Umatilla River Floodplain and Wetlands: A Quantitative Characterization, Classification, and Restoration Concept

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The accompanying CD (obtainable from the author) contains the following:

All collected botanical and geomorphic data, with summary statistics (requires Excel®)
Maps of individual site locations
Digital map of point locations (requires ArcView® or ArcExplorer®)
Topographic plots of site cross-sections, from lateral transects
Panoramic photographs of the sites taken at the time of sampling
This report, in Adobe Acrobat® pdf format

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Acknowledgments

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1. Introduction

1.1 Background

This report summarizes and interprets data collected during Summer 2001 in the floodplain of the lower 80 miles (128.4 km) of the Umatilla River. The study was initiated in March 2001 with a Section 104(b) grant from the U.S. Environmental Protection Agency to the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). The CTUIR contracted a portion of the work to Adamus Resource Assessment, Inc. of Corvallis, Oregon. Dr. Adamus had previously developed Oregon's hydrogeomorphic (HGM) classification and assessment methods for wetlands (Adamus and Field 2001, Adamus 2001a, Adamus 2001b). An initial reconnaissance of the study area wetlands was completed in April 2001, and most field work was conducted during July and August under particularly dry conditions. Umatilla River flows during water-year 2001 were 75% of normal.

Because the Umatilla Tribes have "Treatment as State" status from the U.S. Environmental Protection Agency, they are responsible for managing water quality on reservation lands. Under the federal Clean Water Act, the Tribes have the authority to establish water quality standards, assess compliance, report water quality violations, establish a "303d list" of water bodies (including wetlands) out of compliance, and develop management plans (Total Maximum Daily Loads or "TMDL's") for meeting standards in water bodies on the 303d list. Recognizing that many wetlands help purify water while supporting diverse aquatic life uses, the Tribes are committed to monitoring, conserving, and restoring wetlands within their jurisdiction. Developing the technical means to do this requires placing the Tribes' wetlands in a broader regional context. Describing that context has sometimes necessitated collecting reference data from areas within the same river basin but beyond the reservation boundary.

The data were collected primarily to support development of a quantitative classification that would be applicable to local floodplain environments. Secondarily and in support of the primary objective, data were collected to quantify the range of variability – both natural and human-caused -- of some natural features in the floodplain. Many of these features are believed to indicate the functional health of the floodplain and its wetlands. The collected data and the resulting classification scheme will be used, along with other tools and policies, for (a) identifying the most geomorphically and biologically degraded parts of the system, (b) specifying appropriate in-kind compensation for any unavoidable future alterations to floodplain wetlands, and (c) monitoring the functional recovery of the floodplain system as a result of future restoration projects.

1.2 The Study Area

The study area consisted of the floodplain and riparian zone of the lower Umatilla River, bounded on the upriver (east) end by a tributary, Meacham Creek, and on the lower (northwestern) end by the junction of the Umatilla and Columbia Rivers. This major segment of the Umatilla River extends well beyond the boundaries of CTUIR land, through the cities of Pendleton and Hermiston. The floodplain was defined to include all bottomland areas within the geomorphic floodplain, except for lands structurally protected from river flooding. Some of the floodplain margin included in the field data collection may be inundated only rarely -- at frequencies of decades or even centuries.

Watershed area ranges from 341 km^2 at the upper end of the study area to 5471 km^2 at the lower end. The study area is generally underlain by Columbia River basalt covered extensively by

sedimentary deposits and, within the Umatilla River floodplain, by extensive alluvial deposits. Land cover in most of the watershed is rural residential and agricultural, with extensive bottomlands that have been cleared and irrigated since the early 1900's. Urban land cover is mostly confined to the cities of Pendleton and Hermiston. The climate is generally arid, and during the June-August period the mean monthly precipitation ranges from 6 to 54 mm (0.23 – 2.13 inches), and temperature ranges from 8.1 to 23.3 C (46.6 to 73.9 F). Especially in upper reaches of the study area, river ice may be a significant factor during some winters. Most surface runoff results from melting snow pack, and almost all the flow in the lower river is used for irrigation between June and October. Major floods occurred in 1965 and 1996. The main stem of the river is undammed, but lower portions have severely altered water summertime regimes due to releases from contributing McKay Reservoir (Appendix B). In addition, channel alterations and water diversions, many of which have been in place since the early 1930's, are extensive. At Wenix Springs near the mouth of Squaw Creek, the City of Pendleton has diverted subsurface water for drinking use for many decades. A review of historical aerial photographs in one river reach (rivermile 72.5 to 78.5) showed degradation or loss of 35% of the wetland area as a result of hydrologic stranding, and a similar analysis for another reach (rivermiles 18-24, approximately) revealed stranding of 90% of the wetlands (Stengle and Quaempts 1995). Beaver and salmonid fish species once were dominant ecological forces shaping the Umatilla floodplain system, but have declined dramatically. Salmonid fish runs over the past 10 years have ranged from 1111 to 2892 for steelhead, 68 to 4220 for spring chinook, 91 to 737 for fall chinook, and 409 to 4154 for coho (Saul et al. 2001).

1.3 Riverine Wetlands Classification

Wetlands are defined by characteristic vegetation, water regime, and soils. Especially in floodplain situations, wetlands may appear dry except for a few weeks of the year when flooding from the river occurs. Wetlands within the Umatilla floodplain had previously been mapped by the National Wetland Inventory (NWI), but using only aerial photographs from July 1981 that had relatively coarse resolution. The CTUIR subsequently digitized those NWI maps (Stengle and Quempts 1995). Areas depicted as wetlands on NWI maps do not necessarily meet federal and state jurisdictional criteria for wetlands.

The NWI wetland maps use a national classification scheme for wetlands (Cowardin et al. 1979) that is based mainly on vegetation form and only weakly reflects geomorphologic and functional differences among various sections of the river and its floodplain. NWI maps show most polygons within the Umatilla River floodplain being classified as riverine, palustrine, or (rarely) lacustrine. A newer national classification scheme (Brinson 1993) is believed to be more sensitive to differences in function. It is based on hydrology, geologic landform, and setting. Thus, it is known as the "hydrogeomorphic" or HGM classification. The Oregon Division of State Lands and USEPA recently published an adaptation of the national HGM classification applicable to riparian as well as wetland systems in Oregon (Adamus 2001). Under Oregon's HGM classification, many of the wetland and riparian habitats within the Umatilla River floodplain are classified as "riverine flow-through." That is, they are flooded at least briefly at least once every 2 years by water from the river. Most wetland and riparian habitats that are flooded by the Umatilla River less often, and which are on alluvial soils within the geomorphic floodplain, belong to HGM's "slope" class. That is, they are sustained mainly by groundwater seeps, springs, and elevated water tables from the river. Some annually flooded areas may also receive substantial groundwater inputs, but are still classified as riverine flow-through. Also, parts of the floodplain where surface water is present but

stagnant (not flowing, lentic) at any time of the year belong to HGM's "riverine impounding" subclass.

1.4 Objectives

CTUIR's main objective for this study was to support development of a hierarchical numerical classification that could be applied to the floodplain environments of the lower Umatilla River, including but not limited to its wetlands. The classification is designed to be applied at the scale of an individual wetland (about 0.1-100 acres) located within a floodplain, rather than at the scale of an entire river reach or subwatershed. Ideally, the classification should not be used alone, but in combination with procedures for assessing other watershed components (e.g., channel stability) and wetlands at broader scales. Such an integrated approach is necessary for wetland restoration to succeed, because watershed components have numerous intricate linkages across multiple scales, with cumulative, non-linear interactions among components being common.

The entire lower Umatilla River system, rather than just the portion on CTUIR lands, was included in the study in order to provide the broad foundation necessary for developing a hierarchical classification. It was determined that the classification should be (a) defined by variables that can be readily assessed by resource technicians with minimal training, (b) based on hydrogeomorphic variables (and the vegetation variables that largely reflect them) so that the resulting categories are most pertinent to wetland function, and (c) be compatible with (i.e., represent a localized elaboration on) the HGM classes recognized statewide.

1.5 Study Importance

This study is important because over the past century, human activities have heavily decimated the wetland and riparian environments in the Umatilla River Basin (Stengle and Quaempts 1995, Kagan et al. 2000). For centuries the wetlands in this region have provided native cultures with spiritual meaning, clean water, natural plant and animal foods, and medicines (*Wetland Protection Plan*, CTUIR 1997). Wetlands also help purify water contaminated by human uses and probably help limit the extent of catastrophic flooding in the lower portion of the river basin. Section 3.3 discusses many of these functions of Umatilla River floodplains.

Human alteration of wetlands is regulated by law in order to protect "functions and values" that benefit society as a whole, as well as protecting wetland "ecological integrity." In operational terms, ecological integrity is most often defined as the resemblance of a biological community in a particular wetland to one typical of the least-altered wetlands of the same subclass in the same region, i.e., biological "reference condition" (Karr and Chu 1999, Rheinhardt et al. 1999). In some cases, this definition of ecological integrity is broadened to include some structural components of the riparian system (Innis et al. 2000). The study we conducted on the Umatilla emphasizes wetland functions rather than ecological integrity, partly because of the initially greater time and expense required to assess ecological integrity, subjectivity involved in assessing some of its components, and incompleteness of current integrity assessment methods for describing some of the important services floodplain systems provide to society. Nonetheless, additional analyses of the data already collected could yield information useful to assessing the Umatilla floodplain's ecological integrity.

Many previous attempts have been made to use hydrogeomorphic features to classify river channels (e.g., Rosgen 1996; others reviewed by Kondolf 1995), riparian areas (e.g., Kovalchik

and Chitwood 1990), and wetlands (e.g., Brinson 1993). However, apparently none have specifically proposed a geomorphic classification of wetlands *within floodplains*. That has been a primary objective of this project.

Recently, as science has documented the many benefits of floodplain wetlands to society, increased attention is being given to restoring floodplains to their natural condition, or at least to a condition where some of their original functions are realized more fully. Different floodplain environments respond differently to different types of restoration. Thus, it is important to avoid making decisions arbitrarily with regard to which floodplain areas to restore, how to restore them, and which variables to measure to determine if the restoration is successful. Classification and the collection of data from reference wetlands are useful partly because they provide a context for restoration (Harris 1999, Rheinhardt et al. 1999).

1.6 Limitations of This Study

This study was not intended to verify the delineation of every wetland mapped in the study area by the National Wetland Inventory (NWI), prioritize or assign an HGM subclass to every mapped wetland, measure flood frequency (recurrence interval) for specific locations of the floodplain, determine the morphologic stability or restoration potential of every river segment and wetland, or assess the ecological condition of every wetland within the Umatilla River floodplain. Such important objectives were impractical, given the large extent of the study area, the one-year duration of the study, the dynamic character of most of the floodplain wetlands, and the fact that much of the floodplain was inaccessible due to landowner restrictions. Also, the development of a rapid visual method for assessing wetland functions or ecological condition was not an objective of this project. This study did not prioritize individual wetlands for restoration, based on geomorphic, socioeconomic, or other factors. Rather, its goal was to provide a classification tool that can be used as one component of a complete toolbox needed for future decisionmaking of this nature.

Typically, the legal criteria for defining the jurisdictional boundaries of wetlands are based on vegetation, soils, and hydrology indicators -- as estimated at a fixed point in time. However, in floodplain settings these indicators can vary significantly over short periods, as scouring floods regularly remove vegetation, rework soils and sediments, and repeatedly connect and disconnect individual wetlands. Thus, an ideal classification would recognize and classify *environments* within the floodplain that are conducive to supporting wetlands over much of the longer term, even though at a given spot during a given moment not all indicators necessary to meet criteria for wetland jurisdictional status are evident. Developing and validating tools for predicting such wetland-supportive environments was beyond the scope of this effort, and would likely be a very challenging and long-term effort, partly due to the confounding and ever-changing overlay of human disturbances.

2. Methods

2.1 Study Site Selection

We collected hydrogeomorphic and vegetation data from 40 general locations ("sites") on the lower Umatilla River. Of these 40 sites, we selected 20 in a statistically systematic manner, and thus termed them the "systematic" sites. Specifically, they were situated at intervals of 6 km along the

river, from near its confluence with the Columbia River, upstream to where Meacham Creek enters. Because of difficulties in accessing a few sites, some sites were separated from the nearest site by as much as 9.5 km (the lowest 2 sites) and as little as 4 km (mean= 6.0325 km; standard deviation of 1.1017). When access difficulties were encountered, the potential site was generally moved upriver until a location with access could be found.

We selected the remaining 20 sites subjectively, and thus termed them the "non-systematic" sites[2]. We situated them mainly where concentrations of wetlands were apparent on NWI maps. Also, some were situated above and below confluences with tributaries in order to examine possible geomorphic and botanical influences of the tributaries. Thus, the non-systematic sites do not comprise a probability sample. We used the non-systematic approach because wetlands may be undersampled by a purely systematic approach, due to their generally comprising only a small portion of the landscape. We used the systematic approach partly because some wetlands within floodplains may not be detected by NWI mapping procedures, and because a systematic sample allows for extrapolation of findings across a broader region.

2.2 Selection of Variables to Measure

This study entailed the measurement of a large number of features of the Umatilla River channel, floodplain, and adjoining uplands. In this report, we call these features "variables." We selected them initially based on their:

- anticipated correlation or conceptual relationship with one or more wetland functions
- anticipated correlation or conceptual relationship with human activities
- ease of estimation
- potential usefulness for this localized HGM classification

Within the constraints of this study it was not possible to validate the relationship of variables with particular wetland functions (the first item above), because accurate measurement of wetland function was beyond the scope of this project and typically requires repeated data collection over many seasons and years[3]. However, we were able to examine statistical associations between our variables and some spatial estimates of human activities. To do so we estimated many more variables than we intended to eventually use, and then used statistical analysis to weed out ones that had low capacity to predict human influence on floodplain wetlands, or which were highly correlated with other variables, thus making them redundant.

The variables for which we collected data can be categorized broadly as geomorphic, vegetation, and landscape context variables. Examples of geomorphic variables are floodplain width, soil texture, and floodplain mean slope. Examples of vegetation variables are percent canopy closure, number of dead trees, and percent of herbaceous plant species (per plot) that are not native to the region. Examples of landscape context variables are mean annual precipitation, percent of surrounding land cover that is urban, and distance to the nearest road. We estimated most variables in the field, but also used existing digital maps and GIS to assess some variables over broader areas as needed to infer possible influence of human activities. A list of variables we estimated, with

[2] On data forms and maps, the non-systematic sites were labeled NS1, NS2, etc. and the systematic sites were labeled S1, S2, etc. with one exception: NS5 is a systematic site and S4 is a non-systematic site.
[3] The thermoregulation function of wetland and riparian environments is probably the easiest to measure.

definitions, is provided in Appendix J, and summary statistics (as well as raw data) from systematic and nonsystematic sites are provided in file STATTABS on the accompanying CD.

2.3 Procedures for Estimating Variables

We collected data during a single day-long visit to each site from 25 June to 29 August[4]. At each of the 40 sites, we collected data for the variables using 2 types of transects: greenline and lateral. *Greenline transects* adjoin and parallel the main active channel, following the approximate line where bare, scoured substrate and pioneering vegetation meet. One 400-foot greenline transect was used at each site, and was generally located on whichever bank had the most gradual slope perpendicular to the channel, i.e., widest floodplain. *Lateral transects* cross the center of the greenline and span the entire unconfined geomorphic floodplain[5], perpendicular to the alignment of the main channel.

Along each transect, we examined vegetation in a series of plots centered on the transect, each plot with a radius of 3 feet (or 30 feet for some variables pertaining to woody vegetation, see Appendix J). For each site's greenline transect, we situated plots at the 0-, 100-, 200-, 300-, and 400-foot marks, moving upriver. For each site's lateral transect, we situated 20 plots at equal intervals with the provision that no plots adjoin each other by closer than 10 feet. Unintentionally, only 19 lateral plots were surveyed at one site (S16), 22 at another (S10), and 23 at a third (S13). Where the floodplain was very narrow (<200 ft wide), we added additional lateral transects at the 0-ft and/or 400-ft marks of the greenline in order to sample no fewer than 20 lateral plots while maintaining the minimum separation between plots along the lateral transects. Use of multiple lateral transects was required at 2 non-systematic and 7 systematic sites. Among all lateral transects, the plot spacing ranged from 10 ft (at 12 of the sites) to 50 ft (1 site), with a median of 17 ft.

Within each plot, we identified and estimated relative cover of all plant species (and bare ground, water, plant litter) within 3 vertical feet of the substrate, as well as estimating some other variables pertaining to vegetation structure. After completing each transect, we walked back along the transect to note any new plant species not found in any of the plots, and recorded these separately. Unfamiliar plants were labeled and bagged for later identification in the office.

Using a laser transit, we also measured relative elevation at several points along the transects, including each of the vegetation plots, the channel bottom, wetted edges, bank tops, islands and bars, and other noticeable elevation change points. This provided a cross-sectional profile of each site (viewable on the accompanying CD) that is useful for interpreting plant distribution patterns and floodplain function. Because the measured elevations were not referenced to established topographic benchmarks, they can be used only to compare elevations of plots (not sites) relative to each other.

We used a handheld GPS unit in conjunction with coordinates measured (to within 0.001 degree) from topographic maps to locate our starting point (0-ft mark of the greenline) at each preselected location along the floodplain. We also used the GPS unit to note the coordinates at each end of the

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[4] One site, NS13, was visited on October 18.

[5] Where levees were encountered within the geomorphic floodplain, transects went no further than the top of the levee. Similarly, where cropland was encountered within the outer fringe of the geomorphic floodplain, transects went no further than the edge of the crop field. Where pastureland was encountered within the outer fringe of the floodplain, no more than 1 or 2 plots were situated within that cover type.

greenline and each end of lateral transects, and we recorded the compass bearing of each transect. Accuracy of the handheld GPS is estimated to be on the order of 10-100 ft horizontally. To generally document existing conditions, we took a color photograph using a disposable panoramic camera aimed upriver and downriver at the 0-ft and 400-ft marks of the greenline, as well as perpendicular to the channel in both directions at the 200-ft mark. We spatially staggered our visits to sites to minimize potentially confounding longitudinal and phenological gradients. For example, we avoided visiting all the downriver sites early in the season and all the upriver ones late in the season. Daily river flow conditions during our field season are given in Appendix B.

River systems are recognized as having two major dimensions -- longitudinal and lateral – and sometimes a third (vertical). The "longitudinal" dimension is the upriver-downriver path; the "lateral" dimension is the path perpendicular to the channel; the "vertical" is represented by groundwater discharge and infiltration. In this study, the longitudinal dimension is represented at two scales: that of the 40 sites, and within each site, by 5 plots along a 400-ft greenline transect situated parallel to the channel. The lateral dimension is represented by 20 plots located on lateral transects at each of the 40 sites. Features of the vertical dimension were not measured directly.

3. Results and Discussion

3.1 Extent of Umatilla Floodplain Wetlands

Under Oregon's Removal-Fill Law and Section 404 of the Federal Clean Water Act, most areas meeting the following criteria are defined as "jurisdictional" wetlands:

(a) have ponding or near-surface saturation for at least 2 weeks during the growing season;.
(b) have a predominance of plant species that are characteristically adapted to saturated soil conditions (hydrophytes);
(c) have hydric soils—soils that formed under periodically oxygen deficient conditions due to conditions described by (a).

Water regime, though the crucial driver of wetland conditions, is the most difficult to evaluate directly due to normal seasonal and annual variation. Hydrophytic vegetation is defined by reference to the regional publication, "*List of Plants That Occur in Wetlands*" published by the U.S. Fish and Wildlife Service. In general, species classified by this document as "facultative (FAC)" or wetter are considered to by hydrophytes for purposes of delineating jurisdictional wetlands. Hydric soils are identified by specific morphological indicators of saturation and reduction, i.e., redoximorphic features in the upper 12 inches of the soil profile.

Although data on penetration of floodwaters into specific study plots were not available, we assumed many or most of our plots are inundated by floodwater or saturated by groundwater during at least part of the early growing season during most years, thus also meeting the hydrologic criteria for jurisdictional status. Because of a lack of hydrologic data, we mainly relied on the other two criteria. Of the 1080 plots from which we collected data, approximately 240 (22%) met either or both of those two criteria for "wetland." Of these, 196 (82%) met the above vegetation criteria only, 5 (2%) met the soil criteria only, and 35 (15%) met both.

Maps published by the National Wetland Inventory showed wetlands -- as NWI defined them -- at 12 (60%) of our systematic sites and 15 (75%) of our non-systematic sites. However, the NWI maps were based on examination of July 1981 aerial photographs at a scale of 1:58,000. It can be assumed that maps based on such imagery fail to include many small (<2 acre) wetlands, wetlands beneath canopies of upland-associated trees, and wetlands that formed following post-1981 channel shifts. Moreover, the NWI maps intentionally include many environments -- such as unvegetated channels, sloughs, and open water -- that are not jurisdictional wetlands or would be defined as jurisdictional wetlands only by the prevalence of hydrophytic woody vegetation. We relied solely on herbaceous rather than woody vegetation to define wetlands along our transects, because herbaceous vegetation – with a shorter lifespan than woody -- is a better indicator of the present-day hydrologic environment. Especially in this particular river system, relict woody vegetation can remain (but may not reproduce successfully) long after levees and other alterations have removed hydrologic conditions that define and support wetlands and their functions. Thus, woody vegetation alone can be an ambiguous indicator of wetland occurrence. We did not survey woody plants (other than seedlings) at a plot level -- only at the transect scale.

Of the 240 plots surveyed along greenline transects, 103 (43%) met our criteria for defining wetlands. Of the 840 plots surveyed along lateral transects, 137 (16%) met our criteria for wetlands. These estimates cannot be extrapolated to the entire Umatilla floodplain because they include results from both our non-systematic and systematic sites. If only the plots from systematic sites are considered, then 48% of the greenline plots and 20% of the lateral transect plots were in wetlands. Our estimates of wetland extent are probably conservative because some woody vegetation does indicate present-day conditions, yet due to its shading effect it can reduce the cover of herbaceous vegetation (including wetland herbs) to below 50%.

NWI maps showed no wetlands occurring at 13 of the 40 sites (cross-sections) we examined. In contrast, our field work revealed wetland plots at all but one of the 40 sites (NS7). NWI maps indicated presence of a wetland there, which has perhaps been eliminated since the 1981 imagery was interpreted, or is perhaps an anomaly attributable to NWI's using different definitions for mapping wetlands. Precise overlaps between NWI mapped wetlands and our field-verified wetlands could not be determined because of scale differences (sites vs. plots) and limitations in the spatial precision of the NWI maps.

3.2 General Characterization of Wetlands in the Umatilla Floodplain

In addition to their defining characteristics of soil mottling and predominance of hydrophytic herbaceous vegetation, sample plots that we defined as "wetlands" differed from plots not defined as such, in several ways (all reported results are significant at $p<0.05$, Mann-Whitney one-tailed U-test, data from both systematic and non-systematic plots, see Appendices E and F for complete results). Wetland plots along both the lateral and greenline transects had finer sediments than non-wetland plots, a greater variety of soil texture types, a smaller proportion of plant litter and bare area within and around the plot, and (not surprisingly) greater soil moisture. Wetland plots were especially more likely to occur along transects farther downriver with wider floodplains, greater channel sinuosity (measured 0-2 km downriver and upriver), less extent of constructed levees (measured within 1 km and 2 km), and less channel gradient (measured 0-2 km upriver). Wetland plots were farther than non-wetland plots from levees and tributaries.

Along the *lateral* transects, where wetlands occurred at 16% of the plots, the most statistically significant predictors of total percent-cover of wetland-associated understory plants were: elevation above the active channel, floodplain slope, floodplain width, channel sinuosity upriver, distance to an upriver tributary, canopy closure, and presence of sand, silt, or loam substrate (from a model selected by stepwise regression, which accounted for 25% of the variance after taking into account relationships with all other measured geomorphic variables). Sites with the most wetland plots along their lateral transects were at lower elevation and had low channel gradients and a wide floodplain. Sites with the most plots along their lateral transects showing evidence of soil anaerobic conditions also had the most standing dead trees and willow (*Salix* spp.).

Wetland plots had greater canopy closure, and greater total percent-cover of grasslike plants and of tree seedlings. Percent cover also was greater on a per-species basis for tree seedlings, grasslike plants, and native species. Compared with non-wetland plots along the laterals, wetland plots had more herbaceous plant cover and shrub cover. Plant cover and tended to be divided up among fewer species. In the understory, wetland plots had significantly greater species richness as well as larger numbers of native species, grasslike species, shrub species, and tree species. Native species, grasslike species, and seedlings of tree species also comprised a larger *proportion* of plant richness than at non-wetland plots.

Among the *greenline* transects, where wetlands occurred at 48% of the plots, the most statistically significant predictors of percent-cover of wetland-associated understory plants were soil moisture (volumetric) and proportion of the surrounding 2-km area containing surface water. This result was based on best stepwise regression model, which accounted for 89% of the variance after taking into account relationships with all other measured geomorphic variables. Greenline plots that met wetland criteria had greater total percent cover of grasslike species. Compared with non-wetland plots, wetland plots had greater mean percent cover per plant species, per grasslike species, and per native species; and greater maximum percent cover per species, per forb species, per grasslike species, and per native species. Within wetland plots, plant cover and tended to be divided up among fewer species than in non-wetlands. Wetlands also had more native species and more forb species, both absolutely and as a percent of all native species (and all forb species) found per plot. Wetlands had more grasslike species, and fewer trees and tree seedlings. Plant community composition among wetland plots was more similar (as measured by Jaccard and Morisita similarity indices) than composition among non-wetland plots.

3.3 Focus on Wetland Functions

Ecologically-healthy floodplains and their associated wetlands perform a variety of functions potentially useful to society, including those listed in Table 1. Without measuring these functions directly and surveying local communities to assess the social values attached to each functions, it is not possible to prioritize the functions in a meaningful and defensible way.

Table 1. Floodplain functions and their definitions, quantification, and associated values

Function	Definition	Example of Quantification (but not quantified by this study)	Associated Values
Water Storage & Delay	capacity to store or delay the downriver movement of surface water for long or short periods	cubic feet of water stored or delayed within a wetland per unit time	Minimization of flood-related property damage in downriver areas; Maintenance of channel flow
Sediment Stabilization & Phosphorus Retention	capacity to intercept suspended inorganic sediments, reduce current velocity, resist erosion of underlying sediments, minimize offsite erosion, and/or retain any forms of phosphorus	percent of the grams of total, incoming, waterborne phosphorus and/or inorganic solids (sediment) that are retained in substrates or plant tissue, per unit wetland area, during a single typical growing season	Water purification
Nitrogen Removal	capacity to remove nitrogen from the water column and sediments by supporting temporary uptake of nitrogen by plants, and by supporting the microbial conversion of non-gaseous forms of nitrogen to nitrogen gas	percent of the grams of total, incoming, waterborne nitrogen that are retained in substrates or plant tissue, per unit wetland area, during a single typical growing season	Water purification
Thermoregulation	capacity to maintain or reduce water temperature	decrease in temperature of water exiting a site via surface flow or infiltration, compared with temperature of the water when it enters the site via surface flow	Supporting fish and wildlife
Primary & Instream Wood Production	capacity to use sunlight to create particulate organic matter (e.g., wood, leaves, detritus) through photosynthesis	grams of carbon gained (from photosynthesis) per unit area of wetland per year	Protecting water quality, supporting food webs
Resident Fish Habitat Support	capacity to support the life requirements of most of the non-anadromous (resident) species that are native to the ecoregion	sum of native non-anadromous fish recruited annually from within the site	Recreation, biodiversity, subsistence
Anadromous Fish Habitat Support	capacity to support some of the life requirements of anadromous fish species	sum of native anadromous fish using the site annually for spawning, feeding, and/or refuge	Recreation, biodiversity, subsistence
Invertebrate Habitat Support	capacity to support the life requirements of many invertebrate species characteristic of such habitats in the ecoregion	number of invertebrate species and guilds (functional feeding groups) per unit of sediment, soil, water, and colonizable vegetation within a wetland area	Biodiversity, supporting fish & wildlife

Function	Definition	Example of Quantification (but not quantified by this study)	Associated Values
Amphibian & Turtle Habitat	capacity to support the life requirements of several of species of amphibians and turtles that are native to the ecoregion	sum of native amphibians and turtles that use the site annually for feeding, reproduction, and/or refuge	Biodiversity, supporting other wildlife
Breeding Waterbird Support	capacity to support the requirements of many waterbird species during their reproductive period in the ecoregion	sum of waterbirds that use the site during breeding season for nesting, feeding, and/or refuge	Biodiversity, recreation
Wintering & Migratory Waterbird Support	capacity to support the life requirements of several waterbird species that spend the fall, winter, and/or spring in the ecoregion.	sum of waterbirds that use the site during fall, winter, and/or spring for feeding, roosting, and/or refuge	Biodiversity, recreation
Songbird Habitat Support	capacity to support the life requirements of many native non-waterbird species that are either seasonal visitors or breeders in the ecoregion	sum of native songbirds that use the site at any time of the year for breeding, feeding, roosting, and/or refuge	Biodiversity, recreation
Support of Characteristic Vegetation	capacity to support the life requirements of many plants and plant communities that are native to the ecoregion	dominance (relative to exotic species) of native herbs and woody plants that are characteristic of the ecoregion's wetlands	Biodiversity, water purification, supporting fish & wildlife, subsistence

It could be argued that strictly delimiting parts of a floodplain as either wetland or non-wetland is somewhat artificial because some functions (e.g., Songbird Habitat) grade smoothly across gradients of wetness, rather than switching entirely off or on at sharp lines drawn where standard soil and vegetation criteria are or are not met. However, for many functions, a quantum leap in magnitude would be expected to occur at locations on the floodplain where surface or subsurface water begins to persist into the growing season and anaerobic conditions develop (as indicated by plant species composition and soil mottling).

No single wetland – not even the most pristine -- is likely to be at peak capacity for all of the above functions, all of the time, because some conflicts are implicit among the processes that support the functions. For example, wetlands that function well for Water Storage & Delay may function poorly for Thermoregulation, because surface waters may be more subject to solar warming when detained. This is true regardless of whether or not the Water Storage & Delay function has been degraded by human activities or natural factors. Thus, wetlands are managed most appropriately at a landscape or watershed level, with some individual wetlands (or wetland-generating environments) being allowed to serve at full capacity for some functions, and others for other functions.

At the most fundamental level, these functions are influenced by the magnitude, duration, frequency, and timing of movements of water, sediment, and woody debris into and within the floodplain (Naiman et al. 1992). However, thresholds at which such movements of water, sediment, and woody debris support or trigger significant changes in the above floodplain functions have not been quantified for the Umatilla River system, or for many other systems. Nonetheless, measurable

variables (indicators) that may reflect these and other contributory processes can be described for each function.

Water Storage & Delay: When water is briefly detained on floodplains rather than routed quickly through the main channel, downriver flood peaks tend to be lower and slightly more prolonged. Water detained in side-channel sloughs and floodplain wetlands might also help extend the number of days of non-zero river discharge during the summer, or at least may help bolster river discharge slightly as seasonal contributions from snowmelt and reservoir releases diminish. Floodplain wetlands most important for this function will be ones that are:

- seasonally large and deep (relative to floodplain width and depth);
- not permanently inundated (e.g., by springs) nor ice-covered for long periods (so there is capacity for storage);
- physically isolated from the main channel for long periods (e.g., narrow outlet for surface water, or none at all);
- covered with trees strong enough to resist river flow when shallowly inundated; such floodplain roughness (coupled with evapotranspiration from the trees) can slightly delay the downriver "pile up" of sudden runoff, provided the trees themselves do not displace too much water storage space.

Sediment Stabilization & Phosphorus Retention: Although dynamic erosion is a natural and necessary process for sustaining the functions of floodplains, natural deposition and stabilization of sediments (both suspended and deposited) is also important (Richards et al. 2002). After suspended sediment is intercepted by vegetation, it is deposited and may be protected (at least temporarily) from further erosion by overgrowth of vegetation as floodwaters recede. Retention of phosphorus (a key nutrient) by burial often accompanies this deposition because much incoming phosphorus is adsorbed to fine incoming sediments. Some of this phosphorus is taken up by floodplain plants and eventually re-enters the water column (in somewhat different form) when the plants die, but a portion that is taken up by tree roots can be retained within the floodplain for long periods if it is translocated to parts of the tree roots located below the depth of active floodplain erosion (Fabre et al. 1996). By helping regulate depositional processes, wetlands can dampen sharp fluctuations in river turbidity and phosphorus concentrations and thus contribute to instream water quality. Floodplain wetlands most important for this function will be ones that have:

- large seasonal water storage capacity (see list above);
- extensive cover of rooted plants, especially species that are rated "good" or "excellent" for bank stabilization;
- accumulations of fine sediment and soil organic matter, or conditions that will support delivery of organic matter, especially from belowground primary production, to the soil profile over years and decades; side channels that are completely disconnected from the mainstem sometimes have the greatest soil organic content (Schwartz et al. 1996).

Nitrogen Removal: Nitrogen (as ammonia and nitrate) is commonly applied as fertilizer to croplands in the Umatilla watershed. Although moderate amounts are readily taken up by field crops before the nitrogen reaches the river, evidence suggests residual nitrogen has contaminated some of the region's water bodies and aquifers (deNero 1995). Nitrate contamination of aquifers poses health risks to human users, and excessive concentrations of nitrate in waterways can trigger large growths of algae which accumulate in backwater areas and potentially degrade instream water quality (by reducing dissolved oxygen), and thus degrade salmonid habitat.

Wetlands are the most effective regulators of nitrate on the landscape. That is because they are nearly alone in featuring reducing conditions and abundant organic matter – both of which are key to supporting the microbial process of denitrification. That process converts soluble nitrogen to nitrogen gas, releasing it to the air and causing no further contamination of the landscape. Also, floodplain plants can retain nitrate temporarily by taking it up for their nutritional needs during fast-growth periods of the year. Limited evidence from western Oregon suggests that annual nitrogen uptake is greatest when multiple plant species are present, because the conditions optimal for uptake vary partly by plant species. Floodplain wetlands most important for this function will be ones that have:

- large seasonal water storage capacity that maximizes the contact area between contaminated waters and floodplain wetlands (see list above, under Water Storage & Delay);
- alternating (spatially and temporally) anoxic and oxic sediment conditions; anoxic conditions are suggested by the presence of soil mottling and oxidized rhizospheres;
- saturated soils for much of the growing season, when rates of plant uptake and microbial activity are greatest;
- accumulations of soil organic matter, or conditions that will support delivery of organic matter, especially from belowground primary production, to the soil profile over years and decades; side channels that are completely disconnected from the mainstem sometimes have the greatest soil organic content (Schwartz et al. 1996).

Thermoregulation: Healthy floodplains help maintain cool water temperatures in summer which are crucial to aquatic life. At least in headwater areas and other reaches where channels are narrow, they do so with their shading vegetation. They also contribute to this function by serving as sites for discharge of cool ground water. It can be hypothesized that deep-rooted floodplain vegetation facilitates movement of cool groundwater to the floodplain surface by providing underground channels ("pipes") for such upward seepage, by increasing evapotransporative cooling, and by steepening local potentiometric surfaces (head gradients). On the other hand, floodplain vegetation can cause local accumulation of fine sediments and organic matter, which together can eventually seal off seeps where cool ground water reaches the floodplain surface. Thus, at a basin scale it is important to maintain both the natural patterns of deposition and erosion of sediments, with associated organic matter. Floodplain wetlands most important for this function will be ones that have:

- extensive shading overstory vegetation in their wettest portions;
- extensive areas of known groundwater discharge (as indicated by persistent soil wetness) or which potentially are favorable for hyporheic storage and release of ground water;
- natural erosion-deposition and hydrologic patterns unaltered by levees or other infrastructure.

Primary Production: The production, accumulation, dispersal, and decay of plant material in appropriate amounts and at appropriate times of the year is essential to maintaining healthy aquatic food webs. Wetlands are often highly productive on floodplains because nutrients are regularly cycled through the system by floodwaters, discharging groundwater, and extensive ecotones between oxic and anoxic sediments. Moreover, on floodplains much of the productivity is transferred directly to the river via the seasonal connection of floods. Woody material in particular is important because it provides habitat structure as well as nutrients for many species. Floodplain wetlands that contribute the most to this function usually will be ones that have:

- extensive, fast-growing, large woody vegetation (e.g., cottonwoods) or the capacity to support such, especially in areas of the floodplain least subject to erosion;
- minimal areas of bare ground and exposed bedrock;
- moist conditions throughout much of the growing season, but not permanently inundated or with chronically anoxic sediments;
- mild fluctuations in water level (i.e., magnitude well below "bankfull," Tockner et al. 2000);
- intermediate flood frequencies (Pollock et al. 1998) and frequency of hydrologic connection to the mainstem channel (Knowlton and Jones 1997).

At a landscape scale, delivery of primary production to the channel at diverse times throughout the year would be favored by a wide array of wetland vegetation types, due to differing maturation and decomposition rates of the vegetation. Such a sustained nutrient supply (rather than sharp peaks) is probably more likely to support a diverse assemblage of aquatic animals.

Fish & Aquatic Invertebrates: Floodplain wetlands are renowned for their tremendous capacity to provide habitat for both resident and anadromous fish. Prominent species in the Umatilla River are summer steelhead, spring chinook salmon, and coho salmon; bull trout have also been noted. Floodplain wetlands also contribute to regional biodiversity by providing habitat for aquatic invertebrates (e.g., dragonflies), some species of which are found in few other aquatic habitats. Restoring downriver habitats, which historically were more productive than upriver areas, may be especially critical for salmonids (Nehlsen 1997; Lichatowich et al. 1999). However, it is difficult to single out a particular part of the river or type of wetland as being most important to aquatic animals because (a) many floodplain fish species are quite mobile and depend on a variety of habitats over many miles of river (Torgersen et al. 1999, Baxter 2002), (b) seasonal use of wetlands varies greatly, so most floodplain wetlands will be important for fish and aquatic invertebrates at one season or another. Thus, for this function wetland importance is optimally measured at a landscape scale, and is favored by:

- a diversity of floodplain wetland subclasses (defined by water inundation depths, durations, frequencies, and water sources).

Although the Umatilla River has been the focus of extensive fish monitoring, fish data are generally not available specifically for wetlands in the floodplain during the time of peak annual flooding.

Amphibians & Waterbirds: In the lower Umatilla River, native amphibians (mainly frogs) and waterbirds (mainly ducks, geese, herons) are an important component of the region's biodiversity (Kagan et al. 1999). They use a wide variety of wetland types, both permanently and seasonally inundated, both with and without tree canopy and other characteristics. It is difficult to specify particular wetland types as being more important because habitat requirements are largely species-specific and most species, being highly mobile, use or even require a variety of types. Nonetheless, most species in these groups inhabit wetlands that:

- contain or border shallow unvegetated (open) water where lentic (very slow currents or standing water) conditions prevail.

Collectively, their diversity is fostered by having:

- a diversity of floodplain wetland subclasses (defined by water inundation depths, durations, frequencies, and water sources).

Songbird Habitat: In the arid valley through which the Umatilla River flows, its floodplain vegetation provides a green oasis for migratory, nesting, wintering, and resident bird species. Many of these species are Neotropical migrants, a group of birds which have been a major focus

of conservation concern nationwide. Some riparian species of the Umatilla River Basin, such as American Redstart and Gray Catbird, have a very restricted nesting distribution in Oregon (Adamus et al. 2001b). Although habitat requirements are largely species-specific, most of the river basin's species (and especially the rarer ones) benefit the most from floodplains that:

- contain a zone directly adjoining the river of dense willow, intermixed with patches of herbaceous plants and bordered by a wider zone of cottonwoods and other overstory-forming trees farther from the channel -- or which have the hydrogeomorphic environment that will support such diverse habitat in the future.

Collectively, songbird diversity is fostered by having:

- a diversity of floodplain wetland subclasses (defined by water inundation depths, durations, frequencies, and water sources – which give rise to structurally diverse vegetation communities).

Also:

- Cavities that some bird species excavate in the larger trees are especially important, and are needed by a wide variety of bird and mammal species. Removal of standing dead trees for firewood or other reasons, and creation of hydrologic conditions that inhibit cottonwood germination and maturation, can cause significant loss of cavity habitat for many species.

Nesting-season bird surveys have been conducted systematically along much of the lower Umatilla River for years, although in most cases not directly in the floodplain. The data (available at http://www.mbr-pwrc.usgs.gov/cgi-bin/rtena.pl?69046) could provide useful corroborative evidence of major changes in land use and vegetation in the region's lowlands.

Support of Characteristic Vegetation: In river systems generally, the species richness of floodplain vegetation usually tends to be greatest in areas that:

- are partially scoured by annual or semi-annual floods which (a) carry in the propagules of additional plant species, and (b) remove accumulated plant litter that otherwise can inhibit establishment of many plant species; floodplain surfaces that are 1-4 years old and formed during periods of low bed level sometimes have the greatest species richness (Friedman et al. 1996);
- retain several centimeters of sediment or soil despite scouring, i.e., are not exposed bedrock.;
- are not totally shaded by an overstory;
- remain moist throughout much of the growing season, but not permanently inundated or with chronically anoxic sediments.

Also:

- at a landscape scale, the cumulative richness of plants on floodplains will be greatest when channel complexity, microtopographic variation, and flood frequencies of patches within the floodplain are diverse (Pollock et al. 1998), leading to a diverse array of wetlands.

This is the only function for which we collected data directly. Including both our data and that of other investigators, a notable 257 plant species have been documented from the lower Umatilla River floodplain and vicinity (Appendix D). Of these, we found 151 in areas we identified as wetlands, and 31 were found *only* in such habitats[6]. Many more plant species are

[6] *Alisma plantago-aquatica, Alopecurus aequalis, Anthriscus caucilis, Apocynum cannabinum, Beckmannia syzigachne, Brassica nigra, Bromus japonicus, Buglossoides arvensis, Callitriche palustris, Carex athrostachya, Carex lenticularis, Carex stipata, Chamaesyce glyptosperma, Chenopodium rubrum, Croton setigerus, Epilobium pygmaeum, Equisetum pratense, Geranium molle, Juncus acuminatus, Lemna minor, Lycopus americanus, Lycopus*

likely present because this study and the few botanical surveys that preceded it in the generally same area have not searched comprehensively or targeted particular microhabitats and weeks of the year most likely to reveal some of the rarer species, such as hepatic monkeyflower (*Mimulus jungermannioides*) which has been reported northwest of Reith (Kagan et al. 1999). Apparent declines in many of the traditional medicinal plants have been reported by tribal elders (Stengle and Quaempts 1995).

Floodplain wetlands provide an important refuge for many native plant species in an ocean of agricultural and urban land beset by exotic species. For example, in the non-wetland floodplain plots, 96% of the lateral transect plots and 94% of the greenlines were dominated by (had >49% cover of) exotic plant species, many of which are highly invasive. In contrast, among the wetland plots, plant cover in only 45% of the lateral transect plots and 42% of the greenlines was dominated by exotic species. Of the 104 exotic plant species encountered in our surveys, only 17% occurred exclusively or predominantly in wetlands. Exotic species we found to be most widespread or dominant in Umatilla floodplain wetlands are listed in Table 2.

Table 2. Exotic plant species found most commonly in Umatilla floodplain wetlands

Species	% of wetland plots	mean % cover in wetland plots
Phalaris arundinacea	51.1	43.0
Rumex crispus	14.3	2.5
Plantago major	13.0	3.0
Echinochloa crus-galli	10.4	8.4
Polygonum persicaria	9.5	2.2
Amorpha fruticosa	7.4	22.5
Rubus discolor	3.9	13.4
Poa pratensis	2.6	26.8
Holcus lanatus	1.3	28.3
Poa palustris	1.3	17.3
Rosa eglanteria	1.3	15.3
Bromus diandrus	1.3	11.7
Digitaria sanguinalis	0.4	30.0

Approximately 44% of the species found in the Umatilla River Basin generally (Appendix D) are exotic (i.e., introduced, non-native, alien). In the specific plots we identified as being wetlands, 41% of the 151 species were exotic species. For comparison, 39% of the species on a cumulative list of 216 plant species from 109 Willamette Valley riverine wetlands (Adamus 2001) were exotic species. Surveys by the USEPA of 17 alcoves of the Willamette River found close to 50% of the cumulative species list being comprised on exotics. In the lower McKenzie River watershed near Eugene, Planty-Tabacchi et al. (1996) reported only 25-35% of all plant species were exotics. On a per-site basis (not a cumulative list), in three other floodplains in the Pacific Northwest, about 24-30% of plant richness consisted of exotics (Hood & Naiman 2000).

asper, Mentha rotundifolia, Mimulus guttatus, Myosotis laxa, Paspalum distichum, Poa palustris, Ribes aureum, Ribes lacustre, Salix prolixa, Sparganium angustifolium

For comparison, among all our floodplain plots, exotics averaged 52% per plot, although in just the plots we identified as being wetlands, the average was only 34%.

Both native and exotic plant species differ in their degree of dependence on wetlands. Of the 200 species in Appendix D for which prior information on probable degree of association with wetlands was known, 117 (59%) are species that, when dominant, typically define the presence of wetlands. Of these, 35% are *obligately* associated with wetlands, 29% are *mostly* associated with wetlands, and 40% are facultative (associate with both wetlands and uplands). Considering the flora of just the plots we identified as being wetlands, 39% of the species were species *obligately* associated with wetlands, 37% were ones *mostly* associated with wetlands, and 24% were facultative Surveys of 109 Willamette Valley riverine wetlands revealed strikingly similar proportions: 39% of the species found were obligates, 39% were species mostly associated with wetlands, and 22% were facultative (Adamus 2001a).

3.4 Hydrogeomorphic Classification Scheme for Wetlands in the Umatilla Floodplain

Classification of natural systems requires aggregating environmental attributes (variables) into groups (classes). There are fundamentally two types of classifications: those that group variables based on their relationship to a particular theme or endpoint (focal classification), and those that group variables based solely on their statistical properties (nonfocal classification).

In the first case (focal classification), some estimate of an endpoint is required. For example, wetlands in the floodplain could be classified according to their importance for functional endpoints such as sediment stabilization, nutrient cycling, thermal maintenance, plant diversity, or wildlife habitat. Developing a numerical model to drive such a classification requires that the endpoint be measured. Because quantifying such floodplain functions directly and independently was beyond the scope of this project, it was not feasible to develop a focal classification model. Had direct measurements of functions been available, statistical procedures such as CART or CHAID could have been employed to define a predictive numerical classification.

The alternative which we used (nonfocal classification) involves basing the classification solely on relationships among variables pre-selected by the classification developer. Such an approach defines classes in a manner that minimizes variance (i.e., "distance," "dissimilarity") among class members and maximizes variance among the classes. Expert judgment, sometimes guided by literature review and drafting of conceptual models, is initially used to select variables that will be tested for their usefulness in the classification. The process that is next used to configure the classifying variables so they define a series of classes can be qualitative or quantitative. The national HGM classification for wetlands (Brinson 1993) was developed by qualitatively considering variables important to multiple functions. In contrast, quantitative approaches to classification use actual data (typically numerical) and often require use of ordinations or gradient analysis methods that employ statistical procedures such as PCA, TWINSPAN, CANOCO, and cluster analysis. We chose to use a quantitative approach, and aggregative cluster analysis specifically, to develop the classification of Umatilla River floodplain wetlands. Unlike PCA, TWINSPAN, and CANOCO, output from cluster analysis may require less subjectivity in its interpretation, and it provides a more seamless bridge between data and an easy-to-use field key.

Regardless of which classification approach is used, the outcome will depend on the particular variables that are being considered for use in defining the classes. The author of the national HGM classification suggests that subclasses of the riverine HGM class be identified within regions based on factors such as "water source, position in watershed, stream order, watershed size, channel gradient, and floodplain width" (Brinson et al.1995). Many existing classifications of river channels or riverine wetlands use these or similar variables (Table 3; also see review by Kondolf 1995).

Table 3. Examples of riverine subclasses defined by existing classifications

(source: Adamus 2001a)

NWI Riverine Subclasses (Cowardin et al. 1979):

Tidal: Water flow is controlled by tides and salinity is less than 0.5 parts per thousand. Gradient is low, streambed is mainly mud and sand. Floodplain is broad.
Lower Perennial: No tidal influence. Gradient is low and floodplain is broad.
Upper Perennial: Gradient is high and floodplains are absent or narrow.
Intermittent: Surface water flows in the channel during only part of the year, though it may be present other seasons as small isolated pools.

This classification has been applied to most riverine sites in Oregon. The NWI defines a "riverine" category as including all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by above-surface vegetation such as trees, shrubs, and emergent plants, and (2) saltwater channels. Nearly all sites classified as "riverine" by the NWI would be included in the HGM riverine class. However, the HGM riverine class also includes many sites that would be classified by NWI as palustrine. This is because the NWI riverine category does not include vegetated sites (except those with submerged plants).

Kovalchik (1987):

The author split riparian systems of central Oregon into geomorphic categories as follows, and described their associated plant communities:

- Gradient low (<1% gradient)
  - Elevation low-moderate (<5200 ft); Soil Derivation: rhyolite, tuff
    - Floodplain Active
    - Floodplain Inactive (includes terraces)
  - Elevation moderate-high (>5200 ft); Soil Derivation: basalt
    - Floodplain Active
    - Floodplain Inactive (includes terraces)
- Gradient moderate (2-4% gradient)
  - Floodplain Active
    - Channel shelves
    - Fluvial surfaces, well-developed
  - Floodplain Inactive
- Gradient steep (>4%); first-order streams in V-shaped valleys
  - Streambanks
  - Narrow floodplains and toe slopes

Jensen and Platts (1989); Jensen et al. (1989):

The authors defined at least five "valley bottom types" (VBT's) based fundamentally on geologic origins and recognized directly by shape, gradient, width, side slope gradient, and aspect.

- Glacial Basin (includes many bogs and fens)
- Glacial Valley (U-shaped, Glacial Train or Outwash)
- Erosional Canyon (V-shaped or Notched)
- Depositional Canyon (V-shaped or Notched)
- Alluvium (Confined or Unconfined floodplain)

Jensen's group (White Horse Associates, 1992) also categorized valley bottoms in the Umatilla National Forest as Basin, Low-gradient Canyon, Moderate-gradient Canyon, High-gradient Canyon, or Draw. Each valley bottom type is said to have a unique "ecological potential" and proceeds, following disturbance, through a somewhat predictable "succession of

states." Jensen et al. (1989) further described the valley bottom types by their associated valley widths and by the landforms (fluvial surfaces) they contain. For each landform category, they collected plant community data from a series of reference sites. The landform categories most applicable to these riverine sites were: stream channel, channel levee, floodplain, and alluvial fan.

Rosgen (1996):
This is perhaps the most often used geomorphic classifications for channels, and recognizes the following categories:

Type A. Steep, highly entrenched channels containing step pool systems with high sediment transport potential.
Type B. Moderate gradient channels that are moderately entrenched in gentle to moderately steep terrain, have low sinuosity, and are riffle-dominated.
Type C. Low gradient channels, moderately high sinuosity, pool-riffle bedform with well-developed floodplains.
Type D. Braided channels with moderate channel slope.
Type E. Very low gradient, highly sinuous channel.
Type F. Highly entrenched channel.

Oregon Watershed Assessment Manual (Denman 1999):
A chapter in this manual describes specific, easily-recognized channel types and subtypes. The following types are most likely to contain or border wetlands, and have the most in common with the HGM riverine class:

Alluvial Fan channel
Low Gradient Large Floodplain channel
Low Gradient Medium Floodplain channel
Low Gradient Small Floodplain channel
Low Gradient Moderately Confined channel
Moderate Gradient Moderately Confined channel
Low Gradient Confined channel

Beechie et al. (1994):
In the Skagit River watershed of Washington, channel features were characterized by their geomorphology as follows:

Side channels: small channels branching off the main stem; typically abandoned river channels or overflow channels on the floodplain or on low terraces near the main stem.
Distributary channels: channels that branch off the main stem in the delta and flow into the estuary as separate channels.
Sloughs: Side or distributary channels with >90% of their area consisting of pools, even during flooding

Maxwell et al. (1995):
The authors of this national report propose the following subclasses for riverine systems:

Intermittent Stream, Steep Riverine, Moderate Riverine, Gentle Riverine, Flat Riverine

Pennsylvania HGM Project:
Brooks et al. (1996) split the Riverine HGM class into subclasses as follows:

Floodplain In-stream: sites within banks or channel
Headwater: in floodplain, sites on order-1 or 2 channels
    Impoundment: flow controlled by beaver or humans
    Floodplain: frequent flooding
Mainstem: in floodplain, sites on order 3 or higher channels
    Impoundment: flow controlled by beaver or humans
    Floodplain: frequent flooding

Subsequently, detailed hydrologic data collected by Cole et al. (1997) supported the hypothesis that some of these HGM subclasses were functionally distinct, despite the presence of potentially confounding factors related to human alteration of surrounding land cover and water tables.

North Carolina Piedmont HGM Project:
Brinson et al. (1996) recognized the following riverine subclasses based on presence or absence of overbank flooding, and impounding conditions:

Overbank Flow-dominated
Riparian Source-dominated
Beaver Dam-dominated

Many scientists take a different approach. To classify floodplains and other environments, they use plant species composition, e.g., in the Umatilla Basin vicinity: Crowe and Clausnitzer (1997). Indeed, plants *integrate* many of the geomorphic variables, as well as underlying physical and chemical processes important to wetland functions. Quantitative ordination methods are frequently used to define plant species associations, assemblages, or communities. Our data could easily be analyzed using such an approach. However, Elmore et al. (1994) have noted,

> "..not all questions about a piece of land can be answered by a plant association classification. Therefore, geomorphic classification must be considered to effectively describe and manage riparian ecosystems."

Also, guidance on use of the national HGM classification states,

> "The use of structural vegetative characteristics as the primary criterion for classifying wetlands may be inappropriate because it often places wetlands that are functionally very different into the same class" (Smith 1993).

Nonetheless, the guidance goes on to say,

> "The HGM classification does not explicitly include all factors that control how wetlands function. variables such as climate or vegetation are not used as classification factors, but could eventually be included at lower levels of the classification hierarchy, or as variables in models for assessing specific functions."

Thus, vegetation is not to be neglected when defining HGM subclasses, but normally should play a secondary role to hydrogeomorphic factors.

To be most directly relevant to restoration of functions, an ideal classification for wetlands within a particular floodplain should relate to the major ongoing geophysical and biological processes, by specifying:

- primary water sources during the non-flood season: seepage from upland? seepage from channel? springs? remnants of winter overflow flooding? -- this information is useful for inferring chemical, thermal, and hydrologic regimes;
- the wetland's frequency, duration, magnitude, and season of *flooding*, i.e., connectivity to waters of the mainstem channel, and hydrologic expansion-contraction cycles;
- wetland's location in relation to spatial *pattern* of flooding (diffuse vs. channeled, overflow vs. backflow)(Mertes 1997);
- relative vulnerability of wetland substrate to *scour* when flooding does occur (e.g., as predicted partly from channel sinuosity and wetland position on the floodplain, from which inference can be made regarding maximum annual current velocity, and reach-scale balance between sediment erosion, transport, and deposition);
- proximate *cause* of wetland genesis (cutoff side channel? locally scoured depression? etc.);
- wetland *age*, which is one of the better predictors of vegetation species composition (Friedman et al. 1996); age tends to increase with increasing distance from the channel (Malanson 1993), and correlates positively with organic and nitrogen content of wetland sediments (Schwartz et al. 1996);
- factors currently maintaining wetland's *persistence* (low permeability sediments? blockage of surface water paths?) and their relative influence.

However, it is not possible for most users to reliably determine the above attributes within the context of a rapid assessment method. Therefore, to structure the classification of Umatilla floodplain wetlands, we used variables which are estimated more easily and have data available

from this study. They are believed to be correlated with the above processes, taken as a whole, but specific linkages were not proven because the processes were not measured.

This study measured (or derived from measured data) over 800 geomorphic, climatic, and botanical variables. Use of *all* these variables in a numerical clustering exercise would imply extensive redundancy among variables, resulting in implicit and unknown weighting of some themes (such as botanical themes, which had the most variables). The output would be difficult to interpret and explain, and would likely appear to show relationships that in reality are statistical artifacts of the diverse implicit weightings, scales, and units of measurement represented by the variables. Therefore, just a subset of the 800+ variables was pre-selected for consideration by the clustering procedure. Based on professional judgment of their likely relevance to multiple functions, and consideration of variables used by other riverine classifications as depicted in Table 3, the following variables from our data set were initially considered:

<u>Geomorphic Variables</u> (all except the last were measured with GIS from existing digital data)
1. longitudinal position (RiverKm)
2. historical floodplain width (FPwidth05)
3. present floodplain width (DikedW05)
4. lateral position of the wetland relative to present floodplain width (PctFPwidth)
5. channel sinuosity upriver (UpSin01, UpSin12)
6. channel sinuosity downriver (Dssin01, Dssin12)
7. channel gradient upriver (ElDrop variables)
8. presence/absence of finer-particled sediment (SoilFine)
9. extent of surrounding surface water (Water1kAc, Water2kAc)

<u>Botanical Variables</u> (all were estimated in the field at plot scale)
10. canopy closure (CanSum)
11. dominant vegetation form -- trees, shrubs, herbs, bare (DomVeg)
12. presence/absence of cottonwood seedlings (Popbal)
13. number of wetland species (SpWet)
14. number of wetland species as % of all species found (WtSpPctAll)
15. number of native wetland plant species (SpWetNtv)
16. number of native wetland plant species as % of all species found (WtNPctAll)
17. number of native wetland plant species as % of wetland species found (WtNPctWt)
18. number of native wetland plant species as % of native species found (WtNPctNtv)
19. mean wetness score of plant species (WetScorAv)
20. percent-cover of native plant species (CovSumNtvSp)
21. percent-cover of wetland plant species (CovSumWetSp)
22. percent-cover of native wetland plant species (CovSumNtvWt)
23. similarity of species composition, weighted by %-cover, to that of all other plots (Morisita)

This initial choice of variables considered the likely importance of a variable to *multiple* functions of the floodplain and associated wetlands. Had the study's focus been on just a single function (such as salmonid habitat or nitrogen removal) or attribute (plant biodiversity, floodplain wetland sustainability, cottonwood site potential), a somewhat different set of variables, optimized for that function, might have been used to define the classification.

Also, for a classification to be practical, it should:

(a) be hierarchical and dichotomous, i.e., for each defining variable, allow the user to select from no more than 2 categories, and then proceed to a dichotomous choice using a second variable, a third variable, etc.;

(b) be numerical, so consistency of application is high among users;

(c) define a reasonably small number of classes, so the classification is rapid and does not overinterpret the data upon which it originally was derived.

Data used in the construction of the classification were only from the 201 greenline and lateral plots identified as being wetlands, or in the case of the geomorphic variables, from the 39 systematic and non-systematic sites associated with these plots. To construct a dichotomous classification, it was necessary to first convert all data for the above 23 variables to binary form. For example, longitudinal position (RiverKm) was divided into 2 categorical ranges: (1) downriver, defined as 0 – 70 km from the mouth, and (2) upriver, defined as >70 km from the mouth. In this case, the 70 km point was used because downriver of this location, summertime flows are frequently at or near 0 cfs due to use of the water for irrigation, and this is significant both ecologically and geomorphically. However, the choice of thresholds at which to split the other 23 variables into 2 numerical ranges was fairly subjective. In some instances, review of scatterplots (e.g., FPwidth vs. RiverKm) revealed non-linearities (break points) that were useful. More often, the ranges were defined simply by median values. For this reason, *these exact thresholds cannot be assumed to have a specific geomorphic or biological meaning*, as for example was discussed by Church (2002). Also, unlike the usual practice in some regional "HGM Method" development projects, the ranges for the variables were not derived from a set of "least-altered" or "highest functioning" reference wetlands, because identifying such wetlands was not a component of this project.

After converting all data for the 23 variables to binary, an aggregative clustering algorithm was used (NCSS2001 statistical package), specifying Group Average (unweighted pair-group) for the hierarchical linkage type and Euclidian for the distance method. Clustering was conducted using just the geomorphic variables, then just the botanical ones, and then a combination of subsets from both. This was done many times iteratively, with different combinations of variables. Also, some runs were tried with a few of the variables consciously being split into three numeric ranges, or two ranges but using a different break point. If the clustering is valid, the linking of objects (variables) in a cluster tree should have a strong correlation with the distances between objects in the distance – this is called the cophenetic correlation. From all the iterations, a "best" combination of variables was identified which had the maximum value for the cophenetic correlation coefficient and the minimum for its accompanying delta values. In a few instances, combinations of variables were identified that had virtually the same cophenetic correlation coefficients and deltas. In those cases, a final choice of variables was based on the expected precision and ease with which the variables could be assessed rapidly by future users. The final set consisted of five variables -- longitudinal position, existing floodplain width, lateral position, percent-cover per plot of native plants, and percent-cover per plot of native *wetland* plants (Table 4) -- and had a cophenetic correlation coefficient of 0.90 (>0.75 is considered good), and delta of 0.12 (smaller deltas indicate better goodness of fit). When the original data for the five variables was used instead of the binary version, the cophenetic correlation coefficient was 0.66 and delta was 0.22.

For this five-variable set and a cluster cutoff distance of 0.5, the output suggested a significant drop change in the distance value between 20 and 19 clusters, so 20 was chosen as the number of supportable classes. Finally, the output was used to assign each of the 201 wetland plots to one of

the 20 defined classes – now termed "subclasses." Summary statistics (mean, standard error, minimum, maximum) of variables then were computed for each subclass (Appendices G, H, I).

Table 4. Tabular key to the subclasses of riverine flow-through wetlands of the lower Umatilla River, Columbia Basin ecoregion, Oregon

Note on Use: To classify a Umatilla floodplain wetland, find the row having conditions most similar to those in the wetland. Note the subclass number and then review possible capacity for different functions of that subclass as shown in Table 7.

Longitudinal Position	Associated Floodplain Width	Wetland Lateral Position	Overall Plant Cover in Wetland	Wetland Plant Cover in Wetland	Subclass ID #
lower basin	narrow	fringe	Exotic	exotic	**1**
lower basin	narrow	fringe	Native	exotic	**2**
lower basin	narrow	fringe	Native	native	**3**
lower basin	narrow	plain	Exotic	exotic	**4**
lower basin	narrow	plain	Native	exotic	**5**
lower basin	narrow	plain	Native	native	**6**
lower basin	wide	fringe	Exotic	exotic	**7**
lower basin	wide	fringe	Native	exotic	**8**
lower basin	wide	fringe	Native	native	**9**
lower basin	wide	plain	Exotic	exotic	**10**
lower basin	wide	plain	Native	native	**11**
upper basin	narrow	fringe	Exotic	exotic	**12**
upper basin	narrow	fringe	Native	native	**13**
upper basin	narrow	plain	Exotic	exotic	**14**
upper basin	narrow	plain	Native	exotic	**15**
upper basin	narrow	plain	Native	native	**16**
upper basin	wide	fringe	Exotic	exotic	**17**
upper basin	wide	fringe	Native	native	**18**
upper basin	wide	plain	Exotic	exotic	**19**
upper basin	wide	plain	Native	native	**20**

Numerical equivalents for the above:
"lower" is the lower 70 km (43.5 mi) of the river, measured as channel distance from the confluence with the Columbia River
"wide" is >1800 m (5906 ft, or about 1 mi), measured between levees (if levees present), or measured as the geomorphic floodplain width if levees not present
"fringe" means the wetland contains or has perennial connection to a perennially inundated area; "plain" is the opposite condition and usually means a wetland is higher on the floodplain, i.e., less frequently and persistently flooded.
"exotic" means exotic plant species occupy >50% of the relative cover in most 3-ft radius plots within the wetland; "native" is the opposite condition.

Table 5. Numerical characterization (*means*) of the classifying variables, by subclass

Subclass	Number of identified examples	Longitudinal Position (km)	Associated Floodplain Width (m)	Wetland Lateral Position (%)	All Native Plants in Wetland (% cover)	Wetland Native Plants in Wetland (% cover)
1	14	56.5	192.2	0	22.6	20.1
2	2	46.9	80.7	0	52.5	45.0
3	13	57.2	191.7	0	66.2	66.0
4	17	51.8	293.6	17.7	25.5	23.2
5	2	51.1	55.8	3.6	57.5	32.5
6	16	49.0	269.1	10.1	75.1	70.9
7	13	14.6	6109.0	0	4.4	4.4
8	1	19.5	11659.8	0	70.0	45.0
9	14	21.2	6973.4	0	80.6	80.6
10	17	24.8	4648.7	0.5	16.6	13.8
11	6	26.4	6542.0	0.3	83.7	83.7
12	8	79.0	432.5	0	35.6	35.0
13	11	108.1	1104.8	0	62.0	60.7
14	5	100.8	717.5	27.1	30.0	27.8
15	1	91.5	1704.1	1.4	60.0	40.0
16	10	96.0	759.2	7.2	73.8	72.2
17	6	102.9	2477.4	0	45.7	45.3
18	21	101.1	2651.9	0	67.1	66.2
19	6	98.2	2422.8	3.6	29.8	27.0
20	18	106.5	5063.5	9.4	76.8	74.3

Table 6. Standard errors of means of the classifying variables, by subclass

Subclass	Longitudinal Position	Associated Floodplain Width	Wetland Lateral Position	All Native Plants in Wetland	Wetland Native Plants in Wetland
1	3.9	66.3	0	4.4	4.5
2	1.4	37.3	0	0.5	3.0
3	2.1	43.7	0	2.4	2.4
4	3.7	65.3	6.3	3.9	3.9
5	2.9	12.5	0.8	2.5	12.5
6	3.1	65.5	4.0	3.5	3.3
7	2.7	1073.0	0	2.8	2.8
8	0	0	0	0	0
9	2.9	1026.7	0	4.0	4.0
10	3.1	755.4	0.1	3.9	3.5
11	3.1	1583.1	0.1	7.0	7.0
12	1.9	64.9	0	4	3.9
13	4.6	161.5	0	2.4	2.3
14	9.7	80.7	10.0	8.0	9.5
15	0	0	0	0	0
16	5.6	184.0	3.1	5.3	4.6
17	4.1	214.5	0	1.5	1.4
18	1.8	148.3	0	2.8	2.9
19	1.7	276.9	1.8	7.4	7.9
20	3.4	879.7	2.1	2.9	3.4

One purpose of classification is to represent information from objects (variables) not included explicitly in the classification scheme. Accordingly, it is instructive to examine the degree to which the five "internal" variables are correlated with "external" variables that were not used explicitly in the classification scheme. A review of the Spearman correlation coefficients, calculated for all pairings of the 871 measured variables and using data from both wetland and non-wetland floodplain plots, indicates that collectively these five variables correlated significantly ($p<0.05$) with 484 (56%) of the variables excluded from the classification scheme. Thus, over half of the variability measured in the Umatilla floodplain may be accounted for by the proposed classification scheme, despite two (of 120 possible) correlations being significant among the five variables: CovSumNtvSp and CovSumWetSp; CovSumNtvSp and PctFPwidth. Longitudinal position was correlated with the most variables excluded from the classification (245), followed by percent-cover of native wetland vegetation (129), percent-cover of native vegetation (123), lateral position on the floodplain (121), and present floodplain width (116).

3.5 Possible Functions of the Subclasses

All 20 of the defined subclasses are likely to perform all 11 of the functions described in this document, but differ in their relative capacities to perform these functions. For each function, Table 7 compares the subclasses.

Table 7. Hypothesized, relative capacity of subclasses to perform typical wetland functions

Note #1: This provides only a very coarse and subjective portrayal of the potential, relative capacity of each subclass to perform particular functions. For finer and possibly more accurate resolution of differences between wetlands, the development and calibration of regional, reference-based HGM function scoring models would be required. Such models would likely be more sophisticated, sensitive, and accurate because they would use a wider and more direct array of variables than permitted by the simple 5-variable classification proposed herein.

Note #2: These qualitative ratings reflect only potential wetland functions, and do not account for relative values of the functions or for the relative ability to restore particular functions. Use this table to compare subclasses for a single function, but be cautious in using it to compare functions. The ratings are based on professional judgment after consideration of mean within-subclass values of variables and their covariates (described generally in section 3.3) that were expected to be most relevant to predicting each function.

Subclass #:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Water Storage & Delay	L	L	L	L	L	L	M	M	M	M	M	H	L	L	L	L	H	H	H	H
Sediment Stabilization & Phosphorus Retention	M	M	M	M	M	M	M	M	M	H	H	M	L	L	L	L	M	H	H	H
Nitrogen Removal	H	H	H	M	M	M	H	H	H	H	H	H	M	L	L	L	H	H	H	H
Primary & Instream Wood Production	M	M	M	M	M	M	H	H	H	M	M	H	L	L	L	L	H	H	M	M
Fish Habitat Support	H	H	H	M	M	M	H	H	H	M	M	H	M	L	L	L	H	H	M	M
Invertebrate Habitat Support	H	H	H	L	L	L	H	H	H	M	M	H	H	L	L	L	H	H	M	M
Amphibian & Turtle Habitat Support	L	L	L	M	M	M	H	H	H	H	H	H	L	L	L	L	M	M	H	H
Breeding Waterbird Support	L	L	L	L	L	L	M	M	H	M	H	L	L	L	L	L	M	H	M	H
Wintering & Migratory Waterbird Support	M	M	M	M	M	M	H	H	H	H	H	L	L	L	L	L	L	L	L	L
Songbird Habitat Support	L	M	M	H	H	H	L	M	M	H	H	L	M	H	H	H	L	M	H	H
Support of Characteristic Vegetation	L	M	H	L	M	H	L	M	H	L	H	L	H	L	M	H	L	H	L	H

H= possibly high capacity for this function compared with other subclasses; **M**= moderate; **L**= low.

4. Restoration Concepts

4.1 Processes Important to Sustaining the Subclasses and Their Functions

Understanding the longevity and spatial distribution of wetlands within the Umatilla floodplain requires an understanding of factors involved in genesis of floodplain wetlands. Most floodplain wetlands can be considered a type of fluvial surface. Generally, they are generated at spatial scales below those typical of reach-scale channel dynamics, although the responsible processes are influenced primarily at a reach and basin scale. Conditions suitable for wetland genesis arise when reach-scale geomorphic processes cause a topographic non-linearity to occur in the usual V-shaped or U-shaped floodplain cross-section. Geomorphic processes that can induce such breaks in linear cross-section include sediment scour, transport, and deposition, which are responsible for channel braiding and meandering in low gradient channels. This in turn leads to cycles of creation and abandonment of side channels and oxbows, causing the topographic variation necessary for patches of water to accumulate and wetlands to be born on the floodplain. This variation may not always be apparent at the land surface. In some instances, relict vegetation characteristic of wetland environments might persist at the surface of former side channels that have been buried with alluvium, even though no depression or relict channel is obvious, because the accreted sediments can still act as a conduit for subsurface water within the root zone (Tabacchi et al. 1998). Wetlands also can be formed when side channels become isolated from usual main channel flow as a result of lowering the water table caused by main channel incision or other factors (Wondzell and Swanson 1999).

Erosion, transport, and deposition patterns are influenced strongly by (and themselves influence) floodplain vegetation. Localized deepened pockets in the floodplain surface can be created temporarily where sediments are scoured from the surface by flood currents that encounter trunks of standing trees, upturned root wads from fallen trees, other woody debris accumulations on the floodplain, ice accumulations, or patchy hummocks of robust emergent vegetation. In infrequently scoured parts of the floodplain, groundwater discharge (seepage flow) is sometimes sufficient to reduce sedimentation of topographic depressions (Bornette 2002). Large woody material deposited in a main channel can also mediate separation of the channel into finer channels under some flow conditions (Tabacchi et al. 1998). These processes together can lead to a dispersed pattern of wetland distribution within some floodplains. Vegetation also can foster the localized genesis and persistence of wetlands within the floodplain by stabilizing sediment dams (e.g., natural levees, side channel plugs) that result from flood-related redistribution of sediments. Floodplain vegetation, by contributing to floodplain roughness, can have a measurable influence on hydrologic response characteristics of river systems.

The simple creation of depressions or stabilized sediment dams in the floodplain is not enough to create and sustain true wetlands in such micro-environments, if sediments are so permeable that entrapped floodwaters quickly seep out of the depressions as river stage falls. To persist as wetlands, water outseepage from the depressions must be retarded, at least through the early weeks of the growing season, by (a) a persistent high water table attributable to seepage from the nearby river and groundwater discharge (which in turn are influenced by local geology), and/or (b) accumulation of fine, pore-clogging particles of sediment and organic matter ("colmation"), and/or

(c) partial confinement of the depression by low-permeability strata, e.g., bedrock, natural or constructed levees and dikes. Detailed physical and chemical analysis of sediments, and focused examination of a multiyear sequence of rectified low-altitude aerial photographs, might significantly improve our ability to identify (by simpler measures) which processes contribute predominantly to wetland formation in different floodplain settings. Such an understanding would be invaluable to design of restoration projects on the Umatilla.

Floodplain wetlands can be eliminated by processes that result in reduction of the local water table (e.g., channel downcutting), increased sediment permeability (e.g., from erosional or oxidative loss of sediment organic matter), or chronic and extreme sedimentation of depressions in the floodplain. However, because floodplains are spatially and temporally dynamic, and have sediment processes that are intricately linked across longitudinal and lateral dimensions (e.g., Kondolf 2000), the loss of a particular wetland as a result of dynamic geomorphic processes should normally be of only limited concern, so long as the formational processes themselves remain intact throughout the river system. More than likely, a comparable wetland is being generated at nearly the same time not far away in the floodplain of the same river, if human disturbances of the system are minimal. Thus, sound management of floodplain wetlands requires a long-term, landscape perspective (Amoros and Bornette 2002). Maintaining a nearly constant acreage of wetlands within a floodplain -- while still allowing for their naturally dynamic spatial shifting -- presents a major challenge, especially given the number of human activities that intentionally or unintentionally conspire to alter the formational processes.

4.2 Restoration Objectives

Restoration of degraded natural systems is virtually pointless if no attempts are being made to stem further degradation and loss attributable to the same causes. Maintaining high-quality wetlands is technically easier than trying to construct wetlands or restore degraded wetlands. Thus, the foremost overall goal for floodplain wetlands in the Umatilla River Basin, as elsewhere (Bedford 1996), should be to maintain their current cumulative area. This can be accomplished partly by adopting and enforcing rules, incentives, and policies that discourage building in active floodplains, especially where areas meeting formal criteria for being wetlands are present. Before or shortly after the unavoidable destruction of a Umatilla floodplain wetland occurs, a comparable wetland (as defined by the classification scheme presented in this report) in the Umatilla River Basin should be created or, preferably, restored. An accounting ledger should be kept of future losses and gains of Umatilla floodplain wetlands, detailing the area of each alteration or change, when it occurred, the subclass(es) to which the wetland belongs, and functions likely to have been affected.

Many factors can lead to degradation of the ecological integrity of wetlands (see Adamus 2001x for review of the science). Maintaining wetland quality and avoiding wetland degradation requires regular monitoring with attention to sediment and nutrient budgets, hydrologic regimes, and invasive plants. Likewise, restoration of floodplains should aim to restore specifically the sediment and nutrient budgets, hydrologic regimes, and native wetland plant and animal communities. Effective conservation and restoration of riverine environments will require consideration of upriver processes and upland land use as well (Sedell et al. 1990). At many sites, restoration without modification of upslope land management practices is likely to be ineffective in the long term (Doppelt et al. 1993).

Also, it is not enough to simply restore the physical structure and processes present in former wetlands and their floodplains. Attention should be paid to restoring their biological characteristics and processes as well -- including but not limited to salmon habitat and native plant species requirements. Although restoration of physical processes often results in restoration of biological characteristics and processes, additional measures may sometime be necessary.

4.3 Restoration Options

A host of management activities and measures can be termed "restoration," depending on circumstances of their application. These include:

- reconnecting isolated side channels and sloughs
- restoring high-flow bypass channels
- breaching/ removing levees and dikes
- relocating/ setting back levees and dikes
- restoring natural side slope and internal topographic diversity of floodplains
- restoring meandering, e.g., by using rock sills and grade control structures
- removing migration barriers, e.g., culverts, plugs, other manmade channel constrictions
- "daylighting" culverted channels
- placing large woody debris (LWD) in channels and floodplains until natural LWD-producing processes are fully restored
- replacing riprap with bio-engineered approaches to shoreline stabilization
- managing the timing, duration, and intensity of grazing with fencing or other measures, due to grazing's tendency to degrade native plant communities by facilitating invasion by exotic plants (Kagan et al. 1999)
- controlling invasive exotic vegetation in floodplains or upland buffers through manual methods and water management
- planting and maintaining native vegetation in wetland or upland buffers when natural propagule sources are limited

These may be undertaken individually or assembled as part of a multi-measure restoration project, and implemented simultaneously or sequentially. For guidance in selecting measures appropriate to a particular site, and modifying as necessary, see FISRWG (1998) and Flosi and Reynolds (1998). Generally speaking, at a river basin scale in highly altered river systems, restoration is most geomorphically successful when conducted first in headwaters and then progressing downriver. However, this is less of a concern in large mildly-altered rivers, and in situations where the need for restoring priority functions is greatest low in the basin. In general, restoration projects that seek to mimic naturally-occurring conditions most closely, and which require the least long-term investment of labor and capital, will be most successful for restoring functions.

No restoration measure is likely to be appropriate or successful in all situations. Unless designs and locations are carefully considered, restoration can actually cause loss of some important wetland functions. For example, although reconnecting isolated side channels typically benefits salmon, potential impacts to native wetland plants, amphibians, and birds should first be assessed

by inventorying these resources in the isolated channels at an appropriate season and on a project-by-project basis. Although much overlap of function occurs, observations from other floodplains in Oregon suggest that wetlands good for salmon are not necessarily optimal for many native wetland plants, and wetlands good for native plants are not necessarily optimal for amphibians and birds.

Restoration measures may be prioritized by location after researching magnitude of historical alterations, differences in suitability of sites for the particular restoration measure, landowner long-term commitment to restoration, risks of future impacts to the site, cost-effectiveness of the measure, and functions or condition desired at the specific wetland site. A large component of exotic plants at an anomalous position in the floodplain (e.g., non-native species more typical of uplands being found within a floodplain depression) sometimes signals severe disruption of naturally-occurring hydrology, and can be used to help locate and prioritize particular sites most deserving of restoration.

Focusing specifically on the Umatilla River, consideration should be given to:

- breaching or increasing the setback of some levees, especially in subclasses 10 and 11 (see Table 4);
- allowing floodwaters (at least from large-event, low-frequency floods) increased access via culverts to undeveloped lands behind railroad grades and roads, especially in subclasses 19 and 20 (see Table 4);
- allowing particular channelized sections of the river to meander again, especially in subclasses 10 and 11 (see Table 4);
- increasing the width of vegetated buffers adjoining sloughs that contain perennial surface water, and at areas of known groundwater discharge, especially in subclasses still having a large component of native vegetation, e.g., subclasses 3, 6, 9, 13, 16, 18, 20;
- restoring the naturally diverse topography of floodplains where this has been leveled for cropland or urban development. For example, wetland plant communities, native amphibians, birds, and fish might benefit from excavation of small, seasonally isolated perennial pools (no deeper than elevation of the base flow channel bottom, and <0.1 acre each) at widely scattered locations within the floodplain, provided the potential for fish entrapment and mosquito vector production can be minimized. This measure is most applicable to subclasses 10, 11, 19, and 20.

All of these measures should be considered only where geomorphically and ecologically appropriate and within the critical constraints of maintaining a sustainable regional economy, native culture, and public safety. Priority areas for restoration are likely to be located where the largest complexes of wetlands once existed: Minthorn Springs area (near RiverKm 104), floodplain just west of Pendleton (near RiverKm 76), and the Echo-Umatilla Meadows area (RiverKm 29-39).

4.4 Design and Performance Standards

Reference-standard wetlands are wetlands that are among the least-altered wetlands of a particular HGM subclass in a region or river basin. Reference-standard wetlands (and analogous "reference" channels and floodplains) should be crucial components of any restoration project. Measurements

of functionally-important variables at multiple scales at reference-standard sites can be used to refine the designs of restoration projects. This assumes that return to a least-altered condition is usually an appropriate target to strive towards if restoration of functions is the goal. Least-altered, ecologically healthy channels typically have actively accreting point bars, actively eroding outside bends with deep pools, shallow riffles with clean gravel, large within-reach thermal heterogeneity, sustained production of LWD, varied channel width, and a large component of native hydrophytic species, for example (Naiman et al. 1992, Kondolf 1995, Innis et al. 2000).

Data from reference-standard sites also can be used as a benchmark and performance standard for monitoring progress toward success of restoration projects over time. To do so, numeric reference standards can be derived by spatial and/or by temporal reference. With spatially-based standards, data can be collected from either a single least-altered wetland chosen to match virtually every aspect of the proposed restoration site, or from a sample of (perhaps less perfectly matched) least-altered wetlands of the same subclass that represent different geomorphic stages and vegetation succession stages. With temporally-based standards, relevant variables are estimated for only the proposed restoration site, using historical aerial photographs and public records. If such information is available at a useful scale, and upriver and upland conditions are mostly analogous to the present time, temporal reference often provides the best basis for design and performance standards.

Defining reference-based standards was not a primary objective of this project, so sample site selection was not optimal for that objective and would need to be expanded to include more unaltered low-elevation sites (see next section). Nonetheless, the extensive and detailed database of wetland/floodplain characteristics, assembled from 1080 plots within 40 sites over an 80-mile reach, could provide a partial basis for developing restoration design and performance standards. For example, consider Figure 1 below, plotted from our data:

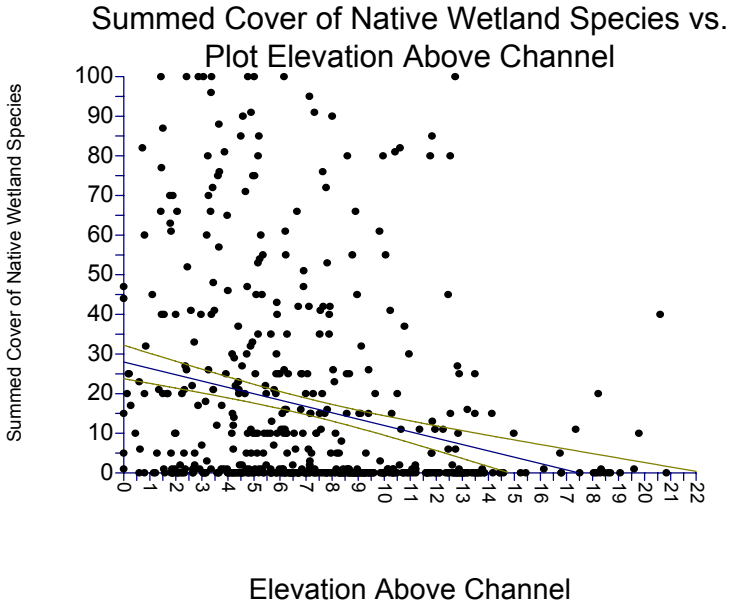

Figure 1. Example of HGM relationship potentially useful for defining restoration performance standards.

One might use such a graph and accompanying regression equation for evaluating the success of a wetland restoration project on the Umatilla floodplain, by determining if native wetland plants have a relative percent-cover of at least 25% (at the 2 ft elevation of the restored wetland, as indicated by the regression line) and 15% (at the 10 ft elevation). If so, and if other criteria derived by a similar statistical process are met, the project might be judged successful. Hundreds of such relationships could be derived from our data set. But for resulting criteria to be defensible, data from many plots in less-altered river systems would need to be incorporated into the analysis, and the data plotted by HGM subclass to contain the scatter.

5. Technical Information Needs

By providing a numerical classification for the region's floodplain wetlands and a detailed characterization of their geomorphic and botanical characteristics, this project has laid part of the foundation needed for, ultimately, the development of a comprehensive restoration plan for the Umatilla Basin. Several complementary efforts are recommended to support such a plan and future restoration activities:

1. To provide a better tool for assessing functions of restored wetlands, *HGM logic models* (Brinson et al. 1995, Adamus and Field 2001) should be developed from our simple 5-variable classification scheme. The function models should be calibrated partly from the data already collected. They should be augmented by collection of comparable calibration data for the same variables from other floodplains in the Columbia Basin/ Blue Mountains ecoregion. In particular, floodplain wetland data are needed from geomorphically comparable reaches of the much-less-altered *Wenaha River*.

2. Using similar methods, a wetland classification scheme and HGM logic models should be developed and calibrated for *non-floodplain* wetlands of the Umatilla River Basin and/or the Columbia/ Blue Mountains ecoregion. Such wetlands in some areas have suffered even greater degradation and loss, and are in need of significant restoration.

3. Continued probing and mapping of this project's data, organized partly around definitions of *plant life history guilds* developed by other researchers (e.g., Galatowitsch and McAdams 1994, Keddy 2000), would allow use of the plant data for improved characterization of (a) natural disturbance regimes essential to wetland genesis and sustainability (e.g., Friedman et al. 1996), (b) spatially anomalous moisture zones that could indicate localized groundwater seepage important to salmonids.

4. Using an expanded array of statistical methods (e.g., CHAID), additional analysis of FLIR and LIDAR data in association with data in this project's empirical database could *help validate water temperature models* which CTUIR is developing in the Umatilla system.

5. Detailed examination of a multiyear sequence of low-altitude *aerial photographs*, and of a daily or near-daily sequence to be taken during the next major early-growing-season flood event, would significantly improve our ability to identify which processes contribute predominantly to wetland

formation in different floodplain settings. It would also facilitate interpretation of the vegetation data, and development of temporal standards for restoration project design and performance.

6. *Modeling and mapping of flood frequency and height*, completed in 1999 for the floodplain from Pendleton to the upriver outer boundary of our study area (CTUIR and Corps of Engineers 1999), should be extended downriver to the confluence with the Columbia River. Ecologists and geomorphologists should be involved in planning the design of the map products and model outputs in order to ensure their seamless applicability to botanical analyses and restoration.

7. *Monitoring of sediment chemical and microbiological features* (e.g., denitrification enzyme activity), in conjunction with hydrodynamic modeling, and with statistically-robust monitoring of water quality simultaneous with water volume or flow measurements, could yield vital insights into wetland water sources and water purification functions.

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Appendix A. A Detailed Statistical Characterization of the Umatilla Floodplain

This appendix describes statistical relationships found between the several hundred geomorphic and botanical variables and a few of the conceptually more important variables, grouped as follows:

Natural Environment Variables:
Longitudinal position (RiverKm)
Floodplain width (FPwidth and Dike variables)
Lateral position (PctFPwidth)
Channel sinuosity (UpSin01, UpSin12, Dssin01, Dssin12)
Water temperature (FLIR variables)
Canopy closure (CanSum)

Altered Environment Variables:
Levee proximity and extent (Up_levee, Dn_levee, Levee1kCu, Levee2kCu)
Developed area extent (Dev1k, Dev2k, Paved1k, Paved2k)

These 8 variables were chosen mainly because they were used in the classification scheme or were anticipated to be most relevant to functional assessment and restoration. Statistical associations computed for these and all other pairs of variables are cataloged in files LCORR1 and GCORR1 on the CD accompanying this document.

Throughout the narratives below, all statements of "increases" or "decreases" are supported by Spearman paired-variable correlations that were significant at $p<0.05$, using the data set from the entire transects (not just the wetland plots). Unless noted otherwise, all correlations are based on the data from all 40 sites. Of 22,692 significant correlation pairs noted from the greenline data set, 7% were significant only for the 20-systematic-sites data set, 40% were significant only for the 40-all-sites data set, and 52% were significant for both. Of 77,077 significant correlation pairs noted from the lateral data set, 11% were significant only for the 20-systematic-sites data set, 40% were significant only for the 40-all-sites data set, and 49% were significant for both.

The correlation results only indicate linear associations between paired variables that were significant at $p<0.05$ and $n=20$ (systematic site data only) or 40 (all sites). As with all such statistical analysis based on empirical data, causative relationships cannot be inferred. For example, when a positive association is reported between water temperature and the "proportion of tree species that are wetland species," we cannot say definitively if warmer water temperature is causing wetland tree species to proliferate, or if wetland tree species provide less shade and thus support warmer water temperatures, or (least likely) if this is simply a random association and a statistical artifact. Spatial autocorrelation among many variables is expected and can bias results. Nonetheless, the correlations described below provide a good initial characterization of the Umatilla floodplain, and suggest many provocative hypotheses worthy of future testing.

Longitudinal Position

Proceeding **up**river from the Umatilla's mouth, our data showed an expected increase in elevation, mean variation in elevation (i.e., topographic relief), mean watershed slope, and precipitation (mean

annual, and individually for April-August). There was an expected decrease in watershed area, watershed perimeter, maximum watershed slope, floodplain width, air temperature (mean annual, and individually for April-August), and the number of sediment sizes in the upper 12 inches of the soil profile. Among the systematic sites there was an upriver increase in channel depth (calculated as the difference between the wetted edge elevation and the channel bottom elevation), but when data from all 40 sites were used, an upriver decrease in this variable was indicated**.** The proportion of greenline plots that met criteria for being wetlands increased upriver. Within 2 km, upriver sites had more forested land, unimproved roads, railroad tracks, land cover consisting of densely-spaced riparian shrubs, and greenline plots with bare ground. Downriver sites had more agricultural land and more non-forested land within 1 km.

Botanically, the number of total plant species and families, per lateral transect and per lateral plot, increased non-uniformly in an upriver direction, as did the number of forb and grasslike species in particular. Native plant species also were more prevalent on upstream transects, with grasslike species and wetland-associated species in particular showing absolute and proportional increases. However, the percentage of forb and shrub species that are native, and the number of native tree species per plot, declined in an upriver direction. Upriver increases were notable for number of shrub species per transect, spatial variation in number of native shrub species, and percent cover of tree seedlings (especially cottonwood) per plot. The lateral variability in plant species richness increased in a downriver direction, although the opposite was true when only the wetland species were considered. Plant communities at downriver sites had a larger proportion of "generalist" species" (species that occurred in many other plots that we surveyed). The predominance of box elder/ Russian olive/ false indigo increased downriver. Downriver increases also were noted for mean wetness score of plant species, wetland forbs as a proportion of all forbs in a plot, wetland tree seedlings as a proportion of all tree seedlings in a plot, and number of species of wetland tree seedlings.

After accounting for possible confounding effects with other variables, longitudinal position was selected by stepwise regression as one of the most statistically significant predictors of the following botanical variables measured on the lateral transects:

- total species richness per plot (final model: 20 variables, accounting for 64% of variance)[7]
- native species richness per plot (final model: 11 variables, accounting for 21% of variance)
- wetland-associated richness per plot (final model: 14 variables, accounting for 29% of variance)
- maximum cover of any species per plot (final model: 4 variables, accounting for 25% of variance)
- minimum wetness score of species per plot (final model: 5 variables, accounting for 27% of variance)
- botanical similarity among lateral transect plots (final model: 6 variables, accounting for 15% of variance)

Focusing just on the plots that were identified as being wetlands, longitudinal position was among the most significant variables for predicting:

- total species richness per wetland plot (final model: 5 variables, accounting for 35% of variance)
- native species richness per wetland plot (final model: 4 variables, accounting for 27% of variance)
- native wetland species per wetland plot (final model: 4 variables, accounting for 27% of variance)
- mean wetness score of species per plot (final model: 3 variables, accounting for 37% of variance)
- native species as a proportion of all species (final model: 4 variables, accounting for 15% of variance)
- botanical similarity among lateral transect plots (final model: 4 variables, accounting for 26% of variance)

[7] the most predictive models account for the highest percentage of variance using the fewest variables

Longitudinal position was not chosen as being among the variables most significant to predicting botanical variables in the greenline plots.

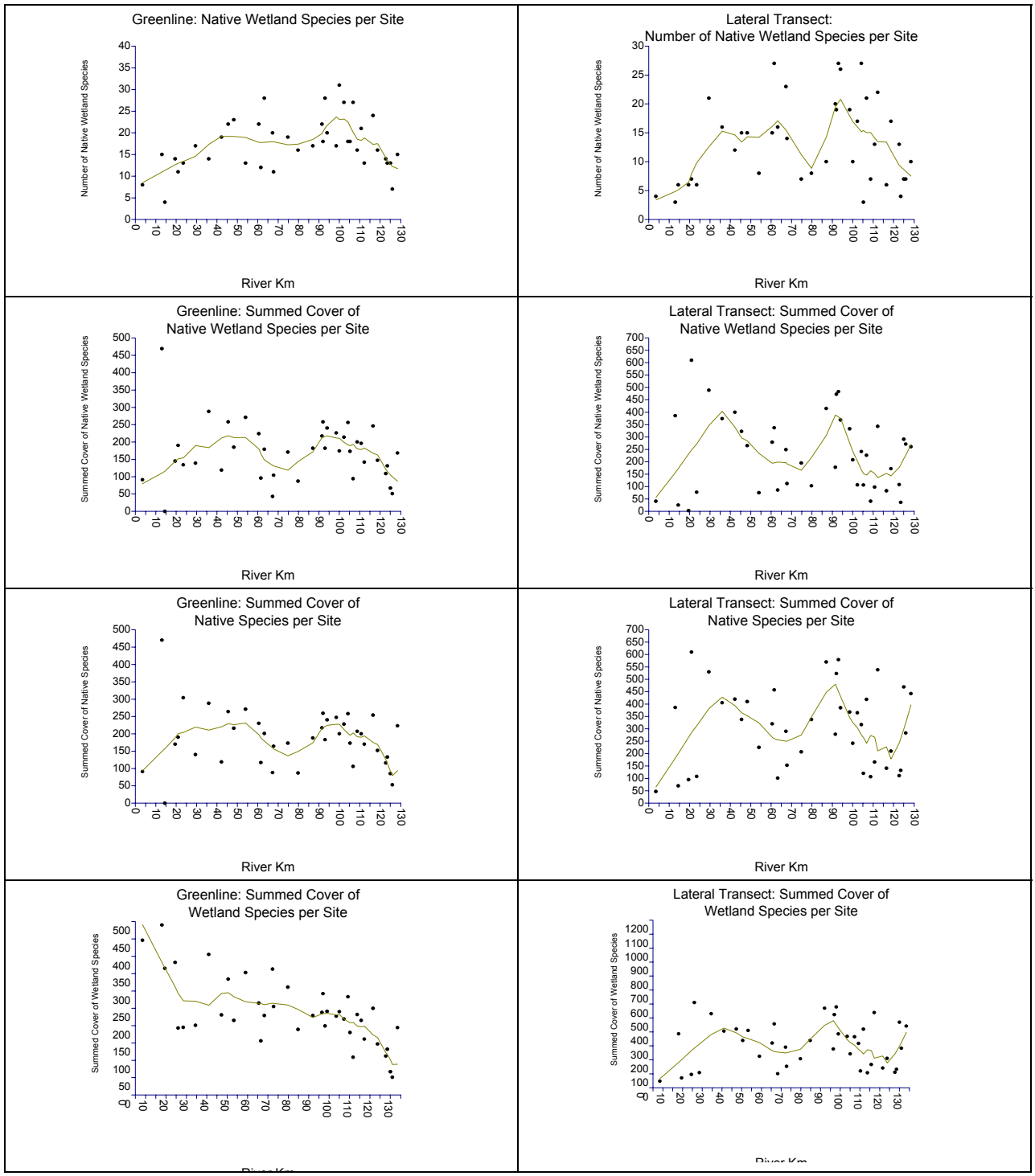

Figure A-1. Longitudinal changes in selected floodplain botanical variables in the Umatilla River (lines are lowess-smoothed – locally weighted robust regression)

Floodplain Width

As is usual for major rivers, width of the historical (geomorphic) floodplain of the Umatilla River increased in a downriver direction despite localized geological formations that briefly result in abrupt narrowing. However, width of the present-day (diked) floodplain actually decreases, overall, in a downriver direction. Both correlations are statistically significant.

After using regression residuals to remove covariation effects associated with longitudinal position, the following variables were found to be greater where the present-day floodplain is wider: channel sinuosity, water temperature, distance to tributaries, bare ground, and native grasslike plants as a proportion of all grasslike plant species in the lateral transect plots. Floodplain slope was more gradual where the geomorphic floodplain was widest, as expected. The following were greater where the present-day floodplain was narrower: number of soil textures per plot, proportional extent of herb cover, tree diameter, tree size diversity, and richness per plot of all plant species, forbs, native species, wetland-associated species, wetland forbs, native forbs, and native grasslike species (all data from the lateral transect plots).

Analyzing the data with stepwise regression to account for confounding effects of all other variables, present-day floodplain width was identified as one of the most statistically significant predictors of the following botanical variables:

- total number of species (final model: 20 variables, accounting for 42% of variance)
- percent-cover of all native wetland species (final model: 20 variables, accounting for 42% of variance)
- number of wetland-associated species in wetlands (final model: 2 variables, accounting for 96% of variance)
- maximum percent-cover of any species in wetlands (final model: 5 variables, accounting for 41% of variance)
- wetness score of plants weighted by their percent-cover (final model: 8 variables, accounting for 21% of variance generally and 35% in wetlands)
- native species as a proportion of all species (final model: 13 variables, accounting for 27% of variance)
- similarity of species composition in wetland plots to that in all other plots (final model: 4 variables, accounting for 29% of variance)

Lateral Position

In general, as one moves outward from the main channel, floodplain elevation relative to channel elevation increases and consequently, flood frequency and duration decrease. The relative influence of land uses and hydrologic sources occurring in the adjoining terrestrial environment, as contrasted with the inchannel environment, also is expected to increase. Lateral position of a plot was represented as a percent of the distance between the main channel (0) and the edge (100) of the geomorphic floodplain as adjusted for existing levees and dikes. As expected, lateral position was correlated positively with height above the active channel. Plots proportionately farther from the channel had less bare ground and cobble-gravel substrate, proportionately more plant litter, less soil moisture, and a wider variety of soil texture types. They were more likely to contain reducing conditions that typify wetlands, and soils classified as sand, silt, or loam.

Plots proportionately (and absolutely) farther from the main channel had more plant species, and herbs comprised a greater proportion of the cover. Species composition of individual plots became less similar to other plots, moving in an upland direction. Not surprisingly, richness, cover, and proportional dominance of wetland-associated plants declined moving away from the channel.

Interestingly, the richness, cover, and proportional dominance of native plants (total, as well as tree, shrub, forb, and grasslike species separately) decreased toward the upland edges of the floodplain, perhaps suggesting that exotic species in the floodplain are originating more from adjoining terrestrial lands than from upriver areas, or at least survive better at reduced flood frequencies. The number of tree seedling species and their percent-cover diminished toward the outer edges of the floodplain, coinciding with an increased density and size of trees, increased canopy cover, and increased proportional cover of shrubs (especially Himalayan blackberry). Also increasing toward the outer margins of the floodplain were dead trees, amount of downed wood, and size-age diversity of the downed wood.

In the analysis using stepwise regression, lateral position was selected as one of the most statistically significant predictors of the following botanical variables measured in plots on the lateral transects:

- percent-cover of native species (final model: 7 variables, accounting for 15% of variance)
- percent-cover of native wetland-associated species (final model: 9 variables, accounting for 22% of variance)
- number of native species as proportion of all species (final model: 13 variables, accounting for 27% of variance)
- number of native wetland-associated species as a proportion of all species (final model: 9 variables, accounting for 24% of variance)
- number of native wetland-associated species as a proportion of native species (final model: 9 variables, accounting for 18% of variance)
- similarity of species composition to that of all other plots (final model: 7 variables, accounting for 13% of variance)

Focusing just on the lateral plots that were identified as being wetlands, lateral position was among the most significant variables for predicting:

- percent-cover of tree seedlings (final model: 16 variables, accounting for 22% of variance)
- number of native species as proportion of all species (final model: 4 variables, accounting for 15% of variance)

Similar to our results (Figure A-2), researchers surveying lateral transects in smaller streams of the Cascades and Sierras have observed a peak in plant species richness slightly back from the channel margin where water remains available from the shallow water table and the substrate is not disturbed as frequently by scouring floods (Gregory et al. 1991). In an Arizona floodplain, however, plant richness was greatest directly at the active channel margin (Stromberg et al. 1997). In still other floodplains, especially where groundwater influx is significant, plant richness can be great in isolated channels some distance from the main channel because isolation reduces competition and extinctions caused by invasive species strongly associated with the main channel (Bornette et al. 1998).

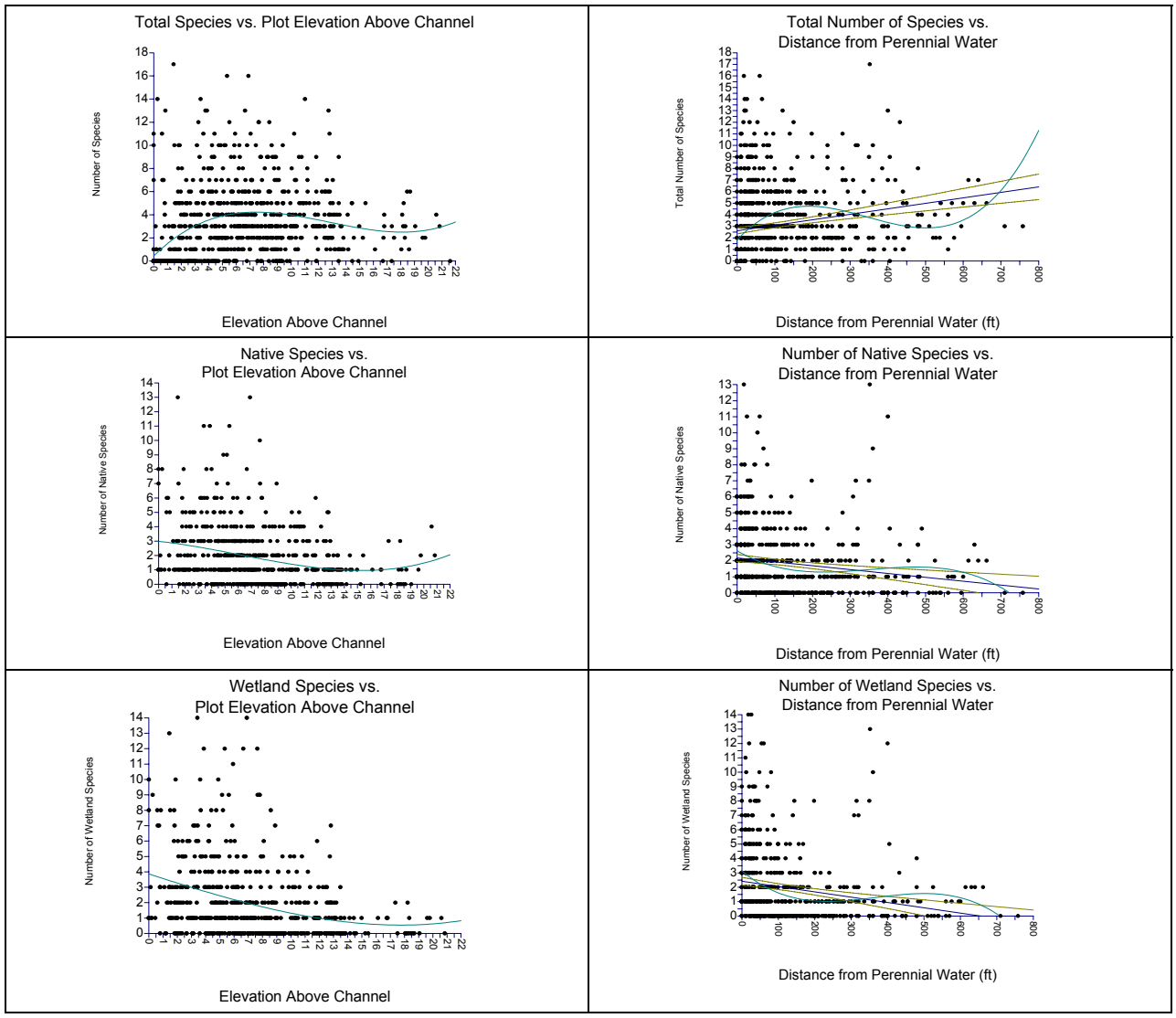

Figure A-2. Lateral changes in selected floodplain botanical variables in the Umatilla River.

Curved line is polynomial regression line (3rd order). Straight line flanked by two other lines, if shown, is the first-order regression line with confidence intervals.

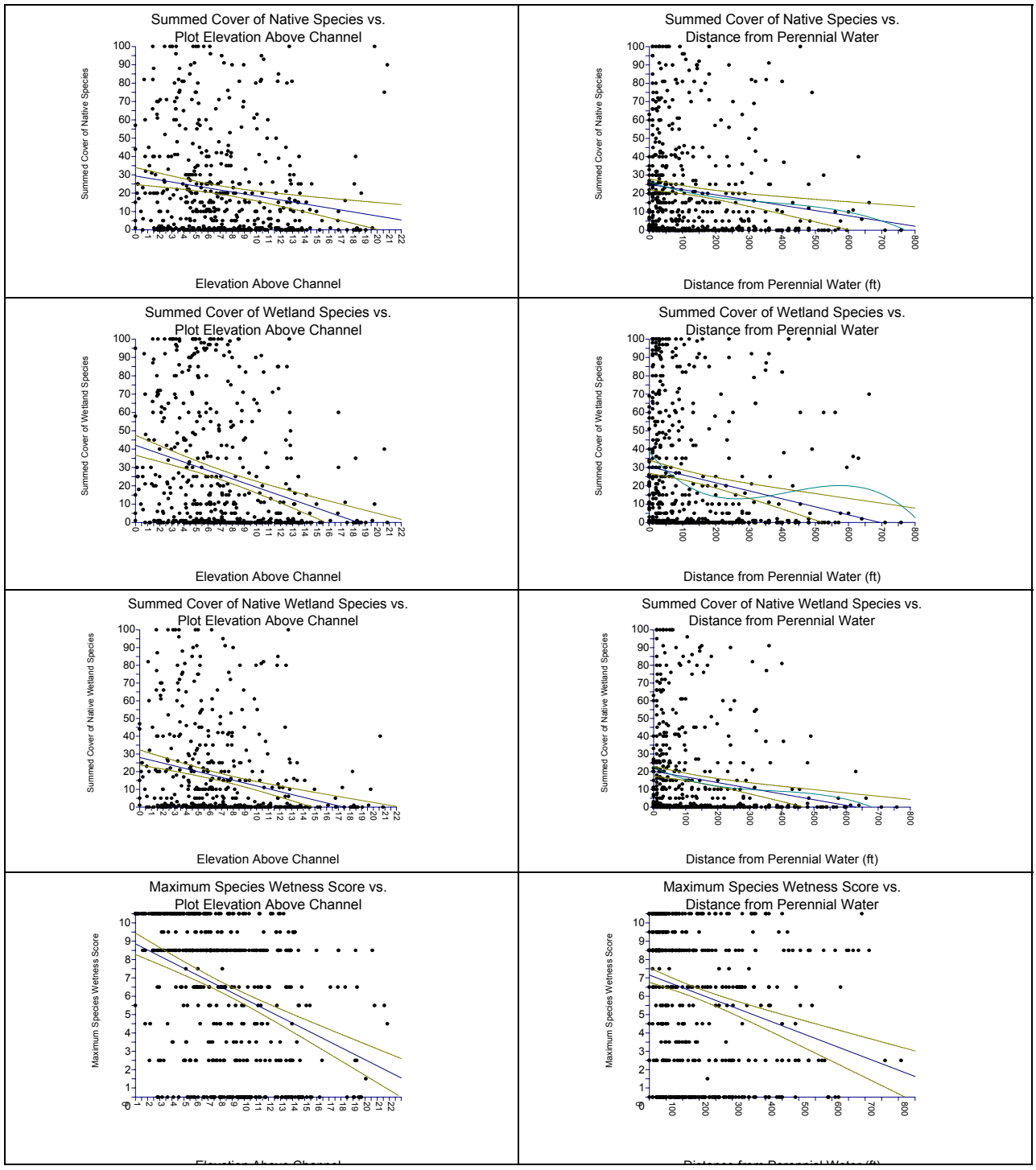

Figure A-2 (continued)

Water Temperature

Water temperature is a crucial indicator of the health of the Umatilla River and other aquatic systems. Analysis of data collected on August 15, 2000 by an aerial thermal sensor (FLIR) indicated water temperature was not correlated with longitudinal position throughout the study area, but was weakly correlated with elevation. It is possible such correlations occurred within specific subsections of the 80-mile segment we studied, but this was not examined. Cooler portions of the Umatilla River occurred where the river is meandering and deep and channel gradient is slight. This is consistent with hypotheses that cooling groundwater enters the river primarily in geomorphically complex reaches. However, shading by topography and vegetation may be at least as influential within some channel reaches. This is hinted at by the association of cooler August temperatures with sites that have a narrow floodplain (FPwidth2), an abrupt lateral slope between the low-flow channel and the floodplain (ElAbovCB), and extensive tree and shrub cover in the vicinity (CC1k80_100, Hard1kAc, Wet2kPalFo, SS1kGT65Ac). Woody vegetation need not be directly along channels to influence channel water temperature. Even at considerable distance from low-flow channels, canopy shading of terrestrial surfaces and floodplain wetlands, and increased cooling as a result of evapotranspiration, can ultimately influence channel water temperature. This is important because our data analysis confirmed that lateral areas closest to the Umatilla low-flow channel have the least woody vegetation, presumably as a result of scouring and inundation by periodic floods.

Data were examined further using stepwise regression. The final site-level model explained 98% of the thermal variability and included the following variables: catchment shape index (a variation of the length-area ratio), geomorphic floodplain width, floodplain slope, channel gradient, channel sinuosity, spatial extent of cobble-gravel and boulder substrate, spatial extent of sediment anaerobic conditions, extent of closed-canopy woodland within 2 km, and extent of NWI-mapped unvegetated palustrine areas within 2 km. The importance of river temperature (or the hydrologic conditions it represents) to floodplain plants was also indicated by regression analysis, which showed, for the greenline data, it was the variable most strongly associated both with total (55% of variance explained) and native (84% of variance explained) plant species richness.

Overstory Closure

The extent of a tree and shrub overstory (canopy) is important to many floodplain functions, partly because trees provide shade, contribute organic matter, maintain soil stability, modify soil structure and chemistry, and dampen air temperature extremes. Overstory closure (CovSum) was one of several variables used to represent the potential influence of woody plants near each plot. As anticipated, overstory closure increased in both upriver (longitudinal) and channel-to-upland (lateral) dimensions, and was correlated negatively with cobble-gravel substrate. Heavily shaded areas had fewer cottonwood seedlings. Also unsurprising was the association of increased overstory closure with greater amounts of dead wood (both standing and downed), variety of downed wood age-diameter classes, and plant litter. With increasing overstory, there were increases in understory plant species richness, native plant richness, wetland plant percent-cover, and dominance by a few understory species. Simultaneously, there were declines in proportionate cover by bare and water substrates, forb richness and percent-cover, and botanical

similarity of plots to each other. Overstory canopy was one of two variables selected as a predictor of native wetland species richness by the stepwise regression analysis, and along with channel gradient, accounted for 93% of the variance in this botanical variable. Similarly, it was one of three variables selected as a predictor of percent-cover of wetland plants by the stepwise regression analysis, and along with greenline gradient and floodplain slope, accounted for 94% of the variance in this botanical variable.

Channel Sinuosity

Low-gradient channels unaltered by humans tend to meander in wide bends. This can be quantified by sinuosity: the ratio of actual channel length to direct-distance length. Analysis of data for the Umatilla River showed -- not surprisingly -- that sites with sinuous channels just upriver also had sinuous channels immediately downriver, and sites where levees were extensive in the vicinity had rather straight channels. For both the greenline and lateral transects, sites with the most winding channels immediately downriver had more identified wetland plots, NWI-mapped wetland area, proportional cover of herbaceous vegetation, downed wood, and sandy-loamy soils. They also had wider geomorphic floodplains and deeper channels. Botanical features of the greenline plots generally did not correlate with channel sinuosity. In the lateral plots, shrub cover was greater where the nearby channel upriver was more sinuous. In plots just upriver of (or within) winding channels, the mean percent-cover of wetland plants and their mean wetness index value were greater. Stepwise regression selected channel sinuosity as one of the most statistically significant predictors of nearly all the major botanical variables we measured.

Levee Proximity and Extent (Up_levee, Dn_levee, Levee1kCu, Levee2kCu)

Although undammed, much of the lower Umatilla River has been physically altered with levees to reduce property losses from flooding. Sites with greater cumulative length of levees within 1 or 2 km generally had greater canopy closure but nonetheless had warmer summertime river temperatures. They also had more bare ground along the lateral transect. For the lateral transect as a whole, the number of total species and wetland species was greater in levied areas than in areas surrounded by fewer levees, but individual plots along the transect averaged fewer wetland species than in unlevied areas. Sites closer to levees had less diversity of tree size classes, smaller frequency of wetland soil profiles along their transects, reduced percent-cover of wetland-associated plant species (mean cover per species). fewer native wetland trees, more willow, and less coverage by box elder, false-indigo, and Russian olive.

Developed Area Extent (Dev1k, Dev2k, Paved1k, Paved2k)

In urban studies, altered hydrologic and water quality regimes as well as degraded aquatic communities have been widely associated with increases in impervious surface from roads and buildings. Fewer studies have examined the potential for such associations in rural areas. Transects at our more developed sites had fewer total plant species and families, native forb species, cottonwood seedlings, and downed wood. Wetness scores of the plant species that were present were generally lower. Tree canopy closure was greater and willows were more prevalent.

Appendix B. Flow and stage of Umatilla River during Summer 2001 collection of floodplain data

Columns 2 and 3 data are from the upriver end of the study area (above Meacham Cr.). Column 4 and 5 data are from the downriver end (Umatilla River at Umatilla).

Date	Height (ft.)	Flow (c.f.s.)	Height (ft.)	Flow (c.f.s.)
June 04	3.04	105	2.87	210
June 05	3.02	100	2.83	191
June 06	3.01	99		
June 07	2.97	92		
June 08	2.95	89		
June 09	2.94	85		
June 10	2.93	83		
June 11	2.92	82		190
June 12	2.97	91	2.81	185
June 13	2.99	96	2.88	216
June 14	2.95	87	2.85	203
June 15	2.91	81	2.79	175
June 16	2.88	76	2.78	170
June 17	2.87	73	2.80	178
June 18	2.86	72	2.84	195
June 19	2.84	68	2.81	185
June 20	2.83	66	2.80	180
June 21	2.82	65	2.85	202
June 22	2.81	63	2.81	185
June 23	2.80	61	2.82	188
June 24	2.80	62	2.83	192
June 25	2.83	67	2.85	200
June 26	2.81	64	2.88	215
June 27	2.86	73	2.89	218
June 28	2.87	74	2.92	235
June 29	2.82	65	2.88	214
June 30	2.79	61	2.86	204
July 01	2.78	58	2.83	191
July 02	2.77	56	2.83	191
July 03	2.76	55	2.74	157
July 04	2.75	54	2.70	143
July 05	2.74	53	2.72	150
July 06	2.74	52	2.68	136
July 07	2.74	52	2.59	116
July 08	2.73	51	2.50	95
July 09	2.72	50	2.31	62
July 10	2.72	49	1.90	25
July 11	2.72	49	1.60	5.30
July 12	2.72	50	1.50	30
July 13	2.72	50	1.50	2.90
July 14	2.71	48	1.60	5.50
July 15	2.70	47	1.52	3.40
July 16	2.70	47	1.50	2.90
July 17	2.70	47	1.50	2.90
July 18	2.70	47	1.56	4.20
July 19	2.70	47	1.49	2.80
July 20	2.71	48	1.50	2.80
July 21	2.72	49	1.52	3.40
July 22	2.70	46	1.53	3.50
July 23	2.69	46	1.67	7.50
July 24	2.69	45	1.71	8.70
July 25	2.69	45	1.73	9.40
July 26	2.68	44	1.68	7.60
July 27	2.68	43	1.68	7.70
July 28	2.68	44	1.68	80
July 29	2.69	46	1.70	8.20
July 30	2.71	48	1.70	8.30
July 31	2.71	48	1.71	8.80
Aug. 01	2.69	45	1.71	8.60
Aug. 02	2.68	44	1.70	8.30
Aug. 03	2.68	43	1.70	8.30
Aug. 04	2.68	44	1.71	8.60
Aug. 05	2.68	44	1.72	8.90
Aug. 06	2.67	43	1.72	8.90
Aug. 07	2.67	42	1.72	9.10
Aug. 08	2.66	41	1.75	10
Aug. 09	2.66	41	1.71	8.70
Aug. 10	2.66	41	1.88	18
Aug. 11	2.66	40	1.82	14
Aug. 12	2.65	40	1.80	13
Aug. 13	2.66	41	1.73	9.30
Aug. 14	2.66	40	1.78	12
Aug. 15	2.65	40	1.74	9.90
Aug. 16	2.65	40	2.00	34
Aug. 17	2.65	39	2.30	60
Aug. 18	2.65	40	2.32	64
Aug. 19	2.65	40	2.36	69
Aug. 20	2.65	40	2.35	68
Aug. 21	2.65	40	2.31	61
Aug. 22	2.65	40	2.30	59
Aug. 23	2.67	42	2.35	68
Aug. 24	2.66	42	2.39	75
Aug. 25	2.66	40	2.38	72
Aug. 26	2.65	40	2.38	72
Aug. 27	2.65	40	2.36	70
Aug. 28	2.65	40	2.36	70
Aug. 29	2.65	40	2.31	62
Aug. 30	2.65	40	2.31	61
Aug. 31	2.65	40	2.29	58

Appendix C. Wetland indicator status: frequencies, percent cover, and measured range of conditions of moisture and shade within which Umatilla River floodplain plant species were found

Indicator Status = The category to which the species is assigned in the Pacific Northwest by the NWI (Reed 1998, and subsequent revisions), reflecting strength of association with wetlands. From most to least associated: OBL>FACW>FAC>FACU (also, + indicates wetter and – indicates drier end of the category).
X = not a wetland indicator. 0 = unknown status (other data in this table may help assign it to a status category for use as a wetland indicator in future studies)
Native? Y= yes, native to this region of the U.S. N= not native (exotic)
G%, L% Percent of the greenline transects, lateral transects, greenline transect plots, and lateral transect plots in which the species was found
Percent Cover: Mean of the relative percent cover among all plots at which it occurred
Height Above River: Approximate height above surface water in the channel during the time of the survey. Mean, maximum, and minimum among all plots at which the species was found. A possible indicator of soil moisture quantity, flood frequency, and flood duration.
Distance to Water: Approximate lateral distance to any surface water present during the time of the survey. Mean, maximum, and minimum among all plots at which the species was found. A possible indicator of soil moisture quantity, flood frequency, and flood duration.
Overstory Percent: Percent canopy closure as estimated using a spherical densiometer. Mean, maximum, and minimum among all plots at which the species was found.

	indicator	native	G%	L %	G %	L %	Percent Cover		Height Above River (ft)			Distance to Water (ft)			Overstory Percent		
Species Found	status	?	sites	sites	plots	plots	mean	max	mean	min	max	mean	min	max	mean	min	max
Acer glabrum	FACU	Y	12.5	15	3	0.7	1.7	5	4.7	1.5	11.0	35.3	10	66	26.3	0.0	64.5
Acer negundo	FAC+	Y	10	10	2	0.5	15.0	20	4.4	4.4	4.4	33.0	33	33	82.2	82.2	82.2
Achillea millefolium	FACU	Y	7.5	20	1.5	1.1	3.0	5	10.5	8.3	12.9	202.0	56	450	21.2	0.0	64.5
Agropyron caninum	FAC-	N	5	10	1	0.9	8.2	10	6.3	6.1	6.9	183.8	147	231	94.9	92.6	98.8
Agropyron repens	FAC-	N	2.5	0	0.5	0.0											
Agrostis stolonifera	FACW	Y	65	32.5	18	2.0	20.4	100	5.5	0.6	12.0	47.6	0	352	13.3	0.0	94.6
Alisma plantago-aquatica	OBL	Y	0	2.5	0	0.1	5.0	5	0.0	0.0	0.0	80.0	80	80	13.5	13.5	13.5
Alnus rhombifolia	FACW	Y	60	57.5	16.5	4.9	12.6	100	5.1	0.3	10.5	55.7	0	352	54.8	0.0	99.8
Alopecurus aequalis	OBL	Y	2.5	0	0.5	0.0	1.0	1									
Amaranthus retroflexus	FACU	N	37.5	15	7.5	0.9	2.4	10	3.8	0.9	7.7	29.9	10	85	5.4	0.0	29.1
Ambrosia artemisifolia	FACU+	N	2.5	2.5	1	0.1	5.3	10	4.3	4.3	4.3	40.0	40	40	0.0	0.0	0.0
Amelanchier alnifolia	FACU	Y	0	5	0	0.2	1.0	1				60.0	60	60	96.2	96.2	96.2
Amorpha fruticosa	FACW	N	15	10	6.5	1.6	20.3	60	5.0	0.6	11.9	24.8	0	90	47.9	0.0	99.8
Anthemis cotula	FACU	N	20	15	4	1.1	2.1	5	4.5	0.3	8.7	114.1	20	280	18.3	0.0	60.3
Anthriscus caucilis	0	N	0	2.5	0	0.2	1.0	1	5.7	5.1	6.2	95.0	90	100	61.9	57.2	66.6
Apocynum cannabinum	FAC	Y	2.5	2.5	1	0.1	33.3	40	3.7	3.7	3.7	10.0	10	10	4.7	4.7	4.7
Arctium minus	X	N	2.5	5	0.5	0.2	1.0	1	6.7	6.7	6.7	336.0	336	336	0.0	0.0	0.0
Arrhenatherum elatius	X	N	12.5	42.5	2.5	4.0	20.8	90	8.3	0.0	17.5	212.0	10	560	62.3	0.0	99.8
Artemisia absinthium	0	N	7.5	22.5	1.5	1.7	23.8	45	8.0	5.1	12.3	220.7	26	600	11.4	0.0	56.2
Artemisia dracunculus	0	Y	2.5	5	0.5	0.2	20.0	20	18.7	18.7	18.7	105.0	105	105	0.0	0.0	0.0
Artemisia ludoviciana	FACU-	Y	0	7.5	0	0.5	13.0	25	9.0	6.2	11.8	85.5	36	135	16.6	0.0	33.3
Artemisia tridentata	X	Y	2.5	7.5	0.5	0.5	23.0	65	13.9	7.7	20.9	105.8	35	143	0.0	0.0	0.0
Asclepias speciosa	FAC+	Y	0	2.5	0	0.1											
Aster eatonii	FAC+	Y	12.5	2.5	2.5	0.1											
Azolla mexicana	OBL	Y	5	7.5	1.5	0.4	9.6	40	2.0	0.1	5.3	0.0	0	0	0.0	0.0	0.0
Beckmannia syzigachne	OBL	Y	2.5	2.5	0.5	0.1	5.0	5	3.4	3.4	3.4	26.0	26	26	0.0	0.0	0.0

Species Found	indicator status	native ?	G% sites	L % sites	G % plots	L % plots	Percent Cover		Height Above River (ft)			Distance to Water (ft)			Overstory Percent		
							mean	max	mean	min	max	mean	min	max	mean	min	max
Betula occidentalis	FACW	Y	0	10	0	0.6	3.3	10	5.5	3.4	8.9	180.8	28	350	0.0	0.0	0.0
Bidens cernua	FACW+	Y	5	0	1.5	0.0	5.3	10									
Bidens frondosa	FACW+	Y	67.5	45	29.5	4.0	3.2	40	4.8	0.6	13.2	47.9	0	360	7.4	0.0	95.7
Brassica hirta	0	N	5	0	1	0.0	1.0	1									
Brassica kaber	0	N	0	5	0	0.5	8.0	20	5.7	0.8	11.2	142.5	20	234	1.3	0.0	5.2
Brassica nigra	0	N	2.5	2.5	0.5	0.1	1.0	1	11.9	11.9	11.9	90.0	90	90	25.0	25.0	25.0
Bromus briziformis	X	N	0	5	0	0.2											
Bromus commutatus	0	N	2.5	12.5	0.5	0.9	8.5	40	11.3	7.1	14.2	81.4	35	280	30.9	0.0	89.4
Bromus diandrus	0	N	22.5	62.5	6.5	9.6	15.4	90	9.3	0.3	20.9	216.7	11	758	21.7	0.0	99.8
Bromus hordeaceus	FACU	N	0	7.5	0	0.5	1.0	1	8.8	7.0	11.0	138.7	66	200	50.4	32.8	64.5
Bromus japonicus	X	N	0	2.5	0	0.1	5.0	5	10.2	10.2	10.2	77.0	77	77	75.9	75.9	75.9
Bromus tectorum	0	N	22.5	65	7	11.5	16.4	95	8.7	2.0	19.1	161.2	11	710	19.1	0.0	99.8
Buglossoides arvensis	0	N	0	2.5	0	0.1	1.0	1				240.0	240	240	47.8	47.8	47.8
Calamagrostis canadensis	FACW+	Y	0	2.5	0	0.1											
Callitriche heterophylla	OBL	Y	0	2.5	0	0.1	20.0	20	1.4	1.4	1.4	308.0	308	308	95.7	95.7	95.7
Callitriche palustris	OBL	Y	0	2.5	0	0.1	20.0	20	5.3	5.3	5.3	0.0	0	0	0.0	0.0	0.0
Cardaria draba	0	N	2.5	12.5	0.5	1.5	8.0	20	8.1	6.0	11.2	296.5	20	614	19.3	0.0	80.1
Carex athrostachya	FACW	Y	10	5	2	0.2	10.0	10									
Carex hystericina	OBL	Y	0	2.5	0	0.1											
Carex lenticularis	FACW+	Y	2.5	5	0.5	0.2	5.0	5									
Carex stipata	OBL	Y	5	5	1	0.2	8.0	15				150.0	150	150	73.8	73.8	73.8
Carex vesicaria	OBL	Y	10	5	2	0.2											
Centaurea biebersteinii	0	N	2.5	0	0.5	0.0											
Centaurea cyanus	0	N	7.5	27.5	1.5	1.5	2.5	5	12.1	6.4	18.5	279.3	50	540	6.5	0.0	28.1
Centaurea diffusa	0	N	17.5	50	3.5	6.4	8.5	40	8.2	3.6	13.4	153.0	21	440	7.0	0.0	64.5
Centaurea maculosa	0	N	0	2.5	0	0.1	1.0	1	3.8	3.8	3.8	20.0	20	20	0.0	0.0	0.0
Centaurea solstitialis	0	N	7.5	22.5	2	3.2	9.6	85	5.4	0.3	9.5	143.9	20	480	3.7	0.0	32.2
Chamaesyce glyptosperma	0	Y	2.5	0	0.5	0.0	1.0	1									
Chamaesyce maculata	X	N	27.5	10	7.5	0.9	1.8	5	3.2	0.6	5.4	37.8	20	60	10.3	0.0	42.6
Chamaesyce serpyllifolia	X	Y	0	2.5	0	0.1	10.0	10	4.6	4.6	4.6	22.0	22	22	0.0	0.0	0.0
Chenopodium album	FAC	N	2.5	5	0.5	0.2	1.0	1	4.7	2.7	6.7	173.5	11	336	0.0	0.0	0.0
Chenopodium botrys	FACU	N	40	22.5	15.5	1.6	2.6	15	5.7	0.6	10.4	42.7	10	90	9.8	0.0	42.6
Chenopodium rubrum	FACW+	Y	2.5	0	0.5	0.0	10.0	10									
Cichorium intybus	X	N	27.5	47.5	5.5	3.5	4.4	25	6.9	2.2	12.5	148.3	20	440	8.6	0.0	96.7
Cirsium arvense	FAC-	N	37.5	47.5	8.5	4.3	10.3	35	7.5	0.0	18.2	229.8	0	662	40.0	0.0	98.8
Cirsium vulgare	FACU	N	2.5	2.5	0.5	0.5	2.0	5	8.4	7.2	9.3	585.3	288	758	22.9	0.0	60.3
Claytonia sibirica	FAC-	Y	0	2.5	0	0.1	1.0	1				90.0	90	90	91.5	91.5	91.5
Clematis ligusticifolia	FAC-	Y	27.5	55	6.5	4.2	10.3	30	9.7	1.2	20.9	169.6	0	640	53.0	0.0	99.8
Conium maculatum	FAC+	Y	22.5	47.5	5	4.6	5.4	25	8.2	1.8	18.4	140.6	35	320	49.1	0.0	99.8
Convolvulus arvensis	0	N	7.5	2.5	1.5	0.4	3.0	5	6.6	3.2	12.2	50.0	10	110	0.0	0.0	0.0
Cornus sericea	FACW	Y	2.5	7.5	0.5	0.4	8.0	15	5.1	4.0	6.2	73.0	46	100	71.8	66.6	77.0
Crataegus douglasii	FAC	Y	0	17.5	0	1.1	16.2	60	5.0	0.0	11.0	111.6	30	252	72.2	29.1	99.8
Croton setigerus	0	Y	7.5	0	1.5	0.0	1.0	1									
Cynoglossum officinale	FACU	N	12.5	40	3	4.4	4.2	25	8.6	1.7	18.3	238.5	0	640	57.4	0.0	98.8
Cyperus aristatus	OBL	Y	47.5	15	16.5	1.0	3.6	20	3.9	1.7	6.9	41.1	0	144	2.5	0.0	11.4
Cyperus esculentus	FACW	Y	60	35	22	2.6	6.8	25	4.4	0.3	8.9	19.9	0	40	0.0	0.0	0.0

Species Found	indicator status	native ?	G% sites	L % sites	G % plots	L % plots	Percent Cover		Height Above River (ft)			Distance to Water (ft)			Overstory Percent		
							mean	max	mean	min	max	mean	min	max	mean	min	max
Dactylis glomerata	FACU	N	12.5	25	2.5	2.3	9.6	40	7.8	0.0	16.8	186.1	10	560	76.1	29.1	98.8
Daucus carota	0	N	40	57.5	9	4.6	2.4	25	6.8	1.5	12.6	130.1	11	480	12.9	0.0	74.9
Deschampsia cespitosa	FACW	Y	20	30	5	3.7	16.1	85	7.7	2.3	15.0	166.6	20	484	77.0	27.0	99.8
Deschampsia elongata	FACW-	Y	2.5	10	0.5	1.2	30.4	90	7.1	3.9	10.2	206.3	77	400	68.6	35.4	91.5
Dianthus armeria	X	N	7.5	15	1.5	1.0	1.4	5	9.2	5.9	13.1	159.0	11	405	42.2	0.0	86.3
Digitaria sanguinalis	FACU	N	5	5	1.5	0.4	55.0	80	2.6	2.0	3.3	15.0	10	20	0.0	0.0	0.0
Dipsacus fullonum	X	N	45	57.5	10.5	6.6	9.6	45	6.9	0.0	14.5	116.0	11	405	11.4	0.0	75.9
Echinochloa crus-galli	FACW	N	47.5	25	18.5	2.3	6.0	50	4.7	0.1	7.8	24.6	0	60	4.1	0.0	68.6
Echium vulgare	0	N	42.5	50	13	11.4	12.5	90	9.1	1.9	14.5	127.3	11	420	13.3	0.0	95.7
Elaeagnus angustifolia	FAC	N	5	0	1	0.0											
Eleocharis acicularis	OBL	Y	7.5	2.5	1.5	0.1	12.0	30	0.6	0.6	0.6	46.0	46	46	42.6	42.6	42.6
Eleocharis ovata	OBL	Y	50	15	15.5	0.7	4.8	20	4.4	1.9	6.9	37.0	12	70	1.8	0.0	7.3
Eleocharis palustris	OBL	Y	65	27.5	17	2.3	14.6	55	4.1	1.3	12.0	41.6	0	352	1.4	0.0	17.7
Elodea canadensis	OBL	Y	10	27.5	3	1.9	16.1	65	2.0	0.0	5.9	0.0	0	0	0.6	0.0	7.3
Elymus elymoides	FACU-	Y	0	2.5	0	0.1											
Elymus glaucus	FACU	Y	12.5	20	4	3.0	8.0	65	8.2	5.0	15.5	125.7	20	480	74.8	0.0	99.8
Elytrigia intermedia	0	N	12.5	30	2.5	3.3	21.6	95	10.6	2.3	19.6	231.3	10	538	30.0	0.0	95.7
Elytrigia repens	FAC-	N	7.5	10	1.5	0.6	15.2	35	9.7	6.5	14.2	147.5	30	480	11.4	0.0	23.9
Epilobium ciliatum	FACW-	Y	15	5	3	0.4	4.5	15	4.0	0.7	7.2	169.0	30	308	45.8	25.0	66.6
Epilobium densiflorum	FACW-	Y	0	2.5	0	0.1	1.0	1	3.8	3.8	3.8	20.0	20	20	0.0	0.0	0.0
Epilobium glaberrimum	FACW	Y	30	7.5	9.5	0.5	2.7	10	8.1	3.9	11.8	52.5	10	135	19.6	0.0	44.7
Epilobium luteum	FACW	Y	2.5	0	0.5	0.0											
Epilobium palustre	OBL	Y	7.5	2.5	2	0.1	2.8	10	12.3	12.3	12.3	33.0	33	33	56.2	56.2	56.2
Epilobium pygmaeum	OBL	Y	2.5	0	0.5	0.0	1.0	1									
Equisetum arvense	FAC	Y	72.5	47.5	24.5	4.2	12.0	55	4.9	0.3	11.9	90.5	0	400	18.2	0.0	90.5
Equisetum hyemale	FACW	Y	2.5	2.5	0.5	0.1	1.0	1	19.6	19.6	19.6	420.0	420	420	49.9	49.9	49.9
Equisetum pratense	FACW	Y	2.5	2.5	0.5	0.1	1.0	1	5.2	5.2	5.2	315.0	315	315	0.0	0.0	0.0
Equisetum sylvaticum	FACW	Y	0	2.5	0	0.2	1.0	1	8.4	5.6	11.2	10.0	0	20	0.0	0.0	0.0
Eremocarpus setigerus	0	Y	2.5	5	0.5	0.4	1.0	1	9.4	9.4	9.4	33.0	33	33	0.0	0.0	0.0
Eriogonum baileyi	0	Y	0	2.5	0	0.2	7.5	10	13.5	13.2	13.8	350.0	350	350	0.0	0.0	0.0
Eriogonum vimineum	0	Y	0	2.5	0	0.1	1.0	1				42.0	42	42	0.0	0.0	0.0
Erodium cicutarium	0	N	2.5	2.5	0.5	0.1	1.0	1	13.0	13.0	13.0	400.0	400	400	0.0	0.0	0.0
Eschscholzia californica	0	N	7.5	22.5	3	2.5	3.5	25	7.4	3.3	10.8	97.1	10	320	8.9	0.0	99.8
Euthamia occidentalis	FACW	Y	60	57.5	24.5	7.4	7.9	35	5.0	0.0	13.5	79.6	0	480	15.3	0.0	99.8
Festuca arundinacea	FAC-	N	0	2.5	0	0.4	40.5	80	8.3	7.9	8.6	400.0	360	440	37.4	28.1	46.8
Galium triflorum	FACU	Y	0	2.5	0	0.1	5.0	5	20.6	20.6	20.6	490.0	490	490	69.7	69.7	69.7
Geranium molle	0	N	0	2.5	0	0.1	1.0	1				150.0	150	150	73.8	73.8	73.8
Gilia capitata	0	Y	12.5	32.5	3	2.7	2.2	15	9.1	1.9	14.5	85.5	21	231	10.4	0.0	56.2
Glyceria borealis	OBL	Y	7.5	10	2	0.9	3.8	10	7.3	4.4	10.2	198.0	50	350	19.0	0.0	75.9
Gnaphalium palustre	FAC+	Y	25	5	5	0.2	1.0	1	2.6	1.5	3.7	22.5	10	35	2.3	0.0	4.7
Grindelia nana	FACU+	Y	2.5	7.5	0.5	0.4											
Grindelia squarrosa	FACU	Y	0	5	0	0.2											
Holcus lanatus	FAC	N	10	22.5	2	1.6	11.6	60	10.0	5.9	12.9	122.7	28	320	53.5	0.0	98.8
Holodiscus discolor	X	Y	2.5	5	0.5	0.2	30.0	30	11.0	11.0	11.0	30.0	30	30	68.6	68.6	68.6
Hordeum jubatum	FAC-	Y	0	2.5	0	0.1	1.0	1	12.8	12.8	12.8	121.0	121	121	91.5	91.5	91.5
Hypericum perforatum	0	N	52.5	57.5	13	7.5	5.1	30	7.8	0.8	14.5	113.1	0	432	11.9	0.0	95.7

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							mean	max	mean	min	max	mean	min	max	mean	min	max
Juncus acuminatus	OBL	Y	2.5	5	0.5	0.2	1.0	1	6.7	6.7	6.7	20.0	20	20	0.0	0.0	0.0
Juncus alpinoarticulatus	OBL	Y	2.5	0	0.5	0.0											
Juncus articulatus	OBL	Y	30	15	7	0.7	6.4	35	5.5	0.0	11.4	67.5	18	144	3.4	0.0	13.5
Juncus bolanderi	OBL	Y	0	2.5	0	0.1											
Juncus brevicaudatus	0	Y	2.5	0	0.5	0.0											
Juncus effusus	FACW	Y	22.5	42.5	4.5	3.3	20.5	65	5.6	0.7	10.8	205.4	0	480	27.5	0.0	99.8
Juncus ensifolius	FACW	Y	7.5	0	1.5	0.0											
Juncus howellii	0	Y	0	2.5	0	0.1											
Lactuca serriola	FACU	N	12.5	27.5	3	2.1	1.0	1	8.9	4.0	18.2	234.8	20	662	27.5	0.0	96.2
Lamium amplexicaule	0	N	0	2.5	0	0.1											
Lamium maculatum	0	N	0	2.5	0	0.1											
Lamium purpureum	0	N	2.5	0	0.5	0.0											
Lapsana communis	X	N	0	7.5	0	0.6	10.7	30	7.8	3.9	13.5	165.7	35	273	91.2	89.4	92.6
Leersia oryzoides	OBL	Y	67.5	47.5	36.5	4.4	22.4	100	3.6	0.6	8.9	32.3	0	352	5.5	0.0	68.6
Lemna minor	OBL	Y	0	2.5	0	0.1	1.0	1	3.9	3.9	3.9	400.0	400	400	58.2	58.2	58.2
Lepidium campestre	0	N	0	2.5	0	0.2	1.0	1	6.2	4.1	8.3	320.0	240	400	14.0	0.0	28.1
Lepidium latifolium	FAC	N	0	2.5	0	0.1	1.0	1	9.1	9.1	9.1	60.0	60	60	30.2	30.2	30.2
Leucanthemum vulgare	X	N	22.5	35	5.5	3.0	5.4	25	8.8	1.5	14.5	162.5	21	400	32.8	0.0	96.7
Leymus triticoides	0	Y	0	2.5	0	0.1	1.0	1				570.0	570	570	0.0	0.0	0.0
Linaria dalmatica	0	N	5	22.5	1	3.2	6.4	20	8.5	1.9	13.5	136.5	23	396	8.9	0.0	86.3
Lolium perenne	FAC	N	0	2.5	0	0.1	1.0	1	11.2	11.2	11.2	20.0	20	20	0.0	0.0	0.0
Lomatium bicolor	X	Y	2.5	0	0.5	0.0	1.0	1									
Lotus corniculatus	FAC	N	2.5	0	0.5	0.0											
Lotus unifoliolatus	X	Y	25	25	6	1.5	5.2	20	6.4	2.3	9.1	69.9	25	150	6.5	0.0	32.8
Ludwigia palustris	OBL	Y	17.5	2.5	4	0.1	6.4	20	0.0	0.0	0.0	80.0	80	80	13.5	13.5	13.5
Lycopus americanus	OBL	Y	37.5	12.5	8	0.6	2.8	10	3.6	1.9	5.4	54.0	48	60	0.0	0.0	0.0
Lycopus asper	OBL	Y	15	5	3	0.2	3.0	5	3.4	3.4	3.4	26.0	26	26	0.0	0.0	0.0
Madia gracilis	0	Y	2.5	5	1	0.2	5.5	10	7.2	7.2	7.2	160.5	21	300	36.9	0.0	73.8
Malus sylvestris	0	N	0	5	0	0.2	1.0	1	5.7	2.7	8.8	223.5	207	240	90.0	81.1	98.8
Marah oreganus	0	Y	17.5	15	3.5	1.4	8.6	35	8.4	2.7	11.9	162.1	11	320	51.3	5.2	95.7
Medicago lupulina	FAC	N	15	7.5	3	0.4	2.3	10	8.1	5.2	10.4	241.7	50	360	10.7	0.0	32.2
Medicago sativa	X	N	0	5	0	0.4	5.0	5	18.3	18.1	18.6	110.5	104	117	7.8	0.0	15.6
Melilotus alba	FACU	N	62.5	40	18	3.2	4.5	50	5.0	0.9	12.8	33.7	10	150	2.5	0.0	29.1
Mentha arvensis	FACW-	Y	42.5	22.5	12	1.4	4.3	30	4.4	0.0	7.1	128.5	10	352	5.6	0.0	27.0
Mentha rotundifolia	X	N	2.5	0	0.5	0.0	1.0	1									
Mentha spicata	OBL	N	7.5	17.5	2	1.0	5.5	15	5.9	2.0	11.2	235.0	17	640	48.6	0.0	98.8
Mimulus guttatus	OBL	Y	10	10	2	0.6	2.6	5	1.5	0.7	2.4	220.0	0	352	14.2	0.0	25.0
Mimulus moschatus	FACW+	Y	2.5	0	0.5	0.0											
Montia perfoliata	FAC	Y	0	2.5	0	0.1	1.0	1				90.0	90	90	91.5	91.5	91.5
Myosotis laxa	OBL	Y	7.5	10	1.5	0.6	1.0	1	3.8	0.0	7.8	140.0	20	308	5.0	0.0	25.0
Nepeta cataria	FAC	N	17.5	32.5	3.5	1.9	1.7	5	6.9	1.8	13.6	160.1	50	294	75.0	0.0	96.7
Onopordum acanthium	0	N	2.5	15	0.5	1.5	5.8	15	10.7	4.2	18.7	296.1	105	640	20.8	0.0	91.5
Pachysandra terminalis	0	N	2.5	2.5	0.5	0.2	33.7	80	9.5	8.1	10.9	15.0	10	20	19.8	0.0	39.5
Panicum capillare	FACU+	Y	40	15	15	1.2	1.3	5	5.8	3.2	8.9	28.4	10	60	0.0	0.0	0.0
Paspalum distichum	FACW	Y	2.5	2.5	1.5	0.1	60.0	80									
Phacelia hastata	0	Y	0	2.5	0	0.1											

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Phalaris arundinacea	FACW	N	87.5	82.5	38.5	16.1	30.8	100	5.5	0.0	18.2	102.8	0	662	32.8	0.0	99.8
Philadelphus lewisii	X	Y	2.5	7.5	0.5	0.4											
Phleum pratense	FAC-	N	0	7.5	0	0.4	1.0	1	12.8	12.8	12.8	135.5	121	150	82.7	73.8	91.5
Physocarpus capitatus	FACW	Y	5	5	1	0.2	20.0	30	4.2	4.2	4.2	69.0	69	69	91.5	91.5	91.5
Plantago lanceolata	FACU+	N	45	52.5	10.5	5.3	5.0	35	7.3	0.0	13.1	102.4	20	432	11.3	0.0	91.5
Plantago major	FAC	N	67.5	35	21	2.6	2.5	10	4.1	0.6	7.7	29.9	10	85	4.2	0.0	42.6
Poa annua	FAC	N	0	2.5	0	0.1	10.0	10	10.2	10.2	10.2	80.0	80	80	44.7	44.7	44.7
Poa bulbosa	0	N	5	27.5	1	2.5	10.2	80	12.0	5.2	18.7	258.9	10	570	13.9	0.0	78.5
Poa nervosa	FACU-	Y	10	0	2	0.0											
Poa palustris	FAC	N	0	7.5	0	0.5	17.3	50	7.5	6.1	8.6	40.0	30	50	2.4	0.0	7.3
Poa pratensis	FAC	N	10	15	2	1.9	16.5	60	10.9	6.7	14.5	108.9	20	360	49.3	0.0	99.8
Polygonum amphibium	OBL	Y	7.5	2.5	2	0.4	22.0	80	3.0	2.0	4.6	46.7	10	70	15.6	0.0	46.8
Polygonum aviculare	FACW-	N	0	2.5	0	0.1	1.0	1	4.2	4.2	4.2	60.0	60	60	0.0	0.0	0.0
Polygonum hydropiperoides	OBL	Y	32.5	22.5	16	1.5	5.5	25	3.5	0.0	8.6	99.2	10	352	10.3	0.0	29.1
Polygonum lapathifolium	FACW	Y	62.5	37.5	22.5	3.1	2.7	25	4.8	0.3	12.8	43.9	0	400	10.5	0.0	68.6
Polygonum persicaria	FACW	N	65	25	19.5	1.5	2.5	10	4.0	0.6	7.7	31.4	0	85	8.3	0.0	42.6
Polypogon monspeliensis	FACW+	N	20	42.5	4.5	3.3	4.3	20	8.3	0.0	13.2	103.6	10	416	20.3	0.0	98.8
Populus balsamifera	FAC+	Y	80	87.5	40.5	14.7	11.5	95	6.3	0.0	17.4	113.4	0	662	29.8	0.0	99.8
Prunella vulgaris	FACU+	N	7.5	2.5	1.5	0.1	10.0	10									
Prunus emarginata	FACU	Y	2.5	2.5	0.5	0.1	30.5	60	10.4	10.4	10.4	10.0	10	10	96.7	96.7	96.7
Prunus virginiana	FACU	Y	2.5	15	0.5	1.1	7.6	20	6.7	1.4	18.2	252.9	46	630	80.7	34.3	95.7
Pseudoroegneria spicata	X	Y	2.5	5	0.5	0.2											
Raphanus sativa	0	N	0	5	0	0.4	2.3	5	11.9	8.9	14.2	120.3	40	200	38.5	0.0	91.5
Rhus glabra	0	Y	7.5	2.5	2	0.6	10.9	25	13.9	13.1	14.6	254.8	182	312	4.8	0.0	12.5
Ribes aureum	FAC+	Y	0	5	0	0.2	10.0	10	5.9	5.9	5.9	40.0	40	40	99.8	99.8	99.8
Ribes lacustre	FAC+	Y	0	2.5	0	0.1	55.0	55	10.1	10.1	10.1	320.0	320	320	60.3	60.3	60.3
Ribes oxyacanthoides	FACW	Y	2.5	2.5	0.5	0.1											
Robinia pseudoacacia	FACU	N	35	27.5	9.5	2.0	13.9	60	8.2	2.3	15.0	59.7	0	270	77.8	0.0	99.8
Rorippa curvisiliqua	OBL	N	27.5	2.5	6.5	0.1	1.7	5									
Rosa eglanteria	FACW	N	12.5	25	2.5	1.4	14.6	35	8.9	5.5	12.8	109.3	20	320	82.2	60.3	98.8
Rosa nutkana	FAC-	Y	0	2.5	0	0.1	1.0	1	14.5	14.5	14.5	234.0	234	234	3.1	3.1	3.1
Rosa woodsii	FACU	Y	15	30	3.5	2.7	20.5	100	5.5	0.8	10.4	168.3	0	320	63.9	19.8	99.8
Rubus discolor	FACU	N	17.5	47.5	3.5	5.2	30.5	95	7.4	1.8	12.9	204.6	13	614	66.9	0.0	99.8
Rubus laciniatus	FACU+	Y	7.5	7.5	1.5	0.4	11.7	15	8.8	5.1	12.5	92.0	52	132	90.5	87.4	93.6
Rumex acetosella	FACU+	N	12.5	22.5	2.5	1.4	7.1	15	9.4	0.0	13.4	69.7	45	112	4.6	0.0	29.1
Rumex aquaticus	FACW+	Y	2.5	0	0.5	0.0											
Rumex conglomeratus	FACW	N	5	10	1	0.7	4.7	10	4.7	0.8	12.8	295.8	144	525	14.1	0.0	70.7
Rumex crispus	FAC+	N	67.5	60	19	5.6	2.5	15	5.5	0.0	12.8	89.6	0	400	8.4	0.0	78.0
Rumex obtusifolius	FAC	N	5	0	1	0.0											
Rumex salicifolius	FACW	Y	42.5	30	9.5	1.6	4.6	10	4.7	0.0	7.8	114.9	10	432	8.8	0.0	47.8
Salix exigua	OBL	Y	62.5	50	19.5	5.7	11.2	80	5.3	0.0	12.3	66.1	0	400	18.5	0.0	98.8
Salix fragilis	X	Y	2.5	7.5	0.5	0.9	36.4	80	3.5	1.7	6.2	56.7	0	100	49.2	11.4	84.2
Salix lasiolepis	FACW	Y	12.5	10	2.5	0.6	12.6	50	5.8	1.8	10.0	64.5	20	168	26.5	0.0	90.5
Salix lucida	FACW+	Y	15	10	3	1.0	12.8	30	5.8	2.3	10.6	43.3	10	110	21.5	0.0	80.1
Salix prolixa	X	Y	0	2.5	0	0.1	5.0	5	5.2	5.2	5.2	70.0	70	70	7.3	7.3	7.3
Salix rigida	OBL	Y	7.5	7.5	2.5	0.5	7.5	25	5.0	2.6	6.2	47.5	0	100	20.3	0.0	66.6

Species Found	indicator status	native ?	G% sites	L % sites	G % plots	L % plots	Percent Cover		Height Above River (ft)			Distance to Water (ft)			Overstory Percent		
							mean	max	mean	min	max	mean	min	max	mean	min	max
Salix scouleriana	FAC	Y	0	7.5	0	0.5	32.8	85	8.7	5.2	13.5	244.0	92	405	70.2	53.0	94.6
Salsola kali	FACU	N	0	2.5	0	0.1	1.0	1	8.7	8.7	8.7	758.0	758	758	8.3	8.3	8.3
Sambucus racemosa	FACU	Y	2.5	10	0.5	0.6	22.5	25	13.3	13.0	13.6	75.0	50	100	44.7	22.9	66.6
Saponaria officinalis	X	N	17.5	17.5	3.5	1.4	5.0	15	11.5	0.0	19.1	109.0	52	210	50.7	0.0	99.8
Schoenoplectus tabernaemontani	OBL	Y	55	37.5	15.5	2.2	4.8	20	3.2	0.0	7.7	50.6	0	400	13.9	0.0	68.6
Scirpus americanus	OBL	Y	17.5	7.5	4	0.5	10.3	20	4.0	1.9	10.2	36.3	10	77	26.8	0.0	75.9
Scirpus microcarpus	OBL	Y	15	15	3.5	1.0	18.4	70	5.7	3.9	7.7	266.8	54	400	64.9	0.0	98.8
Secale cereale	0	N	0	5	0	0.5	24.3	85	15.6	6.7	18.7	180.3	70	336	25.0	0.0	99.8
Senecio pseudaureus	FACW	Y	0	5	0	0.9	8.3	25	11.8	8.7	12.9	112.4	77	160	63.0	0.0	93.6
Setaria viridis	0	N	20	5	4	0.5	1.7	5	4.4	4.3	4.8	32.5	20	40	0.0	0.0	0.0
Sisymbrium altissimum	FACU-	N	2.5	2.5	0.5	0.1	20.0	20	19.1	19.1	19.1	175.0	175	175	0.0	0.0	0.0
Smilacina racemosa	FAC-	Y	0	2.5	0	0.1	1.0	1	10.1	10.1	10.1	280.0	280	280	34.3	34.3	34.3
Solanum dulcamara	FAC+	Y	37.5	27.5	9.5	2.0	13.1	90	6.5	1.4	10.4	142.6	20	480	65.4	0.0	99.8
Solanum nigrum	FACU	N	0	2.5	0	0.1	1.0	1	0.6	0.6	0.6	46.0	46	46	42.6	42.6	42.6
Solanum physalifolium	0	N	2.5	2.5	0.5	0.1											
Solidago canadensis	FAC-	Y	35	52.5	15	5.6	9.6	45	7.1	0.0	18.2	183.8	10	662	30.3	0.0	91.5
Sonchus arvensis	FACU+	N	7.5	5	1.5	0.2	1.0	1	6.7	4.2	9.1	100.0	60	140	60.8	30.2	91.5
Sonchus asper	FAC-	N	2.5	7.5	0.5	0.4	1.0	1	7.9	7.0	8.8	52.5	50	55	0.0	0.0	0.0
Sparganium angustifolium	OBL	Y	7.5	7.5	1.5	0.4	5.5	10	0.0	0.0	0.0	80.0	80	80	13.5	13.5	13.5
Stellaria calycantha	FACW	Y	5	5	1	0.4	3.0	5	10.6	10.6	10.6	123.7	11	270	56.2	0.0	91.5
Streptopus amplexifolius	FAC-	Y	0	2.5	0	0.1											
Symphoricarpos albus	FACU	Y	15	47.5	3	4.6	22.9	90	9.2	1.8	20.6	160.4	20	525	62.2	0.0	96.2
Taeniatherum caput-medusae	0	N	2.5	12.5	0.5	0.7	5.8	25	9.0	4.0	12.4	176.5	11	450	2.3	0.0	9.4
Tanacetum parthenium	0	N	0	2.5	0	0.1	15.0	15	9.1	9.1	9.1	120.0	120	120	35.4	35.4	35.4
Taraxacum officinale	FACU	N	5	0	1	0.0	1.0	1									
Thermopsis macrophylla	X	Y	0	5	0	0.2	1.0	1	10.6	10.6	10.6	11.0	11	11	0.0	0.0	0.0
Thermopsis rhombifolia	FACU	Y	5	7.5	1	0.4	7.0	15	3.6	3.3	4.0	31.5	17	46	38.5	0.0	77.0
Thlaspi montanum	0	Y	2.5	0	0.5	0.0											
Toxicodendron rydbergii	FACU	Y	2.5	7.5	0.5	0.4	30.3	70	10.2	9.0	10.9	27.0	11	50	0.0	0.0	0.0
Tragopogon dubius	0	N	5	22.5	1	1.2	1.0	1	9.4	7.0	11.8	191.7	0	510	31.8	0.0	99.8
Trifolium arvense	0	N	7.5	35	1.5	4.3	8.7	50	9.6	4.1	15.3	187.6	11	570	9.8	0.0	85.3
Trifolium dubium	X	N	7.5	5	2	0.2	1.0	1									
Trifolium pratense	FACU	N	2.5	0	0.5	0.0											
Trifolium repens	FAC-	N	12.5	2.5	2.5	0.1	2.3	5									
Triticum aestivum	0	N	2.5	0	0.5	0.0											
Typha latifolia	OBL	Y	5	20	1	1.6	18.6	50	4.5	0.0	9.0	194.9	51	400	26.9	0.0	68.6
Urtica dioica	FAC+	Y	25	25	7.5	2.0	12.8	80	7.6	3.4	11.9	149.4	40	576	62.5	0.0	99.8
Verbascum blattaria	X	N	35	25	7	1.6	2.0	10	6.5	2.1	9.5	114.9	17	300	13.4	0.0	73.8
Verbascum thapsus	X	N	27.5	42.5	6.5	3.1	2.9	10	6.8	0.3	10.4	72.5	10	168	14.5	0.0	92.6
Verbena bracteata	FAC	Y	12.5	10	2.5	0.6	1.0	1	3.6	2.9	4.3	32.0	20	44	0.0	0.0	0.0
Verbena hastata	FAC+	Y	65	45	32	3.8	3.7	25	5.7	0.3	12.8	61.4	0	352	4.6	0.0	42.6
Veronica americana	OBL	Y	2.5	5	0.5	0.4	1.0	1	4.4	3.9	4.9	380.0	360	400	29.1	0.0	58.2
Veronica anagallis-aquatica	OBL	Y	25	2.5	6	0.1	1.0	1									
Vicia sativa	X	N	2.5	2.5	1	1.0	4.1	10	7.8	4.1	10.4	275.0	160	400	39.8	0.0	83.2

Species Found	indicator status	native ?	G% sites	L % sites	G % plots	L % plots	Percent Cover		Height Above River (ft)			Distance to Water (ft)			Overstory Percent		
							mean	max	mean	min	max	mean	min	max	mean	min	max
Viola glabella	FAC	Y	0	7.5	0	0.7	16.8	40	15.1	7.7	20.6	297.8	40	630	62.4	23.9	90.5
Vulpia myuros	FACU	N	7.5	27.5	1.5	2.5	14.1	75	7.6	1.9	13.1	139.4	13	432	15.7	0.0	69.7
Xanthium strumarium	FAC	Y	87.5	67.5	44.5	7.0	5.7	25	5.4	0.0	13.2	58.5	0	480	8.4	0.0	95.7

Appendix D. Records of vascular plant species within or near the floodplain of the lower Umatilla River

Form: T= tree, S= shrub, G= grasslike plant, F= leafy forb
CTUIR Minthorn are records from an unpublished list of plants found in previous surveys of the Minthorn Springs wetland by CTUIR botanists
Alpert & Kagan are unpublished records from 5 riparian plots surveyed by the Oregon Natural Heritage Program
Bar M Ranch are unpublished records provided by Jerry Baker from land a short distance upriver from our highest site
Crowe & Clauznitzer are records of species found in lowland riparian cottonwood stands of the Umatilla/Wallowa National Forests

Species	Form	This Study	CTUIR Minthorn	Alpert & Kagan	Bar M Ranch	Crowe & Clauznitzer	Taxomonmic Family
Abies grandis	T				X	X	Pinaceae
Abies lasiocarpa	T				X		Pinaceae
Acer glabrum	S	X	X	X	X	X	Aceraceae
Acer negundo	T	X					Aceraceae
Achillea millefolium	F	X	X		X	X	Asteraceae
Aconitum columbianum	F				X	X	Ranunculaceae
Actaea rubra	F					X	Ranunculaceae
Adenocaulon bicolor	F		X		X	X	Asteraceae
Agastache urticifolia	F				X		Lamiaceae
Agropyron caninum	G	X					Poaceae
Agropyron repens	G	X					Poaceae
Agrostis exarata	G			X			Poaceae
Agrostis stolonifera	G	X				X	Poaceae
Alisma plantago-aquatica	F	X					Alismataceae
Allium douglasii	F		X		X		Liliaceae
Allium fibrillum	F				X		Liliaceae
Allium macrum	F		X				Liliaceae
Allium tolmiei	F				X		Liliaceae
Alnus incana	S			X		X	Betulaceae
Alnus rhombifolia	T	X	X		X		Betulaceae
Alnus rubra	T		X				Betulaceae
Alopecurus aequalis	G	X					Poaceae
Amaranthus retroflexus	F	X					Amaranthaceae
Ambrosia artemisifolia	G	X					Asteraceae
Amelanchier alnifolia	S	X	X	X	X	X	Rosaceae
Amorpha fruticosa	T	X					Legumaceae
Amsinckia retrorsa	F				X		Boraginaceae
Anaphalis margaritacea	F				X		Asteraceae
Anemone piperi	F				X	X	Ranunculaceae
Angelica arguta	F					X	Apiaceae
Anthemis cotula	F	X		X			Asteraceae
Anthriscus caucilis	F	X					Apiaceae
Apocynum androsaemifolium	F		X		X		Apocynaceae
Apocynum cannabinum	F	X					Apocynaceae
Aquilegia formosa	F				X		Ranunculaceae
Arabis glabra	F				X		Brassicaceae
Arctium minus	F	X					Asteraceae
Arnica cordifolia	F		X				Asteraceae
Arnica discoidea	F				X		Asteraceae
Arrhenatherum elatius	G	X	X				Poaceae
Artemisia absinthium	F	X					Asteraceae
Artemisia dracunculus	F	X	X				Asteraceae
Artemisia ludoviciana	F	X				X	Asteraceae
Artemisia tridentata	S	X					Asteraceae
Asarum caudatum	F				X		Aristolochiaceae
Asclepias fascicularis	F		X		X		Asclepiadaceae
Asclepias speciosa	F	X			X		Asclepiadaceae
Asperugo procumbens	F				X		Boraginaceae
Aster chilensis	F				X		Asteraceae
Aster conspicuous	F				X		Asteraceae
Aster eatonii	F	X					Asteraceae
Aster foliaceus	F			X			Asteraceae

Species	Form	This Study	CTUIR Minthorn	Alpert & Kagan	Bar M Ranch	Crowe & Clauznitzer	Taxomonmic Family
Astragalus reventus	F				X		Fabaceae
Astragalus whitneyi	F				X		Fabaceae
Avena fatua	G		X	X			Poaceae
Azolla mexicana	F	X					Salviniaceae
Balsamorhiza incana	F				X		Asteraceae
Balsamorhiza sagittata	F				X		Asteraceae
Beckmannia syzigachne	G	X					Poaceae
Bellis perennis	F				X		Asteraceae
Berberis aquifolium	S				X		Berberidaceae
Berberis nervosa	S				X		Berberidaceae
Berberis repens	S				X	X	Berberidaceae
Besseya rubra	F		X		X		Scrophulariaceae
Betula occidentalis	S	X	X		X		Betulaceae
Bidens cernua	F	X					Asteraceae
Bidens frondosa	F	X					Asteraceae
Blepharipappus scaber	F				X		Asteraceae
Boisduvalia densiflora	F				X		Onagraceae
Brassica hirta	F	X					Brassicaceae
Brassica kaber	F	X					Brassicaceae
Brassica nigra	F	X					Brassicaceae
Bromus briziformis	G	X	X				Poaceae
Bromus commutatus	G	X					Poaceae
Bromus diandrus	G	X					Poaceae
Bromus hordeaceus	G	X					Poaceae
Bromus japonicus	G	X					Poaceae
Bromus mollis	G		X				Poaceae
Bromus rigidus	G		X				Poaceae
Bromus tectorum	G	X	X	X	X		Poaceae
Bromus vulgaris	G					X	Poaceae
Buglossoides arvensis	F	X					Boraginaceae
Calamagrostis canadensis	G	X					Poaceae
Callitriche heterophylla	F	X					Callitrichaceae
Callitriche palustris	F	X					Callitrichaceae
Calochortus elegans	F				X		Liliaceae
Calypso bulbosa	F				X		Orchidaceae
Camassia quamash	F		X		X		Liliaceae
Capsella bursa-pastoris	F		X		X		Brassicaceae
Cardamine lyallii	F				X		Brassicaceae
Cardaria draba	F	X	X				Brassicaceae
Carex athrostachya	G	X					Cyperaceae
Carex deweyana	G			X		X	Cyperaceae
Carex geyeri	G					X	Cyperaceae
Carex hystericina	G	X					Cyperaceae
Carex lenticularis	G	X					Cyperaceae
Carex microptera	G					X	Cyperaceae
Carex stipata	G	X					Cyperaceae
Carex vesicaria	G	X					Cyperaceae
Castilleja hispida	F				X		Scrophulariaceae
Ceanothus sanguineus	S				X		Rhamnaceae
Ceanothus velutinus	S				X		Rhamnaceae
Centaurea biebersteinii	F	X					Asteraceae
Centaurea cyanus	F	X					Asteraceae
Centaurea diffusa	F	X			X		Asteraceae
Centaurea maculosa	F	X	X				Asteraceae
Centaurea solstitialis	F	X					Asteraceae
Cephalanthera austiniae	F				X		Orchidaceae
Cerastium arvense	F			X			Caryophyllaceae
Chamaesyce glyptosperma	F	X					Euphorbiaceae
Chamaesyce maculata	F	X					Euphorbiaceae
Chamaesyce serpyllifolia	F	X					Euphorbiaceae
Chenopodium album	F	X	X				Chenopodiaceae
Chenopodium botrys	F	X					Chenopodiaceae
Chenopodium rubrum	F	X					Chenopodiaceae
Chorispora tenella	F				X		Brassicaceae
Chrysothamnus viscidiflorus	S				X		
Cichorium intybus	F	X					Asteraceae
Cicuta douglasii	F		X				Apiaceae

Species	Form	This Study	CTUIR Minthorn	Alpert & Kagan	Bar M Ranch	Crowe & Clauznitzer	Taxomonmic Family
Cinna latifolia	G					X	Poaceae
Circaea alpina	F			X		X	Onagraceae
Cirsium arvense	F	X	X		X		Asteraceae
Cirsium vulgare	F	X	X		X		Asteraceae
Clarkia pulchella	F		X		X		Onagraceae
Clarkia rhomboidea	F				X		Onagraceae
Claytonia cordifolia	F				X		Portulacaceae
Claytonia lanceolata	F		X				Portulacaceae
Claytonia perfoliata	F				X		Portulacaceae
Claytonia sibirica	F	X			X		Portulacaceae
Clematis columbiana	S				X		Ranunculaceae
Clematis ligusticifolia	S	X	X		X		Ranunculaceae
Clintonia uniflora	F				X		Liliaceae
Collinsia parviflora	F				X		Scrophulariaceae
Collomia grandiflora	F				X		Polemoniaceae
Comandra umbellata	F				X		Santalaceae
Conium maculatum	F	X					Apiaceae
Convolvulus arvensis	F	X	X				Convolvulaceae
Conyza canadensis	F		X				Asteraceae
Corallorhiza maculata	F				X		Orchidaceae
Corallorhiza mertensiana	F				X		Orchidaceae
Corallorhiza striata	F				X		Orchidaceae
Corallorhiza trifida	F				X		Orchidaceae
Cornus sericea	S	X	X		X	X	Cornaceae
Cornus stolonifera	S		X		X	X	Cornaceae
Crataegus douglasii	S	X	X		X	X	Rosaceae
Crocidium multicaule	F				X		Asteraceae
Croton setigerus	F	X					Euphorbiaceae
Cynoglossum officinale	F	X	X		X		Boraginaceae
Cyperus aristatus	G	X					Cyperaceae
Cyperus esculentus	G	X					Cyperaceae
Cypripedium fasciculatum	F				X		Orchidaceae
Cypripedium montanum	F				X		Orchidaceae
Dactylis glomerata	G	X	X	X	X	X	Poaceae
Daucus carota	F	X	X	X	X		Apiaceae
Delphinium nuttallianum	F				X		Ranunculaceae
Deschampsia cespitosa	G	X	X				Poaceae
Deschampsia elongata	G	X					Poaceae
Dianthus armeria	F	X			X		Caryophyllaceae
Dicentra cucullaria	F				X		Fumariaceae
Digitaria sanguinalis	G	X					Poaceae
Dipsacus fullonum	F	X					Dipsacaceae
Disporum hookeri	F					X	Liliaceae
Disporum trachycarpum	F				X		Liliaceae
Dodecatheon conjugens	F				X		Primulaceae
Draba verna	F		X		X		Brassicaceae
Echinochloa crus-galli	G	X	X				Poaceae
Echium vulgare	F	X	X		X		Boraginaceae
Elaeagnus angustifolia	T	X					Elaeagnaceae
Eleocharis acicularis	G	X					Cyperaceae
Eleocharis ovata	F	X					Cyperaceae
Eleocharis palustris	G	X					Cyperaceae
Elodea canadensis	F	X					Hydrocharitaceae
Elodea sp.	F	X					Hydrocharitaceae
Elymus caput-medusae	G		X				Poaceae
Elymus elymoides	G	X					Poaceae
Elymus glaucus	G	X	X	X		X	Poaceae
Elytrigia intermedia	G	X					Poaceae
Elytrigia repens	G	X					Poaceae
Epilobium angustifolium	F				X		Onagraceae
Epilobium ciliatum	F	X		X			Onagraceae
Epilobium densiflorum	F	X					Onagraceae
Epilobium glaberrimum	F	X					Onagraceae
Epilobium luteum	F	X					Onagraceae
Epilobium palustre	F	X					Onagraceae
Epilobium pygmaeum	F	X					Onagraceae
Equisetum arvense	F	X					Equisetaceae

Species	Form	This Study	CTUIR Minthorn	Alpert & Kagan	Bar M Ranch	Crowe & Clauznitzer	Taxomonmic Family
Equisetum hyemale	F	X					Equisetaceae
Equisetum pratense	F	X					Equisetaceae
Equisetum sylvaticum	F	X					Equisetaceae
Eremocarpus setigerus	F	X					Euphorbiaceae
Eriogonum baileyi	S	X					Polygonaceae
Eriogonum compositum	F				X		Polygonaceae
Eriogonum heracleoides	F				X		Polygonaceae
Eriogonum sp.	F	X					Polygonaceae
Eriogonum strictum	F				X		Polygonaceae
Eriogonum umbellatum	F				X		Polygonaceae
Eriogonum vimineum	F	X					Polygonaceae
Eriophyllum lanatum	F				X		Asteraceae
Erodium cicutarium	F	X	X		X		Geraniaceae
Erysimum asperum	F				X		Brassicaceae
Eschscholzia californica	F	X					Papaveraceae
Euthamia occidentalis	F	X					Asteraceae
Festuca arundinacea	G	X					Poaceae
Festuca idahoensis	G				X		Poaceae
Festuca megalura	G		X				Poaceae
Festuca occidentalis	G					X	Poaceae
Festuca rubra	G					X	Poaceae
Festuca subulata	G					X	Poaceae
Fragaria vesca	F			X	X	X	Rosaceae
Fragaria virginiana	F					X	Rosaceae
Frangula purshiana	T		X		X		Rhamnaceae
Frasera speciosa	F				X		Gentianaceae
Fritillaria pudica	F				X		Liliaceae
Gaillardia aristata	F		X		X		Asteraceae
Galium aparine	F			X	X		Rubiaceae
Galium triflorum	F	X				X	Rubiaceae
Gaultheria shallon	S				X		Ericaceae
Geranium molle	F	X	X				Geraniaceae
Geranium viscosissimum	F				X		Geraniaceae
Geum macrophyllum	F			X	X	X	Rosaceae
Geum triflorum	F				X		Rosaceae
Gilia aggregata	F		X		X		Polemoniaceae
Gilia capitata	F	X		X			Polemoniaceae
Glyceria borealis	G	X					Poaceae
Glyceria elata	G			X		X	Poaceae
Gnaphalium palustre	F	X					Asteraceae
Goodyera oblongifolia	F		X		X		Orchidaceae
Grindelia nana	F	X			X		Asteraceae
Grindelia squarrosa	F	X					Asteraceae
Habenaria saccata	F		X				Orchidaceae
Hackelia micrantha	F				X		Boraginaceae
Helianthella uniflora	F				X		Asteraceae
Helianthus annuus	F				X		Asteraceae
Heracleum lanatum	F		X			X	Apiaceae
Heracleum maximum	F				X		Apiaceae
Hesperochiron pumilus	F				X		Hydrophyllaceae
Heuchera micrantha	F		X		X		Saxifragaceae
Hieracium albiflorum	F				X		Asteraceae
Hieracium cynoglossoides	F				X		Asteraceae
Holcus lanatus	G	X	X				Poaceae
Holodiscus discolor	S	X	X	X	X		Rosaceae
Hordeum jubatum	G	X			X		Poaceae
Hydrophyllum capitatum	F		X		X		Hydrophyllaceae
Hydrophyllum fendleri	F				X		Hydrophyllaceae
Hypericum perforatum	F	X	X	X	X		Clusiaceae
Hypochaeris radicata	F		X				Asteraceae
Ipomopsis aggregata	F		X		X		Polemoniaceae
Iris missouriensis	F		X				Iridaceae
Juncus acuminatus	G	X					Juncaceae
Juncus alpinoarticulatus	G	X					Juncaceae
Juncus arcticus	G		X		X		Juncaceae
Juncus articulatus	G	X					Juncaceae
Juncus balticus	G		X		X		Juncaceae

Species	Form	This Study	CTUIR Minthorn	Alpert & Kagan	Bar M Ranch	Crowe & Clauznitzer	Taxomonmic Family
Juncus bolanderi	G	X					Juncaceae
Juncus brevicaudatus	G	X					Juncaceae
Juncus effusus	G	X					Juncaceae
Juncus ensifolius	G	X	X				Juncaceae
Juncus howellii	G	X					Juncaceae
Lactuca serriola	F	X	X		X		Asteraceae
Lagophylla ramosissima	F				X		Asteraceae
Lamium amplexicaule	F	X					Lamiaceae
Lamium maculatum	F	X					Lamiaceae
Lamium purpureum	F	X					Lamiaceae
Lapsana communis	F	X			X		Asteraceae
Larix occidentalis	T				X		Pinaceae
Lathyrus latifolius	F				X		Fabaceae
Lathyrus nevadensis	F				X		Fabaceae
Leersia oryzoides	G	X					Poaceae
Lemna minor	F	X	X				Lemnaceae
Lepidium campestre	F	X	X		X		Brassicaceae
Lepidium latifolium	F	X					Brassicaceae
Leucanthemum vulgare	F	X			X		Asteraceae
Lewisia rediviva	F				X		Portulacaceae
Leymus triticoides	G	X					Poaceae
Linaria dalmatica	F	X	X				Scrophulariaceae
Linaria vulgaris	F				X		Scrophulariaceae
Linnaea borealis	S				X		Caprifoliaceae
Linum perenne	F		X				Linaceae
Listera convallarioides	F				X		Orchidaceae
Lithophragma glabrum	F				X		Saxifragaceae
Lithophragma parviflorum	F		X		X		Saxifragaceae
Lithospermum ruderale	F				X		Boraginaceae
Lolium perenne	G	X	X				Poaceae
Lomatium bicolor	F	X					Apiaceae
Lomatium cous	F				X		Apiaceae
Lomatium dissectum	F				X		Apiaceae
Lomatium grayi	F				X		Apiaceae
Lomatium macrocarpum	F				X		Apiaceae
Lomatium sp.	F	X					Apiaceae
Lomatium triternatum	F				X		Apiaceae
Lonicera ciliosa	S				X		Caprifoliaceae
Lonicera utahensis	S				X		Caprifoliaceae
Lotus corniculatus	F	X	X				Fabaceae
Lotus unifoliolatus	F	X			X		Fabaceae
Ludwigia palustris	F	X					Onagraceae
Lupinus lepidus	F				X		Fabaceae
Lupinus leucophyllus	F				X		Fabaceae
Lupinus sabinianus	F				X		Fabaceae
Lupinus sulphureus	F		X		X		Fabaceae
Lycopus americanus	F	X					Lamiaceae
Lycopus asper	F	X					Lamiaceae
Machaeranthera canescens	F		X				Asteraceae
Madia gracilis	F	X					Asteraceae
Mahonia nervosa	S				X		Berberidaceae
Mahonia repens	S				X	X	Berberidaceae
Malus sylvestris	T	X					Rosaceae
Malva neglecta	F		X				Malvaceae
Marah oreganus	F	X					Cucurbitaceae
Marrubium vulgare	F		X				Lamiaceae
Matricaria discoidea	F		X		X		Asteraceae
Matricaria matricarioides	F		X				Asteraceae
Medicago falcata	F		X				Fabaceae
Medicago lupulina	F	X					Fabaceae
Medicago sativa	F	X					Fabaceae
Melilotus alba	F	X					Fabaceae
Melilotus officinalis	F				X		Fabaceae
Mentha arvensis	F	X	X	X	X		Lamiaceae
Mentha canadensis	F		X				Lamiaceae
Mentha rotundifolia	F	X					Lamiaceae
Mentha spicata	F	X					Lamiaceae

Species	Form	This Study	CTUIR Minthorn	Alpert & Kagan	Bar M Ranch	Crowe & Clauznitzer	Taxomonmic Family
Mertensia longiflora	F				X		Boraginaceae
Mimulus alsinoides	F			X			Scrophulariaceae
Mimulus guttatus	F	X	X	X	X		Scrophulariaceae
Mimulus lewisii	F				X		Scrophulariaceae
Mimulus moschatus	F	X		X	X		Scrophulariaceae
Mitella pentandra	F					X	Saxifragaceae
Mitella stauropetala	F				X	X	Saxifragaceae
Monardella odoratissima	F				X		Lamiaceae
Monotropa uniflora	F				X		Monotropaceae
Montia cordifolia	F				X		Portulacaceae
Montia parvifolia	F		X				Portulacaceae
Montia perfoliata	F	X	X				Portulacaceae
Myosotis laxa	F	X					Boraginaceae
Myosotis micrantha	F		X				Boraginaceae
Myosotis stricta	F		X		X		Boraginaceae
Navarretia intertexta	F		X				Polemoniaceae
Nepeta cataria	F	X			X		Lamiaceae
Oenothera elata	F				X		Onagraceae
Onopordum acanthium	F	X					Asteraceae
Orobanche pinorum	F				X		Orobanchaceae
Orobanche uniflora	F				X		Orobanchaceae
Osmorhiza occidentalis	F				X		Apiaceae
Pachysandra terminalis	F	X					Buxaceae
Paeonia brownii	F				X		Paeoniaceae
Panicum capillare	G	X					Poaceae
Paspalum distichum	G	X					Poaceae
Paxistima myrsinites	S				X		Celastraceae
Penstemon davidsonii	S				X		Scrophulariaceae
Penstemon deustus	F				X		Scrophulariaceae
Penstemon venustus	F				X		Scrophulariaceae
Perideridia gairdneri	F				X		Apiaceae
Petasites frigidus	F			X	X		Asteraceae
Phacelia hastata	F	X	X		X		Hydrophyllaceae
Phacelia linearis	F		X		X		Hydrophyllaceae
Phacelia sp.	F	X					Hydrophyllaceae
Phalaris arundinacea	G	X	X	X			Poaceae
Philadelphus lewisii	S	X	X	X	X	X	Hydrangeaceae
Phleum pratense	G	X		X		X	Poaceae
Phlox caespitosa	F			X			Polemoniaceae
Phlox diffusa	F				X		Polemoniaceae
Phlox gracilis	F				X		Polemoniaceae
Physocarpus capitatus	S	X	X		X		Rosaceae
Physocarpus malvaceus	S				X		Rosaceae
Picea engelmannii	T				X	X	Pinaceae
Pinus contorta	T				X		Pinaceae
Pinus monticola	T				X		Pinaceae
Pinus ponderosa	T		X		X	X	Pinaceae
Piperia elegans	F				X		Orchidaceae
Plantago lanceolata	F	X	X	X			Plantaginaceae
Plantago major	F	X	X	X			Plantaginaceae
Platanthera dilatata	F					X	Orchidaceae
Platanthera saccata	F		X				Orchidaceae
Poa annua	G	X					Poaceae
Poa bulbosa	G	X	X		X		Poaceae
Poa nervosa	G	X					Poaceae
Poa palustris	G	X	X				Poaceae
Poa pratensis	G	X	X	X		X	Poaceae
Poa sandbergii	G		X				Poaceae
Poa secunda	G		X				Poaceae
Polygonum amphibium	F	X	X				Polygonaceae
Polygonum aviculare	F	X	X				Polygonaceae
Polygonum douglasii	F				X		Polygonaceae
Polygonum hydropiperoides	F	X		X			Polygonaceae
Polygonum lapathifolium	F	X					Polygonaceae
Polygonum persicaria	F	X			X		Polygonaceae
Polypogon monspeliensis	G	X	X	X			Poaceae
Populus balsamifera	T	X			X	X	Salicaceae

Species	Form	This Study	CTUIR Minthorn	Alpert & Kagan	Bar M Ranch	Crowe & Clauznitzer	Taxomonmic Family
Potentilla glandulosa	F				X		Rosaceae
Potentilla gracilis	F				X		Rosaceae
Prunella vulgaris	F	X			X		Lamiaceae
Prunus emarginata	S	X	X		X		Rosaceae
Prunus virginiana	S	X	X		X		Rosaceae
Pseudoroegneria spicata	G	X			X		Poaceae
Pseudotsuga menziesii	T			X		X	Pinaceae
Pterospora andromedea	F				X		Monotropaceae
Purshia tridentata	S				X		Rosaceae
Pyrola asarifolia	F					X	Ericaceae
Pyrola secunda	F					X	Ericaceae
Pyrus malus	T		X				
Ranunculus aquatilis	F		X				Ranunculaceae
Ranunculus glaberrimus	F				X		Ranunculaceae
Ranunculus occidentalis	F				X		Ranunculaceae
Ranunculus orthorhynchus	F					X	Ranunculaceae
Ranunculus sp.	F	X					Ranunculaceae
Ranunculus uncinatus	F				X		Ranunculaceae
Raphanus sativa	F	X					Brassicaceae
Rhamnus purshiana	T		X		X		Rhamnaceae
Rhus glabra	S	X					Anacardiaceae
Ribes aureum	S	X	X		X		Grossulariaceae
Ribes hudsonianum	S					X	Grossulariaceae
Ribes irriguum	S					X	Grossulariaceae
Ribes lacustre	S	X	X			X	Grossulariaceae
Ribes oxyacanthoides	S	X					Grossulariaceae
Ribes viscosissimum	S				X		Grossulariaceae
Robinia pseudoacacia	T	X	X		X		Fabaceae
Rorippa curvisiliqua	F	X					Brassicaceae
Rorippa nasturtium-aquaticum	F		X		X		Brassicaceae
Rosa eglanteria	S	X					Rosaceae
Rosa gymnocarpa	S		X	X	X		Rosaceae
Rosa nutkana	S	X					Rosaceae
Rosa woodsii	S	X	X	X		X	Rosaceae
Rubus armeniacus	S		X		X		Rosaceae
Rubus discolor	S	X	X		X		Rosaceae
Rubus laciniatus	S	X			X		Rosaceae
Rubus leucodermis	S		X		X		Rosaceae
Rubus parviflorus	S		X		X	X	Rosaceae
Rubus ursinus	S			X	X		Rosaceae
Rudbeckia occidentalis	F					X	Asteraceae
Rumex acetosella	F	X	X		X		Polygonaceae
Rumex aquaticus	F	X					Polygonaceae
Rumex conglomeratus	F	X					Polygonaceae
Rumex crispus	F	X	X	X	X		Polygonaceae
Rumex obtusifolius	F	X		X			Polygonaceae
Rumex paucifolius	F			X			Polygonaceae
Rumex salicifolius	F	X		X	X		Polygonaceae
Rumex sp.	F	X					Polygonaceae
Salix exigua	S	X	X		X		Salicaceae
Salix fragilis	S	X					Salicaceae
Salix lasiolepis	T	X	X				Salicaceae
Salix lucida	S	X	X		X	X	Salicaceae
Salix prolixa	T	X					Salicaceae
Salix rigida	S	X	X			X	Salicaceae
Salix scouleriana	S	X	X				Salicaceae
Salsola kali	F	X	X				Chenopodiaceae
Salsola tragus	F		X				Chenopodiaceae
Sambucus racemosa	S	X	X		X		Caprifoliaceae
Sanguisorba occidentalis	F				X		Rosaceae
Saponaria officinalis	F	X					Caryophyllaceae
Satureja douglasii	F		X				Lamiaceae
Saussurea americana	F		X			X	Asteraceae
Saxifraga integrifolia	F				X		Saxifragaceae
Schoenoplectus tabernaemontani	G	X					Cyperaceae

Species	Form	This Study	CTUIR Minthorn	Alpert & Kagan	Bar M Ranch	Crowe & Clauznitzer	Taxomonmic Family
Scirpus americanus	G	X					Cyperaceae
Scirpus microcarpus	G	X			X	X	Cyperaceae
Secale cereale	G	X					Poaceae
Sedum lanceolatum	F				X		Crassulaceae
Sedum stenopetalum	F		X		X		Crassulaceae
Senecio integerrimus	F		X		X		Asteraceae
Senecio pseudaureus	F	X					Asteraceae
Senecio serra	F					X	Asteraceae
Senecio triangularis	F				X		Asteraceae
Setaria viridis	G	X					Poaceae
Sidalcea oregana	F				X		Malvaceae
Silene douglasii	F				X		Caryophyllaceae
Sisymbrium altissimum	F	X	X		X		Brassicaceae
Sisyrinchium angustifolium	F				X		Iridaceae
Sisyrinchium inflatus	F		X				Iridaceae
Sitanion hystrix	G		X				
Smilacina racemosa	F	X					Liliaceae
Smilacina stellata	F					X	Smilacaceae
Solanum dulcamara	S	X		X	X		Solanaceae
Solanum nigrum	F	X					Solanaceae
Solanum physalifolium	S	X					Solanaceae
Solidago canadensis	F	X		X	X	X	Asteraceae
Sonchus arvensis	F	X					Asteraceae
Sonchus asper	F	X	X				Asteraceae
Sparganium angustifolium	F	X					Sparganiaceae
Spiraea betulifolia	S				X		Rosaceae
Stellaria calycantha	F	X					Caryophyllaceae
Stellaria media	F			X			Caryophyllaceae
Stipa comata	G				X		
Streptopus amplexifolius	F	X			X	X	Liliaceae
Symphoricarpos albus	S	X	X	X	X	X	Caprifoliaceae
Synthyris missurica	F				X		Scrophulariaceae
Taeniatherum caput-medusae	G	X					Poaceae
Tanacetum parthenium	F	X			X		Asteraceae
Taraxacum officinale	F	X	X	X	X	X	Asteraceae
Taxus brevifolia	S				X		Taxaceae
Thalictrum fendleri	F				X		Ranunculaceae
Thalictrum occidentale	F					X	Ranunculaceae
Thermopsis macrophylla	F	X					Fabaceae
Thermopsis montana	F		X				Fabaceae
Thermopsis rhombifolia	F	X	X		X		Fabaceae
Thlaspi montanum	F	X			X		Brassicaceae
Tiarella trifoliata	F				X		Saxifragaceae
Toxicodendron rydbergii	S	X					Anacardiaceae
Tragopogon dubius	F	X			X		Asteraceae
Tragopogon pratensis	F		X				Asteraceae
Trautvetteria caroliniensis	F				X	X	Ranunculaceae
Tribulus terrestris	F		X				Zygophyllaceae
Trifolium arvense	F	X					Fabaceae
Trifolium douglasii	F				X		Fabaceae
Trifolium dubium	F	X		X			Fabaceae
Trifolium macrocephalum	F				X		Fabaceae
Trifolium pratense	F	X					Fabaceae
Trifolium repens	F	X	X		X	X	Fabaceae
Trifolium sp.	F	X					Fabaceae
Trillium ovatum	F		X				Liliaceae
Trillium petiolatum	F				X		Liliaceae
Triticum aestivum	G	X					Poaceae
Typha latifolia	F	X	X				Typhaceae
Ulmus americanus	T				X		Ulmaceae
Urtica dioica	F	X	X	X	X	X	Urticaceae
Vaccinium scoparium	S				X		Ericaceae
Valerianella locusta	F				X		Valerianaceae
Ventenata dubia	G		X				Poaceae
Veratrum californicum	F				X		Liliaceae
Veratrum viride	F		X		X		Liliaceae

Species	Form	This Study	CTUIR Minthorn	Alpert & Kagan	Bar M Ranch	Crowe & Clauznitzer	Taxomonmic Family
Verbascum blattaria	F	X	X		X		Scrophulariaceae
Verbascum thapsus	F	X	X		X		Scrophulariaceae
Verbena bracteata	F	X					Verbenaceae
Verbena hastata	F	X		X			Verbenaceae
Veronica americana	F	X			X		Scrophulariaceae
Veronica anagallis-aquatica	F	X					Scrophulariaceae
Vicia americana	F				X		Fabaceae
Vicia sativa	F	X					Fabaceae
Viola adunca	F				X		Violaceae
Viola glabella	F	X			X	X	Violaceae
Viola palustris	F		X				Violaceae
Viola vallicola	F				X		Violaceae
Vulpia myuros	G	X					Poaceae
Wyethia amplexicaulis	F				X		Asteraceae
Xanthium strumarium	F	X	X	X			Asteraceae
Zigadenus venenosus	F				X		Liliaceae

Appendix E. Comparison of *greenline* plots classified as wetlands vs. as non-wetlands: results of Mann-Whitney U-test for difference in means

See Appendix J for definitions of variables. "Yes" in column 4 indicates the variable was significantly greater among wetlands. "Yes" in column 5 indicates the variable was significantly greater among non-wetlands. "No" or blank in both columns indicates wetlands and non-wetlands did not differ significantly.

Variable	Non-wetland Mean	Wetland Mean	Wetland Greater?	Non-wetland Greater?
CovAvgNtvSp	0.8023	0.9186	Yes	No
CovAvgSp	0.8490	1.1280	Yes	No
CovAvgWetSp	0.8080	1.1704	Yes	No
CovAvNtvWt	0.7598	0.9212	Yes	No
CovForbMx	0.7941	0.9094	Yes	No
CovGrassAv	0.6072	1.1467	Yes	No
CovGrassMx	0.6778	1.3260	Yes	No
CovGrasSum	0.7430	1.4413	Yes	No
CovMaxNtvSp	1.0575	1.2831	Yes	No
CovMaxSp	1.2156	1.5820	Yes	No
CovMxNtvWt	0.9627	1.2726	Yes	No
CovSumFair	0.1823	0.3123	Yes	No
CovSumNtvSp	1.2709	1.5252	Yes	No
CovSumNtvWt	1.1544	1.5036	Yes	No
Dev2kAc	0.6651	1.8770	Yes	No
Dssin12	0.3353	0.3487	Yes	No
ForbNpctF	0.1751	0.2036	Yes	No
ForbNtvSp	0.4843	0.5733	Yes	No
ForbNtvWtSp	0.4511	0.5721	Yes	No
ForbNWpctF	0.1580	0.1896	Yes	No
ForbScorMn	0.4257	0.5311	Yes	No
ForbScorMx	0.8364	0.8240	Yes	No
ForbWetSp	0.4904	0.5416	Yes	No
ForbWpctF	0.1811	0.2156	Yes	No
FPwidth_1k	2.6049	2.7578	Yes	No
FPwidth05	2.6267	2.7572	Yes	No
GammWetMax	0.2425	0.2543	Yes	No
GammWetSum	0.4797	0.6078	Yes	No
GamWtNtSum	0.4134	0.5491	Yes	No
GamWtNtvAv	0.1760	0.1838	Yes	No
GamWtNtvMx	0.2270	0.2373	Yes	No
GrasNWpctG	0.0803	0.1704	Yes	No
GrasPctAll	0.0799	0.1328	Yes	No
GrasScorMn	0.7347	0.9056	Yes	No
GrasScorMx	0.8366	1.0086	Yes	No
GrassNpctG	0.1203	0.1794	Yes	No

Variable	Non-wetland Mean	Wetland Mean	Wetland Greater?	Non-wetland Greater?
GrassNtvSp	0.2483	0.4254	Yes	No
GrassNtvWtSp	0.1936	0.4286	Yes	No
GrassWetSp	0.3133	0.4914	Yes	No
GrasWpctG	0.1570	0.2684	Yes	No
Herb15	1.2212	1.4794	Yes	No
Jaccard	0.0336	0.0413	Yes	No
Morisita	0.0386	0.0580	Yes	No
NDom10PctN	0.1127	0.1316	Yes	No
NDom20PctN	0.0516	0.0707	Yes	No
NDom50PctN	0.0012	0.0203	Yes	No
NtvPctAll	0.2014	0.2186	Yes	No
Shift_	0.0268	0.0547	Yes	No
Shiftd1	0.0713	0.1218	Yes	No
Sp10PctAll	0.1122	0.1605	Yes	No
Sp20PctAll	0.0597	0.1009	Yes	No
Sp50PctAll	0.0048	0.0443	Yes	No
SpDom10	0.3800	0.5431	Yes	No
SpDom20	0.1724	0.3422	Yes	No
SpDom50	0.0090	0.0973	Yes	No
SpGrass	0.3367	0.4860	Yes	No
SpNtv	0.6492	0.7230	Yes	No
SpNtvDom10	0.3314	0.4767	Yes	No
SpNtvDom20	0.2345	0.2941	Yes	No
SpWet	0.6640	0.8090	Yes	No
SpWetDom10	0.3431	0.5220	Yes	No
SpWetDom20	0.2263	0.3656	Yes	No
SpWetDom50	0.0000	0.3010	Yes	No
SpWetNtv	0.2934	0.4767	Yes	No
SpWetNtv10	0.3279	0.4950	Yes	No
SpWetNtv20	0.2150	0.3109	Yes	No
SpWetNtv50	0.0000	0.2377	Yes	No
TexNum1	0.7148	0.7370	Yes	No
TexNum2	0.3800	0.4754	Yes	No
TexTypes	0.3857	0.4098	Yes	No
TreeScorMx	0.8365	0.8837	Yes	No
WDom10PctW	0.1167	0.1714	Yes	No
WDom20PctW	0.0546	0.1133	Yes	No
WDom50PctW	0.0000	0.0492	Yes	No
WetScorAvg	0.8159	0.9200	Yes	No
WetScorMax	0.9710	1.0181	Yes	No
WetScorMin	0.4482	0.6561	Yes	No
WN10PctWN	0.1902	0.2487	Yes	No
WN20PctWN	0.0783	0.1444	Yes	No
WN50PctWN	0.0000	0.0337	Yes	No

Variable	Non-wetland Mean	Wetland Mean	Wetland Greater?	Non-wetland Greater?
WNpctN	0.1127	0.1316	Yes	No
WtdWetScor	2.2178	2.7542	Yes	No
WtNPctAll	0.0782	0.1051	Yes	No
WtSpPctAll	0.2108	0.2712	Yes	No
Artific3	0.0060	0.0000	No	No
BankNoData	0.7382	0.7762	No	No
Bedrock1	0.0089	0.0152	No	No
Boulder2	0.0030	0.0091	No	No
CanMax	0.5495	0.4994	No	No
CanMin	0.2633	0.1869	No	No
Canopyb	0.4094	0.2990	No	No
Canopyf	0.3720	0.3625	No	No
Canopyl	0.3381	0.2922	No	No
Canopyr	0.4632	0.3692	No	No
CanSum	0.6971	0.6234	No	No
CBchg	0.2178	0.1130	No	No
Clay10	0.0030	0.0030	No	No
CobbGrv4	0.2504	0.2372	No	No
CovForbAv	0.5987	0.6521	No	No
CovForbSum	1.0573	1.1034	No	No
CovShrAv	0.2441	0.2119	No	No
CovShrMx	0.2530	0.2170	No	No
CovShrSum	0.2635	0.2255	No	No
CovSumExc	0.2444	0.3543	No	No
CovSumPoor	0.0821	0.0546	No	No
CovTreeAv	0.4949	0.4170	No	No
CovTreeMx	0.5017	0.4301	No	No
CovTreeSum	0.5082	0.4456	No	No
Dead4	0.0030	0.0000	No	No
DeadTot	0.0030	0.0000	No	No
Debris5	0.0089	0.0091	No	No
Dike_05k	3.0904	3.0139	No	No
Dike_1k	3.0789	3.0026	No	No
Dn_levee	0.0517	0.0893	No	No
Dn_trib	0.4622	0.4464	No	No
Downlb	0.0060	0.0000	No	No
Downlm	0.0166	0.0109	No	No
Downlr	0.0060	0.0030	No	No
Downmb	0.0060	0.0000	No	No
DownMedSum	0.0539	0.0352	No	No
Downmm	0.0479	0.0352	No	No
Downsb	0.0119	0.0048	No	No
Downsm	0.0479	0.0563	No	No
DownSmSum	0.0586	0.0593	No	No

Variable	Non-wetland Mean	Wetland Mean	Wetland Greater?	Non-wetland Greater?
DownTot	0.1275	0.0988	No	No
DownYr1Sum	0.1042	0.0940	No	No
DownYr2Sum	0.0060	0.0030	No	No
Dssin01	0.3319	0.3396	No	No
El2Drop1k	0.9609	0.9229	No	No
ElAbovCB	0.5158	0.4634	No	No
FLIR_05k	1.3851	1.3748	No	No
FLIR_1k	1.3812	1.3728	No	No
GammaAv	0.2040	0.1919	No	No
GammaMax	0.2637	0.2621	No	No
GammaSum	0.6261	0.6594	No	No
GammNtvAvg	0.1899	0.1879	No	No
GammNtvMax	0.2441	0.2407	No	No
GammWetAvg	0.1814	0.1845	No	No
GamWtNtvMn	0.0909	0.0913	No	No
GLchg	0.1228	0.1029	No	No
NumDownTypes	0.0969	0.0727	No	No
NumLiveCl	0.3136	0.3597	No	No
Rail1kL	3.1933	2.9557	No	No
Rail2k	3.7172	3.4161	No	No
Redox_	0.0119	0.0152	No	No
RedoxD	0.0119	0.0152	No	No
Road1kAll	3.3521	3.4528	No	No
Road2kAll	4.1136	4.1338	No	No
Shiftd2	0.0118	0.0225	No	No
ShrNpctS	0.0916	0.0861	No	No
ShrNtvSp	0.3230	0.3186	No	No
ShrNtvWtSp	0.2152	0.2806	No	No
ShrNWpctS	0.0659	0.0760	No	No
ShrPctAll	0.0303	0.0255	No	No
ShrScorMn	0.7871	0.9027	No	No
ShrScorMx	0.8608	0.9395	No	No
Shrub15	0.7678	0.8419	No	No
ShrWetSp	0.2387	0.2885	No	No
ShrWpctS	0.0672	0.0770	No	No
SpForb	0.6447	0.6021	No	No
SpNtvDom50	0.1003	0.1881	No	No
SppAll	0.8315	0.8652	No	No
SpShrub	0.1094	0.1026	No	No
SpTree	0.1972	0.1625	No	No
TexNum3	0.0242	0.0212	No	No
Tree12	0.0154	0.0030	No	No
Tree20	0.0000	0.0109	No	No
TreeDmax	0.9027	0.7379	No	No

Variable	Non-wetland Mean	Wetland Mean	Wetland Greater?	Non-wetland Greater?
TreeNtvSp	0.2780	0.2906	No	No
TreeNtvWtSp	0.2970	0.2931	No	No
TreeScorMn	0.8176	0.8306	No	No
TreeWetSp	0.2881	0.3171	No	No
Up_levee	0.0398	0.0506	No	No
Up_trib	0.4324	0.4877	No	No
UpSin01	0.3327	0.3296	No	No
UpSin12	0.3220	0.3273	No	No
VMC	1.5738	1.5454	No	No
WatDepth	0.3781	0.3533	No	No
Water2kAc	4.8848	5.1604	No	No
WEchg	0.1477	0.1114	No	No
Wet1kPalOW	3.1537	3.4157	No	No
Wet1kRiv	4.9460	4.9406	No	No
Wet2kPalOW	4.3307	4.5734	No	No
WetAcGL	2.0831	1.8131	No	No
WNpctW	0.1194	0.1198	No	No
Bare15	1.8083	1.6549	No	Yes
Bare3	0.2027	0.0091	No	Yes
CovSumGood	0.4544	0.3474	No	Yes
El2Drop05	0.6760	0.6038	No	Yes
El4Drop05	0.7031	0.6369	No	Yes
El4Drop15	1.1087	1.0318	No	Yes
El4Drop1k	0.9776	0.9442	No	Yes
El4Drop2k	1.2603	1.1870	No	Yes
ElAbovWE	0.2748	0.1870	No	Yes
ElDrop05_0	0.4905	0.4299	No	Yes
ELdrop15_0	0.8677	0.7930	No	Yes
ELdrop1k_0	0.7185	0.6499	No	Yes
ForbPctAll	0.1911	0.1580	No	Yes
Levee1kCu	3.5889	3.4639	No	Yes
Levee2kCu	3.7954	3.7153	No	Yes
Litter3	0.0089	0.0000	No	Yes
Riverkm	1.9089	1.7084	No	Yes
Tree4	0.0489	0.0101	No	Yes
TreeNpctT	0.1601	0.1092	No	Yes
TreeNWpctT	0.1601	0.1092	No	Yes
TreePctAll	0.0477	0.0356	No	Yes
TreeTot	0.0610	0.0214	No	Yes
TreeWpctT	0.1691	0.1336	No	Yes
Wet1kPalFo	4.2430	3.8548	No	Yes
Wet2kPalFo	4.9389	4.7901	No	Yes
Wet2kRiv	5.4955	5.2841	No	Yes
WetNoData	0.1893	0.0636	No	Yes

Appendix F. Comparison of *lateral transect* plots classified as wetlands vs. as non-wetlands: results of Mann-Whitney U-test for difference in means

See Appendix J for definitions of variables. "Yes" in column 4 indicates the variable was significantly greater among wetlands. "Yes" in column 5 indicates the variable was significantly greater among non-wetlands. "No" in both columns indicates wetlands and non-wetlands did not differ significantly.

Variable	Non-wetland Mean	Wetland Mean	Wetland Greater?	Non-wetland Greater?
Canopyf	0.4733	0.5934	Yes	No
Canopyl	0.4367	0.5583	Yes	No
CanSum	0.7272	0.8789	Yes	No
CovAvgNtvSp	0.5655	1.1021	Yes	No
CovAvgWetSp	0.4407	1.3932	Yes	No
CovAvNtvWt	0.3604	1.0873	Yes	No
CovGrassAv	0.5931	1.2314	Yes	No
CovGrassMx	0.6336	1.3452	Yes	No
CovGrasSum	0.6721	1.4022	Yes	No
CovMaxNtvSp	0.6332	1.3503	Yes	No
CovMaxWetSp	0.5038	1.7075	Yes	No
CovMxNtvWt	0.4013	1.3076	Yes	No
CovSumExc	0.1005	0.3771	Yes	No
CovSumFair	0.1713	0.4644	Yes	No
CovSumGood	0.2540	0.5589	Yes	No
CovSumNtvSp	0.6933	1.5240	Yes	No
CovSumNtvWt	0.4366	1.4640	Yes	No
CovSumPoor	0.0773	0.0991	Yes	No
CovSumWetSp	0.5547	1.9017	Yes	No
CovTreeAv	0.1446	0.5906	Yes	No
CovTreeMx	0.1473	0.6075	Yes	No
CovTreeSum	0.1495	0.6155	Yes	No
Debris5	0.0053	0.0137	Yes	No
Dev1kAc	0.7041	1.0803	Yes	No
Dev2kAc	1.1566	1.7255	Yes	No
DistToWater	1.3052	1.6744	Yes	No
Dssin01	0.3339	0.3448	Yes	No
Dssin12	0.3408	0.3485	Yes	No
ForbNpctF	0.0714	0.1836	Yes	No
ForbNtvSp	0.2239	0.3911	Yes	No
ForbNtvWtSp	0.2343	0.3596	Yes	No
ForbScorMn	0.2167	0.5538	Yes	No
ForbScorMx	0.3840	0.7243	Yes	No
ForbWetSp	0.2378	0.3652	Yes	No
ForbWpctF	0.0632	0.1851	Yes	No
FPwidth_1k	2.6492	2.8413	Yes	No
FPwidth05	2.6635	2.8230	Yes	No
GammaSum	0.4459	0.5343	Yes	No

Variable	Non-wetland Mean	Wetland Mean	Wetland Greater?	Non-wetland Greater?
GammNtvMax	0.1794	0.2325	Yes	No
GammNtvSum	0.2512	0.4316	Yes	No
GammWetAvg	0.1272	0.1740	Yes	No
GammWetMax	0.1496	0.2380	Yes	No
GammWetSum	0.2077	0.4585	Yes	No
GamWtNtSum	0.1625	0.3939	Yes	No
GamWtNtvAv	0.1082	0.1764	Yes	No
GamWtNtvMn	0.0861	0.1032	Yes	No
GamWtNtvMx	0.1231	0.2187	Yes	No
GrasPctAll	0.0916	0.1220	Yes	No
GrasScorMn	0.4478	0.8797	Yes	No
GrasScorMx	0.5237	0.9767	Yes	No
GrassNpctG	0.0386	0.0964	Yes	No
GrassNtvSp	0.1524	0.2306	Yes	No
GrassNtvWtSp	0.1617	0.2339	Yes	No
GrassWetSp	0.2879	0.4058	Yes	No
GrasWpctG	0.0750	0.2448	Yes	No
Herb15	0.9301	1.6524	Yes	No
NDom10PctN	0.0936	0.1786	Yes	No
NDom20PctN	0.0446	0.1176	Yes	No
NDom50PctN	0.0036	0.0514	Yes	No
NtvPctAll	0.1201	0.2073	Yes	No
PctDis	0.6743	0.9008	Yes	No
Redox_	0.0022	0.0684	Yes	No
RedoxD	0.0029	0.0821	Yes	No
Shift_	0.0435	0.1209	Yes	No
Shiftd1	0.0963	0.2794	Yes	No
Shiftd2	0.0025	0.0401	Yes	No
ShrNpctS	0.0719	0.1001	Yes	No
ShrNtvWtSp	0.1300	0.2603	Yes	No
ShrScorMn	0.5449	0.7834	Yes	No
ShrScorMx	0.6008	0.8640	Yes	No
Shrub15	0.4624	0.9352	Yes	No
ShrWetSp	0.1370	0.2637	Yes	No
ShrWpctS	0.0222	0.0846	Yes	No
Sp10PctAll	0.1638	0.1992	Yes	No
Sp20PctAll	0.0848	0.1454	Yes	No
Sp50PctAll	0.0186	0.0761	Yes	No
SpDom10	0.3797	0.5323	Yes	No
SpDom20	0.1973	0.3998	Yes	No
SpDom50	0.0402	0.1688	Yes	No
SpGrass	0.2409	0.3739	Yes	No
SpNtv	0.2965	0.5752	Yes	No
SpNtvDom10	0.2603	0.4316	Yes	No
SpNtvDom20	0.1806	0.2882	Yes	No
SpNtvDom50	0.0860	0.1621	Yes	No

Variable	Non-wetland Mean	Wetland Mean	Wetland Greater?	Non-wetland Greater?
SppAll	0.4296	0.7442	Yes	No
SpShrub	0.1094	0.1395	Yes	No
SpTree	0.0611	0.1798	Yes	No
SpWet	0.2497	0.6606	Yes	No
SpWetDom10	0.2590	0.4958	Yes	No
SpWetDom20	0.1589	0.3833	Yes	No
SpWetDom50	0.0000	0.3010	Yes	No
SpWetNtv	0.2320	0.4316	Yes	No
SpWetNtv10	0.2685	0.4300	Yes	No
SpWetNtv20	0.1695	0.2964	Yes	No
SpWetNtv50	0.0000	0.1817	Yes	No
TexNum1	0.7495	0.8296	Yes	No
TexNum2	0.2636	0.4093	Yes	No
TexNum3	0.0034	0.0212	Yes	No
TexTypes	0.3598	0.3995	Yes	No
TreeNpctT	0.0493	0.1444	Yes	No
TreePctAll	0.0247	0.0497	Yes	No
TreeScorMn	0.8158	0.8489	Yes	No
TreeScorMx	0.8350	0.8677	Yes	No
TreeWetSp	0.2986	0.3189	Yes	No
TreeWpctT	0.0515	0.1587	Yes	No
Up_levee	0.0403	0.0816	Yes	No
Up_trib	0.4432	0.5568	Yes	No
UpSin01	0.3300	0.3404	Yes	No
VMC	0.9355	1.2850	Yes	No
WDom10PctW	0.0703	0.2178	Yes	No
WDom20PctW	0.0284	0.1677	Yes	No
WDom50PctW	0.0000	0.0983	Yes	No
Wet1kPalOW	3.1695	3.8508	Yes	No
Wet2kPalOW	4.4143	4.6413	Yes	No
WetScorAvg	0.5250	0.8885	Yes	No
WetScorMax	0.6204	0.9912	Yes	No
WetScorMin	0.3248	0.6635	Yes	No
WN10PctWN	0.0707	0.2374	Yes	No
WN20PctWN	0.0269	0.1610	Yes	No
WN50PctWN	0.0000	0.0661	Yes	No
WNpctW	0.0749	0.1619	Yes	No
WtdWetScor	1.6519	2.7948	Yes	No
WtNPctAll	0.0583	0.1338	Yes	No
WtSpPctAll	0.1014	0.2556	Yes	No
Artific3	0.0040	0.0091	No	No
BdgLL	0.1574	0.1512	No	No
BdgLR	0.1930	0.1851	No	No
Bedrock1	0.0018	0.0046	No	No
CanMax	0.5526	0.6646	No	No
CanMin	0.3474	0.4066	No	No

Variable	Non-wetland Mean	Wetland Mean	Wetland Greater?	Non-wetland Greater?
Canopyb	0.4291	0.4627	No	No
Canopyr	0.4501	0.5107	No	No
CovForbAv	0.6632	0.6603	No	No
CovForbMx	0.8029	0.8161	No	No
CovForbSum	0.9241	0.9395	No	No
CovShrAv	0.3364	0.3919	No	No
CovShrMx	0.3493	0.4084	No	No
CovShrSum	0.3633	0.4272	No	No
Dead12	0.0019	0.0023	No	No
Dead20	0.0013	0.0000	No	No
Dead4	0.0055	0.0121	No	No
DeadTot	0.0084	0.0144	No	No
Dike_05k	3.0523	2.9817	No	No
Dike_1k	3.0457	2.9633	No	No
Dn_levee	0.0632	0.1196	No	No
Dn_trib	0.4464	0.4853	No	No
Downlb	0.0039	0.0079	No	No
Downlm	0.0069	0.0115	No	No
Downlr	0.0048	0.0147	No	No
Downmb	0.0034	0.0079	No	No
Downmm	0.0242	0.0161	No	No
Downmr	0.0044	0.0079	No	No
Downsb	0.0254	0.0147	No	No
Downsm	0.0425	0.0413	No	No
DownSmSum	0.0671	0.0515	No	No
Downsr	0.0015	0.0079	No	No
DownTot	0.1004	0.0717	No	No
DownYr1Sum	0.0658	0.0545	No	No
DownYr2Sum	0.0108	0.0181	No	No
El2Drop05	0.6434	0.6072	No	No
ElAbovMin	0.7284	0.7674	No	No
FLIR_1k	1.3778	1.3689	No	No
FPslopeAv	0.5628	0.5131	No	No
FPslopeLL	0.3449	0.3611	No	No
FPslopeLR	0.5865	0.5299	No	No
GammNtvAvg	0.1609	0.1878	No	No
GammNtvMin	0.1314	0.1098	No	No
Hard1kAc	4.2504	4.3441	No	No
Hard2kAc	5.2479	5.2388	No	No
NumDownTypes	0.0662	0.0477	No	No
NumLiveCl	0.3386	0.3136	No	No
Paved1kL	3.3092	3.1645	No	No
Paved2k	4.0051	4.0253	No	No
Road1kAll	3.4194	3.2385	No	No
Road2kAll	4.1225	4.1022	No	No
RR_LL	0.0810	0.0764	No	No

Variable	Non-wetland Mean	Wetland Mean	Wetland Greater?	Non-wetland Greater?
RR_LR	0.0961	0.0714	No	No
ShrNtvSp	0.3024	0.3192	No	No
ShrPctAll	0.0444	0.0400	No	No
SpForb	0.4281	0.4587	No	No
Tree20	0.0102	0.0046	No	No
Tree4	0.0617	0.0386	No	No
TreeNtvSp	0.2896	0.3077	No	No
TreeNtvWtSp	0.2971	0.3079	No	No
TreeTot	0.0854	0.0454	No	No
Water1kAc	4.5453	4.6656	No	No
Water2kAc	5.0081	5.1245	No	No
Wet2kRiv	5.3960	5.3546	No	No
WetAreaLL	0.8778	0.9080	No	No
WetAreaLR	1.6236	1.7797	No	No
WetPalAcLR	0.6713	0.5345	No	No
WetRivAcLL	0.6476	0.8758	No	No
WetRivAcLR	0.9523	1.2451	No	No
Bare15	1.7245	0.9712	No	Yes
Bare3	0.0830	0.0000	No	Yes
CobbGrv4	0.2184	0.1847	No	Yes
CropUrb_LL	0.1126	0.0908	No	Yes
CropUrb_LR	0.1263	0.1004	No	Yes
DownMedSum	0.0304	0.0195	No	Yes
El2Drop1k	0.9522	0.8796	No	Yes
El4Drop15	1.0829	0.9879	No	Yes
El4Drop2k	1.2385	1.1290	No	Yes
FLIR_05k	1.3809	1.3713	No	Yes
ForbPctAll	0.1706	0.1407	No	Yes
GammaAv	0.2316	0.1880	No	Yes
GammWetMin	0.0918	0.0650	No	Yes
Levee1kCu	3.5346	3.4774	No	Yes
Levee2kCu	3.7604	3.7215	No	Yes
Litter3	0.0462	0.0000	No	Yes
PtIntervl	1.2935	1.2532	No	Yes
Riverkm	1.8249	1.7210	No	Yes
TransLength	2.2926	2.2149	No	Yes
Tree12	0.0232	0.0036	No	Yes
TreeDmax	1.0523	0.8611	No	Yes
UpSin12	0.3247	0.3233	No	Yes
Water3	0.1008	0.0114	No	Yes
Wet2kPalFo	4.8711	4.7930	No	Yes
WetPalAcLL	0.2302	0.0321	No	Yes

Appendix G. Variation of botanical variables within subclasses: standard errors of the subclass means

See Appendix J for definitions of the variables, and Table 4 for descriptions of the numbered subclasses.

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CovAvNtvWt	1.01	1.33	1.77	1.78	1.25	3.75	.82	0	6.81	1.58	8.21	1.21	1.68	3.57	0	10.79	.48	1.69	2.82	7.07
CovAvgNtvSp	.95	.95	1.78	1.68	.83	3.73	.82	0	6.83	1.63	8.21	.9	1.37	2.84	0	9.84	.36	1.71	2.81	6.49
CovAvgSp	4.2	2.03	1.51	5.48	6.92	2.77	9.63	0	5.2	4.87	6.17	1.57	1.07	3.42	0	10.21	.33	1.38	3.32	3.33
CovAvgWetSp	6.52	1.86	1.49	6.82	5.83	2.79	9.54	0	5.35	6.41	8.21	1.66	1.67	9.07	0	10.8	.55	1.7	8.41	6.15
CovForbAv	.66	3.36	2.03	1.47	12.17	1.63	1.18	0	1.96	1.81	12.8	2.64	.71	3.11	0	2.9	.68	1.58	1.86	.79
CovForbMx	2.32	10	4.22	2.92	7.5	5.12	2.3	0	5.33	2.52	12.76	5.36	3.71	4.99	0	4.55	2.39	3.21	3.88	1.41
CovForbSum	3.69	11.5	5.98	4.5	6.5	7	2.37	0	6.53	2.76	13.15	6.14	5.01	6.81	0	7.35	6.96	4.52	7.7	3.01
CovGrasSum	7.32	4	5.26	5.87	15	6.97	9.48	0	9.79	5.83	21.08	5.69	6.45	4.13	0	5.58	5.77	4.21	10.88	8.9
CovGrassAv	9.11	1	2.16	7.08	15	2.44	10.17	0	4.99	5.84	10.54	3.81	1.68	3.7	0	4.49	1.4	1.81	9.35	3.94
CovGrassMx	7.98	0	4.27	6.13	15	4.77	9.63	0	7.21	5.37	16.87	3.89	4.34	7	0	5.52	3	2.37	10.46	8.42
CovMaxNtvSp	2.5	7.5	3.16	2.64	0	5.21	2.47	0	5.32	2.96	8.82	4.22	4.38	5.57	0	8.43	2.11	3.48	4.01	6.51
CovMaxSp	7.16	7.5	3.16	5.47	5	5.21	7.19	0	5.32	5.02	8.82	3.13	4.38	7	0	8.18	1.67	3.48	7.92	6.22
CovMaxWetSp	7.16	7.5	3.16	5.47	5	5.34	7.19	0	5.32	5.02	8.82	3.13	4.38	7	0	8.18	1.67	3.48	7.92	6.22
CovMxNtvWt	2.66	7.5	3.16	2.69	5	5.34	2.47	0	5.32	2.62	8.82	4.22	4.38	6.78	0	8.43	2.11	3.48	4.17	6.51
CovShrAv	1.09	5	.08	1.62	0	5.4	.12	0	6.38	1.86	2.71	1.17	.09	4.83	0	5.14	1.61	2.23	5.73	2.62
CovShrMx	1.09	5	.08	1.65	0	6.17	.12	0	8.21	1.86	2.71	1.17	.09	4.83	0	8.34	1.61	2.23	5.73	4.29
CovShrSum	1.09	5	.08	1.73	0	7.41	.12	0	8.47	1.86	2.71	1.16	.27	4.83	0	9.76	1.61	2.23	5.73	5.75
CovSumExc	1.93	10	3.45	2.04	15	3.53	.08	0	5.99	.8	4.17	5.87	.37	1.96	0	3.02	1.61	3.38	2.47	3.61
CovSumFair	.36	1	2.8	2.68	0	5.35	0	0	3.05	3.18	8.33	.18	4.51	7.78	0	4.47	2.17	1.95	3.42	6.66
CovSumGood	1.45	0	1.05	2.4	5	6.32	0	0	1.42	2.71	4.08	2.55	6.51	3.95	0	13.47	2.39	4.24	.82	6.9
CovSumNtvSp	4.37	.5	2.39	3.86	2.5	3.5	2.75	0	3.97	3.86	7.01	3.99	2.38	7.99	0	5.25	1.5	2.85	7.42	2.87
CovSumNtvWt	4.46	3	2.38	3.89	12.5	3.27	2.75	0	3.97	3.51	7.01	3.86	2.27	9.46	0	4.64	1.38	2.93	7.92	3.39
CovSumPoor	.36	15	.12	3.85	0	.62	0	0	0	0	0	0	1.35	7.6	0	.1	.21	.07	0	.29
CovSumWetSp	5.18	4.5	4.03	4.08	2.5	2.98	4.9	0	3.55	4.49	7.01	3.01	2.14	2.75	0	5.22	2.51	2.91	4.23	3.36
CovTreeAv	1.42	0	1.01	2.61	5	5.75	5.49	0	1.43	2.88	6.14	1.59	6.4	3.81	0	11.97	2.08	3.22	.82	6.95
CovTreeMx	1.44	0	1.04	2.69	5	5.86	5.49	0	1.43	3.12	8.21	1.59	6.51	3.81	0	12.09	2.47	4.22	.82	6.92
CovTreeSum	1.45	0	1.05	2.79	5	5.92	5.49	0	1.43	3.42	12.36	2.55	7.2	3.81	0	12.27	4.08	4.26	.82	6.91
ForbNWpctF	.09	.15	.09	.1	.17	.07	.11	0	.11	.1	.22	.13	.05	.1	0	.15	.04	.05	.14	.1
ForbNpctF	.08	.11	.1	.09	.33	.08	.11	0	.11	.11	.22	.13	.05	.09	0	.14	.03	.05	.15	.1
ForbNtvSp	.37	.5	.83	.34	0	.41	.6	0	.39	.24	.63	.42	.63	.2	0	.43	.33	.44	1	.58
ForbNtvWtSp	.45	0	.78	.3	.5	.39	.5	0	.39	.28	.63	.41	.65	.24	0	.45	.43	.45	1.07	.53
ForbPctAll	.05	.02	.06	.05	.13	.05	.06	0	.07	.06	.14	.06	.06	.08	0	.1	.03	.03	.09	.06
ForbScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ForbScorMn	.67	1	.57	.57	2	.66	.61	0	.76	.8	1.67	.82	.71	.92	0	.7	.67	.59	.81	.66
ForbScorMx	.77	0	.84	.68	2	.61	.97	0	1.12	.86	2.01	1.24	.39	1.79	0	1.45	.22	.28	1.88	.98
ForbWetSp	.59	1.5	.86	.34	.5	.53	.35	0	.47	.26	.63	.41	.79	.37	0	.6	.54	.55	1.24	.61
ForbWpctF	.1	.02	.08	.1	.17	.07	.12	0	.11	.12	.22	.13	.06	.13	0	.15	.07	.04	.18	.11
GamWtNtSum	.49	1.78	.63	.4	.54	.43	.34	0	.34	.2	.42	.47	.62	.73	0	.31	.6	.44	1.01	.5
GamWtNtvAv	.07	.09	.02	.07	.26	.05	.1	0	.04	.08	.07	.05	.03	.18	0	.08	.05	.03	.12	.06
GamWtNtvMn	.06	.22	.06	.07	.22	.08	.08	0	.07	.08	.12	.08	.06	.21	0	.1	.09	.05	.14	.09
GamWtNtvMx	.1	.08	.02	.09	.31	.04	.12	0	.03	.09	.08	.05	.02	.19	0	.08	.05	.02	.14	.06
GammNtvAvg	.06	.09	.02	.06	.11	.04	.1	0	.04	.08	.07	.04	.03	.1	0	.07	.05	.03	.12	.06
GammNtvMax	.09	.08	.03	.08	.09	.04	.12	0	.03	.09	.08	.05	.02	.06	0	.08	.05	.02	.14	.06
GammNtvMin	.07	.22	.06	.07	.22	.08	.08	0	.07	.08	.12	.08	.06	.16	0	.1	.09	.05	.14	.09
GammNtvSum	.47	2.1	.71	.41	.32	.45	.34	0	.36	.22	.42	.55	.61	.62	0	.31	.63	.48	1.14	.56
GammWetAvg	.05	.07	.02	.06	.18	.05	.07	0	.04	.05	.07	.05	.03	.19	0	.08	.04	.03	.13	.05
GammWetMax	.07	.08	.02	.09	.31	.04	.12	0	.03	.09	.08	.05	.03	.19	0	.08	.05	.02	.15	.04
GammWetMin	.06	.22	.06	.06	0	.09	0	0	.08	0	.12	0	.06	.22	0	.11	.08	.05	.14	.09
GammWetSum	.68	2.44	.7	.43	.54	.6	.47	0	.38	.21	.42	.53	.79	1.01	0	.4	.82	.56	1.2	.55
GammaAv	.03	.05	.02	.05	.08	.05	.07	0	.04	.03	.07	.04	.02	.11	0	.07	.02	.02	.06	.05
GammaMax	.03	0	.03	.06	.09	.04	.12	0	.03	.06	.04	.05	.02	.03	0	.09	.02	.02	.05	.03
GammaMin	.06	.22	.06	.05	0	.08	0	0	.08	0	.12	0	.06	.16	0	.1	.08	.05	.14	.09
GammaSum	.63	2.76	.77	.44	.32	.62	.47	0	.41	.22	.36	.62	.72	1.61	0	.58	.46	.73	1.35	.67
GrasNWpctG	.08	.17	.07	.05	0	.11	.06	0	.12	.04	.2	.11	.1	.13	0	.15	.09	.09	.16	.07
GrasPctAll	.06	.03	.06	.05	.04	.05	.08	0	.08	.04	.2	.06	.05	.04	0	.04	.04	.04	.06	.07
GrasScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GrasScorMn	0	0	.6	.24	0	.38	0	0	.22	.33	2.67	0	1.15	1.36	0	1.22	.83	.69	1.12	.85
GrasScorMx	.25	0	0	.31	0	.42	.21	0	.26	.13	0	.38	.31	.92	0	.4	.33	.21	.49	.34
GrasWpctG	.06	0	.03	.04	0	.1	.04	0	.1	.02	.2	0	.11	.12	0	.16	.04	.08	.16	.1
GrassNpctG	.08	.17	.07	.05	0	.11	.06	0	.12	.05	.2	.11	.09	.1	0	.15	.06	.09	.18	.08
GrassNtvSp	.3	1	.34	.18	0	.36	.58	0	.31	.2	.33	.33	.43	.51	0	.21	.42	.38	.96	.3
GrassNtvWtSp	.35	1	.28	.21	0	.36	1.5	0	.31	.15	.33	.33	.45	.58	0	.21	.43	.33	.71	.24
GrassWetSp	.3	.5	.39	.17	0	.42	.31	0	.31	.14	.33	.33	.64	.68	0	0	.45	.43	.75	.27
Jaccard	.01	.01	.01	0	.01	.01	0	0	.01	0	.01	.01	.01	.01	0	0	.01	.01	.01	0
Morisita	.02	.03	.01	.01	.03	.01	.01	0	.02	0	.01	.02	.02	.02	0	.01	.01	.01	.02	.01
NDomPctN	.08	.18	.13	.14	.17	.13	.03	0	.16	.13	.21	.09	.12	.33	0	.29	.08	.08	.31	.15
NtvPctAll	.07	.03	.03	.06	.13	.04	.08	0	.06	.08	.08	.02	.03	.07	0	.08	.03	.04	.13	.05
ShrNWpctS	.11	.5	.08	.12	0	.11	.12	0	.1	.1	.21	.18	.09	0	0	.15	.22	.1	.17	.09
ShrNpctS	.11	.5	.08	.12	0	.12	.12	0	.11	.11	.21	.16	.09	0	0	.16	.22	.1	.17	.11
ShrNtvSp	.25	0	0	.15	0	.24	0	0	.25	0	0	.21	0	0	0	.32	0	0	.5	.22

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ShrNtvWtSp	.33	0	0	.11	0	.2	0	0	.41	0	0	.31	0	0	0	.2	0	0	.5	.26
ShrPctAll	.03	.03	.01	.03	.04	.07	.04	0	.08	.04	.08	.04	.03	.03	0	.1	.02	.02	.05	.06
ShrScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ShrScorMn	1.91	0	0	.75	2	1.09	1.33	0	1.71	1.33	2	1.67	0	0	0	1.89	0	0	1	1.42
ShrScorMx	1.91	0	0	.62	2	.88	1.33	0	1.5	1.33	2	1.69	0	0	0	1.59	0	0	1	1.5
ShrWetSp	.25	0	0	.11	0	.22	0	0	.41	.24	0	.37	0	0	0	.2	0	0	0	.26
ShrWpctS	.11	.5	.08	.12	0	.12	.12	0	.1	.1	.21	.18	.09	0	0	.15	.22	.1	.21	.09
Sorenson	.02	.02	.02	.01	.02	.01	.01	0	.02	0	.01	.01	.02	.01	0	.01	.01	.01	.01	.01
SorensonAb	.01	.01	.01	.01	.02	.01	.01	0	.01	0	0	.01	.01	.01	0	.01	0	.01	.01	0
SpDom	.47	.5	.58	.59	1	.58	.46	0	.65	.41	.71	.49	.69	.44	0	.69	.78	.47	.91	.57
SpForb	.53	2.5	.93	.5	1	.6	.35	0	.49	.26	.63	.42	.77	.66	0	.83	.54	.7	1.09	.81
SpGrass	.34	.5	.46	.17	0	.4	.31	0	.35	.17	.45	.33	.63	.68	0	.21	.48	.47	.92	.4
SpNtv	.72	2	1.01	.57	0	.66	.5	0	.54	.4	.56	.67	.8	.6	0	.51	.4	.71	1.94	.85
SpNtvDom	.41	1.5	.36	.37	.5	.4	.44	0	.43	.36	.65	.48	.41	.61	0	.41	.64	.37	.45	.36
SpPctAll	.13	.05	.09	.13	.46	.14	.3	0	.14	.13	.21	.08	.1	.32	0	.32	.07	.11	.27	.16
SpShrub	.13	.5	.08	.17	0	.24	.12	0	.2	.11	.21	.35	.27	.24	0	.26	.22	.1	.21	.22
SpTree	.17	0	.24	.15	0	.16	.14	0	.13	.19	.34	.26	.25	.24	0	.21	.34	.15	.21	.17
SpWet	.95	2.5	1.04	.6	.5	.89	.67	0	.62	.42	.56	.6	1.12	1.08	0	.65	.77	.85	2.03	.92
SpWetDom	.3	1	.5	.41	.5	.42	.31	0	.51	.33	.65	.49	.41	.37	0	.56	.43	.37	.66	.43
SpWetNtv	.72	2.5	.36	.58	.5	.6	.74	0	.43	.59	.65	.48	.41	.61	0	.7	.64	.61	.69	.36
SppAll	.88	3.5	1.15	.68	1	.93	.67	0	.67	.41	.48	.73	.99	1.59	0	.91	.37	1.06	2.14	1.08
TreeNWpctT	.13	0	.14	.12	0	.12	0	0	.11	.12	.21	.19	.13	.24	0	.16	.17	.11	.21	.12
TreeNpctT	.13	0	.14	.12	0	.12	0	0	.11	.12	.21	.19	.13	.24	0	.16	.17	.11	.21	.11
TreeNtvSp	.26	0	.22	.15	0	.09	0	0	.24	.33	.5	.25	0	.33	0	.17	0	.1	0	.11
TreeNtvWtSp	.2	0	.22	.15	0	.09	0	0	.24	.33	.5	.25	0	.33	0	.17	0	.1	0	.15
TreePctAll	.02	.02	.02	.03	.04	.03	.06	0	.03	.05	.11	.05	.03	.06	0	.12	.03	.02	.02	.04
TreeScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TreeScorMn	.42	1	.33	.31	1	.3	0	0	.98	.33	0	0	.81	1.76	0	.42	2	.55	0	.62
TreeScorMx	.45	1	.42	.33	1	.31	0	0	.98	.35	1	.5	0	1.76	0	.45	0	.33	0	.6
TreeWetSp	.17	0	.22	.1	0	.12	0	0	.2	.22	.5	.25	0	.33	0	.17	0	.1	0	.15
TreeWpctT	.14	0	.14	.12	0	.12	.14	0	.13	.12	.21	.19	.13	.24	0	.16	.17	.11	.21	.12
WDomPctW	.17	.09	.09	.24	.33	.14	.3	0	.14	.22	.21	.09	.14	.35	0	.32	.09	.08	.48	.15
WNPctWN	.23	.63	.1	.2	.17	.2	.18	0	.18	.21	.13	.15	.21	.42	0	.25	.11	.14	.17	.23
WNpctN	.05	.11	.08	.09	0	.06	.03	0	.07	.08	.08	.05	.05	.15	0	.07	.05	.05	.15	.08
WNpctW	.05	.09	.07	.06	.25	.05	.02	0	.06	.07	.08	.04	.07	.14	0	.14	.06	.05	.1	.12
WetScorAvg	.36	.11	.2	.27	.25	.27	.2	0	.34	.25	.61	.23	.45	.66	0	.52	.45	.24	.69	.29
WetScorMax	.28	0	0	.31	0	.35	.21	0	.14	.17	.33	0	.28	.49	0	.56	0	.18	.4	.4

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
WetScorMin	.56	1	.56	.36	2	.59	.37	0	.64	.55	1.05	.6	.58	.98	0	.63	.6	.57	.81	.51
WtNPctAll	.03	.07	.07	.06	.13	.05	.02	0	.06	.06	.09	.04	.03	.1	0	.09	.03	.05	.07	.07
WtSpPctAll	.06	.02	.02	.06	0	.04	.03	0	.03	.05	.08	.03	.06	.14	0	.08	.06	.03	.11	.06
WtdGamSum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WtdWetScor	47.24	1.5	32.33	40.59	80	30.41	43.18	0	34.24	34.79	81.94	31.95	29.24	46.74	0	49.71	28.84	30.84	28.72	28.59

Appendix H. Variation of botanical variables within subclasses: minimum values of the subclasses

See Appendix J for definitions of the variables, and Table 4 for descriptions of the numbered subclasses.

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CovAvNtvWt	0	4.2	4.3	0	20	6.5	0	45	9.7	0	11.4	5.5	5	0	20	12.2	4.4	5	0	6.1
CovAvgNtvSp	0	4.7	4.1	0	18.3	6.5	0	35	9.7	0	11.4	5.1	4.7	5.5	20	12.2	4.4	4.9	0	5.2
CovAvgSp	3.8	3.9	3.7	6.9	11.2	6.7	9.6	33.3	9	14.1	11.4	6.8	3.9	7.7	25	7.8	4.1	3.9	3.4	3.9
CovAvgWetSp	3.8	4.2	3.9	8.8	18.3	6.7	9.6	37.5	9.7	16.2	11.4	8.4	4.1	9.3	26.7	10.1	4.3	4.6	3.8	4.8
CovForbAv	0	3.5	0	0	5.7	0	0	25	0	0	0	0	1	0	15	0	1.6	1	1	0
CovForbMx	0	10	0	0	15	0	0	25	0	0	0	0	1	0	20	0	5	1	1	0
CovForbSum	0	38	0	0	17	0	0	25	0	0	0	0	1	0	30	0	11	2	1	0
CovGrasSum	7	18	11	20	10	0	1	30	0	20	0	11	0	45	40	0	8	0	0	0
CovGrassAv	2.3	4.5	3.7	12.5	10	0	1	30	0	20	0	5.5	0	12.6	40	0	2	0	0	0
CovGrassMx	5	15	5	15	10	0	1	30	0	20	0	10	0	20	40	0	5	0	0	0
CovMaxNtvSp	0	15	20	0	30	25	0	45	30	0	30	10	15	10	30	25	10	15	0	20
CovMaxSp	20	15	20	30	30	25	30	45	30	25	30	20	15	20	40	25	15	15	15	20
CovMaxWetSp	20	15	20	30	30	25	30	45	30	25	30	20	15	20	40	25	15	15	15	20
CovMxNtvWt	0	15	20	0	20	25	0	45	30	0	30	10	15	0	30	25	10	15	0	20
CovShrAv	0	0	0	0	10	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0
CovShrMx	0	0	0	0	10	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0
CovShrSum	0	0	0	0	10	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0
CovSumExc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
CovSumFair	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CovSumGood	0	1	0	0	20	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0
CovSumNtvSp	0	52	57	0	55	52	0	70	52	0	57	15	50	10	60	55	40	50	0	57
CovSumNtvWt	0	42	56	0	20	52	0	45	52	0	57	15	50	0	40	55	40	50	0	51
CovSumPoor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CovSumWetSp	50	54	57	53	55	62	55	75	58	50	57	52	51	50	80	55	50	50	52	51
CovTreeAv	0	1	0	0	20	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0
CovTreeMx	0	1	0	0	20	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0
CovTreeSum	0	1	0	0	20	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0
ForbNWpctF	0	.4	0	0	0	0	0	0	0	0	0	0	.3	0	.5	0	.4	.3	0	0
ForbNpctF	0	.5	0	0	.3	0	0	1	0	0	0	0	.3	0	1	0	.5	.3	0	0
ForbNtvSp	1	4	0	0	1	0	0	1	0	0	0	0	1	0	2	0	4	1	0	0
ForbNtvWtSp	1	4	0	0	0	0	2	0	0	0	0	0	1	0	1	0	3	1	0	0
ForbPctAll	0	.6	0	0	.3	0	0	.3	0	0	0	0	.1	0	.5	0	.6	.4	.3	0

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ForbScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ForbScorMn	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	0	2	0	0	0
ForbScorMx	0	10	0	0	4	0	0	0	0	0	0	0	6	0	5	0	9	5	0	0
ForbWetSp	0	4	0	0	0	0	0	0	0	0	0	0	1	0	1	0	4	1	0	0
ForbWpctF	0	.6	0	0	0	0	0	0	0	0	0	0	.3	0	.5	0	.6	.3	0	0
GamWtNtSum	0	4	1.9	0	0	.5	0	.8	.6	0	.5	1	1.4	0	.6	0	2.7	.9	0	0
GamWtNtvAv	0	.6	.5	0	0	.3	0	.8	.5	0	.4	.4	.5	0	.3	0	.5	.4	0	0
GamWtNtvMn	0	0	0	0	0	0	0	.8	0	0	0	0	0	0	0	0	0	0	0	0
GamWtNtvMx	0	.8	.7	0	0	.5	0	.8	.6	0	.5	.6	.7	0	.6	0	.7	.6	0	0
GammNtvAvg	0	.6	.5	0	.5	.3	0	.8	.5	0	.4	.4	.5	.4	.4	0	.5	.4	0	0
GammNtvMax	0	.8	.7	0	.8	.5	0	.8	.6	0	.5	.6	.7	.6	.6	0	.7	.6	0	0
GammNtvMin	0	0	0	0	0	0	0	.8	0	0	0	0	0	0	0	0	0	0	0	0
GammNtvSum	0	4	1.9	0	1.4	.5	0	.8	.6	0	.5	1	2.1	.6	1.3	0	2.7	.9	0	0
GammWetAvg	0	.6	.4	0	0	.2	0	.4	.4	0	.4	.3	.5	0	.2	0	.5	.4	0	.3
GammWetMax	0	.8	.7	0	0	.5	0	.8	.6	0	.5	.6	.7	0	.6	0	.7	.6	0	.5
GammWetMin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GammWetSum	0	4.8	2	0	0	.5	0	.8	.6	0	.5	1	1.4	0	.6	0	3.3	.9	0	.6
GammaAv	.3	.6	.4	0	.4	.2	0	.4	.4	0	.4	.3	.5	.3	.3	0	.6	.5	.5	.3
GammaMax	.6	1	.7	0	.8	.5	0	.8	.6	0	.8	.6	.7	.8	.6	0	.8	.7	.6	.5
GammaMin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GammaSum	.6	6.4	2	0	1.4	.5	0	.8	.6	0	1.2	1	2.8	.9	1.3	0	5.6	.9	1.5	.6
GrasNWpctG	0	.7	.2	0	0	0	0	0	0	0	0	0	0	0	0	0	.5	0	0	0
GrasPctAll	.1	.2	.1	.1	.2	0	.3	.3	0	.2	0	.1	0	.5	.3	0	.1	0	0	0
GrasScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GrasScorMn	8	8	3	5	8	5	8	8	8	3	2	8	0	0	8	2	3	3	3	0
GrasScorMx	8	10	10	5	8	5	8	8	8	8	10	8	8	5	8	8	8	8	8	7
GrasWpctG	.3	1	.6	.5	1	0	.5	1	0	.7	0	1	0	.3	1	0	.8	0	0	0
GrassNpctG	0	.7	.2	0	0	0	0	0	0	0	0	0	0	0	0	0	.7	0	0	0
GrassNtvSp	0	2	1	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	1	0
GrassNtvWtSp	0	2	1	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0
GrassWetSp	1	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Jaccard	0	.1	.1	0	0	0	.1	.1	0	0	0	.1	0	0	.1	0	.1	0	0	0
Morisita	0	.1	0	0	.1	0	0	.1	0	.1	0	.1	0	0	.1	0	.1	0	0	0
NDomPctN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NtvPctAll	0	.6	.5	0	.5	.4	0	.7	.3	0	.5	.7	.6	.3	.8	.5	.5	.5	0	.3
ShrNWpctS	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
ShrNpctS	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ShrNtvSp	0	1	1	1	1	1	1	1	1	1	1	1	3	0	0	0	1	1	0	1
ShrNtvWtSp	0	1	1	1	0	0	1	1	0	1	1	0	3	0	0	0	1	1	0	0
ShrPctAll	0	0	0	0	.2	0	0	.3	0	0	0	0	0	0	0	0	0	0	0	0
ShrScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ShrScorMn	2	10	9	4	0	0	6	6	2	2	6	2	6	2	0	2	10	10	8	1
ShrScorMx	2	10	9	6	0	2	6	6	4	2	6	2	10	2	0	2	10	10	8	1
ShrWetSp	0	1	1	1	0	0	1	1	0	0	1	0	3	0	0	0	1	1	1	0
ShrWpctS	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Sorenson	0	.1	.1	0	.1	0	.1	.1	0	.1	0	.1	.1	0	.1	0	.2	0	0	0
SorensonAb	0	.1	0	0	0	0	0	.1	0	.1	0	.1	0	0	.1	0	.1	0	0	0
SpDom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SpForb	0	6	0	0	1	0	0	1	0	0	0	0	1	0	2	0	7	2	1	0
SpGrass	1	3	2	1	1	0	1	1	0	1	0	1	0	2	1	0	1	0	0	0
SpNtv	0	7	3	0	3	1	0	2	1	0	1	2	4	1	3	1	7	2	0	1
SpNtvDom	0	0	1	0	0	1	0	0	1	0	1	0	1	0	0	1	0	1	0	1
SpPctAll	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SpShrub	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SpTree	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
SpWet	1	8	3	1	2	2	1	2	1	1	1	3	3	1	3	1	7	2	1	1
SpWetDom	1	0	1	1	0	1	1	0	1	1	1	0	1	1	0	1	0	1	1	1
SpWetNtv	0	0	1	0	0	1	0	0	1	0	1	0	1	0	0	1	0	1	0	1
SppAll	1	10	3	1	4	2	1	3	1	1	2	3	5	3	4	1	11	2	3	2
TreeNWpctT	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
TreeNpctT	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
TreeNtvSp	0	1	1	0	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1
TreeNtvWtSp	0	1	1	0	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	0
TreePctAll	0	.1	0	0	.2	0	0	0	0	0	0	0	0	0	.3	0	0	0	0	0
TreeScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TreeScorMn	6	6	6	6	6	6	8	0	2	6	6	6	2	2	6	6	2	2	6	0
TreeScorMx	6	6	6	6	6	6	8	0	2	6	6	6	6	2	6	6	6	6	6	0
TreeWetSp	1	1	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	0
TreeWpctT	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
WDomPctW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNPctWN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNpctN	0	.1	.1	0	1	.2	0	1	.2	0	.6	.1	.1	.3	1	.5	.3	.2	0	.2
WNpctW	0	.1	.1	0	1	.1	0	1	.1	0	.6	.1	.1	.1	1	.4	.2	.2	0	.1
WetScorAvg	5	7.1	7	4.3	5.5	5.2	6	7	5.3	5	6	6.7	3.7	4	5.8	3.5	5.6	5.3	2.7	4

Subclass #:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
WetScorMax	8	10	10	5	8	6	8	8	8	8	8	10	8	8	8	5	10	8	8	5
WetScorMin	0	0	2	2	0	0	5	6	2	0	2	2	0	0	4	2	2	0	0	0
WtNPctAll	0	.1	.1	0	.5	.1	0	.7	.1	0	.5	.1	.1	.1	.8	.3	.2	.1	0	.1
WtSpPctAll	.3	.8	.7	.2	.5	.6	.7	.7	.7	.3	.5	.8	.4	.3	.8	.3	.6	.5	.3	.3
WtdGamSum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WtdWetScor	305	536	532	292	440	410	401	510	524	370	411	436	285	335	630	355	330	359	365	340

Appendix I. Variation of botanical variables within subclasses: maximum values of the subclasses

See Appendix J for definitions of the variables, and Table 4 for descriptions of the numbered subclasses.

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CovAvNtvWt	12.5	6.9	21.7	20	22.5	55	10.7	45	90	20	70	15.7	23.7	22.5	20	100	7.8	30.5	20	90
CovAvgNtvSp	13.3	6.6	21.7	20	20	55	10.7	35	90	20	70	12	19	22.5	20	100	6.9	30.5	20	90
CovAvgSp	50	8	21.7	100	25	45	100	33.3	80	100	50	20	14.6	25	25	100	6.4	30	25	50
CovAvgWetSp	95	7.9	21.7	100	30	45	100	37.5	80	100	70	20	23.7	60	26.7	100	8.1	30.5	60	90
CovForbAv	8	10.2	27.5	17.5	30	23	15.5	25	25.3	25	80	23	9.8	17.5	15	25	5.1	30	13.3	10
CovForbMx	30	30	45	30	30	80	30	25	65	35	80	45	45	25	20	40	20	55	30	20
CovForbSum	48	61	63	65	30	92	31	25	76	40	80	46	55	35	30	53	51	71	52	42
CovGrasSum	95	26	80	100	40	81	100	30	100	100	100	56	66	65	40	46	41	55	70	95
CovGrassAv	95	6.5	27.5	100	40	30.5	100	30	50	100	50	35	16.5	32.5	40	40	10.3	35	60	45.5
CovGrassMx	95	15	60	100	40	60	100	30	80	100	90	45	45	60	40	45	25	35	60	90
CovMaxNtvSp	30	30	60	30	30	95	30	45	90	35	90	45	60	40	30	100	25	70	30	95
CovMaxSp	95	30	60	100	40	95	100	45	90	100	90	45	60	60	40	100	25	70	60	95
CovMaxWetSp	95	30	60	100	40	95	100	45	90	100	90	45	60	60	40	100	25	70	60	95
CovMxNtvWt	30	30	60	30	30	95	30	45	90	30	90	45	60	40	30	100	25	70	30	95
CovShrAv	15	10	1	25	10	75	1	45	80	30	15	10	1	25	0	50	10	45	35	35
CovShrMx	15	10	1	25	10	75	1	45	90	30	15	10	1	25	0	85	10	45	35	60
CovShrSum	15	10	1	25	10	75	1	45	95	30	15	10	3	25	0	100	10	45	35	80
CovSumExc	21	20	45	35	30	40	1	0	80	10	25	45	4	10	20	30	10	56	15	60
CovSumFair	5	2	30	30	0	80	0	0	40	50	50	1	45	41	0	45	10	30	20	85
CovSumGood	20	1	10	30	30	95	0	0	20	40	25	20	60	20	30	100	15	70	5	95
CovSumNtvSp	48	53	81	44	60	96	32	70	101	42	100	48	76	45	60	100	49	97	48	100
CovSumNtvWt	48	48	81	44	45	96	32	45	101	42	100	47	74	45	40	100	49	97	47	100
CovSumPoor	5	30	1	60	0	10	0	0	0	0	0	0	15	40	0	1	1	1	0	5
CovSumWetSp	100	63	94	101	60	97	100	75	101	101	100	77	74	65	80	100	64	97	77	100
CovTreeAv	20	1	10	35	30	95	60	0	20	40	37.5	10	60	20	30	100	12.5	60	5	95
CovTreeMx	20	1	10	35	30	95	60	0	20	40	50	10	60	20	30	100	15	70	5	95
CovTreeSum	20	1	10	35	30	95	60	0	20	41	75	20	60	20	30	100	25	71	5	95
ForbNWpctF	1	.7	1	1	.3	1	1	0	1	1	1	1	1	.5	.5	1	.7	1	.8	1
ForbNpctF	1	.7	1	1	1	1	1	1	1	1	1	1	1	.5	1	1	.7	1	.8	1
ForbNtvSp	5	5	10	5	1	6	3	1	5	3	4	4	9	1	2	4	6	7	6	8
ForbNtvWtSp	5	4	9	4	1	6	3	0	5	3	4	4	9	1	1	4	6	7	6	7
ForbPctAll	.8	.6	.8	.8	.5	.8	.5	.3	.8	.7	.8	.6	.8	.5	.5	.9	.8	1	1	.7

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ForbScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ForbScorMn	10	2	6	8	8	8	5	0	10	9	10	8	6	4	4	5	5	10	5	8
ForbScorMx	10	10	10	10	8	10	9	0	10	9	10	10	10	10	5	10	10	10	10	10
ForbWetSp	7	7	11	5	1	7	4	0	5	3	4	4	11	2	1	6	7	9	7	8
ForbWpctF	1	.7	1	1	.3	1	1	0	1	1	1	1	1	.7	.5	1	1	1	1	1
GamWtNtSum	6.7	7.6	9.3	6	1.1	6.6	3.9	.8	4.5	2.1	3.6	4.3	8	3.8	.6	3	6.7	8.9	7	7.7
GamWtNtvAv	.8	.8	.8	.9	.6	1	.8	.8	.8	1	.9	.8	.8	1	.3	1	.7	1	.8	1
GamWtNtvMn	.6	.5	.6	.8	.5	1	.8	.8	.8	1	.8	.5	.5	1	0	1	.5	1	.8	1
GamWtNtvMx	1	1	1	1	.6	1	1	.8	1	1	1	1	1	1	.6	1	1	1	.9	1
GammNtvAvg	.8	.7	.8	.8	.7	1	.8	.8	.8	.8	.9	.8	.8	1	.4	.9	.7	1	.8	.9
GammNtvMax	1	1	1	1	1	1	1	.8	1	1	1	1	1	1	.6	1	1	1	.9	1
GammNtvMin	.6	.5	.6	.8	.5	1	.8	.8	.8	.8	.8	.5	.5	.9	0	.9	.5	1	.8	.9
GammNtvSum	6.7	8.2	10.1	6	2.1	6.6	3.9	.8	4.6	2.4	3.6	5.3	8.8	3.8	1.3	3	6.7	9.7	7.8	8.4
GammWetAvg	.8	.7	.7	.9	.4	1	.6	.4	.9	.6	.9	.7	.8	.9	.2	1	.7	1	.9	1
GammWetMax	1	1	1	1	.6	1	1	.8	1	1	1	1	1	1	.6	1	1	1	.9	1
GammWetMin	.7	.5	.5	.9	0	.9	0	0	.8	0	.8	0	.5	.9	0	1	.5	1	.8	1
GammWetSum	9.8	9.6	10	6.6	1.1	9.1	6.3	.8	5.2	2.8	3.6	4.8	10.3	5	.6	4.5	8.4	11.9	8.4	7.7
GammaAv	.8	.7	.7	.9	.5	1	.6	.4	.8	.6	.9	.7	.8	.9	.3	.9	.7	1	.8	.9
GammaMax	1	1	1	1	1	1	1	.8	1	1	1	1	1	1	.6	1	1	1	.9	1
GammaMin	.7	.5	.5	.7	0	.9	0	0	.8	0	.8	0	.5	.7	0	.9	.5	1	.8	.9
GammaSum	9.8	12	10.8	6.6	2.1	9.1	6.3	.8	5.3	3.6	3.6	6.2	11.1	9.6	1.3	6.9	8.4	16.4	10	10.5
GrasNWpctG	.8	1	1	.7	0	1	.6	0	1	.5	1	.7	1	.6	0	1	1	1	1	1
GrasPctAll	1	.3	1	1	.3	.7	1	.3	1	1	1	.7	.6	.7	.3	.3	.3	.6	.4	1
GrasScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GrasScorMn	8	8	10	8	8	10	8	8	10	8	10	8	10	8	8	10	8	10	8	8
GrasScorMx	10	10	10	10	8	10	10	8	10	10	10	10	10	10	8	10	10	10	10	10
GrasWpctG	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
GrassNpctG	.8	1	1	.7	0	1	.6	0	1	.7	1	.7	1	.6	0	1	1	1	1	1
GrassNtvSp	3	4	6	2	0	4	3	0	3	2	2	2	5	3	0	1	4	6	5	3
GrassNtvWtSp	3	4	5	2	0	4	3	0	3	1	2	2	5	3	0	1	4	5	4	3
GrassWetSp	4	4	7	3	1	6	5	1	4	3	2	3	7	4	1	1	4	8	5	4
Jaccard	.2	.1	.1	.1	.1	.1	.1	.1	.2	.1	0	.1	.2	.1	.1	.1	.2	.2	.1	.1
Morisita	.3	.1	.2	.1	.1	.1	.2	.1	.3	.1	0	.3	.2	.1	.1	.1	.2	.2	.1	.1
NDomPctN	1	.5	1.3	1.5	1.7	1	.3	1	1	1.5	1	.8	1.4	1	1.7	1	.7	1.5	1	1
NtvPctAll	.8	.7	1	.8	.8	1	.8	.7	1	.8	1	.9	.9	.7	.8	1	.8	1	.8	1
ShrNWpctS	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1
ShrNpctS	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ShrNtvSp	1	1	1	2	1	3	1	1	2	1	1	2	3	0	0	2	1	1	1	2
ShrNtvWtSp	1	1	1	2	0	2	1	1	2	1	1	2	3	0	0	1	1	1	1	2
ShrPctAll	.3	.1	.1	.4	.3	1	.3	.3	1	.5	.5	.3	.3	.2	0	1	.1	.3	.3	1
ShrScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ShrScorMn	10	10	9	10	4	9	10	6	10	10	10	10	6	2	0	10	10	10	10	10
ShrScorMx	10	10	9	10	4	10	10	6	10	10	10	10	10	2	0	10	10	10	10	10
ShrWetSp	1	1	1	2	0	2	1	1	2	1	1	2	3	0	0	1	1	1	1	2
ShrWpctS	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1
Sorenson	.3	.2	.2	.1	.1	.1	.2	.1	.3	.1	.1	.2	.3	.1	.1	.1	.3	.3	.1	.1
SorensonAb	.2	.1	.2	.1	.1	.1	.1	.1	.2	.1	0	.2	.2	.1	.1	.1	.1	.2	.1	.1
SpDom	6	6	8	10	7	9	6	3	8	6	4	6	8	8	7	8	7	8	7	8
SpForb	7	11	12	7	3	7	4	1	5	3	4	4	11	4	2	9	10	15	8	11
SpGrass	4	4	8	3	1	6	5	1	4	3	2	3	7	5	1	2	4	9	6	6
SpNtv	9	11	14	8	3	11	6	2	7	5	5	7	13	4	3	5	9	13	13	13
SpNtvDom	4	5	7	4	5	8	1	2	7	3	4	4	7	2	5	6	5	8	3	7
SpPctAll	1	.5	1.5	1	1.8	1.5	1	1	1	1	1.5	1.1	1.1	1.3	1.8	1	.6	1.3	2	1.5
SpShrub	1	1	1	2	1	3	1	1	2	1	1	3	3	1	0	2	1	1	1	3
SpTree	2	1	2	2	1	2	1	0	1	3	2	2	2	1	1	2	2	2	1	2
SpWet	13	13	15	10	3	14	10	2	9	6	5	8	15	7	3	7	12	17	14	13
SpWetDom	6	5	8	8	5	8	6	2	8	6	4	6	7	4	5	8	6	8	7	8
SpWetNtv	4	8	7	4	6	7	1	3	7	3	4	4	7	2	6	6	5	8	3	7
SppAll	13	17	16	10	6	14	10	3	9	7	5	9	16	11	4	10	13	24	16	17
TreeNWpctT	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1
TreeNpctT	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1
TreeNtvSp	2	1	2	2	1	2	0	0	1	3	2	2	1	1	1	2	1	2	1	2
TreeNtvWtSp	1	1	2	2	1	2	0	0	1	3	2	2	1	1	1	2	1	2	1	2
TreePctAll	.3	.1	.3	.4	.3	.3	.5	0	.3	.6	.7	.3	.3	.3	.3	1	.2	.3	.1	.5
TreeScorAv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TreeScorMn	8	8	8	8	8	8	8	0	8	8	6	6	6	8	6	8	6	8	6	8
TreeScorMx	8	8	8	8	8	8	8	0	8	8	8	8	6	8	6	8	6	8	6	8
TreeWetSp	2	1	2	2	1	2	1	0	1	3	2	2	1	1	1	2	1	2	1	2
TreeWpctT	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
WDomPctW	1	.4	1.5	1	1	1.5	1	1	1	1	1	1.2	1.7	1	1.7	1	.8	1.5	1	1
WNPctWN	1	1	1.3	1	1	1	1	.5	1	1	1	1	1	1	1	1	1.5	1	1	1
WNpctN	.7	.4	1	1	1	1	.3	1	1	1	1	.5	.6	1	1	1	.6	1	1	1
WNpctW	.7	.3	1	.8	1.5	1	.3	1	1	1	1	.5	.8	1	1	2	.6	1	.7	2
WetScorAvg	9.3	7.3	9.3	9	6	8.8	9.3	7	10	8.5	10	8.4	8.1	7.3	5.8	8.2	8.4	10	7.4	8

Subclass #:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
WetScorMax	10	10	10	10	8	10	10	8	10	10	10	10	10	10	8	10	10	10	10	10
WetScorMin	8	2	8	8	4	8	8	6	10	8	10	6	5	6	4	8	5	10	5	6
WtNPctAll	.3	.2	1	.7	.8	1	.3	.7	1	.7	1	.4	.4	.7	.8	1	.4	1	.4	1
WtSpPctAll	1	.8	1	1	.5	1	1	.7	1	1	1	1	1	1	.8	1	1	1	1	1
WtdGamSum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WtdWetScor	840	539	839	826	600	841	800	510	945	810	1000	706	619	630	630	800	541	958	569	799

Appendix J. Definitions of the project data files and variables on the accompanying CD

This appendix describes the 16 major data files that resulted from this project, and defines their variables and codes. The files are mainly in Excel® (XLS) format, which can be imported into MS Access® and some other applications. The files are named as follows:

PLOTDATA
PLOTVARS
GREENPL
LATPLNT1
LATPLNT2
HGMGPLOT
HGMLPLOT
HGMGSITE
HGMLSITE
NUMPLOTS
LSCAPE
LCORR1
LCORRSUM
GCORR1
GCORSUM
STATTABS

If you, the reader, intend to publish reports or articles based on further statistical analysis of any of these data, please first contact the Principal Investigator (Paul Adamus) and the CTUIR-Natural Resources project officer (James Webster) to discuss specific data assumptions and opportunities for collaboration and shared authorship.

Data directory for: PLOTDATA

By plot, 5990 records of plant species in greenline and greenline survey plots and along transects. This is the complete raw data set from which other files were calculated.

#	Variable	Explanation of Variable	Footnotes & Codes
1	SiteOld	obsolete identifier for site, this is the identifier used by the hard-copy version of the file	
2	SiteType	type of site	0= non-systematic, 1= systematic
3	SiteNnew	valid identifier for site (but not for the plot)	
4	LineType	type of survey transect	G= greenline; L= lateral
5	LineCode	code for laterals at sites with multiple laterals	G= greenline; L= lateral (L2= second lateral at same site, L3= third)
6	Side	side of the channel, looking upriver	L= left, R= right
7	Dist	For lateral transects, the distance from the centerpoint (200 ft mark) of the greenline. For greenlines, the distance from the greenline's beginning (0 ft mark of).	blank= species observed incidentally outside the standard plots
8	PlotCode	The full, valid, unique plot code	created by appending codes from #3, 5, 6, and 7 above
9	Wetland	plot has wetland conditions?	0= no, 1= yes
10	SpCode	obsolete 6-letter species code	created by taking first 3 letters of genus and of species
11	FxdCode	corrected 6-letter species code	
12	PctCov	relative percent cover of each species, also specifies relative cover of water, bare ground, moss, and litter	% of 3-ft radius circle; not estimated for species found along the line but outside the plots
13	TaxLev	full species or unidentified?	1= full species, 0= identified only to genus or less
14	Nativ?	native to Oregon?	1= probably native, 0= probably not
15	Form	whether plant species, when mature, is typically a tree, shrub, grasslike plant, or leafy forb	1= tree, 2= shrub, 3= grasslike plant, 4= leafy forb & all others
16	BankStab	Rating of plant species for bank stabilization capacity, based on root structure and reproductive mode, according to Crowe & Clausnitzer (1997) and Winward (2000). This was known for only 20% of the reported species.	E= excellent, G= good, F= fair, P= poor
17	NWIstatus	Characteristic affinity of the species for wet soils, according to the National Wetland Inventory. Official classifications from the 1993 NWI National List are used unless more recent (unofficial 1996 list) affinities had been reported. This was known for 75% of the reported species.	see #18
18	WetScore	wetness score, a number assigned to the species to reflect its wetland status class as given in #17, as was done by Small et al. (1996)	blank= unknown indicator status0= upland species (driest); 1= FACU- 2= FACU 3= FACU+ 4= FAC- 5= FAC 6= FAC+ 7= FACW- 8= FACW 9= FACW+ 10=OBL (wettest)

19	WtdWetScor	species wetness score multiplied by (weighted by) percent cover of the species	
20	GammaScore	gamma score, a number I assigned to each species which is computed as (1- proportion of plots in which the species was found)	0 (occurred in the most plots) to 1 (occurred in the fewest plots). This is essentially species richness weighted by regional rarity of the component species
21	WtdGamma	gamma score of a species multiplied by the species' percent cover (i.e., weighted gamma score)	0 to 100; this weights the rarer species found by the study according to how dominant they are within the plots
22	Family	phylogenetic Family	
23	SpName	scientific name (genus + species), mostly according to Flora ID Nortwest	
24	Comment	miscellaneous comment about the survey plot	

Data directory for PLOTVARS

By plot, for 1080 plots, variables created from data from PLOTDATA.
Note: Blank cells in this database are intentional: do not change to 0's.
NOTE: **tree and shrub** includes ***only*** seedlings and young plants <3 ft tall at time of the survey

#	Variable Name	Explanation of Variable
1	SiteNnew	valid identifier for site (but not for the plot); links to PLOTDATA
2	SiteType	type of site: 0= non-systematic, 1= systematic
3	Line	survey line code; links to PLOTDATA
4	LineType	type of survey transect
5	Side	side of the channel, looking upriver; links to PLOTDATA
6	Dist	For lateral transects, the distance from the centerpoint (200 ft mark) of the greenline. For greenlines, the distance from the greenline's beginning (0 ft mark of); links to PLOTDATA; blank= non-plot data (plants observed between plots but on the transect)
7	PlotCode	The full, valid, unique plot code. Created by appending codes from #1, 3, 4, and 5 above
8	WetlandCover	Whether the plot had >49% cover of wetland-associated species (0= no, 1= yes), from #49
9	WetlandRedox	Whether the plot had soil indicators of anaerobic conditions (0= no, 1= yes), from #31 in HGMGPLOT and #32 in HGMLPLOT
10	Wetland?	Whether the site had either of the above: cover or redox (0= no, 1= yes)
11	SppAll	Total number of species (including unique forms unidentified to species). Value of 0 indicates no plants are present in the 3 ft radius plot circle; i.e., only bare substrate or water
12	SpTree	Number of tree species
13	SpShrub	Number of shrub species
14	SpGrass	Number of species of grasslike plants
15	SpForb	Number of species of leafy forbs & other plants
16	SpDom10	Number of species having at least 10% relative cover within the 3-ft radius plot
17	SpDom20	Number of species having at least 20% relative cover within the 3-ft radius plot
18	SpDom50	Number of species having at least 50% relative cover within the 3-ft radius plot
19	SpNtv	Number of species that are believed to be native to Oregon
20	SpWet	Number of characteristically "wetland" species; i.e. those classified as FAC or wetter
21	SpWetNtv	Number of characteristically "wetland" species that also are believed to be native to Oregon
22	SpNtvDom10	Number of native species having at least 10% relative cover within the 3-ft radius plot
23	SpNtvDom20	Number of native species having at least 20% relative cover within the 3-ft radius plot
24	SpNtvDom50	Number of native species having at least 50% relative cover within the 3-ft radius plot
25	SpWetDom10	Number of wetland species having at least 10% relative cover within the 3-ft radius plot
26	SpWetDom20	Number of wetlandspecies having at least 20% relative cover within the 3-ft radius plot
27	SpWetDom50	Number of wetland species having at least 50% relative cover within the 3-ft radius plot
28	SpWetNtv10	Number of species having at least 10% relative cover within the 3-ft radius plot
29	SpWetNtv20	Number of species having at least 20% relative cover within the 3-ft radius plot
30	SpWetNtv50	Number of species having at least 50% relative cover within the 3-ft radius plot
31	TreeNtvSp	Number of native species which when mature are typically a tree. Only includes plants shorter than 3 ft at the time of the survey.
32	ShrNtvSp	Number of native species which when mature are typically a shrub. Only includes plants shorter than 3 ft at the time of the survey.
33	GrassNtvSp	Number of native grasslike species
34	ForbNtvSp	Number of native leafy forb species
35	TreeWetSp	Number of characteristically wetland tree species. Only includes plants shorter than 3 ft at the time of the survey.
36	ShrWetSp	Number of characteristically wetland species. Only includes plants shorter than 3 ft at the time of the survey.

#	Variable Name	Explanation of Variable
37	GrassWetSp	Number of characteristically wetland grasslike species
38	ForbWetSp	Number of characteristically wetland leafy forb species
39	TreeNtvWtSp	Number of native characteristically wetland tree species. Only includes plants shorter than 3 ft at the time of the survey.
40	ShrNtvWtSp	Number of native characteristically wetland species. Only includes plants shorter than 3 ft at the time of the survey.
41	GrassNtvWtSp	Number of native characteristically wetland grasslike species
42	ForbNtvWtSp	Number of native characteristically wetland leafy forb species
43	CovAvgSp	Mean percent cover among species at the plot
44	CovMaxSp	Maximum percent cover among species at the plot
45	CovAvgNtvSp	Mean percent cover among native species at the plot
46	CovMaxNtvSp	Maximum percent cover among native species at the plot
47	CovSumNtvSp	Sum of the percent covers of native species at the plot
48	CovAvgWetSp	Mean percent cover among characteristically wetland species at the plot
49	CovMaxWetSp	Maximum percent cover among characteristically wetland species at the plot
50	CovSumWetSp	Sum of the percent covers of characteristically wetland species at the plot
51	CovAvNtvWt	Mean percent cover among native characteristically wetland species at the plot
52	CovMxNtvWt	Maximum percent cover among native characteristically wetland species at the plot
53	CovSumNtvWt	Sum of the percent covers of native characteristically wetland species at the plot
54	CovTreeAv	Mean percent cover among tree species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
55	CovShrAv	Mean percent cover among shrub species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
56	CovGrassAv	Mean percent cover among grasslike species at the plot
57	CovForbAv	Mean percent cover among forb species at the plot
58	CovTreeMx	Maximum percent cover among tree species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
59	CovShrMx	Maximum percent cover among shrub species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
60	CovGrassMx	Maximum percent cover among grasslike species at the plot
61	CovForbMx	Maximum percent cover among forb species at the plot
62	CovTreeSum	Sum of percent covers of tree species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
63	CovShrSum	Sum of percent covers of shrub species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
64	CovGrasSum	Sum of percent covers of grasslike species at the plot
65	CovForbSum	Sum of percent covers of forb species at the plot
66	CovSumExc	Sum of percent covers of species rated as Excellent for their bank stabilization capacity
67	CovSumGood	Sum of percent covers of species rated as Good for their bank stabilization capacity
68	CovSumFair	Sum of percent covers of species rated as Fair for their bank stabilization capacity
69	CovSumPoor	Sum of percent covers of species rated as Poor for their bank stabilization capacity
70	WetScorAvg	Mean wetness score among plant species at the plot
71	WetScorMax	Maximum wetness score among plant species at the plot
72	WetScorMin	Minimum wetness score among plant species at the plot
73	WtdWetSum	Sum of the weighted species wetness scores, weighted by percent cover (#12 in the PLOTDATA file).
74	TreeScorAv	Mean wetness score among tree species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
75	ShrScorAv	Mean wetness score among shrub species at the plot. Only includes plants shorter than 3 ft at the time of the survey.

#	Variable Name	Explanation of Variable
76	GrasScorAv	Mean wetness score among grasslike species at the plot
77	ForbScorAv	Mean wetness score among forb species at the plot
78	TreeScorMx	Maximum wetness score among tree species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
79	ShrScorMx	Maximum wetness score among shrub species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
80	GrasScorMx	Maximum wetness score among grasslike species at the plot
81	ForbScorMx	Maximum wetness score among forb species at the plot
82	TreeScorMn	Minimum wetness score among tree species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
83	ShrScorMn	Minimum wetness score among shrub species at the plot. Only includes plants shorter than 3 ft at the time of the survey.
84	GrasScorMn	Minimum wetness score among grasslike species at the plot
85	ForbScorMn	Minimum wetness score among forb species at the plot
86	GammaAvg	mean of the gamma scores of species in this plot
87	GammaMax	maximum of the gamma scores of species in this plot
88	GammaMin	minimum of the gamma scores of species in this plot
89	GammaSum	sum of the gamma scores of species in this plot
90	WtdGamSum	sum of the gamma scores of species in this plot weighted by percent cover
91	GammNtvAvg	mean of the gamma scores of native species in this plot
92	GammNtvMax	maximum of the gamma scores of native species in this plot
93	GammNtvMin	minimum of the gamma scores of native species in this plot
94	GammNtvSum	sum of the gamma scores of native species in this plot
95	GammWetAvg	mean of the gamma scores of characteristically wetland species in this plot
96	GammWetMax	maximum of the gamma scores of characteristically wetland species in this plot
97	GammWetMin	minimum of the gamma scores of characteristically wetland species in this plot
98	GammWetSum	sum of the gamma scores of characteristically wetland species in this plot
99	GamWtNtvAv	mean of the gamma scores of native wetland species in this plot
100	GamWtNtvMx	maximum of the gamma scores of native wetland species in this plot
101	GamWtNtvMn	minimum of the gamma scores of native wetland species in this plot
102	GamWtNtSum	sum of the gamma scores of native wetland species in this plot
103	TreePctAll	Proportion of total species that are tree species
104	ShrPctAll	Proportion of total species that are shrub species
105	GrasPctAll	Proportion of total species that are grasslike species
106	ForbPctAll	Proportion of total species that are leafy forb species
107	Sp10PctAll	Proportion of total species that had a percent-cover of at least 10% in the survey plots
108	Sp20PctAll	Proportion of total species that had a percent-cover of at least 20% in the survey plots
109	Sp50PctAll	Proportion of total species that had a percent-cover of at least 50% in the survey plots
110	NtvPctAll	Proportion of total species that are native species
111	WtSpPctAll	Proportion of total species that are characteristically native species
112	WtNPctAll	Proportion of total species that are native wetland species
113	NDom10PctN	Proportion of native species that had a percent-cover of at least 10% in the survey plots
114	NDom20PctN	Proportion of native species that had a percent-cover of at least 20% in the survey plots
115	NDom50PctN	Proportion of native species that had a percent-cover of at least 50% in the survey plots
116	WDom10PctW	Proportion of characteristically wetland species that had a percent-cover of at least 10% in the survey plots
117	WDom20PctW	Proportion of characteristically wetland species that had a percent-cover of at least 20% in the survey plots

#	Variable Name	Explanation of Variable
118	WDom50PctW	Proportion of characteristically wetland species that had a percent-cover of at least 50% in the survey plots
119	WN10PctWN	Proportion of native wetland species that had a percent-cover of at least 10% in the survey plots
120	WN20PctWN	Proportion of native wetland species that had a percent-cover of at least 20% in the survey plots
121	WN50PctWN	Proportion of native wetland species that had a percent-cover of at least 50% in the survey plots
122	TreeNpctT	Proportion of tree species that are native
123	ShrNpctS	Proportion of shrub species that are native
124	GrassNpctG	Proportion of grasslike species that are native
125	ForbNpctF	Proportion of leafy forb species that are native
126	TreeWpctT	Proportion of tree species that are wetland species
127	ShrWpctS	Proportion of shrub species that are wetland species
128	GrasWpctG	Proportion of grasslike species that are wetland species
129	ForbWpctF	Proportion of leafy forb species that are wetland species
130	WNpctW	Proportion of wetland species that are native wetland species
131	WNpctN	Proportion of native species that are native wetland species
132	TreeNWpctT	Proportion of tree species that are native wetland species
133	ShrNWpctS	Proportion of shrub species that are native wetland species
134	GrasNWpctG	Proportion of grasslike species that are native wetland species
135	ForbNWpctF	Proportion of leafy forb species that are native wetland species
136	Jaccard	Similarity of plant species in this plot to those of all other plots, as calculated by Jaccard index
137	Sorenson	Similarity of plant species in this plot to those of all other greenline or lateral transect plots that contained plants, as calculated by Sorenson index
138	SorensonAb	Similarity of plant species in this plot to those of all other greenline or lateral transect plots that contained plants, as calculated by Sorenson index weighted by percent cover of the component species
139	Morisita	Similarity of plant species in this plot to those of all other greenline or lateral transect plots that contained plants, as calculated by Morisita-Horn index which accounts for percent cover of the component species
140	BankNoData	Number of analyzed species that had been classified according to their capacity to stabilize shorelines
141	WetNoData	Number of analyzed species that had been classified according to their wetland status

Data directory for GREENPL

By site (40 sites), variables summarized for greenline transects. Created from data from 200 plots along the greenlines (5 plots per greenline).
NOTE: Blank cells in this database are intentional: do not change to 0's.
NOTE: **tree and shrub** includes ***only*** seedlings and young plants <3 ft tall at time of the survey

#	Variable	Explanation of Variable
1	SiteNnew	valid identifier for site (but not for the plot)
2	SiteType	type of site: 0= non-systematic, 1= systematic
3	TotCumuSpp	cumulative number of species among the 5 plots of each greenline
4	CumuFamils	cumulative number of plant families among the 5 plots of each greenline
5	TreeCumuSp	cumulative number of tree species among the 5 plots of each greenline
6	ShrCumuSp	cumulative number of shrub species among the 5 plots of each greenline
7	GrasCumuSp	cumulative number of grasslike species among the 5 plots of each greenline
8	ForbCumuSp	cumulative number of leafy forb species among the 5 plots of each greenline
9	CumuDom10	cumulative number of species that occupied at least 10% of any of the 5 plots of each greenline
10	CumuDom20	cumulative number of species that occupied at least 20% of any of the 5 plots of each greenline
11	CumuDom50	cumulative number of species that occupied at least 50% of any of the 5 plots of each greenline
12	NtvCumuSpp	cumulative number of native plant species among the 5 plots of each greenline
13	WetCumuSpp	cumulative number of characteristically wetland species among the 5 plots of each greenline
14	NtvWetCuSp	cumulative number of native wetland plant species among the 5 plots of each greenline
15	Dom10ntvCu	cumulative number of native species that occupied at least 10% of any of the 5 plots of each greenline
16	Dom20ntvCu	cumulative number of native species that occupied at least 20% of any of the 5 plots of each greenline
17	Dom50ntvCu	cumulative number of native species that occupied at least 50% of any of the 5 plots of each greenline
18	Dom10wetCu	cumulative number of wetland species that occupied at least 10% of any of the 5 plots of each greenline
19	Dom20wetCu	cumulative number of wetland species that occupied at least 20% of any of the 5 plots of each greenline
20	Dom50wetCu	cumulative number of wetland species that occupied at least 50% of any of the 5 plots of each greenline
21	Dom10wtntv	cumulative number of native wetland species that occupied at least 10% of any of the 5 plots of each greenline
22	Dom20wtntv	cumulative number of native wetland species that occupied at least 20% of any of the 5 plots of each greenline
23	Dom50wtntv	cumulative number of native wetland species that occupied at least 50% of any of the 5 plots of each greenline
24	CovMaxAll	maximum cover of any species in any of the 5 greenline plots
25	CovMaxNtv	maximum cover of any native plant species in any of the 5 greenline plots
26	CovWetMax	maximum cover of any characteristically wetland species in any of the 5 greenline plots
27	CovNtvWtMx	maximum cover of any native characteristically wetland species in any of the 5 greenline plots
28	TreeCovMx	maximum cover of any tree species in any of the 5 greenline plots
29	ShrCovMx	maximum cover of any shrub species in any of the 5 greenline plots
30	GrasCovMx	maximum cover of any grasslike species in any of the 5 greenline plots
31	ForbCovMx	maximum cover of any forb species in any of the 5 greenline plots
32	StabilExcl	summed percent covers of species rated Excellent for their bank stabilization capacity
33	StabilGood	summed percent covers of species species rated Good for their bank stabilization capacity
34	StabilFair	summed percent covers of species rated Fair for their bank stabilization capacity
35	StabilPoor	summed percent covers of species rated Poor for their bank stabilization capacity

#	Variable	Explanation of Variable
36	WetScorAvg	mean of the wetness scores of greenline species
37	WetScorMax	maximum of the wetness scores of greenline species
38	WetScorMin	minimum of the wetness scores of greenline species
39	SumWetScor	sum of the wetness scores, all species in all greenline plots
40	SumWtdWet	sum of the wetness scores weighted by percent cover, all species in all greenline plots
41	GGammaAvg	mean of the gamma scores of greenline species
42	GGammaMax	maximum of the gamma scores of greenline species
43	GGammaMin	minimum of the gamma scores of greenline species
44	GGammaSum	sum of the gamma scores of greenline species
45	SumWtdGGam	sum of the gamma scores weighted by percent cover, all species in all greenline plots
46	TreePctAll	Proportion of total species in the greenline plots that are tree species
47	ShrPctAll	Proportion of total species in the greenline plots that are shrub species
48	GrasPctAll	Proportion of total species in the greenline plots that are grasslike species
49	ForbPctAll	Proportion of total species in the greenline plots that are leafy forb species
50	Dom10pctAll	Proportion of total species in the greenline plots that had a percent-cover of at least 10%
51	Dom20pctAll	Proportion of total species in the greenline plots that had a percent-cover of at least 20%
52	Dom50pctAll	Proportion of total species in the greenline plots that had a percent-cover of at least 50%
53	NtvPctAll	Proportion of total species in the greenline plots that are native species
54	WetPctAll	Proportion of total species in the greenline plots that are characteristically wetland species
55	NtvWetPctA	Proportion of total species in the greenline plots that are native wetland species
56	Dom10NpctN	Proportion of native species in the greenline plots that had a percent-cover of at least 10%
57	Dom20NpctN	Proportion of native species in the greenline plots that had a percent-cover of at least 20%
58	Dom50NpctN	Proportion of native species in the greenline plots that had a percent-cover of at least 50%
59	Dom10WpctW	Proportion of characteristically wetland species in the greenline plots that had a percent-cover of at least 10%
60	Dom20WpctW	Proportion of characteristically wetland species in the greenline plots that had a percent-cover of at least 20%
61	Dom50WpctW	Proportion of characteristically wetland species in the greenline plots that had a percent-cover of at least 50%
62	Dom10WnWn	Proportion of native wetland species in the greenline plots that had a percent-cover of at least 10%
63	Dom20WnWn	Proportion of native wetland species in the greenline plots that had a percent-cover of at least 20%
64	Dom50WnWn	Proportion of native wetland species in the greenline plots that had a percent-cover of at least 50%
65	CovWx_MxA	Ratio of maximum percent-cover of any wetland species to maximum percent-cover of any species
66	CovNWx_xA	Ratio of maximum percent-cover of any native wetland species to maximum percent-cover of any species
67	TcovMx_MxA	Ratio of maximum percent-cover of any tree species to maximum percent-cover of any species
68	ScovMx_MxA	Ratio of maximum percent-cover of any shrub species to maximum percent-cover of any species
69	GcovMx_MxA	Ratio of maximum percent-cover of any grasslike species to maximum percent-cover of any species
70	FcovMx_MxA	Ratio of maximum percent-cover of any leafy forb species to maximum percent-cover of any species
71	BankPctExc	Proportion of rated species with a rating of Excellent for bank stabilization capacity
72	BnkPctGood	Proportion of rated species with a rating of Good for bank stabilization capacity
73	BnkPctFair	Proportion of rated species with a rating of Fair for bank stabilization capacity
74	BnkPctPoor	Proportion of rated species with a rating of Poor for bank stabilization capacity
75	TreeNpctT	Proportion of tree species in the greenline plots that are native
76	ShrNpctS	Proportion of shrub species in the greenline plots that are native
77	GrasNpctG	Proportion of grasslike species in the greenline plots that are native

#	Variable	Explanation of Variable
78	ForbNpctF	Proportion of leafy forb species in the greenline plots that are native
79	TreeWpctT	Proportion of tree species in the greenline plots that are wetland species
80	ShrWpctS	Proportion of shrub species in the greenline plots that are wetland species
81	GrasWpctG	Proportion of grasslike species in the greenline plots that are wetland species
82	ForbWpctF	Proportion of leafy forb species in the greenline plots that are wetland species
83	NWtreePctT	Proportion of tree species in the greenline plots that are native wetland species
84	NWshrPctS	Proportion of shrub species in the greenline plots that are native wetland species
85	NWgrasPctG	Proportion of grasslike species in the greenline plots that are native wetland species
86	NWforbPctF	Proportion of leafy forb species in the greenline plots that are native wetland species
87	WNpctW	Proportion of wetland species in the greenline plots that are native wetland species
88	WNpctN	Proportion of native species in the greenline plots that are native wetland species
89	NoDataWet	Proportion of greenline species that had not been classified according to their wetland status (so could not be used in calculation of the wetness index); variable is useful for measuring potential bias in variables based on wetland-associated plant species
90	NoDataBank	Proportion of greenline species that had not been classified according to their capacity to stabilize shorelines; variable is useful for measuring potential bias in #32-35 and #71-74
91	SppallCV	Coefficient of variation in number of species per plot, among all plots on this site's greenline transects
92	SptreeCV	Coefficient of variation in number of tree species per plot, among all plots on this site's greenline transects
93	SpShrubCV	Coefficient of variation in number of shrub species per plot, among all plots on this site's greenline transects
94	SpgrassCV	Coefficient of variation in number of grasslike species per plot, among all plots on this site's greenline transects
95	SpForbCV	Coefficient of variation in number of forb species per plot, among all plots on this site's greenline transects
96	Spdom10CV	Coefficient of variation in number of species per plot that have at least 10 percent cover within the plot, among all plots on this site's greenline transects
97	Spdom20CV	Coefficient of variation in number of species per plot that have at least 20 percent cover within the plot, among all plots on this site's greenline transects
98	Spdom50CV	Coefficient of variation in number of species per plot that have at least 50 percent cover within the plot, among all plots on this site's greenline transects
99	SpntvCV	Coefficient of variation in number of native species per plot, among all plots on this site's greenline transects
100	SpwetCV	Coefficient of variation in number of characteristically wetland species per plot, among all plots on this site's greenline transects
101	SpwetntvCV	Coefficient of variation in number of native wetland species per plot, among all plots on this site's greenline transects
102	SpNdom10CV	Coefficient of variation in number of native species per plot that have at least 10 percent cover within the plot, among all plots on this site's greenline transects
103	SpNdom20CV	Coefficient of variation in number of native species per plot that have at least 20 percent cover within the plot, among all plots on this site's greenline transects
104	SpNdom50CV	Coefficient of variation in number of native species per plot that have at least 50 percent cover within the plot, among all plots on this site's greenline transects
105	SpWdom10cv	Coefficient of variation in number of wetland species per plot that have at least 10 percent cover within the plot, among all plots on this site's greenline transects
106	SpWdom20cv	Coefficient of variation in number of wetland species per plot that have at least 20 percent cover within the plot, among all plots on this site's greenline transects
107	SpWdom50cv	Coefficient of variation in number of wetland species per plot that have at least 50 percent cover within the plot, among all plots on this site's greenline transects
108	SpWN10cv	Coefficient of variation in number of native wetland species per plot that have at least 10 percent cover within the plot, among all plots on this site's greenline transects
109	SpWN20cv	Coefficient of variation in number of native wetland species per plot that have at least 20 percent cover within the plot, among all plots on this site's greenline transects

#	Variable	Explanation of Variable
110	SpWN50cv	Coefficient of variation in number of native wetland species per plot that have at least 50 percent cover within the plot, among all plots on this site's greenline transects
111	TreeNcv	Coefficient of variation in number of native tree species per plot, among all plots on this site's greenline transects
112	ShrNcv	Coefficient of variation in number of native shrub species per plot, among all plots on this site's greenline transects
113	GrassNcv	Coefficient of variation in number of native grasslike species per plot, among all plots on this site's greenline transects
114	ForbBcv	Coefficient of variation in number of native forb species per plot, among all plots on this site's greenline transects
115	TreeWcv	Coefficient of variation in number of wetland tree species per plot
116	ShrWcv	Coefficient of variation in number of wetland shrub species per plot
117	GrassWcv	Coefficient of variation in number of wetland grasslike species per plot
118	ForbWcv	Coefficient of variation in number of wetland forb species per plot, among all plots on this site's greenline transects
119	TreeWNcv	Coefficient of variation in number of native wetland tree species per plot, among all plots on this site's greenline transects
120	ShrnWNcv	Coefficient of variation in number of native wetland shrub species per plot, among all plots on this site's greenline transects
121	GrasWNcv	Coefficient of variation in number of native wetland grasslike species per plot, among all plots on this site's greenline transects
122	ForbWNcv	Coefficient of variation in number of native wetland forb species per plot, among all plots on this site's greenline transects
123	CovavgCV	Coefficient of variation in average species percent cover per plot, among all plots on this site's greenline transects
124	CovmaxCV	Coefficient of variation in maximum species percent cover per plot, among all plots on this site's greenline transects
125	CovavgNcv	Coefficient of variation in average native species percent cover per plot, among all plots on this site's greenline transects
126	CovmaxNcv	Coefficient of variation in maximum native species percent cover per plot, among all plots on this site's greenline transects
127	CovsumNcv	Coefficient of variation in sum of native species percent cover per plot, among all plots on this site's greenline transects
128	CovavgWcv	Coefficient of variation in average wetland species percent cover per plot, among all plots on this site's greenline transects
129	CovmaxWcv	Coefficient of variation in maximum wetland species percent cover per plot, among all plots on this site's greenline transects
130	CovsumWcv	Coefficient of variation in sum of wetland species percent cover per plot, among all plots on this site's greenline transects
131	CovavWNcv	Coefficient of variation in average native wetland species percent cover per plot, among all plots on this site's greenline transects
132	CovmxWNcv	Coefficient of variation in maximum native wetland species percent cover per plot, among all plots on this site's greenline transects
133	CovsuWNcv	Coefficient of variation in sum of native wetland species percent cover per plot, among all plots on this site's greenline transects
134	CovAvTcv	Coefficient of variation in tree species mean percent cover per plot, among all plots on this site's greenline transects
135	CovAvShrcv	Coefficient of variation in shrub species mean percent cover per plot among all plots on this site's greenline transects
136	CovAvGraCV	Coefficient of variation in grasslike species mean percent cover per plot among all plots on this site's greenline transects
137	CovAvFbCV	Coefficient of variation in forb species mean percent cover per plot among all plots on this site's greenline transects
138	CovMxTcv	Coefficient of variation in tree species maximum percent cover per plot, among all plots on this site's greenline transects

#	Variable	Explanation of Variable
139	CovMxShrCV	Coefficient of variation in shrub species maximum percent cover per plot among all plots on this site's greenline transects
140	CovMxGrCV	Coefficient of variation in grasslike species maximum percent cover per plot among all plots on this site's greenline transects
141	CovMxFbCV	Coefficient of variation in forb species maximum percent cover per plot among all plots on this site's greenline transects
142	CovTsumCV	Coefficient of variation in tree species summed percent cover per plot, among all plots on this site's greenline transects
143	CovSsumCV	Coefficient of variation in shrub species summed percent cover per plot among all plots on this site's greenline transects
144	CovGsumCV	Coefficient of variation in grasslike species summed percent cover per plot among all plots on this site's greenline transects
145	CovFsumCV	Coefficient of variation in forb species summed percent cover per plot among all plots on this site's greenline transects
146	AvWetscCV	Coefficient of variation in mean wetness score per plot, among all plots on this site's greenline transects (see #15-16 in PLOTDATA)
147	MxWetscCV	Coefficient of variation in maximum wetness score per plot
148	MnWetscCV	Coefficient of variation in minimum wetness score per plot
149	WtdwetscCV	Coefficient of variation in wetness score weighted by percent cover, per plot among all plots on this site's greenline transects
150	TreeWtscCV	Coefficient of variation in tree mean wetness score per plot, among all plots on this site's greenline transects
151	ShrWetscCV	Coefficient of variation in shrub mean wetness score per plot
152	GrasWtscCV	Coefficient of variation in grasslike species mean wetness score per plot
153	ForbWtscCV	Coefficient of variation in forb mean wetness score per plot
154	MxWtscTcv	Coefficient of variation in tree maximum wetness score per plot, among all plots on this site's greenline transects
155	MxWtscScv	Coefficient of variation in shrub maximum wetness score per plot
156	MxWtscGcv	Coefficient of variation in grasslike species maximum wetness score per plot
157	MxWtscFcv	Coefficient of variation in forb maximum wetness score per plot
158	AvGammaCV	Coefficient of variation in mean gamma score per plot, among all plots on this site's greenline transects
159	MxGammaCV	Coefficient of variation in maximum gamma score per plot, among all plots on this site's greenline transects
160	MinGammaCV	Coefficient of variation in minimum gamma score per plot, among all plots on this site's greenline transects
161	SumGammaCV	Coefficient of variation in summed gamma score per plot, among all plots on this site's greenline transects
162	SumWtdGamCV	Coefficient of variation in weighted gamma score per plot, among all plots on this site's greenline transects (see #18 in PlotVar file)
163	TreePctCV	Coefficient of variation in tree minimum wetness score per plot, among all plots on this site's greenline transects
164	ShrPctCV	Coefficient of variation in shrub minimum wetness score per plot
165	GrassPctCV	Coefficient of variation in grasslike species minimum wetness score per plot
166	ForbPctCV	Coefficient of variation in forb minimum wetness score per plot
167	Sp10pctCV	Proportion of all plant species in the plot that occupied at least 10% of the plot, coefficient of variation of all plots on this site's greenline transect
168	Sp20pctCV	Proportion of all plant species in the plot that occupied at least 20% of the plot, coefficient of variation of all plots on this site's greenline transect mean of all plots on this site's greenline transect
169	Sp50pctCV	Proportion of all plant species in the plot that occupied at least 50% of the plot, coefficient of variation of all plots on this site's greenline transect mean of all plots on this site's greenline transect

#	Variable	Explanation of Variable
170	NtvpctCV	Proportion of all plant species in the plot that were native species, coefficient of variation of all plots on this site's greenline transect mean of all plots on this site's greenline transect
171	WtspPctCV	Proportion of all plant species in the plot that were characteristically wetland species, coefficient of variation of all plots on this site's greenline transect
172	WNpctCV	Proportion of all plant species in the plot that were native wetland species, coefficient of variation of all plots on this site's greenline transect
173	Ndom10%Ncv	Native species that occupied at least 10% of the plot, coefficient of variation of all plots on this site's greenline transect
174	Ndom20%Ncv	Native species that occupied at least 20% of the plot, as a proportion of all wetland natives in the plot, coefficient of variation of all plots on this site's greenline transect
175	Ndom50%Ncv	Native species that occupied at least 50% of the plot, as a proportion of all wetland natives in the plot, coefficient of variation of all plots on this site's greenline transect
176	Wdom10%Wcv	Wetland species that occupied at least 10% of the plot, coefficient of variation of all plots on this site's greenline transect
177	Wdom20%Wcv	Wetland species that occupied at least 20% of the plot, as a proportion of all wetland wetlands in the plot, coefficient of variation of all plots on this site's greenline transect
178	Wdom50%Wcv	Wetland species that occupied at least 50% of the plot, as a proportion of all wetland wetlands in the plot, coefficient of variation of all plots on this site's greenline transect
179	Wn10%WnCV	Native wetland species that occupied at least 10% of the plot, coefficient of variation of all plots on this site's greenline transect
180	Wn20%WnCV	Native wetland species that occupied at least 20% of the plot, as a proportion of all wetland natives in the plot, coefficient of variation of all plots on this site's greenline transect
181	Wn50%WnCV	Native wetland species that occupied at least 50% of the plot, as a proportion of all wetland natives in the plot, coefficient of variation of all plots on this site's greenline transect
182	TreeN%Tcv	Native tree species as a proportion of all tree species in the plot, coefficient of variation of all plots on this site's greenline transect
183	ShrN%Scv	Native shrub species as a proportion of all shrub species in the plot, coefficient of variation of all plots on this site's greenline transect
184	GrassN%Gcv	Native grasslike species as a proportion of all grasslike species in the plot
185	ForbN%Fcv	Native forb species as a proportion of all forb species in the plot
186	TreeW%Tcv	Wetland tree species as a proportion of all tree species in the plot, coefficient of variation of all plots on this site's greenline transect
187	ShrW%Scv	Wetland shrub species as a proportion of all shrub species in the plot, coefficient of variation of all plots on this site's greenline transect
188	GrasW%Gcv	Wetland grasslike species as a proportion of all grasslike species in the plot
189	ForbW%Fcv	Wetland forb species as a proportion of all forb species in the plot
190	WN%Wcv	Native wetland species as a proportion of all wetland species in the plot, coefficient of variation of all plots on this site's greenline transect
191	WN%Ncv	Native wetland species as a proportion of all native species in the plot, coefficient of variation of all plots on this site's greenline transect
192	TreeNW%Tcv	Native wetland tree species as a proportion of all tree species in the plot, coefficient of variation of all plots on this site's greenline transect
193	ShrWN%Scv	Native wetland shrub species as a proportion of all shrub species in the plot, coefficient of variation of all plots on this site's greenline transect
194	GrasWN%Gcv	Native wetland grasslike species as a proportion of all grasslike species in the plot, coefficient of variation of all plots on this site's greenline transect
195	ForbWN%Fcv	Native wetland forb species as a proportion of all forb species in the plot, coefficient of variation of all plots on this site's greenline transect
196	JaccSiteAv	Similarity of the cumulative plant list from this site's greenline to that of other site's greenlines, as calculated by Jaccard index, mean of comparisons with all other sites
197	JaccSiteMx	Similarity of the cumulative plant list from this site's greenline to that of the most floristically similar other site, as calculated by Jaccard index

#	Variable	Explanation of Variable
198	JaccSiteMn	Similarity of the cumulative plant list from this site's greenline to that of the least floristically similar other site, as calculated by Jaccard index
199	SorSiteAv	Similarity of the cumulative plant list from this site's greenlin to that of other site's greenlines, as calculated by Sorenson index, mean of comparisons with all other sites
200	SorSiteMx	Similarity of the cumulative plant list from this site's greenline to that of the most floristically similar other site, as calculated by Sorenson index
201	SorSiteMn	Similarity of the cumulative plant list from this site's greenline to that of the least floristically similar other site, as calculated by Sorenson index
202	SorAbSiAv	Similarity of the cumulative plant list from this site's greenlin to that of other site's greenlines, as calculated by Sorenson index weighted by summed percent cover, mean of comparisons with all other sites
203	SorAbSiMx	Similarity of the cumulative plant list from this site's greenline to that of the most floristically similar other site, as calculated by Sorenson index weighted by summed percent cover,
204	SorAbSiMn	Similarity of the cumulative plant list from this site's greenline to that of the least floristically similar other site, as calculated by Sorenson index weighted by summed percent cover,
205	MorSiteAv	Similarity of the cumulative plant list from this site's greenlin to that of other site's greenlines, as calculated by Morisita index, mean of comparisons with all other sites
206	MorSiteMx	Similarity of the cumulative plant list from this site's greenline to that of the most floristically similar other site, as calculated by Morisita index
207	MorSiteMn	Similarity of the cumulative plant list from this site's greenline to that of the least floristically similar other site, as calculated by Morisita index
208	JaccPtAv	Similarity of plant species composition in each greenline plot to that of other greenline plots, as calculated by Jaccard index, mean of all plots on this site's greenline transect
209	SorPtAv	Similarity of plant species composition in each greenline plot to that of other greenline plots, as calculated by Sorenson index, mean of all plots on this site's greenline transect
210	SorAbPtAv	Similarity of plant species composition in each greenline plot to that of other greenline plots, as calculated by Sorenson index weighted by percent cover of the component species, mean of all plots on this site's greenline transect
211	MorPtAv	Similarity of plant species composition in each greenline plot to that of other greenline plots, as calculated by Morisita-Horn index which accounts for percent cover of the component species, mean of all plots on this site's greenline transect

Data directory for LATPLNT1

By site (40 sites), variables created from data from 801 greenline transect plots (687 of which contained plants), usually 20 plots per site. Except where noted otherwise, includes statistics calculated from the CUMULATIVE list of species (lists from all plots were composited).
NOTE: **tree and shrub** includes ***only*** seedlings and young plants <3 ft tall at time of the survey
Note: Blank cells in this database are intentional: do not change to 0's.

#	Variable	Explanation of Variable
1	SiteNum	valid identifier for site
2	SiteType	type of site: 0= non-systematic, 1= systematic
3	TotCuSpp	cumulative number of species among the ~20 plots of the lateral transect(s)
4	FamilyCu	cumulative number of plant families among the ~20 plots of the lateral transect(s)
5	TreeCumuSp	cumulative number of tree species among the ~20 plots of the lateral transect(s)
6	ShrCumuSp	cumulative number of shrub species among the ~20 plots of the lateral transect(s)
7	GrasCumuSp	cumulative number of grasslike species among the ~20 plots of the lateral transect(s)
8	ForbCumuSp	cumulative number of leafy forb species among the ~20 plots of the lateral transect(s)
9	Dom10Cu	cumulative number of species that occupied at least 10% of any of the ~20 plots of each lateral transect
10	Dom20Cu	cumulative number of species that occupied at least 20% of any of the ~20 plots of each lateral transect
11	Dom50Cu	cumulative number of species that occupied at least 50% of any of the ~20 plots of each lateral transect
12	WetSpCu	cumulative number of native plant species among the ~20 plots of the lateral transect(s)
13	NtvSpCu	cumulative number of characteristically wetland species among the ~20 plots of each lateral transect (see #15-16 in PLOTDATA)
14	NtvWetSpCu	cumulative number of native wetland plant species among the ~20 plots of the lateral transect(s)
15	NtvDom10Cu	cumulative number of native wetland species that occupied at least 10% of any of the ~20 plots of the lateral transect(s)
16	NtvDom20Cu	cumulative number of native wetland species that occupied at least 20% of any of the ~20 plots of the lateral transect(s)
17	NtvDom50Cu	cumulative number of native wetland species that occupied at least 50% of any of the ~20 plots of the lateral transect(s)
18	WetDom10Cu	cumulative number of characteristically wetland species that occupied at least 10% of any of the ~20 plots of the lateral transect(s)
19	WetDom20Cu	cumulative number of characteristically wetland species that occupied at least 20% of any of the ~20 plots of the lateral transect(s)
20	WetDom50Cu	cumulative number of characteristically wetland species that occupied at least 50% of any of the ~20 plots of the lateral transect(s)
21	NtvWtDom10	cumulative number of native wetland species that occupied at least 10% of any of the ~20 plots of the lateral transect(s)
22	NtvWtDom20	cumulative number of native wetland species that occupied at least 20% of any of the ~20 plots of the lateral transect(s)
23	NtvWtDom50	cumulative number of native wetland species that occupied at least 50% of any of the ~20 plots of the lateral transect(s)
24	TreeNtvCu	cumulative number of native tree species among the ~20 plots of the lateral transect(s)
25	ShrNtvCu	cumulative number of native shrub species among the ~20 plots of the lateral transect(s)
26	GrasNtvCu	cumulative number of native leafy forb species among the ~20 plots of the lateral transect(s)
27	ForbNtvCu	cumulative number of native grasslike species among the ~20 plots of the lateral transect(s)

#	Variable	Explanation of Variable
28	TreeWetCu	cumulative number of characteristically wetland tree species among the ~20 plots of the lateral transect(s)
29	ShrWetCu	cumulative number of characteristically wetland shrub species among the ~20 plots of the lateral transect(s)
30	GrassWetCu	cumulative number of characteristically wetland grasslike species among the ~20 plots of the lateral transect(s)
31	ForbWetCu	cumulative number of characteristically wetland leafy forb species among the ~20 plots of the lateral transect(s)
32	TreeWNcu	cumulative number of native wetland tree species among the ~20 plots of the lateral transect(s)
33	ShrWNcu	cumulative number of native wetland shrub species among the ~20 plots of the lateral transect(s)
34	GrassWNcu	cumulative number of native wetland grasslike species among the ~20 plots of the lateral transect(s)
35	ForbWNcu	cumulative number of native wetland forb species among the ~20 plots of the lateral transect(s)
36	CovSpAvg	mean percent cover of species among the ~20 plots of the lateral transect(s)
37	CovSpMax	maximum percent cover of any species among the ~20 plots of the lateral transect(s)
38	CovNtvAvg	mean percent cover of native species among the ~20 plots of the lateral transect(s)
39	CovNtvMax	maximum percent cover of any native species among the ~20 plots of the lateral transect(s)
40	CovWetSpAv	mean percent cover of characteristically wetland species among the ~20 plots of the lateral transect(s)
41	CovWetSpMx	maximum percent cover of characteristically wetland species among the ~20 plots of the lateral transect(s)
42	CovNtvWtAv	mean percent cover of native wetland species among the ~20 plots of the lateral transect(s)
43	CovNtvWtMx	maximum percent cover of native wetland species among the ~20 plots of the lateral transect(s)
44	TreeCovAv	mean percent cover of tree species among the ~20 plots of the lateral transect(s)
45	ShrCovAv	mean percent cover of shrub species among the ~20 plots of the lateral transect(s)
46	GrassCovAv	mean percent cover of grasslike species among the ~20 plots of the lateral transect(s)
47	ForbCovAv	mean percent cover of leafy forb species among the ~20 plots of the lateral transect(s)
48	TreeCovMax	maximum percent cover of tree species among the ~20 plots of the lateral transect(s)
49	ShrCovMax	maximum percent cover of shrub species among the ~20 plots of the lateral transect(s)
50	GrassCovMx	maximum percent cover of grasslike species among the ~20 plots of the lateral transect(s)
51	ForbCovMax	maximum percent cover of leafy forb species among the ~20 plots of the lateral transect(s)
52	WetnessAvg	mean of the wetness scores of species (see #15-16 in PLOTDATA)
53	WetnessMax	maximum of the wetness scores of species
54	WetnessMin	minimum of the wetness scores of species
55	TreeWetAvg	mean of the wetness scores of tree species in the lateral transect plots
56	ShrWetAvg	mean of the wetness scores of shrub species in the lateral transect plots
57	GrasWetAvg	mean of the wetness scores of grasslike species in the lateral transect plots
58	ForbWetAvg	mean of the wetness scores of leafy forb species in the lateral transect plots
59	TreeWetMax	maximum of the wetness scores of tree species in the lateral transect plots
60	ShrWetMax	maximum of the wetness scores of shrub species in the lateral transect plots
61	GrasWetMax	maximum of the wetness scores of grasslike species in the lateral transect plots
62	ForbWetMax	maximum of the wetness scores of leafy forb species in the lateral transect plots
63	TreeWetMin	minimum of the wetness scores of tree species in the lateral transect plots
64	ShrWetMin	minimum of the wetness scores of shrub species in the lateral transect plots

#	Variable	Explanation of Variable
65	GrasWetMin	minimum of the wetness scores of grasslike species in the lateral transect plots
66	ForbWetMin	minimum of the wetness scores of leafy forb species in the lateral transect plots
67	LgammaAvg	mean of the gamma scores of species in the lateral transect plots
68	LgammaMax	maximum of the gamma scores of species in the lateral transect plots
69	LgammaMin	minimum of the gamma scores of species in the lateral transect plots
70	LgammaSum	sum of the gamma scores of species in the lateral transect plots
71	TreePctAll	Proportion of total species in the lateral transect plots that are tree species
72	ShrPctAll	Proportion of total species in the lateral transect plots that are shrub species
73	GrasPctAll	Proportion of total species in the lateral transect plots that are grasslike species
74	ForbPctAll	Proportion of total species in the lateral transect plots that are leafy forb species
75	Dom10PctA	Proportion of total species in the lateral transect plots that had a percent-cover of at least 10%
76	Dom20PctA	Proportion of total species in the lateral transect plots that had a percent-cover of at least 20%
77	Dom50PctA	Proportion of total species in the lateral transect plots that had a percent-cover of at least 50%
78	WetSpPctA	Proportion of total species in the lateral transect plots that are characteristically wetland species
79	NtvSpPctA	Proportion of total species in the lateral transect plots that are native species
80	NtvWetPctA	Proportion of total species in the lateral transect plots that are native wetland species
81	NDom10PctN	Number of native species having at least 10% relative cover within the 3-ft radius plot
82	NDom20PctN	Number of native species having at least 20% relative cover within the 3-ft radius plot
83	NDom50PctN	Number of native species having at least 50% relative cover within the 3-ft radius plot
84	WDom10PctW	Number of wetland species having at least 10% relative cover within the 3-ft radius plot
85	WDom20PctW	Number of wetlandspecies having at least 20% relative cover within the 3-ft radius plot
86	WDom50PctW	Number of wetland species having at least 50% relative cover within the 3-ft radius plot
87	NW10PctNW	Number of native wetland species having at least 10% relative cover within the 3-ft radius plot
88	NW20pctNW	Number of native wetland species having at least 20% relative cover within the 3-ft radius plot
89	NW50pctNw	Number of native wetland species having at least 50% relative cover within the 3-ft radius plot
90	TreeNpctT	Number of native species which when mature are typically a tree. Only includes plants shorter than 3 ft at the time of the survey.
91	ShrNpctS	Number of native species which when mature are typically a shrub. Only includes plants shorter than 3 ft at the time of the survey.
92	GrasNpctG	Number of native grasslike species
93	ForbNpctF	Number of native leafy forb species
94	TreeWpctT	Number of characteristically wetland tree species. Only includes plants shorter than 3 ft at the time of the survey.
95	ShrWpctS	Number of characteristically wetland species. Only includes plants shorter than 3 ft at the time of the survey.
96	GrassWpctG	Number of characteristically wetland grasslike species
97	ForbWpctF	Number of characteristically wetland leafy forb species
98	CovNtvAvPctAllC	Ratio of mean percent cover of native species to mean percent cover of all species
99	CovWetAvPctAllC	Ratio of mean percent cover of wetland species to mean percent cover of all species
100	SppallCV	Coefficient of variation in number of species per plot, among all plots on this site's lateral transects

#	Variable	Explanation of Variable
101	SptreeCV	Coefficient of variation in number of tree species per plot, among all plots on this site's lateral transects
102	SpShrubCV	Coefficient of variation in number of shrub species per plot, among all plots on this site's lateral transects
103	SpgrassCV	Coefficient of variation in number of grasslike species per plot, among all plots on this site's lateral transects
104	SpForbCV	Coefficient of variation in number of forb species per plot, among all plots on this site's lateral transects
105	Spdom10CV	Coefficient of variation in number of species per plot that have at least 10 percent cover within the plot, among all plots on this site's lateral transects
106	Spdom20CV	Coefficient of variation in number of species per plot that have at least 20 percent cover within the plot, among all plots on this site's lateral transects
107	Spdom50CV	Coefficient of variation in number of species per plot that have at least 50 percent cover within the plot, among all plots on this site's lateral transects
108	SpntvCV	Coefficient of variation in number of native species per plot, among all plots on this site's lateral transects
109	SpwetCV	Coefficient of variation in number of characteristically wetland species per plot, among all plots on this site's lateral transects
110	SpwetNcv	Coefficient of variation in number of native wetland species per plot, among all plots on this site's lateral transects
111	Ndom10cv	Coefficient of variation in number of native species per plot that have at least 10 percent cover within the plot, among all plots on this site's lateral transects
112	Ndom20cv	Coefficient of variation in number of native species per plot that have at least 20 percent cover within the plot, among all plots on this site's lateral transects
113	Ndom50cv	Coefficient of variation in number of native species per plot that have at least 50 percent cover within the plot, among all plots on this site's lateral transects
114	Wdom10cv	Coefficient of variation in number of wetland species per plot that have at least 10 percent cover within the plot, among all plots on this site's lateral transects
115	Wdom20cv	Coefficient of variation in number of wetland species per plot that have at least 20 percent cover within the plot, among all plots on this site's lateral transects
116	Wdom50cv	Coefficient of variation in number of wetland species per plot that have at least 50 percent cover within the plot, among all plots on this site's lateral transects
117	WN10cv	Coefficient of variation in number of native wetland species per plot that have at least 10 percent cover within the plot, among all plots on this site's lateral transects
118	WN20cv	Coefficient of variation in number of native wetland species per plot that have at least 20 percent cover within the plot, among all plots on this site's lateral transects
119	WN50cv	Coefficient of variation in number of native wetland species per plot that have at least 50 percent cover within the plot, among all plots on this site's lateral transects
120	TreeNcv	Coefficient of variation in number of native tree species per plot, among all plots on this site's lateral transects
121	ShrNcv	Coefficient of variation in number of native shrub species per plot, among all plots on this site's lateral transects
122	GrassNcv	Coefficient of variation in number of native grasslike species per plot, among all plots on this site's lateral transects
123	ForbNcv	Coefficient of variation in number of native forb species per plot, among all plots on this site's lateral transects
124	TreeWcv	Coefficient of variation in number of tree species per plot
125	ShrWcv	Coefficient of variation in number of shrub species per plot
126	GrassWcv	Coefficient of variation in number of grasslike species per plot
127	ForbWcv	Coefficient of variation in number of forb species per plot, among all plots on this site's lateral transects
128	Treentvwts	Coefficient of variation in number of native wetland tree species per plot, among all plots on this site's lateral transects
129	Shrntvwtsp	Coefficient of variation in number of native wetland shrub species per plot, among all plots on this site's lateral transects

#	Variable	Explanation of Variable
130	Grassntvwt	Coefficient of variation in number of native wetland grasslike species per plot, among all plots on this site's lateral transects
131	Forbntvwts	Coefficient of variation in number of native wetland forb species per plot, among all plots on this site's lateral transects
132	Covavgsp	Coefficient of variation in average species percent cover per plot, among all plots on this site's lateral transects
133	Covmaxsp	Coefficient of variation in maximum species percent cover per plot, among all plots on this site's lateral transects
134	Covavgntvs	Coefficient of variation in average native species percent cover per plot, among all plots on this site's lateral transects
135	Covmaxntvs	Coefficient of variation in maximum native species percent cover per plot, among all plots on this site's lateral transects
136	Covsumntvs	Coefficient of variation in sum of native species percent cover per plot, among all plots on this site's lateral transects
137	Covavgwets	Coefficient of variation in average wetland species percent cover per plot, among all plots on this site's lateral transects
138	Covmaxwets	Coefficient of variation in maximum wetland species percent cover per plot, among all plots on this site's lateral transects
139	Covsumwets	Coefficient of variation in sum of wetland species percent cover per plot, among all plots on this site's lateral transects
140	Covavntvwt	Coefficient of variation in average native wetland species percent cover per plot, among all plots on this site's lateral transects
141	Covmxntvwt	Coefficient of variation in maximum native wetland species percent cover per plot, among all plots on this site's lateral transects
142	Covsumntvw	Coefficient of variation in sum of native wetland species percent cover per plot, among all plots on this site's lateral transects
143	Covtreeav	Coefficient of variation in tree species mean percent cover per plot, among all plots on this site's lateral transects
144	Covshrav	Coefficient of variation in shrub species mean percent cover per plot among all plots on this site's lateral transects
145	Covgrassav	Coefficient of variation in grasslike species mean percent cover per plot among all plots on this site's lateral transects
146	Covforbav	Coefficient of variation in forb species mean percent cover per plot among all plots on this site's lateral transects
147	Covtreemx	Coefficient of variation in tree species maximum percent cover per plot, among all plots on this site's lateral transects
148	Covshrmx	Coefficient of variation in shrub species maximum percent cover per plot among all plots on this site's lateral transects
149	Covgrassmx	Coefficient of variation in grasslike species maximum percent cover per plot among all plots on this site's lateral transects
150	Covforbmx	Coefficient of variation in forb species maximum percent cover per plot among all plots on this site's lateral transects
151	Covtreesum	Coefficient of variation in tree species summed percent cover per plot, among all plots on this site's lateral transects
152	Covshrsum	Coefficient of variation in shrub species summed percent cover per plot among all plots on this site's lateral transects
153	Covgrassum	Coefficient of variation in grasslike species summed percent cover per plot among all plots on this site's lateral transects
154	Covforbsum	Coefficient of variation in forb species summed percent cover per plot among all plots on this site's lateral transects
155	Wetscoravg	Coefficient of variation in mean wetness score per plot, among all plots on this site's lateral transects (see #15-16 in PLOTDATA)
156	Wetscormax	Coefficient of variation in maximum wetness score per plot
157	Wetscormin	Coefficient of variation in minimum wetness score per plot

#	Variable	Explanation of Variable
158	Wtdwetscor	Coefficient of variation in wetness score weighted by percent cover, per plot among all plots on this site's lateral transects
159	Treescorav	Coefficient of variation in tree mean wetness score per plot, among all plots on this site's lateral transects
160	Shrscorav	Coefficient of variation in shrub mean wetness score per plot
161	Grasscorav	Coefficient of variation in grasslike species mean wetness score per plot
162	Forbscorav	Coefficient of variation in forb mean wetness score per plot
163	Treescormx	Coefficient of variation in tree maximum wetness score per plot, among all plots on this site's lateral transects
164	Shrscormx	Coefficient of variation in shrub maximum wetness score per plot
165	Grasscormx	Coefficient of variation in grasslike species maximum wetness score per plot
166	Forbscormx	Coefficient of variation in forb maximum wetness score per plot
167	Treescormn	Coefficient of variation in tree minimum wetness score per plot, among all plots on this site's lateral transects
168	Shrscormn	Coefficient of variation in shrub minimum wetness score per plot
169	Grasscormn	Coefficient of variation in grasslike species minimum wetness score per plot
170	Forbscormn	Coefficient of variation in forb minimum wetness score per plot
171	Gammaav	Coefficient of variation in mean gamma score per plot, among all plots on this site's lateral transects (see #18 in PLOTVAR file)
172	Gammamax	Coefficient of variation in maximum gamma score per plot, among all plots on this site's lateral transects
173	Gammamin	Coefficient of variation in minimum gamma score per plot, among all plots on this site's lateral transects
174	Gammasum	Coefficient of variation in summed gamma score per plot, among all plots on this site's lateral transects
175	WtdgamAv	Coefficient of variation in mean weighted gamma score per plot, among all plots on this site's lateral transects (see #18 in PLOTVAR file)
176	WtdgamMx	Coefficient of variation in maximum weighted gamma score per plot, among all plots on this site's lateral transects
177	Gammntvavg	Coefficient of variation in mean native species gamma score per plot, among all plots on this site's lateral transects (see #18 in PLOTVAR file)
178	Gammntvmax	Coefficient of variation in maximum native species gamma score per plot, among all plots on this site's lateral transects
179	Gammntvmin	Coefficient of variation in minimum native species gamma score per plot, among all plots on this site's lateral transects
180	Gammntvsum	Coefficient of variation in summed native species gamma score per plot, among all plots on this site's lateral transects
181	Gammwetavg	Coefficient of variation in mean wetland species gamma score per plot, among all plots on this site's lateral transects (see #18 in PLOTVAR file)
182	Gammwetmax	Coefficient of variation in maximum wetland species gamma score per plot, among all plots on this site's lateral transects
183	Gammwetmin	Coefficient of variation in minimum wetland species gamma score per plot, among all plots on this site's lateral transects
184	Gammwetsum	Coefficient of variation in summed wetland species gamma score per plot, among all plots on this site's lateral transects
185	Gamwtntvav	Coefficient of variation in mean native wetland species gamma score per plot, among all plots on this site's lateral transects (see #18 in PLOTVAR file)
186	Gamwtntvmx	Coefficient of variation in maximum native wetland species gamma score per plot, among all plots on this site's lateral transects
187	Gamwtntvmn	Coefficient of variation in minimum native wetland species gamma score per plot, among all plots on this site's lateral transects
188	Gamwtntsum	Coefficient of variation in summed native wetland species gamma score per plot, among all plots on this site's lateral transects
189	Sp10pctall	Proportion of all plant species in the plot that occupied at least 10% of the plot, coefficient of variation among all plots on this site's lateral transect

#	Variable	Explanation of Variable
190	Sp20pctall	Proportion of all plant species in the plot that occupied at least 20% of the plot, coefficient of variation among all plots on this site's lateral transect
191	Sp50pctall	Proportion of all plant species in the plot that occupied at least 50% of the plot, coefficient of variation among all plots on this site's lateral transect
192	Ntvpctall	Proportion of all plant species in the plot that were native species, coefficient of variation among all plots on this site's lateral transect
193	Wtsppctall	Proportion of all plant species in the plot that were characteristically wetland species, coefficient of variation among all plots on this site's lateral transect
194	Wtnpctall	Proportion of all plant species in the plot that were native wetland species, coefficient of variation among all plots on this site's lateral transect
195	Wn10pctwn	Wetland native species that occupied at least 10% of the plot, as a proportion of all wetland natives in the plot, coefficient of variation among all plots on this site's lateral transect
196	Wn20pctwn	Wetland native species that occupied at least 20% of the plot, as a proportion of all wetland natives in the plot, coefficient of variation among all plots on this site's lateral transect
197	Wn50pctwn	Wetland native species that occupied at least 50% of the plot, as a proportion of all wetland natives in the plot, coefficient of variation among all plots on this site's lateral transect
198	Grassnpctg	Native grasslike species as a proportion of all grasslike species in the plot, coefficient of variation among all plots on this site's lateral transect
199	Graswpctg	Grasslike wetland species as a proportion of all grasslike species in the plot, coefficient of variation among all plots on this site's lateral transect
200	Wnpctw	Native wetland species as a proportion of all wetland species in the plot, coefficient of variation among all plots on this site's lateral transect
201	Wnpctn	Native wetland species as a proportion of all native species in the plot, coefficient of variation among all plots on this site's lateral transect
202	Treenwpctt	Wetland trees as a proportion of all tree species in the plot, coefficient of variation among all plots on this site's lateral transect
203	Shrnwpcts	Wetland shrubs as a proportion of all shrub species in the plot
204	Grasnwpctg	Wetland grasslike species as a proportion of all grasslike species in the plot
205	Forbnwpctf	Wetland forbs as a proportion of all forb species in the plot
206	NoDataWet	Proportion of lateral transect species that had not been classified according to their wetland status (so could not be used in calculation of the wetness index); variable is useful for measuring potential bias in other variables that deal with wetness
207	NwetspAny	number of plots along the lateral transect that contained any characteristically wetland-associated species in the understory
208	NntvspAny	number of plots along the lateral transect that contained any native species in the understory
209	Nntvwet	number of plots along the lateral transect that contained any native wetland species in the understory
210	Ndom50	number of plots along the lateral transect that contained >50% relative cover of a single plant species
211	Nntv10	number of plots along the lateral transect in which summed percent cover of native species exceeded 10%
212	Nntv20	number of plots along the lateral transect in which summed percent cover of native species exceeded 20%
213	Nntv50	number of plots along the lateral transect in which summed percent cover of native species exceeded 50%
214	NwetNtv10	number of plots along the lateral transect in which summed percent cover of native wetland species exceeded 10%
215	NwetNtv20	number of plots along the lateral transect in which summed percent cover of native wetland species exceeded 20%
216	NwetNtv50	number of plots along the lateral transect in which summed percent cover of native wetland species exceeded 50%

#	Variable	Explanation of Variable
217	JacSiteAv	Similarity of the cumulative plant list from this site's lateral transect to that of other site's lateral transects, as calculated by Jaccard index, mean of comparisons with all other sites
218	JacSiteMx	Similarity of the cumulative plant list from this site's lateral transect to that of the most floristically similar other site, as calculated by Jaccard index
219	JacSiteMn	Similarity of the cumulative plant list from this site's lateral transect to that of the least floristically similar other site, as calculated by Jaccard index
220	SorSiteAv	Similarity of the cumulative plant list from this site's greenlin to that of other site's lateral transects, as calculated by Sorenson index, mean of comparisons with all other sites
221	SorSiteMx	Similarity of the cumulative plant list from this site's lateral transect to that of the most floristically similar other site, as calculated by Sorenson index
222	SorSiteMn	Similarity of the cumulative plant list from this site's lateral transect to that of the least floristically similar other site, as calculated by Sorenson index
223	SorAbSiAv	Similarity of the cumulative plant list from this site's greenlin to that of other site's lateral transects, as calculated by Sorenson index weighted by summed percent cover, mean of comparisons with all other sites
224	SorAbSiMx	Similarity of the cumulative plant list from this site's lateral transect to that of the most floristically similar other site, as calculated by Sorenson index weighted by summed percent cover,
225	SorAbSiMn	Similarity of the cumulative plant list from this site's lateral transect to that of the least floristically similar other site, as calculated by Sorenson index weighted by summed percent cover,
226	MorSiteAv	Similarity of the cumulative plant list from this site's greenlin to that of other site's lateral transects, as calculated by Morisita index, mean of comparisons with all other sites
227	MorSiteMx	Similarity of the cumulative plant list from this site's lateral transect to that of the most floristically similar other site, as calculated by Morisita index
228	MorSiteMn	Similarity of the cumulative plant list from this site's lateral transect to that of the least floristically similar other site, as calculated by Morisita index
229	JaccPtAv	Similarity of plant species composition in each lateral transect plot to that of other lateral transect plots, as calculated by Jaccard index, mean of all plots on this site's lateral transect transect
230	SorPtAv	Similarity of plant species composition in each lateral transect plot to that of other lateral transect plots, as calculated by Sorenson index, mean of all plots on this site's lateral transect transect
231	SorAbPtAv	Similarity of plant species composition in each lateral transect plot to that of other lateral transect plots, as calculated by Sorenson index weighted by percent cover of the component species, mean of all plots on this site's lateral transect transect
232	MorPtAv	Similarity of plant species composition in each lateral transect plot to that of other lateral transect plots, as calculated by Morisita-Horn index which accounts for percent cover of the component species, mean of all plots on this site's lateral transect transect

Data directory for HGMGPLOT

Variables for 200 greenline plots, mostly describing physical features and gross vegetation characteristics.
NOTE: In this file, "trees" are defined as woody plants that currently are >20 ft tall, and "shrubs" are woody plants that currently are 3-20 ft tall.
Note: Blank cells in this database are intentional: do not change to 0's.

#	Variable	Explanation of Variable
1	Sitecode	valid identifier for site (but not for the plot)
2	SiteType	type of site (0= non-systematic, 1= systematic)
3	Side	side of the channel, looking upriver
4	Point	distance of plot from beginning of greenline (0-ft mark) at this site
5	PtCode	the full, valid, unique identifier for site
6	Wetland	Plot has >49% percent cover of wetland-associated plants (FAC and wetter) in the understory (1= yes, 0= no)
7	CBchg	difference in elevation between this channel bottom point and the next one upriver in the channel
8	WEchg	difference in elevation between this wetted edge point and the next one upriver and parallel to the channel
9	GLchg	difference in elevation between this greenline point and the next one, parallel to channel
10	ElAbovWE	Elevation of the botanical survey point above the wetted edge
11	ElAbovCB	Elevation of the botanical survey point above the channel bottom
12	VMC	volumetric moisture content, mean of 2 measurements made at the point with a HydroSense moisture content meter during the survey visit
13	Water3	surface water in 3-ft radius plot (1= yes, 0= no)
14	Bare3	Bare substrate in plot (1= yes, 0= no)
15	Litter3	Plant litter in plot (1= yes, 0= no)
16	TexNum1	Soil texture in upper 12" (1=bedrock, 2=boulder, 3= artificial, 4= cobble/gravel, 5= woody debris, 6= sand, 7= sandy loam, 8=silt, 9= loam, 10= clay)
17	TexNum2	Soil texture in upper 12" (if two textures present) – see codes above
18	TexNum3	Soil texture in upper 12" (if three textures present) – see codes above
19	TexTypes	Number of texture categories in upper 12"
20	Bedrock1	Presence/absence of bedrock in upper 12" of soil or sediment (1= yes, 0= no))
21	Boulder2	Presence/absence of boulders in upper 12" of soil or sediment (1= yes, 0= no)
22	Artific3	Presence/absence of artificial substrate in upper 12" of soil or sediment (1= yes, 0= no)
23	CobbGrv4	Presence/absence of cobble or gravel in upper 12" of soil or sediment (1= yes, 0= no)
24	Debris5	Presence/absence of woody debris in upper 12" of soil or sediment (1= yes, 0= no)
25	SSLoam678	Presence/absence of sand, sandy silt loam, silt loam, or silt in upper 12" of soil or sediment (1= yes, 0= no)
26	Loam9	Presence/absence of loam in upper 12" of soil or sediment (1= yes, 0= no)
27	Clay10	Presence/absence of clay in upper 12" of soil or sediment (1= yes, 0= no)
28	Shift?	Presence/absence of shift in soil texture in upper 12" (1= yes, 0= no)
29	Shiftd1	Minimum depth at which a shift in substrate texture occurs, in upper 12"
30	Shiftd2	Maximum depth at which a shift in substrate texture occurs, in upper 12"
31	Redox?	Presence/absence of redoximorphic indicators in soil (1= yes, 0= no)
32	RedoxD	Minimum depth at which redoximorphic indicators are present, in upper 12" (0= no redox)
33	Canopyf	Densiometer reading for forward quadrant (facing upriver)
34	Canopyr	Densiometer reading for right-facing quadrant
35	Canopyb	Densiometer reading for backward-facing quadrant
36	Canopyl	Densiometer reading for left-facing quadrant
37	CanSum	Overstory closure (sum of densiometer readings X 1.04)
38	CanMax	Densiometer reading, maximum of 4 quadrants, X 1.04

#	Variable	Explanation of Variable
39	CanMin	Densiometer reading, minimum of 4 quadrants, X 1.04
40	Shrub15	Shrub & vine relative percent cover within 15 ft radius
41	Herb15	Herbaceous vegetation relative percent cover within 15 ft radius
42	Bare15	Bare ground, litter, downed wood, and water relative percent cover within 15 ft radius
43	DomVeg	Which is largest proportionage -- shrub, herb, or bare? (from above) (S=shrub, H-herb, B= bare)
44	Tree4	Number of live trees in the 4-12” dbh class within 15 ft radius
45	Tree12	Number of live trees in the 12-20” dbh class within 15 ft radius
46	Tree20	Number of live trees in the >20” dbh class within 15 ft radius
47	TreeTot	Total number of live trees within 15 ft radius
48	NumLiveCl	Number of live trees within 15 ft radius
49	TreeDmax	DBH of the largest live tree within 15 ft radius
50	Dead4	Number of dead standing trees in the 4-12” dbh class within 15 ft radius
51	Dead12	Number of dead standing trees in the 12-20” dbh class within 15 ft radius
52	Dead20	Number of dead standing trees in the >20” dbh class within 15 ft radius
53	DeadTot	Total number of dead standing trees within 15 ft radius
54	NumDeadCl	Number of dead standing trees within 15 ft radius
55	DeadDmax	DBH of the largest standing dead tree within 15 ft radius
56	Downsb	Downed wood: 1-5” diameter with branches & bark mostly intact
57	Downsm	Downed wood: 1-5” diameter with intermediate decay
58	Downsr	Downed wood: 1-5” diameter with advanced decay
59	Downmb	Downed wood: 5-10” diameter with branches & bark mostly intact
60	Downmm	Downed wood: 5-10” diameter with intermediate decay
61	Downmr	Downed wood: 5-10” diameter with advanced decay
62	Downlb	Downed wood: >10” diameter with branches & bark mostly intact
63	Downlm	Downed wood: >10” diameter with intermediate decay
64	Downlr	Downed wood: >10” diameter with advanced decay
65	DownTot	Total pieces of downed wood at least 6 ft long
66	NumDownTypes	Number of types of downed wood (from 9 above)
67	DownSmSum	Downed wood: 1-5” diameter, all decay classes
68	DownMedSum	Downed wood: 5-10” diameter, all decay classes
69	DownBigSum	Downed wood: >10” diameter, all decay classes
70	DownNewSum	Downed wood: with branches & bark mostly intact, all size classes
71	DownYr1Sum	Downed wood: with intermediate decay, all size classes
72	DownYr2Sum	Downed wood: with advanced decay, all size classes
73	Comments	

Data directory for HGMLPLOT

Variables for 810 lateral transect plots, mostly describing physical features and gross vegetation characteristics.
NOTE: In this file, "trees" are defined as woody plants that currently are >20 ft tall, and "shrubs" are woody plants that currently are 3-20 ft tall.
Note: Blank cells in this database are intentional: do not change to 0's.

#	Variable	Explanation of Variable
1	Sitecode	valid identifier for site (but not for the plot)
2	SiteType	type of site (0= non-systematic, 1= systematic)
3	Line	code for laterat transect line (L2 indicates a second transect, L3 a third, etc.)
4	Side	side of the channel, looking upriver
5	Point	distance of plot from midpoint (200-ft mark) of greenline
6	PctFPwidth	lateral position in the floodplain; = distance to water / floodplain width (diked)
7	PtCode	the full, valid, unique identifier for site
8	TransLength	length of the lateral transect
9	ElAbovMin	elevation (ft) of plot above the minimum elevation of the transect (usually, the channel bottom)
10	Water3	surface water in 3-ft radius plot (1= yes, 0= no)
11	Bare3	Bare substrate in plot (1= yes, 0= no)
12	Litter3	Plant litter in plot (1= yes, 0= no)
13	Wetland	Plot has >49% percent cover of wetland-associated plants (FAC and wetter) in the understory or has mottled soils (1= yes, 0= no)
14	DistToWater	Distance to surface water (ft), either the river channel or in floodplain
15	VMC	volumetric moisture content, mean of 2 measurements made at the point with a HydroSense moisture content meter during the survey visit
16	PtIntervl	Interval between points in this transect (ft)
17	TexNum1	Soil texture in upper 12" (1=bedrock, 2=boulder, 3= artificial, 4= cobble/gravel, 5= woody debris, 6= sand, 7= sandy loam, 8=silt, 9= loam, 10= clay)
18	TexNum2	Soil texture in upper 12" (if two textures present)
19	TexNum3	Soil texture in upper 12" (if three textures present)
20	TexTypes	Number of texture categories in upper 12"
21	Bedrock1	Presence/absence of bedrock in upper 12" of soil or sediment (1= yes, 0= no))
22	Boulder2	Presence/absence of boulders in upper 12" of soil or sediment ((1= yes, 0= no)
23	Artific3	Presence/absence of artificial substrate in upper 12" of soil or sediment (1= yes, 0= no)
24	CobbGrv4	Presence/absence of cobble or gravel in upper 12" of soil or sediment (1= yes, 0= no)
25	Debris5	Presence/absence of woody debris in upper 12" of soil or sediment (1= yes, 0= no)
26	SSLoam678	Presence/absence of sand, sandy silt loam, silt loam, or silt in upper 12" of soil or sediment (1= yes, 0= no)
27	Loam9	Presence/absence of loam in upper 12" of soil or sediment (1= yes, 0= no)
28	Clay10	Presence/absence of clay in upper 12" of soil or sediment (1= yes, 0= no)
29	Shift?	Presence/absence of shift in soil texture in upper 12" (1= yes, 0= no)
30	Shiftd1	Minimum depth at which a shift in substrate texture occurs, in upper 12"
31	Shiftd2	Maximum depth at which a shift in substrate texture occurs, in upper 12"
32	Redox?	Presence/absence of redoximorphic indicators in soil (1= yes, 0= no)
33	RedoxD	Minimum depth at which redoximorphic indicators are present, in upper 12"
34	Canopyf	Densiometer reading for forward quadrant (facing upriver)
35	Canopyr	Densiometer reading for right-facing quadrant
36	Canopyb	Densiometer reading for backward-facing quadrant
37	Canopyl	Densiometer reading for left-facing quadrant
38	CanSum	Overstory closure (sum of densiometer readings X 1.04)
39	CanMax	Densiometer reading, maximum of 4 quadrants, X 1.04
40	CanMin	Densiometer reading, minimum of 4 quadrants, X 1.04
41	Shrub15	Shrub & vine relative percent cover within 15 ft radius
42	Herb15	Herbaceous vegetation relative percent cover within 15 ft radius
43	Bare15	Bare ground, litter, downed wood, and water relative percent cover within 15 ft radius

#	Variable	Explanation of Variable
44	DomVeg	Which is largest proportionage -- shrub, herb, or bare? (from above) (S=shrub, H-herb, B= bare)
45	Tree4	Number of live trees in the 4-12” dbh class within 15 ft radius
46	Tree12	Number of live trees in the 12-20” dbh class within 15 ft radius
47	Tree20	Number of live trees in the >20” dbh class within 15 ft radius
48	TreeTot	Total number of live trees within 15 ft radius
49	NumLiveCl	Number of live trees within 15 ft radius
50	TreeDmax	DBH of the largest live tree within 15 ft radius
51	Dead4	Number of dead standing trees in the 4-12” dbh class within 15 ft radius
52	Dead12	Number of dead standing trees in the 12-20” dbh class within 15 ft radius
53	Dead20	Number of dead standing trees in the >20” dbh class within 15 ft radius
54	DeadTot	Total number of dead standing trees within 15 ft radius
55	NumDeadCl	Number of dead standing trees within 15 ft radius
56	DeadDmax	DBH of the largest standing dead tree within 15 ft radius
57	Downsb	Downed wood: 1-5” diameter with branches & bark mostly intact
58	Downsm	Downed wood: 1-5” diameter with intermediate decay
59	Downsr	Downed wood: 1-5” diameter with advanced decay
60	Downmb	Downed wood: 5-10” diameter with branches & bark mostly intact
61	Downmm	Downed wood: 5-10” diameter with intermediate decay
62	Downmr	Downed wood: 5-10” diameter with advanced decay
63	Downlb	Downed wood: >10” diameter with branches & bark mostly intact
64	Downlm	Downed wood: >10” diameter with intermediate decay
65	Downlr	Downed wood: >10” diameter with advanced decay
66	DownTot	Total pieces of downed wood at least 6 ft long
67	NumDownTypes	Number of types of downed wood (from 9 above)
68	DownSmSum	Downed wood: 1-5” diameter, all decay classes
69	DownMedSum	Downed wood: 5-10” diameter, all decay classes
70	DownBigSum	Downed wood: >10” diameter, all decay classes
71	DownNewSum	Downed wood: with branches & bark mostly intact, all size classes
72	DownYr1Sum	Downed wood: with intermediate decay, all size classes
73	DownYr2Sum	Downed wood: with advanced decay, all size classes
74	Comments	

Data directory for HGMGSITE

By site (for 40 sites), data and summary statistical measures from greenline transects (5 plots/site). Contains data on gradient, substrate, general vegetation structure, dominant woody cover types, spatial coefficients of variation of these, and other variables.

NOTE: In this file, "trees" are defined as woody plants that currently are >20 ft tall, and "shrubs" are woody plants that currently are 3-20 ft tall.
Note: Blank cells in this database are intentional: do not change to 0's.

#	Variable	Explanation of Variable
1	SiteNnew	identifier for site
2	SiteType	type of site (0= non-systematic, 1= systematic)
3	Nwetland	number of plots along the greenline that were "wetland" (i.e., >49% percent cover of characteristically wetland-associated plants in understory)
4	Shr15av	percent shrub cover within 15 ft, mean of the 5 greenline plots
5	Shr15max	percent shrub cover within 15 ft, maximum of the 5 greenline plots
6	Shr15min	percent shrub cover within 15 ft, minimum of the 5 greenline plots
7	Herb15av	percent herb cover within 15 ft, mean of the 5 greenline plots
8	Herb15max	percent herb cover within 15 ft, maximum of the 5 greenline plots
9	Herb15min	percent herb cover within 15 ft, minimum of the 5 greenline plots
10	Bare15av	percent unvegetated (bare substrate or water) cover within 15 ft, mean of the 5 greenline plots
11	Bare15max	percent unvegetated cover within 15 ft, maximum of the 5 greenline plots
12	Bare15min	percent unvegetated cover within 15 ft, minimum of the 5 greenline plots
13	Tree4av	number of 4-12" diameter live trees within 15 ft, mean of the 5 greenline plots
14	Tree4max	number of 4-12" diameter live trees within 15 ft, maximum of the 5 greenline plots
15	Tree12av	number of 12-20" diameter live trees within 15 ft, mean of the 5 greenline plots
16	Tree12max	number of 12-20" diameter live trees within 15 ft, maximum of the 5 greenline plots
17	Tree20av	number of >20" diameter live trees within 15 ft, mean of the 5 greenline plots
18	Tree20max	number of >20" diameter live trees within 15 ft, maximum of the 5 greenline plots
19	TreeTotav	number of live trees (all sizes) within 15 ft, mean of the 5 greenline plots
20	TreeTotmax	number of live trees (all sizes) within 15 ft, maximum of the 5 greenline plots
21	NumLivClAv	number of live tree size classes (of 3 possible), mean of the 5 greenline plots
22	NumLivClMx	number of live tree size classes (of 3 possible), maximum of the 5 greenline plots
23	NumLivClMn	number of live tree size classes (of 3 possible), minimum of the 5 greenline plots
24	TreeDbigAv	diameter (dbh) of the largest live tree along the greenline, mean of the 5 greenline plots
25	TreeDbigMax	diameter (dbh) of the largest live tree along the greenline, maximum of the 5 greenline plots
26	TreeDbigMin	diameter (dbh) of the largest live tree along the greenline, minimum of the 5 greenline plots
27	DownSBav	number of small (<5" diameter), newly fallen woody debris pieces within 15 ft., mean of the 5 greenline plots
28	DownSBmax	number of small (<5" diameter), newly fallen woody debris pieces within 15 ft., maximum of the 5 greenline plots
29	DownSMav	number of small (<5" diameter), slightly decayed woody debris pieces within 15 ft., mean of the 5 greenline plots
30	DownSMmax	number of small (<5" diameter), slightly decayed woody debris pieces within 15 ft., maximum of the 5 greenline plots
31	DownMBav	number of mid-sized (<5-10" diameter), newly fallen woody debris pieces within 15 ft., mean of the 5 greenline plots
32	DownMBmax	number of mid-sized (<5-10" diameter), newly fallen woody debris pieces within 15 ft., maximum of the 5 greenline plots
33	DownMMav	number of mid-sized (<5-10" diameter), slightly decayed woody debris pieces within 15 ft., mean of the 5 greenline plots

#	Variable	Explanation of Variable
34	DownMMmax	number of mid-sized (<5-10” diameter), slightly decayed woody debris pieces within 15 ft., maximum of the 5 greenline plots
35	DownLBav	number of large (>10” diameter)newly fallen woody debris pieces within 15 ft., mean of the 5 greenline plots
36	DownLBmax	number of large (>10” diameter) newly fallen woody debris pieces within 15 ft., maximum of the 5 greenline plots
37	DownLMav	number of large (>10” diameter) slightly decayed woody debris pieces within 15 ft., mean of the 5 greenline plots
38	DownLMax	number of large (>10” diameter) slightly decayed woody debris pieces within 15 ft., maximum of the 5 greenline plots
39	DownLRav	number of large (>10” diameter) well-decayed woody debris pieces within 15 ft., mean of the 5 greenline plots
40	DownLRmax	number of large (>10” diameter) well-decayed woody debris pieces within 15 ft., maximum of the 5 greenline plots
41	DownTotAv	number of downed woody debris pieces (all sizes and decay classes), mean of the 5 greenline plots
42	DownTotMax	number of downed woody debris pieces (all sizes and decay classes), maximum of the 5 greenline plots
43	DownTypsAv	number of classes of downed woody debris (of 9 possible sizes and decay class combinations), mean of the 5 greenline plots
44	DownTypsMx	number of classes of downed woody debris (of 9 possible sizes and decay class combinations), maximum of the 5 greenline plots
45	DownSSumAv	number of small (<5” diameter) woody debris pieces (all decay classes) within 15 ft., mean of the 5 greenline plots
46	DownSSumMx	number of small (<5” diameter) woody debris pieces (all decay classes) within 15 ft., maximum of the 5 greenline plots
47	DownMSumAv	number of mid-sized (5-10” diameter) woody debris pieces (all decay classes) within 15 ft., mean of the 5 greenline plots
48	DownMSumMx	number of mid-sized (5-10” diameter) woody debris pieces (all decay classes) within 15 ft., maximum of the 5 greenline plots
49	DownLSumAv	number of large (>10” diameter) woody debris pieces (all decay classes) within 15 ft., mean of the 5 greenline plots
50	DownLSumMx	number of large (>10” diameter) woody debris pieces (all decay classes) within 15 ft., maximum of the 5 greenline plots
51	DownNewAv	number of newly fallen woody debris pieces (all size classes) within 15 ft., mean of the 5 greenline plots
52	DownNewMx	number of newly fallen woody debris pieces (all size classes) within 15 ft., maximum of the 5 greenline plots
53	DownYr1Av	number of slightly decayed woody debris pieces (all size classes) within 15 ft., mean of the 5 greenline plots
54	DownYr1Mx	number of slightly decayed woody debris pieces (all size classes) within 15 ft., maximum of the 5 greenline plots
55	DownYr2Av	number of well-decayed woody debris pieces (all size classes) within 15 ft., mean of the 5 greenline plots
56	DownYr2Mx	number of well-decayed woody debris pieces (all size classes) within 15 ft., maximum of the 5 greenline plots
57	CanSumAv	percent canopy cover within 15 ft, mean of the 5 greenline plots
58	CanSumMax	percent canopy cover within 15 ft, maximum of the 5 greenline plots
59	CanSumMin	percent canopy cover within 15 ft, minimum of the 5 greenline plots
60	CanMaxAv	maximum densiometer reading in any of 4 quadrants of each plot, mean of the 5 greenline plots
61	CanMaxMax	maximum densiometer reading in any of 4 quadrants of each plot, maximum of the 5 greenline plots
62	CanMaxMin	maximum densiometer reading in any of 4 quadrants of each plot, minimum of the 5 greenline plots

#	Variable	Explanation of Variable
63	CanMinAv	minimum densiometer reading in any of 4 quadrants of each plot, mean of the 5 greenline plots
64	CanMinMax	minimum densiometer reading in any of 4 quadrants of each plot, maximum of the 5 greenline plots
65	CanMinMin	minimum densiometer reading in any of 4 quadrants of each plot, minimum of the 5 greenline plots
66	Bare3Num	number of plots along the greenline that were >80% unvegetated (bare substrate or water) within 3 ft.
67	Litr3Num	number of plots along the greenline that contained >80% dead plant material (leaves, woody debris, etc.) within 3 ft
68	BedRockN	number of plots along the greenline that contained bedrock within 12" of the surface
69	BoulderN	number of plots along the greenline that contained boulder within 12" of the surface
70	ArtificN	number of plots along the greenline that contained artificially placed material within 12" of the surface
71	CobbGravN	number of plots along the greenline that contained cobble or gravel within 12" of the surface
72	DebrisN	number of plots along the greenline that contained woody debris within 12" of the surface
73	SandN	number of plots along the greenline that contained sand within 12" of the surface
74	SandLoamN	number of plots along the greenline that contained sandy loam within 12" of the surface
75	SiltN	number of plots along the greenline that contained silt within 12" of the surface
76	LoamN	number of plots along the greenline that contained loam within 12" of the surface
77	ClayN	number of plots along the greenline that contained clay within 12" of the surface
78	TexTypNav	number of types of substrate (of the 10 types above) per plot, mean of the 5 greenline plots
79	TexTypNmax	number of types of substrate (of the 10 types above) per plot, maximum of the 5 greenline plots
80	NumShift	number of greenline plots in which substrate type shifted within 12" of the surface
81	NumRedox	number of greenline plots in which redoximorphic features were visible within 12" of the surface
82	CansumCV	percent canopy cover within 15 ft, coefficient of variation among the 5 greenline plots
83	CanmaxCV	maximum densiometer reading in any of 4 quadrants of each plot, coefficient of variation among the 5 greenline plots
84	CanminCV	minimum densiometer reading in any of 4 quadrants of each plot, coefficient of variation among the 5 greenline plots
85	Shrub15CV	percent shrub cover within 15 ft, coefficient of variation of the 5 greenline plots
86	Herb15CV	percent herb cover within 15 ft, coefficient of variation of the 5 greenline plots
87	Bare15CV	percent unvegetated (water or bare substrate) within 15 ft, coefficient of variation of the 5 greenline plots
88	TreetotCV	number of live trees per plot, coefficient of variation of the 5 greenline plots
89	DowntotCV	number of pieces of downed wood (all sizes and decay classes), coefficient of variation of the 5 greenline plots
90	ACENEGA	predominance of *Acer negundo* (box elder) or *Amorpha fruticosa* (W. false-indigo) anywhere along the greenline (0= no, 1= yes)
91	ELEANG	predominance of *Elaeagnus angustifolia* (Russian olive) anywhere along the greenline (0= no, 1= yes)
92	ALNRHO	predominance of *Alnus rhombifolia* (white alder) anywhere along the greenline (0= no, 1= yes)
93	APOCANR	predominance of *Apocynum cannabinum* (hemp dogbane), *Rosa woodsii* (Wood's rose), *Robinia pseudoacacia* (black locust), or *Pinus ponderosa* (ponderosa pine) anywhere along the greenline (0= no, 1= yes)

#	Variable	Explanation of Variable
94	POPBAL	predominance of *Populus balsamifera* var. t*richocarpa* (black cottonwood) anywhere along the greenline (0= no, 1= yes)
95	RUBDIS	predominance of *Rubus discolor* (Himalayan blackberry) anywhere along the greenline (0= no, 1= yes)
96	SALEXI	predominance of *Salix exigua* (coyote willow) anywhere along the greenline (0= no, 1= yes)
97	SALIX	predominance of other willow species anywhere along the greenline (0= no, 1= yes)
98	WatDepthMx	deepest channel water depth at time of survey; calculated as the difference between the wetted edge elevation and the channel bottom elevation; mean of greenline points
99	ElAboveWE	height of plant survey plots above the wetted edge elevation; mean of greenline points
100	ElAboveCB	height of plant survey plots above the channel bottom elevation; mean of greenline points
101	GradCBav	channel bottom gradient: the mean change in elevation among adjoining pairs of points located along the thalweg's channel bottom (0, 100, 200, 300, and 400 ft marks), divided by 400 ft, multiplied by 100
102	GradWEav	wetted edge gradient: the mean change in elevation among adjoining pairs of points located along the greenline (0, 100, 200, 300, and 400 ft marks) divided by 400 ft, multiplied by 100

Data directory for HGMLSITE

By site (40 sites), contains data and summary statistical measures from greenline transects (usually 20 plots/site). Contains data on gradient, substrate, general vegetation structure, dominant woody cover types, spatial coefficients of variation of these, and other variables.
NOTE: In this file, "trees" are defined as woody plants that currently are >20 ft tall, and "shrubs" are woody plants that currently are 3-20 ft tall.
Note: Blank cells in this database are intentional: do not change to 0's.

#	Variable	Explanation of Variable
1	Sitecode	valid identifier for site (but not for the plot)
	SiteType	type of site (0= non-systematic, 1= systematic)
3	PtInterval	interval between points in this transect (ft)
4	NumPlots	number of plots (usually 20) among all lateral transects at this site
5	NumTrans	number of lateral transects
6	TotLength	total length of lateral transects (ft)
7	ElRange	floodplain height (maximum – minimum elevation in ft)
8	FPslope	floodplain slope (= ElRange/TotLength)
9	ElCV	coefficient of variation of elevations along the site's lateral transect
10	DistWatrAv	mean distance (ft) to water of any plot on the lateral transect
11	DistWatrMx	farthest distance (ft) to water of any plot on the lateral transect
12	PlotHtAv	height of plant survey plots above the minimum transect elevation; mean of transect points (in ft)
13	PlotHtMax	maximum height of any plant survey plot above the minimum transect elevation
14	GradientChan	channel bottom gradient: the mean change in elevation among adjoining pairs of points located along the thalweg's channel bottom (0, 100, 200, 300, and 400 ft marks), divided by 400 ft, multiplied by 100
15	GradientGL	greenline gradient: mean change in elevation among adjoining pairs of points located along the wetted edge of the channel as existed at time of the survey, parallel to the 0, 100, 200, 300, and 400 ft points of the greenline
16	GradientWE	wetted edge gradient: the mean change in elevation among adjoining pairs of points located along the greenline (0, 100, 200, 300, and 400 ft marks) divided by 400 ft, multiplied by 100
17	Water3N	number of plots along the lateral that had >80% surface water within 3 ft radius, at the time of the survey
18	Bare3N	number of plots along the lateral that had >80% bare substrate within 3 ft. radius, at the time of the survey
19	Litter3N	number of plots along the lateral that contained >80% dead plant material (leaves, woody debris, etc.) within 3 ft at the time of the survey
20	WetlandN	number of plots along the transect that are "wetland" (i.e., >49% percent cover of characteristically wetland-associated plants in understory)
21	TextureN	number of types of substrate (of 10 possible), cumulative along the lateral transect
22	TexShiftN	number of lateral transect plots in which substrate type shifted within 12" of the surface
23	RedoxN	number of lateral transect plots in which redoximorphic features were visible within 12" of the surface
24	CanopyAv	percent canopy cover within 15 ft, mean of the ~20 lateral transect plots
25	CanopyMax	percent canopy cover within 15 ft, maximum of the ~20 lateral transect plots
26	CanopySum	percent canopy cover within 15 ft, sum of the ~20 lateral transect plots
27	Shrub15av	percent shrub cover within 15 ft, mean of the ~20 lateral transect plots
28	Shrub15max	percent shrub cover within 15 ft, maximum of the ~20 lateral transect plots
29	Herb15av	percent herb cover within 15 ft, mean of the ~20 lateral transect plots
30	Herb15max	percent herb cover within 15 ft, maximum of the ~20 lateral transect plots
31	Herb15min	percent herb cover within 15 ft, minimum of the ~20 lateral transect plots
32	Bare15av	percent unvegetated (bare substrate or water) cover within 15 ft, mean of the ~20 lateral transect plots
33	Bare15max	percent unvegetated cover within 15 ft, maximum of the ~20 lateral transect plots

#	Variable	Explanation of Variable
34	Bare15min	percent unvegetated cover within 15 ft, minimum of the ~20 lateral transect plots
35	Tree4sum	number of 4-12” diameter trees within 15 ft, sum of the ~20 lateral transect plots
36	Tree12sum	number of 12-20” diameter trees within 15 ft, sum of the ~20 lateral transect plots
37	Tree20sum	number of >20” diameter trees within 15 ft, sum of the ~20 lateral transect plots
38	TreeTotSum	sum of live trees (all size classes) within 15 ft, all ~20 lateral transect plots
39	TreeDbigAv	diameter (dbh) of the largest live tree along the lateral, mean of all ~20 lateral transect plots
40	TreeDbigMx	diameter (dbh) of the largest live tree along the lateral, maximum of all ~20 lateral transect plots
41	TreeDbigMn	diameter (dbh) of the largest live tree along the lateral, minimum of all ~20 lateral transect plots
42	Dead4sum	number of 4-12” dbh dead standing trees, sum for all ~20 lateral transect plots
43	Dead12sum	number of 12-20” dbh dead standing trees, sum for all ~20 lateral transect plots
44	Dead20sum	number of >20” dbh dead standing trees within 15 ft, sum for all ~20 lateral transect plots
45	DeadTotSum	number of dead standing trees (all sizes) within 15 ft, sum of the ~20 lateral transect plots
46	DownNtypes	number of types of downed woody debris (of 9 potential size and decay classes) within 15 ft, all lateral plots combined
47	DownTotSum	number of pieces of downed woody debris within 15 ft, all size and decay classes, all lateral plots combined
48	DownSumSm	number of pieces of small (<5”diameter) downed woody debris within 15 ft, all decay classes, all lateral plots combined
49	DownSumMed	number of pieces of mid-sized (5-10”) downed woody debris within 15 ft, all decay classes, all lateral plots combined
50	DownSumBig	number of pieces of large (>20”) downed woody debris within 15 ft., all decay classes, all lateral plots combined,
51	DownSumNew	number of pieces of recently fallen downed woody debris within 15 ft, all decay classes, all lateral plots combined
52	DownSumYr1	number of pieces of slightly decayed downed woody debris within 15 ft, all decay classes, all lateral plots combined
53	DownSumYr2	number of pieces of well-decayed downed woody debris within 15 ft, all decay classes, all lateral plots combined
54	DownSBsum	number of small (<5” diameter), newly fallen woody debris pieces within 15 ft., all lateral plots combined
55	DownSMsum	number of small (<5” diameter), slightly decayed downed woody debris pieces within 15 ft., all lateral plots combined
56	DownSRsum	number of pieces of small (<5” diameter), well-decayed downed woody debris within 15 ft, all lateral plots combined
57	DownMBsum	number of pieces of mid-sized (5-10”diameter), newly fallen downed woody debris within 15 ft, all lateral plots combined
58	DownMMsum	number of pieces of mid-sized, slightly decayed downed woody debris within 15 ft, all lateral plots combined
59	DownMRsum	number of pieces of mid-sized, well-decayed, downed woody debris within 15 ft, all lateral plots combined
60	DownLBsum	number of pieces of large (>10” diameter) recently fallen downed woody debris within 15 ft, all lateral plots combined
61	DownLMsum	number of pieces of large, slightly decayed downed woody debris within 15 ft, all lateral plots combined
62	DownLRsum	number of pieces of large, well-decayed downed woody debris within 15 ft, all lateral plots combined
63	NumSdom	number of lateral plots in which shrubs were spatially dominant
64	NumHdom	number of lateral plots in which herbs were spatially dominant
65	NumBdom	number of lateral plots in which surface water or bare substrates were spatially dominant

#	Variable	Explanation of Variable
66	CansumCV	percent canopy cover within 15 ft, coefficient of variation among the lateral transect plots
67	CanmaxCV	maximum densiometer reading in any of 4 quadrants of each plot, coefficient of variation among the lateral transect plots
68	CanminCV	minimum densiometer reading in any of 4 quadrants of each plot, coefficient of variation among the lateral transect plots
69	Shrub15CV	percent shrub cover within 15 ft, coefficient of variation among the ~20 lateral transect plots
70	Herb15CV	percent herb cover within 15 ft, coefficient of variation among the ~20 lateral transect plots
71	Bare15CV	percent unvegetated (water, bare, or litter) within 15 ft, coefficient of variation among the ~20 lateral transect plots
72	TreetotCV	total number of living trees within 15 ft, coefficient of variation among the ~20 lateral transect plots
73	DeadtotCV	total number of standing dead trees within 15 ft, coefficient of variation among the ~20 lateral transect plots
74	DowntotCV	total pieces of downed wood within 15 ft, coefficient of variation among the ~20 lateral transect plots
75	ACENEGA	predominance of *Acer negundo* (box elder), *Amorpha fruticosa* (W. false-indigo), or *Elaeagnus angustifolia* (Russian olive) anywhere along the lateral transect (0= no, 1= yes)
76	ALNRHO	predominance of *Alnus rhombifolia* (white alder) anywhere along the lateral transect (0= no, 1= yes)
77	APOCAN_ROSW	predominance of *Apocynum cannabinum* (hemp dogbane), *Rosa woodsii* (Wood's rose), *Robinia pseudoacacia* (black locust), or *Pinus ponderosa* (ponderosa pine) anywhere along the lateral transect (0= no, 1= yes)
78	ARTABS	predominance of *Artenisia absinthium* (wormwood) anywhere along the lateral transect (0= no, 1= yes)
79	BETOCC	predominance of *Betula occidentalis* (red birch) anywhere along the lateral transect (0= no, 1= yes)
80	CRADOU	predominance of *Crataegus douglasii* (black hawthorn), *Prunus virginiana* (chokecherry), or *Rhus glabra* (W. sumac) anywhere along the lateral transect (0= no, 1= yes)
81	HOLDIS	predominance of *Holodiscus discolor* (oceanspray) or *Physocarpus capitatus* (ninebark) anywhere along the lateral transect (0= no, 1= yes)
82	POPBAL_A	predominance of *Populus balsamifera* var. t*richocarpa* (black cottonwood) anywhere along the lateral transect (0= no, 1= yes)
83	RIBAUR	predominance of *Ribes aureum* (golden currant) anywhere along the lateral transect (0= no, 1= yes)
84	RUBDIS	predominance of *Rubus discolor* (Himalayan blackberry) anywhere along the lateral transect (0= no, 1= yes)
85	SALEXI	predominance of *Salix exigua* (coyote willow) anywhere along the lateral transect (0= no, 1= yes)
86	SALIX	predominance of other willow species anywhere along the lateral transect (0= no, 1= yes)
87	SAMRAC	predominance of *Sambucus racemosa* (elderberry) anywhere along the lateral transect (0= no, 1= yes)
88	SYMALB	predominance of *Symphoricarpos alba* (snowberry) anywhere along the lateral transect (0= no, 1= yes)
89	NumTCLmx	number of live tree size classes (of 3 possible), maximum of the 5 lateral transect plots
90	BedRockN	number of plots along the lateral transect that contained bedrock within 12" of the surface
91	ArtificN	number of plots along the lateral transect that contained artificially placed material within 12" of the surface

#	Variable	Explanation of Variable
92	CobbGravN	number of plots along the lateral transect that contained cobble or gravel within 12” of the surface
93	DebrisN	number of plots along the lateral transect that contained woody debris within 12” of the surface
94	SandN	number of plots along the lateral transect that contained sand within 12” of the surface
95	SandLoamN	number of plots along the lateral transect that contained sandy loam within 12” of the surface
96	SiltN	number of plots along the lateral transect that contained silt within 12” of the surface
97	LoamN	number of plots along the lateral transect that contained loam within 12” of the surface
98	TexTypNmax	maximum number of soil texture types in any plot along the lateral transect

Data directory for NUMPLOTS

Variables summarizing the number or proportion of plots containing specified plant community features, based on 129 unique combinations of site, plot type, and side of channel.

#	Variable	Explanation of Variable
1	SiteNnew	valid identifier for site
2	Line	type of survey line
3	Side	side of the channel, looking upriver
4	NumOfPlots	number of plots associated with the particular site-line-side combination, including plots with no vegetation
5	WetlndPlot	number of plots in which the percent cover of characteristically wetland species was at least 50%
6	PlotsWetSp	number of plots containing any characteristically wetland species
7	PlotsNtvSp	number of plots containing any native plant species
8	PlotsWtNtv	number of plots containing any native wetland species
9	Plotswtree	number of plots with tree species
10	Plotswshr	number of plots with shrub species
11	Plotswgras	number of plots with grasslike species
12	Plotswforb	number of plots with leafy forb species
13	PlotsDom50	number of plots with at least one very dominant species (a species that occupied at least 50% of any plot)
14	WetPlotPct	proportion of plots in which the percent cover of characteristically wetland species (summed) was at least 50%
15	WetSpPct	proportion of plots containing any characteristically wetland species
16	NtvSpPct	proportion of plots with any native plant species
17	NtvWetSpPct	proportion of plots with any native wetland species
18	TreesPct	proportion of plots with tree species
19	ShrubsPct	proportion of plots with shrub species
20	GrassPct	proportion of plots with grasslike species
21	ForbsPct	proportion of plots with leafy forb species
22	Dom50Pct	proportion of plots with at least one very dominant species (a species that occupied at least 50% of any plot)
23	NoWetDpct	proportion of records involving species with no information on their characteristic wetland affinities

Data directory for: LSCAPE

By site (40 sites), contains data measured by CTUIR using a GIS and existing spatial databases. **None of these variables were derived from our field data.** Contains contextual data from the vicinity of each site pertaining to elevation, slope, climate, land cover, wetlands, vegetation form, hyporheic potential, and other variables.

#	Variable	Explanation of Variable	Footnotes & Codes
1	Site	valid identifier for site (but not for the plot)	
2	SiteType	type of site	0= non-systematic, 1= systematic
3	Riverkm	channel-distance (km) upriver from confluence with the Columbia R.	
4	DistPct	Riverkm expressed as a percent of length of the entire study segment	
5	ShedArea	area (km2) of the catchment, measured from the Riverkm (whole integer) nearest the site	
6	ShedPerim	perimeter (km) of the catchment, measured from the Riverkm (whole integer) nearest the site	
7	ElevGL2	elevation (in m, above m.s.l) of the midpoint of the greenline transect at the site	from DEM coverage
8	EL05U2	elevation (in m, above m.s.l) at 0.5 km upriver of the midpoint of the greenline transect at the site	from DEM coverage
9	EL05D2	elevation (in m, above m.s.l) at 0.5 km downriver of the midpoint of the greenline transect at the site	from DEM coverage
10	EL10U2	elevation (in m, above m.s.l) at 1.0 km upriver of the midpoint of the greenline transect at the site	from DEM coverage
11	EL10D2	elevation (in m, above m.s.l) at 1.0 km downriver of the midpoint of the greenline transect at the site	from DEM coverage
12	EL05U4	elevation (in m, above m.s.l) at 0.5 km upriver of the upriver end of the greenline transect at the site	from DEM coverage
13	EL05D4	elevation (in m, above m.s.l) at 0.5 km downriver of the upriver end of the greenline transect at the site	from DEM coverage
14	EL10U4	elevation (in m, above m.s.l) at 1.0 km upriver of the upriver end of the greenline transect at the site	from DEM coverage
15	EL10D4	elevation (in m, above m.s.l) at 1.0 km downriver of the upriver end of the greenline transect at the site	from DEM coverage
16	EL15U4	elevation (in m, above m.s.l) at 1.5 km upriver of the upriver end of the greenline transect at the site	from DEM coverage
17	EL15D4	elevation (in m, above m.s.l) at 1.5 km downriver of the upriver end of the greenline transect at the site	from DEM coverage
18	EL20U4	elevation (in m, above m.s.l) at 2.0 km upriver of the upriver end of the greenline transect at the site	from DEM coverage

#	Variable	Explanation of Variable	Footnotes & Codes
19	EL20D4	elevation (in m, above m.s.l) at 2.0 km downriver of the upriver end of the greenline transect at the site	from DEM coverage
20	ElevLL	elevation (in m, above m.s.l) at the left end of the greenline transect (looking upriver)	from DEM coverage
21	ElevLR	elevation (in m, above m.s.l) at the right end of the greenline transect (looking upriver)	from DEM coverage
22	UpSin01	sinuosity between 0 and 1 km upriver of the midpoint of the greenline transect at the site	From July 1998 TM imagery at 1:24000 scale
23	UpSin12	sinuosity between 1 and 2 km upriver of the midpoint of the greenline transect at the site	From July 1998 TM imagery at 1:24000 scale
24	Dssin01	sinuosity between 0 and 1 km downriver of the midpoint of the greenline transect at the site	From July 1998 TM imagery at 1:24000 scale
25	Dssin12	sinuosity between 1 and 2 km downriver of the midpoint of the greenline transect at the site	From July 1998 TM imagery at 1:24000 scale
26	Meanaprilt2	mean annual temperature (C) (x 10) during April in the vicinity of the site	estimated by the PRISM model
27	Meanmayt2	mean annual temperature (C) (x 10) during May in the vicinity of the site	estimated by the PRISM model
28	Meanjunet2	mean annual temperature (C) (x 10) during June in the vicinity of the site	estimated by the PRISM model
29	Meanjulyt2	mean annual temperature (C) (x 10) during July in the vicinity of the site	estimated by the PRISM model
30	Meanaugt2	mean annual temperature (C) (x 10) during August in the vicinity of the site	estimated by the PRISM model
31	Meanannual2	mean annual temperature (C) (x 10) year-round, in the vicinity of the site	estimated by the PRISM model
32	Pptmay2	mean annual precipitation (mm) during April in the vicinity of the site	estimated by the PRISM model
33	Pptjune2	mean annual precipitation (mm) during May in the vicinity of the site	estimated by the PRISM model
34	Pptjuly2	mean annual precipitation (mm) during June in the vicinity of the site	estimated by the PRISM model
35	Pptaugust2	mean annual precipitation (mm) during July in the vicinity of the site	estimated by the PRISM model
36	Pptapril2	mean annual precipitation (mm) during August in the vicinity of the site	estimated by the PRISM model
37	Pptannual2	mean annual precipitation (mm), year-round, in the vicinity of the site	estimated by the PRISM model
38	FLIR_05k	water temperature at one point near the site	From 2001 CTUIR data derived from an aerial sensor (Forward Looking Infrared Radiometer)
39	Hyporhe05	hypothesized hyporheic potential based on gross landscape form, at one channel point near the site	hypothesized by CTUIR
40	Dike_05k	width of the present floodplain after accounting for confining dikes/levees, at one point near the site	interpreted by CTUIR from topographic maps and July 1998 TM imagery at 1:24000 scale
41	FPwidth05	width (m) of the geomorphic (historical) floodplain or valley bottom at one point near the site	interpreted by CTUIR from topographic maps

#	Variable	Explanation of Variable	Footnotes & Codes
42	FLIR_1k	water temperature at another point near the site on same time and date as FLIR_05k	From 2001 CTUIR data derived from an aerial sensor (Forward Looking Infrared Radiometer)
43	Hyporhe_1k	hypothesized hyporheic potential based on gross landscape form, at another channel point near the site	calculated by CTUIR using a conceptual model
44	Dike_1k	width of the present floodplain after accounting for confining dikes/levees, at another point near the site	interpreted by CTUIR from topographic maps and July 1998 TM imagery at 1:24000 scale
45	FPwidth_1k	width (m) of the geomorphic (historical) floodplain or valley bottom at another point near the site	interpreted by CTUIR from topographic maps
46	Up_levee	channel distance (km) from center of greenline upriver to nearest constructed levee	0.01 = levee is present at the sample site
47	Dn_levee	channel distance (km) from center of greenline downriver to nearest constructed levee	0.01 = levee is present at the sample site
48	Up_trib	channel distance (km) from center of greenline upriver to nearest tributary	From July 1998 TM imagery at 1:24000 scale
49	Dn_trib	channel distance (km) from center of greenline downriver to nearest tributary	From July 1998 TM imagery at 1:24000 scale
50	BdgLL	distance (km) from the uphill end of left lateral transect to the nearest building	From July 1998 TM imagery at 1:24000 scale
51	BdgLR	distance (km) from the uphill end of right lateral transect to the nearest building	From July 1998 TM imagery at 1:24000 scale
52	RR_LL	distance (km) from the uphill end of left lateral transect to the nearest railroad	From July 1998 TM imagery at 1:24000 scale
53	RR_LR	distance (km) from the uphill end of right lateral transect to the nearest railroad	From July 1998 TM imagery at 1:24000 scale
54	CropUrb_LL	distance (km) from the uphill end of left lateral transect to the nearest cropland or urban polygon	From July 1998 TM imagery at 1:24000 scale
55	CropUrb_LR	distance (km) from the uphill end of right lateral transect to the nearest cropland or urban polygon	From July 1998 TM imagery at 1:24000 scale
56	WetAcGL	area (m^2) of NWI wetland polygon, if any, intercepted by the centerpoint of the greenline	based on mapping of conditions visible in July 1981 aerial photos (1:58000 scale)
57	WetRivAcLL	area (m^2) of NWI Riverine wetland polygon, if any, intercepted by the end of the left greenline transect	based on mapping of conditions visible in July 1981 aerial photos (1:58000 scale)
58	WetPalAcLL	area (m^2) of NWI Palustrine wetland polygon, if any, intercepted by the end of the left greenline transect	based on mapping of conditions visible in July 1981 aerial photos (1:58000 scale)
59	WetAreaLL	area (m^2) of NWI wetland polygon if any, intercepted by the end of the left greenline transect	based on mapping of conditions visible in July 1981 aerial photos (1:58000 scale)
60	WetRivAcLR	area (m^2) of NWI Riverine wetland polygon, if any, intercepted by the end of the right greenline transect	based on mapping of conditions visible in July 1981 aerial photos (1:58000 scale)
61	WetPalAcLR	area (m^2) of NWI Palustrine wetland polygon, if any, intercepted by the end of the right greenline transect	based on mapping of conditions visible in July 1981 aerial photos (1:58000 scale)

#	Variable	Explanation of Variable	Footnotes & Codes
62	WetAreaLR	area (m^2) of NWI wetland polygon, if any, intercepted by the end of the right greenline transect	based on mapping of conditions visible in July 1981 aerial photos (1:58000 scale)
63	ShedSlopeMx	maximum slope (%) of the catchment above the site	calculated using GIS algorithm
64	ShedSlopeAv	average slope (%) of the catchment above the site	calculated using GIS algorithm
65	ShedElevMx	maximum elevation (in m, above m.s.l) of the catchment above the site	calculated using GIS algorithm
66	ShedElevAv	average elevation (in m, above m.s.l) of the catchment above the site	calculated using GIS algorithm
67	ShedElevSD	standard deviation in the elevation (in m, above m.s.l) of the catchment above the site, i.e., its topographic relief	calculated using GIS algorithm
68	ShedChanMx	length (km) of the longest watercourse above the site	The distance from the pour point along the longest watercourse to the catchment boundary.
69	ShedLength	equivalent length (km) of catchment above the site	The longer side of rectangle which has the same area and perimeter as the catchment. $= [P+ (P^2 - 16*A)^{0.5}]/4$. If $P^2 - 16*A$ is < 0 then no value was calcuated. $P^2 - 16*A = 0$ applies to a square and $P^2 - 16*A < 0$ to a circle. Calculated by CTUIR.
70	ShedShape	relative longest watercourse length (dimensionless). Large values indicate an elongated catchment or meandering channel	$= L/A^{0.5}$. (Used by the Department of Water Affairs and Forestry, South Africa). Calculated by CTUIR.
71	DirtRd1kL	cumulative length (m) of unimproved roads within 1 km of center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
72	Paved1kL	cumulative length (m) of paved roads within 1 km of center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
73	Road1kAll	cumulative length (m) of all roads within 1 km of center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
74	Rail1kL	cumulative length (m) of railroads within 1 km of center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
75	DirtRd2k	cumulative length (m) of unimproved roads within 2 km of center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
76	Paved2k	cumulative length (m) of paved roads within 2 km of center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
77	Road2kAll	cumulative length (m) of all roads within 2 km of center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
78	Rail2k	cumulative length (m) of railroads within 2 km of center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
79	Levee1kCu	cumulative length (m) of constructed levees within 1 km of center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
80	Levee2kCu	cumulative length (m) of constructed levees within 2 km of center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale

#	Variable	Explanation of Variable	Footnotes & Codes
81	Cc1k0_10	area (m2) within 1km of the center of the greenline of the site containing vegetation crown closure of 0-10%, i.e., non-forested	From July 1998 TM imagery at 1:24000 scale
82	Cc1k10_35	area (m2) within 1km of the center of the greenline of the site containing vegetation crown closure of 11-35%	From July 1998 TM imagery at 1:24000 scale
83	Cc1k35_60	area (m2) within 1km of the center of the greenline of the site containing vegetation crown closure of 36-60%	From July 1998 TM imagery at 1:24000 scale
84	Cc1k60_80	area (m2) within 1km of the center of the greenline of the site containing vegetation crown closure of 61-80%	From July 1998 TM imagery at 1:24000 scale
85	Cc1k80_100	area (m2) within 1km of the center of the greenline of the site containing vegetation crown closure of 80-100%	From July 1998 TM imagery at 1:24000 scale
86	Water1kAc	area (m2) of surface water within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
87	Rock1kAc	area (m2) of rock & sparsely vegetated land within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
88	Herb1kAc	area (m2) of herbaceous vegetation (no overstory) within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
89	Agr1kAc	area (m2) of agricultural lands within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
90	Dev1kAc	area (m2) of developed lands within 1km of the center of the greenline of the site (lands with <25% herb & shrub cover and <10% tree cover, and not rock, water, or agriculture)	From July 1998 TM imagery at 1:24000 scale
91	BigTrees1k	area (m2) of polygons within 1km of the center of the greenline of the site that contain stands of mostly large or extra large trees (>20" dbh), either single- or multiple-story	From July 1998 TM imagery at 1:24000 scale
92	Water1kPm	cumulative perimeter (m) of surface water polygons within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
93	Devel1kPm	cumulative perimeter (m) of surface water polygons within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
94	SS1k25_65A	area (m2) of polygons with widely spaced riparian shrubs within 1 km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
95	SS1kGT65A	area (m2) of polygons with densely spaced riparian shrubs within 1 km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
96	Hard1kAc	area (m2) of polygons that mostly contain hardwood trees within 1 km of the center of the greenline of the site (tree stands whose crown closure is >80% hardwoods)	From July 1998 TM imagery at 1:24000 scale

#	Variable	Explanation of Variable	Footnotes & Codes
97	Hard1kPm	cumulative perimeter (m) of polygons that mostly contain hardwood trees within 1 km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
98	Cc2k0_10	area (m2) within 1km of the greenline of the site containing vegetation crown closure of 0-10%, i.e., non-forested	From July 1998 TM imagery at 1:24000 scale
99	Cc2k10_35	area (m2) within 1km of the greenline of the site containing vegetation crown closure of 11-35%	From July 1998 TM imagery at 1:24000 scale
100	Cc2k35_60	area (m2) within 1km of the greenline of the site containing vegetation crown closure of 36-60%	From July 1998 TM imagery at 1:24000 scale
101	Cc2k60_80	area (m2) within 1km of the greenline of the site containing vegetation crown closure of 61-80%	From July 1998 TM imagery at 1:24000 scale
102	Cc2k80_100	area (m2) within 1km of the greenline of the site containing vegetation crown closure of 80-100%	From July 1998 TM imagery at 1:24000 scale
103	Water2kAc	area (m2) of surface water within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
104	Bare2kAc	area (m2) of rock & sparsely vegetated land within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
105	Herb2kAc	area (m2) of herbaceous vegetation (no overstory) within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
106	Ag2kAc	area (m2) of agricultural lands within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
107	Dev2kAc	area (m2) of developed lands within 1km of the center of the greenline of the site (lands with <25% herb & shrub cover and <10% tree cover, and not rock, water, or agriculture)	From July 1998 TM imagery at 1:24000 scale
108	Shrub2kAc	area (m2) of developed lands within 1km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
109	BigTree2k	area (m2) of polygons within 1km of the center of the greenline of the site that contain stands of mostly large or extra large trees (>20" dbh), either single- or multiple-story	From July 1998 TM imagery at 1:24000 scale
110	SS2k25_65A	area (m2) of polygons within 1 km of the center of the greenline of the site that have widely spaced riparian shrubs (crown closure of 25-65%)	From July 1998 TM imagery at 1:24000 scale
111	SS2kGT65Ac	area (m2) of polygons within 1 km of the center of the greenline of the site that have densely spaced riparian shrubs (crown closure of >65%)	From July 1998 TM imagery at 1:24000 scale
112	Hard2kAc	area (m2) of polygons within 1 km of the center of the greenline of the site that mostly contain hardwood trees (tree stands whose crown closure is >80% hardwoods)	From July 1998 TM imagery at 1:24000 scale

#	Variable	Explanation of Variable	Footnotes & Codes
113	Dev2kPm	cumulative perimeter (m) of polygons within 1 km of the center of the greenline of the site that are mostly developed	From July 1998 TM imagery at 1:24000 scale
114	Hard2kPm	cumulative perimeter (m) of polygons within 1 km of the center of the greenline of the site that mostly contain hardwood trees	From July 1998 TM imagery at 1:24000 scale
115	Wet1kPalOW	area (m2) of NWI polygons within 1 km of the center of the greenline of the site that mainly contain palustrine emergent or aquatic bed vegetation or open water conditions	based on mapping of conditions visible in July 1981 aerial photos (1
116	Wet1kPalFo	area (m2) of NWI polygons within 1 km of the center of the greenline of the site that mainly contain palustrine forested or scrub-shrub vegetation	based on mapping of conditions visible in July 1981 aerial photos (1
117	Wet1kRiv	area (m2) of NWI polygons within 1 km of the center of the greenline of the site that mainly contain riverine conditions	based on mapping of conditions visible in July 1981 aerial photos (1
118	Wet2kPalOW	area (m2) of NWI polygons within 2 km of the center of the greenline of the site that mainly contain palustrine emergent or aquatic bed vegetation or open water conditions	based on mapping of conditions visible in July 1981 aerial photos (1
119	Wet2kPalFo	area (m2) of NWI polygons within 2 km of the center of the greenline of the site that mainly contain palustrine forested or scrub-shrub vegetation	based on mapping of conditions visible in July 1981 aerial photos (1
120	Wet2kRiv	area (m2) of NWI polygons within 2 km of the center of the greenline of the site that mainly contain riverine conditions	based on mapping of conditions visible in July 1981 aerial photos (1
121	El2Drop05	Drop in elevation (m) from a point 0.5 km upriver to a point 0.5 km downriver, measured from the center of the greenline transect at the site.	estimated elevations from the DEM coverage
122	El2Drop1k	Drop in elevation (m) from a point 1.0 km upriver to a point 1.0 km downriver, measured from the center of the greenline transect at the site.	estimated elevations from the DEM coverage
123	El4Drop05	Drop in elevation (m) from a point 0.5 km upriver to a point 0.5 km downriver, measured from the upper end of the greenline transect at the site	estimated elevations from the DEM coverage
124	El4Drop1k	Drop in elevation (m) from a point 1.0 km upriver to a point 1.0 km downriver, measured from the upper end of the greenline transect at the site	estimated elevations from the DEM coverage
125	El4Drop15	Drop in elevation (m) from a point 1.5 km upriver to a point 1.5 km downriver, measured from the upper end of the greenline transect at the site	estimated elevations from the DEM coverage

#	Variable	Explanation of Variable	Footnotes & Codes
126	El4Drop2k	Drop in elevation (m) from a point 2.0 km upriver to a point 2.0 km downriver, measured from the upper end of the greenline transect at the site	estimated elevations from the DEM coverage
127	ElDrop05_0	Drop in elevation (m) from a point 0.5 km upriver of the site, to the center of the greenline transect at the site.	estimated elevations from the DEM coverage
128	ELdrop1k_0	Drop in elevation (m) from a point 1 km upriver of the site, to the center of the greenline transect at the site.	estimated elevations from the DEM coverage
129	ELdrop15_0	Drop in elevation (m) from a point 1.5 km upriver of the site, to the center of the greenline transect at the site.	estimated elevations from the DEM coverage
130	ELdrop2k_0	Drop in elevation (m) from a point 2.0 km upriver of the site, to the center of the greenline transect at the site.	estimated elevations from the DEM coverage
131	FPslopeLL	Difference in elevation between the upland end of the left greenline transect and the channel edge (the center of the greenline)	estimated elevations from the DEM coverage
132	FPslopeLR	Difference in elevation between the upland end of the right greenline transect and the channel edge (the center of the greenline)	estimated elevations from the DEM coverage
133	FPslopeAv	Average of FPslopeLL and FPslopeLR	estimated elevations from the DEM coverage
134	Wat1kA_Pm	Ratio of water area (m2) to water perimeter (m), for water within 1 km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
135	Dev1kA_Pm	Ratio of developed land area (m2) to developed land perimeter (m) for developed lands within 1 km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale
136	Hard1kA_Pm	Ratio of hardwood forest area (m2) to hardwood forest perimeter (m) for hardwood forest within 1 km of the center of the greenline of the site	From July 1998 TM imagery at 1:24000 scale

Data directory for: LCORR1

Correlations among 872 variables associated with the lateral transects, sorted alphabetically.

#	Variable	Explanation of Variable	Footnotes & Codes
1	V1	a lateral transect variable	
2	V1type	type of variable	B= plant richness or cover (mostly herbs) BB= bank stabilization capacity BF= woody plant richness or cover BN= native vs. non-native variable BU= plot botanical uniqueness BW= plant wetness indices C= climate variable DLC= land cover & wetlands in surrounding areas DS= soil disturbance variable HGM= hydrogeomorphic variable S= soil variable SW= woody substrates variable VB= botanical spatial variation variable VF= woody plant spatial variation VS= soil spatial variation
3	V2	another lateral transect variable, paired with	
4	V2type	type of variable	(see V1type above)
5	Plot/Site	source of the variable's data	lateral transect plots (P) or sites (S)
6	SigSys	statistical significance of the correlation, using data from laterals at just the systematic sites	X = significant at the p<.05 level
7	SigAll	statistical significance of the correlation, using data from laterals at all sites	X = significant at the p<.05 level
8	RsignSys	sign of the correlation coefficient associated with SigSys	N= negative, P= positive
9	RsignAll	sign of the correlation coefficient associated with SigAll	N= negative, P= positive
10	P_Sys	p value, using data from laterals just the systematic sites	
11	P_All	p value, using data from laterals at all sites	
12	R_Sys	correlation coefficient (r), using data from laterals just at the systematic sites	
13	R_All	correlation coefficient (r), using data from laterals at all sites	

Data directory for: LCORRSUM

For each of the 872 variables associated with the lateral transects, this table gives the proportion of its correlations that were statistically significant using data from the 20 systematic sites, or data from all 40 sites. Also shows the proportion of its correlations that were statistically significant at BOTH of these scales. Note: There is a larger number and proportion of significant correlations for PctSigAll than for PctSigSys because of the larger sample size (40 sites instead of 20).

#	Variable	Explanation of Variable
1	Variable	the lateral transect variable
2	PctSigSys	proportion of its correlations that were statistically significant (p<.05) using data from the 20 systematic sites
3	PctSigAll	proportion of its correlations that were statistically significant (p<.05) using data from all 40 sites
4	PctSigBoth	proportion of its correlations that were statistically significant (p<.05) for BOTH the 20 sites and for all 40 sites

Data directory for: GCORR1

Correlations among 421 variables associated with the greenline transects, sorted alphabetically.

#	Variable	Explanation of Variable	Footnotes & Codes
1	V1	a greenline transect variable	
2	V1type	type of variable	B= plant richness or cover (mostly herbs) BB= bank stabilization capacity BF= woody plant richness or cover BN= native vs. non-native variable BU= plot botanical uniqueness BW= plant wetness indices C= climate variable DLC= land cover & wetlands in surrounding areas DS= soil disturbance variable HGM= hydrogeomorphic variable S= soil variable SW= woody substrates variable VB= botanical spatial variation variable VF= woody plant spatial variation VS= soil spatial variation
3	V2	another greenline transect variable, paired with V1	
4	V2type	type of variable	(see V1type above)
5	Plot/Site	source of the variable's data	greenline transect plots (P) or sites (S)
6	SigSys	statistical significance of the correlation, using data from greenlines at just the systematic sites	X = significant at the p<.05 level
7	SigAll	statistical significance of the correlation, using data from greenlines at all sites	X = significant at the p<.05 level
8	RsignSys	sign of the correlation coefficient associated with SigSys	N= negative, P= positive
9	RsignAll	sign of the correlation coefficient associated with SigAll	N= negative, P= positive
10	P_Sys	p value, using data from greenlines just the systematic sites	
11	P_All	p value, using data from greenlines at all sites	
12	R_Sys	correlation coefficient (r), using data from greenlines just at the systematic sites	
13	R_All	correlation coefficient (r), using data from greenlines at all sites	

Data directory for: GCORRSUM

For each of the 421 variables associated with the greenline transects, the proportion of its correlations that were statistically significant using data from the 20 systematic sites, or data from all 40 sites. Also the proportion of its correlations that were statistically significant at BOTH of these scales.

#	**Variable**	**Explanation of Variable**
1	Variable	the greenline variable
2	PctSigSys	proportion of its correlations that were statistically significant (p<.05) using data from the 20 systematic sites
3	PctSigAll	proportion of its correlations that were statistically significant (p<.05) using data from all 40 sites
4	PctSigBoth	proportion of its correlations that were statistically significant (p<.05) for BOTH the 20 sites and for all 40 sites

Data directory for: STATTABS

This file contains three "sheets" labeled: Both, NS, and S. "Both" contains the following summary statistics calculated for all study sites, "NS" for the non-systematic sites only, and "S" for the systematic sites only. Each sheet is further divided into sections for greenline data variables, landscape data variables, and lateral transect data variables.

#	Variable
1	Variable
2	Mean
3	Median
4	Standard Deviation
5	COV (Coefficient of Variation)
6	Minimum
7	Maximum