Predicting the distribution of potential habitat for *Spiranthes diluvialis* on National Forests in Idaho by fifth field watersheds: Phase 3 – Develop a Predictive Model

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SUMMARY

Spiranthes diluvialis is an orchid that was listed as Threatened under the Endangered Species Act of 1992. Populations are known in Idaho along the Snake River between the Henrys Fork confluence and Palisades Dam, an area that includes approximately 50 river miles. The U.S. Fish and Wildlife Service has established a Section 7 consultation area for the species that includes wetland and riparian habitats between 700 and 7,000 feet throughout the state of Idaho. It is recommended by the Service that surveys be conducted in watersheds that are adjacent to or similar to watersheds where the orchid is known to occur.

This report summarizes the results of a project to predict the distribution of potential habitat for *Spiranthes diluvialis* on National Forest lands in Idaho. The model was developed in three phases. Information gathered during the first phase was used to identify habitat indicators throughout the range of the species to develop habitat profiles by ecoregions. Phase 2 of the project included mapping the distribution of plant associations on National Forest lands. In the final phase a Geographical Information System was populated with habitat indicators for Elevation, Vegetation Zones, Plant Associations containing populations, Plant Associations adjacent to populations, and Bedrock Lithology.

The indicators were used to develop a simple, additive model to predict potential habitat for the species. The results of the model were used to populate fifth field watersheds on scale of 0 (low) to 6 (high) based on the likelihood that potential habitat was present. These data are illustrated on the enclosed hard copy map and can also be viewed in ARCVIEW on the enclosed CD-ROM.

The model identified 51 watersheds with high to very high potential for potential habitat. A significant number of the watersheds are within the Southern Rocky Mountains Ecoregion in the eastern part of the state. This ecoregion supports some of the known Idaho populations and most of the populations in adjacent states. Fewer watersheds were identified in the northern part of the state as having a high likelihood that potential habitat is present. In central Idaho the results are less clear and are complicated somewhat by the lack of plant association data for the Payette National Forest.

Further refinement of the model can be accomplished at the forest level. This may include integrating additional layers into the Geographical Information System for micro- and/or meso-scale indicators or other data that were unavailable for use in the statewide model. In addition, survey results (both negative and positive) and expert knowledge can be used to supplement the results presented here.

INTRODUCTION

The Conservation Data Center is under contract to the U.S. Forest Service to create a GIS model to predict the distribution of potential habitat for *Spiranthes diluvialis* (SPDI) on National Forests (NF) in Idaho. This has been done in three phases, the first two running concurrently:

Phase 1 - Develop a rangewide habitat profile for SPDI.
Phase 2 - Map the known distribution of riparian plant associations on NF land in Idaho.
Phase 3 - Develop a model, using Phase 1 and 2 products, to predict distribution of potential SPDI habitat.

In a 1997 status report for Idaho, Moseley (1998) proposed viewing SPDI habitat at three scales: micro-, meso-, and macro- scales. Indicators at each scale can be used to assess potential habitat. Micro-scale indicators are within-community microsites and include soil profile and textural characteristics, microhydrologic gradients, and associated species. Meso-scale indicators include general characteristics of the habitat, such as geologic and floodplain features, landscape setting, plant associations, and broad hydrologic gradients. Macro-scale characteristics are broad-scale ecological patterns using ecoregional classifications (Bailey 1995), or in the context of broad life zones expressed as vegetation zones (e.g., Daubenmire 1943; Barbour and Billings 1988).

Habitat indicators at the two largest scales, meso- and macro-, were used to develop a habitat profile for *Spiranthes diluvialis* during Phase 1 of this project because site specific data on micro-scale indicators are not available on a statewide basis. A Geographical Information System model was then populated with habitat indicator values based on the habitat profile. This report summarizes the methods and results of Phase 3, develop a predictive model of potential habitat for SPDI.

METHODS

DEVELOP A MODEL TO PREDICT THE POTENTIAL HABITAT FOR *SPIRANTHES DILUVIALUS*

Rangewide habitat indicators at the two largest scales, meso- and macro-, were used to develop an ecoregional habitat profile for *Spiranthes diluvialis*. The data were compiled from throughout the range of SPDI during Phase 1 of this project (Moseley 1999). Element Occurrences of the state natural heritage programs were used as the basis for compiling information on habitat indicators (Appendix 1). Sources of occurrence-specific data were primarily the Element Occurrence Records (EOR's) from Heritage databases, supplemented by inventory reports, status reports, and selected interviews with knowledgeable individuals. Other, more general documents were also used, such as the draft recovery plan and Section 7 guidelines. The occurrence-specific data were summarized into a series of ecoregional habitat profiles (Appendix 2).

The ecoregional habitat profiles were used to develop decision rules for a Geographic Information System (GIS) model. The GIS was populated with attributes related to Elevation (ELEV), Vegetation Zones (VEGZONE), Plant Associations Containing SPDI (PA), and Plant Associations Adjacent (ADJPA) for National Forest Lands in Idaho. The hydrologic setting of known populations of SPDI includes both riverine and non-riverine wetlands. Hydrography was not used in this model, as originally proposed due to the difficulty of capturing isolated non-riverine wetlands.

A draft map of the predicted distribution of habitat for SPDI was initially developed using a simple additive model (ELEV+PA+ADJPA+VEGZONE) to code fifth field watersheds. The watersheds are approximately 18,000 acres. The watersheds were coded on a scale of 0 to 5 with 5 indicating that there was a high likelihood that potential habitat for SPDI was present in the

watershed. The draft map was distributed to interested parties for review. Comments on the draft map were used to refine the model and its presentation.

A number of occurrences of SPDI are known from sites where the soils are moderately to strongly alkaline (Moseley 1999, U.S. Fish and Wildlife Service 2001). In the development of the final model, digital data on bedrock lithology (LITH) was integrated to weight watersheds underlain by calcareous-alkaline bedrock.

Elevation

Idaho spans a large north to south gradient that can be illustrated by the elevation of upper treeline. In southern Idaho the upper treeline is over 10,000 ft while at the Canadian border it is between 7,500 and 8,000 ft. To account for this variation in elevational attributes throughout the state, Moseley (1999) assigned elevational limits by Baileys ecoregions. As an example, in the Northern Rocky Mountains Ecoregion, the known occurrence of Spiranthes diluvialis is at 1,800 ft in elevation. Above 2,500 ft stream gradient increases limiting development of landforms that support SPDI. Thus, within this ecoregion, at elevations below 2,500 ft a weight of 1 was assigned and elevation over 2,500 ft have a value of 0. Appendix 3 lists the weights assigned to elevations by ecoregions.

Vegetation Zones

A list of upland vegetation zones known to support populations of SPDI was developed by Moseley (1999) based on occurrence information throughout the range of the species. For the GIS model map units from the existing vegetation of Idaho, which includes natural vegetation, potential natural vegetation, and cultural vegetation were used (Caicco 1989). Map units were identified that support known populations of SPDI (Appendix 4). Over 99 percent of the 3020 fifth field watersheds in the state contain at least a small percentage of the vegetation zones identified. Thus, if strict presence absence weights (0, 1) were used nearly all the watersheds would score as having potential habitat for SPDI based on vegetation zones. Therefore, weights ranging from 0 to 2 were assigned based on the percentage of the watershed that was occupied by the vegetation zone (Table 1).

Table 1. Weights used for targeted upland vegetation zones based on the percent of the watershed occupied by the attribute.

Percent of watershed	**Weight**
< 10 %	0
10 – 50 %	1
> 50 %	2

Plant Associations

Point locations for over 3800 plant associations, based on the standardized National Vegetation Classification (Anderson et al. 1998), were entered into the GIS. The sources for data are listed in Appendix 5. These data were used for two attributes identified in the SPDI profile. Twenty four plant associations were identified that support known populations as well as associations that are adjacent to known populations of SPDI. The associations were identified based on element occurrence records from throughout the range of the species in Phase 1 of this project. Appendix 6 lists the associations that were given a weight of 1 for either of the two attributes.

Lithology

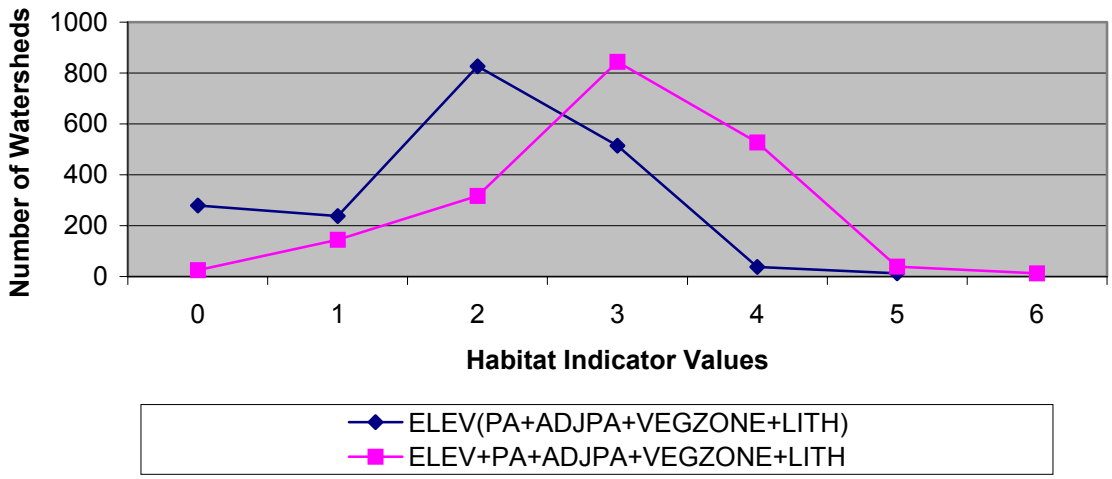
A classification of bedrock lithology was developed for the Interior Columbia Basin Ecosystem Management Project (Johnson and Raines 1995). Formations from the state Geologic Map of Idaho were classified into bedrock lithology map units. Four map units were identified and weighted that indicated calcareous or alkaline conditions (Appendix 7).

RESULTS and CONCLUSIONS:

PREDICTED DISTRIBUTION OF POTENTIAL HABITAT FOR *SPIRANTHES DILUVIALIS*

In the final model, five sets of information were used to predict the presence of potential habitat within fifth field watersheds. The watersheds were populated with the results of the model to develop a map illustrating the likelihood that SPDI habitat is present on NF lands in Idaho (Map 1; see also MODEL_APR on CD-ROM). The model was run using elevation as a key variable where watersheds were given a score of 0 if suitable elevations were not present using the following formula:[ELEV(PA + ADJPA + VEGZONE + LITH)]. This model resulted in identification of 3 percent of the watersheds as having a high (4) to very high (5) likelihood that potential habitat is present and 27 percent having low (1) to very low (0) likelihood that potential habitat is present (Figure 1). The model was also run considering all attributes equally with the following formula: (ELEV + PA + ADJPA + VEGZONE + LITH). The distribution of scores by watershed for both iterations is shown in Figure 1.

Figure 1. Habitat Indicator Values assigned to watersheds based on elevation being considered a key variable and considering all variables equally.



The final model was developed using the latter formula and considering all variables equally. This was based on reviewing the results of the two models and recognizing that there were numerous watersheds that were given a score of 0 when elevation was considered a key variable even though the remaining attributes were present. In addition, during review of the draft the consensus was that elevation should not be given higher weight without further ground truthing of the elevation ranges that were used in the model. In the final model, 3 percent of the watersheds were identified as having a high (5) to very high (6) Habitat Indicator Values. Nine percent were identified as having low (1) to very low (0) likelihood that potential habitat is present.

The United States Fish and Wildlife Service's (2001) Section 7 consultation guidelines indicate that SPDI needs to be considered as a potential species within riverine and non-riverine wetlands ranging from 700 to 7,000 feet in elevation. Surveys are recommended in watersheds that are proximate and/or similar in character to those watersheds with known occurrences. Fifty one watersheds were identified as having high to very high potential for the presence of SPDI habitat (Figure 1, Map 1). The distribution of watersheds with high to very high scores for the Habitat Indicator Values is consistent with information on known locations of populations by ecoregions. Watersheds with high Habitat Indicator Values should be targeted for future surveys as areas that contain potential habitat. Watersheds that scored lower on the targeted attributes, particularly those with Habitat Indicator Values ranging from 0 to 2, should be considered as watersheds where the likelihood of potential habitat is minimal.

The majority of the high Habitat Indicator Values occur in the eastern part of the state within the Southern Rocky Mountains Ecoregion. Some of the Idaho occurrences are within this ecoregion as well as most other occurrences throughout the range of SPDI. In the northern part of the state high to very high scores for the Habitat Indicator Values are less common. The availability of plant association data needs to be considered when interpreting the results of the statewide model. Most forests were well represented in terms of plant association data. Exceptions to this include the Payette and Bitterroot National Forests. Thus interpretation of model results for these forests must come with the caveat that watersheds potentially could have scored higher had plant association data been available.

This project was developed to predict potential habitat not location of populations. The accuracy was assessed in the office based on knowledge of potential habitat in known locations in the state. Accuracy will be best assessed by future site visits to watersheds to note whether potential habitat is present. The results of the model can be used to stratify these survey efforts.

An Arcview Project on CD – Rom with the map and data is being provided with this report. The intent is that data set used here could be supplemented with data (and local knowledge) that are not available on a statewide basis. Some forests may have complete coverage of other data sets such as the National Wetlands Inventory, valley bottom characteristics, or other micro- and/or meso-scale data that could be used to refine the model at the local forest level. In addition, survey results (both positive and negative) for SPDI and potential habitat could be added as layers to the original model. The Conservation Data Center welcomes comments on the model and its application. We will be continuing modeling efforts for the remainder of the state and there is potential for refinement of the model and output based on inclusion of additional data layers, feedback from users, and results of monitoring known SPDI populations.

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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. 1998. Ute ladies tresses (*Spiranthes diluvialis*) in Idaho: 1997 status report. Conservation Data Center, Idaho Department of Fish and Game, Boise, ID. 35 p.

Moseley, R. K. 1999. Predicting the distribution of potential habitat for *Spiranthes diluvialis* on National Forests in Idaho: Phase 1 - Habitat Profile. Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise. 14 p. plus appendix.

U.S. Fish and Wildlife Service. 2001. Section 7 guidelines: *Spiranthes diluvialis*, Ute Ladies'-tresses (Threatened). U.S. Fish and Wildlife Service, Snake River Basin Field Office, Boise. Not paged

Appendix 2
ECOREGIONAL PROFILES FOR PREDICTING POTENTIAL HABITAT IN IDAHO

Intermountain Semidesert Ecoregion
In Idaho, this ecoregion encompasses the Snake River Plain and Owyhee Uplands, as well as the isolated mountains and valleys along the Utah and Nevada borders. Idaho SPDI occurrences are known from the extreme eastern edge of this ecoregion.

Plant Associations – Most of the associations occur in this ecoregion, although the *Alnus incana* and *Eleocharis pauciflora* types are rare and the *Elaeagnus comutata* type only occurs within the known range of SPDI on the Snake River.

Adjacent Riparian Communities – The herbaceous and shrub communities all are common in this ecoregion. *Populus angustifolia*-dominated deciduous forests are limited, occurring only on the Snake River from the ecoregion boundary, downstream to American Falls Reservoir. *Populus trichocarpa* dominates most other forested communities along rivers and large streams.

Elevation – Elevations range from about 2,000 to 10,300', with most of the region lying below 5,000'. The known populations in the ecoregion occur between 4,820' and 5,015'. Applying the elevational limits of 2,000 to 7,000' is warranted for this ecoregion.

Vegetation Zone – There are few coniferous forest stands in this ecoregion. Nearly all of it is covered with sagebrush-steppe and, to a lesser extent, juniper, pinyon-juniper, and mountain mahogany woodlands.

Hydrologic Setting – Appropriate hydrologic settings are present throughout the ecoregion.

Southern Rocky Mountains Ecoregion
This ecoregion encompasses the mountains of far eastern Idaho, adjacent to the Wyoming border. It contains some of the known populations of SPDI in Idaho, as well as most other occurrences throughout its range.

Plant Associations – All of the associations are common in this ecoregion, although the *Elaeagnus comutata* type occurs only along the Snake River.

Adjacent Riparian Communities – The herbaceous, shrub, and forest communities all are common in this ecoregion.

Elevation – Elevations range from 5,000 to 10,000'. The known populations in the ecoregion occur between 5,100 and 5,300'. Applying the upper elevational limit of 7,000' is warranted for this ecoregion.

Vegetation Zone – Coniferous forests, interspersed with sagebrush-steppe and juniper woodlands, cover most of this ecoregion in Idaho. In this respect, it is similar to other landscapes in the ecoregion containing SPDI occurrences, especially the Wasatch and Uinta mountains of Utah.

Hydrologic Setting – Appropriate hydrologic settings are present throughout the ecoregion, although there are few large streams above 6,500'.

Middle Rocky Mountains Ecoregion
In Idaho, this ecoregion encompasses the mountainous central portion of the state, between the Lochsa-Clearwater river area and the Snake River Plain, and includes a large diversity of vegetation types, landforms, and climates. Within the context of SPDI habitat modeling, it is appropriate to subdivide this ecoregion into the next lower level of Bailey's (1995) ecoregional classification hierarchy, that is the Section. There are four sections in Idaho: Beaverhead

Section, Challis Volcanics Section, Idaho Batholith Section, and Blue Mountains Section (McNab and Avers 1994). No SPDI is known from the Idaho portion of this ecoregion, although it does occur in the valleys of adjacent southwestern Montana, some of which are in the Beaverhead Section.

Plant Associations – Most of the associations occur in this ecoregion, although the *Elaeagnus comutata* type is very limited. Of special note is that the relatively rare alkaline wetlands, typical of the Montana occurrences, occur in the Idaho portion of the Beaverhead Section.

Adjacent Riparian Communities – Herbaceous and shrub communities all are common in this ecoregion. Deciduous forest communities are dominated by *Populus trichocarpa*; no *P. angustifolia* types occur here.

Elevation – Elevations range from about 1,200' to over 12,600'. Because of the diversity encompassed by this ecoregion, especially as it relates to SPDI habitat indicators, elevation parameters for the habitat model will differ across the four sections. An upper elevational limit of 7,000' is appropriate for the Beaverhead Section, while 6,500 is more appropriate for the Challis Volcanics and Idaho Batholith sections. The upper limit for the Blue Mountains Section will be 5,000'. In addition, because there are no hydrologic and plant community indicators in the deep canyons of the Salmon, Snake and Clearwater rivers through this ecoregion, a lower elevational limit of 3,500' will be used in these drainages.

Vegetation Zone – Except for the Beaverhead Mountains Section, most of the ecoregion is covered by coniferous forest. Intermontane valleys throughout the area are dominated by sagebrush-steppe and the Salmon, Snake and Clearwater canyons are dominated by steppe.

Hydrologic Setting – Appropriate hydrologic settings are present in the broad intermontane valleys. They are generally not present in the mountains or steep canyons of the ecoregion, where the stream gradients are very steep and the flood plains very narrow, being scoured annually during spring runoff.

Great Plains-Palouse Dry Steppe Ecoregion

The Palouse Prairie of Idaho and Washington represents a disjunct Section of this ecoregion, being separated from the Great Plains by the Rocky Mountains. In Idaho, it is confined to the basalt plateaus along the Washington border and is bisected by the Clearwater River canyon. No SPDI occurrences are known from Idaho, but it does occur on the Great Plains of Nebraska, Wyoming, and Colorado.

Plant Associations – None (or very few) of the associations containing SPDI probably occur in this ecoregion in Idaho.

Adjacent Riparian Communities – Same as above, none (or very few) of the adjacent riparian communities probably occur in this ecoregion in Idaho.

Elevation – Elevations range from about 800' to around 4,000'. Because there are no hydrologic and plant community indicators in the Clearwater Canyon, a lower elevational limit of 1,500' will be used in this ecoregion.

Vegetation Zone – Native vegetation in this ecoregion was steppe, but most has been converted to agriculture. Some of the higher elevations are covered with coniferous forests.

Hydrologic Setting – Appropriate hydrologic settings are largely not present in this ecoregion, except possibly along some of the larger drainages on the plateau at the border with the Northern Rocky Mountains Ecoregion.

Northern Rocky Mountains Ecoregion
This ecoregion encompasses the mountains and intermontane valleys of northern Idaho influenced by a maritime-like climate. No SPDI occurrences are know from the Idaho, but the single Washington population occurs at the western edge of this ecoregion.

Plant Associations – Very few of the associations containing SPDI probably occur in this ecoregion in Idaho. No alkaline wetlands similar to the Washington site occur in this ecoregion in Idaho.

Adjacent Riparian Communities – Same as above, very few of the adjacent riparian communities probably occur in this ecoregion in Idaho.

Elevation – Elevations range from about 1,800' to around 7,500'. Because montane coniferous forests cover most of this ecoregion (see below), and the known occurrence in this ecoregion is at 1,800', the upper elevation limit will be 2,500'. Also, the gradients of most streams above 2,500 feet are very steep.

Vegetation Zone – Native vegetation of this ecoregion consists almost entirely of maritime-like coniferous forests. A small area of native steppe occurred on the Rathdrum Prairie. No shrub-steppe similar to the Washington site occurs in Idaho.

Hydrologic Setting – Appropriate hydrologic settings are present in the broad intermontane valleys at low elevations in the ecoregion. Most streams descend from the mountains at very steep gradients.

Appendix 3
Elevation ranges and assigned weights

Ecoregion	Elevation Range	Weight
Northern Rockies	> 2500 ft	0
	< 2500 ft	1
Great Plains	> 1500 ft	0
	< 1500 ft	1
Intermountain Semi-Desert	> 7000 ft	0
	2000 – 7000 ft	1
Southern Rocky Mountains	> 7000 ft	0
	< 7000 ft	1
Middle Rocky Mountains		
Beaverhead Section	> 7000 ft	0
	< 7000 ft	1
Challis Volcanics Section	> 6500 ft	0
	< 6500 ft	1
Blue Mountains Section	> 5000 ft	0
	3500 - 5000 ft	1
	<3500 ft	0
Idaho Batholith Section	> 6500 ft	0
	3500-6500	1
	< 3500 ft	0

Appendix 4

Upland vegetation zones surrounding known occurrences of *Spriranthes diluvialis* ("+" populations known from within vegetation zone; "-" populations not known from within vegetation zone)

ID	VEGETATION ZONE	POPULATIONS KNOWN?
1000	Urban	-
1001	High Intensity Urban	-
1002	Low Intensity Urban	+
1101	Disturbed High	-
1102	Disturbed Low	+
2000	Agriculture	+
3101	Foothills Grassland	+
3102	Disturbed Grassland	+
3103	Herbaceous Clearcut	+
3104	Montane Parkland/Subalpine Meadow	-
3105	Wet Meadow	-
3106	Herbaceous Burn	+
3107	Shrub/Steppe Annual Grass-Forb	+
3109	Perennial Grassland	+
3110	Perennial Grass Slope	+
3201	Mesic Upland Shrubs	+
3202	Warm Mesic Shrubs	-
3301	Curlleaf Mountain Mahogany	+
3304	Bitterbrush	+
3305	Mountain Big Sagebrush	+
3306	Wyoming Big Sagebrush	+
3307	Basin & Wyoming Big Sagebrush	+
3308	Black Sagebrush Steppe	+
3309	Silver Sage	+
3310	Salt-desert Shrub	+
3312	Rabbitbrush	+
3315	Low Sagebrush	+
3316	Mountain Low Sagebrush	+
4101	Aspen	-
4102	Cottonwood	-
4103	Maple	-
4201	Englemann Spruce	-
4203	Lodgepole Pine	-
4206	Ponderosa Pine	+
4207	Grand Fir	-
4208	Subalpine Fir	-
4210	Western Red Cedar	-
4211	Western Hemlock	-
4212	Douglas-fir	+
4215	Western Larch	-
4216	Douglas-fir/Limber Pine	-
4217	Subalpine Pine	-
4218	Subalpine Fir/Whitebark Pine	-
4219	Mixed Whitebark Pine Forest	-
4220	Mixed Subalpine Forest	-
4221	Mixed Mesic Forest	-
4222	Mixed Xeric Forest	-
4223	Douglas-fir/Lodgepole Pine	+
4224	Standing Burnt or Dead Timber	-
4225	Douglas-fir/Grand Fir	-
4226	W. Red Cedar/Grand Fir Forest	-
4227	W. Red Cedar/W. Hemlock Forest	-
4228	W. Larch/Lodgepole Pine	-
4229	W. Larch/Douglas-fir	-

4230	Utah Juniper	+
4231	Western Juniper	+
4232	Pinyon Pine/Juniper	+
4301	Mixed Needlefeaf/Broadleaf Forest	+
5000	Water	-
6101	Needleleaf Dominated Riparian	-
6102	Broadleaf Dominated Riparian	-
6103	Needleleaf/Broadleaf Riparian	-
6104	Mixed Riparian (Forest & Non-forest)	-
6201	Graminoid or Forb Dominated Riparian	-
6202	Shrub Dominated Riparian	-
6203	Mixed Non-forest Riparian	-
6301	Deep Marsh	-
6302	Shallow Marsh	-
6303	Aquatic Bed	-
6304	Mud Flat	-
7201	Sand Dune	-
7202	Vegetated Sand Dune	-
7300	Exposed Rock	-
7301	Lava	-
7302	Vegetated Lava	-
7800	Mixed Barren Land	-
7900	Shoreline & Stream Gravel Bars	-
8100	Alpine Meadow	-
9100	Perennial Ice Snow	-
9800	Cloud	-
9900	Cloud Shadow	-

Appendix 5
Sources for plant association data

Study Description	Number Plots/ Observations	Citation
Forest Inventory & Analysis plots	90	U.S. Forest Service. 1999. Forest Inventory and Analysis Program database - Idaho riparian plots. U.S. Forest Service, Rocky Mountain Research Station, Odgen, UT.
Youngblood et al. 1985 plots (does not include Mutz's Centennial plots)	120	Youngblood, A.P., W.G. Padgett, and A.H. Winward. 1985. Riparian ecological plot forms from Idaho, 1983-1984. Unpublished data on file at the Conservation data Center, Idaho Department of Fish and Game, Boise, ID.
Mutz & Queiroz 1983 Centennial Mountains plots (used by Youngblood et al. 1985 for classification)	61	Mutz, K.M., and J. Queiroz. 1983. Riparian plot forms from the Centennial Mountains, 1982. Unpublished data on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Mutz & Queiroz 1983 South Fork Salmon plots	54	Mutz, K.M., and J. Queiroz. 1983. Riparian ecological plot forms from the South Fork Salmon River drainage, 1982. Unpublished data on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Targhee NF Ecological Unit Inventory (EUI)	41	Targhee National Forest. No date. Riparian plots from Targhee National Forest Ecological Unit Inventory (U97BOW-1IDUS). On file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Padgett et al. 1989 plots from Idaho	65	Padgett, W.G., A.P. Youngblood, and A.H. Winward. 1989. Riparian ecological plots from southeastern Idaho, 1984-1986. Unpublished data on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Tuhy's 1981 thesis plots	397	Tuhy, J.S. 1981. Riparian ecological plot forms from the Sawtooth Valley, Idaho, 1979. Unpublished data on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Tuhy and Jensen 1982 plots	162	Tuhy, J.S., and S. Jensen. 1982. Riparian ecological plot forms from central Idaho, 1981. Unpublished data on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.

Nez Perce NF - forest-wide riparian plots	125	Nez Perce National Forest. 1999. Riparian ecological plot data collected on the Nez Perce National Forest between 1989 and 1991. Unpublished data on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Idaho Panhandle NFs - Riparian ECODATA plots	33	Idaho Panhandle National Forests. 1999. Riparian ECODATA plots, 1988-1990. Unpublished data from USFS Region 1 database; on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Idaho Panhandle NFs Timber Stand Inventory db	1724	Idaho Panhandle National Forests. 1999. Riparian community observations on the Idaho Panhandle National Forests. Electionic spreadsheet on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Clearwater NF - Riparian ECODATA plots	11	Clearwater National Forest. 1999. Riparian ECODATA plots, 1991-1995. Unpublished data from USFS Region 1 database; on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Nez Perce NF - Riparian ECODATA plots	20	Nez Perce National Forest. 1999. Riparian ECODATA plots, 1987-1995. Unpublished data from USFS Region 1 database; on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Caribou NF Forest-wide Level II Riparian Inventories	132	Caribou National Forest. No date. Forest-wide riparian surveys (Level II and Level III). USDA Forest Service, Caribou National Forest, Pocatello, ID. On file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Targhee NF - Layser (Level II) Riparian Inventories	172	Layser, E. F. 1994. Riparian Evaluations-Level II Vegetation. Prepared by Land Management Services for the Targhee National Forest. On file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
Sawtooth NF - Trail Creek Level II Inventory	22	Sawtooth National Forest. 1988. Riparian Evaluation - Level II: lower Trail Creek and lower Corral Creek. Unpublished document on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise ID.
Plot and point observations from various surveys completed by the Conservation Data Center.	652	Biological and Conservation Data System. 2000. Wetland and riparian plant community data from the the Biological and Conservatio Data System. Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise Idaho.
Total Plots / Observations	**3881**	

Appendix 6
Plant associations and assigned weights

Plant association	Plant association within weight	Plant association adjacent weight
Forested		
Populus angustifolia/Cornus sericea	0	1
Populus angustifolia/Elaeagnus commutata	0	1
Populus angustifolia/Poa pratensis	1	0
Populus angustifolia/Rhus trilobata	0	1
Populus angustifolia/Symphoricarpos occidentalis	0	1
Scrub-shrub		
Alnus incana/Mesic graminoid	1	0
Betula occidentalis/Mesic forb	1	0
Betula occidentalis/Mesic graminoid	1	0
Elaeagnus commutata	1	0
Salix exigua/Barren	0	1
Salix exigua/Mesic graminoid	1	0
Salix exigua/Poa pratensis	1	1
Emergent		
Agrostis stolonifera	1	0
Carex aquatilis	0	1
Carex lanuginose	1	1
Carex praegracilis	0	1
Carex simulata	1	0
Deschampsia cespitosa	1	1
Eleocharis palustris	0	1
Eleocharis pauciflora	1	0
Eleocharis rostellata	1	1
Equisetum variegatum	1	0
Juncus balticus	1	0
Typha latifolia	0	1

Appendix 7
Bedrock lithology units and assigned weights

ID	LITHOLOGY	WEIGHT
1	not identified	0
2	Alluvium	0
3	argillite and slate	0
4	calc-alkaline intrusive	1
5	calc-alkaline meta-volcanic	1
6	calc-alkaline volcanoclastic	1
7	Carbonate	1
8	Conglomerate	0
9	dune sand	0
10	felsic pyroclastic	0
11	felsic volcanic flow	0
12	glacial drift	0
13	Granite	0
14	granitic gneiss	0
15	interlayered meta-sedimentary	0
16	lake sediment and playa	0
17	Landslide	0
18	Loess	0
19	mafic gneiss	0
2-	mafic intrusive	0
21	mafic meta-volcanic	0
22	mafic pyroclastic	0
23	mafic schist and greenstone	0
24	mafic volcanic flow	0
25	meta-conglomerate	0
26	meta-sedimentary phyllite and schist	0
27	meta-siltstone	0
28	metamorphosed carbonate and shale	0
29	mixed carbonate and shale	0
30	mixed eugeosynclinal	0
31	mixed miogeosynclinal	0
32	open water	0
33	Quartzite	0
34	Sandstone	0
35	shale and mudstone	0
36	Siltstone	0
37	Tuff	0
38	Unclassified	0