest habitat types of northern Idaho: a second approximation. USDA Forest Service General Technical Report INT-236. Intermountain Research Station, Ogden. 143 pp.
- Cooper, S. V., P. Lesica, R. L. DeVelice, and J. T. McGarvey. 1995. Classification of southwestern Montana plant communities with emphasis on those of Dillon Resource Area, Bureau of Land Management. Montana Natural Heritage Program, Helena, Montana. 152 pp.
- Crawford, R. C. 2003. Riparian vegetation of the Columbia Basin, Washington. National Heritage Program Report 2003-03. Washington Dept. Natural Resources. Olympia, WA. 118 pp.
- Crowe, E. A., and R. R. Clausnitzer. 1997. Mid-montane wetlands classification of the Malheur, Umatilla, and Wallowa-Whitman National Forests. Wallowa-Whitman National Forest, Pacific Northwest Region, USDA Forest Service. 188 pp. plus appendices.
- Crowe, E. A., B. L. Kovalchik, and M. Kerr. 2004. Riparian and wetland vegetation of central and eastern Oregon. Oregon State University, Portland, OR. 473 pp.
- Daubenmire, R. 1970. Steppe vegetation of Washington. Washington State University Technical Bulletin 62. Washington Agricultural Experiment Station, College of Agriculture, Pullman. 131 pp.

- Day, T.A. and R.G. Wright. 1985. The vegetation types of Craters of the Moon National Monument. Bulletin Number 38, Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow. 6 pp. plus map.
- DeVelice, R. L., and P. Lesica. 1993. Plant community classification for vegetation on BLM lands, Pryor Mountains, Carbon County, Montana. Montana Natural Heritage Program, Helena, Montana. 78 pp.
- Eggler, W. A. 1941. Primary succession on volcanic deposits in southern Idaho. *Ecological Monographs* 11(3): 277-298.
- Evans, S. 1989. Provisional riparian and aquatic wetland plant communities on the Columbia Plateau. Prepared for Washington State Department of Ecology, Contract No. C0089098. 52 pp.
- FGDC. 1997. Vegetation Classification Standard. FGDC-STD-005. Vegetation Subcommittee, Federal Geographic Data Committee, FGDC Secretariat, U.S. Geological Survey. Reston, VA. 58pp.
- FGDC. 2006. National Vegetation Classification Standard Version 2 (submitted draft November 30, 2006). FGDC-STD-005 (Version 2). Vegetation Subcommittee, Federal Geographic Data Committee, FGDC Secretariat, U.S. Geological Survey. Reston, VA. 128pp.
- Franklin, J.F. and C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. USDA Forest Service General Technical Report PNW-8. Pacific Northwest Forest and Range Experiment Station. Portland, OR. 417 pp.
- Francis, R. E. 1983. Sagebrush-steppe habitat types in Northern Colorado: a first approximation. Pages 67-71 in W. H. Moir, and L. Hendzel, Proceedings of the workshop on southwestern habitat types, April 8-10, 1983, Albuquerque, New Mexico. USDA Forest Service, Southwestern Region, Albuquerque, NM.
- Hall, F. C. 1973. Plant Communities of the Blue Mountains in Eastern Oregon and Southeastern Washington. USDA Forest Service R6-8200-1. Pacific Northwest Region. 46 pp.
- Hansen, P., S. Chadde, R. Pfister, J. Joy, D. Svoboda, J. Pierce, and L. Myers. 1988. Riparian site types, habitat types, and community types of southwestern Montana. Missoula, MT: University of Montana, Montana Riparian Association, School of Forestry. 140 p.
- Hansen, P.L., R.D. Pfister, K. Boggs, B.J. Cook, J. Joy, and D.K. Hinckley. 1995. Classification and Management of Montana's Riparian and Wetland Sites. Montana Forest and Conservation Experiment Station, School of Forestry, Missoula, MT. 646 pp.
- Hansen, P. L., and J. B. Hall. 2002. Classification and management of the USDI Bureau of Land Management's riparian and wetland sites in eastern and southern Idaho. Unpublished draft prepared for the Upper Snake River District, Bureau of Land Management, by Bitterroot Restoration, Inc., Corvallis, MT.

- Hironaka, M., M.A. Fosberg, A.H. Winward. 1983. Sagebrush-grass Habitat Types of Southern Idaho. Forest, Wildlife, and Range Experiment Station. University of Idaho, Moscow, Idaho. Bulletin No. 35.
- Idaho Natural Heritage Program, Oregon Natural Heritage Data Base, and Washington Natural Heritage Program. 1986. Final Report, Phase I, 1986 National Natural Landmark Project, Pacific Northwest Region, National Park Service; Including classification of the following ecological themes: Antelope Bitterbrush Shrub Steppe, Big Sagebrush Steppe, Mountain Mahogany Chapparral, and Palouse and Plateau Grasslands. Prepared for the U.S. Department of the Interior, National Park Service. 48 pp.
- Jankovsky-Jones, M., C. Murphy, and C. Coulter. 2001. Riparian and wetland plant associations of southwestern Idaho with a focus on the Bureau of Land Management's Lower Snake River District. Miscellaneous Report BLM/ID/ST-01/001+1730. Bureau of Land Management, Boise, ID. 191 pp. plus appendices.
- Jennings, M. D., D. Faber-Langendoen, R. K. Peet, O. L. Loucks, D. C. Glenn-Lewin, A. Damman, M. G. Barbour, R. Pfister, D. H. Grossman, D. Roberts, D. Tart, M. Walker, S. S. Talbot, J. Walker, G. S. Hartshorn, G. Waggoner, M. D. Abrams, A. Hill, M. Rejmanek. 2006. Description, documentation, and evaluation of associations and alliances within the U.S. National Vegetation Classification, Version 4.5. Ecological Society of America, Vegetation Classification Panel. Washington. 119p.
- Johnson, C. G., Jr., and R. R. Clausnitzer. 1992. Plant associations of the Blue and Ochoco Mountains. USDA Forest Service R6-ERW-TP-036-92. Pacific Northwest Region, Wallowa-Whitman National Forest. 164 pp. plus appendices.
- Johnson, C.G. Jr., and S.A. Simon. 1987. Plant associations of the Wallowa-Snake Province, Wallowa-Whitman National Forest. USDA Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest, R6-ECOL-TP-255A-86. 400 pp.
- Jones, G. 1992. Wyoming plant community classification. Wyoming Natural Diversity Database, University of Wyoming, Laramie. 184 pp.
- Kagan, J. S., J. A. Christy, M. P. Murray, and J. A. Titus. 2004. Classification of native vegetation of Oregon. January 2004. Oregon Natural Heritage Information Center, Portland. 52 pp.
- Kittel, G., E. VanWie, M. Damm, R. Rondeau, S. Kettler, A. McMullen, and J. Sanderson. 1999. A classification of riparian wetland plant associations of Colorado: A users guide to the classification project. Colorado Natural Heritage Program, Colorado State University, Fort Collins. 71 pp plus appendices.
- Knight, D.H., G.P. Jones, Y. Akashi, and R.W. Myers. 1987. Vegetation ecology in the Bighorn Canyon National Recreation Area. Unpublished report prepared for the USDI National Park Service and the Univ. of Wyoming-Nat. Park Service Research

- Kovalchik, B. L. 1987. Riparian Zone Associations: Deschutes, Ochoco, Fremont, and Winema National Forests. USDA Forest Service, Region 6 Ecology Technical Paper 279-87. Pacific Northwest Region, Portland, OR. 171 pp.
- Kovalchik, B. L. and R. R. Clausnitzer. 2004. Classification and management of aquatic, riparian, and wetland sites on the national forests of eastern Washington: series description. Gen. Tech. Rep. PNW-GTR-593. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. In cooperation with: Pacific Northwest Region, Colville, Okanogan, and Wenatchee National Forests. 354 p. Available: <http://www.fs.fed.us/pnw/publications/gtr593/>.
- Lillybridge, T. R., B. L. Kovalchik, C. K. Williams, and B. G. Smith. 1995. Field guide for forested plant associations of the Wenatchee National Forest. Pacific Northwest Research Station General Technical Report No. 359. United States Department of Agriculture, Forest Service, and Pacific Northwest Research Station Portland, Oregon, in cooperation with Pacific Northwest Region Wenatchee National Forest. 273 pp. plus appendices.
- Lewis, M. E. 1975. Plant communities of the Jarbidge Mountain Complex, Humboldt National Forest. Unpublished report compiled for the USDA Forest Service, Intermountain Region. 22 pp.
- Lewis, M. E., and R. Riegelhuth. 1964. Sawtooth Mountain study area: ecology and vegetation. National Park Service and U. S. Forest Service, Study report No. 2. 25 pp.
- Manning, M. E., and W. G. Padgett. 1995. Riparian community type classification for the Humboldt and Toiyabe National Forests, Nevada and eastern California. USDA Forest Service, Intermountain Region Ecology and Classification Program, Ogden, UT. 274 pp.
- McCune, B. and M. J. Mefford. 2006. PC-ORD. Multivariate Analysis of Ecological Data, Version 5.06. MjM Software, Gleneden Beach, Oregon, U.S.A.
- McCune, B. and J. B. Grace. 2002. Analysis of Ecological Communities. With a contribution by Dean L. Urban. MjM Software, Gleneden Beach. 304 pp.
- McLean, A. 1970. Plant communities of the Similkameen Valley, British Columbia, and their relationships to soils. Ecological Monographs 40: 403-423.
- McNab, W. H. and P. E. Avers, comps. 1994. Ecological subregions of the United States: Section Descriptions. Administrative Publication WO-WSA-5. Washington, DC: U. S. Department of Agriculture, Forest Service. 267 p.
- Moseley, R. K. 1999. Riparian and wetland communities in southwestern Idaho: second-year inventory results and preliminary catalog of community types. Unpublished report prepared for Lower Snake River District Bureau of Land Management and Idaho Field Office, The Nature Conservancy. 43 pp. plus appendices.

- Moseley, R. K., and R. J. Bursik. 1994. Black cottonwood communities of Spion Kop Research Natural Area, Coeur d'Alene River, Idaho. Cooperative Challenge Cost Share Project, Idaho Panhandle National Forests and Idaho Conservation Data Center, Idaho Department of Fish and Game. 14 pp. plus appendices.
- Mueggler, W. F. and W. L. Stewart. 1980. Grassland and shrubland habitat types of Western Montana. USDA Forest Service General Technical Report INT-66. Intermountain Forest and Range Experiment Station, Ogden, UT. 154 pp.
- NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.2. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer>. (Accessed on numerous dates; data current as of June 8, 2007).
- Northwest Management Inc. 2006. Report on the NPS Vegetation Mapping Project at Craters of the Moon National Monument. Unpublished report prepared for US Department of the Interior, Inventory and Monitoring Program, Upper Columbia Basin Network, Moscow, 18 pp.
- Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1989. Riparian community type classification of Utah and southeastern Idaho. USDA Forest Service R4-Ecol-89-01. Intermountain Region, Ogden, UT. 191 pp.
- Peek, J. M., J. J. Yeo, W. O. Hickey, J. L. Lauer, and J. C. Claar. 2005. Shrub-steppe vegetation of the East Fork and the Middle Fork of the Salmon River drainages. University of Idaho Wildlife and Range Experiment Station Bulletin 82, Moscow, ID. 78 pp.
- Pfister, R. D., B. L. Kovalchik, S. F. Arno, and R. C. Presby. 1977. Forest habitat types of Montana. USDA Forest Service General Technical Report INT-34. Intermountain Forest and Range Experiment Station, Ogden, UT. 174 pp.
- R Development Core Team. 2007. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing. Vienna. Available online at <http://www.R-project.org>.
- Reid, M., P. Comer, H. Barrett, S. Caicco, R. Crawford, C. Jean, G. Jones, J. Kagan, M. Karl, G. Kittel, P. Lyon, M. Manning, E. Peterson, R. Rosentreter, and S. Rust. 2002. International classification of ecological communities: Terrestrial vegetation of the United States. Sagebrush Vegetation of the Western United States. Final Report for the USGS Forest and Rangeland Ecosystem Science Center, Boise. NatureServe, Arlington. 154 pp. plus appendices.
- Rust, S. K., and J. J. Miller. 2008. Classification of upland shrubland vegetation on Boise and Sawtooth National Forests. Unpublished report prepared for Boise and Sawtooth National Forests, USDA Forest Service, Boise National Forest, Boise. 194 pp.
- Rust, S. K. and P. Wolken. 2008. Classification of the plant communities of Craters of the Moon National Monument and Preserve, Idaho. Natural Resource Technical Report, NPS/UCBN/NRTR – 2008/096. National Park Service, Fort Collins, Colorado.

- Sawyer, J. O., and T. Keeler-Wolf. 1995. A manual of California vegetation. California Native Plant Society. 471 pp.
- Schlatterer, E. F. 1972. A preliminary description of plant communities found on the Sawtooth, White Cloud, Boulder, and Pioneer Mountains. USDA, Forest Service, Intermountain Region, Ogden, UT. 111 pp.
- Steele, R., R. D. Pfister, R. A. Ryker, and J. A. Kittams. 1981. Forest habitat types of central Idaho. USDA Forest Service General Technical Report INT-114. Intermountain Forest and Range Experiment Station, Ogden, UT. 138 pp.
- Tart, D., C. Williams, J. DiBenedetto, E. Crowe, M. Girard, H. Gordon, K. Sleavin, M. Manning, J. Haglund, B. Short, and D. Wheeler. 2005. Section 2: Existing vegetation classification protocol. In: R. Brohman and L. Bryant, eds. Existing Vegetation Classification and Mapping Technical Guide. USDA Forest Service, Ecosystem Management Coordination Staff, Gen. Tech. Rep. WO-67. Washington. 34 pp.
- The Nature Conservancy and Environmental Systems Research Institute. 1994a. Field Methods for Vegetation Mapping. Unpublished report prepared for US Department of the Interior, National Biological Survey and National Park Service by The Nature Conservancy and Environmental Systems Research Institute, Arlington.
- The Nature Conservancy and Environmental Systems Research Institute. 1994b. Standardized National Vegetation Classification System. Unpublished report prepared for US Department of the Interior, National Biological Survey and National Park Service by The Nature Conservancy and Environmental Systems Research Institute, Arlington.
- Thilenius, J. F., G. R. Brown, and A. L. Medina. 1994. Vegetation on semi-arid rangelands, Cheyenne River Basin, Wyoming. General Technical Report RM-GTR-263. Fort Collins, CO: U. S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experimental station. 60 p.
- Tisdale, E. W. 1986. Canyon grasslands and associated shrublands of west-central Idaho and adjacent areas. Bulletin Number 40; Forest, Wildlife and Range Experiment Station; Moscow. 42 pp.
- Twit, S. J., and K. E. Houston. 1980. Grassland and shrubland habitat types of the Shoshone National Forest. USDA Forest Service, Rocky Mountain Region, Shoshone National Forest. 143 pp.
- Tuhy, J. S., and S. Jensen. 1982. Riparian classification for the Upper Salmon/Middle Fork Salmon River drainages, Idaho. White Horse Associates, Smithfield, UT. 183 pp.
- USDA Forest Service. 2008. LANDFIRE.RR\_EVT [digital raster data]. USDA Forest Service, Landfire Program, Missoula. Available online at <http://www.landfire.gov/>.

- USDA, NRCS. 2007. The PLANTS Database (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
- Winward, A. H. 1970. Taxonomic and ecological relationships of the big sagebrush complex in Idaho. Unpublished dissertation, University of Idaho, Moscow. 80 pp.
- Youngblood, A. P., W. G. Padgett, and A. H. Winward. 1985. Riparian community type classification of eastern Idaho - western Wyoming. USDA Forest Service R4-Ecol-85-01. Intermountain Region, Ogden, UT. 78 pp.



## Appendix A. Dichotomous Key to the Classification

The field key to plant communities of the National Recreation Area follows. The key is structured into physiognomic classes (or lifeform groups). These classes do not constrain the classification *per se*, rather they are employed to assist in applying the classification. In the field, different expressions of a given plant association may occur as different physiognomic classes. Given this, associations may be found through multiple pathways within the key.

### Use of the Key

To use the field key most effectively, identify a representative, homogeneous stand of vegetation. Work through the entire hierarchy of the key, beginning with *Key to Lifeform Groups*, to each sequential dichotomous lead. Estimate plant cover on an area of approximately 405 m<sup>2</sup>. If a satisfactory determination is not made in stands with low total cover, consider adjusting diagnostic species cover break-points downward. Assignment of individual species to lifeform follows USDA, NRCS (2007).

In the key, the term *relative cover* is used. In this context relative cover refers to the proportional abundance of the given species (or group of species) with respect to the total abundance of the associated group. The value is calculated by dividing the percent cover of the species under consideration by the total cover of the respective group of species. For example, the relative cover of native graminoid species is calculated as follows: (sum of native graminoid species cover within the sample) / (total cover of all graminoids within the sample) = (relative native graminoid composition).

The dichotomous key refers to shrub indicator species. These species include: *Symphoricarpos albus*, *Amelanchier alnifolia*, *Artemisia tridentata*, *Mahonia aquifolium*, *Mahonia repens*, *Purshia tridentata*, and *Shepherdia canadensis*.

*Betula occidentalis* is considered a tree species following USDA, NRCS (2007). For this reason the *Betula occidentalis* / *Cornus sericea* (BEOC2/COSE16) association appears in Part A of the following key, though it is classified as shrubland (following NatureServe 2007 and see Table 1).

### Key to Lifeform Groups

- 1a) Tree canopy cover (alone or combined)  $\geq 10\%$ , **Part A: Forest, Woodland, and Savannah**, lead 4a.
- 1b) Tree canopy cover  $< 10\%$ , lead 2a.
  - 2a) Shrub canopy cover  $\geq 10\%$ , **Part B: Shrublands and Shrub-Steppe**, lead 23a.
  - 2b) Shrub canopy cover  $< 10\%$ , lead 3a.
    - 3a) Herbaceous canopy cover  $\geq 10\%$ , **Part C: Herbaceous Vegetation**, lead 46a.
    - 3b) Herbaceous canopy cover  $< 10\%$ , **Part D: Sparse Vegetation**, lead 66a.

### Part A: Forest, Woodland, and Savannah

- 4a) *Pseudotsuga menziesii*  $< 7\%$  cover, lead 5a.
  - 5a) *Pinus ponderosa*  $\geq 7\%$  cover, lead 6a.
    - 6a) *Populus balsamifera* spp. *trichocarpa* is more abundant than *Pinus ponderosa*, lead 7a.
      - 7a) *Symphoricarpos albus* or *Cornus sericeus*  $\geq 10\%$  cover, **POBAT/SYAL**.

- 7b) *Symphoricarpos albus* or *Cornus sericeus* <10% cover, **POBAT/SAEX**.
- 6b) *Populus balsamifera* spp. *trichocarpa* is less abundant than *Pinus ponderosa*, lead 8a.
- 8a) Total shrub cover  $\geq 6\%$ , lead 9a.
- 9a) *Crataegus douglasii*  $\geq 5\%$  cover, **PIPO/CRDO2**.
- 9b) *Crataegus douglasii* <5% cover, lead 10a.
- 10a) *Symphoricarpos albus*  $\geq 50\%$  relative to the total cover of indicator shrub species or the most abundant shrub indicator species (see the list of species above), **PIPO/SYAL**.
- 10b) *Symphoricarpos albus* <50% relative to the total cover of indicator shrub species and is less abundant than other shrub indicator species, lead 11a.
- 11a) *Purshia tridentata*  $\geq 50\%$  relative to the total cover of indicator shrub species, **PIPO/PUTR2**.
- 11b) *Purshia tridentata* <50% relative to the total cover of indicator shrub species, lead 12a.
- 12a) *Amelanchier alnifolia*  $\geq 50\%$  relative to the total cover of indicator shrub species or the most abundant shrub indicator species, **PIPO/AMAL2**.
- 12b) *Amelanchier alnifolia* <50% relative to the total cover of indicator shrub species, lead 13a.
- 13a) *Shepherdia canadensis*  $\geq 50\%$  relative to the total cover of indicator shrub species or the most abundant shrub indicator species, **PIPO/SHCA**.
- 13b) *Shepherdia canadensis* <50% relative to the total cover of indicator shrub species, lead 14a.
- 14a) *Mahonia repens*  $\geq 2\%$  cover, **PIPO/MARE11**.
- 14b) *Mahonia repens* <2% cover, **PIPO/MAAQ2**.
- 8b) Total shrub cover <6%, lead 15a.
- 15a) Native graminoid composition <50% relative cover, **PIPO/BRTE**.
- 15b) Native graminoid composition  $\geq 50\%$  relative cover, lead 16a.
- 16a) *Hesperostipa comata*  $\geq 3\%$  cover, **PIPO/HECO26**.
- 16b) *Hesperostipa comata* <3% cover, lead 17a.
- 17a) *Festuca idahoensis*  $\geq 3\%$  cover, **PIPO/FEID**.
- 17b) *Festuca idahoensis* <3% cover, lead 18a.
- 18a) *Pseudoroegneria spicata*  $\geq 1\%$  cover, **PIPO/PSSP6**.
- 18b) *Pseudoroegneria spicata* <1% cover, **PIPO/AMAL2**.
- 5b) *Pinus ponderosa* <7% cover, minor forest and woodland associations and cover types (represented on  $\leq 2$  sample plots) including POTR5/SYAL, BEOC2/COSE16, BEPA, JUSC2, ACPL, PYCO/SYAL, ROPS and ULAM/BRTE. Determination of these associations and cover types is based on the dominant tree species in the following order: POTR5>BEOC2>BEPA>JUSC2>ACPL>ULAM>PYCO>ROPS.
- 4b) *Pseudotsuga menziesii*  $\geq 7\%$  cover, lead 19a.
- 19a) *Pinus ponderosa*  $\geq 7\%$  cover, lead 7a.
- 19b) *Pinus ponderosa* <7% cover, lead 20a.
- 20a) *Holodiscus discolor* or *Physocarpus malvaceus* (alone or in combination)  $\geq 6\%$  cover or greater than the combined cover of *Acer glabrum* and *Corylus cornuta*, **PSME/PHMA5**.
- 20b) *Holodiscus discolor* or *Physocarpus malvaceus* (alone or in combination) <6%, lead 21a.
- 21a) *Acer glabrum* or *Corylus cornuta* (alone or in combination)  $\geq 4\%$  cover, **PSME/ACGL**.

- 21b) *Acer glabrum* and *Corylus cornuta* (in combination) <4% cover, lead 22a.
- 22a) *Symphoricarpos albus*  $\geq 3\%$  cover, **PSME/SYAL**.
- 22b) *Symphoricarpos albus* <3% cover, **PSME/PSSP6**.

Part B: Shrublands and Shrub-Steppe

- 23a) *Artemisia tridentata*  $\geq 7\%$  cover or  $\geq$  *Purshia tridentata*, lead 24a.
- 24a) *Festuca idahoensis*  $\geq 3\%$  cover, **ARTR2/FEID**.
- 24b) *Festuca idahoensis* <3% cover, lead 25a.
- 25a) *Pseudoroegneria spicata*  $\geq 3\%$  cover, **ARTRW8/PSSP6**.
- 25b) *Pseudoroegneria spicata* <3% cover, lead 26a.
- 26a) *Leymus cinereus*  $\geq 4\%$  cover, **ARTR2/LECI4**.
- 26b) *Leymus cinereus* <4% cover, lead 27a.
- 27a) *Hesperostipa comata* is present, **ARTRW8/HECO26**.
- 27b) *Hesperostipa comata* is absent, **ARTR2/BRTE**.
- 23b) *Artemisia tridentata* <7 % cover, lead 28a.
- 28a) *Purshia tridentata* <7% cover, lead 29a.
- 29a) *Artemisia tripartita* spp. *tripartita*  $\geq 7\%$  cover, **ARTRT2/POSE**.
- 29b) *Artemisia tripartita* spp. *tripartita* <7% cover, lead 30a.
- 30a) *Alnus viridis* ssp. *sinuata*  $\geq 25\%$  cover, **ALVIS/MESIC FORBS**.
- 30b) *Alnus viridis* ssp. *sinuata* <25% cover, lead 31a.
- 31a) *Alnus incana*  $\geq 25\%$  cover, **ALIN2/MESIC FORBS**.
- 31b) *Alnus incana* <25% cover, lead 32a.
- 32a) *Crataegus douglasii*  $\geq 7\%$  cover, **CRDO2/MESIC GRAMINOIDS**.
- 32b) *Crataegus douglasii* <7% cover, lead 33a.
- 33a) *Prunus virginiana*  $\geq 25\%$  cover, **PRVI**.
- 33b) *Prunus virginiana* <25% cover, lead 34a.
- 34a) *Ericameria nauseosa*  $\geq 5\%$  cover, **ERNA10/BRTE**.
- 34b) *Ericameria nauseosa* <5% cover, lead 35a.
- 35a) *Salix exigua*  $\geq 10\%$  cover, lead 36a.
- 36a) *Equisetum arvense*  $\geq 10\%$  cover, **SAEX/EQAR**.
- 36b) *Equisetum arvense* <10% cover, **SAEX/BARREN**.
- 35b) *Salix exigua* <10% cover, lead 37a.
- 37a) *Rosa woodsii*  $\geq 7\%$  cover, **ROWO**.
- 37b) *Rosa woodsii* <7% cover, lead 38a.
- 38a) *Symphoricarpos albus*  $\geq 7\%$  cover, **SYAL**.
- 38b) *Symphoricarpos albus* <7% cover, lead 39a.
- 39a) *Amalanchier alnifolia*  $\geq 7\%$  cover, **AMAL2/PSSP6**.
- 39b) *Amalanchier alnifolia* <7% cover, lead 40a.
- 40a) *Philadelphus lewisii*  $\geq 3\%$  cover, **PHLE4/PSSP6**.
- 40b) *Philadelphus lewisii* <3% cover and *Rhus glabra* present, **RHGL/HECO26**.
- 28b) *Purshia tridentata*  $\geq 7\%$  cover, lead 40a.
- 41a) *Festuca idahoensis*  $\geq 3\%$  cover, **PUTR2/FEID**.
- 41b) *Festuca idahoensis* <3% cover, lead 42a.
- 42a) *Pseudoroegneria spicata*  $\geq 3\%$  cover, **PUTR2/PSSP6**.
- 42b) *Pseudoroegneria spicata* <3% cover, lead 43a.
- 43a) *Salvia dorrii*  $\geq 3\%$  cover, **PUTR2-SADO4/PSSP6**.
- 43b) *Salvia dorrii* <3% cover, lead 44a.

- 44a) *Hesperostipa comata*  $\geq 1\%$  cover, **PUTR2/HECO26**.
- 44b) *Hesperostipa comata*  $< 1\%$  cover, lead 45a.
- 45a) *Achnatherum hymenoides*  $\geq 1\%$  cover, **PUTR2/ACHY**.
- 45b) *Achnatherum hymenoides*  $< 1\%$  cover, **PUTR2/BRTE**.

#### Part C: Herbaceous Vegetation

- 46a) Tree species  $\geq 7\%$  cover (alone or in combination), lead 4a.
- 46b) Tree species  $< 7\%$  cover, lead 47a.
  - 47a) Shrub species  $\geq 7\%$  cover, lead 23a.
  - 47b) Shrub species  $< 7\%$  cover, lead 48a.
    - 48a) *Phalaris arundinacea*, *Juncus balticus*, or *Schoenoplectus acutus*  $\geq 2\%$  cover, lead 49a.
      - 49a) *Schoenoplectus acutus*  $\geq 25\%$  cover, **SCAC3**.
      - 49b) *Schoenoplectus acutus*  $< 25\%$  cover, lead 50a.
        - 50a) *Carex vulpinoidea*  $\geq 10\%$  cover, **CAVU2-PHAR3**.
        - 50b) *Carex vulpinoidea*  $< 10\%$  cover, lead 51a.
          - 51a) *Juncus balticus*  $\geq 10\%$  cover, **JUBA**.
          - 51b) *Juncus balticus*  $< 10\%$  cover, lead 52a.
            - 52a) *Distichlis spicata*  $\geq 25\%$  cover, **DISP**.
            - 52b) *Distichlis spicata*  $< 25\%$  cover, **PHAR3**.
- 48b) *Phalaris arundinacea*, *Juncus balticus*, and *Schoenoplectus acutus*  $< 2\%$  cover, lead 53a.
  - 53a) Mixed composition of hydrophytic or mesic species occur on seasonally flooded lacustrine or riverine gravel deposits, **GRAVEL BAR**.
  - 53b) Various vegetation compositions not occurring on seasonally flooded lacustrine or riverine gravel deposits, lead 54a.
    - 54a) Open vegetation occurring on drifting sand, **HERBACEOUS ACTIVE DUNE**.
    - 54a) Drifting sand is not present lead 55a.
      - 55a) Total graminoid composition  $< 20\%$  native, lead 56a.
        - 56a) *Eriogonum niveum* present, **ERNI2/BRTE**.
        - 56b) *Eriogonum niveum* absent, lead 57a.
          - 57a) Exotic perennial grass species  $\geq 10\%$ , **Introduced Upland Vegetation - Perennial Grassland and Forbland** (known dominance types include: **AGCR**, **BRIN**, **DAGL**, **FEOV**, **POPR**, **SECE**, and **THIN**).
          - 57b) Exotic perennial grass species  $< 10\%$ , **Introduced Upland Vegetation - Annual Grassland or Introduced Upland Vegetation - Annual and Biennial Forbland** (known dominance types include: **BRTE** and **CEDI3**).
- 55b) Total graminoid composition  $\geq 20\%$  native, lead 58a.
  - 58a) *Hesperostipa comata*  $< 3\%$  cover, lead 59a.
    - 59a) *Eriogonum compositum*  $\geq 5\%$  cover, **ERCO12/POSE**.
    - 59b) *Eriogonum compositum*  $< 5\%$  cover, lead 60a.
      - 60a) *Leymus cinereus*  $\geq 5\%$  cover, **LECI4**.
      - 60b) *Leymus cinereus*  $< 5\%$  cover, lead 61a.
        - 61a) *Festuca idahoensis*  $\geq 3\%$  cover, **FEID**.
        - 61b) *Festuca idahoensis*  $< 3\%$  cover, lead 62a.
          - 62a) *Pseudoroegneria spicata*  $\geq 3\%$  cover, lead 63a.
          - 63a) *Eriogonum heracleoides*  $\geq 2\%$  cover, **PSSP6/ERHE2**.

- 63b) *Eriogonum heracleoides* <2% cover, **PSSP6-POSE/BASA3.**
- 62b) *Pseudoroegneria spicata* <3% cover, lead 64a.
  - 64a) *Sporobolus cryptandrus*  $\geq$ 10% cover, **SPCR.**
  - 64b) *Sporobolus cryptandrus* <10% cover, lead 65a.
    - 65a) Total graminoid composition  $\geq$ 40% native, **DIOLS.**
    - 65b) Total graminoid composition <40% native, **Introduced Upland Vegetation.**
- 58b) *Hesperostipa comata*  $\geq$ 3% cover, **HECO26.**

Part D: Sparse Vegetation.

- 66a) Bedrock or large rock ( $\geq$ 10 cm diameter) is the dominant surface substrate, lead 67a.
  - 67a) Bedrock is the dominant substrate, **PHLE4/PSSPS ROCK.**
  - 67b) Large rock is the dominant substrate, **PSME/PHLE4 TALUS.**
- 66a) Bedrock or large rock ( $\geq$ 10 cm diameter) is not the dominant surface substrate, lead 68a.
  - 68a) Steep to very steep lacustrine shoreline slopes derived in gravel, clay, or loam soils, **LACUSTRINE CUT BANK.**
  - 68b) Gentle to steep slopes derived in sandy soil, lead 69a.
    - 69a) *Ericameria nauseosa* is present with *Achnatherum hymenoides*, **ERNA10/ACHY.**
    - 69a) *Ericameria nauseosa* and *Achnatherum hymenoides* are not present, lead 70a.
      - 70a) Sparse vegetation is present on drifting sand, **HERBACEOUS ACTIVE DUNE.**
      - 70a) Sparse vegetation on other substrates, unclassified sparse vegetation.



## Appendix B. Classification crosswalk to ecological system and alliance

Plant associations are listed with ecological system, alliance, and element code (association, elcode; ecological system, ES elcode; and alliance, alliance key) by National Vegetation Classification physiognomic class. Element codes are listed for each classification unit if the respective unit (association, ecological system, or alliance) is identified within the National Vegetation Classification (NatureServe 2007). If an appropriate ecological system has not been identified by NatureServe (2007), a system level cover type name is taken from USDA Forest Service (2008).

| Association Name                                 | Elcode         | Ecological System Name                                                | ES<br>Elcode   | Alliance Name                                         | Alliance Common Name                                 | Alliance<br>Key |
|--------------------------------------------------|----------------|-----------------------------------------------------------------------|----------------|-------------------------------------------------------|------------------------------------------------------|-----------------|
| <b>Forest and Woodland</b>                       |                |                                                                       |                |                                                       |                                                      |                 |
| Acer platanoides Planted Woodland                |                | Developed Open-space                                                  |                | Acer platanoides Planted Woodland Alliance            | Norway Maple Planted Woodland Alliance               |                 |
| Juniperus scopulorum Woodland                    | CEGL00<br>3550 | Northern Rocky Mountain Foothill Conifer Wooded Steppe                | CES306<br>.958 | Juniperus scopulorum Woodland Alliance                | Rocky Mountain Juniper Woodland Alliance             | A.506           |
| Pinus ponderosa / Amelanchier alnifolia Woodland | CEGL00<br>0840 | Northern Rocky Mountain Ponderosa Pine Woodland and Savanna           | CES306<br>.030 | Pinus ponderosa Woodland Alliance                     | Ponderosa Pine Woodland Alliance                     | A.530           |
| Pinus ponderosa / Bromus tectorum Woodland       |                | Northern Rocky Mountain Ponderosa Pine Woodland and Savanna           | CES306<br>.030 | Pinus ponderosa Woodland Alliance                     | Ponderosa Pine Woodland Alliance                     | A.530           |
| Pinus ponderosa / Crataegus douglasii Woodland   | CEGL00<br>0855 | Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland | CES306<br>.804 | Pinus ponderosa Temporarily Flooded Woodland Alliance | Ponderosa Pine Temporarily Flooded Woodland Alliance | A.565           |
| Pinus ponderosa / Festuca idahoensis Woodland    | CEGL00<br>0857 | Northern Rocky Mountain Ponderosa Pine Woodland and Savanna           | CES306<br>.030 | Pinus ponderosa Woodland Alliance                     | Ponderosa Pine Woodland Alliance                     | A.530           |
| Pinus ponderosa / Hesperostipa comata Woodland   | CEGL00<br>0879 | Northern Rocky Mountain Ponderosa Pine Woodland and Savanna           | CES306<br>.030 | Pinus ponderosa Woodland Alliance                     | Ponderosa Pine Woodland Alliance                     | A.530           |
| Pinus ponderosa / Mahonia aquifolium Woodland    |                | Northern Rocky Mountain Ponderosa Pine Woodland and Savanna           | CES306<br>.030 | Pinus ponderosa Woodland Alliance                     | Ponderosa Pine Woodland Alliance                     | A.530           |
| Pinus ponderosa / Mahonia repens Forest          | CEGL00<br>0187 | Northern Rocky Mountain Ponderosa Pine Woodland and Savanna           | CES306<br>.030 | Pinus ponderosa Woodland Alliance                     | Ponderosa Pine Woodland Alliance                     | A.530           |

| Association Name                                                              | Elcode         | Ecological System Name                                               | ES<br>Elcode   | Alliance Name                                                                  | Alliance Common Name                                       | Alliance<br>Key |
|-------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------|------------------------------------------------------------|-----------------|
| Pinus ponderosa /<br>Pseudoroegneria spicata<br>Woodland                      | CEGL00<br>0865 | Northern Rocky Mountain<br>Ponderosa Pine Woodland<br>and Savanna    | CES306<br>.030 | Pinus ponderosa Woodland<br>Alliance                                           | Ponderosa Pine Woodland<br>Alliance                        | A.530           |
| Pinus ponderosa / Purshia<br>tridentata Woodland                              | CEGL00<br>0867 | Northern Rocky Mountain<br>Ponderosa Pine Woodland<br>and Savanna    | CES306<br>.030 | Pinus ponderosa Woodland<br>Alliance                                           | Ponderosa Pine Woodland<br>Alliance                        | A.530           |
| Pinus ponderosa /<br>Shepherdia canadensis<br>Woodland                        |                | Northern Rocky Mountain<br>Ponderosa Pine Woodland<br>and Savanna    | CES306<br>.030 | Pinus ponderosa Woodland<br>Alliance                                           | Ponderosa Pine Woodland<br>Alliance                        | A.530           |
| Pinus ponderosa /<br>Symphoricarpos albus<br>Forest                           | CEGL00<br>0203 | Northern Rocky Mountain<br>Ponderosa Pine Woodland<br>and Savanna    | CES306<br>.030 | Pinus ponderosa Woodland<br>Alliance                                           | Ponderosa Pine Woodland<br>Alliance                        | A.530           |
| Populus balsamifera ssp.<br>trichocarpa / Mixed Herbs<br>Forest               | CEGL00<br>0675 | Columbia Basin Foothill<br>Riparian Woodland and<br>Shrubland        | CES304<br>.768 | Populus balsamifera ssp.<br>trichocarpa Temporarily<br>Flooded Forest Alliance | Black Cottonwood<br>Temporarily Flooded Forest<br>Alliance | A.311           |
| Populus balsamifera ssp.<br>trichocarpa / Salix exigua<br>Forest              | CEGL00<br>0676 | Columbia Basin Foothill<br>Riparian Woodland and<br>Shrubland        | CES304<br>.768 | Populus balsamifera ssp.<br>trichocarpa Temporarily<br>Flooded Forest Alliance | Black Cottonwood<br>Temporarily Flooded Forest<br>Alliance | A.311           |
| Populus balsamifera ssp.<br>trichocarpa /<br>Symphoricarpos albus<br>Woodland | CEGL00<br>0677 | Columbia Basin Foothill<br>Riparian Woodland and<br>Shrubland        | CES304<br>.768 | Populus balsamifera ssp.<br>trichocarpa Temporarily<br>Flooded Forest Alliance | Black Cottonwood<br>Temporarily Flooded Forest<br>Alliance | A.311           |
| Populus tremuloides /<br>Symphoricarpos albus<br>Forest                       | CEGL00<br>0609 | Rocky Mountain Aspen<br>Forest and Woodland                          | CES306<br>.813 | Populus tremuloides Forest<br>Alliance                                         | Quaking Aspen Forest<br>Alliance                           | A.274           |
| Pseudotsuga menziesii /<br>Acer glabrum Forest                                | CEGL00<br>0418 | Northern Rocky Mountain<br>Dry-Mesic Montane Mixed<br>Conifer Forest | CES306<br>.805 | Pseudotsuga menziesii<br>Forest Alliance                                       | Douglas-fir Forest Alliance                                | A.157           |
| Pseudotsuga menziesii /<br>Physocarpus malvaceus<br>Forest                    | CEGL00<br>0447 | Northern Rocky Mountain<br>Dry-Mesic Montane Mixed<br>Conifer Forest | CES306<br>.805 | Pseudotsuga menziesii<br>Forest Alliance                                       | Douglas-fir Forest Alliance                                | A.157           |
| Pseudotsuga menziesii /<br>Pseudoroegneria spicata<br>Woodland                | CEGL00<br>0908 | Northern Rocky Mountain<br>Ponderosa Pine Woodland<br>and Savanna    | CES306<br>.030 | Pseudotsuga menziesii<br>Woodland Alliance                                     | Douglas-fir Woodland<br>Alliance                           | A.552           |
| Pseudotsuga menziesii /<br>Symphoricarpos albus<br>Forest                     | CEGL00<br>0459 | Northern Rocky Mountain<br>Dry-Mesic Montane Mixed<br>Conifer Forest | CES306<br>.805 | Pseudotsuga menziesii<br>Forest Alliance                                       | Douglas-fir Forest Alliance                                | A.157           |
| Robinia pseudoacacia<br>Semi-natural Forest                                   |                | Introduced Upland<br>Vegetation - Treed                              |                | Robinia pseudoacacia<br>Semi-natural Forest<br>Alliance                        | Black Locust Semi-natural<br>Forest Alliance               |                 |

| Association Name                                                                    | Elcode         | Ecological System Name                                                      | ES<br>Elcode   | Alliance Name                                                           | Alliance Common Name                                  | Alliance<br>Key |
|-------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------|-------------------------------------------------------|-----------------|
| Ulmus americana /<br>Bromus tectorum Semi-<br>natural Woodland                      |                | Columbia Basin Foothill<br>Riparian Woodland and<br>Shrubland               | CES304<br>.768 | Ulmus americana Semi-<br>natural Woodland Alliance                      | American Elm Semi-natural<br>Woodland Alliance        |                 |
| <b>Shrubland and Shrub-steppe</b>                                                   |                |                                                                             |                |                                                                         |                                                       |                 |
| Alnus incana / Mesic<br>Forbs Shrubland                                             | CEGL00<br>1147 | Northern Rocky Mountain<br>Lower Montane Riparian<br>Woodland and Shrubland | CES306<br>.804 | Alnus incana Temporarily<br>Flooded Shrubland Alliance                  | Gray Alder Temporarily<br>Flooded Shrubland Alliance  | A.950           |
| Alnus viridis ssp. sinuata /<br>Mesic Forbs Shrubland                               | CEGL00<br>2633 | Northern Rocky Mountain<br>Lower Montane Riparian<br>Woodland and Shrubland | CES306<br>.804 | Alnus viridis ssp. sinuata<br>Temporarily Flooded<br>Shrubland Alliance | Sitka alder Temporarily<br>Flooded Shrubland Alliance | A.966           |
| Amelanchier alnifolia /<br>Pseudoroegneria spicata -<br>Bunchgrass Shrubland        | CEGL00<br>1065 | Northern Rocky Mountain<br>Montane-Foothill Deciduous<br>Shrubland          | CES306<br>.994 | Amelanchier alnifolia<br>Shrubland Alliance                             | Saskatoon Serviceberry<br>Shrubland Alliance          | A.913           |
| Artemisia tridentata /<br>Bromus tectorum Semi-<br>natural Shrubland                |                | Inter-Mountain Basins Big<br>Sagebrush Shrubland                            | CES304<br>.777 | Artemisia tridentata<br>Shrubland Alliance                              | Basin Big Sagebrush<br>Shrubland Alliance             | A.829           |
| Artemisia tridentata /<br>Festuca idahoensis Shrub<br>Herbaceous Vegetation         | CEGL00<br>1530 | Inter-Mountain Basins Big<br>Sagebrush Steppe                               | CES304<br>.778 | Artemisia tridentata Shrub<br>Herbaceous Alliance                       | Basin Big Sagebrush Shrub<br>Herbaceous Alliance      | A.1521          |
| Artemisia tridentata /<br>Leymus cinereus Shrub<br>Herbaceous Vegetation            | CEGL00<br>1458 | Inter-Mountain Basins Big<br>Sagebrush Steppe                               | CES304<br>.778 | Artemisia tridentata Shrub<br>Herbaceous Alliance                       | Basin Big Sagebrush Shrub<br>Herbaceous Alliance      | A.1521          |
| Artemisia tridentata ssp.<br>wyomingensis /<br>Hesperostipa comata<br>Shrubland     | CEGL00<br>1051 | Inter-Mountain Basins Big<br>Sagebrush Shrubland                            | CES304<br>.777 | Artemisia tridentata ssp.<br>wyomingensis Shrubland<br>Alliance         | Wyoming Big Sagebrush<br>Shrubland Alliance           | A.832           |
| Artemisia tridentata ssp.<br>wyomingensis /<br>Pseudoroegneria spicata<br>Shrubland | CEGL00<br>1009 | Inter-Mountain Basins Big<br>Sagebrush Shrubland                            | CES304<br>.777 | Artemisia tridentata ssp.<br>wyomingensis Shrubland<br>Alliance         | Wyoming Big Sagebrush<br>Shrubland Alliance           | A.832           |
| Artemisia tripartita ssp.<br>tripartita / Poa secunda<br>Shrubland                  |                | Inter-Mountain Basins Big<br>Sagebrush Shrubland                            | CES304<br>.777 | Artemisia tripartita ssp.<br>tripartita Shrub Herbaceous<br>Alliance    | Threetip Sagebrush Shrub<br>Herbaceous Alliance       | A.1528          |
| Betula occidentalis /<br>Cornus sericea Shrubland                                   | CEGL00<br>1161 | Northern Rocky Mountain<br>Lower Montane Riparian<br>Woodland and Shrubland | CES306<br>.804 | Betula occidentalis<br>Temporarily Flooded<br>Shrubland Alliance        | Water Birch Temporarily<br>Flooded Shrubland Alliance | A.967           |
| Betula papyrifera Forest                                                            | CEGL00<br>0520 | Northern Rocky Mountain<br>Lower Montane Riparian<br>Woodland and Shrubland | CES306<br>.804 | Betula papyrifera Forest<br>Alliance                                    | Paper Birch Forest Alliance                           | A.267           |

| Association Name                                                                                   | Elcode         | Ecological System Name                                             | ES<br>Elcode   | Alliance Name                                                        | Alliance Common Name                                               | Alliance<br>Key |
|----------------------------------------------------------------------------------------------------|----------------|--------------------------------------------------------------------|----------------|----------------------------------------------------------------------|--------------------------------------------------------------------|-----------------|
| Chrysothamnus<br>viscidiflorus / Bromus<br>tectorum Semi-natural<br>Shrub Herbaceous<br>Vegetation |                | Inter-Mountain Basins Big<br>Sagebrush Steppe                      | CES304<br>.778 | Chrysothamnus viscidiflorus<br>Shrub Herbaceous Alliance             | Yellow Rabbitbrush Shrub<br>Herbaceous Alliance                    |                 |
| Crataegus douglasii /<br>Mesic Graminoids Shrub<br>Herbaceous Vegetation                           |                | Northern Rocky Mountain<br>Montane-Foothill Deciduous<br>Shrubland | CES306<br>.994 | Crataegus douglasii<br>Shrubland Alliance                            | Black Hawthorn Shrubland<br>Alliance                               | A.917           |
| Ericameria nauseosa /<br>Bromus tectorum Semi-<br>natural Shrubland                                | CEGL00<br>2937 | Inter-Mountain Basins Big<br>Sagebrush Shrubland                   | CES304<br>.777 | Ericameria nauseosa<br>Shrubland Alliance                            | Rubber Rabbitbrush<br>Shrubland Alliance                           | A.835           |
| Eriogonum niveum /<br>Bromus tectorum Dwarf-<br>shrub Herbaceous<br>Vegetation                     |                | Columbia Plateau Scabland<br>Shrubland                             | CES304<br>.770 | Poa secunda Dwarf-shrub<br>Herbaceous Alliance                       | Curly Bluegrass Dwarf-shrub<br>Herbaceous Alliance                 | A.1568          |
| Philadelphus lewisii /<br>Pseudoroegneria spicata<br>Shrubland                                     |                | Columbia Basin Foothill<br>Riparian Woodland and<br>Shrubland      | CES304<br>.768 | Philadelphus lewisii<br>Intermittently Flooded<br>Shrubland Alliance | Lewis' Mock Orange<br>Intermittently Flooded<br>Shrubland Alliance | A.939           |
| Prunus virginiana<br>Shrubland                                                                     |                | Northern Rocky Mountain<br>Montane-Foothill Deciduous<br>Shrubland | CES306<br>.994 | Prunus virginiana<br>Shrubland Alliance                              | Chokecherry Shrubland<br>Alliance                                  | A.919           |
| Purshia tridentata - Salvia<br>dorrui / Pseudoroegneria<br>spicata ssp. spicata<br>Dwarf-shrubland |                | Inter-Mountain Basins Big<br>Sagebrush Steppe                      | CES304<br>.778 | Purshia tridentata Shrub<br>Herbaceous Alliance                      | Bitterbrush Shrub<br>Herbaceous Alliance                           | A.1523          |
| Purshia tridentata /<br>Achnatherum hymenoides<br>Shrubland                                        | CEGL00<br>1058 | Inter-Mountain Basins<br>Active and Stabilized Dune                | CES304<br>.775 | Purshia tridentata Shrub<br>Herbaceous Alliance                      | Bitterbrush Shrub<br>Herbaceous Alliance                           | A.1523          |
| Purshia tridentata /<br>Bromus tectorum Semi-<br>natural Shrubland                                 |                | Inter-Mountain Basins Big<br>Sagebrush Steppe                      | CES304<br>.778 | Purshia tridentata Shrub<br>Herbaceous Alliance                      | Bitterbrush Shrub<br>Herbaceous Alliance                           | A.1523          |
| Purshia tridentata /<br>Festuca idahoensis Shrub<br>Herbaceous Vegetation                          | CEGL00<br>2674 | Inter-Mountain Basins Big<br>Sagebrush Steppe                      | CES304<br>.778 | Purshia tridentata Shrub<br>Herbaceous Alliance                      | Bitterbrush Shrub<br>Herbaceous Alliance                           | A.1523          |
| Purshia tridentata /<br>Hesperostipa comata<br>Shrub Herbaceous<br>Vegetation                      | CEGL00<br>1498 | Inter-Mountain Basins Big<br>Sagebrush Steppe                      | CES304<br>.778 | Purshia tridentata Shrub<br>Herbaceous Alliance                      | Bitterbrush Shrub<br>Herbaceous Alliance                           | A.1523          |

| Association Name                                                                  | Elcode         | Ecological System Name                                                      | ES<br>Elcode   | Alliance Name                                                         | Alliance Common Name                                                         | Alliance<br>Key |
|-----------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------|
| Purshia tridentata /<br>Pseudoroegneria spicata<br>Shrub Herbaceous<br>Vegetation | CEGL00<br>1495 | Inter-Mountain Basins Big<br>Sagebrush Steppe                               | CES304<br>.778 | Purshia tridentata Shrub<br>Herbaceous Alliance                       | Bitterbrush Shrub<br>Herbaceous Alliance                                     | A.1523          |
| Rhus glabra /<br>Hesperostipa comata<br>Shrubland                                 |                | Northern Rocky Mountain<br>Montane-Foothill Deciduous<br>Shrubland          | CES306<br>.994 | Rhus glabra Shrub<br>Herbaceous Alliance                              | Smooth Sumac Shrub<br>Herbaceous Alliance                                    | A.1536          |
| Rosa gymnocarpa<br>Shrubland                                                      |                | Northern Rocky Mountain<br>Montane-Foothill Deciduous<br>Shrubland          | CES306<br>.994 | Rosa gymnocarpa<br>Shrubland Alliance                                 | Dwarf Rose Shrubland<br>Alliance                                             |                 |
| Rosa woodsii Shrubland                                                            | CEGL00<br>1126 | Northern Rocky Mountain<br>Montane-Foothill Deciduous<br>Shrubland          | CES306<br>.994 | Rosa woodsii Temporarily<br>Flooded Shrubland Alliance                | Woods' Rose Temporarily<br>Flooded Shrubland Alliance                        | A.959           |
| Salix alba / Poa pratensis<br>Semi-natural Shrubland                              |                | Columbia Basin Foothill<br>Riparian Woodland and<br>Shrubland               | CES304<br>.768 | Salix alba Semi-natural<br>Shrubland Alliance                         | White Willow Semi-natural<br>Shrubland Alliance                              |                 |
| Salix exigua / Barren<br>Shrubland                                                | CEGL00<br>1200 | Northern Rocky Mountain<br>Lower Montane Riparian<br>Woodland and Shrubland | CES306<br>.804 | Salix (exigua, interior)<br>Temporarily Flooded<br>Shrubland Alliance | (Coyote Willow, Sandbar<br>Willow) Temporarily Flooded<br>Shrubland Alliance | A.947           |
| Salix exigua / Equisetum<br>arvense Shrubland                                     | CEGL00<br>1201 | Northern Rocky Mountain<br>Lower Montane Riparian<br>Woodland and Shrubland | CES306<br>.804 | Salix (exigua, interior)<br>Temporarily Flooded<br>Shrubland Alliance | (Coyote Willow, Sandbar<br>Willow) Temporarily Flooded<br>Shrubland Alliance | A.947           |
| Symphoricarpos albus /<br>Bromus tectorum Semi-<br>natural Shrubland              |                | Northern Rocky Mountain<br>Montane-Foothill Deciduous<br>Shrubland          | CES306<br>.994 | Symphoricarpos albus<br>Shrubland Alliance                            | Common Snowberry<br>Shrubland Alliance                                       | A.925           |
| Symphoricarpos albus<br>Shrubland                                                 | CEGL00<br>5890 | Northern Rocky Mountain<br>Montane-Foothill Deciduous<br>Shrubland          | CES306<br>.994 | Symphoricarpos albus<br>Shrubland Alliance                            | Common Snowberry<br>Shrubland Alliance                                       | A.925           |
| <b>Herbaceous Vegetation</b>                                                      |                |                                                                             |                |                                                                       |                                                                              |                 |
| Active Dune Herbaceous<br>Vegetation                                              |                | Inter-Mountain Basins<br>Active and Stabilized Dune                         | CES304<br>.775 | Active Dune Herbaceous<br>Alliance                                    | Active Dune Herbaceous<br>Alliance                                           |                 |
| Agropyron cristatum Semi-<br>natural Herbaceous<br>Vegetation                     |                | Introduced Upland<br>Vegetation - Perennial<br>Grassland and Forbland       |                | Agropyron cristatum Semi-<br>natural Herbaceous<br>Alliance           | Crested Wheatgrass Semi-<br>natural Herbaceous Alliance                      |                 |
| Bromus inermis Semi-<br>natural Herbaceous<br>Vegetation                          |                | Introduced Upland<br>Vegetation - Perennial<br>Grassland and Forbland       |                | Bromus inermis Semi-<br>natural Herbaceous<br>Alliance                | Smooth Brome Semi-natural<br>Herbaceous Alliance                             |                 |
| Bromus tectorum Semi-<br>natural Herbaceous<br>Vegetation                         | CEGL00<br>3019 | Introduced Upland<br>Vegetation - Annual<br>Grassland                       |                | Bromus tectorum Semi-<br>natural Herbaceous<br>Alliance               | Cheatgrass Semi-natural<br>Herbaceous Alliance                               | A.1814          |

| Association Name                                                             | Elcode         | Ecological System Name                                                      | ES<br>Elcode   | Alliance Name                                                           | Alliance Common Name                                          | Alliance<br>Key |
|------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------|---------------------------------------------------------------|-----------------|
| Carex vulpinoidea -<br>Phalaris arundinacea<br>Herbaceous Vegetation         |                | Rocky Mountain Alpine-<br>Montane Wet Meadow                                | CES306<br>.812 | Carex vulpinoidea<br>Herbaceous Alliance                                | Fox Sedge Herbaceous<br>Alliance                              |                 |
| Centaurea diffusa Semi-<br>natural Herbaceous<br>Vegetation                  |                | Introduced Upland<br>Vegetation - Annual and<br>Biennial Forbland           |                | Centaurea diffusa Semi-<br>natural Herbaceous<br>Alliance               | Diffuse Knapweed Semi-<br>natural Herbaceous Alliance         |                 |
| Dactylis glomerata Semi-<br>natural Herbaceous<br>Vegetation                 |                | Introduced Upland<br>Vegetation - Perennial<br>Grassland and Forbland       |                | Dactylis glomerata Semi-<br>natural Herbaceous<br>Alliance              | Orchard Grass Semi-natural<br>Herbaceous Alliance             |                 |
| Dichanthelium<br>oligosanthes var.<br>scribnerianum<br>Herbaceous Vegetation |                | Northern Rocky Mountain<br>Lower Montane, Foothill<br>and Valley Grassland  | CES306<br>.040 | Dichanthelium oligosanthes<br>var. scribnerianum<br>Herbaceous Alliance | Scribner's Rosette Rrass<br>Herbaceous Alliance               |                 |
| Distichlis spicata<br>Herbaceous Vegetation                                  | CEGL00<br>1770 | North American Arid West<br>Emergent Marsh                                  | CES300<br>.729 | Distichlis spicata<br>Intermittently Flooded<br>Herbaceous Alliance     | Salt Grass Intermittently<br>Flooded Herbaceous<br>Alliance   | A.1332          |
| Eriogonum compositum /<br>Poa secunda Dwarf-shrub<br>Herbaceous Vegetation   | CEGL00<br>1784 | Columbia Plateau Scabland<br>Shrubland                                      | CES304<br>.770 | Poa secunda Dwarf-shrub<br>Herbaceous Alliance                          | Curly Bluegrass Dwarf-shrub<br>Herbaceous Alliance            | A.1568          |
| Festuca idahoensis<br>Herbaceous Vegetation                                  | CEGL00<br>1897 | Northern Rocky Mountain<br>Foothill Conifer Wooded<br>Steppe                | CES306<br>.958 | Festuca idahoensis<br>Herbaceous Alliance                               | Idaho Fescue Herbaceous<br>Alliance                           | A.1251          |
| Festuca ovina Semi-<br>natural Herbaceous<br>Vegetation                      |                | Northern Rocky Mountain<br>Foothill Conifer Wooded<br>Steppe                | CES306<br>.958 | Festuca ovina Semi-natural<br>Herbaceous Alliance                       | Sheep Fescue Semi-natural<br>Herbaceous Alliance              |                 |
| Gravel Bar Herbaceous<br>Vegetation                                          |                | Northern Rocky Mountain<br>Lower Montane Riparian<br>Woodland and Shrubland | CES306<br>.804 | Gravel Bar Herbaceous<br>Alliance                                       | Gravel Bar Herbaceous<br>Alliance                             |                 |
| Hesperostipa comata ssp.<br>comata Herbaceous<br>Vegetation                  |                | Northern Rocky Mountain<br>Lower Montane, Foothill<br>and Valley Grassland  | CES306<br>.040 | Hesperostipa comata<br>Bunch Herbaceous Alliance                        | Needle-and-Thread Bunch<br>Herbaceous Alliance                | A.1270          |
| Juncus balticus<br>Herbaceous Vegetation                                     | CEGL00<br>1838 | Rocky Mountain Alpine-<br>Montane Wet Meadow                                | CES306<br>.812 | Juncus balticus Seasonally<br>Flooded Herbaceous<br>Alliance            | Baltic Rush Seasonally<br>Flooded Herbaceous<br>Alliance      | A.1374          |
| Leymus cinereus<br>Herbaceous Vegetation                                     | CEGL00<br>1479 | Columbia Plateau Steppe<br>and Grassland                                    | CES304<br>.083 | Leymus cinereus<br>Herbaceous Alliance                                  | Great Basin Lyme Grass<br>Herbaceous Alliance                 | A.1204          |
| Phalaris arundinacea<br>Western Herbaceous<br>Vegetation                     | CEGL00<br>1474 | Rocky Mountain Alpine-<br>Montane Wet Meadow                                | CES300<br>.729 | Phalaris arundinacea<br>Seasonally Flooded<br>Herbaceous Alliance       | Reed Canarygrass<br>Seasonally Flooded<br>Herbaceous Alliance | A.1381          |

| Association Name                                                                     | Elcode         | Ecological System Name                                               | ES<br>Elcode   | Alliance Name                                                                                        | Alliance Common Name                                                              | Alliance<br>Key |
|--------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------|
| Poa pratensis Semi-natural Herbaceous Vegetation                                     |                | Introduced Upland Vegetation - Perennial Grassland and Forbland      |                | Poa pratensis Semi-natural Herbaceous Alliance                                                       | Kentucky Bluegrass Semi-natural Herbaceous Alliance                               |                 |
| Pseudoroegneria spicata - Poa secunda / Balsamorhiza sagittata Herbaceous Vegetation | CEGL00<br>1662 | Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland | CES306<br>.040 | Pseudoroegneria spicata Herbaceous Alliance                                                          | Bluebunch Wheatgrass Herbaceous Alliance                                          | A.1265          |
| Pseudoroegneria spicata / Eriogonum heracleoides Herbaceous Vegetation               | CEGL00<br>1668 | Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland | CES306<br>.040 | Pseudoroegneria spicata Herbaceous Alliance                                                          | Bluebunch Wheatgrass Herbaceous Alliance                                          | A.1265          |
| Puccinellia nuttalliana Herbaceous Vegetation                                        | CEGL00<br>1799 | Rocky Mountain Alpine-Montane Wet Meadow                             | CES306<br>.812 | Puccinellia nuttalliana Intermittently Flooded Herbaceous Alliance                                   | Nuttall's Alkali Grass Intermittently Flooded Herbaceous Alliance                 | A.1335          |
| Schoenoplectus acutus Herbaceous Vegetation                                          | CEGL00<br>1840 | Rocky Mountain Alpine-Montane Wet Meadow                             | CES306<br>.812 | Schoenoplectus acutus - (Schoenoplectus tabernaemontani) Semipermanently Flooded Herbaceous Alliance | Hardstem Bulrush - (Softstem Bulrush) Semipermanently Flooded Herbaceous Alliance | A.1443          |
| Secale cereale Planted Herbaceous Vegetation                                         | CEGL00<br>4382 | Introduced Upland Vegetation - Perennial Grassland and Forbland      |                | Secale cereale Planted Herbaceous Alliance                                                           | Cereal Rye Planted Herbaceous Alliance                                            |                 |
| Sporobolus cryptandrus Shrub Herbaceous Vegetation                                   | CEGL00<br>1514 | Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland | CES306<br>.040 | Sporobolus cryptandrus Shrub Herbaceous Alliance                                                     | Sand Dropseed Shrub Herbaceous Alliance                                           | A.1525          |
| Thinopyrum intermedium Semi-natural Herbaceous Vegetation                            | CEGL00<br>2935 | Introduced Upland Vegetation - Perennial Grassland and Forbland      |                | Thinopyrum intermedium Semi-natural Herbaceous Alliance                                              | Intermediate Wheatgrass Semi-natural Herbaceous Alliance                          | A.2529          |
| <b>Sparse Vegetation</b>                                                             |                |                                                                      |                |                                                                                                      |                                                                                   |                 |
| Ericameria nauseosa / Achnatherum hymenoides Sparse Vegetation                       |                | Inter-Mountain Basins Active and Stabilized Dune                     | CES304<br>.775 | Ericameria nauseosa Sparsely Vegetated Alliance                                                      | Rubber Rabbitbrush Sparsely Vegetated Alliance                                    |                 |
| Lacustrine Cut Bank Sparse Vegetation                                                |                | Rocky Mountain Cliff, Canyon and Massive Bedrock                     | CES306<br>.815 | Lacustrine Cut Bank Sparsely Vegetated Alliance                                                      | Lacustrine Cut Bank Sparsely Vegetated Alliance                                   |                 |
| Philadelphus lewisii / Pseudoroegneria spicata Rock Outcrop Sparse Vegetation        |                | Rocky Mountain Cliff, Canyon and Massive Bedrock                     | CES306<br>.815 | Philadelphus lewisii Rock Outcrop Sparsely Vegetated Alliance                                        | Lewis' Mock Orange Rock Outcrop Sparsely Vegetated Alliance                       |                 |

| Association Name                                                                     | Elcode | Ecological System Name                                 | ES<br>Elcode   | Alliance Name                                                        | Alliance Common Name                                    | Alliance<br>Key |
|--------------------------------------------------------------------------------------|--------|--------------------------------------------------------|----------------|----------------------------------------------------------------------|---------------------------------------------------------|-----------------|
| Pseudotsuga menziesii /<br>Philadelphus lewisii Talus<br>Sparse Wooded<br>Vegetation |        | Rocky Mountain Cliff,<br>Canyon and Massive<br>Bedrock | CES306<br>.815 | Pseudotsuga menziesii<br>Talus Wooded Sparsely<br>Vegetated Alliance | Douglas-fir Talus Wooded<br>Sparsely Vegetated Alliance |                 |

## Appendix C. Summary of classification literature

Local and regional literature regarding the classification of plant associations found within Lake Roosevelt National Recreation Area is listed alphabetically by plant association.

| Association Name                                                                                | References                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Alnus incana</i> / Mesic Forbs Shrubland                                                     | Padgett et al. 1989, Kovalchik and Clausnitzer 2004, Manning and Padgett 1995, Kittel et al. 1999, Carsey et al. 2003, Crowe et al. 2004, Kagan et al. 2004                                                                                                                                                                                                                   |
| <i>Alnus viridis</i> ssp. <i>sinuata</i> / Mesic Forbs Shrubland                                | Kovalchik and Clausnitzer 2004, Crowe and Clausnitzer 1997                                                                                                                                                                                                                                                                                                                    |
| <i>Amelanchier alnifolia</i> / <i>Pseudoroegneria spicata</i> Shrubland                         | Jones 1992                                                                                                                                                                                                                                                                                                                                                                    |
| <i>Artemisia tridentata</i> / <i>Festuca idahoensis</i> Shrub Herbaceous Vegetation             | Lewis and Riegelhuth 1964, Daubenmire 1970, McLean 1970, Franklin and Dyrness 1973, Hall 1973, Mueggler and Stewart 1980, Hironaka et al. 1983                                                                                                                                                                                                                                |
| <i>Artemisia tridentata</i> / <i>Leymus cinereus</i> Shrub Herbaceous Vegetation                | Blackburn et al. 1969, Franklin and Dyrness 1973, Kittel et al. 1999                                                                                                                                                                                                                                                                                                          |
| <i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / <i>Hesperostipa comata</i> Shrubland     | Winward 1970, Blackburn et al. 1971, Hironaka et al. 1983, Reid et al. 2002, Kagan et al. 2004, Rust and Miller 2008                                                                                                                                                                                                                                                          |
| <i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / <i>Pseudoroegneria spicata</i> Shrubland | Schlatterer 1972, Mueggler and Stewart 1980, Tweit and Houston 1980, Francis 1983, Hironaka et al. 1983, Knight et al. 1987, Jones 1992, Cooper et al. 1995, Boweman et al. 1997, Reid et al. 2002, Peek et al. 2005                                                                                                                                                          |
| <i>Betula occidentalis</i> / <i>Cornus sericea</i> Shrubland                                    | Hansen et al. 1988, Padgett et al. 1989, Manning and Padgett 1995, Moseley 1999, Jankovsky-Jones et al. 2001, Crawford 2003                                                                                                                                                                                                                                                   |
| <i>Betula papyrifera</i> Forest                                                                 | Jones 1992                                                                                                                                                                                                                                                                                                                                                                    |
| <i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation                                       | Sawyer and Keeler-Wolf 1995, Cogan et al. 2004, Rust and Wolken 2008                                                                                                                                                                                                                                                                                                          |
| <i>Distichlis spicata</i> Herbaceous Vegetation                                                 | Daubenmire 1970, Hansen et al. 1988, Evans 1989, Jones 1992, Hansen et al. 1995, Kittel et al. 1999, Jankovsky-Jones et al. 2001, Carsey et al. 2003                                                                                                                                                                                                                          |
| <i>Ericameria nauseosa</i> / <i>Bromus tectorum</i> Semi-natural Shrubland                      | Cogan et al. 2004                                                                                                                                                                                                                                                                                                                                                             |
| <i>Eriogonum compositum</i> / <i>Poa secunda</i> Dwarf-shrub Herbaceous Vegetation              | Daubenmire 1970                                                                                                                                                                                                                                                                                                                                                               |
| <i>Festuca idahoensis</i> Herbaceous Vegetation                                                 | Tweit and Houston 1980, Idaho Natural Heritage Program et al. 1986, Johnson and Clausnitzer 1992                                                                                                                                                                                                                                                                              |
| <i>Juncus balticus</i> Herbaceous Vegetation                                                    | Blackburn et al. 1971, Tuhy and Jensen 1982, Youngblood et al. 1985, Hansen et al. 1988, Evans 1989, Padgett et al. 1989, Jones 1992, Cooper et al. 1995, Hansen et al. 1995, Manning and Padgett 1995, Crowe and Clausnitzer 1997, Kittel et al. 1999, Moseley 1999, Jankovsky-Jones et al. 2001, Hansen and Hall 2002, Carsey et al. 2003, Crawford 2003, Crowe et al. 2004 |
| <i>Leymus cinereus</i> Herbaceous Vegetation                                                    | Day and Wright 1985, Johnson and Simon 1987, Hansen et al. 1988, Evans 1989, Anderson 1991, Jones 1992, Crowe et al. 2004                                                                                                                                                                                                                                                     |

| Association Name                                                                                          | References                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Phalaris arundinacea</i> Western Herbaceous Vegetation                                                 | Hansen et al. 1988, Cooper et al. 1995, Hansen et al. 1995, Hansen and Hall 2002, Carsey et al. 2003, Crawford 2003                                                                                                                          |
| <i>Pinus ponderosa</i> / <i>Crataegus douglasii</i> Woodland                                              | Crowe et al. 2004, McLean 1970, Hall 1973, Pfister et al. 1977, Steele et al. 1981, Johnson and Simon 1987, Cooper et al. 1991, Johnson and Clausnitzer 1992, Jones 1992                                                                     |
| <i>Pinus ponderosa</i> / <i>Pseudoroegneria spicata</i> Woodland                                          | Lewis and Riegelhuth 1964, McLean 1970, Schlatterer 1972, Hall 1973, Pfister et al. 1977, Steele et al. 1981, Johnson and Simon 1987, Cooper et al. 1991, Johnson and Clausnitzer 1992, Jones 1992, Thilenius et al. 1995                    |
| <i>Pinus ponderosa</i> / <i>Purshia tridentata</i> Woodland                                               | Pfister et al. 1977, Steele et al. 1981                                                                                                                                                                                                      |
| <i>Pinus ponderosa</i> / <i>Symphoricarpos albus</i> Forest                                               | Pfister et al. 1977, Steele et al. 1981, Johnson and Simon 1987, Kovalchik 1987, Cooper et al. 1991, Jones 1992, Crowe and Clausnitzer 1997, Crowe et al. 2004                                                                               |
| <i>Populus balsamifera</i> ssp. <i>trichocarpa</i> / Mixed Herbs Forest                                   | Hansen et al. 1995, Hansen and Hall 2002, Manning and Padgett 1992                                                                                                                                                                           |
| <i>Populus balsamifera</i> ssp. <i>trichocarpa</i> / <i>Symphoricarpos albus</i> Woodland                 | Hansen et al. 1995, Crowe and Clausnitzer 1997, Moseley 1999, Jankovsky-Jones et al. 2001, Hansen and Hall 2002, Crawford 2003, Crowe et al. 2004                                                                                            |
| <i>Populus tremuloides</i> / <i>Symphoricarpos albus</i> Forest                                           | Kagan et al. 2004                                                                                                                                                                                                                            |
| <i>Pseudoroegneria spicata</i> - <i>Poa secunda</i> / <i>Balsamorhiza sagittata</i> Herbaceous Vegetation | Tisdale 1986, Peek et al. 2005                                                                                                                                                                                                               |
| <i>Pseudoroegneria spicata</i> / <i>Eriogonum heracleoides</i> Herbaceous Vegetation                      | Johnson and Simon 1987                                                                                                                                                                                                                       |
| <i>Pseudotsuga menziesii</i> / <i>Acer glabrum</i> Forest                                                 | Steele et al. 1981, Johnson and Simon 1987, Jones 1992, Boweman et al. 1997, Jankovsky-Jones et al. 2001                                                                                                                                     |
| <i>Pseudotsuga menziesii</i> / <i>Physocarpus malvaceus</i> Forest                                        | Pfister et al. 1977, Steele et al. 1981, Johnson and Simon 1987, Cooper et al. 1991, Johnson and Clausnitzer 1992, Jones 1992, Cooper et al. 1995                                                                                            |
| <i>Pseudotsuga menziesii</i> / <i>Pseudoroegneria spicata</i> Woodland                                    | McLean 1970, Pfister et al. 1977, Steele et al. 1981, Cooper et al. 1991, DeVelice and Lesica 1993, Lillybridge et al. 1995                                                                                                                  |
| <i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> Forest                                         | Daubenmire 1970, Pfister et al. 1977, Steele et al. 1981, Johnson and Simon 1987, Cooper et al. 1991, Johnson and Clausnitzer 1992, Jones 1992, Boweman et al. 1997, Crawford 2003                                                           |
| <i>Purshia tridentata</i> / <i>Achnatherum hymenoides</i> Shrubland                                       | Idaho Natural Heritage Program et al. 1986, Kagan et al. 2004                                                                                                                                                                                |
| <i>Purshia tridentata</i> / <i>Festuca idahoensis</i> Shrub Herbaceous Vegetation                         | Daubenmire 1970, Franklin and Dyrness 1973, Hall 1973, Lewis 1975, Mueggler and Stewart 1980, Tweit and Houston 1980, Idaho Natural Heritage Program et al. 1986, Johnson and Simon 1987, Jones 1992, Peek et al. 2005, Rust and Miller 2008 |
| <i>Purshia tridentata</i> / <i>Hesperostipa comata</i> Shrub Herbaceous Vegetation                        | Daubenmire 1970, Hironaka et al. 1983, Idaho Natural Heritage Program et al. 1986, Rust and Miller 2008                                                                                                                                      |
| <i>Purshia tridentata</i> / <i>Pseudoroegneria spicata</i> Shrub Herbaceous Vegetation                    | Daubenmire 1970, Hall 1973, Mueggler and Stewart 1980, Hironaka et al. 1983, Idaho Natural Heritage Program et al. 1986, Johnson and Simon 1987, Johnson and Clausnitzer 1992, Peek et al. 2005, Rust and Miller 2008                        |

| Association Name                                                 | References                                                                                                                                                                         |
|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Rosa woodsii</i> Shrubland                                    | Hansen et al. 1988, Hansen et al. 1995, Manning and Padgett 1995, Hansen and Hall 2002, Crawford 2003, Kagan et al. 2004                                                           |
| <i>Salix exigua</i> / Barren Shrubland                           | Tuhy and Jensen 1982, Padgett et al. 1989, Cooper et al. 1995, Kittel et al. 1999, Moseley 1999, Jankovsky-Jones et al. 2001, Carsey et al. 2003, Crawford 2003, Kagan et al. 2004 |
| <i>Salix exigua</i> / <i>Equisetum arvense</i> Shrubland         | Youngblood et al. 1985, Jones 1992                                                                                                                                                 |
| <i>Schoenoplectus acutus</i> Herbaceous Vegetation               | Hansen et al. 1988, Evans 1989, Hansen et al. 1995, Jankovsky-Jones et al. 2001, Hansen and Hall 2002, Crowe et al. 2004                                                           |
| <i>Sporobolus cryptandrus</i> Shrub Herbaceous Vegetation        | Johnson and Simon 1987                                                                                                                                                             |
| <i>Symphoricarpos albus</i> Shrubland                            | Hall 1973, Johnson and Clausnitzer 1992                                                                                                                                            |
| <i>Thinopyrum intermedium</i> Semi-natural Herbaceous Vegetation | Cogan et al. 2004                                                                                                                                                                  |



## Appendix D. Synthesis tables

The species compositions of plant associations sampled on  $\geq 3$  fixed area plots (Table 1) on Lake Roosevelt National Recreation Area are summarized. The tables are organized alphabetically by physiognomic class: Part A: Forest, Woodland and Savanna; Part B: Shrublands and Shrub-Steppe; and Part C: Herbaceous Vegetation. Data summaries for wetland and riparian associations are presented separately in Part C. Species composition data are summarized as percent frequency followed by characteristic cover (the later shown in parentheses). For the purpose of comparison, species lists are selected for each group of associations. In some instances blank rows will appear as the summary for a given physiognomic class may span over several pages. Please refer to Table 1 for association sample sizes.

### Part A: Forest, Woodland, and Savanna.

Associations: PIPO/AMAL2, PIPO/BRTE, PIPO/HECO26, PIPO/MAAQ2, PIPO/MARE11, PIPO/PSSP6, PIPO/PUTR2

| Species                                                   | PIPO/<br>AMAL2<br>(n=22) | PIPO/<br>BRTE<br>(n=22) | PIPO/<br>HECO26<br>(n=3) | PIPO/<br>MAAQ2<br>(n=4) | PIPO/<br>MARE11<br>(n=5) | PIPO/<br>PSSP6<br>(n=11) | PIPO/<br>PUTR2<br>(n=33) |
|-----------------------------------------------------------|--------------------------|-------------------------|--------------------------|-------------------------|--------------------------|--------------------------|--------------------------|
| <b>Trees</b>                                              |                          |                         |                          |                         |                          |                          |                          |
| <i>Pinus ponderosa</i>                                    | 100<br>(32.4)            | 100<br>(29.6)           | 100 (9.8)                | 100 (37)                | 100<br>(18.5)            | 100<br>(29.3)            | 100<br>(20.5)            |
| <i>Pseudotsuga menziesii</i>                              | 36 (1.2)                 | 9 (2)                   | 33 (0.5)                 | -                       | 60 (0.8)                 | 18 (4)                   | 15 (1.4)                 |
| <b>Dwarf-shrubs</b>                                       |                          |                         |                          |                         |                          |                          |                          |
| <i>Arctostaphylos uva-ursi</i>                            | 4 (0.5)                  | 5 (0.5)                 | -                        | 25 (0.5)                | -                        | 9 (7.5)                  | -                        |
| <i>Eriogonum heracleoides</i>                             | 8 (1)                    | -                       | 67 (2)                   | -                       | 20 (1.5)                 | 27 (2.5)                 | 33 (2)                   |
| <b>Shrubs</b>                                             |                          |                         |                          |                         |                          |                          |                          |
| <i>Acer glabrum</i>                                       | -                        | -                       | -                        | -                       | -                        | -                        | -                        |
| <i>Amelanchier alnifolia</i>                              | 100<br>(3.2)             | 36 (2)                  | 33 (1.5)                 | 75 (1.2)                | 80 (3.8)                 | 73 (0.9)                 | 61 (1.9)                 |
| <i>Corylus cornuta</i>                                    | -                        | -                       | -                        | -                       | -                        | -                        | -                        |
| <i>Crataegus douglasii</i>                                | 4 (0.5)                  | 5 (0.5)                 | -                        | 25 (0.5)                | 20 (0.5)                 | -                        | 6 (0.5)                  |
| <i>Holodiscus discolor</i>                                | 8 (2)                    | 5 (1.5)                 | -                        | -                       | 40 (7)                   | -                        | 3 (3.5)                  |
| <i>Mahonia aquifolium</i>                                 | 52 (1.1)                 | 9 (0.5)                 | -                        | 100 (9)                 | -                        | 64 (1.2)                 | 3 (0.5)                  |
| <i>Mahonia repens</i>                                     | 12 (2.8)                 | -                       | -                        | -                       | 100<br>(12.2)            | -                        | 6 (2)                    |
| <i>Philadelphus lewisii</i>                               | -                        | -                       | -                        | 25 (3.5)                | -                        | -                        | 3 (0.5)                  |
| <i>Physocarpus malvaceus</i>                              | 16 (5.5)                 | -                       | -                        | -                       | -                        | -                        | 3 (1.5)                  |
| <i>Prunus virginiana</i>                                  | 12 (0.8)                 | 5 (0.5)                 | -                        | 25 (3.5)                | 60 (4.2)                 | -                        | 12 (0.8)                 |
| <i>Purshia tridentata</i>                                 | 12 (0.8)                 | 18 (0.5)                | -                        | -                       | -                        | -                        | 100<br>(19.5)            |
| <i>Rosa woodsii</i>                                       | 12 (1.8)                 | 9 (1)                   | -                        | 50 (0.5)                | 80 (3.3)                 | -                        | 15 (0.7)                 |
| <i>Shepherdia canadensis</i>                              | 12 (2.5)                 | 14 (1.5)                | -                        | 25 (1.5)                | -                        | 9 (1.5)                  | -                        |
| <i>Spiraea betulifolia</i>                                | 8 (4)                    | -                       | -                        | -                       | -                        | -                        | 6 (0.5)                  |
| <i>Symphoricarpos albus</i>                               | 80 (1.8)                 | 45 (1.2)                | 33 (3.5)                 | 100 (4)                 | 100 (2.7)                | 55 (1.7)                 | 64 (1.7)                 |
| <b>Graminoids</b>                                         |                          |                         |                          |                         |                          |                          |                          |
| <i>Achnatherum occidentale</i><br><i>ssp. occidentale</i> | 16 (1.5)                 | 9 (0.5)                 | 33 (0.5)                 | -                       | -                        | 18 (1)                   | 27 (1.1)                 |
| <i>Bromus hordeaceus ssp.</i><br><i>hordeaceus</i>        | 16 (0.8)                 | 14 (0.8)                | 33 (0.5)                 | 25 (0.5)                | 40 (1)                   | 9 (1.5)                  | 9 (0.8)                  |

| <b>Species</b>                                                 | <b>PIPO/<br/>AMAL2<br/>(n=22)</b> | <b>PIPO/<br/>BRTE<br/>(n=22)</b> | <b>PIPO/<br/>HECO26<br/>(n=3)</b> | <b>PIPO/<br/>MAAQ2<br/>(n=4)</b> | <b>PIPO/<br/>MARE11<br/>(n=5)</b> | <b>PIPO/<br/>PSSP6<br/>(n=11)</b> | <b>PIPO/<br/>PUTR2<br/>(n=33)</b> |
|----------------------------------------------------------------|-----------------------------------|----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| <i>Bromus japonicus</i>                                        | 24 (0.7)                          | 18 (2.5)                         | 67 (0.5)                          | -                                | 20 (0.5)                          | 18 (1)                            | 39 (1.7)                          |
| <i>Bromus tectorum</i>                                         | 52 (2.9)                          | 82 (5.7)                         | 67 (4.5)                          | 75 (1.5)                         | 80 (3.5)                          | 82 (3.2)                          | 82 (7.5)                          |
| <i>Calamagrostis rubescens</i>                                 | 8 (1)                             | -                                | -                                 | -                                | 40 (1)                            | -                                 | 6 (1)                             |
| <i>Carex geyeri</i>                                            | 12 (1.2)                          | 9 (0.5)                          | -                                 | 25 (0.5)                         | -                                 | 9 (3.5)                           | 24 (0.6)                          |
| <i>Carex rossii</i>                                            | 56 (0.9)                          | 27 (0.8)                         | 67 (0.5)                          | 25 (0.5)                         | 20 (30)                           | 45 (0.7)                          | 36 (1)                            |
| <i>Dactylis glomerata</i>                                      | 24 (0.5)                          | -                                | -                                 | -                                | 40 (1)                            | 18 (0.5)                          | 15 (0.7)                          |
| <i>Dichanthelium oligosanthes</i><br><i>var. scribnerianum</i> | 20 (1.3)                          | 18 (1.8)                         | 67 (2)                            | 50 (0.5)                         | 20 (0.5)                          | 36 (0.8)                          | 9 (1.8)                           |
| <i>Elymus glaucus</i>                                          | 64 (1.3)                          | 14 (1.5)                         | 33 (0.5)                          | 25 (1.5)                         | 80 (0.8)                          | 27 (0.8)                          | 30 (1.3)                          |
| <i>Festuca idahoensis</i>                                      | 20 (1.7)                          | 14 (2.8)                         | -                                 | -                                | 20 (1.5)                          | 36 (3.3)                          | 24 (1.4)                          |
| <i>Festuca occidentalis</i>                                    | 28 (1.2)                          | 5 (0.5)                          | -                                 | -                                | 20 (1.5)                          | 9 (0.5)                           | 9 (0.8)                           |
| <i>Hesperostipa comata</i> ssp.<br><i>comata</i>               | 8 (1)                             | 18 (5.6)                         | 100<br>(13.7)                     | -                                | 20 (3.5)                          | 9 (1.5)                           | 33 (2.1)                          |
| <i>Koeleria macrantha</i>                                      | 48 (1.1)                          | 18 (0.8)                         | 33 (0.5)                          | 25 (1.5)                         | -                                 | 36 (1.8)                          | 9 (0.5)                           |
| <i>Poa bulbosa</i>                                             | 52 (1.1)                          | 77 (2)                           | 33 (0.5)                          | 25 (0.5)                         | 60 (0.5)                          | 55 (1.2)                          | 91 (2.9)                          |
| <i>Poa compressa</i>                                           | 16 (3)                            | 18 (1.3)                         | -                                 | -                                | -                                 | 18 (1)                            | 3 (0.5)                           |
| <i>Poa pratensis</i>                                           | 40 (0.8)                          | 55 (4)                           | 33 (0.5)                          | 50 (0.5)                         | 40 (0.5)                          | 18 (0.5)                          | 21 (1.1)                          |
| <i>Poa secunda</i>                                             | 8 (0.5)                           | 32 (1.2)                         | -                                 | -                                | -                                 | -                                 | 24 (0.6)                          |
| <i>Pseudoroegneria spicata</i><br>ssp. <i>spicata</i>          | 48 (1.7)                          | 23 (0.7)                         | 33 (0.5)                          | 75 (2.2)                         | 20 (0.5)                          | 100 (4.4)                         | 45 (1.7)                          |
| <i>Trisetum canescens</i>                                      | 16 (2.3)                          | 9 (1)                            | 33 (3.5)                          | -                                | -                                 | 9 (3.5)                           | 6 (0.5)                           |
| <b>Forbs</b>                                                   |                                   |                                  |                                   |                                  |                                   |                                   |                                   |
| <i>Achillea millefolium</i>                                    | 88 (1)                            | 77 (1.1)                         | 33 (1.5)                          | 50 (1.5)                         | 80 (0.5)                          | 64 (1.2)                          | 91 (0.8)                          |
| <i>Apocynum</i><br><i>androsaemifolium</i>                     | 24 (1.3)                          | 9 (4.5)                          | -                                 | -                                | 80 (0.5)                          | 9 (3.5)                           | 12 (1.5)                          |
| <i>Balsamorhiza sagittata</i>                                  | 40 (4.3)                          | 27 (1.5)                         | 67 (2)                            | 75 (2.5)                         | 40 (1.5)                          | 64 (4.6)                          | 67 (3.2)                          |
| <i>Centaurea diffusa</i>                                       | 28 (0.8)                          | 18 (0.5)                         | -                                 | -                                | -                                 | 27 (0.5)                          | 3 (0.5)                           |
| <i>Collomia grandiflora</i>                                    | 8 (0.5)                           | 9 (0.5)                          | -                                 | -                                | -                                 | 9 (0.5)                           | 21 (0.5)                          |
| <i>Crepis acuminata</i>                                        | -                                 | -                                | -                                 | -                                | 20 (0.5)                          | 18 (0.5)                          | 18 (0.5)                          |
| <i>Fragaria virginiana</i>                                     | 16 (0.8)                          | -                                | -                                 | 25 (0.5)                         | 60 (0.5)                          | 18 (0.5)                          | 9 (0.5)                           |
| <i>Gaillardia aristata</i>                                     | 28 (0.6)                          | 23 (0.7)                         | -                                 | 50 (0.5)                         | 20 (0.5)                          | 18 (1)                            | 30 (0.6)                          |
| <i>Galium aparine</i>                                          | 12 (0.8)                          | 14 (0.8)                         | -                                 | -                                | 20 (0.5)                          | 9 (0.5)                           | 39 (0.7)                          |
| <i>Hieracium albiflorum</i>                                    | 36 (0.9)                          | 14 (0.5)                         | -                                 | -                                | 40 (0.5)                          | -                                 | 12 (1)                            |
| <i>Hieracium cynoglossoides</i>                                | 28 (1.1)                          | 14 (0.5)                         | -                                 | -                                | -                                 | 36 (1)                            | 21 (0.8)                          |
| <i>Hypericum perforatum</i>                                    | 28 (1.4)                          | 18 (1.8)                         | 33 (1.5)                          | -                                | 20 (0.5)                          | 18 (0.5)                          | 9 (0.5)                           |
| <i>Lithospermum ruderales</i>                                  | 36 (0.7)                          | 5 (1.5)                          | 33 (1.5)                          | 50 (0.5)                         | 100 (0.7)                         | 36 (0.5)                          | 61 (1.4)                          |
| <i>Lupinus sericeus</i>                                        | 52 (4.4)                          | 68 (4.1)                         | 33 (7.5)                          | 25 (12.5)                        | 80 (1.3)                          | 73 (3.4)                          | 73 (3.3)                          |
| <i>Penstemon confertus</i>                                     | 32 (1.1)                          | 5 (0.5)                          | -                                 | 50 (0.5)                         | 20 (0.5)                          | 27 (0.5)                          | 9 (1.8)                           |
| <i>Potentilla arguta</i>                                       | 12 (0.8)                          | -                                | 33 (1.5)                          | -                                | 20 (0.5)                          | 9 (0.5)                           | 3 (3.5)                           |
| <i>Rumex acetosella</i>                                        | 52 (1.6)                          | 55 (1.8)                         | 100 (0.8)                         | 75 (0.8)                         | 40 (0.5)                          | 64 (1.5)                          | 45 (1.8)                          |
| <i>Silene menziesii</i>                                        | 16 (0.5)                          | 9 (0.5)                          | -                                 | -                                | -                                 | 9 (1.5)                           | 6 (0.5)                           |
| <i>Taraxacum officinale</i>                                    | 8 (0.5)                           | 5 (0.5)                          | 33 (0.5)                          | 25 (0.5)                         | 20 (0.5)                          | 9 (0.5)                           | 6 (0.5)                           |
| <i>Tragopogon dubius</i>                                       | 44 (0.5)                          | 45 (0.5)                         | 33 (0.5)                          | 50 (0.5)                         | 40 (0.5)                          | 45 (0.5)                          | 67 (0.5)                          |
| <i>Triteleia grandiflora</i> var.<br><i>grandiflora</i>        | -                                 | 5 (0.5)                          | -                                 | -                                | -                                 | -                                 | 45 (0.5)                          |
| <i>Verbascum thapsus</i>                                       | 8 (0.5)                           | 18 (0.5)                         | -                                 | -                                | 20 (0.5)                          | -                                 | 12 (0.5)                          |
| <i>Vicia villosa</i>                                           | 28 (1.2)                          | 23 (1.9)                         | 67 (2)                            | 50 (0.5)                         | 40 (1)                            | 27 (0.5)                          | 15 (0.9)                          |

Associations: PIPO/SHCA, PIPO/SYAL, PSME/ACGL, PSME/PHMA5, PSME/SYAL

| Species                                                     | PIPO/<br>SHCA<br>(n=7) | PIPO/<br>SYAL<br>(n=89) | PSME/<br>ACGL<br>(n=9) | PSME/<br>PHMA5<br>(n=16) | PSME/<br>PSSP6<br>(n=5) | PSME/<br>SYAL<br>(n=14) |
|-------------------------------------------------------------|------------------------|-------------------------|------------------------|--------------------------|-------------------------|-------------------------|
| <b>Trees</b>                                                |                        |                         |                        |                          |                         |                         |
| <i>Pinus ponderosa</i>                                      | 100<br>(33.6)          | 100 (23.3)              | 44 (6.4)               | 63 (5.4)                 | 100 (9.7)               | 86 (11.2)               |
| <i>Pseudotsuga menziesii</i>                                | 43 (5.7)               | 39 (3.2)                | 100 (30.3)             | 100 (25.9)               | 100 (14.9)              | 100 (31)                |
| <b>Dwarf-shrubs</b>                                         |                        |                         |                        |                          |                         |                         |
| <i>Arctostaphylos uva-ursi</i>                              | 43 (5.8)               | 7 (1.2)                 | -                      | 6 (0.5)                  | 20 (1.5)                | 7 (0.5)                 |
| <i>Eriogonum heracleoides</i>                               | 29 (1)                 | 22 (1.2)                | -                      | 13 (0.5)                 | 20 (7.5)                | -                       |
| <b>Shrubs</b>                                               |                        |                         |                        |                          |                         |                         |
| <i>Acer glabrum</i>                                         | -                      | 4 (3.5)                 | 89 (12.9)              | 25 (3.8)                 | -                       | -                       |
| <i>Amelanchier alnifolia</i>                                | 100 (1.1)              | 88 (2.5)                | 44 (4.3)               | 75 (2.9)                 | 100 (1.1)               | 79 (3.5)                |
| <i>Corylus cornuta</i>                                      | -                      | 6 (2.9)                 | 56 (7.9)               | 6 (3.5)                  | -                       | 14 (2.5)                |
| <i>Crataegus douglasii</i>                                  | 14 (0.5)               | 12 (1.9)                | -                      | -                        | -                       | -                       |
| <i>Holodiscus discolor</i>                                  | -                      | 9 (2.4)                 | 44 (3.3)               | 94 (9.7)                 | -                       | 7 (1.5)                 |
| <i>Mahonia aquifolium</i>                                   | 100 (3.5)              | 48 (3.8)                | 100 (3.3)              | 50 (2.1)                 | 20 (3.5)                | 71 (4.8)                |
| <i>Mahonia repens</i>                                       | -                      | 21 (2.7)                | -                      | 31 (4.1)                 | 20 (0.5)                | 29 (4.5)                |
| <i>Philadelphus lewisii</i>                                 | 14 (3.5)               | 9 (2)                   | 33 (2.8)               | 44 (2.1)                 | 20 (1.5)                | -                       |
| <i>Physocarpus malvaceus</i>                                | -                      | 9 (0.8)                 | 33 (3.2)               | 81 (7.8)                 | -                       | 21 (2.5)                |
| <i>Prunus virginiana</i>                                    | 43 (2.2)               | 39 (2.2)                | 33 (2.8)               | 25 (1.5)                 | 40 (2)                  | 29 (1.8)                |
| <i>Purshia tridentata</i>                                   | -                      | 18 (2.9)                | -                      | -                        | 40 (4.5)                | 7 (1.5)                 |
| <i>Rosa woodsii</i>                                         | 29 (0.5)               | 38 (1.2)                | 22 (1)                 | 19 (1.8)                 | -                       | 36 (1.1)                |
| <i>Shepherdia canadensis</i>                                | 100 (7.2)              | 8 (2.6)                 | -                      | -                        | 20 (3.5)                | 7 (3.5)                 |
| <i>Spiraea betulifolia</i>                                  | 14 (7.5)               | 15 (2.7)                | 11 (3.5)               | 6 (0.5)                  | -                       | 29 (1.8)                |
| <i>Symphoricarpos albus</i>                                 | 71 (1.9)               | 100 (14.4)              | 100 (10.1)             | 94 (8)                   | 20 (1.5)                | 100 (19)                |
| <b>Graminoids</b>                                           |                        |                         |                        |                          |                         |                         |
| <i>Achnatherum occidentale</i> ssp. <i>occidentale</i>      | 43 (0.5)               | 13 (0.7)                | -                      | 6 (0.5)                  | -                       | 14 (1)                  |
| <i>Bromus hordeaceus</i> ssp. <i>hordeaceus</i>             | -                      | 11 (1.3)                | -                      | 19 (0.5)                 | -                       | -                       |
| <i>Bromus japonicus</i>                                     | -                      | 34 (0.9)                | 11 (0.5)               | 19 (1.2)                 | 20 (0.5)                | 36 (1.3)                |
| <i>Bromus tectorum</i>                                      | 43 (1.2)               | 56 (4.2)                | 33 (2.2)               | 38 (3.7)                 | 80 (6.8)                | 36 (5.5)                |
| <i>Calamagrostis rubescens</i>                              | -                      | 10 (22.8)               | 11 (1.5)               | 31 (9.1)                 | 20 (3.5)                | 29 (10.9)               |
| <i>Carex geyeri</i>                                         | -                      | 11 (2.2)                | 11 (0.5)               | 19 (0.5)                 | -                       | 36 (2.3)                |
| <i>Carex rossii</i>                                         | 43 (0.8)               | 31 (3.9)                | 22 (2)                 | 13 (0.5)                 | 20 (0.5)                | 7 (0.5)                 |
| <i>Dactylis glomerata</i>                                   | 29 (0.5)               | 19 (1.3)                | 22 (1)                 | 6 (0.5)                  | -                       | 29 (1)                  |
| <i>Dichanthelium oligosanthes</i> var. <i>scribnerianum</i> | 29 (2)                 | 18 (0.6)                | -                      | -                        | -                       | 14 (0.5)                |
| <i>Elymus glaucus</i>                                       | 29 (1)                 | 55 (1.3)                | 56 (3.5)               | 50 (3)                   | 20 (0.5)                | 64 (1.3)                |
| <i>Festuca idahoensis</i>                                   | 57 (0.8)               | 25 (1.1)                | -                      | 31 (1.1)                 | 60 (4.2)                | 43 (1.2)                |
| <i>Festuca occidentalis</i>                                 | 14 (0.5)               | 12 (0.7)                | 44 (0.5)               | 44 (0.9)                 | 40 (0.5)                | 21 (0.5)                |
| <i>Hesperostipa comata</i> ssp. <i>comata</i>               | -                      | 8 (1.5)                 | -                      | -                        | -                       | -                       |
| <i>Koeleria macrantha</i>                                   | 43 (0.8)               | 26 (1.4)                | -                      | 6 (1.5)                  | 80 (1)                  | 21 (0.8)                |
| <i>Poa bulbosa</i>                                          | 29 (0.5)               | 63 (1.8)                | -                      | 50 (0.6)                 | 40 (0.5)                | 57 (1.4)                |
| <i>Poa compressa</i>                                        | 29 (0.5)               | 10 (3.1)                | 11 (0.5)               | 31 (2.5)                 | -                       | 7 (1.5)                 |
| <i>Poa pratensis</i>                                        | 14 (1.5)               | 47 (1.5)                | 22 (4)                 | 38 (1.2)                 | 20 (1.5)                | 50 (3.2)                |
| <i>Poa secunda</i>                                          | 14 (0.5)               | 16 (0.7)                | 11 (0.5)               | 19 (1.8)                 | 60 (2.2)                | 14 (16.8)               |
| <i>Pseudoroegneria spicata</i> ssp. <i>spicata</i>          | 71 (0.7)               | 53 (2.1)                | 11 (3.5)               | 56 (2.7)                 | 100 (4.9)               | 29 (2.3)                |

| Species                                                 | PIPO/<br>SHCA<br>(n=7) | PIPO/<br>SYAL<br>(n=89) | PSME/<br>ACGL<br>(n=9) | PSME/<br>PHMA5<br>(n=16) | PSME/<br>PSSP6<br>(n=5) | PSME/<br>SYAL<br>(n=14) |
|---------------------------------------------------------|------------------------|-------------------------|------------------------|--------------------------|-------------------------|-------------------------|
| <i>Trisetum canescens</i>                               | 29 (1)                 | 8 (0.5)                 | -                      | 25 (0.8)                 | -                       | 29 (1.3)                |
| <b>Forbs</b>                                            |                        |                         |                        |                          |                         |                         |
| <i>Achillea millefolium</i>                             | 86 (1)                 | 87 (1.1)                | 22 (1)                 | 69 (0.7)                 | 80 (1.8)                | 64 (0.8)                |
| <i>Apocynum androsaemifolium</i>                        | 29 (1.5)               | 28 (1.6)                | -                      | 13 (0.5)                 | 20 (3.5)                | 43 (0.8)                |
| <i>Balsamorhiza sagittata</i>                           | 57 (2.3)               | 63 (4.1)                | 11 (0.5)               | 56 (1.4)                 | 100 (2.9)               | 64 (1.8)                |
| <i>Centaurea diffusa</i>                                | 14 (0.5)               | 17 (0.6)                | 11 (0.5)               | 19 (0.5)                 | -                       | 14 (0.5)                |
| <i>Collomia grandiflora</i>                             | -                      | 12 (0.5)                | -                      | 6 (0.5)                  | -                       | 7 (0.5)                 |
| <i>Crepis acuminata</i>                                 | -                      | 15 (0.5)                | 11 (0.5)               | 19 (0.5)                 | 40 (0.5)                | 14 (0.5)                |
| <i>Fragaria virginiana</i>                              | 14 (0.5)               | 16 (0.7)                | 11 (0.5)               | 13 (0.5)                 | -                       | 21 (1.2)                |
| <i>Gaillardia aristata</i>                              | 57 (0.5)               | 19 (0.6)                | -                      | 6 (0.5)                  | 20 (0.5)                | 14 (0.5)                |
| <i>Galium aparine</i>                                   | -                      | 27 (0.5)                | 33 (0.8)               | 38 (0.7)                 | 40 (0.5)                | 43 (0.7)                |
| <i>Hieracium albiflorum</i>                             | 57 (1)                 | 11 (0.7)                | 22 (2)                 | 13 (0.5)                 | -                       | 36 (0.7)                |
| <i>Hieracium cynoglossoides</i>                         | 14 (0.5)               | 36 (1)                  | -                      | 50 (0.9)                 | 60 (0.8)                | 43 (1)                  |
| <i>Hypericum perforatum</i>                             | 14 (1.5)               | 33 (1.1)                | 22 (0.5)               | 38 (1.3)                 | 20 (0.5)                | 29 (0.5)                |
| <i>Lithospermum ruderae</i>                             | 43 (0.5)               | 73 (1)                  | 11 (1.5)               | 25 (0.8)                 | -                       | 57 (0.8)                |
| <i>Lupinus sericeus</i>                                 | -                      | 64 (3.8)                | 11 (7.5)               | 44 (1.9)                 | 40 (1.5)                | 50 (6.6)                |
| <i>Penstemon confertus</i>                              | 57 (1.8)               | 22 (1.1)                | 22 (0.5)               | -                        | -                       | 21 (0.5)                |
| <i>Potentilla arguta</i>                                | 14 (0.5)               | 17 (0.8)                | 22 (0.5)               | 19 (1.8)                 | -                       | 14 (0.5)                |
| <i>Rumex acetosella</i>                                 | 57 (1)                 | 43 (0.9)                | -                      | 6 (0.5)                  | 20 (1.5)                | 29 (1)                  |
| <i>Silene menziesii</i>                                 | 29 (0.5)               | 10 (1.1)                | 11 (0.5)               | -                        | -                       | 21 (0.8)                |
| <i>Taraxacum officinale</i>                             | 14 (0.5)               | 12 (0.5)                | 33 (0.5)               | 44 (0.5)                 | 20 (0.5)                | 36 (0.5)                |
| <i>Tragopogon dubius</i>                                | 29 (0.5)               | 58 (0.5)                | 33 (0.5)               | 50 (0.5)                 | 40 (0.5)                | 50 (0.5)                |
| <i>Triteleia grandiflora</i> var.<br><i>grandiflora</i> | -                      | 12 (0.5)                | -                      | 19 (0.5)                 | 20 (0.5)                | 14 (0.5)                |
| <i>Verbascum thapsus</i>                                | -                      | 10 (0.6)                | 22 (0.5)               | -                        | -                       | 7 (0.5)                 |
| <i>Vicia villosa</i>                                    | 29 (3.5)               | 26 (3)                  | -                      | 6 (3.5)                  | -                       | 14 (0.5)                |

## Part B: Shrublands and Shrub-steppe.

Associations: AMAL2/PSSP6, ARTRW8/HECO26, ARTRW8/PSSP6, ERNA10/BRTE, ERNI2/BRTE, PUTR2/BRTE

| Species                                                        | AMAL2/<br>PSSP6<br>(n=5) | ARTRW8/<br>HECO26<br>(n=5) | ARTRW8/<br>PSSP6<br>(n=6) | ERNA10/<br>BRTE<br>(n=7) | ERNI2/<br>BRTE<br>(n=3) | PUTR2/<br>BRTE<br>(n=10) |
|----------------------------------------------------------------|--------------------------|----------------------------|---------------------------|--------------------------|-------------------------|--------------------------|
| <b>Trees</b>                                                   |                          |                            |                           |                          |                         |                          |
| <i>Pinus ponderosa</i>                                         | 4 (11)                   | -                          | 1 (0.5)                   | -                        | -                       | 4 (12)                   |
| <b>Dwarf-shrubs</b>                                            |                          |                            |                           |                          |                         |                          |
| <i>Artemisia dracunculus</i>                                   | -                        | -                          | -                         | 43 (0.8)                 | -                       | 40 (0.8)                 |
| <i>Eriogonum heracleoides</i>                                  | 20 (0.5)                 | 80 (1.3)                   | 50 (1.2)                  | 29 (1)                   | -                       | 50 (2.3)                 |
| <i>Eriogonum niveum</i>                                        | -                        | -                          | -                         | 57 (1.8)                 | 100 (1.2)               | 30 (1.8)                 |
| <i>Opuntia polyacantha</i>                                     | -                        | 20 (0.5)                   | -                         | 29 (0.5)                 | -                       | 30 (0.5)                 |
| <i>Salvia dorrii</i>                                           | -                        | -                          | 17 (0.5)                  | -                        | -                       | -                        |
| <b>Shrubs</b>                                                  |                          |                            |                           |                          |                         |                          |
| <i>Amelanchier alnifolia</i>                                   | 100 (8.5)                | -                          | 17 (0.5)                  | 29 (0.5)                 | -                       | 40 (1.3)                 |
| <i>Artemisia tridentata</i>                                    | -                        | 100 (33)                   | 100 (18.3)                | 14 (1.5)                 | -                       | 10 (0.5)                 |
| <i>Artemisia tripartita</i>                                    | -                        | 40 (10)                    | 33 (7)                    | -                        | -                       | -                        |
| <i>Chrysothamnus viscidiflorus</i>                             | -                        | 40 (0.5)                   | 17 (7.5)                  | 71 (6.3)                 | -                       | 20 (1)                   |
| <i>Crataegus douglasii</i>                                     | 20 (1.5)                 | -                          | -                         | -                        | -                       | 10 (1.5)                 |
| <i>Ericameria nauseosa</i>                                     | -                        | -                          | 17 (12.5)                 | 100 (21.8)               | -                       | 20 (7.5)                 |
| <i>Philadelphus lewisii</i>                                    | 40 (4.5)                 | -                          | -                         | -                        | -                       | 20 (2.5)                 |
| <i>Prunus virginiana</i>                                       | 20 (1.5)                 | -                          | -                         | -                        | -                       | 20 (2.5)                 |
| <i>Purshia tridentata</i>                                      | -                        | 100 (1.9)                  | 33 (5.5)                  | 57 (1)                   | -                       | 100 (18.6)               |
| <i>Rhus glabra</i>                                             | -                        | -                          | -                         | -                        | -                       | -                        |
| <i>Rosa woodsii</i>                                            | 20 (0.5)                 | -                          | -                         | -                        | -                       | 20 (2)                   |
| <i>Symphoricarpos albus</i>                                    | 100 (1.7)                | -                          | -                         | 14 (1.5)                 | -                       | 50 (8.4)                 |
| <i>Tetradymia canescens</i>                                    | -                        | 40 (2)                     | 17 (0.5)                  | 29 (0.5)                 | -                       | -                        |
| <b>Graminoids</b>                                              |                          |                            |                           |                          |                         |                          |
| <i>Achnatherum occidentale</i><br><i>ssp. occidentale</i>      | -                        | -                          | 17 (0.5)                  | 14 (3.5)                 | -                       | 40 (2.3)                 |
| <i>Bromus hordeaceus ssp.</i><br><i>hordeaceus</i>             | 60 (0.8)                 | -                          | -                         | -                        | -                       | 10 (0.5)                 |
| <i>Bromus inermis</i>                                          | -                        | -                          | -                         | 14 (3.5)                 | -                       | 10 (7.5)                 |
| <i>Bromus japonicus</i>                                        | 40 (1.5)                 | 20 (3.5)                   | 17 (1.5)                  | 29 (2)                   | 100 (12.3)              | 50 (1.7)                 |
| <i>Bromus tectorum</i>                                         | 80 (2.5)                 | 100 (19.5)                 | 100 (11.3)                | 100 (15.5)               | 100 (24.2)              | 100 (5.6)                |
| <i>Carex rossii</i>                                            | 20 (0.5)                 | -                          | -                         | -                        | -                       | 20 (0.5)                 |
| <i>Dichanthelium oligosanthes</i><br><i>var. scribnerianum</i> | -                        | -                          | -                         | -                        | -                       | 10 (3.5)                 |
| <i>Elymus glaucus</i>                                          | -                        | -                          | -                         | -                        | -                       | 10 (1.5)                 |
| <i>Festuca idahoensis</i>                                      | 20 (1.5)                 | 20 (0.5)                   | 17 (0.5)                  | 14 (0.5)                 | -                       | 10 (0.5)                 |
| <i>Hesperostipa comata ssp.</i><br><i>comata</i>               | -                        | 100 (8.6)                  | 33 (1.5)                  | 43 (1.8)                 | 33 (0.5)                | 20 (0.5)                 |
| <i>Koeleria macrantha</i>                                      | -                        | 20 (0.5)                   | 17 (1.5)                  | -                        | -                       | 10 (1.5)                 |
| <i>Poa bulbosa</i>                                             | 40 (1.5)                 | 60 (0.5)                   | 17 (3.5)                  | 71 (2.5)                 | 100 (2.8)               | 90 (2.1)                 |
| <i>Poa pratensis</i>                                           | 20 (0.5)                 | -                          | -                         | 29 (0.5)                 | 33 (3.5)                | 30 (10.7)                |
| <i>Poa secunda</i>                                             | 20 (1.5)                 | 80 (0.5)                   | 83 (0.9)                  | 29 (0.5)                 | -                       | 20 (1.5)                 |
| <i>Pseudoroegneria spicata</i><br><i>ssp. spicata</i>          | 100 (4.1)                | 60 (1.5)                   | 100 (7.2)                 | 14 (1.5)                 | -                       | 30 (0.5)                 |
| <i>Thinopyrum intermedium</i>                                  | -                        | -                          | 33 (0.5)                  | 14 (3.5)                 | -                       | 20 (8)                   |

| Species                                                 | AMAL2/<br>PSSP6<br>(n=5) | ARTRW8/<br>HECO26<br>(n=5) | ARTRW8/<br>PSSP6<br>(n=6) | ERNA10/<br>BRTE<br>(n=7) | ERNI2/<br>BRTE<br>(n=3) | PUTR2/<br>BRTE<br>(n=10) |
|---------------------------------------------------------|--------------------------|----------------------------|---------------------------|--------------------------|-------------------------|--------------------------|
| <b>Forbs</b>                                            |                          |                            |                           |                          |                         |                          |
| <i>Achillea millefolium</i>                             | 60 (0.8)                 | 60 (0.5)                   | 67 (0.8)                  | 71 (1.3)                 | -                       | 80 (1.1)                 |
| <i>Amsinckia lycopsoides</i>                            | -                        | -                          | -                         | 14 (0.5)                 | 67 (1)                  | -                        |
| <i>Astragalus purshii</i>                               | -                        | 20 (0.5)                   | 33 (0.5)                  | 29 (0.5)                 | -                       | -                        |
| <i>Balsamorhiza sagittata</i>                           | 60 (4.8)                 | 40 (2.5)                   | 17 (0.5)                  | 43 (1.2)                 | 67 (15.3)               | 60 (3.8)                 |
| <i>Centaurea diffusa</i>                                | 20 (0.5)                 | -                          | -                         | -                        | 33 (0.5)                | 10 (0.5)                 |
| <i>Chaenactis douglasii</i>                             | -                        | -                          | -                         | 29 (0.5)                 | -                       | 10 (0.5)                 |
| <i>Collomia grandiflora</i>                             | -                        | -                          | -                         | 14 (0.5)                 | 33 (0.5)                | 10 (0.5)                 |
| <i>Collomia linearis</i>                                | -                        | -                          | 33 (0.5)                  | 29 (0.5)                 | 33 (0.5)                | 10 (0.5)                 |
| <i>Comandra umbellata</i>                               | -                        | -                          | 17 (1.5)                  | 14 (1.5)                 | -                       | -                        |
| <i>Descurainia pinnata</i>                              | -                        | 20 (0.5)                   | -                         | -                        | -                       | -                        |
| <i>Eriogonum elatum</i>                                 | -                        | 60 (0.8)                   | 17 (0.5)                  | 43 (0.5)                 | -                       | 20 (1)                   |
| <i>Gaillardia aristata</i>                              | 20 (0.5)                 | -                          | 17 (0.5)                  | 14 (0.5)                 | -                       | 10 (0.5)                 |
| <i>Galium aparine</i>                                   | -                        | -                          | -                         | -                        | -                       | 20 (0.5)                 |
| <i>Helianthus annuus</i>                                | 20 (0.5)                 | -                          | -                         | -                        | -                       | 10 (0.5)                 |
| <i>Hypericum perforatum</i>                             | 40 (1)                   | -                          | -                         | -                        | -                       | 20 (2)                   |
| <i>Lactuca serriola</i>                                 | -                        | -                          | -                         | 29 (0.5)                 | 33 (1.5)                | 10 (0.5)                 |
| <i>Leptodactylon pungens</i>                            | -                        | 20 (0.5)                   | 17 (1.5)                  | 14 (0.5)                 | -                       | 10 (0.5)                 |
| <i>Linaria dalmatica</i>                                | 40 (1)                   | 40 (0.5)                   | 17 (0.5)                  | 14 (0.5)                 | -                       | 10 (1.5)                 |
| <i>Lithophragma parviflorum</i>                         | -                        | -                          | 17 (0.5)                  | -                        | -                       | 10 (1.5)                 |
| <i>Lithospermum ruderales</i>                           | 40 (1)                   | 20 (0.5)                   | 17 (1.5)                  | 57 (3)                   | -                       | 40 (2.8)                 |
| <i>Lomatium bicolor</i>                                 | -                        | -                          | 17 (3.5)                  | -                        | 33 (0.5)                | 10 (0.5)                 |
| <i>Lomatium dissectum</i>                               | -                        | 80 (1.5)                   | 17 (0.5)                  | -                        | -                       | -                        |
| <i>Lomatium triternatum</i>                             | 20 (0.5)                 | 20 (0.5)                   | -                         | 57 (0.5)                 | -                       | -                        |
| <i>Lupinus sericeus</i>                                 | 60 (1.8)                 | 40 (2)                     | 33 (1)                    | 71 (3.3)                 | 100 (2.8)               | 50 (1.9)                 |
| <i>Phacelia hastata</i>                                 | -                        | -                          | -                         | 14 (0.5)                 | -                       | 20 (0.5)                 |
| <i>Phacelia linearis</i>                                | -                        | 40 (0.5)                   | 17 (0.5)                  | -                        | -                       | 10 (0.5)                 |
| <i>Phlox longifolia</i>                                 | -                        | 60 (0.5)                   | 67 (0.8)                  | 29 (0.5)                 | -                       | 10 (0.5)                 |
| <i>Plantago patagonica</i>                              | -                        | 40 (0.5)                   | 17 (0.5)                  | -                        | 33 (0.5)                | 30 (0.8)                 |
| <i>Rumex acetosella</i>                                 | 20 (0.5)                 | -                          | -                         | -                        | 33 (3.5)                | 10 (1.5)                 |
| <i>Selaginella densa</i>                                | -                        | 40 (4)                     | -                         | -                        | -                       | 10 (1.5)                 |
| <i>Sisymbrium altissimum</i>                            | 20 (0.5)                 | -                          | -                         | 14 (1.5)                 | 67 (0.5)                | 10 (0.5)                 |
| <i>Tragopogon dubius</i>                                | 60 (0.5)                 | 20 (0.5)                   | 33 (0.5)                  | 57 (0.5)                 | 100 (0.8)               | 50 (0.5)                 |
| <i>Triteleia grandiflora</i> var.<br><i>grandiflora</i> | 20 (0.5)                 | 40 (0.5)                   | -                         | -                        | -                       | 40 (0.5)                 |
| <i>Verbascum thapsus</i>                                | 20 (0.5)                 | -                          | -                         | -                        | -                       | 20 (0.5)                 |
| <i>Vicia villosa</i>                                    | 20 (1.5)                 | -                          | -                         | -                        | 33 (3.5)                | 40 (1.5)                 |

Associations: PUTR2/FEID, PUTR2/HECO26, PUTR2/PSSP6, RHGL/HECO26, SYAL

| Species                                                     | PUTR2/<br>FEID<br>(n=4) | PUTR2/<br>HECO26<br>(n=12) | PUTR2/<br>PSSP6<br>(n=6) | RHGL/<br>HECO26<br>(n=3) | SYAL<br>(n=15) |
|-------------------------------------------------------------|-------------------------|----------------------------|--------------------------|--------------------------|----------------|
| Tress                                                       |                         |                            |                          |                          |                |
| <i>Pinus ponderosa</i>                                      | -                       | 3 (13)                     | 1 (3.5)                  | 1 (3.5)                  | 9 (27)         |
| Dwarf-shrubs                                                |                         |                            |                          |                          |                |
| <i>Artemisia dracunculoides</i>                             | -                       | 25 (0.8)                   | -                        | 33 (0.5)                 | 33 (0.9)       |
| <i>Eriogonum heracleoides</i>                               | 100 (3.5)               | 33 (3)                     | 83 (1.1)                 | 33 (0.5)                 | 47 (1.2)       |
| <i>Eriogonum niveum</i>                                     | -                       | 8 (0.5)                    | 67 (1.5)                 | -                        | -              |
| <i>Opuntia polyacantha</i>                                  | 25 (0.5)                | 50 (0.5)                   | -                        | -                        | -              |
| <i>Salvia dorrii</i>                                        | 25 (0.5)                | 8 (0.5)                    | -                        | -                        | -              |
| Shrubs                                                      |                         |                            |                          |                          |                |
| <i>Amelanchier alnifolia</i>                                | 75 (2.5)                | 8 (0.5)                    | 33 (1)                   | -                        | 73 (2.4)       |
| <i>Artemisia tridentata</i>                                 | -                       | 25 (1.8)                   | -                        | -                        | -              |
| <i>Artemisia tripartita</i>                                 | -                       | 25 (1.2)                   | 17 (7.5)                 | -                        | -              |
| <i>Chrysothamnus viscidiflorus</i>                          | 100 (1.5)               | 58 (3.6)                   | -                        | -                        | 7 (1.5)        |
| <i>Crataegus douglasii</i>                                  | -                       | -                          | -                        | -                        | 7 (1.5)        |
| <i>Ericameria nauseosa</i>                                  | 100 (2.3)               | 75 (4.6)                   | 17 (0.5)                 | -                        | 20 (0.8)       |
| <i>Philadelphus lewisii</i>                                 | 25 (1.5)                | -                          | 17 (0.5)                 | -                        | 7 (1.5)        |
| <i>Prunus virginiana</i>                                    | 25 (0.5)                | -                          | 17 (3.5)                 | -                        | 13 (2.5)       |
| <i>Purshia tridentata</i>                                   | 100 (9)                 | 100 (21.2)                 | 100 (11.7)               | -                        | 20 (1.2)       |
| <i>Rhus glabra</i>                                          | -                       | -                          | -                        | 100 (18.3)               | -              |
| <i>Rosa woodsii</i>                                         | -                       | 17 (0.5)                   | -                        | -                        | 53 (2)         |
| <i>Symphoricarpos albus</i>                                 | 25 (0.5)                | 8 (3.5)                    | 67 (4)                   | -                        | 100 (24)       |
| <i>Tetradymia canescens</i>                                 | -                       | 8 (7.5)                    | -                        | -                        | -              |
| Graminoids                                                  |                         |                            |                          |                          |                |
| <i>Achnatherum occidentale</i> ssp. <i>occidentale</i>      | -                       | 8 (0.5)                    | 17 (0.5)                 | -                        | 7 (3.5)        |
| <i>Bromus hordeaceus</i> ssp. <i>hordeaceus</i>             | -                       | -                          | 17 (1.5)                 | 33 (0.5)                 | 33 (1.3)       |
| <i>Bromus inermis</i>                                       | -                       | 17 (0.5)                   | -                        | -                        | 13 (4)         |
| <i>Bromus japonicus</i>                                     | -                       | 33 (1)                     | 83 (1.1)                 | 67 (1)                   | 53 (2.9)       |
| <i>Bromus tectorum</i>                                      | 100 (14.6)              | 100 (13.3)                 | 100 (18.3)               | 67 (4.5)                 | 87 (8.3)       |
| <i>Carex rossii</i>                                         | -                       | -                          | -                        | -                        | 20 (0.5)       |
| <i>Dichanthelium oligosanthes</i> var. <i>scribnerianum</i> | -                       | -                          | -                        | 100 (3.5)                | 13 (0.5)       |
| <i>Elymus glaucus</i>                                       | -                       | 8 (0.5)                    | -                        | -                        | 27 (1)         |
| <i>Festuca idahoensis</i>                                   | 100 (4.9)               | 25 (1.2)                   | 17 (0.5)                 | 33 (0.5)                 | 20 (1.5)       |
| <i>Hesperostipa comata</i> ssp. <i>comata</i>               | 50 (7)                  | 100 (5.5)                  | 50 (1.2)                 | 100 (7.8)                | 13 (0.5)       |
| <i>Koeleria macrantha</i>                                   | -                       | -                          | -                        | -                        | 20 (0.8)       |
| <i>Poa bulbosa</i>                                          | 75 (0.8)                | 67 (4)                     | 33 (3.5)                 | 67 (0.5)                 | 53 (4.7)       |
| <i>Poa pratensis</i>                                        | 50 (1)                  | 17 (0.5)                   | -                        | -                        | 60 (1.1)       |
| <i>Poa secunda</i>                                          | 50 (0.5)                | 50 (1.3)                   | 100 (1.2)                | -                        | 20 (0.5)       |
| <i>Pseudoroegneria spicata</i> ssp. <i>spicata</i>          | 50 (8)                  | 25 (1.5)                   | 100 (4.8)                | 33 (0.5)                 | 20 (1.8)       |
| <i>Thinopyrum intermedium</i>                               | -                       | -                          | -                        | -                        | 33 (6.3)       |
| Forbs                                                       |                         |                            |                          |                          |                |
| <i>Achillea millefolium</i>                                 | 75 (0.8)                | 92 (1)                     | 83 (0.5)                 | 33 (0.5)                 | 80 (1.2)       |
| <i>Amsinckia lycopsoides</i>                                | -                       | 17 (0.5)                   | 33 (0.5)                 | -                        | -              |
| <i>Astragalus purshii</i>                                   | -                       | 8 (0.5)                    | -                        | -                        | -              |

| <b>Species</b>                                          | <b>PUTR2/<br/>FEID<br/>(n=4)</b> | <b>PUTR2/<br/>HECO26<br/>(n=12)</b> | <b>PUTR2/<br/>PSSP6<br/>(n=6)</b> | <b>RHGL/<br/>HECO26<br/>(n=3)</b> | <b>SYAL<br/>(n=15)</b> |
|---------------------------------------------------------|----------------------------------|-------------------------------------|-----------------------------------|-----------------------------------|------------------------|
| <i>Balsamorhiza sagittata</i>                           | 75 (2.8)                         | 58 (3.9)                            | 50 (4.2)                          | 33 (3.5)                          | 47 (3.6)               |
| <i>Centaurea diffusa</i>                                | -                                | -                                   | -                                 | 33 (0.5)                          | 13 (1.3)               |
| <i>Chaenactis douglasii</i>                             | -                                | 17 (0.5)                            | -                                 | -                                 | -                      |
| <i>Collomia grandiflora</i>                             | -                                | -                                   | 67 (0.5)                          | -                                 | 7 (0.5)                |
| <i>Collomia linearis</i>                                | -                                | 17 (0.5)                            | 17 (0.5)                          | -                                 | 7 (0.5)                |
| <i>Comandra umbellata</i>                               | -                                | 25 (0.8)                            | 17 (0.5)                          | -                                 | -                      |
| <i>Descurainia pinnata</i>                              | -                                | 8 (0.5)                             | 17 (0.5)                          | 33 (0.5)                          | 27 (0.5)               |
| <i>Eriogonum elatum</i>                                 | 100 (1.8)                        | 75 (1.6)                            | 17 (3.5)                          | 33 (1.5)                          | 13 (2)                 |
| <i>Gaillardia aristata</i>                              | -                                | 17 (0.5)                            | -                                 | 33 (0.5)                          | 13 (0.5)               |
| <i>Galium aparine</i>                                   | 75 (0.5)                         | 58 (1.1)                            | 33 (0.5)                          | -                                 | 33 (0.5)               |
| <i>Helianthus annuus</i>                                | -                                | -                                   | -                                 | -                                 | 33 (0.5)               |
| <i>Hypericum perforatum</i>                             | -                                | 8 (1.5)                             | -                                 | 33 (1.5)                          | 60 (2.1)               |
| <i>Lactuca serriola</i>                                 | -                                | 17 (0.5)                            | 17 (0.5)                          | 33 (0.5)                          | 20 (0.8)               |
| <i>Leptodactylon pungens</i>                            | 25 (0.5)                         | 8 (0.5)                             | -                                 | -                                 | -                      |
| <i>Linaria dalmatica</i>                                | -                                | 17 (1.5)                            | -                                 | -                                 | 7 (0.5)                |
| <i>Lithophragma parviflorum</i>                         | 25 (0.5)                         | 8 (0.5)                             | -                                 | -                                 | 13 (0.5)               |
| <i>Lithospermum ruderae</i>                             | 50 (1)                           | 50 (0.7)                            | 33 (0.5)                          | -                                 | 53 (0.9)               |
| <i>Lomatium bicolor</i>                                 | -                                | 8 (0.5)                             | 17 (0.5)                          | -                                 | 7 (0.5)                |
| <i>Lomatium dissectum</i>                               | 25 (0.5)                         | 17 (0.5)                            | 50 (2.5)                          | -                                 | 7 (7.5)                |
| <i>Lomatium triternatum</i>                             | 25 (0.5)                         | 42 (0.5)                            | 33 (0.5)                          | -                                 | 13 (0.5)               |
| <i>Lupinus sericeus</i>                                 | 50 (1.5)                         | 50 (1.7)                            | 50 (0.8)                          | 67 (2.5)                          | 60 (2.1)               |
| <i>Phacelia hastata</i>                                 | -                                | 17 (0.5)                            | 17 (0.5)                          | -                                 | 7 (0.5)                |
| <i>Phacelia linearis</i>                                | -                                | 33 (0.5)                            | 33 (1)                            | 33 (0.5)                          | 7 (0.5)                |
| <i>Phlox longifolia</i>                                 | 25 (0.5)                         | 33 (0.5)                            | 17 (0.5)                          | -                                 | 7 (0.5)                |
| <i>Plantago patagonica</i>                              | -                                | 8 (0.5)                             | 17 (0.5)                          | 67 (0.5)                          | -                      |
| <i>Rumex acetosella</i>                                 | -                                | 8 (0.5)                             | -                                 | 67 (1.5)                          | 40 (0.7)               |
| <i>Selaginella densa</i>                                | -                                | -                                   | 67 (0.8)                          | -                                 | -                      |
| <i>Sisymbrium altissimum</i>                            | 25 (1.5)                         | -                                   | 33 (0.5)                          | 33 (1.5)                          | 33 (1.1)               |
| <i>Tragopogon dubius</i>                                | 75 (0.5)                         | 42 (0.5)                            | 67 (0.5)                          | 67 (0.5)                          | 60 (0.5)               |
| <i>Triteleia grandiflora</i> var.<br><i>grandiflora</i> | 75 (0.5)                         | 42 (0.5)                            | 17 (0.5)                          | -                                 | 20 (0.5)               |
| <i>Verbascum thapsus</i>                                | 25 (0.5)                         | 8 (0.5)                             | -                                 | -                                 | 47 (0.6)               |
| <i>Vicia villosa</i>                                    | -                                | 8 (1.5)                             | -                                 | 67 (2.5)                          | 60 (2.5)               |

## Part C: Herbaceous Vegetation

| Species                                                        | BRTE<br>(n=18) | DIOLS<br>(n=6) | FEOV<br>(n=3) | HECO26<br>(n=4) | POPR<br>(n=7) | PSSP6-<br>POSE/<br>BASA3<br>(n=4) | THIN6<br>(n=7) |
|----------------------------------------------------------------|----------------|----------------|---------------|-----------------|---------------|-----------------------------------|----------------|
| Tress                                                          |                |                |               |                 |               |                                   |                |
| <i>Pinus ponderosa</i>                                         | 17 (1.5)       | 33 (3)         | 33 (3.5)      | 25 (0.5)        | 43 (4)        | 25 (1.5)                          | 0(0)           |
| Dwarf-shrubs                                                   |                |                |               |                 |               |                                   |                |
| <i>Eriogonum heracleoides</i>                                  | -              | -              | 33 (0.5)      | 25 (0.5)        | -             | -                                 | 14 (0.5)       |
| Shrubs                                                         |                |                |               |                 |               |                                   |                |
| <i>Amelanchier alnifolia</i>                                   | 6 (0.5)        | 17 (0.5)       | -             | -               | -             | 25 (0.5)                          | 14 (0.5)       |
| <i>Ericameria nauseosa</i>                                     | 22 (1.3)       | -              | -             | -               | -             | 25 (1.5)                          | 29 (1)         |
| <i>Purshia tridentata</i>                                      | -              | 17 (3.5)       | -             | 25 (1.5)        | -             | 25 (1.5)                          | -              |
| <i>Rosa woodsii</i>                                            | 6 (0.5)        | -              | -             | -               | 14 (0.5)      | -                                 | 29 (1)         |
| <i>Symphoricarpos albus</i>                                    | 11 (0.5)       | -              | -             | -               | 29 (0.5)      | 25 (0.5)                          | 14 (3.5)       |
| Graminoids                                                     |                |                |               |                 |               |                                   |                |
| <i>Bromus hordeaceus</i> ssp.<br><i>hordeaceus</i>             | 28 (3.3)       | 17 (1.5)       | 33 (0.5)      | -               | 86 (2.7)      | -                                 | 43 (1.5)       |
| <i>Bromus inermis</i>                                          | 11 (2)         | 33 (2)         | -             | -               | 14 (1.5)      | -                                 | -              |
| <i>Bromus japonicus</i>                                        | 50 (3.9)       | 67 (1)         | 33 (1.5)      | 50 (2)          | 57 (4)        | 75 (1.2)                          | 71 (0.9)       |
| <i>Bromus tectorum</i>                                         | 100 (15.7)     | 67 (3.5)       | 67 (4.5)      | 100 (3.5)       | 57 (3)        | 100 (5.5)                         | 71 (8.4)       |
| <i>Dactylis glomerata</i>                                      | 11 (2)         | -              | -             | -               | 14 (1.5)      | -                                 | 29 (0.5)       |
| <i>Dichanthelium oligosanthes</i><br>var. <i>scribnerianum</i> | 6 (0.5)        | 100 (4)        | 67 (1)        | 75 (6.2)        | 29 (1.5)      | -                                 | 14 (0.5)       |
| <i>Elymus glaucus</i>                                          | 17 (0.5)       | -              | -             | 25 (1.5)        | 14 (0.5)      | -                                 | 14 (1.5)       |
| <i>Elymus repens</i>                                           | 22 (2.5)       | 17 (1.5)       | -             | -               | 14 (7.5)      | -                                 | 14 (12.5)      |
| <i>Festuca idahoensis</i>                                      | 17 (0.5)       | -              | -             | -               | -             | -                                 | -              |
| <i>Festuca ovina</i>                                           | 6 (1.5)        | 17 (0.5)       | 100<br>(30)   | -               | -             | -                                 | -              |
| <i>Hesperostipa comata</i> ssp.<br><i>comata</i>               | 17 (0.8)       | -              | 33 (7.5)      | 100 (14.4)      | 14 (0.5)      | -                                 | -              |
| <i>Poa bulbosa</i>                                             | 61 (3.7)       | 67 (2.3)       | 67 (1)        | 25 (0.5)        | 29 (1)        | 50 (5.5)                          | 43 (1.2)       |
| <i>Poa compressa</i>                                           | 6 (0.5)        | 33 (0.5)       | -             | -               | 14 (3.5)      | -                                 | -              |
| <i>Poa pratensis</i>                                           | 17 (0.8)       | 17 (1.5)       | -             | -               | 100<br>(18.4) | -                                 | 71 (1.9)       |
| <i>Poa secunda</i>                                             | 6 (0.5)        | 17 (3.5)       | 33 (1.5)      | 25 (0.5)        | 57 (0.8)      | 50 (0.5)                          | 14 (0.5)       |
| <i>Pseudoroegneria spicata</i><br>ssp. <i>spicata</i>          | 11 (2)         | -              | -             | 25 (0.5)        | -             | 100<br>(11.1)                     | -              |
| <i>Thinopyrum intermedium</i>                                  | 33 (1.5)       | 17 (3.5)       | 33 (1.5)      | -               | -             | 25 (0.5)                          | 100<br>(22.5)  |
| Forbs                                                          |                |                |               |                 |               |                                   |                |
| <i>Achillea millefolium</i>                                    | 44 (1.1)       | 17 (0.5)       | -             | 25 (0.5)        | 43 (3.2)      | 50 (1)                            | 57 (0.5)       |
| <i>Amaranthus blitoides</i>                                    | 6 (1.5)        | 17 (0.5)       | -             | -               | -             | -                                 | -              |
| <i>Amsinckia lycopsoides</i>                                   | 28 (0.7)       | -              | -             | -               | -             | -                                 | 14 (0.5)       |
| <i>Balsamorhiza sagittata</i>                                  | -              | -              | -             | 25 (0.5)        | -             | 75 (9.5)                          | 14 (0.5)       |
| <i>Centaurea diffusa</i>                                       | 11 (2)         | 33 (1)         | -             | -               | 14 (0.5)      | -                                 | -              |
| <i>Collomia grandiflora</i>                                    | 11 (0.5)       | 17 (0.5)       | -             | -               | -             | 50 (0.5)                          | -              |
| <i>Collomia linearis</i>                                       | 6 (0.5)        | 33 (1.5)       | -             | 25 (3.5)        | 14 (0.5)      | -                                 | -              |
| <i>Descurainia pinnata</i>                                     | 28 (0.7)       | 17 (0.5)       | -             | 25 (0.5)        | 29 (1)        | -                                 | 29 (0.5)       |
| <i>Epilobium brachycarpum</i>                                  | 6 (0.5)        | 33 (0.5)       | -             | 25 (0.5)        | -             | 25 (0.5)                          | -              |
| <i>Equisetum arvense</i>                                       | 17 (4.2)       | 17 (0.5)       | -             | 25 (0.5)        | -             | -                                 | -              |
| <i>Equisetum laevigatum</i>                                    | 6 (0.5)        | 17 (1.5)       | 33 (0.5)      | 50 (0.5)        | -             | -                                 | -              |

| <b>Species</b>                                    | <b>BRTE<br/>(n=18)</b> | <b>DIOLS<br/>(n=6)</b> | <b>FEOV<br/>(n=3)</b> | <b>HECO26<br/>(n=4)</b> | <b>POPR<br/>(n=7)</b> | <b>PSSP6-<br/>POSE/<br/>BASA3<br/>(n=4)</b> | <b>THIN6<br/>(n=7)</b> |
|---------------------------------------------------|------------------------|------------------------|-----------------------|-------------------------|-----------------------|---------------------------------------------|------------------------|
| <i>Erodium cicutarium</i>                         | 17 (1.5)               | 17 (0.5)               | 33 (3.5)              | 25 (3.5)                | 14 (1.5)              | -                                           | -                      |
| <i>Galium aparine</i>                             | 6 (1.5)                | -                      | -                     | -                       | -                     | -                                           | 43 (0.8)               |
| <i>Hypericum perforatum</i>                       | 6 (0.5)                | 33 (1)                 | 33 (0.5)              | 25 (0.5)                | 43 (0.8)              | -                                           | 14 (0.5)               |
| <i>Lactuca serriola</i>                           | 67 (2.2)               | 17 (0.5)               | -                     | 50 (0.5)                | 71 (0.7)              | -                                           | 86 (1.2)               |
| <i>Linaria dalmatica</i>                          | 11 (3.5)               | 33 (0.5)               | 33 (0.5)              | 25 (3.5)                | 29 (1.5)              | 25 (1.5)                                    | -                      |
| <i>Lithospermum ruderales</i>                     | 17 (1.5)               | -                      | 33 (0.5)              | -                       | 14 (0.5)              | 50 (1)                                      | 29 (1)                 |
| <i>Lupinus sericeus</i>                           | 6 (0.5)                | 17<br>(12.5)           | -                     | 50 (1.5)                | -                     | 75 (2.8)                                    | 14 (1.5)               |
| <i>Medicago sativa</i>                            | 17 (10.3)              | -                      | -                     | -                       | -                     | -                                           | 14 (0.5)               |
| <i>Phacelia hastata</i>                           | 6 (0.5)                | -                      | -                     | 25 (0.5)                | -                     | 25 (1.5)                                    | -                      |
| <i>Phlox gracilis ssp. gracilis</i>               | -                      | 33 (0.5)               | -                     | 25 (0.5)                | -                     | 25 (0.5)                                    | -                      |
| <i>Plantago patagonica</i>                        | 6 (0.5)                | 50 (2.5)               | 33 (0.5)              | 50 (2)                  | 14 (0.5)              | -                                           | -                      |
| <i>Potentilla glandulosa</i>                      | 6 (0.5)                | 17 (3.5)               | -                     | -                       | 14 (0.5)              | -                                           | -                      |
| <i>Potentilla recta</i>                           | -                      | 17<br>(12.5)           | -                     | -                       | 14 (0.5)              | -                                           | -                      |
| <i>Rumex acetosella</i>                           | 6 (3.5)                | 67 (1)                 | 33 (0.5)              | 75 (1.8)                | 14 (1.5)              | 25 (0.5)                                    | 14 (0.5)               |
| <i>Sisymbrium altissimum</i>                      | 78 (4.1)               | 17 (1.5)               | 33 (0.5)              | 25 (0.5)                | 71 (2.3)              | -                                           | 86 (1.3)               |
| <i>Tragopogon dubius</i>                          | 61 (0.6)               | 83 (0.5)               | 67 (0.5)              | 75 (0.5)                | 86 (1)                | 50 (0.5)                                    | 71 (0.5)               |
| <i>Trifolium repens</i>                           | 11 (2)                 | 17 (3.5)               | -                     | -                       | 14 (0.5)              | -                                           | -                      |
| <i>Triteleia grandiflora var.<br/>grandiflora</i> | 6 (0.5)                | -                      | -                     | -                       | -                     | 25 (0.5)                                    | 14 (0.5)               |
| <i>Verbascum thapsus</i>                          | 39 (0.6)               | 17 (1.5)               | -                     | -                       | 29 (1)                | -                                           | 29 (0.5)               |
| <i>Vicia villosa</i>                              | 50 (12.6)              | 17 (1.5)               | 67 (2.5)              | 50 (5.5)                | 57<br>(17.8)          | 25 (1.5)                                    | 100 (6.2)              |

## Part D: Wetland and Riparian Vegetation

| Species                                            | CAVU2-<br>PHAR3<br>(n=4) | JUBA<br>(n=3) | PHAR3<br>(n=8) | POBAT/<br>SYAL<br>(n=5) |
|----------------------------------------------------|--------------------------|---------------|----------------|-------------------------|
| Trees                                              |                          |               |                |                         |
| <i>Pinus ponderosa</i>                             | -                        | -             | -              | 60 (8.8)                |
| <i>Populus balsamifera</i> ssp. <i>trichocarpa</i> | -                        | -             | -              | 100 (33.5)              |
| <i>Prunus domestica</i>                            | -                        | -             | -              | 20 (1.5)                |
| Shrubs                                             |                          |               |                |                         |
| <i>Amelanchier alnifolia</i>                       | -                        | -             | -              | 60 (2.8)                |
| <i>Cornus sericea</i> ssp. <i>sericea</i>          | -                        | -             | -              | 20 (30)                 |
| <i>Crataegus douglasii</i>                         | 25 (0.5)                 | -             | -              | 40 (2.5)                |
| <i>Mahonia aquifolium</i>                          | -                        | -             | -              | 80 (6.3)                |
| <i>Rosa woodsii</i>                                | 25 (0.5)                 | -             | 25 (2)         | 80 (2.3)                |
| <i>Salix exigua</i>                                | -                        | -             | 13 (0.5)       | 20 (1.5)                |
| <i>Symphoricarpos albus</i>                        | -                        | 33 (0.5)      | 13 (0.5)       | 100 (27.9)              |
| Graminoids                                         |                          |               |                |                         |
| <i>Agrostis gigantea</i>                           | 25 (1.5)                 | -             | -              | -                       |
| <i>Agrostis stolonifera</i>                        | 25 (0.5)                 | -             | -              | 20 (0.5)                |
| <i>Bromus inermis</i>                              | -                        | -             | -              | 20 (0.5)                |
| <i>Bromus japonicus</i>                            | -                        | 33 (1.5)      | 13 (0.5)       | 20 (3.5)                |
| <i>Carex brevior</i>                               | -                        | 33 (1.5)      | -              | 20 (0.5)                |
| <i>Carex interior</i>                              | 25 (3.5)                 | -             | 13 (0.5)       | 20 (0.5)                |
| <i>Carex pellita</i>                               | -                        | 33 (1.5)      | 13 (0.5)       | 20 (1.5)                |
| <i>Carex vulpinoidea</i>                           | 100 (16.9)               | 33 (1.5)      | 13 (7.5)       | -                       |
| <i>Dactylis glomerata</i>                          | -                        | -             | -              | 40 (1)                  |
| <i>Elymus glaucus</i>                              | -                        | -             | -              | 100 (2.5)               |
| <i>Elymus repens</i>                               | 75 (2.5)                 | 100 (3.8)     | -              | 20 (0.5)                |
| <i>Juncus balticus</i>                             | 75 (10.8)                | 100 (18.3)    | 25 (1)         | 20 (3.5)                |
| <i>Phalaris arundinacea</i>                        | 100 (9)                  | 67 (2)        | 100 (38.1)     | 40 (2)                  |
| <i>Poa bulbosa</i>                                 | -                        | -             | -              | 20 (0.5)                |
| <i>Poa compressa</i>                               | 50 (0.5)                 | 33 (1.5)      | 13 (0.5)       | 20 (0.5)                |
| <i>Poa pratensis</i>                               | 75 (10.7)                | 100 (9.5)     | 38 (3.8)       | 100 (1.5)               |
| <i>Thinopyrum intermedium</i>                      | 50 (0.5)                 | -             | -              | 20 (0.5)                |
| Forbs                                              |                          |               |                |                         |
| <i>Achillea millefolium</i>                        | -                        | -             | -              | 20 (1.5)                |
| <i>Amaranthus blitoides</i>                        | 75 (1.5)                 | -             | 13 (1.5)       | -                       |
| <i>Cirsium arvense</i>                             | 25 (3.5)                 | 33 (1.5)      | 38 (0.8)       | -                       |
| <i>Equisetum arvense</i>                           | -                        | -             | 13 (0.5)       | 20 (0.5)                |
| <i>Equisetum laevigatum</i>                        | 25 (3.5)                 | 67 (0.5)      | 38 (0.5)       | 20 (1.5)                |
| <i>Galium aparine</i>                              | -                        | -             | -              | 20 (0.5)                |
| <i>Galium parisiense</i>                           | 25 (1.5)                 | -             | 13 (0.5)       | -                       |
| <i>Hypericum perforatum</i>                        | -                        | 33 (0.5)      | 13 (0.5)       | 40 (0.5)                |
| <i>Lactuca serriola</i>                            | -                        | 33 (0.5)      | -              | 20 (0.5)                |
| <i>Maianthemum stellatum</i>                       | -                        | -             | -              | 40 (10)                 |
| <i>Medicago lupulina</i>                           | -                        | -             | -              | 40 (1)                  |
| <i>Ophioglossum pusillum</i>                       | -                        | -             | 25 (0.5)       | -                       |
| <i>Polygonum amphibium</i> var. <i>emersum</i>     | -                        | -             | 25 (0.5)       | -                       |

| <b>Species</b>               | <b>CAVU2-<br/>PHAR3<br/>(n=4)</b> | <b>JUBA<br/>(n=3)</b> | <b>PHAR3<br/>(n=8)</b> | <b>POBAT/<br/>SYAL<br/>(n=5)</b> |
|------------------------------|-----------------------------------|-----------------------|------------------------|----------------------------------|
| <i>Polygonum hydropiper</i>  | -                                 | -                     | 25 (0.5)               | -                                |
| <i>Potentilla biennis</i>    | 25 (0.5)                          | 33 (0.5)              | -                      | -                                |
| <i>Potentilla recta</i>      | -                                 | 67 (0.5)              | -                      | -                                |
| <i>Rorippa curvisiliqua</i>  | -                                 | -                     | 25 (0.5)               | -                                |
| <i>Sisymbrium altissimum</i> | -                                 | 33 (0.5)              | -                      | 20 (0.5)                         |
| <i>Taraxacum officinale</i>  | -                                 | 33 (0.5)              | 13 (0.5)               | -                                |
| <i>Tragopogon dubius</i>     | -                                 | 67 (0.5)              | -                      | 60 (0.5)                         |
| <i>Trifolium repens</i>      | -                                 | -                     | 13 (0.5)               | 20 (0.5)                         |
| <i>Verbascum thapsus</i>     | -                                 | 33 (0.5)              | 13 (0.5)               | 20 (0.5)                         |
| <i>Vicia americana</i>       | -                                 | -                     | 13 (0.5)               | 20 (0.5)                         |
| <i>Vicia villosa</i>         | 25 (0.5)                          | 33 (0.5)              | -                      | 60 (4.2)                         |

## Appendix E. Statistical summary

Multi-response permutation procedure (MRPP) results for tests of the null hypothesis of no difference in the composition of associations identified in the final classification are summarized. The analyses were completed on associations (with  $n \geq 2$  fixed area samples) grouped by physiognomic class. MRPP results and ordinations of samples are shown by physiognomic class: Part A, Forest and Woodland; Part B, Shublands and Shrub-steppe; and Part C, Herbaceous Vegetation. There is no summary for sparse vegetation as these associations are primarily represented by stand-level observations (Table 1).

Group summaries provide values for each MRPP analysis result (abbreviations are:  $\delta_{obs}$ , observed delta;  $\delta_{exp}$ , expected delta;  $var(\delta_{exp})$ , variance of expected delta;  $T$  [calculated as  $(\delta_{obs} - \delta_{exp})/var(\delta_{exp})$ ]; and  $A$ , chance-corrected within group agreement. The MRPP test statistic ( $T$ ) describes the separation between groups. The more negative the value, the greater the separation. The chance-corrected agreement statistic ( $A$ ) describes within group homogeneity compared to the random expectation. When all samples are identical  $\delta_{obs} = 0$  and  $A = 1$ . If the heterogeneity within groups is equal to that expected by chance  $A = 0$ . If there is less agreement within groups than expected by chance  $A < 0$ . Values of  $A < 0.1$  are common in plant community ecology. Values of  $A > 0.3$  are considered high (McCune and Grace 2002).

Observed delta ( $\delta_{obs}$ ) is the calculated weighted mean within group distance. The variance and skewness of delta describe the distribution of all possible deltas. The MRPP probability value ( $p$ ) is an expression of the likelihood of achieving a delta  $\leq \delta_{obs}$ . For all MRPP results  $p < 0.0001$ . For this reason, these values are not shown.

Association summaries list the association symbol, numeric code (also displayed in pair-wise summaries and ordination graphics), size (the number of samples assigned to the association), and the average distance (relative Sorensen distance, abbreviated RelSorDist) between samples within the association. Smaller within-association average distances imply greater within-association homogeneity.

Association pair-wise summaries provide values for  $T$ ,  $A$ , and  $p$  (as described above) calculated for the respective pair of associations. MRPP tests of the pair-wise significance of difference between associations are sensitive to sample size. Associations with relatively few samples (e.g.,  $n=2$ ) often appear insignificantly different. Though some classification units were joined on the basis of the MRPP result, many are retained, though  $p > 0.05$ ,  $T > 0$ , or  $A < 0$ , on the basis of their apparent ecological significance.

Detrended correspondence analysis (DCA) is used to rapidly display the reduced multi-variate spatial relation among samples by association. Graphic plots are of samples in species ordination space. The amount of variance accounted for by each DCA axis (coefficient of variance,  $r^2$ ) is listed in the ordination figure caption. It should be noted that better results were typical at more detailed levels of the analysis.

## Part A: Forest and Woodland

Group Summary - Forest and Woodland:  $\delta_{\text{obs}}=0.5207$ ;  $\delta_{\text{exp}}=0.6767$ ;  $\text{var}(\delta_{\text{exp}})=0.0000$ ;  $T=-54.2018$ ;  $A=0.2305$

### Association Summary - Forest and Woodland

| Association | Code | Size | RelSorDist |
|-------------|------|------|------------|
| PIPO/AMAL2  | 34   | 25   | 0.4874     |
| PIPO/BRTE   | 37   | 22   | 0.5354     |
| PIPO/HECO26 | 39   | 3    | 0.6097     |
| PIPO/MAAQ2  | 41   | 4    | 0.5072     |
| PIPO/MARE11 | 42   | 5    | 0.6103     |
| PIPO/PSSP6  | 44   | 11   | 0.4605     |
| PIPO/PUTR2  | 45   | 33   | 0.4677     |
| PIPO/SHCA   | 46   | 7    | 0.4044     |
| PIPO/SYAL   | 47   | 89   | 0.5416     |
| POBAT/SYAL  | 52   | 5    | 0.6503     |
| PSME/SYAL   | 59   | 14   | 0.5156     |
| ROPS        | 70   | 2    | 0.1947     |
| POTR5/SYAL  | 86   | 2    | 0.6892     |
| PSME/ACGL   | 94   | 9    | 0.5769     |
| PSME/PHMA5  | 95   | 16   | 0.5492     |
| PSME/PSSP6  | 96   | 5    | 0.5173     |

### Association Pair-wise Comparison - Forest and Woodland

| Group | Group | T        | A      | P      |
|-------|-------|----------|--------|--------|
| 45    | 47    | -51.9297 | 0.1081 | 0.0000 |
| 45    | 96    | -12.3617 | 0.0973 | 0.0000 |
| 45    | 59    | -27.3307 | 0.2225 | 0.0000 |
| 45    | 37    | -20.8063 | 0.1221 | 0.0000 |
| 45    | 44    | -16.0964 | 0.1189 | 0.0000 |
| 45    | 95    | -30.0617 | 0.2533 | 0.0000 |
| 45    | 52    | -17.2035 | 0.1436 | 0.0000 |
| 45    | 34    | -24.0572 | 0.1514 | 0.0000 |
| 45    | 42    | -9.7513  | 0.0750 | 0.0000 |
| 45    | 46    | -14.9964 | 0.1315 | 0.0000 |
| 45    | 41    | -7.9429  | 0.0707 | 0.0000 |
| 45    | 70    | -12.0245 | 0.1341 | 0.0001 |
| 45    | 94    | -24.2274 | 0.2192 | 0.0000 |
| 45    | 39    | -5.5017  | 0.0479 | 0.0003 |
| 45    | 86    | -8.2135  | 0.0840 | 0.0000 |
| 47    | 96    | -14.5501 | 0.0347 | 0.0000 |
| 47    | 59    | -29.3629 | 0.0632 | 0.0000 |
| 47    | 37    | -27.9125 | 0.0578 | 0.0000 |
| 47    | 44    | -15.5551 | 0.0351 | 0.0000 |
| 47    | 95    | -46.7027 | 0.1052 | 0.0000 |
| 47    | 52    | -14.2930 | 0.0349 | 0.0000 |
| 47    | 34    | -26.7337 | 0.0561 | 0.0000 |

| Group | Group | T        | A      | P      |
|-------|-------|----------|--------|--------|
| 47    | 42    | -6.1530  | 0.0145 | 0.0001 |
| 47    | 46    | -14.1739 | 0.0333 | 0.0000 |
| 47    | 41    | -3.4617  | 0.0088 | 0.0060 |
| 47    | 70    | -14.9110 | 0.0464 | 0.0000 |
| 47    | 94    | -32.0633 | 0.0728 | 0.0000 |
| 47    | 39    | -4.9644  | 0.0130 | 0.0006 |
| 47    | 86    | -6.3142  | 0.0197 | 0.0000 |
| 96    | 59    | -4.6323  | 0.0697 | 0.0012 |
| 96    | 37    | -8.8501  | 0.1102 | 0.0000 |
| 96    | 44    | -6.3265  | 0.1504 | 0.0003 |
| 96    | 95    | -7.1722  | 0.0852 | 0.0000 |
| 96    | 52    | -5.1871  | 0.2390 | 0.0014 |
| 96    | 34    | -9.7616  | 0.1229 | 0.0000 |
| 96    | 42    | -5.0547  | 0.1621 | 0.0023 |
| 96    | 46    | -6.2222  | 0.2361 | 0.0008 |
| 96    | 41    | -4.1407  | 0.2005 | 0.0055 |
| 96    | 70    | -3.6372  | 0.4023 | 0.0101 |
| 96    | 94    | -5.7027  | 0.1320 | 0.0003 |
| 96    | 39    | -3.4051  | 0.1519 | 0.0078 |
| 96    | 86    | -3.4094  | 0.2391 | 0.0101 |
| 59    | 37    | -19.8778 | 0.2172 | 0.0000 |
| 59    | 44    | -14.1939 | 0.2438 | 0.0000 |
| 59    | 95    | -8.2027  | 0.0651 | 0.0000 |
| 59    | 52    | -8.5319  | 0.1432 | 0.0000 |
| 59    | 34    | -20.6189 | 0.2178 | 0.0000 |
| 59    | 42    | -8.4615  | 0.1380 | 0.0000 |
| 59    | 46    | -11.8389 | 0.2374 | 0.0000 |
| 59    | 41    | -7.7280  | 0.1501 | 0.0000 |
| 59    | 70    | -8.0541  | 0.2306 | 0.0014 |
| 59    | 94    | -4.7083  | 0.0541 | 0.0010 |
| 59    | 39    | -6.7322  | 0.1323 | 0.0001 |
| 59    | 86    | -4.8501  | 0.1024 | 0.0008 |
| 37    | 44    | -3.4646  | 0.0287 | 0.0091 |
| 37    | 95    | -22.5171 | 0.2472 | 0.0000 |
| 37    | 52    | -11.6977 | 0.1519 | 0.0000 |
| 37    | 34    | -3.5039  | 0.0227 | 0.0111 |
| 37    | 42    | -5.2934  | 0.0592 | 0.0009 |
| 37    | 46    | -6.7505  | 0.0671 | 0.0001 |
| 37    | 41    | -2.1690  | 0.0271 | 0.0379 |
| 37    | 70    | -7.8328  | 0.1497 | 0.0002 |
| 37    | 94    | -17.2437 | 0.2247 | 0.0000 |
| 37    | 39    | -2.7028  | 0.0390 | 0.0183 |
| 37    | 86    | -5.8661  | 0.0962 | 0.0002 |
| 44    | 95    | -16.1199 | 0.2589 | 0.0000 |
| 44    | 52    | -8.9584  | 0.2358 | 0.0000 |
| 44    | 34    | -2.4084  | 0.0199 | 0.0325 |
| 44    | 42    | -5.6473  | 0.1071 | 0.0005 |
| 44    | 46    | -5.1813  | 0.0772 | 0.0005 |
| 44    | 41    | -1.2048  | 0.0232 | 0.1174 |
| 44    | 70    | -7.0760  | 0.3009 | 0.0024 |

| Group | Group | T        | A      | P      |
|-------|-------|----------|--------|--------|
| 44    | 94    | -11.8480 | 0.2817 | 0.0000 |
| 44    | 39    | -4.1925  | 0.0890 | 0.0024 |
| 44    | 86    | -6.0013  | 0.1830 | 0.0021 |
| 95    | 52    | -10.9674 | 0.1561 | 0.0000 |
| 95    | 34    | -22.9546 | 0.2446 | 0.0000 |
| 95    | 42    | -10.2468 | 0.1410 | 0.0000 |
| 95    | 46    | -13.8444 | 0.2522 | 0.0000 |
| 95    | 41    | -10.2440 | 0.1670 | 0.0000 |
| 95    | 70    | -9.2923  | 0.1989 | 0.0011 |
| 95    | 94    | -5.7520  | 0.0566 | 0.0002 |
| 95    | 39    | -8.4565  | 0.1365 | 0.0000 |
| 95    | 86    | -6.4340  | 0.0998 | 0.0009 |
| 52    | 34    | -12.3335 | 0.1494 | 0.0000 |
| 52    | 42    | -4.9277  | 0.1738 | 0.0009 |
| 52    | 46    | -6.7131  | 0.2639 | 0.0003 |
| 52    | 41    | -4.0868  | 0.1916 | 0.0024 |
| 52    | 70    | -3.2732  | 0.3336 | 0.0133 |
| 52    | 94    | -6.6877  | 0.1692 | 0.0001 |
| 52    | 39    | -3.4368  | 0.1881 | 0.0046 |
| 52    | 86    | -1.5839  | 0.1096 | 0.0706 |
| 34    | 42    | -4.7935  | 0.0535 | 0.0024 |
| 34    | 46    | -4.3166  | 0.0402 | 0.0037 |
| 34    | 41    | -0.9750  | 0.0118 | 0.1461 |
| 34    | 70    | -9.6381  | 0.1630 | 0.0001 |
| 34    | 94    | -18.1497 | 0.2225 | 0.0000 |
| 34    | 39    | -4.0855  | 0.0537 | 0.0033 |
| 34    | 86    | -6.1533  | 0.0944 | 0.0001 |
| 42    | 46    | -5.3005  | 0.1499 | 0.0015 |
| 42    | 41    | -2.7064  | 0.0919 | 0.0219 |
| 42    | 70    | -3.6792  | 0.3566 | 0.0104 |
| 42    | 94    | -7.3396  | 0.1922 | 0.0001 |
| 42    | 39    | -2.4806  | 0.0870 | 0.0222 |
| 42    | 86    | -3.5417  | 0.1865 | 0.0108 |
| 46    | 41    | -2.0235  | 0.0382 | 0.0335 |
| 46    | 70    | -5.0791  | 0.4251 | 0.0056 |
| 46    | 94    | -9.3450  | 0.2837 | 0.0000 |
| 46    | 39    | -4.7674  | 0.1653 | 0.0014 |
| 46    | 86    | -4.8577  | 0.2453 | 0.0055 |
| 41    | 70    | -2.9610  | 0.4508 | 0.0160 |
| 41    | 94    | -6.4523  | 0.2042 | 0.0002 |
| 41    | 39    | -2.5309  | 0.1270 | 0.0153 |
| 41    | 86    | -2.7418  | 0.2265 | 0.0171 |
| 70    | 94    | -5.5848  | 0.2752 | 0.0037 |
| 70    | 39    | -2.1959  | 0.4330 | 0.0000 |
| 70    | 86    | -1.4142  | 0.4465 |        |
| 94    | 39    | -5.5900  | 0.1885 | 0.0004 |
| 94    | 86    | -3.6607  | 0.1222 | 0.0078 |
| 39    | 86    | -2.0688  | 0.2317 |        |

## Part B: Shrubland and Shrub-steppe.

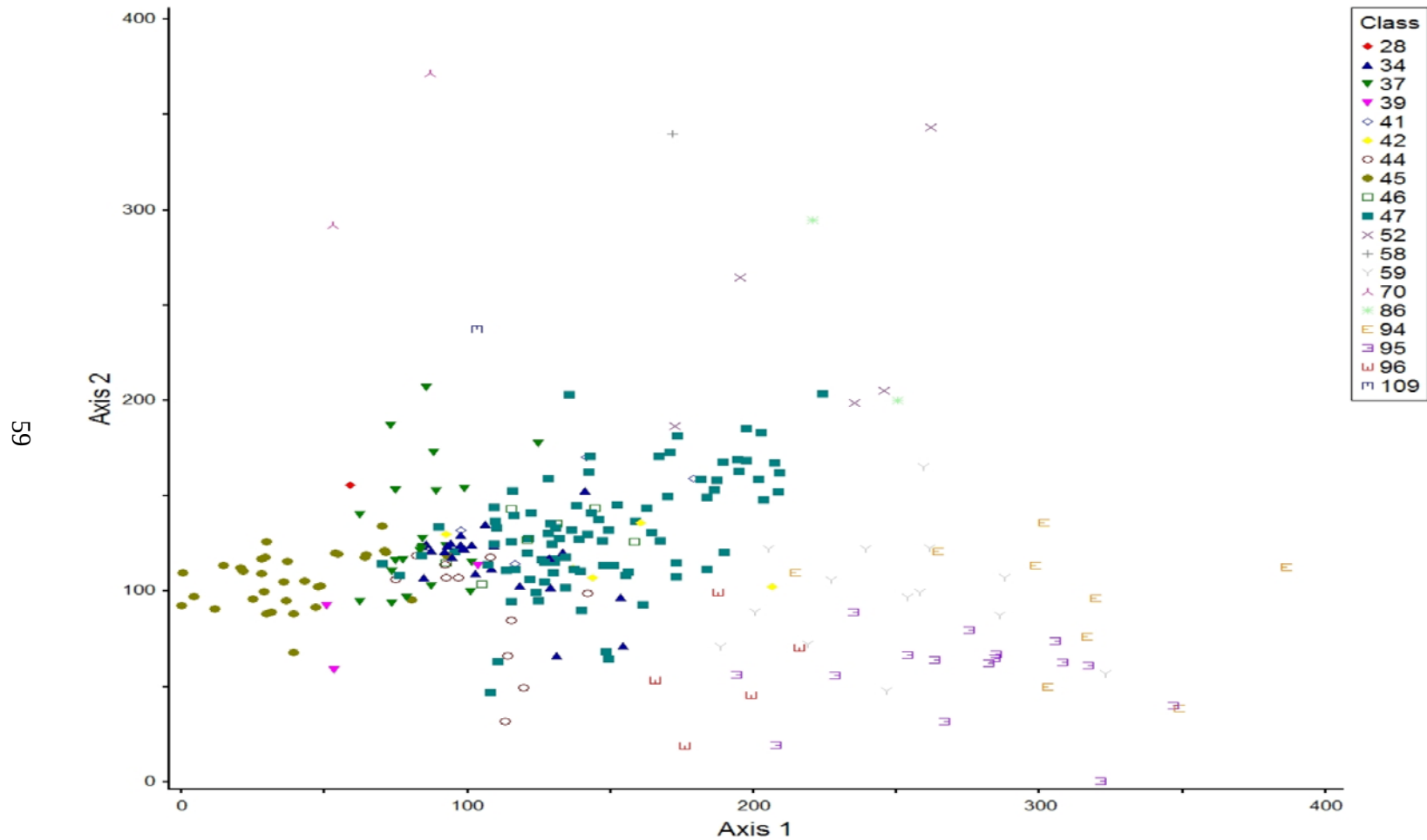


**Figure 2.** 7Ordination of Samples - Forest and Woodland. Forest and woodland samples are plotted by association in relation to DCA axes 1 and 2. A list of association numeric codes is provided in the association summary (above). Coefficients of determination ( $r^2$ ) using relative Euclidean distances for DCA axes 1 through 3 are 0.444, 0.159, and 0.053, respectively.

Group Summary - Shrubland and Shrub-steppe:  $\delta_{\text{obs}}=0.5372$ ;  $\delta_{\text{exp}}=0.8355$ ;  $\text{var}(\delta_{\text{exp}})=0.0001$ ;  $T=-25.1021$ ;  $A=0.3570$ .

Association Summary - Shrubland and Shrub-steppe.

| Association       | Code | Size | RelSorDist |
|-------------------|------|------|------------|
| AMAL2/PSSP6       | 4    | 5    | 0.6162     |
| ARTR2/FEID        | 6    | 2    | 0.7229     |
| ARTRW8/HECO26     | 7    | 5    | 0.4427     |
| ARTR2/LECI4       | 8    | 2    | 0.2574     |
| ARTRW8/PSSP6      | 9    | 6    | 0.4963     |
| ARTRT2/POSE       | 10   | 2    | 0.5834     |
| CRDO2/MESIC       | 13   | 2    | 0.4048     |
| GRAMINOIDS        |      |      |            |
| ERNA10/BRTE       | 17   | 7    | 0.4532     |
| ERNI2/BRTE        | 24   | 3    | 0.9043     |
| PUTR2-SADO4/PSSP6 | 62   | 2    | 0.3640     |
| PUTR2/FEID        | 65   | 4    | 0.5448     |
| PUTR2/HECO26      | 66   | 12   | 0.5560     |
| PUTR2/PSSP6       | 68   | 6    | 0.4440     |
| RHGL/HECO26       | 69   | 3    | 0.3592     |
| ROWO              | 72   | 2    | 0.6786     |
| PUTR2/BRTE        | 91   | 10   | 0.6086     |
| SYAL              | 98   | 15   | 0.5611     |

Association Pari-wise Comparison - Shrubland and Shrub-steppe.

| Group | Group | T        | A      | p      |
|-------|-------|----------|--------|--------|
| 7     | 17    | -6.8882  | 0.3655 | 0.0005 |
| 7     | 91    | -8.3989  | 0.2521 | 0.0001 |
| 7     | 9     | -1.8547  | 0.0494 | 0.0494 |
| 7     | 10    | -3.1721  | 0.2496 | 0.0116 |
| 7     | 66    | -8.5021  | 0.2270 | 0.0000 |
| 7     | 65    | -4.8214  | 0.2961 | 0.0028 |
| 7     | 68    | -6.2629  | 0.3381 | 0.0009 |
| 7     | 98    | -10.6893 | 0.2546 | 0.0000 |
| 7     | 62    | -3.4664  | 0.3177 | 0.0110 |
| 7     | 4     | -5.7073  | 0.3120 | 0.0016 |
| 7     | 13    | -3.6199  | 0.3836 | 0.0107 |
| 7     | 69    | -4.2076  | 0.3863 | 0.0038 |
| 7     | 6     | -1.5720  | 0.0696 | 0.0751 |
| 7     | 72    | -3.5269  | 0.2779 | 0.0112 |
| 7     | 24    | -4.1402  | 0.2086 | 0.0038 |
| 7     | 8     | -3.3300  | 0.2762 | 0.0124 |
| 17    | 91    | -9.1421  | 0.2480 | 0.0000 |
| 17    | 9     | -6.8643  | 0.3211 | 0.0005 |
| 17    | 10    | -4.0665  | 0.2401 | 0.0058 |
| 17    | 66    | -9.1474  | 0.2256 | 0.0000 |
| 17    | 65    | -5.7551  | 0.2667 | 0.0008 |
| 17    | 68    | -7.6876  | 0.3556 | 0.0003 |
| 17    | 98    | -11.9903 | 0.2670 | 0.0000 |

| Group | Group | T        | A      | p      |
|-------|-------|----------|--------|--------|
| 17    | 62    | -4.2883  | 0.3075 | 0.0055 |
| 17    | 4     | -6.7969  | 0.2938 | 0.0004 |
| 17    | 13    | -4.5864  | 0.3256 | 0.0057 |
| 17    | 69    | -5.4175  | 0.3703 | 0.0008 |
| 17    | 6     | -3.0230  | 0.1536 | 0.0091 |
| 17    | 72    | -4.2224  | 0.2401 | 0.0060 |
| 17    | 24    | -4.3600  | 0.1646 | 0.0018 |
| 17    | 8     | -4.5038  | 0.3468 | 0.0055 |
| 91    | 9     | -8.6650  | 0.2354 | 0.0001 |
| 91    | 10    | -4.5464  | 0.1458 | 0.0029 |
| 91    | 66    | -1.1433  | 0.0153 | 0.1223 |
| 91    | 65    | -3.3494  | 0.0702 | 0.0093 |
| 91    | 68    | -3.9864  | 0.0632 | 0.0028 |
| 91    | 98    | -11.3644 | 0.1878 | 0.0000 |
| 91    | 62    | -3.0668  | 0.0948 | 0.0100 |
| 91    | 4     | -7.3348  | 0.1808 | 0.0001 |
| 91    | 13    | -5.3877  | 0.1882 | 0.0028 |
| 91    | 69    | -6.9101  | 0.2466 | 0.0001 |
| 91    | 6     | -3.7182  | 0.1120 | 0.0041 |
| 91    | 72    | -3.7654  | 0.1151 | 0.0046 |
| 91    | 24    | -4.2484  | 0.0962 | 0.0023 |
| 91    | 8     | -5.3056  | 0.2021 | 0.0026 |
| 9     | 10    | -2.7374  | 0.1737 | 0.0127 |
| 9     | 66    | -9.3169  | 0.2315 | 0.0000 |
| 9     | 65    | -4.9989  | 0.2415 | 0.0021 |
| 9     | 68    | -6.5931  | 0.2588 | 0.0006 |
| 9     | 98    | -11.1447 | 0.2509 | 0.0000 |
| 9     | 62    | -3.8371  | 0.2731 | 0.0076 |
| 9     | 4     | -6.0810  | 0.2412 | 0.0009 |
| 9     | 13    | -4.1371  | 0.3286 | 0.0074 |
| 9     | 69    | -4.9233  | 0.3764 | 0.0017 |
| 9     | 6     | -0.4612  | 0.0172 | 0.3052 |
| 9     | 72    | -3.7802  | 0.2084 | 0.0080 |
| 9     | 24    | -4.4241  | 0.1851 | 0.0027 |
| 9     | 8     | -3.5371  | 0.2252 | 0.0084 |
| 10    | 66    | -4.6394  | 0.1384 | 0.0024 |
| 10    | 65    | -2.6079  | 0.2251 | 0.0184 |
| 10    | 68    | -3.6952  | 0.2226 | 0.0070 |
| 10    | 98    | -4.8414  | 0.1301 | 0.0008 |
| 10    | 62    | -1.4035  | 0.3817 |        |
| 10    | 4     | -3.3540  | 0.1966 | 0.0104 |
| 10    | 13    | -1.4139  | 0.4030 |        |
| 10    | 69    | -2.2065  | 0.4063 | 0.0000 |
| 10    | 6     | -1.2777  | 0.1754 |        |
| 10    | 72    | -1.3931  | 0.2466 |        |
| 10    | 24    | -2.1201  | 0.1585 |        |
| 10    | 8     | -1.4141  | 0.4484 |        |
| 66    | 65    | -2.4257  | 0.0500 | 0.0272 |
| 66    | 68    | -5.7657  | 0.0951 | 0.0002 |
| 66    | 98    | -14.8738 | 0.2504 | 0.0000 |
| 66    | 62    | -2.4915  | 0.0723 | 0.0228 |

| Group | Group | T        | A      | p      |
|-------|-------|----------|--------|--------|
| 66    | 4     | -8.9789  | 0.2140 | 0.0000 |
| 66    | 13    | -5.9602  | 0.1953 | 0.0019 |
| 66    | 69    | -6.7235  | 0.2179 | 0.0001 |
| 66    | 6     | -3.3379  | 0.0961 | 0.0063 |
| 66    | 72    | -4.7362  | 0.1366 | 0.0023 |
| 66    | 24    | -4.9331  | 0.1076 | 0.0008 |
| 66    | 8     | -5.9721  | 0.2052 | 0.0019 |
| 65    | 68    | -4.2468  | 0.1143 | 0.0021 |
| 65    | 98    | -7.1392  | 0.1690 | 0.0001 |
| 65    | 62    | -2.6883  | 0.1803 | 0.0172 |
| 65    | 4     | -4.5041  | 0.1994 | 0.0033 |
| 65    | 13    | -2.9234  | 0.3496 | 0.0161 |
| 65    | 69    | -3.5240  | 0.3558 | 0.0106 |
| 65    | 6     | -1.6971  | 0.0853 | 0.0443 |
| 65    | 72    | -2.6715  | 0.2126 | 0.0174 |
| 65    | 24    | -3.4451  | 0.1592 | 0.0098 |
| 65    | 8     | -2.9396  | 0.3785 | 0.0161 |
| 68    | 98    | -10.2051 | 0.2235 | 0.0000 |
| 68    | 62    | -3.5590  | 0.1637 | 0.0068 |
| 68    | 4     | -6.1702  | 0.2289 | 0.0009 |
| 68    | 13    | -4.3022  | 0.3449 | 0.0073 |
| 68    | 69    | -5.0735  | 0.3952 | 0.0014 |
| 68    | 6     | -4.0373  | 0.1887 | 0.0074 |
| 68    | 72    | -3.9447  | 0.2063 | 0.0072 |
| 68    | 24    | -4.8592  | 0.1724 | 0.0014 |
| 68    | 8     | -4.3156  | 0.3715 | 0.0073 |
| 98    | 62    | -5.6402  | 0.1621 | 0.0006 |
| 98    | 4     | -6.3557  | 0.1315 | 0.0005 |
| 98    | 13    | -5.3103  | 0.1446 | 0.0007 |
| 98    | 69    | -8.3785  | 0.2171 | 0.0000 |
| 98    | 6     | -3.6275  | 0.0966 | 0.0022 |
| 98    | 72    | -2.8603  | 0.0725 | 0.0079 |
| 98    | 24    | -4.6453  | 0.0938 | 0.0014 |
| 98    | 8     | -5.4652  | 0.1614 | 0.0007 |
| 62    | 4     | -3.5510  | 0.2664 | 0.0103 |
| 62    | 13    | -1.4141  | 0.5090 |        |
| 62    | 69    | -2.1965  | 0.4534 | 0.0000 |
| 62    | 6     | -1.4135  | 0.3030 |        |
| 62    | 72    | -1.4141  | 0.3637 |        |
| 62    | 24    | -2.1840  | 0.2119 |        |
| 62    | 8     | -1.4141  | 0.5537 |        |
| 4     | 13    | -3.4976  | 0.2725 | 0.0103 |
| 4     | 69    | -4.3088  | 0.3243 | 0.0038 |
| 4     | 6     | -2.9263  | 0.1395 | 0.0117 |
| 4     | 72    | -3.0308  | 0.1337 | 0.0115 |
| 4     | 24    | -3.5296  | 0.1076 | 0.0055 |
| 4     | 8     | -3.3070  | 0.2769 | 0.0107 |
| 13    | 69    | -2.2122  | 0.4677 | 0.0000 |
| 13    | 6     | -1.4142  | 0.3327 |        |
| 13    | 72    | -1.4117  | 0.3215 |        |
| 13    | 24    | -2.1770  | 0.2185 |        |

| Group | Group | T       | A      | p      |
|-------|-------|---------|--------|--------|
| 13    | 8     | -1.4095 | 0.5334 |        |
| 69    | 6     | -2.1753 | 0.3252 | 0.0000 |
| 69    | 72    | -2.2035 | 0.3567 | 0.0000 |
| 69    | 24    | -2.8279 | 0.2305 | 0.0228 |
| 69    | 8     | -2.2002 | 0.5456 | 0.0000 |
| 6     | 72    | -1.3415 | 0.1836 |        |
| 6     | 24    | -2.0605 | 0.0897 |        |
| 6     | 8     | -1.4110 | 0.2655 |        |
| 72    | 24    | -2.0643 | 0.1321 |        |
| 72    | 8     | -1.4130 | 0.4070 |        |
| 24    | 8     | -2.2003 | 0.2279 | 0.0000 |

### Part C. Herbaceous Vegetation

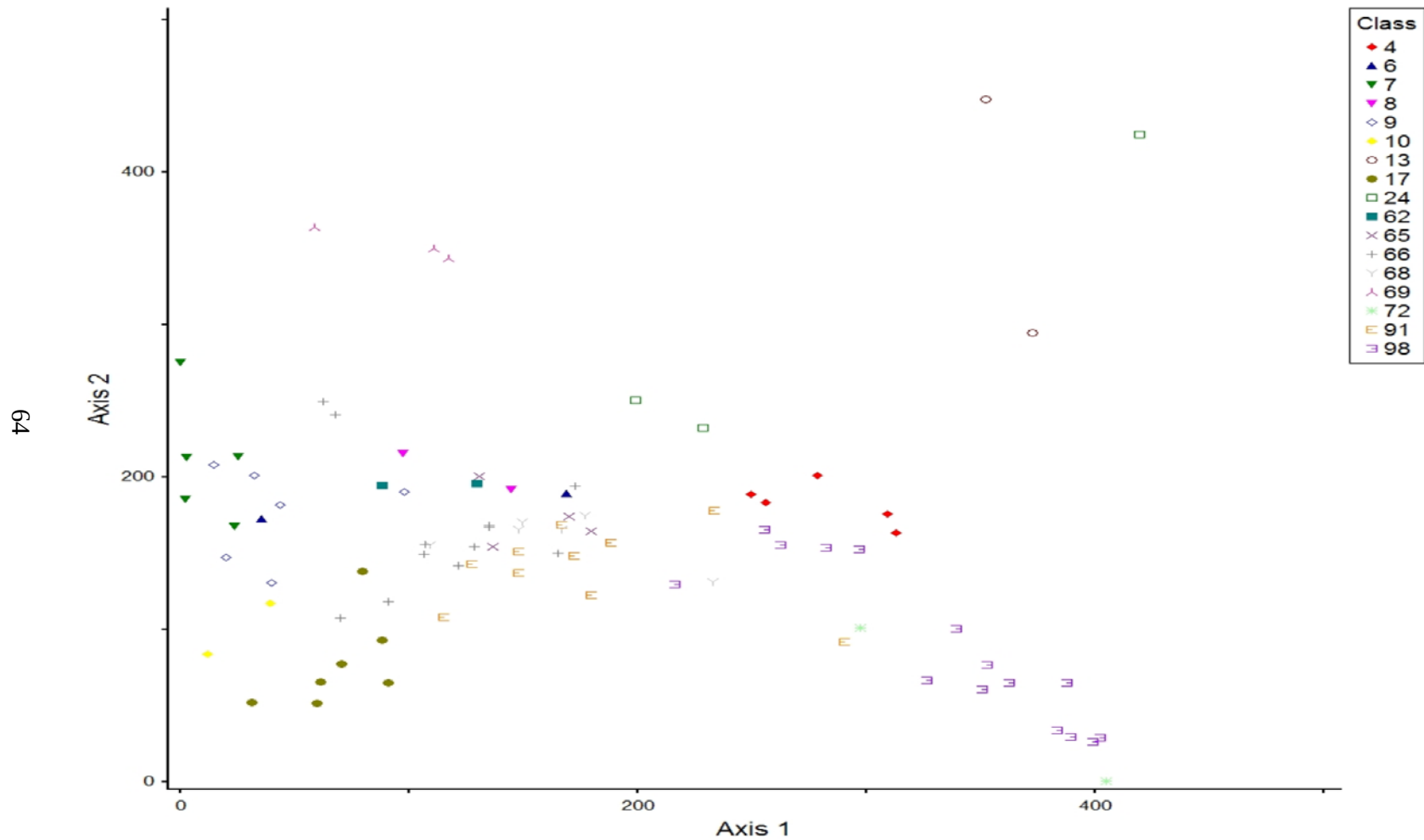


**Figure 3.** Ordination of Samples - Shrubland and Shrub-steppe. Shrubland and shrub-steppe samples are plotted by association in relation to DCA axes 1 and 2. A list of association numeric codes is provided in the shrubland association summary (above). Coefficients of determination ( $r^2$ ) using relative Euclidean distances for DCA axes 1 through 3 are 0.254, 0.088, and 0.093, respectively.

Group Summary - Herbaceous Vegetation:  $\delta_{\text{obs}}=0.5534$ ;  $\delta_{\text{exp}}=0.8627$ ;  $\text{var}(\delta_{\text{exp}})=0.0002$ ;  $T=-23.9307$ ;  $A=0.3585$ .

Association Summary - Herbaceous Vegetation.

| Association          | Code | Size | RelSorDist |
|----------------------|------|------|------------|
| BRTE                 | 12   | 18   | 0.6879     |
| HECO26               | 26   | 4    | 0.5267     |
| JUBA                 | 27   | 3    | 0.3584     |
| PHAR3                | 31   | 8    | 0.1520     |
| POPR                 | 51   | 7    | 0.6634     |
| PSSP6-<br>POSE/BASA3 | 55   | 4    | 0.5471     |
| THIN6                | 84   | 7    | 0.4678     |
| DIOLS                | 105  | 6    | 0.7702     |
| FEID                 | 106  | 2    | 0.7143     |
| FEOV                 | 107  | 3    | 0.3584     |
| GRAVEL BAR           | 108  | 2    | 1.0000     |
| CAVU2-PHAR3          | 111  | 4    | 0.4055     |

Association Pari-wise Comparison - Herbaceous Vegetation.

| Group | Group | T        | A      | p      |
|-------|-------|----------|--------|--------|
| 12    | 31    | -15.8983 | 0.3282 | 0.0000 |
| 12    | 55    | -5.3565  | 0.0708 | 0.0004 |
| 12    | 27    | -8.7354  | 0.1510 | 0.0000 |
| 12    | 51    | -6.8018  | 0.0838 | 0.0001 |
| 12    | 26    | -7.0473  | 0.0984 | 0.0000 |
| 12    | 84    | -8.8584  | 0.1292 | 0.0000 |
| 12    | 108   | -0.3340  | 0.0058 | 0.3294 |
| 12    | 107   | -7.9380  | 0.1313 | 0.0000 |
| 12    | 111   | -10.4352 | 0.1768 | 0.0000 |
| 12    | 106   | -3.0873  | 0.0546 | 0.0076 |
| 12    | 105   | -5.4554  | 0.0584 | 0.0005 |
| 31    | 55    | -7.1662  | 0.5261 | 0.0003 |
| 31    | 27    | -6.2585  | 0.5820 | 0.0004 |
| 31    | 51    | -9.0293  | 0.4313 | 0.0001 |
| 31    | 26    | -7.1759  | 0.5350 | 0.0003 |
| 31    | 84    | -9.1807  | 0.5478 | 0.0001 |
| 31    | 108   | -4.8991  | 0.2745 | 0.0041 |
| 31    | 107   | -6.4888  | 0.6086 | 0.0003 |
| 31    | 111   | -6.5834  | 0.5023 | 0.0004 |
| 31    | 106   | -5.5050  | 0.4314 | 0.0043 |
| 31    | 105   | -8.5192  | 0.4027 | 0.0001 |
| 55    | 27    | -3.6438  | 0.3961 | 0.0095 |
| 55    | 51    | -5.1851  | 0.1952 | 0.0010 |
| 55    | 26    | -4.0865  | 0.2499 | 0.0058 |
| 55    | 84    | -5.1612  | 0.2791 | 0.0018 |
| 55    | 108   | -2.0009  | 0.0981 | 0.0310 |
| 55    | 107   | -3.5709  | 0.3619 | 0.0096 |
| 55    | 111   | -4.2296  | 0.3841 | 0.0061 |

| Group | Group | T       | A       | p      |
|-------|-------|---------|---------|--------|
| 55    | 106   | -2.5924 | 0.2048  | 0.0191 |
| 55    | 105   | -4.4882 | 0.1316  | 0.0012 |
| 27    | 51    | -4.2140 | 0.1650  | 0.0020 |
| 27    | 26    | -3.6717 | 0.4028  | 0.0096 |
| 27    | 84    | -5.2740 | 0.3573  | 0.0009 |
| 27    | 108   | -2.2223 | 0.2123  |        |
| 27    | 107   | -2.9900 | 0.5113  | 0.0215 |
| 27    | 111   | -2.9985 | 0.2661  | 0.0167 |
| 27    | 106   | -2.2272 | 0.3479  | 0.0000 |
| 27    | 105   | -4.8785 | 0.2392  | 0.0015 |
| 51    | 26    | -5.1829 | 0.1808  | 0.0007 |
| 51    | 84    | -6.6443 | 0.1963  | 0.0002 |
| 51    | 108   | -1.2331 | 0.0387  | 0.1133 |
| 51    | 107   | -5.2024 | 0.2511  | 0.0008 |
| 51    | 111   | -5.3045 | 0.2479  | 0.0009 |
| 51    | 106   | -3.1104 | 0.1225  | 0.0135 |
| 51    | 105   | -5.2899 | 0.1091  | 0.0005 |
| 26    | 84    | -5.6363 | 0.2829  | 0.0010 |
| 26    | 108   | -2.0008 | 0.0537  | 0.0313 |
| 26    | 107   | -3.5656 | 0.3369  | 0.0094 |
| 26    | 111   | -4.2517 | 0.3935  | 0.0061 |
| 26    | 106   | -2.6117 | 0.1848  | 0.0175 |
| 26    | 105   | -3.7001 | 0.0891  | 0.0022 |
| 84    | 108   | -2.1148 | 0.1016  | 0.0284 |
| 84    | 107   | -5.1851 | 0.3494  | 0.0010 |
| 84    | 111   | -6.0342 | 0.3774  | 0.0007 |
| 84    | 106   | -3.1179 | 0.1786  | 0.0080 |
| 84    | 105   | -6.2549 | 0.1966  | 0.0006 |
| 108   | 107   | -2.0213 | 0.1980  | 0.0000 |
| 108   | 111   | -1.8810 | 0.1446  | 0.0420 |
| 108   | 106   | -0.3253 | 0.0275  |        |
| 108   | 105   | 1.0942  | -0.0302 | 0.8639 |
| 107   | 111   | -3.6003 | 0.4753  | 0.0103 |
| 107   | 106   | -2.1976 | 0.2889  |        |
| 107   | 105   | -4.7621 | 0.2123  | 0.0014 |
| 111   | 106   | -2.6737 | 0.3112  | 0.0181 |
| 111   | 105   | -5.3940 | 0.2516  | 0.0014 |
| 106   | 105   | -1.3557 | 0.0379  | 0.0884 |

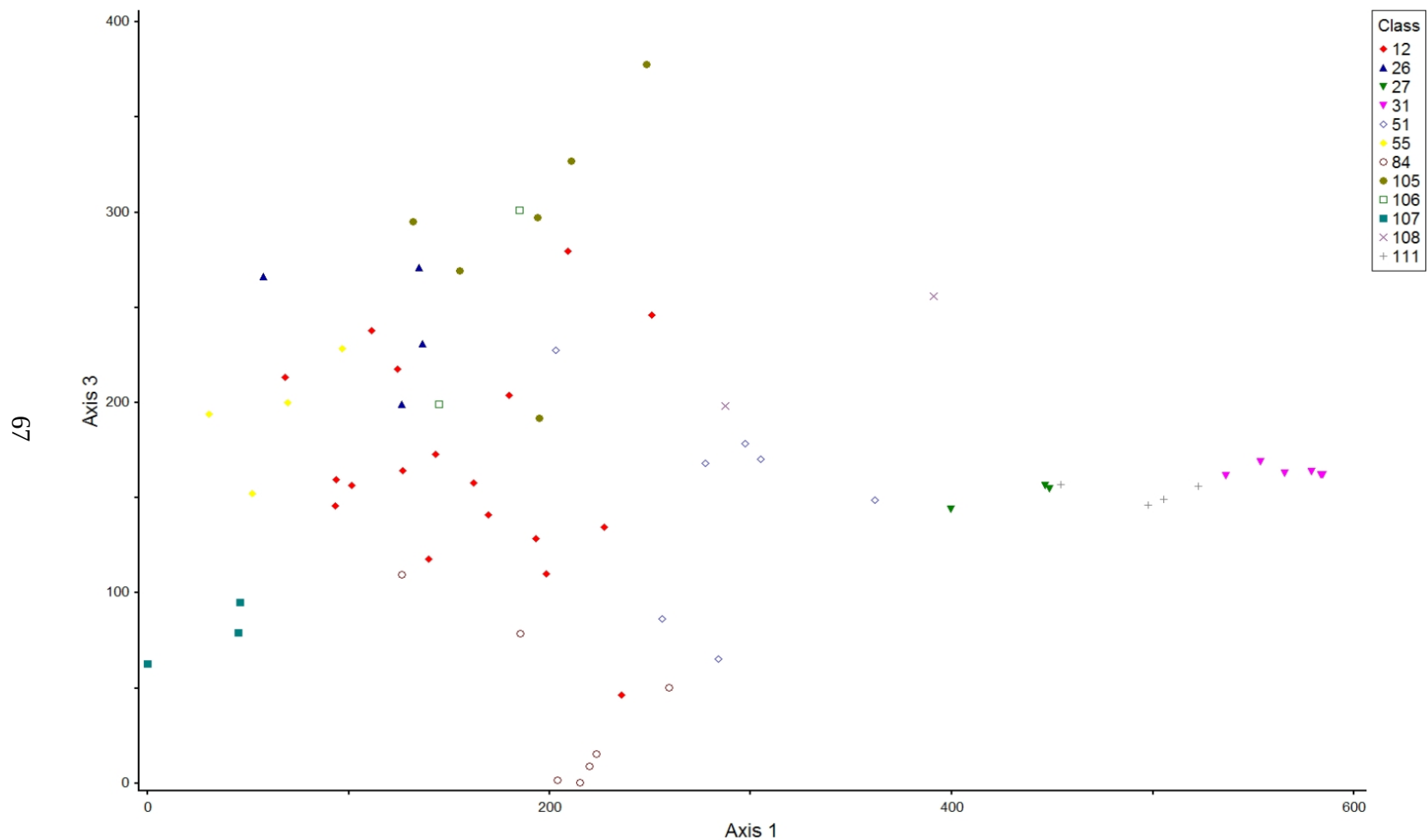


**Figure 4.** 999Ordination of Samples - Herbaceous Vegetation. Herbaceous vegetation samples are plotted by association in relation to DCA axes 1 and 3. A list of association numeric codes is provided in the association summary (above). Coefficients of determination ( $r^2$ ) using relative Euclidean distances for DCA axes 1 through 3 are 0.232, 0.055, and 0.104, respectively.



The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 606/138814, June 2017

**National Park Service**  
**U.S. Department of the Interior**



---

**Natural Resource Stewardship and Science**  
1201 Oakridge Drive, Suite 150  
Fort Collins, CO 80525

[www.nature.nps.gov](http://www.nature.nps.gov)

EXPERIENCE YOUR AMERICA <sup>TM</sup>