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Title: Ecology and Distribution of Riparian Vegetation in the Trout Creek Mountains of Southeastern Oregon

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Vegetation-environment relationships were studied in highly disturbed riparian ecosystems in the northern Great Basin. Twenty-eight riparian community types are described from data collected along four streams in the Trout Creek Mountains. Two tree-dominated, fifteen shrub-dominated and eleven herbaceous community types are identified. Descriptions of site features, community composition and structure, and comparison to other classifications are presented for each type. Examination of species and sample ordinations indicate that moisture and elevation are major environmental factors influencing riparian vegetation distribution in the Trout Creek Mountains.

Six unique valley bottom settings were delineated using a multifactor classification of site variables. A description of the physical setting and associated disturbance regime is presented for each valley bottom type.

Relationships of vegetation to environmental and geomorphic variables were analyzed at three levels; species, communities and aggregations of communities. Riparian plant species and community type occurrence correlated well with valley bottom type. In addition, many community types were repeatedly associated and formed predictable clusters which correspond to the valley bottom types. Correspondence of vegetation occurrence

and geomorphic surface was not as predictable, for many species and community types were observed to occur on multiple surfaces. Occurrence patterns of several species and community types were highly correlated with level of livestock use.

An analysis of size-classes of woody riparian species indicated that distributions are largely skewed toward large, mature individuals, with little representation in the seedling or smaller classes. Typical recruitment sites for many of the woody species are low-lying gravel bars, silt deposits and banks.

Ecology and Distribution of Riparian Vegetation in the Trout Creek Mountains of Southeastern Oregon

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INTRODUCTION

The presence of water in semiarid rangelands of the Great Basin is often evidenced by conspicuously lush vegetation in an otherwise sparsely vegetated environment. These interfaces between aquatic and terrestrial ecosystems, known as riparian areas, are characterized by a concentration of moisture and nutrients which provide favorable conditions for plant growth. They support unique vegetation assemblages which contrast sharply with surrounding sagebrush-bunchgrass upland assemblages. Riparian vegetation may be well developed structurally and with high levels of species diversity (Haslan 1978, Brown and others 1978). In semiarid regions these areas add significantly to overall habitat and landscape diversity.

Riparian areas along streams and rivers are dynamic with periodic disturbances of varying magnitude. Floodplains are continually being reshaped by geomorphic and hydrologic processes such as flooding, deposition and erosion (Morrisawa 1968). Vegetation interacts with these processes in many ways including the development of extensive root systems that serve as a stabilizing matrix for streambanks. Aboveground biomass assists in sediment deposition by providing hydraulic resistance.

The ecological relationships and functional properties of riparian systems are extremely complex, and are not clearly understood. During the past century land use practices in Great Basin riparian zones and surrounding uplands have drastically altered the balance and nature of interrelationships between biotic and abiotic processes.

Introduction of livestock, accompanied by uncontrolled grazing practices, resulted in severely degraded rangelands throughout the Great Basin by the turn of the century (Griffiths 1902). In the decades following, several changes in grazing use occurred, including a general shift from sheep to cattle. Grazing systems were implemented and forage permits were granted. In many locations these changes resulted in an overall improvement in upland forage resources. However, these season-long, and sometimes continuous grazing practices continued to have negative effects in the riparian setting.

Indirect and direct effects of grazing have precluded successful establishment of new generations of riparian plants and have resulted in an overall reduction in vegetative cover in riparian zones. As a result, most riparian areas have not been able to maintain their integrity. Along many streams, channel downcutting has resulted in drastically lowered water tables, and systems incapable of supporting the moisture-dependent riparian plant species. In many Great Basin floodplains big sagebrush (*Artemisia tridentata*) and assorted upland species, have replaced the riparian plants.

Concern for condition and management of riparian systems has grown rapidly in recent years. These areas are valued for water supply, fisheries and wildlife habitat, recreation, forage production, erosion control and aesthetics (Brown and others 1978, Meehan and others 1977, Odum 1978, Thomas 1979). Riparian vegetation is the common denominator for each of these values. An important function of riparian vegetation is the physical structure it provides, which interacts with fluvial processes to shape the stream and floodplain setting. Riparian recovery projects, based on exclusion of livestock, have demonstrated the importance of vegetation and the enormous restorative potential of many of these ecosystems (Dahlem 1979, Duff 1979, Winegar 1977). The recovery response varies in rate and magnitude depending on the type of riparian setting and the many contributing and interacting biotic and abiotic variables.

Well developed vegetative communities, with diverse structure, are the goal of many riparian recovery efforts. Some stream systems, once excluded from livestock grazing, need little intervention on the part of land managers. Other systems, however, exhibit a much slower and/or lower recovery potential. In many of these systems managers have deemed it desirable to speed up the recovery process by artificial enhancement including planting of woody riparian species. Unfortunately, few of these planting efforts, particularly with native members of the willow family (Salicaceae), have been successful. Failures can be attributed to a lack of understanding of riparian plant ecology and of basic functional processes and relationships in riparian systems.

Information on riparian plant species and community ecology is greatly needed. Knowledge of environmental limits on plant species and plant community distribution within riparian zones is important if we are to adequately manage these systems. Recent community classification studies have focused on relatively intact riparian systems and not highly degraded areas (Kovalchik 1987, Youngblood and others 1985).

This thesis research is focused on the ecology and distribution of riparian vegetation along stream systems which typify the highly disturbed conditions found in the northern Great Basin. An area in the Trout Creek Mountains of southeastern Oregon was selected for these investigations. The purpose of this study is to provide managers with some basic ecological information on disturbed riparian ecosystems. This work demonstrates the importance of understanding the structure and function of these systems as a basis for management. The objectives of this study were:

1. Develop a community type classification for degraded riparian systems and relate these communities to important environmental factors (Chapter 1);

2. Broadly characterize the geomorphic setting and the associated disturbance processes of degraded riparian systems (Chapter 2); and

3. Examine the relationships between riparian vegetation and valley bottom landforms, environmental gradients, and disturbance regimes (Chapter 2).

CHAPTER 1

RIPARIAN PLANT COMMUNITY TYPES OF THE TROUT CREEK MOUNTAINS, SOUTHEASTERN OREGON

ABSTRACT

Twenty-eight riparian community types are described from data collected along four streams in the Trout Creek Mountains. Two tree-dominated, fifteen shrub-dominated and eleven herbaceous community types are identified. For each type, a description of site features, community composition and structure, and comparisons to other classifications is provided.

Most of the community types described may be categorized as disturbance induced types. Some communities, such as the *Eleocharis palustris* c.t. and the *Alopecurus aequalis* c.t. rapidly colonize moist mineral surfaces adjacent to the active stream channel following flooding disturbance. Other community types, such as the *Poa pratensis* c.t. and *Juncus balticus* c.t. appear to be grazing induced types which have replaced later seral communities dominated by native species. Some later seral communities are present only in areas which have escaped livstock grazing either due to steep terrain, boggy soils, or exclusion through fencing. Examples of these community types include the *Populus tremuloides/Salix scouleriana* c.t., *Carex scopulorum* c.t. and the *Carex lanuginosa* c.t.

Examination of species and sample ordinations indicate that moisture and elevation are major environmental factors influencing riparian vegetation distribution in the Trout Creek Mountains. Distinct patterns of community type association occur along the elevational gradient of the study area. At low elevations, the *Salix lasiandra-Rosa woodsii* c.t., *Salix lasiandra/Poa pratensis* c.t., *Rosa woodsii* c.t., and *Alnus incana/Poa pratensis* c.t. are often associated. The *Salix lemmonii/Mixed Graminoid-Forb* c.t. is the most prevalent type along very disturbed stream reaches at mid to high elevations. High elevations are the only location for some community types, including the *Carex scopulorum* c.t. and the *Ranunculus macounii-Polygonum bistortoides* c.t..

INTRODUCTION

Riparian zones in the Great Basin landscape support narrow and verdant corridors of vegetation which contrast sharply with surrounding sagebrush-bunchgrass uplands. These riparian areas form the interface between aquatic and terrestrial ecosystems and are characterized by a concentration of moisture and nutrients which favor plant growth.

Although these riparian areas are small in size, they are extremely important components of the landscape. They play significant roles in protection of watershed values, in providing habitats that sustain fish, wildlife, and plant diversity, and in providing forage for domestic livestock. The importance of riparian areas has recently made them a priority with land management agencies. Since little is known about the vegetation ecology of these ecosystems, this study was undertaken.

Disturbance processes and microenvironmental features influence vegetation composition and structure. The interaction of natural and man-induced disturbance has resulted in widespread deterioration of Great Basin riparian ecosystems. Uncontrolled livestock grazing appears to have had the most severe impact (Griffiths 1902, Platts 1981b). By the late 1800s stocking levels were so high that only inaccessible areas remained untouched. Forage surveys conducted at the turn of the century reported stocking levels exceeding 500 sheep per square mile in the northern Great Basin (Griffiths 1902). In the early 1900s sheep were replaced by cattle on much of the mountain rangeland, but season-long and continuous grazing practices persisted. Grazing systems were eventually implemented, but stocking levels were still excessive and deterioration of riparian areas continued (Platts 1981a).

Vegetation removal and trampling effects associated with livestock grazing produced ecosystems more susceptible to other perturbations (Platts and others 1985). Without the stabilizing effects of riparian vegetation, large flooding events incised stream channels and lowered water tables. Foraging and dam building activities of beaver (*Castor canadensis*) also altered riparian vegetation and habitat (Naiman et al. 1986, Ives 1947). Fire, both natural and man-caused has added to a dynamic and complex riparian disturbance regime.

An analysis of the composition and distribution of plant communities is a useful first step in sorting out the complex relationships of riparian ecosystems. Such data are presented in this paper, and they complement other efforts to classify riparian vegetation in the Intermountain West (Youngblood and others 1985, Winward 1984, Kovalchik 1987, Hansen 1988, Padgett and others In Press). Sampling in other studies has focused on relatively intact areas with well-developed riparian plant communities.

An area in the Trout Creek Mountains of southeastern Oregon was selected for this study. Riparian conditions within the study area were judged to be representative of the highly disturbed systems throughout the Great Basin.

The definition of meaningful and identifiable community types provides a means of stratifying these complex systems. These defined groupings also facilitate communication about these ecosystems and allow for comparison of vegetation patterns and management treatments with other areas. The intent of this study is to provide land managers with a useful framework for understanding and managing riparian vegetation. Hence, the objectives of this study were to: 1) develop a riparian community type classification for an area typifying the highly disturbed conditions found in the northern portion of the Great Basin Physiographic Province, 2) relate these riparian communities to important environmental factors, and 3) relate this classification to other existing riparian classifications.

STUDY AREA DESCRIPTION

This study was conducted in the Trout Creek Mountains of southeastern Oregon, located in the southern portions of Harney and Malheur Counties, just north of the Nevada border (Fig. 1-1). Like other ranges in the Great Basin Physiographic Province, the Trout Creeks were formed through block faulting and trend in a north-south direction. These mountains are considered geologically young (Fenneman 1931) and are comprised of a thick volcanic/ pyroclastic sequence of rocks (Carlton 1968). Lower layers of this sequence have been correlated with the Steens Basalt. Upper layers contain ash-flow tuff sheets derived from nearby calderas.

An upthrown block on the east side of the Pueblo Valley (graben) forms the Trout Creek Mountains, which are characterized by mesas, buttes, and tilted fault blocks with steep scarps (Carlton 1968). The main part of the Trout Creek Mountains forms a gently northward-tilted plateau with elevations reaching from 1372 m (4500 ft) at the basin edge to over 2438 m (8000 ft) on

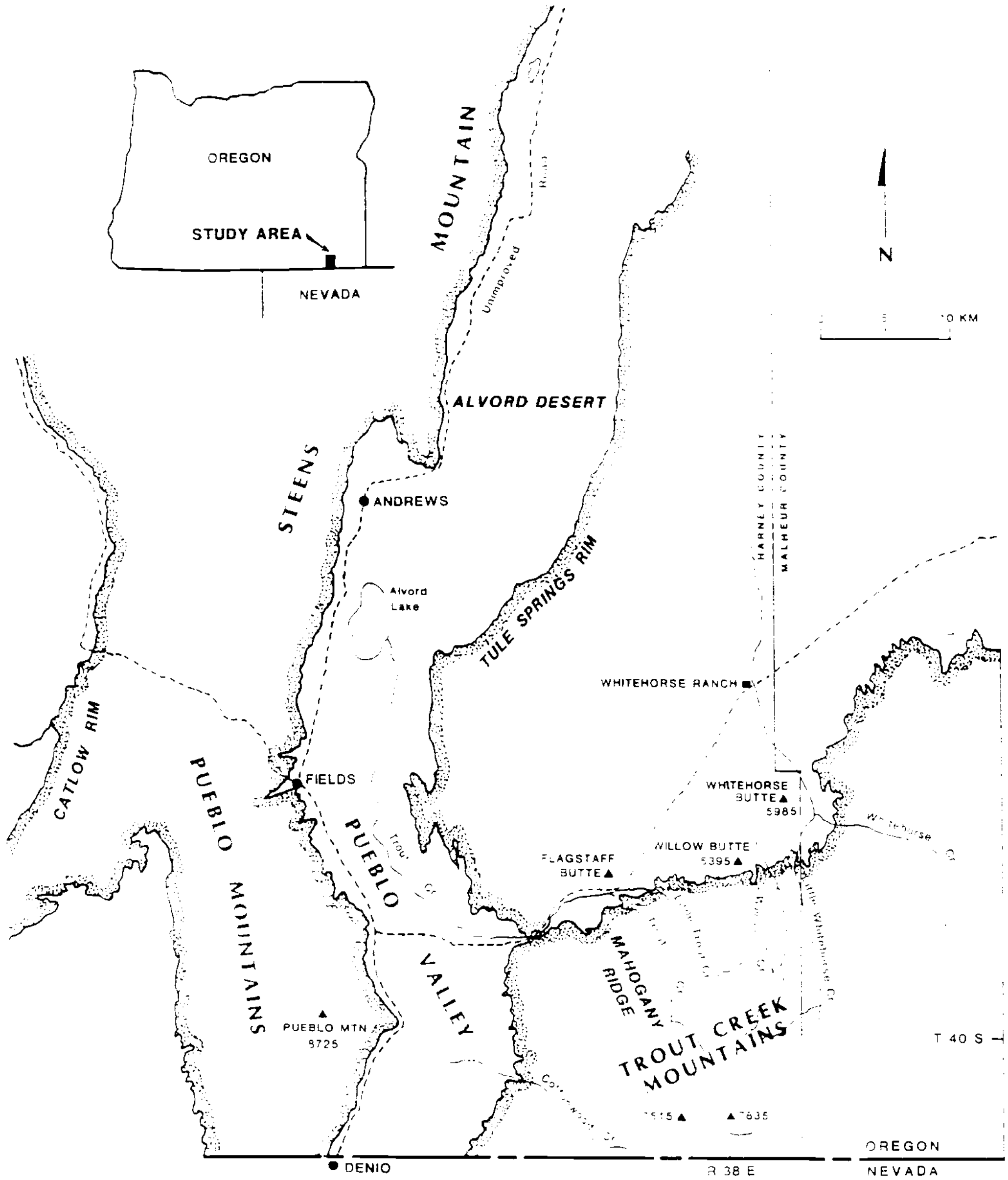

Figure 1-1. Map of Trout Creek Mountain study area and surrounding region. State location map inset in upper left-hand corner.

the south-end. This plateau is dissected by narrow north, northwest-trending stream canyons with depths as great as 300 meters. Mahogany Ridge is the largest fault block in the area (Carlton 1968) forming a mesa 7.5 km long by 1.3 km wide along the western boundary of the study area.

Trout Creek and its tributaries form the largest perennial stream draining from this mountain range. It drains toward Alvord Lake, a large playa to the north. Water seldom makes it to the playa due to upstream irrigation use and infiltration. The other perennial streams in the study area are Willow Creek and Little Whitehorse Creek. Both of these streams also drain to the north and become intermittent in their lower reaches. As is typical of the Great Basin, the drainage is enclosed.

The natural upland vegetation of the study area is predominantly comprised of sagebrush-bunchgrass communities. At high elevations *Artemisia tridentata* ssp. *vaseyana* is dominant, where at lower elevations *A. tridentata* ssp. *wyomingensis* is common. Several bunchgrasses are associated with these communities, including *Festuca idahoensis* on moist aspects and *Agropyron spicatum* on drier aspects. Isolated patches of *Cercocarpus ledifolius* and *Ceanothus velutinus* are found at higher elevations. Also at high elevations on north and east facing slopes are numerous aspen groves associated with sidehill springs. At lower elevations where the mountains meet the basin floors are salt desert shrub communities, characterized by such species as *Atriplex confertifolia*, *Grayia spinosa*, *Artemisia spinescens*, *Sarcobatus vermiculatus* and *Distichlis spicata*.

The semiarid climate of this area is characteristic of the Great Basin, with hot summers and cool winters. Precipitation occurs largely in the mountains in the form of winter snows. Total annual precipitation is much lower in the valleys. Intense summer thunderstorms are common and typically localized. Streamflows generally peak shortly following larger rainfall and snowfall events. Springtime melting of mountain snowpacks may also result in flooding in some streams between April and June (Fenneman 1931). Long-term climatic records are available for locations in the basin bottoms including Denio at 1277 m (4190 ft) and Whitehorse Ranch at 1281 m (4200 ft). Total annual precipitation at Denio is 220 mm (8.5 in) and 230 mm (8.6 in) at Whitehorse Ranch. Precipitation is fairly evenly distributed throughout the year except for July and August when it is very dry. Snowfall averages 47 cm (18 in) per year and mostly comes during December and January. Average minimum temperatures range from 20 F (-7 C) in January to 52 F (11 C) in July, where average maximum temperatures range from 42 F (6 C) in January to 92 F (33 C) in July.

Twenty-eight years of data from a snow depth marker at the head of Trout Creek indicate that early April snow packs average 749 mm (28 in) (SCS 1989). The water equivalent is estimated to be 275 mm (10.3 in).

METHODS

This community type classification incorporates data collected using two strategies. Each data set was analyzed independently, but using the same techniques. Results for both analyses are presented in this chapter.

VEGETATION SAMPLING

Approach 1

Drainages were reconnoitered prior to selection of sampling locations. Sampling covered most of the elevational range of riparian vegetation and valley bottom locales along four streams in the Trout Creek Mountains (Fig. 1-1). Sampling locations were selected subjectively, without preconceived bias (Mueller-Dombois and Ellenberg 1974). Thirty stream reaches between 1370 and 2440 m (4500 and 8000 ft) elevation along Trout Creek, Little Trout Creek, Willow Creek and Little Whitehorse Creek, were selected for intensive study, and sampled during the 1987 field season. All samples in this data set, along Little Whitehorse Creek and Willow Creek, were located inside livestock exclosures. One reach along Little Trout Creek was grazed briefly in the fall. All other reaches were within actively grazed portions of allotments.

Along each reach a 50 to 100 meter line was established parallel to the stream axis and along the edge of the riparian zone. From this base line, three to six points were randomly selected to become the starting point for vegetation transects. Each transect extended from one edge of the riparian zone to the other. Along the transect, at one-half to one meter intervals, a 0.5 by 1 meter quadrat was placed for purpose of recording vegetation and site data. A total of 3109 quadrats were sampled. Of these, 484 occurred over the channel and were not included in this analysis. The remaining 2535 quadrats were analyzed.

Vegetation data for each quadrat included a complete species list with visual estimates of projected crown cover. Canopy cover values were assigned to one of the following classes; T = <1%, P = 1-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, and F = 95-100%. Cover estimates were also made for exposed bare ground, gravel, rock, bedrock, moss and litter. Environmental information for each quadrat includes type of geomorphic surface, height of surface above stream channel, distance of surface from edge of channel, surface soil texture class, rock content class, and surface soil moisture class. Additional information was collected for each reach and included elevation, drainage area, valley form and width, channel gradient, width and depth, and riparian zone width. Sketch maps of each reach showing the transect locations and major riparian features were also completed, and are available from the author.

Approach 2

Systematic sampling of vegetation associated with specific geomorphic surfaces was conducted along a low elevation segment of Willow Creek. This portion of Willow Creek contains a series of three livestock exclosures. Sampling was performed between June and August 1986 both inside and outside of these exclosures. Riparian zone geomorphic surfaces included silt deposits, gravel bars, banks, lower terraces, and terraces. In most cases surfaces were small (<50 square meters) and the entire surface was included in the sample. When surfaces were larger, a 5 x 10 meter area was sampled. For each geomorphic surface, a releve, consisting of a comprehensive species list and estimated percent canopy cover for each species was completed. The same cover classes described in Approach 1 were used. Cover estimates of bare ground, gravel, rock, and litter were also made. In addition, height of geomorphic surface above the channel and distance away from the channel were recorded. A total of 173 surfaces were sampled. Maps were sketched for the entire riparian zone, showing locations of all the geomorphic surfaces sampled.

Voucher specimens were collected for several species and placed in the Oregon State University Herbarium (OSC). Nomenclature of vascular plants follows Cronquist and others (1977) for Monocotyledons, Dorn (1977) for Salicaceae, and Hitchcock and Cronquist (1973) for all other taxa.

DATA PREPARATION

In preparation for community analysis it was necessary to regroup the quadrat data collected in Approach 1 into more manageable and interpretable units. This was accomplished through examination of transect data, field notes and maps. The bounds of vegetation units (stands) were noted as they were intercepted along each transect. Each unit was comprised of a distinct plant community. All quadrats lying within a particular unit were combined into a single new unit (stand) by averaging cover values for all species. Environmental data were also combined in a similar manner. By this process, the 2535 quadrats were regrouped into 361 new units. These units were utilized as the stands in the data analysis.

Data collected via Approach 2 were entered in the original groups. In this case a stand is equivalent to the entire geomorphic surface (or portion thereof) sampled.

All data were coded and entered in the ECODATA data base management system on the USDA Forest Service Northern Region computer for analysis. This data base and the associated Ecodata Software Package (ECOPAC) were developed by R.E. Keane (Jensen and Keane 1987) for the Region 1 Ecology Program, and were utilized for all analyzes described below.

VEGETATION ANALYSIS

The goal of this analysis was to develop a classification of riparian plant community types. This procedure combined manual table sorting based on field judgments with more objective computer analyses.

With all species included, the entire data set was massive and needed to be simplified prior to analysis. In order for a species to be included in the analysis it had to occur in a least five samples or be present with greater than 5 percent cover. Using these criteria the number of species in the large data set was reduced from 227 to 132, and from 93 to 54 in the smaller data set. Next, stands with less than 25 percent total vegetative cover were dropped from the analysis. Typically, these were sparsely vegetated surfaces such as gravel bars, silt deposits and disturbed banks. Analysis of these stands focused only on noting important associated species. Summary data for these stands are available from the author.

Synthesis tables (Mueller-Dombois and Ellenberg 1974) were developed for the remaining data, and manually sorted to group floristically similar stands. As a complementary and more objective approach cluster and ordination analyses were also performed. Two-way indicator species analysis was applied to data using the program TWINSPAN (Hill 1979). This program is a hierarchical, polythetic, divisive classification technique which places similar samples and species into groups and arranges groups based on differential species (Gauch 1982). DECORANA, a detrended correspondence analysis program (Hill 1979) was used to ordinate stands and species. DECORANA is an improved eigenvector ordination technique developed to correct two problems of reciprocal averaging (RA): an arch distortion effect and compression of axis ends relative to the axis middle (Gauch 1982).

In addition, Sorensen's similarity coefficients, Shannon's Index, species richness, and a dominance index were calculated and provided additional tools in comparing stands and delineating groups. Site environmental data were also summarized for aiding analysis.

Riparian plant community types were delineated based upon the combined results of these different procedures. TWINSPAN was useful in identifying outlier stands and in identifying the strongest groupings. Outlier stands which did not fit recognized types were dropped from further analysis. Final ordinations using DECORANA included only the stands which were assigned to community type groups. Stand and species output scores from the first two DECORANA axes were plotted to assist in interpretation of environmental relationships. In addition, the order of community type groups along each axis was compared to measured environmental variables. In order to further assess the relationships between closely related community types, cluster analysis and ordinations were performed on a subset of the data. This subset included only the stands in community types which were positioned closely to one another in the original ordination.

Data for final community types were summarized in constancy-cover tables (Tables 1-3 and 1-6) and site summary tables (Tables 1-4 and 1-7). Descriptions for each riparian community type were then prepared.

TERMINOLOGY

The community type approach to classification was chosen because of the dynamic and highly disturbed nature of most of the riparian vegetation. A community type is an aggregation of plant communities sharing floristic and structural similarities. Community types are defined based on existing vegetation with no reference to successional status. The riparian community types in this study are named on the basis of characteristic or dominant plant species in the various structural layers. Different lifeforms in a community type name are separated by a slash (/), and a dash (-) is used to separate members of the same lifeform. Single species may be used to describe some community types where only one structural layer is present such as meadow communities and some shrub communities. Six digit alphacodes, used for all species, are constructed using the first three letters of the genus followed by the first three letters of the epithet.

RESULTS AND DISCUSSION

Floristic Analysis. A total of 227 species of vascular plants were encountered in the Trout Creek Mountain riparian sample plots (Appendix A). This diverse vascular flora includes 42 families and 130 genera. The Poaceae was represented by 16 genera and 39 species, and Asteraceae by 19 genera and 27 species (Table 1-1). The Cyperaceae had a low number of genera (3) but a high number of species (12). Similarly, the Salicaceae had only two genera, represented by eight species, all but one species being of the genus *Salix*. Fourteen families were represented by five or more taxa.

The herbaceous components of riparian communities harbor the most floristic diversity, with 57 graminoids and 149 forbs. Woody species are represented by one tree and 20 shrubs.

Vegetation Analysis. Twenty-eight plant community types are recognized from the riparian areas sampled in the Trout Creek Mountains (Table 1-2). The overall patch size of any given community is typically small. Edges are therefore common, and vegetative diversity is great in these riparian settings.

Most of the community types described here may be categorized as disturbance induced types. Some communities, such as the **ELEPAL c.t.** and

Table 1-1. Twenty vascular plant families with the greatest number of species.

Family	Genera	Species
POACEAE	16	39
ASTERACEAE	19	27
BRASSICACEAE	12	15
CYPERACEAE	3	12
RANUNCULACEAE	5	9
ONAGRACEAE	5	9
CARYOPHYLLACEAE	5	9
ROSACEAE	6	8
SALICACEAE	2	8
FABACEAE	4	7
SCROPHULARIACEAE	4	7
POLYGONACEAE	2	7
POLEMONIACEAE	5	6
BORAGINACEAE	4	6
HYDROPHYLLACEAE	3	5
GROSSULARIACEAE	1	5
JUNCACEAE	1	5
GERANIACEAE	2	4
RUBIACEAE	1	4
LABIATAE	3	3

Table 1-2. Riparian plant community types of the Trout Creek Mountains.

TREE COMMUNITY TYPES	
Populus tremuloides-Salix scouleriana c.t.	POPTRE/SALSCO
Populus tremuloides-Rosa woodsii c.t.	POPTRE/ROSWOO
SHRUB COMMUNITY TYPES	
Alnus incana-Rosa woodsii c.t.	ALNINC-ROSWOO
Alnus incana/Poa pratensis c.t.	ALNINC/POAPRA
Alnus incana/Carex lanuginosa c.t.	ALNINC/CARLAN
Salix lemmonii/Mesic Graminoid-Forb c.t.	SALLEM/MGF
Salix geyeriana/Mesic Graminoid-Forb c.t.	SALGEY/MGF
Salix lasiandra/Mesic Graminoid-Forb c.t.	SALLAS/MGF
Salix lasiandra-Rosa woodsii c.t.	SALLAS/ROSWOO
Salix lasiandra/Poa pratensis c.t.	SALLAS/POAPRA
Salix lutea/Mesic Graminoid c.t.	SALLUT/MG
Salix lutea-Rosa woodsii c.t.	SALLUT-ROSWOO
Salix exigua/Mesic Graminoid-Forb c.t.	SALEXI/MGF
Rosa woodsii c.t.	ROSWOO
Rosa woodsii/Poa pratensis c.t.	ROSWOO/POAPRA
Artemisia tridentata/Poa pratensis c.t.	ARTTRI/POAPRA*
Artemisia tridentata/Bromus tectorum c.t.	ARTTRI/BROTEC*
HERBACEOUS COMMUNITY TYPES	
Carex scopulorum c.t.	CARSCO
Scirpus microcarpos c.t.	SCIMIC
Glyceria grandis c.t.	GLYGRA
Eleocharis palustris c.t.	ELEPAL
Agrostis stolonifera c.t.	AGRSTO
Juncus balticus c.t.	JUNBAL
Poa palustris c.t.	POAPAL
Carex lanuginosa c.t.	CARLAN
Poa pratensis c.t.	POAPRA
Ranunculus macounii-Polygonum bistortoides c.t	RANMAC-POLBIS
Alopecurus aequalis c.t.	ALOAEQ*

*These three community types are described only by data collected along lower Willow Creek using Approach 2.

the **ALOAEQ c.t.** rapidly colonize moist mineral surfaces adjacent to the active stream channel following flooding disturbance. Other community types, such as the **POAPRA c.t.** and **JUNBAL c.t.**, appear to be grazing induced types which have replaced later seral communities dominated by native species. Some later seral communities are present only in areas which have escaped livestock grazing either due to steep terrain, boggy soils, or exclusion through fencing. Examples of these community types include the **POPTRE/SALSCO c.t.**, **CARSCO c.t.** and **CARLAN c.t.**.

Riparian community types of the Trout Creek Mountains are also structurally diverse. *Populus tremuloides* dominated communities have the tallest and densest canopies, commonly composed of multiple layers. The shrub dominated types have varied structure. Closely spaced individuals with thick canopies often characterize communities dominated by *Alnus incana* and *Salix lemmonii*. On the other hand, overstories of community types characterized by *S. lasiandra* and *S. lutea* consist of more widely scattered individuals. Communities dominated by *Rosa woodsii* may form impenetrable dense thickets. Herbaceous cover and composition associated with shrub dominated community types appears to be related to the amount of light reaching the soil surface, soil moisture and disturbance. Understory composition may also vary by microsite within a community type. Herbaceous community types are characterized by one vegetative layer, typically less than a half-meter in height.

Distinct patterns of community type association occur along the elevational gradient of the study area. At low elevations, the **SALLAS/ROSWOO c.t.**, **SALLAS/POAPRA c.t.**, **POAPRA c.t.**, **ROSWOO c.t.**, and **ALNINC/POAPRA c.t.** are often associated. Low elevation communities dominated by *Alnus incana* or *Salix lasiandra* are often located in close proximity to the stream channel, where the **ROSWOO c.t.** and **ROSWOO/POAPRA c.t.**are commonly located on higher positions away from the channel. The **SALLEM/MGF c.t.** is the most prevalent type along very disturbed stream reaches at mid to high elevations. High elevations are the only location for some community types, including the **CARSCO c.t.** and **RANMAC/POLBIS c.t.**

Two tree-dominated, fifteen shrub-dominated and eleven herbaceous community types are identified and described below. Species constancy and average cover are compared between plant community types in Tables 1-3 and 1-6. Site variables by community type are summarized in Tables 1-4 and

1-7. Table 1-5 summarizes data on species richness, dominance and Shannon's Index for each community type.

The first 25 community type descriptions are based on data collected by Approach 1, and represent samples from all four streams. Three additional community types are described for the lower reaches of Willow Creek (Approach 2).

TREE DOMINATED TYPES. Aspen communities are most common at mid to high elevations along small tributaries and sidehill springs and seeps. In this study sampling was focused on communities occurring along distinct stream courses, and not associated with seeps on sideslopes. Two community types dominated by *Populus tremuloides* were sampled (Table 1-3). Aspen is one of two tree species occurring in the Trout Creek Mountains. The other is *Populus trichocarpa* (Black Cottonwood) which is not represented in the stands sampled. Conifers are conspicuously absent from the area.

Populus tremuloides/Salix scouleriana c.t. (n=4) **POPTRE/ROSWOO**

Site -- POPTRE/SALSCO communities occupy relatively stable banks and lower sideslopes in narrow v-shaped valleys at mid-elevations of 1740 m (5709 ft). Mean valley bottom width where these communities occur is 9.9 meters. Stream channels in these valleys average 1.5 m in width and are confined by steep banks. In average years, spring run-off is contained within these banks. The steep channel gradient (x=8.4%) reflects an environment of transport rather than retention of materials and moisture. Land surfaces supporting the **POPTRE/SALSCO c.t.** are typically situated about a half a meter above the stream channel. The stony and silty upper soil horizons are dry during most of the growing season.

Riparian zone width nearly equals valley floor width on these sites (R:V = 0.9). The dense tree canopy cover provides shading for more than 90% of the stream channel.

Vegetation -- These communities are characterized by dense canopies of *Populus tremuloides* and *Salix scouleriana* which result in shady, cool, and sparsely vegetated ground surface environments. Approximately 75% of the understory is unvegetated (Table 1-4). *Rosa woodsii* is present in all sampled communities with an average cover of 15%. Other shrubs may be found in minor amounts, including *Amelanchier alnifolia*, and *Prunus virginiana*.

Table 1-3. Constancy and average canopy cover of important plant species in 25 riparian community types.

COMMUNITY TYPE	POTR/SASC* N = 8	POTR/ROWO* N = 4	ALIN-ROWO* N = 21	ALIN/POPR* N = 16	ALIN/CALA* N = 3	SALE/MGF* N = 28	SAGE/MGF* N = 3
***** TREES *****							
Populus tremuloides	100(44)	100(67)	10(15)	......	......	4(t)	......
***** SHRUBS *****	100(80)	100(70)	100(99)	94(95)	100(99)	100(82)	100(58)
Alnus incana	25(20)	25(10)	100(77)	100(68)	100(89)	4(3)	......
Amelanchier alnifolia	50(t)	50(26)	10(45)	6(3)	......	......	......
Artemisia tridentata	......	25(20)	43(8)	81(15)	33(t)	21(1)	33(t)
Clematis ligusticifolia	......	......	14(7)	19(8)	33(3)	......	......
Cornus stolonifera	......	......	......	......	......	......	......
Prunus virginiana	50(t)	......	5(t)	......	......	......	......
Ribes aureum	......	......	......	......	......	......	......
Ribes lacustre	38(4)	......	......	......	......	32(7)	100(4)
Rosa woodsii	100(15)	100(43)	76(49)	69(14)	33(40)	......	......
Salix exigua	......	......	......	......	......	......	......
salix geyeriana	......	......	......	......	......	......	100(56)
Salix lasiandra	13(t)	25(30)	......	......	33(10)	21(35)	......
Salix lemmonii	13(20)	......	......	......	......	100(73)	......
Salix lutea	......	......	5(50)	6(10)	......	......	......
Salix scouleriana	100(60)	......	......	......	......	......	......
Symphoricarpos oreophillis	......	......	......	......	......	21(2)	......
***** GRAMINOIDS *****	100(7)	100(14)	90(13)	100(51)	100(56)	93(18)	100(22)
Agrostis exarata	......	......	......	6(3)	......	25(t)	33(3)
Agrostis scabra	......	......	......	......	......	18(1)	33(t)
Agrostis stolonifera	......	......	......	13(6)	33(3)	11(9)	......
Agropyron trachycaulum	......	......	5(3)	......	......	7(t)	67(t)
Alopecurus aequalis	......	......	......	......	......	36(1)	33(3)
Bromus tectorum	25(t)	50(2)	19(4)	69(1)	......	21(t)	......
Carex athrostachya	......	......	......	......	......	46(2)	33(t)
Carex douglasii	......	......	5(t)	13(6)	......	4(3)	......
Carex lanuginosa	......	......	29(7)	25(2)	100(33)	7(6)	......
Carex microptera	......	......	......	......	33(t)	75(1)	100(5)
Carex nebrascensis	......	......	......	......	......	4(20)	......
Carex praegracilis	......	......	......	......	......	......	......
Carex scopulorum	......	......	......	......	......	25(8)	......
Deschampsia cespitosa	......	......	......	......	......	32(5)	......
Deschampsia elongata	......	......	5(t)	......	......	25(t)	33(t)
Eleocharis palustris	......	......	......	......	......	7(2)	......
Eleocharis pauciflora	......	......	......	......	......	......	33(t)
Elymus triticoides	75(t)	50(2)	52(5)	56(12)	......	......	......
Glyceria grandis	......	......	......	......	......	25(1)	33(3)
Hordeum brachyantherum	......	......	......	13(5)	......	......	......
Juncus balticus	......	......	......	19(1)	33(t)	7(t)	33(t)
Juncus ensifolius	......	......	......	......	......	14(1)	67(2)
Juncus mertensianus	......	......	......	......	......	25(2)	......
Phleum alpinum	......	......	......	......	......	21(1)	......
Phleum pratense	......	......	......	......	......	4(t)	......
Poa bulbosa	13(t)	50(t)	14(1)	25(5)	......	......	......
Poa palustris	75(5)	50(5)	29(6)	25(10)	......	57(4)	67(t)
Poa pratensis	25(2)	100(8)	57(6)	100(34)	67(10)	43(6)	100(5)
Scirpus americanus	......	......	......	......	......	......	......
Scirpus microcarpos	......	......	5(t)	13(5)	100(14)	......	......

*POTR/SASC = Populus tremuloides/Salix scouleriana c.t.. POTR/ROWO = Populus tremuloides/Rosa woodsii c.t..
ALIN/ROWO = Alnus incana-Rosa woodsii c.t.. ALIN/POPR = Alnus incana/Poa pratensis c.t..
ALIN/CALA = Alnus incana/Carex lanuginosa c.t.. SALE = Salix lemmonii/Mesic Graminoid-Forb c.t..
SAGE = Salix geyeriana/Mesic Graminoid-Forb c.t..

Table 1-3. (cont.). Constancy and average canopy cover of important plant species in 25 riparian community types.

COMMUNITY TYPE	POTR/SASC*	POTR/ROWO*	ALIN-ROWO*	ALIN/POPR*	ALIN/CALA*	SALE/MGF*	SAGE/MGF*
	N = 8	N = 4	N = 21	N = 16	N = 3	N = 28	N = 3
***** FORBS *****	100(29)	100(38)	90(14)	69(14)	100(5)	100(23)	100(35)
Achillea millefolium	38(t)	100(1)	14(t)	38(3)	......	54(3)	100(5)
Allium bisceptrum	50(t)	25(t)	14(1)	13(2)	......	4(t)	33(t)
Aquilegia formosa	63(1)	50(17)	10(5)	......	......	......	......
Artemisia ludoviciana	......	......	......	6(t)	......	7(2)	33(3)
Aster spp.	......	......	......	6(t)	......	4(3)	......
Aster foliaceous	......	......	......	......	......	14(1)	67(10)
Barbarea orthoceras	......	......	......	......	......	36(1)	33(t)
Cicuta douglasii	......	......	......	......	......	......	......
Cirsium spp.	63(t)	......	5(t)	......	......	14(t)	33(t)
Cirsium vulgare	25(t)	......	5(t)	31(3)	......	......	......
Conyza canadensis	......	......	......	......	......	......	......
Epilobium glaberrimum	13(t)	25(t)	10(t)	6(10)	......	7(2)	......
Epilobium watsonii	38(t)	......	10(5)	6(3)	......	64(1)	33(3)
Floerkea proserpinacoides	......	......	......	......	......	4(t)	......
Galium triflorum	100(4)	100(11)	43(6)	25(6)	......	14(1)	......
Geum macrophyllum	......	......	......	......	......	36(1)	33(t)
Heracleum lanatum	25(2)	......	5(3)	......	......	4(t)	......
Lactuca serriola	25(t)	......	......	6(t)	......	......	......
Linanthus septentrionales	......	......	......	......	......	18(2)	33(t)
Mentha arvense	25(t)	......	......	6(t)	67(5)	7(t)	......
Mimulus guttatus	13(t)	25(t)	......	......	......	71(3)	33(3)
Mimulus primuloides	......	......	......	......	......	11(t)	......
Montia chamissoi	38(t)	......	......	6(t)	......	43(t)	33(t)
Montia perfoliata	75(1)	......	19(t)	13(t)	......	21(4)	......
Osmarhiza occidentalis	38(5)	75(11)	5(10)	6(3)	......	......	......
Plantago major	......	......	5(t)	......	......	......	......
Polygonum bistortoides	......	......	......	......	......	......	100(1)
Potentilla biennis	13(t)	......	......	......	......	4(t)	......
Potentilla gracilis	......	......	......	......	......	......	67(t)
Ranunculus cymbalaria	13(t)	......	......	......	......	11(t)	......
Ranunculus macounii	......	......	......	......	......	36(1)	67(2)
Ranunculus sceleratus	......	......	......	......	......	......	......
Rumex spp.	38(1)	......	5(10)	......	......	75(3)	33(3)
Senecio serra	......	25(3)	......	......	......	4(t)	33(t)
Sidalcea oregana	......	......	......	......	......	39(t)	67(3)
Silene menziesii	50(1)	25(10)	......	......	......	7(t)	......
Smilacina stellata	88(3)	......	43(13)	6(t)	......	25(5)	......
Stellaria longipes	50(t)	50(t)	......	6(t)	......	11(t)	33(t)
Taraxacum officinale	88(3)	75(2)	24(1)	31(7)	33(t)	71(2)	......
Trifolium cyanthiferum	......	......	......	......	......	11(t)	......
Trifolium spp.	......	......	......	6(3)	......	25(t)	......
Trifolium longipes	......	......	......	......	......	4(t)	......
Urtica dioica	88(6)	......	10(2)	19(2)	......	39(4)	100(t)
Veronica americana	38(1)	......	......	......	......	54(4)	67(5)
Veratrum californicum	......	......	......	......	......	11(1)	......
Equisetum arvense	......	......	5(10)	6(t)	......	......	......
Equisetum laevigatum	......	......	......	13(10)	33(3)	......	......

*POTR/SASC = Populus tremuloides/Salix scouleriana c.t.. POTR/ROWO = Populus tremuloides/Rosa woodsii c.t..
ALIN/ROWO = Alnus incana-Rosa woodsii c.t.. ALIN/POPR = Alnus incana/Poa pratensis c.t..
ALIN/CALA = Alnus incana/Carex lanuginosa c.t.. SALE = Salix lemmonii/Mesic Graminoid-Forb c.t..
SAGE = Salix geyeriana/Mesic Graminoid-Forb c.t..

Table 1-3. (cont.). Constancy and average canopy cover of important plant species in 25 riparian community types.

COMMUNITY TYPE	SALA/MGF*	SALA-ROWO*	SALA/POPR*	SALU/MG*	SALU-ROWO*	SALEX/MGF*	ROWO*
	N = 7	N = 9	N = 8	N = 4	N = 6	N = 3	N = 17
***** TREES *****							
Populus tremuloides	......	11(10)	13(t)	......	17(10)	......	12(10)
***** SHRUBS *****	100(58)	100(91)	100(81)	100(64)	100(89)	100(52)	100(67)
Alnus incana	......	......	25(30)	......	......	......	12(10)
Amelanchier alnifolia	......	11(t)	......	......	......	......	......
Artemisia tridentata	29(t)	22(3)	25(5)	......	50(4)	......	65(9)
Clematis ligusticifolia	14(3)	11(t)	13(t)	......	33(5)	......	12(15)
Cornus stolonifera	......	......	13(t)	......	......	......	6(10)
Prunus virginiana	14(t)	......	......	......	......	......	6(40)
Ribes aureum	......	44(4)	......	......	33(12)	......	6(10)
Ribes lacustre	14(t)	......	......	......	......	......	......
Rosa woodsii	29(10)	100(36)	63(9)	25(3)	100(18)	33(3)	100(55)
Salix exigua	......	......	......	......	......	100(40)	6(10)
Salix geyeriana	......	......	......	......	......	......	......
Salix lasiandra	100(54)	100(68)	100(70)	......	......	......	......
Salix lemmonii	......	......	......	......	......	......	......
Salix lutea	......	......	13(10)	100(63)	100(67)	67(15)	......
Salix scouleriana	......	......	......	......	......	......	......
Symphoricarpos oreophilus	......	......	......	......	......	......	......
***** GRAMINOIDS ****	86(15)	100(26)	100(45)	100(53)	100(26)	100(47)	100(16)
Agrostis exarata	......	......	13(t)	......	......	......	6(t)
Agrostis scabra	......	......	......	......	......	......	......
Agrostis stolonifera	......	......	38(5)	......	17(t)	......	......
Agropyron trachycaulum	......	......	......	......	......	......	......
Alopecurus aequalis	14(10)	11(3)	25(t)	......	......	......	6(t)
Bromus tectorum	29(t)	44(7)	25(t)	......	67(3)	......	71(5)
Carex athrostachya	29(t)	......	13(t)	......	......	......	......
Carex douglasii	14(t)	22(5)	25(t)	......	......	......	18(t)
Carex lanuginosa	14(3)	11(t)	25(3)	50(5)	33(7)	67(20)	18(2)
Carex microptera	......	33(t)	25(2)	......	......	......	......
Carex nebrascensis	......	......	......	......	......	......	......
Carex praegracilis	......	......	......	25(t)	......	......	6(t)
Carex scopulorum	......	......	......	......	......	......	......
Deschampsia cespitosa	......	11(3)	......	......	......	......	......
Deschampsia elongata	......	......	......	......	......	......	......
Eleocharis palustris	29(t)	......	13(t)	25(t)	......	33(t)	......
Eleocharis pauciflora	......	......	......	......	......	......	......
Elymus triticoides	......	56(2)	38(t)	......	67(3)	33(10)	71(6)
Glyceria grandis	29(5)	......	......	25(10)	......	......	......
Hordeum brachyantherum	......	......	13(10)	50(t)	......	......	......
Juncus balticus	29(t)	11(3)	50(2)	50(5)	17(t)	33(t)	12(t)
Juncus ensifolius	14(t)	......	25(t)	......	......	......	......
Juncus mertensianus	......	......	......	......	......	......	......
Phleum alpinum	......	......	......	......	......	......	......
Phleum pratense	......	......	......	50(12)	......	33(t)	......
Poa bulbosa	14(t)	22(2)	13(t)	......	17(3)	......	24(3)
Poa palustris	71(7)	56(16)	63(9)	100(18)	50(8)	100(2)	12(t)
Poa pratensis	29(10)	56(14)	100(30)	100(4)	83(16)	67(2)	71(7)
Scirpus americanus	......	......	......	25(t)	......	......	6(t)
Scirpus microcarpos	......	......	25(2)	100(18)	17(t)	67(35)	6(t)

*SALA = Salix lasiandra/Mesic Graminoid-Forb c.t.. SALA-ROWO = Salix lasiandra-Rosa woodsii c.t..
SALA/POPR = Salix lasiandra/Poa pratensis c.t.. SALU = Salix lutea/Mesic Graminoid c.t..
SALU-ROWO = Salix lutea-Rosa woodsii c.t.. SAEX = Salix exigua/Mesic Graminoid-Forb c.t.. ROWO = Rosa woodsii c.t..

Table 1-3. (cont.). Constancy and average canopy cover of important plant species in 25 riparian community types.

COMMUNITY TYPE	SALA/MGF*	SALA-ROWO*	SALA/POPR*	SALU/MG*	SALU-ROWO*	SALEX/MGF*	ROWO*
	N = 7	N = 9	N = 8	N = 4	N = 6	N = 3	N = 17
***** FORBS ****	100(16)	100(20)	100(23)	100(40)	100(23)	100(53)	89(10)
Achillea millefolium	29(t)	33(1)	75(1)	50(t)	50(t)	......	12(t)
Allium bisceptrum	......	......	......	......	33(t)	......	6(t)
Aquilegia formosa	......	11(t)	13(t)	......	17(10)	......	......
Artemisia ludoviciana	14(t)	33(t)	25(t)	......	......	......	6(t)
Aster spp.	......	11(t)	13(3)	......	......	......	12(t)
Aster foliaceous	......	......	......	......	......	......	......
Barbarea orthoceras	14(t)	......	......	......	......	......	6(t)
Cicuta douglasii	43(2)	......	25(3)	75(7)	......	100(10)	......
Cirsium spp.	43(t)	22(5)	25(2)	50(2)	17(t)	......	6(t)
Cirsium vulgare	29(t)	44(1)	38(5)	......	......	......	18(t)
Conyza canadensis	......	......	13(t)	......	......	......	......
Epilobium glaberrimum	43(1)	44(1)	25(t)	......	17(t)	33(t)	6(3)
Epilobium watsonii	43(4)	11(t)	25(t)	25(t)	17(t)	......	6(t)
Floerkea proserpinacoides	......	......	......	......	......	......	.....
Galium triflorum	14(t)	56(8)	25(5)	......	33(2)	......	35(5)
Geum macrophyllum	......	......	13(t)	......	......	......	6(3)
Heracleum lanatum	......	.....	......	25(3)	17(10)	......	6(10)
Lactuca serriola	......	11(3)	25(t)	......	17(t)	......	......
Linanthus septentrionales	......	......	......	......	......	......	......
Mentha arvense	29(t)	11(t)	13(t)	50(t)	......	100(4)	6(t)
Mimulus guttatus	14(t)	11(t)	13(t)	......	17(t)	......	......
Mimulus primuloides	......	......	......	......	......	......	......
Montia chamissoi	14(t)	11(3	13(10)	25(t)	17(t)	......	......
Montia perfoliata	......	......	13(t)	......	33(t)	......	18(t)
Osmarhiza occidentalis	......	22(15)	13(t)	......	17(40)	......	12(2)
Plantago major	71(t)	11(t)	63(3)	75(1)	......	......	6(t)
Polygonum bistortoides	......	......	......	......	......	......	......
Potentilla biennis	......	22(t)	13(t)	......	17(t)	......	6(10)
Potentilla gracilis	......	......	......	......	......	......	......
Ranunculus cymbalaria	43(1)	11(t)	25(t)	......	......	......	6(t)
Ranunculus macounii	......	......	......	......	......	......	......
Ranunculus sceleratus	14(10)	11(t)	......	......	......	......	......
Rumex spp.	86(t)	33(4)	25(5)	100(2)	17(t)	67(t)	6(t)
Senecio serra	......	22(5)	......	......	......	......	......
Sidalcea oregana	......	......	13(t)	......	......	......	......
Silene menziesii	14(t)	......	13(t)	......	......	......	6(t)
Smilacina stellata	......	11(10)	13(10)	50(5)	33(7)	33(3)	18(2)
Stellaria longipes	......	......	......	......	17(t)	......	......
Taraxacum officinale	57(t)	56(t)	75(1)	75(t)	83(t)	33(t)	24(1)
Trifolium cyantniferum	14(t)	......	13(t)	......	......	......	......
Trifolium spp.	29(10)	......	13(t)	75(t)	......	67(2)	6(t)
Trifolium longipes	14(t)	......	13(3)	......	......	......	......
Urtica dioica	14(t)	44(1)	25(2)	......	33(2)	......	18(5)
Veronica americana	57(3)	22(2)	25(5)	50(t)	17(t)	33(t)	......
Veratrum californicum	......	......	......	......	......	......	......
Equisetum arvense	29(t)	......	13(10)	100(18)	33(t)	100(30)	6(t)
Equisetum laevigatum	43(t)	22(t)	25(t)	50(2)	17(t)	100(4)	24(2)

*SALA = Salix lasiandra/Mesic Graminoid-Forb c.t.. SALA-ROWO = Salix lasiandra-Rosa woodsii c.t..
SALA/POPR = Salix lasiandra/Poa pratensis c.t.. SALU = Salix lutea/Mesic Graminoid c.t..
SALU-ROWO = Salix lutea-Rosa wooosii c.t.. SAEX = Salix exigua/Mesic Graminoid-Forb c.t.. ROWO = Rosa woodsii c.t..

Table 1-3. (cont.). Constancy and average canopy cover of important plant species in 25 riparian community types.

COMMUNITY TYPE	ROWO/POPR*	CASC*	SCMI*	GLGR*	ELPA*	AGST*	JUBA*
	N = 19	N = 6	N = 5	N = 6	N = 5	N = 5	N = 12
***** TREES *****							
Populus tremuloides	11(7)	......	......	......	......	......	......
***** SHRUBS *****	100(48)	17(t)	80(16)	......	60(7)	......	33(2)
Alnus incana	......	......	......	......	20(t)	......	......
Amelanchier alnifolia	......	......	......	......	......	......	......
Artemisia tridentata	84(19)	......	......	......	......	......	......
Clematis ligusticifolia	16(24)	......	......	......	......	......	......
Cornus stolonifera	5(t)	......	......	......	......	......	......
Prunus virginiana	......	......	......	......	......	......	......
Ribes aureum	......	......	......	......	......	......	......
Ribes lacustre	......	......	......	......	......	......	8(t)
Rosa woodsii	95(29)	......	60(5)	......	......	......	......
Salix exigua	......	......	40(5)	......	......	......	......
Salix geyeriana	......	......	......	......	......	......	25(1)
Salix lasiandra	16(7)	......	......	......	40(3)	......	......
Salix lemmonii	......	17(t)	......	......	......	......	......
Salix lutea	11(t)	......	80(8)	......	20(10)	......	......
Salix scouleriana	......	......	......	......	......	......	......
Symphoricarpos oreophillis	......	......	......	......	......	......	......
***** GRAMINOIDS ****	100(52)	100(69)	100(81)	100(57)	100(63)	100(62)	100(59)
Agrostis exarata	......	......	20(t)	33(2)	20(10)	......	42(3)
Agrostis scabra	......	17(t)	......	......	......	......	17(t)
Agrostis stolonifera	16(1)	......	......	......	60(2)	100(20)	......
Agropyron trachycaulum	......	......	......	......	......	......	8(t)
Alopecurus aequalis	......	17(t)	20(t)	50(1)	60(7)	60(11)	17(5)
Bromus tectorum	58(5)	......	......	......	......	......	8(t)
Carex athrostachya	......	17(t)	......	83(1)	......	80(11)	33(1)
Carex douglasii	32(6)	......	......	......	......	......	8(t)
Carex lanuginosa	26(15)	......	100(9)	......	40(2)	......	......
Carex microptera	21(t)	17(t)	......	50(7)	......	40(t)	91(3)
Carex nebrascensis	......	......	20(10)	......	20(10)	......	17(10)
Carex praegracilis	11(5)	......	......	......	......	......	......
Carex scopulorum	......	100(45)	......	17(10)	......	......	33(7)
Deschampsia cespitosa	......	83(8)	......	50(4)	......	......	25(20)
Deschampsia elongata	......	17(t)	20(t)	17(t)	......	20(t)	......
Eleocharis palustris	......	......	60(2)	17(t)	100(28)	......	......
Eleocharis pauciflora	......	33(5)	......	67(8)	......	......	25(5)
Elymus triticoides	68(5)	......	......	......	......	......	......
Glyceria grandis	......	17(10)	......	100(27)	40(2)	......	25(2)
Hordeum brachyantherum	5(t)	......	......	17(t)	......	20(t)	58(1)
Juncus balticus	26(t)	33(11)	100(9)	67(13)	80(5)	80(10)	100(29)
Juncus ensifolius	......	17(t)	40(t)	17(10)	60(5)	......	42(4)
Juncus mertensianus	......	33(t)	......	17(3)	......	......	25(t)
Phleum alpinum	......	83(2)	......	33(5)	......	......	50(6)
Phleum pratense	......	......	20(t)	......	20(t)	......	......
Poa bulbosa	26(4)	......	......	......	......	......	......
Poa palustris	21(13)	......	40(t)	......	80(8)	100(12)	8(t)
Poa pratensis	100(33)	......	60(1)	17(3)	80(2)	60(8)	33(4)
Scirpus americanus	......	......	......	......	20(t)	......	......
Scirpus microcarpos	......	......	100(54)	......	80(5)	......	......

*ROWO/POPR = *Rosa woodsii/Poa pratensis* c.t.. CASC = *Carex scopulorum* c.t.. SCMI = *Scirpus microcarpos* c.t..
GLGR = *Glyceria grandis* c.t.. ELPA = *Eleocharis palustris* c.t., AGST = *Agrostis stolonifera* c.t..
JUBA = *Juncus balticus* c.t..

Table 1-3. (cont.). Constancy and average canopy cover of important plant species in 25 riparian community types.

COMMUNITY TYPE	ROWO/POPR* N = 19	CASC* N = 6	SCMI* N = 5	GLGR* N = 6	ELPA* N = 5	AGST* N = 5	JUBA* N = 12
***** FORBS ****	74(15)	100(22)	100(16)	100(37)	100(27)	100(32)	100(34)
Achillea millefolium	53(3)	......	20(t)	......	......	80(3)	75(1)
Allium bisceptrum	16(t)	......	......	......	......	......	......
Aquilegia formosa	......	......	......	......	......	......	......
Artemisia ludoviciana	11(t)	......	......	......	20(3)	......	17(2)
Aster spp.	11(2)	......	40(2)	......	......	......	......
Aster foliaceous	......	17(3)	......	......	......	......	58(3)
Barbarea orthoceras	......	17(t)	......	33(3)	......	......	25(t)
Cicuta douglasii	......	......	60(5)	......	40(5)	......	......
Cirsium spp.	32(2)	......	20(t)	......	......	......	17(t)
Cirsium vulgare	32(5)	......	40(t)	......	......	......	......
Conyza canadensis	......	......	40(t)	......	40(2)	......	......
Epilobium glaberrimum	......	......	20(t)	17(3)	60(2)	40(2)	17(t)
Epilobium watsonii	......	50(t)	40(t)	67(4)	20(t)	......	67(4)
Floerkea proserpinacoides	......	......	......	17(t)	......	......	8(t)
Galium triflorum	26(t)	......	......	......	......	......	......
Geum macrophyllum	......	17(t)	......	17(3)	......	......	33(3)
Heracleum lanatum	......	......	......	......	......	......	......
Lactuca serriola	16(t)	......	......	......	......	......	......
Linanthus septentrionales	......	......	......	......	......	......	......
Mentha arvense	5(t)	......	80(1)	......	40(12)	......	......
Mimulus guttatus	......	33(t)	60(t)	83(11)	40(t)	80(13)	33(4)
Mimulus primuloides	......	50(2)	......	50(t)	......	......	33(1)
Montia chamissoi	......	50(17)	......	50(2)	20(t)	40(2)	42(2)
Montia perfoliata	5(t)	......	......	......	......	......	......
Osmarhiza occidentalis	......	......	......	......	......	......	......
Plantago major	11(t)	......	40(2)	......	60(5)	......	......
Polygonum bistortoides	......	33(2)	......	......	......	......	50(5)
Potentilla biennis	5(t)	......	......	......	20(t)	......	......
Potentilla gracilis	......	17(t)	......	......	......	......	33(10)
Ranunculus cymbalaria	......	33(t)	40(t)	33(5)	......	40(5)	8(t)
Ranunculus macounii	......	17(20)	......	50(5)	......	......	42(8)
Ranunculus sceleratus	......	......	......	......	......	......	......
Rumex spp.	5(t)	......	80(1)	50(11)	60(4)	......	25(2)
Senecio serra	5(3)	......	......	......	......	......	8(t)
Sidalcea oregana	5(t)	......	......	......	......	......	33(t)
Silene menziesii	21(1)	......	......	......	......	......	......
Smilacina stellata	11(2)	......	20(t)	......	......	......	......
Stellaria longipes	5(t)	33(t)	......	......	......	60(1)	58(t)
Taraxacum officinale	47(2)	50(1)	......	17(t)	20(t)	100(3)	83(1)
Trifolium cyanthiferum	......	......	......	......	20(t)	......	......
Trifolium spp.	11(t)	17(t)	40(t)	33(5)	20(20)	......	58(3)
Trifolium longipes	5(t)	33(2)	......	......	20(10)	60(10)	42(5)
Urtica dioica	16(4)	......	......	......	......	......	8(t)
Veronica americana	......	67(2)	......	100(4)	40(2)	60(5)	50(4)
Veratrum californicum	......	......	......	......	......	......	25(t)
Equisetum arvense	5(10)	......	60(5)	......	......	......	......
Equisetum laevigatum	21(5)	......	60(t)	......	20(t)	......	......

*ROWO/POPR = Rosa woodsii/Poa pratensis c.t.. CASC = Carex scopulorum c.t.. SCMI = Scirpus microcarpos c.t.. GLGR = Glyceria grandis c.t.. ELPA = Eleocharis palustris c.t.. AGST = Agrostis stolonifera c.t.. JUBA = Juncus balticus c.t..

Table 1-3. (cont.). Constancy and average canopy cover of important plant species in 25 riparian community types.

COMMUNITY TYPE	POPA*	CALA*	POPR*	RAMA-POBI*
	N = 7	N = 12	N = 31	N = 7
***** TREES *****				
Populus tremuloides	......	......	......	......
***** SHRUBS *****	100(17)	58(17)	84(13)	......
Alnus incana	29(7)	25(2)	10(14)	......
Amelanchier alnifolia	......	......	......	......
Artemisia tridentata	14(10)	17(2)	48(4)	......
Clematis ligusticifolia	14(3)	......	......	......
Cornus stolonifera	......	......	......	......
Prunus virginiana	......	......	......	......
Ribes aureum	......	......	......	......
Ribes lacustre	......	......	......	......
Rosa woodsii	29(2)	25(17)	58(8)	......
Salix exigua	......	17(7)	7(5)	......
Salix geyeriana	......	......	3(10)	......
Salix lasiandra	57(4)	17(5)	23(7)	......
Salix lemmonii	......	......	3(3)	......
Salix lutea	14(10)	17(15)	......	......
Salix scouleriana	......	......	......	......
Symphoricarpos oreophillis	......	......	......	......
***** GRAMINOIDS *****	100(50)	100(73)	100(59)	100(38)
Agrostis exarata	14(10)	25(1)	16(1)	14(t)
Agrostis scabra	......	......	3(t)	......
Agrostis stolonifera	14(20)	50(5)	26(9)	......
Agropyron trachycaulum	......	......	......	......
Alopecurus aequalis	71(7)	25(4)	16(4)	43(1)
Bromus tectorum	43(t)	33(t)	26(2)	......
Carex athrostachya	29(5)	......	13(4)	86(6)
Carex douglasii	14(3)	17(2)	36(10)	......
Carex lanuginosa	......	100(33)	42(6)	......
Carex microptera	29(2)	33(t)	16(2)	71(3)
Carex nebrascensis	......	......	7(2)	.....
Carex praegracilis	......	17(2)	10(t)	......
Carex scopulorum	......	......	......	43(11)
Deschampsia cespitosa	29(t)	......	......	29(3)
Deschampsia elongata	......	17(t)	7(2)	71(2)
Eleocharis palustris	43(7)	75(9)	23(2)	......
Eleocharis pauciflora	.....	8(3)	3(3)	14(t)
Elymus triticoides	14(3)	25(8)	39(5)	......
Glyceria grandis	14(t)	8(t)	3(t)	......
Hordeum brachvantherum	14(t)	25(1)	16(11)	57(1)
Juncus balticus	57(1)	58(6)	74(5)	86(10)
Juncus ensifolius	29(t)	25(5)	19(1)	......
Juncus mertensianus	......	......	3(t)	......
Phleum alpinum	......	......	......	100(7)
Phleum pratense	......	8(10)	7(5)	......
Poa bulbosa	......	......	10(4)	......
Poa palustris	100(29)	75(5)	29(7)	......
Poa pratensis	43(5)	75(7)	97(34)	86(3)
Scirpus americanus	......	......	3(t)	......
Scirpus microcarpos	......	67(9)	32(3)	.....

*POPA = Poa palustris c.t.. CALA = Carex lanuginosa c.t.. POPR = Poa pratensis c.t.. RAMA-POBI = Ranunculus macounii-Polygonum bistortoides c.t..

Table 1-3. (cont.). Constancy and average canopy cover of important plant species in 25 riparian community types.

COMMUNITY TYPE	POPA* N = 7	CALA* N = 12	POPR* N = 31	RAMA-POBI* N = 7
***** FORBS ** ***	100(30)	100(28)	100(26)	100(48)
Achillea millefolium	29(5)	25(t)	81(3)	......
Allium bisceptrum	......	......	7(t)	......
Aquilegia formosa	......	......	......	......
Artemisia ludoviciana	14(t)	17(5)	23(3)	......
Aster spp.	......	8(t)	16(3)	......
Aster foliaceous	......	......	3(3)	71(2)
Barbarea orthoceras	43(1)	......	7(t)	57(1)
Cicuta douglasii	......	33(7)	13(t)	......
Cirsium spp.	43(t)	17(t)	32(2)	14(t)
Cirsium vulgare	43(t)	33(1)	52(4)	......
Conyza canadensis	......	42(2)	19(1)	......
Epilobium glaberrimum	86(5)	42(1)	32(4)	57(t)
Epilobium watsonii	14(3)	8(t)	10(t)	57(t)
Floerkea proserpinacoides	......	......	......	29(2)
Galium triflorum	......	......	7(t)	......
Geum macrophyllum	29(t)	......	7(t)	14(t)
Heracleum lanatum	......	......	7(5)	......
Lactuca serriola	......	......	16(t)	......
Linanthus septentrionales	......	......	......	......
Mentha arvense	29(t)	75(4)	36(1)	......
Mimulus guttatus	43(1)	17(t)	7(t)	29(t)
Mimulus primuloides	......	......	3(3)	57(t)
Montia chamissoi	......	8(t)	......	29(t)
Montia perfoliata	......	......	......	......
Osmarniza occidentalis	......	......	......	......
Plantago major	71(4.4)	83(5)	45(4)	......
Polygonum bistortoides	......	......	......	100(16)
Potentilla biennis	43(1)	17(t)	16(t)	......
Potentilla gracilis	......	......	......	29(2)
Ranunculus cymbalaria	57(2)	25(t)	19(1)	29(t)
Ranunculus macounii	......	......	10(1)	100(20)
Ranunculus sceleratus	14(3)	......	10(1)	......
Rumex spp.	57(11)	83(3)	42(1)	14(t)
Senecio serra	......	......	3(t)	......
Sidalcea oregana	14(t)	......	10(t)	......
Silene menziesii	......	......	3(t)	......
Smilacina stellata	......	17(2)	10(14)	......
Stellaria longipes	......	......	16(t)	14(t)
Taraxacum officinale	57(t)	67(2)	61(4)	71(1)
Trifolium cyanthiferum	......	8(3)	13(3)	......
Trifolium spp.	......	33(10)	16(7)	43(t)
Trifolium longipes	29(2)	17(t)	3(3)	29(t)
Urtica dioica	29(t)	8(t)	7(t)	......
Veronica americana	57(5)	17(3)	19(3)	57(1)
Veratrum californicum	......	......	......	......
Equisetum arvense	......	33(3)	16(2)	......
Equisetum laevigatum	14(t)	50(4)	61(4)	......

*POPA = Poa palustris c.t.. CALA = Carex lanuginosa c.t.. POPR = Poa pratensis c.t.. RAMA-POBI = Ranunculus macounii-Polygonum bistortoides c.t..

Although abundance of individual herbaceous taxa is relatively low, these are floristically diverse communities with an average species richness of 21 (Table 1-5). *Poa palustris* and *Elymus triticoides* are common grass associates, whereas *Galium triflorum*, *Smilacina stellata*, *Urtica dioica*, *Taraxacum officinale*, and *Montia perfoliata* are common forbs. Other herbaceous species which are associated with the **POPTRE/SALSCO c.t.** include *Aquilegia formosa*, *Cirsium* spp., *Osmarhiza occidentalis*, *Silene menziesii*, and *Allium bisceptrum*. Moist microsites (ie. immediately adjacent to stream channel) occasionally support *Mentha arvense*, *Epilobium watsonii*, *Montia chamissoi* and *Heracleum lanatum*.

The structural diversity associated with this community type provides habitat for many birds and mammals. Due to steepness of terrain and dense vegetation these communities are typically inaccessible to livestock.

Other -- A **POTR/SASC c.t.** has recently been described for the Intermountain Region (Mueggler 1988). This type was found to be fairly common in the mountains of northeastern Nevada, just to the south of the present study area. Mueggler's **POTR/SASC c.t.** is very similar to the type being described here with some minor differences in species composition. The Intermountain Region **POTR/SASC c.t.** is described as occurring along mid-slope positions on moderately steep, north- and east-facing slopes. This pattern of occurrence is also repeated in the Trout Creek Mountains. In addition to the upland positions our **POPTRE/SALSCO c.t.** is also found adjacent to small stream channels, and therefore included in this study.

Populus tremuloides/Rosa woodsii c.t. (n=4) **POPTRE/ROSWOO**

Site -- All four samples of this minor community type occur along a first order tributary at 1585 m (5200 ft) in elevation. These communities occupy a steep narrow valley only a few meters wide. The stream channel is only a half meter wide and less than 10 cm deep. Dense vegetative growth of this community type provides shade to 85% of the channel area. The channel and valley floor gradient is 14%.

The **POPTRE/ROSWOO c.t.** occupies low lying terraces about 0.4 meters above the stream channel. Soils are predominantly silty with < 35% coarse fragments in the upper layers. Surface soil was dry at the time of sampling in late June.

Table 1-4. Means and standard deviations of important site variables for riparian community types of the Trout Creek Mountains.

COMMUNITY TYPE NAMES

SITE VARIABLES	POTR/SASC* N = 8	POTR/ROWO* N = 4	ALIN-ROWO* N = 21	ALIN/POPR* N = 16	ALIN/CALA* N = 3	SALE/MGF* N = 28	SAGE/MGF* N = 3
HEIGHT OF SURFACE (m)	.6 (.1)	.4 (.2)	.8 (.4)	.9 (.4)	.4 (.2)	.5 (.3)	.7 (.4)
ASPECT (DEGREES)	309.6 (50.2)	269.0 (.0)	226.4 (138.9)	267.8 (101.7)	199.3 (159.7)	321.7 (35.7)	116.0 (.0)
GRADIENT (%)	8.4 (4.7)	14.0 (.0)	5.5 (3.6)	5.4 (3.4)	3.7 (.6)	5.1 (1.4)	4.0 (.0)
ELEVATION (M)	1739.3 (3.0)	1585.0 (.0)	1549.9 (38.1)	1547.3 (33.3)	1512.0 (12.0)	2094.7 (83.8)	2170.0 (.7)
BARE/GRAVEL COVER-%	10.1 (6.1)	4.3 (4.5)	7.8 (7.5)	5.3 (5.5)	5.0 (5.2)	32.1 (20.6)	21.3 (33.5)
ROCK COVER (%)	2.6 (3.1)	3.8 (4.3)	3.6 (5.8)	1.6 (2.3)	1.0 (.0)	7.9 (8.7)	1.0 (.0)
ORGANIC COVER (%)	66.0 (12.0)	31.0 (8.2)	66.7 (15.4)	37.4 (17.8)	28.0 (24.6)	29.7 (20.8)	31.0 (26.5)
LITTER COVER (%)	65.0 (12.0)	30.0 (8.2)	65.2 (15.7)	36.4 (17.8)	27.0 (24.6)	27.0 (21.5)	27.0 (30.1)
DIST FROM STREAM (m)	2.6 (.7)	2.3 (1.5)	3.8 (1.7)	4.3 (2.1)	1.3 (.6)	3.1 (1.7)	3.0 (1.7)
STREAM SHADED %	91.9 (2.6)	85.0 (.0)	72.6 (23.9)	56.6 (29.0)	48.3 (32.1)	27.0 (25.7)	5.0 (.0)
CHANNEL WIDTH (m)	1.5 (.3)	.5 (.0)	1.7 (1.2)	1.8 (1.0)	2.0 (.4)	2.1 (1.0)	.7 (.0)
CHANNEL DEPTH (cm)	10.0 (.0)	4.0 (.0)	12.4 (5.4)	12.2 (4.7)	12.7 (.6)	8.6 (3.2)	10.0 (.0)
RIPARIAN WIDTH (R)	9.3 (1.0)	12.0 (.0)	15.5 (3.1)	13.0 (4.1)	11.0 (5.3)	9.2 (2.3)	9.0 (.0)
VALLEY WIDTH (V)	9.9 (1.6)	12.0 (.0)	22.4 (9.1)	22.6 (8.7)	31.7 (2.9)	27.4 (20.7)	12.0 (.0)
R:V	.9 (.1)	1.0 (.0)	.8 (.2)	.7 (.3)	.3 (.2)	.5 (.3)	.8 (.0)
CHANNEL W:D	1.5 (.3)	1.3 (.0)	1.3 (.3)	1.4 (.3)	1.5 (.2)	2.4 (.6)	.7 (.0)

*POTR/SASC = *Populus tremuloides/Salix scouleriana* c.t., POTR/ROWO = *Populus tremuloides/Rosa woodsii* c.t., ALIN-ROWO = *Alnus incana-Rosa woodsii* c.t., ALIN/POPR = *Alnus incana/Poa pratensis* c.t., ALIN/CALA = *Alnus incana/Carex lanuginosa* c.t., SALE/MGF = *Salix lemmanii/Mesic Graminoid-Forb* c.t., SAGE/MGF = *Salix geyeriana/Mesic Graminoid-Forb* c.t..

Table 1-4. (cont.). Means and standard deviations of important site variables for riparian community types of the Trout Creek Mountains.

COMMUNITY TYPE NAMES

SITE VARIABLES	SALA/MGF* N = 7	SALA-ROWO* N = 9	SALA/POPR* N = 8	SALU/MG* N = 4	SALU-ROWO* N = 6	SAEX/MGF* N = 3	ROWO* N = 17
HEIGHT OF SURFACE (m)	.3 (.2)	.6 (.4)	.5 (.3)	.4 (.1)	.6 (.2)	.3 (.2)	.8 (.4)
ASPECT (DEGREES)	269.1 (39.4)	312.4 (27.9)	283.0 (32.8)	230.0 (.0)	301.0 (28.4)	230.0 (.0)	237.8 (131.5)
GRADIENT (%)	2.0 (1.4)	5.2 (5.1)	3.6 (4.2)	2.0 (.0)	5.0 (4.5)	2.0 (.0)	5.2 (3.4)
ELEVATION (M)	1530.3 (44.5)	1557.3 (56.4)	1503.6 (48.8)	1433.0 (.0)	1557.8 (52.1)	1433.0 (.0)	1556.5 (58.9)
BARE/GRAVEL COVER-%	41.3 (26.9)	4.4 (3.8)	7.1 (6.8)	7.0 (4.7)	5.7 (4.2)	2.7 (1.2)	14.1 (14.2)
ROCK COVER (%)	7.1 (14.5)	3.0 (4.0)	1.0 (.0)	1.5 (1.0)	1.0 (.0)	1.0 (.0)	8.0 (13.1)
ORGANIC COVER (%)	21.4 (14.6)	48.8 (17.9)	34.6 (16.8)	6.5 (5.2)	52.7 (17.2)	2.0 (.0)	51.1 (24.4)
LITTER COVER (%)	20.4 (14.6)	47.8 (17.9)	32.5 (16.7)	5.5 (5.2)	51.7 (17.2)	1.0 (.0)	50.1 (24.4)
DIST FROM STREAM (m)	4.6 (3.4)	12.0 (14.4)	7.9 (10.6)	4.3 (2.6)	4.5 (2.2)	2.7 (2.9)	5.4 (4.1)
STREAM SHADED %	32.1 (16.0)	29.4 (32.1)	33.1 (30.2)	70.0 (.0)	35.0 (25.3)	70.0 (.0)	41.2 (31.9)
CHANNEL WIDTH (m)	4.7 (.4)	3.0 (1.9)	2.4 (1.5)	1.9 (.0)	1.9 (1.2)	1.9 (.0)	2.6 (1.8)
CHANNEL DEPTH (cm)	33.4 (8.2)	15.7 (8.4)	15.5 (10.5)	13.0 (.0)	13.7 (6.4)	13.0 (.0)	16.7 (6.7)
RIPARIAN WIDTH (R)	19.3 (5.4)	25.4 (20.4)	25.0 (15.3)	32.0 (.0)	19.7 (5.5)	32.0 (.0)	18.8 (13.9)
VALLEY WIDTH (V)	22.1 (10.4)	30.1 (20.0)	39.6 (23.3)	65.0 (.0)	25.3 (10.9)	65.0 (.0)	28.6 (14.7)
R:V	.9 (.1)	.8 (.2)	.8 (.3)	.5 (.0)	.8 (.1)	.5 (.0)	.7 (.3)
CHANNEL W:D	1.5 (.3)	1.8 (.5)	1.6 (.4)	1.5 (.0)	1.3 (.2)	1.5 (.0)	1.5 (.6)

*SALA/MGF = *Salix lasiandra/Mesic Graminoid-Forb* c.t., SALA-ROMO = *Salix lasiandra-Rosa woodsii* c.t., SALA/POPR = *Salix lasiandra/Poa pratensis* c.t., SALU/MG = *Salix lutea/Mesic Graminoid* c.t., SALU-ROWO = *Salix lutea-Rosa woodsii* c.t., SAEX/MGF = *Salix exigua/Mesic Graminoid-Forb* c.t., ROWO = *Rosa woodsii* c.t..

Table 1-4. (cont.). Means and standard deviations of important site variables for riparian community types of the Trout Creek Mountains.

COMMUNITY TYPE NAMES

SITE VARIABLES	ROWO/POPR* N = 19	CASC* N = 6	SCMI* N = 5	GLGR* N = 6	ELPA* N = 5	AGST* N = 5	JUBA* N = 12
HEIGHT OF SURFACE (m)	.8 (.3)	.4 (.2)	.5 (.2)	.3 (.1)	.2 (.1)	.3 (.1)	.4 (.2)
ASPECT (DEGREES)	303.9 (75.7)	286.7 (10.3)	141.2 (121.6)	308.3 (20.4)	272.6 (33.9)	300.0 (.0)	203.0 (91.2)
GRADIENT (%)	3.5 (1.5)	5.0 (1.5)	2.8 (1.1)	6.5 (1.2)	2.2 (.8)	4.0 (.0)	4.8 (1.4)
ELEVATION (M)	1553.4 (41.9)	2381.3 (87.8)	1457.4 (33.4)	2241.5 (64.9)	1484.0 (32.7)	2036.0 (.0)	2261.5 (114.3)
BARE/GRAVEL COVER-%	6.3 (5.5)	7.0 (7.7)	5.6 (4.9)	8.3 (4.2)	6.8 (7.4)	17.0 (14.5)	16.9 (16.9)
ROCK COVER (%)	2.4 (3.4)	8.7 (7.1)	1.0 (.0)	12.2 (12.8)	1.4 (.9)	8.8 (7.5)	2.8 (3.4)
ORGANIC COVER (%)	28.4 (14.5)	2.0 (.0)	15.8 (14.3)	6.3 (3.6)	8.0 (8.2)	2.4 (.9)	12.8 (15.1)
LITTER COVER (%)	27.4 (14.5)	1.0 (.0)	12.6 (15.9)	1.0 (.0)	7.0 (8.2)	1.0 (.0)	9.8 (15.0)
DIST FROM STREAM (m)	6.8 (5.0)	6.7 (6.4)	9.4 (3.9)	2.7 (2.3)	5.0 (7.8)	1.2 (.4)	5.8 (4.2)
STREAM SHADED %	27.6 (25.4)	1.0 (.0)	52.0 (24.6)	4.2 (7.8)	31.0 (26.1)	2.0 (.0)	3.0 (2.1)
CHANNEL WIDTH (m)	2.6 (1.4)	1.2 (.2)	1.5 (.5)	1.7 (.4)	2.5 (1.4)	.6 (.0)	1.0 (.3)
CHANNEL DEPTH (cm)	16.0 (5.0)	4.3 (.5)	15.8 (3.8)	5.8 (2.0)	18.2 (12.2)	6.0 (.0)	7.3 (2.9)
RIPARIAN WIDTH (R)	25.6 (17.2)	27.7 (13.4)	34.4 (3.3)	39.5 (13.5)	22.2 (5.7)	4.0 (.0)	20.5 (15.4)
VALLEY WIDTH (V)	34.8 (17.6)	48.3 (2.6)	59.0 (8.2)	40.8 (10.2)	45.0 (22.9)	6.0 (.0)	29.7 (18.6)
R:V	.8 (.3)	.6 (.3)	.6 (.1)	.9 (.2)	.6 (.3)	.7 (.0)	.8 (.2)
CHANNEL W:D	1.6 (.6)	2.8 (.2)	1.1 (.5)	2.9 (.2)	1.4 (.1)	1.0 (.0)	1.8 (1.1)

*ROWO/POPR = *Rosa woodsii/Poa pratensis* c.t., CASC = *Carex scopulorum* c.t., SCMI = *Scirpus microcarpos* c.t., GLGR = *Glyceria grandis* c.t., ELPA = *Eleocharis palustris* c.t., AGST = *Agrostis stolenifera* c.t., JUBA = *Juncus balticus* c.t..

Table 1-4. (cont.). Means and standard deviations of important site variables for riparian community types of the Trout Creek Mountains.

COMMUNITY TYPE NAMES

SITE VARIABLES	POPA* N = 7	CALA* N = 12	POPR* N = 31	RAMA-POBI* N = 7
HEIGHT OF SURFACE (m)	.2 (.1)	.4 (.2)	.6 (.3)	.9 (.2)
ASPECT (DEGREES)	314.9 (17.9)	219.7 (102.8)	273.5 (86.0)	300.0 (.0)
GRADIENT (%)	3.3 (2.2)	2.7 (.9)	3.4 (2.0)	7.0 (.0)
ELEVATION (M)	1604.4 (164.4)	1480.7 (35.6)	1573.5 (168.9)	2268.0 (.0)
BARE/GRAVEL COVER	17.0 (14.0)	10.0 (11.9)	7.4 (9.9)	25.3 (9.8)
ROCK COVER (%)	7.4 (14.4)	1.5 (.9)	1.7 (2.3)	2.3 (3.4)
ORGANIC COVER (%)	7.6 (7.2)	7.4 (5.7)	17.5 (11.0)	5.7 (3.7)
LITTER COVER (%)	6.6 (7.2)	6.4 (5.7)	16.5 (11.0)	4.4 (3.9)
DIST FROM STREAM (m)	9.3 (17.1)	4.1 (3.2)	5.8 (4.1)	16.3 (13.2)
STREAM SHADED %	14.3 (12.4)	37.9 (25.5)	25.7 (21.4)	1.0 (.0)
CHANNEL WIDTH (m)	3.3 (1.5)	2.0 (1.0)	2.4 (1.5)	1.5 (.0)
CHANNEL DEPTH (cm)	13.9 (5.1)	16.4 (7.9)	17.0 (10.0)	5.0 (.0)
RIPARIAN WIDTH (R)	37.9 (27.6)	25.1 (10.7)	21.8 (15.5)	45.0 (.0)
VALLEY WIDTH (V)	44.3 (20.7)	51.7 (16.1)	32.0 (20.6)	45.0 (.0)
R:V	.8 (.4)	.5 (.2)	.8 (.3)	1.0 (.0)
CHANNEL W:D	2.4 (.6)	1.3 (.4)	1.5 (.6)	3.0 (.0)

*POPA = *Poa palustris* c.t., CALA = *Carex lanuginosa* c.t., POPR = *Poa pratensis* c.t., RAMA-POBI = *Ranunculus macounii-Polygonum bistortoides* c.t..

Vegetation -- The tree overstory of the **POPTRE/ROSWOO c.t.** is dominated by *Populus tremuloides*, where *Rosa woodsii* is consistently the dominant species in the shrub layer. Other shrubs which are associated with this type include *Alnus incana*, *Salix lasiandra*, *Amelanchier alnifolia*, and *Artemisia tridentata*. Herbaceous species are somewhat patchy in their occurrence. *Rosa woodsii* tends to form dense thickets with little understory outside of occasional individuals of *Galium triflorum*, and *Elymus triticoides*. Species occurring on more open and moist microsites in the understory are: *Poa palustris*, *Poa pratensis*, *Aquilegia formosa*, *Osmarhiza occidentalis*, *Mimulus guttatus*, *Senecio serra*, *Taraxacum officinale*, and *Collomia grandiflora*. Disturbed openings and edges may occasionally support *Bromus tectorum*, *Bromus commutatus*, or *Poa bulbosa*.

Tall and dense tree canopies of this community type are important bird habitat. Steep topography and dense vegetative growth limit livestock use in this community type.

Other -- The **POPTRE/ROSWOO c.t.** has not been previously described. However, in preliminary studies of riparian communities in Nevada, Padgett and Manning (1988) identify a potential (preliminary) community type which is similar.

SHRUB-DOMINATED TYPES. Three *Alnus incana* (thinleaf alder), eight *Salix* spp. (willow), and two *Rosa woodsii* (rose) community types were identified and are described below.

Alnus incana-Rosa woodsii c.t. (n=21) **ALNINC-ROSWOO**

Site -- The **ALNINC-ROSWOO c.t.** is a common type found at elevations ranging from 1500 to 1615 m (4920-5300 ft). Valley bottoms in these locations are moderately wide and average 22.4 m in width. Sideslopes of these valleys are typically steep on both sides and lined with basalt. Stream channels at **ALNINC-ROSWOO c.t.** sampling locations average 1.3 m in width and have a mean gradient of 5.5 percent. Average channel depth is 12.4 cm. The dense Alnus overstory results in over 70% of the stream channel being shaded.

The **ALNINC-ROSWOO c.t.** is found on terraces and banks with an average height of 0.8 m above the stream channel. Surface soils on the *Alnus* dominated terraces are silty to sandy, and were dry to moist at the time of sampling. These terraces are subject to overbank flow and deposition in high water years, but not in years of average flow.

Vegetation -- This community type is dominated by *Alnus incana* and *Rosa woodsii*. *Artemisia tridentata* is often found in openings along the edges of these communities. Dense shrubby thickets of *Rosa woodsii* and *Alnus incana* shade the soil surface during the growing season. In this environment, herbaceous cover is sparse and species richness is low (Table 1-5). Species common, but not abundant, in the understory include *Poa pratensis*, *Elymus triticoides*, *Galium triflorum*, and *Smilacina stellata*.

This community type provides important fish and wildlife habitat. Low forage production combined shrub thickets precludes substantial livestock use in this type.

Other --Several *Alnus incana* dominated community types have been described throughout the Intermountain West (Hansen and others 1988, Kovalchik 1987, Padgett 1981, Padgett and Manning 1988, and Youngblood and others 1988). The **ALNINC/ROSWOO c.t.** described here is differs in understory composition.

Alnus incana/Poa pratensis c.t. (n=16) **ALNINC/POAPRA**

Site -- The geomorphic setting for the **ALNINC/POAPRA c.t.** is similar to the **ALNINC-ROSWOO c.t.**. Communities in the **ALNINC/POAPRA c.t.** occur in the same elevation range (mean elev = 1547 m /5075 ft) and in the same valleys as the **ALNINC-ROSWOO c.t.**. These communities occupy terraces and banks about 0.9 m above the stream channel and about 4 m away from the edge of the channel. Average stream channel gradient is 5.4% and channel width is 1.4 meters. Surface soils are predominantly silty and were dry at the time of sampling.

Vegetation -- The **ALNINC/POAPRA c.t.** is similar in species composition and environment to the **ALNINC-ROSWOO c.t.** described above. The main distinction in these two community types is a difference in vegetative structure. *Alnus incana* is the dominant overstory in the **ALNINC/POAPRA c.t.**. Although *Rosa woodsii* is also present, it occurs with far less canopy cover resulting in a more open understory environment. *Artemisia tridentata* is present in a high percentage of the samples and comparable to *Rosa woodsii* with 15% cover. The herbaceous layer is dominated by *Poa pratensis* with an average cover of 33 percent. Commonly associated understory species include *Elymus*

Table 1-5. Diversity measures for riparian community types in descending order of species richness.

Community Type		Species Richness* Mean	Total	Shannon Index	Dominance Index
SALGEY/MGF	(n= 3)	23.7	49.0	0.85	0.72
SALLEM/MGF	(n=28)	21.4	119.0	0.61	0.80
POPTRE/SALSCO	(n= 8)	21.0	50.0	0.72	0.74
SALLUT/MG	(n= 4)	19.3	37.0	0.83	0.66
JUNBAL	(n=16)	19.2	70.0	0.87	0.68
CARLAN	(n=12)	18.1	63.0	0.88	0.62
RANMAC-POLBIS	(n= 7)	18.0	41.0	0.82	0.73
POAPAC	(n= 7)	17.9	58.0	0.90	0.58
POAPRA	(n=31)	17.3	115.0	0.83	0.64
SALLAS/POAPRA	(n= 8)	17.1	70.0	0.68	0.70
SCIMIC	(n= 5)	16.6	37.0	0.68	0.73
SALLUT/ROSWOO	(n= 6)	16.5	54.0	0.70	0.70
ELEPAL	(n= 5)	15.4	40.0	0.88	0.56
SALLAS/MGF	(n= 7)	15.1	55.0	0.54	0.84
SALLAS-ROSWOO	(n= 9)	14.7	60.0	0.67	0.70
SALEXI/MGF	(n= 3)	14.3	25.0	0.79	0.59
POPTRE/ROSWOO	(n= 4)	13.8	26.0	0.76	0.62
GLYGRA	(n= 6)	13.8	35.0	0.83	0.57
AGRSTO	(n= 5)	12.4	22.0	0.87	0.48
ROSWOO/POAPRA	(n=19)	11.8	63.0	0.70	0.58
CARSCO	(n= 6)	11.7	35.0	0.58	0.72
ALNINC/POAPRA	(n=16)	11.0	58.0	0.65	0.59
ROSWOO	(n=17)	10.1	71.0	0.55	0.68
ALNINC-ROSWOO	(n=21)	8.0	50.0	0.50	0.62
ALNINC/CARLAN	(n= 3)	7.7	15.0	0.54	0.61

*(Mean species richness, Total number of species recorded across all communities defining community type, Shannon's diversity Index (Log 2), and Dominance Index).

triticoides, *Achillea millefolium*, *Taraxacum officinale*, and *Bromus tectorum*. Other herbaceous species occur with low constancy and low cover. Average species richness equals 11 and is slightly higher than in the **ALNINC/ROSWOO c.t.**.

The more open nature of this community type allows for development of herbaceous undergrowth which provides forage for livestock. This community type receives more livestock use than the previously described type. It is possible that with heavy grazing this type may move toward the **ALNINC/ROSWOO c.t.**.

Other -- Our type is similar to the **Alnus incana/Mesic Graminoid c.t.** described by Padgett and others (In press).

Alnus incana/Carex lanuginosa c.t. (n=3) **ALNINC/CARLAN**

Site -- The **ALNINC/CARLAN c.t.** is found at low elevations (1500 m/4920 ft) in v-shaped valleys. This community occupies banks immediately adjacent to the stream channel and about 0.4 m in height. Channel gradient is slightly less than the other two Alnus dominated types and averages 3.7 percent. The stream channels at the three sample locations average 1.5 m wide. The more open nature of these communities results in only half of the stream channel being shaded by the vegetation.

Vegetation -- This community type is dominated by an *Alnus incana* overstory and may contain minor occurrences of other shrubs. The herbaceous layer is dominated by *Carex lanuginosa*. *Scirpus microcarpus* is a constant associate occupying moister microsites within these communities. Other species which may be associated with this type include *Poa pratensis*, *Mentha arvense*, *Juncus balticus*, *Equisetum laevigatum*, and *Agrostis stolonifera*.

This type was only observed in areas excluded from livestock grazing and appears to represent a later successional stage than the **ALNINC/POAPRA c.t.**. The dense growth of *C. lanuginosa* allows for development of overhanging streambanks providing good trout habitat.

Other -- The **ALNINC/CARLAN c.t.** has not been previously described.

Salix lemmonii/Mesic Graminoid-Forb c.t. (n=28) **SALLEM/MGF**

Site -- The **SALLEM/MGF c.t.** is common in the upper stream reaches of the Trout Creek Mts. and is represented by 28 samples occurring from 1975 to 2219 m (6480-7280 ft) in elevation. This type is found in v-shaped valleys. Average valley width for the **SALLEM/MGF c.t.** is 27 meters, with the riparian zone occupying about one-third of the bottom. Uplands are typically dominated by *Artemisia tridentata* ssp. *vaseyana* and *Populus tremuloides*.

The **SALLEM/MGF c.t.** commonly occupies low lying gravel bars, banks and terraces. Average height of these geomorphic surfaces above the stream channel is 0.5 meters. Mean distance of these communities from the edge of the stream channel is 3 m, with a range of 0 to 7 meters. Stream channels average 2 m wide, 8 cm deep, and have an average gradient of 5 percent. Vegetation provides shade to approximately 27% of the channel area. Surface soils are commonly rocky and silty or sandy. Moisture at the soil surface was dry to moist at the time of sampling. In early May the gravel bars and lower terraces supporting *Salix lemmonii* were observed to be inundated with water.

Vegetation -- The overstory is dominated by a medium stature, many branched willow, *S. lemmonii*. *Salix lemmonii* is a precocious (flowering before leaves are extended) willow and was observed to be flowering in early May. On about a third of the sites *Ribes lacustre* was observed growing directly around the base of *S. lemmonii* individuals where it appeared to be protected from grazing. Other shrubs which may be associated with this type include *Symphoricarpos oreophilus*, *Salix lasiandra*, and *Artemisia tridentata* var. *vaseyana*. The understory of this community type is highly disturbed and has an average richness of 21 species, with a total of 119 species recorded across all samples (Table 1-5). No single species dominates the understory. Herbaceous species with high constancy and low cover values for this type include *Carex microptera*, *Rumex* spp., *Mimulus guttatus*, *Taraxacum officinale*, *Epilobium watsonii*, *Poa palustris*, *Achillea millefolium*, *Veronica americana*, *Montia chamissoi*, *Carex athrostachya* and *Poa pratensis*.

Frequent inundation and disturbance from livestock grazing may be directly related to the high species diversity and relatively open aspect of the understory in these communities. The dense canopies of *S. lemmonii* appear to provide important bird habitat.

Other -- Padgett (1981) identified a **SALE riparian type** on the Malheur National Forest in eastern Oregon. *Salix lemmonii* community types are presently being described for Nevada (Padgett and Manning, in review), and are likely to be similar to our **SALLEM/MGF c.t.**.

Salix geyeriana/Mesic Graminoid-Forb c.t. **SALGEY/MGF**
(n=3)

Site -- The **SALGEY/MGF c.t.** was sampled in a 12 m wide valley with gently sloping sideslopes, at 2170 m (7120 ft) elevation. These communities occur on gravel bars and banks in this narrow valley. The stream channel is accordingly small and is 0.7 m wide and 10 cm deep. Channel gradient is moderate at 4 percent. Surface soils are sandy and silty and are moist to dry by mid-summer, depending upon the elevation above the stream channel. The sampled communities are located an average distance of 3 m from the edge of the stream and provide only 5% shade cover to the channel.

Vegetation -- This type is found only at higher elevations and is not common in the study area. *Salix geyeriana* is the dominant species in the overstory with an average cover of 56 percent. This willow is of moderate stature and grows in large clumps with multiple stems, and is typically widely spaced. *Ribes lacustre* is also associated with *S. geyeriana* and is found growing amongst the lower willow stems where it is protected from grazing.

The average richness for the three sample communities is 23 species (Table 1-5). The understory of this disturbed community type is characterized by a wide array of graminoids and forbs. None of the herbaceous taxa are represented by greater than 10% canopy cover. The following species are present in all three samples *Carex microptera*, *Poa pratensis*, *Achillea millefolium*, *Polygonum bistortoides*, and *Urtica dioica*.

Other -- Although numerous community types dominated by *Salix geyeriana* have been described (Youndblood and others 1985, Padgett 1981, Kovalchik 1987, Padgett and others In press, and Padgett and Manning 1988), our type appears different. The primary distinction in our type is the very disturbed condition of the communities in the Trout Creek Mountains from overuse by livestock. It is possible that our **SALGEY/MGF c.t.** is a deteriorated state of the **SALGEY/POAPRA c.t.** described by Youngblood and Padgett (1985).

Salix lasiandra/Mesic Graminoid-Forb c.t. (n=7) **SALLAS/MGF**

Site-- The **SALLAS/MGF c.t.** is situated on low lying depositional surfaces and banks with an average height of 0.3 m above the channel. The valleys where these communities occur are moderate v-shaped, with an average elevation of 1530 m (5020 ft). The riparian zone occupies most of the 20-meter wide valley bottom. Surface soils are predominantly silty in texture and were moist to saturated at the time of sampling. Some of the communities sampled occurred along a reach with active beaver dams. The larger values for channel width and depth, and elevated water tables of these sampled communities can be attributed to the beaver activity. Stream channel gradient for this community type averaged 2 percent. Vegetation shades approximately 30% of the stream channel.

Vegetation -- This community type is dominated by a mature overstory of the tree-like willow, *Salix lasiandra*. Herbaceous vegetation cover is generally low and patchy in its distribution. Understory species showing the highest constancy are *Poa palustris*, *Plantago major*, *Rumex* spp., *Taraxacum officinale*, and *Veronica americana*.

The tree-like *S. lasiandra* provides habitat for a diversity of birds. This willow is also an important source of food and building material for beaver.

Other -- Only two *Salix lasiandra* dominated community types have been described (Padgett and Manning 1988, Hansen and others 1988). Our **SALLAS/MGF c.t.** shares a common overstory, but otherwise differs from these other types.

Salix lasiandra/Rosa woodsii c.t. (n=9) **SALLAS/ROSWOO**

Site -- The **SALLAS/ROSWOO c.t.** is found in moderate v-shaped valleys at elevations ranging from 1469 to 1615 m (4820 - 5300 ft). Valley floor widths average 30 meters. Streams channels are approximately 3 m wide and 15 cm deep, and have a moderate gradient of 5 percent. Typically, the **SALLAS/ROSWOO c.t.** occurs on terraces and banks from a level equal to the stream channel up to 1.3 m above the channel. Surface soils are silty and sandy and were moist to dry at the time of sampling. This community type provides shade to about 30% of the channel area.

Vegetation -- A dense cover of *Salix lasiandra* and *Rosa woodsii* form two distinct layers in the overstory of this community type. The mature *Salix* reach heights of seven meters. Thickets of *R. woodsii*, 2 to 3 m in height, form in openings under the *Salix* canopy. The dense cover of the understory prevents light from reaching the soil surface resulting in a sparsely vegetated herbaceous layer. Often over half of a stand is bare except for a light layer of leaf litter. A diversity of herbaceous species may be associated with this community type. The most commonly encountered species are *Poa palustris*, *Poa pratensis*, *Galium triflorum*, *Elymus triticoides*, *Cirsium vulgare* and *Bromus tectorum*. Moist microsites within this type may be occupied by *Veronica americana* and *Epilobium glabrum*.

Dense overstories associated with this community type produce good cover for wildlife. The sparse understory vegetation provides little forage for livestock. Thickets of *R. woodsii* preclude livestock access to the interior of these communities. This community type may be a deteriorated state of the **SALLAS/POAPRA c.t.** described next.

Other -- The **SALLAS/ROSWOO c.t.** is similar to the **Salix lasiandra-Salix lasiandra p.c.t.** (potential community type) identified by Padgett and Manning (1988). Similar types have not been described in the literature.

Salix lasiandra/Poa pratensis c.t. (n=8) **SALLAS/POAPRA**

Site -- This community type is located in moderate to broad v-shaped valleys at elevations ranging from 1469 to 1555 m (4820-5100 ft). Valley width averages 40 m with stream channels about 2.4 m wide and 16 cm deep. Mean stream channel gradient is 3.6 % where these communities were sampled.

The **SALLAS/POAPRA c.t.** is situated on banks and terraces with an average surface height of 0.5 m above the stream channel. These communities are mostly found in close proximity to the channel but in some cases were located up to 33 m away from the active channel. In the later case these are channels which were previously occupied and now are abandoned by the stream. Surface soils are silty and sandy and were dry to saturated at the time of sampling.

Vegetation --Mature *Salix lasiandra* dominate the overstory in the **SALLAS/POAPRA c.t.**. *Rosa woodsii* is often associated with this community type, where other shrubs may occur in minor amounts. The main component of the understory is *Poa pratensis* with an average cover of 30 percent. As in many of the other communities, species richness is high and understory species composition is varied. Species commonly found in the herbaceous component of the **SALLAS/POAPRA c.t.** are *Poa palustris*, *Achillea millefolium*, *Taraxacum officinale*, *Plantago major*, *Juncus balticus*, and *Cirsium vulgare*. Many other species may occupy moister microsites within the **SALLAS/POAPRA c.t.** including *Carex lanuginosa*, *Carex microptera*, *Juncus ensifolius*, *Scirpus* *microcarpos*, *Artemisia ludoviciana*, *Cicuta douglasii*, *Epilobium watsonii*, *Equisetum laevigatum*, and *Veronica americana*.

This community type provides forage and shade to grazing animals. The highly disturbed condition of this community type reflects heavy livestock use.

Other -- Our type appears to be similar to the **Salix lasiandra/Mesic Graminoid p.c.t.** being described in Nevada (Padgett and Manning 1988).

Salix lutea/Mesic Graminoid c.t. (n=4) **SALLUT/MG**

Site -- The **SALLUT/MG c.t.** was sampled along one low elevation second order stream in a fairly broad valley at 1433 m (4700 ft) elevation. This community type occurs on moist banks and terraces with silty surface soils. At the time of sampling, surface soil moisture was moist to saturated. The average geomorphic surface height of these communities was 0.4 m above the stream channel. The **SALLUT/MG c.t.** grows immediately adjacent to the stream and back several meters on moist terraces of the floodplain. In addition to moisture provided by the stream these particular communities are subirrigated from a small sidehill spring. This moisture is adequate to support the relatively dense cover of *Scirpus microcarpos*.

Vegetation -- This minor community type is dominated by relatively young to mature individuals of *Salix lutea*. The understory is a dense sward of mesic graminoids and forbs with little bare ground exposed. Dominant herbaceous species are *Poa palustris*, *Scirpus microcarpos*, *Equisetum arvense* and *Cicuta douglasii*. Other species associated with this type include *Plantago major*, *Poa pratensis*, *Taraxacum officinale*, *Trifolium* spp., *Veronica americana*, *Carex lanuginosa*, *Juncus balticus*, *Hordeum brachyantherum*, and *Equisetum laevigatum*.

This community type was sampled on sites excluded from livestock use. These well developed herbaceous communities are important in filtering sediment.

Other -- *Salix lutea* community types have been described for Eastern Idaho and Western Wyoming (Youngblood and others 1985), eastern Oregon (Padgett 1981), and Nevada (Padgett and Manning 1988). Our **SALLUT/MG c.t.** differs from these other types.

Salix lutea/Rosa woodsii c.t. (n=6) **SALLUT/ROSWOO**

Site -- The **SALLUT/ROSWOO c.t.** occurs at low elevations (1557 m /5100 ft) in moderate v-shaped valleys. Stream channels average 1.9 m wide and 14 cm deep, with a mean gradient of 5 percent. This community type occupies banks and terraces a half meter to a meter in height above the stream channel. Soil texture of the upper soil horizon is silty and was mostly dry at time of sampling.

Vegetation -- The **SALLUT/ROSWOO c.t.** is dominated by mature *Salix lutea* associated with a relatively dry and open understory environment. *Rosa woodsii* is present in all samples with an average cover of 18 percent. The understory is fairly open with greater than half of the soil surface unvegetated and covered with a light layer of leaf litter. Herbaceous species with high constancy in the **SALLUT/ROSWOO c.t.** include *Poa pratensis*, *Smilacina stellata*, *Taraxacum officinale*, *Bromus tectorum*, *Elymus triticoides*, *Erodium cicutarium*, *Achillea millefolium*, and *Poa palustris*. Of these species *Poa pratensis* has the highest constancy (83) and percent cover (16 %).

Other -- The **SALLUT/ROSWOO c.t.** is similar to the **Salix lutea cover type** described in Nevada (Padgett and Manning 1988).

Salix exigua/Mesic Graminoid-Forb c.t. (n=3) **SALEXI/MGF**

Site -- The **SALEXI/MGF c.t.** was sampled in the same low elevation broad valley as the **SALLUT/MG c.t.**. This community type is found on moist streambanks and terraces. Surface soils are silty and were saturated to moist at the time of sampling.

Vegetation -- The medium stature willow, *Salix exigua* dominates the shrub layer of this minor community type. *Salix lutea* is present in all three samples of the **SALEXI/MGF c.t.**. The dense herbaceous undergrowth in this community type is comprised of moisture dependent species including *Equisetum arvense*, *Scirpus microcarpos*, *Cicuta douglasii*, *Carex lanuginosa*, *Mentha arvense*, *Poa palustris*, *Poa pratensis* and *Trifolium* spp..

The **SALEXI/MGF c.t.** is an early seral type. *Salix exigua* is an aggressive colonizer of exposed sandy floodplain surfaces.

Other -- Several *Salix exigua* community types have been described from the Intermountain West (Youngblood and others 1985, Pierce 1986, Padgett 1981, and Padgett and others In press). Our **SALEXI/MGF c.t.** appears to be most closely allied with the **SAEX/Mesic Forb p.c.t.** being described in Nevada (Padgett and Manning 1988).

Rosa woodsii c.t. (n=17) **ROSWOO**

Site -- The **ROSWOO c.t.** is common on terraces at low elevations (1557 m/5110 ft) in moderate v-shaped valleys. These terraces rise about 0.8 m above a moderately wide stream channel. The mean gradient of the stream channel for this community type is 5 percent. Surface soil texture is silty to sandy. The upper soil profile often has a high rock content and is dry throughout most of the growing season.

Vegetation -- The **ROSWOO c.t.** is dominated by dense and mature thickets of *Rosa woodsii* which reach 3 m in height. *Artemisia tridentata* is commonly associated with this type, although other species such as *Alnus incana*, *Clematis ligusticifolia*, *Prunus virginiana*, *Ribes aureum*, and *Salix exigua* may be present. Sunlight is only able to penetrate through small openings in the shrub overstory supporting sparse undergrowth. Most of the soil surface is covered with a light layer of leaf litter and some openings of bare ground are present. Average species richness for this community type is relatively low (10 species) but a total of 70 species were observed across all samples. The most commonly observed species in the understory were *Bromus tectorum*, *Elymus triticoides*, *Poa pratensis*, and *Galium triflorum*.

Other -- Padgett and Manning (1988) describe a similar type for Nevada. Their **Rosa woodsii-Rosa woodsii p.c.t.** appears to include both our **ROSWOO c.t.** and **ROSWOO/POAPRA ct.**. Hansen and others have described a **Rosa woodsii riparian dominance type** in Montana.

Rosa woodsii/Poa pratensis c.t. (n=19) **ROSWOO/POAPRA**

Site -- The **ROSWOO/POAPRA c.t.** occurs in moderate v-shaped valleys at elevations ranging from 1494 to 1628 m (4900-5340 ft). Like the other *R. woodsii* dominated communities, the **ROSWOO/POAPRA c.t.** occupies dry terraces elevated about 0.8 m above the stream channel. Surface soil texture is predominantly silty and was dry at the time of sampling. Stream channel width for this type averages 2.6 m with a depth of 16 cm. Channel gradient is 3.5 percent. Since this community type is located from 3 to 22 m away from the edge of the stream, it does not provide shade to the channel.

Vegetation -- The **ROSWOO/POAPRA c.t.** is similar in species composition to the **ROSWOO c.t.** described above and differs mainly in structure. *Rosa woodsii* is the dominant species in the shrub layer of the **ROSWOO/POAPRA c.t.**, but occurs with lower cover than the previous type. The **ROSWOO c.t.** may reflect a more disturbed state of the **ROSWOO/ POAPRA c.t.**. *Artemisia tridentata* is co-dominant in most sampled communities in the **ROSWOO/POAPRA c.t.**. The open aspect of the shrub overstory in this community type allows light through to support a more robust herbaceous community. *Poa pratensis* is present in all sampled communities and is the dominant species with an average cover of 33 percent. A large number of species were observed to be associated with the **ROSWOO/POAPRA c.t.**, but species richness averaged 12 species (Table 1-5). The following species commonly occur in this community type: *Elymus triticoides*, *Bromus tectorum*, *Achillea millefolium*, *Taraxacum officinale*, *Carex douglasii*, *Cirsium vulgare*, *Silene menziesii*, *Equisetum laevigatum*, *Erodium cicutarium*, *Poa palustris*, *Poa bulbosa*, *Juncus balticus*, *Carex lanuginosa* and *Carex microptera*.

Other -- This type is similar to the **Rosa woodsii-Rosa woodsii p.c.t.** being described in Nevada (Padgett and Manning 1988).

HERBACEOUS-DOMINATED TYPES. Ten community types dominated by herbaceous species are described below. All but one of these community types is dominated by graminoids.

Carex scopulorum c.t. (n=6) **CARSCO**

Site -- The **CARSCO c.t.** is a minor type which occurs along headwater streams in broad valleys with gentle slopes. The communities sampled ranged from 2268 to 2438 m (7440-8000 ft) in elevation. Upper soil horizons are largely organic and were mostly saturated to moist at the time of sampling. On some sites this organic layer was greater than half a meter. Valley width of the sampling locations averages 48 m with stream channels about 1 m wide and 4 cm deep. The **CARSCO c.t.** occupies banks and terraces, in positions from immediately adjacent to the channel up to 18 m away.

Vegetation --The **CARSCO c.t.** is dominated by the low profile tufted sedge, *Carex scopulorum*. Two common associates of this community type are *Juncus balticus* and *Deschampsia caespitosa*, which have an average cover of 10% and 8%, respectively. *Glyceria grandis* and *Montia chamissoii* are locally abundant on very wet microsites along watercourses within some of the communities sampled. In addition, *Ranunculus macounii* contributed 20% cover to one of the communities sampled. Other species present in minor or trace amounts include *Phleum alpinum*, *Epilobium watsonii*, *Epilobium alpinum*, *Mimulus primuloides*, *Taraxacum officinale*, *Veronica americana*, *Salix lemmonii*, *Eleocharis pauciflora*, *Juncus mertensianus*, *Mimulus guttatus*, *Polygonum bistortoides* and *Trifolium longipes*. Approximately 15% of the surface area is unvegetated, and may be exposed bare ground or occasional boulders. This is a late seral community type which has escaped heavy grazing use due to extremely boggy soils.

Other -- Similar community types have been described by Kovalchik (1985), Pierce (1986), Halpern and others (1984), and Padgett and Manning (1988). Our **CARSCO c.t.** appears to be most closely related with the **CARSCO p.c.t.** described from Nevada (Padgett and Manning 1988).

Scirpus microcarpos c.t. (n=5) **SCIMIC**

Site -- The **SCIMIC c.t.** is a minor type which occurs in v-shaped valleys at elevations below 1500 m (4920 ft). The average valley width for the sites sampled is 59 meters. In these settings stream channels averaged 1.5 m in width and 16 cm in depth. The **SCIMIC c.t.** occurs on moist terraces about 0.5 m above the stream channel. Average stream channel gradient is 2.8 percent. Along one of the stream reaches sampled this community type is located up to 14 m away from the stream. At this site additional moisture from a sidehill seep supports the moisture dependent species of this community. Soils are silty and sandy and were saturated to dry at the time of sampling.

Vegetation -- These communities are characterized by a lush herbaceous layer dominated by *Scirpus microcarpos* with an average of 54% cover. Both *Carex lanuginosa* and *Juncus balticus* are constant associates and together account for approximately 20% of the total cover. Young *Salix exigua* and *S. lutea* occur in most of the communities sampled. Several other species may be present in minor amounts and include *Eleocharis palustris*, *Poa pratensis*, *Cicuta douglasii*, *Equisetum laevigatum*, *Equisetum arvense*, *Mentha arvense*, *Mimulus guttatus*, *Rumex* spp., *Rosa woodsii*, *Juncus ensifolius*, *Poa palustris*, *Aster* spp., *Epilobium watsonii*, *Plantago major*, *Ranunculus cymbalaria*, and *Viola nephrophylla*. Exposed bare ground and litter accounted for approximately 20% of the total cover.

The **SCIMIC c.t.** is an early successional type which was sampled only within livestock exclosures. This community type produces large amounts of above ground biomass which functions in filtering sediment and building banks.

Other -- A **SCMI(CAAM) association** has been described by Kovalchik (1987) for central Oregon but appears to differ from the one described here.

Glyceria grandis/Mesic Forb c.t. (n=6) **GLYGRA/MF**

Site -- The **GLYGRA/MF c.t.** occurs in broad low v-shaped valleys at high elevations (mean= 2241 m/7350 ft). It occupies low-lying banks and streamside terraces no more than 0.3 m above the channel. Soils are predominantly silty in texture and were saturated to moist at the time of sampling.

Vegetation -- The **GLYGRA/MF c.t.** is a minor type which was sampled at high elevations. *Glyceria grandis* is a moisture dependent species and is most often found immediately along the stream channel in saturated soils which are often inundated early in the season. These communities are typically only a few square meters in size. *Glyceria grandis* is the dominant species but only has an average cover of 27 percent. *Veronica americana* is always present but has low overall cover. Species with high constancy and relatively high cover include *Mimulus guttatus*, *Juncus balticus*, *Eleocharis pauciflora*, *Epilobium watsonii*, and *Rumex* spp.. Although occurring in minor amounts, several species are often present and are good indicators of the moist conditions associated with this community type. Included in this group would be *Carex athrostachya*, *Montia chamissoi*, *Mimulus primuloides*, *Ranunculus macounii*, *Rumex* spp., *Alopecurus aequalis*, and *Carex microptera*. Exposed bare ground and gravel comprise about 20 % of the total cover.

Other -- The **GLYGRA/MF c.t.** has not been previously described.

Eleocharis palustris c.t. (n=5) **ELEPAL**

Site -- This community type occurs at elevations from 1433 to 1506 m (4700-4940 ft) in moderate v-shaped valleys. Stream channel gradient is around 2% and channels are moderately wide and deep. The **ELEPAL c.t.** is found on low banks and terraces immediately adjacent to the stream and at a maximum height of 0.2 m above the channel. These communities are restricted to small areas no more than a few square meters. Surface soils are silty and sandy and were saturated at time of sampling. The geomorphic surfaces supporting the **ELEPAL c.t.** are typically inundated by the stream channel during the early part of the growing season.

Vegetation -- The **ELEPAL c.t.** is a minor community type at low elevations. *Eleocharis palustris* is the dominant species with an average of 28% cover in the communities sampled. Common associated species include *Poa palustris*, *Juncus balticus*, *Scirpus microcarpos*, *Rumex* spp., *Alopecurus aequalis*, *Juncus ensifolius*, *Agrostis stolonifera*, *Plantago major*, and *Epilobium glabrum*. Patches of exposed ground are common in this type. The **ELEPAL c.t.** is an early successional type which occurs on recently deposited alluvium.

Other -- Similar community types have been described by Kovalchik (1987), Hansen and others (1988), and Pierce (1986). Padgett and others (In press) and Padgett and Manning (1988) describe **ELEPAL c.t.**'s from non-stream (lentic) riparian settings.

Agrostis stolonifera c.t. (n=5) **AGRSTO**

Site -- All samples for this community type occur in the upper reaches of Little Trout Creek at 2036 m (6680 ft) elevation. The riparian setting here is an extremely narrow valley (6 m wide) with steep side slopes. The channel averages 0.6 m wide and 6 cm deep. The **AGRSTO c.t.** is found on rocky and gravelly banks and low terraces only slightly higher (0.3 m) than the stream channel. The surface soil texture is silty and was moist to dry at the time of sampling.

Vegetation -- The **AGRSTO c.t.** is a minor type occurring on moist low-lying surfaces adjacent to the stream channel. The dominant species in this community type is *Agrostis stolonifera*. Other important and commonly associated species include *Poa pratensis*, *Carex athryostachya*, *Mimulus guttatus*, *Taraxacum officinale*, *Juncus balticus*, *Alopecurus aequalis*, *Trifolium longipes*, *Veronica americana*, *Veronica peregrina*, and *Taraxacum officinale*. These are fairly open communities with about 30% of the area unvegetated with exposed bare ground, gravel and rock. The **AGRSTO c.t.** is an early successional type which colonizes low-lying gravel bars.

Other -- Similar types include a **Agrostis stolonifera-Agrostis stolonifera c.t.** for Nevada (Padgett and Manning 1988). Hansen and others (1988) describe a similar **Agrostis stolonifera dominance type** for Montana. The **AGRSTO c.t.** is also present along the lower reaches of Willow Creek and is described in further detail later.

Juncus balticus c.t. (n=12) **JUNBAL**

Site -- The **JUNBAL c.t.** was sampled at high elevations ranging from 2170 to 2438 m (7120-8000 ft). This community type is located in broad headwater valleys of Trout Creek. Average valley width is 30 m and channel gradients are moderate at 5 percent. Stream channels are about 1 m wide and a few cm deep. The **JUNBAL c.t.** occupies moist low banks and terraces averaging 0.4 m in height above the stream channel. Surface soils are predominantly silty and sandy, although 3 communities were sampled from a location with a thick organic horizon. Soil moisture near the surface was moist to dry at the time of sampling. This community type occupies geomorphic surfaces immediately adjacent to the stream up to 14 m away from the channel.

Vegetation -- This grazing-induced community type is dominated by *Juncus balticus* with an average cover of 30 percent. Overall species diversity is high with an average of 19 species per community sampled and a total of 70 different species observed. Species with high constancy (50% and above) include *Carex microptera*, *Poa pratensis*, *Taraxacum officinale*, *Achillea millefolium*, *Epilobium watsonii*, *Aster foliaceous*, *Stellaria longipes*, *Trifolium* spp., *Veratrum californicum*, *Polygonum bistortoides*, and *Phleum alpinum*. Many other species occur in minor amounts. This is a highly disturbed community type as evidenced by the large amount of *Juncus balticus*, high species diversity, and large amounts of exposed ground. Positions presently occupied by this community type likely once supported communities dominated by *Deschampsia caespitosa*.

Other -- A very similar **Juncus balticus c.t.** has been described for Nevada (Padgett and Manning 1988). Other studies have documented similar types throughout the West including central Oregon (Kovalchik 1987), Utah (Padgett and others In review), eastern Idaho and western Wyoming (Youngblood and others 1985) and Montana (Hansen and others 1988).

Poa palustris c.t. (n=7) **POAPAL**

Site -- The **POAPAL c.t.** was sampled at mostly low elevations around 1500 m (4920 ft), but one sample was located at 1975 m (6480 ft). Valleys where this community type occurs are moderate v-shaped with an average width of 44 meters. Stream channels in the sampled communities ranges from 1 to 4.4 m wide and 5 to 35 cm deep. Average channel gradient is 3.3 percent. The **POAPAL c.t.** is commonly situated on very low terraces, banks and gravel bars. Upper soil horizons are very rocky and have silty and sandy soils. At the time of sampling surface soils were moist to saturated.

Vegetation -- This minor community type is characterized by a diversity of herbaceous and sometimes shrubby species. When present, woody species are usually of a younger age class. The dominant species in the **POAPAL c.t.** is *Poa palustris*. Other species which are often present include *Alopecurus aequalis, Epilobium glabrum, Plantago major, Ranunculus cymbalaria, Veronica americana, Taraxacum officinale, Juncus balticus, Salix lasiandra* and *Eleocharis palustris*. About 30% of the ground layer is exposed gravel, bareground or litter. These communities have a very open appearance, with a mixture of tall and low growing herbs.

Other -- Similar community types have been described for eastern Idaho and western Wyoming (Youngblood and others 1985) and Montana (Pierce 1986, Hansen and others 1988).

Carex lanuginosa c.t. (n=12) **CARLAN**

Site -- The **CARLAN c.t.** is found on banks, and terraces along low elevation (1480 m/4856 ft) stream reaches in moderate to broad v-shaped valleys with low channel gradient. Stream channels are about 2 m wide and 16 cm deep. Geomorphic surfaces supporting this community type are about 0.4 m higher than the stream channel. The upper soil horizon of these surfaces may be rocky and soil texture is either silty or sandy. Surface soil moisture ranged from dry to saturated at the time of sampling.

Vegetation -- The **CARLAN c.t.** is a mid to late successional type which occurs along streambanks at low elevations. The dominant species in this community type is *Carex lanuginosa*, a tall and robust sedge. Even though species diversity is high in this type (Table 1-5), in several locations *Carex lanuginosa* was observed to form small dense nearly monospecific stands. Other graminoids commonly associated with this type include *Poa pratensis, Poa palustris, Juncus balticus, Scirpus microcarpos*, and *Agrostis stolonifera*. Several woody species are present in minor amounts. Forb species associated with the **CARLAN c.t.** are *Mentha arvense, Rumex* spp., *Plantago major, Taraxacum officinale, Conzya canadensis, Epilobium glabrum* and *Equisetum laevigatum*.

The **CARLAN c.t.** occurs mostly in areas excluded from livestock grazing. The dense root system and foliage of *C. lanuginosa* are effective in stabilizing streambanks.

Other -- Carex lanuginosa c.t.'s have been described for central Oregon (Kovalchik 1987), Utah (Padgett and others In press) and Nevada (Padgett and Manning 1988). A **Carex lanuginosa dominance type** has been described by Hansen and others (1987) for Montana. Our **CARLAN c.t.** is most similar to the types described for Nevada and Utah.

Poa pratensis c.t. (n= 31) **POAPRA**

Site -- The **POAPRA c.t.** is widespread along moderate gradient streams in narrow to broad v-shaped valleys. Communities were sampled at elevations ranging from 1433 to 2170 m (4700-7120 ft). Streams in these valleys varied in size, from 1 to 5 m in width. Terraces and banks are the main geomorphic surfaces supporting the **POAPRA c.t.**. These surfaces average 0.6 m in height, and soil texture of the upper surface is silty and/or sandy and was dry to moist at the time of sampling.

Vegetation -- The **POAPRA c.t.** is a very common type along low to mid elevation stream reaches. It is dominated by the rhizomatous grass *Poa pratensis* which has an average canopy cover of 34 percent. Species diversity is very high, a total of 115 taxa were recorded across all samples defining this community type. The most common herbaceous associates in this type are *Juncus balticus*, *Achillea millefolium*, *Equisetum laevigatum*, *Taraxacum officinale*, *Plantago major*, *Cirsium vulgare*, and *Carex lanuginosa*. Both *Rosa woodsii* and *Artemisia tridentata* occur in half the samples but with low cover. Other shrubs are present but in minor amounts.

This community type provides valuable forage for livestock. The relatively shallow root systems of *P. pratensis*, however, are not particularly effective in stabilizing banks.

Other -- Poa pratensis c.t.'s are varied and have been described throughout the Intermountain West (Kovalchik 1987, Padgett and Manning 1988, Padgett and others In press, Hansen and others 1988, and Youngblood and others 1985).

Ranunculus macounii/Polygonum bistortoides c.t. **RANMAC/POLBIS** (n=7)

Site -- These communities were sampled in a broad headwater valley along the East Fork of Trout Creek at 2268 m (7440 ft) elevation. The **RANMAC/POLBIS c.t.** is located on moist terraces on the outer fringe of the riparian zone. These communities are nearly a meter higher than the main stream channel and had dry surface soils at the time of sampling. On the lower moister slopes these communities grade into the **CARSCO c.t.**. Soils in this community type have a high organic matter content, although less than the adjacent **CARSCO c.t.**.

Vegetation -- The **RANMAC/POLBIS c.t.** is a highly disturbed minor type dominated by two forbs, *Ranunculus macounii* and *Polygonum bistortoides*. Common graminoid associates include *Carex athrostachya*, *Juncus balticus*, *Carex microptera*, *Poa pratensis*, and *Carex scopulorum*. The following forb species occur in this type with fairly high constancy but low cover, *Aster foliaceous*, *Taraxacum officinale*, *Mimulus primuloides*, *Epilobium watsonii*, *Epilobium glabrum* and *Barbarea orthoceras*.

Other -- This type has not been previously described.

PLANT COMMUNITIES ALONG LOWER REACHES OF WILLOW CREEK

A total of ten plant community types were defined from data collected along the lower reaches of Willow Creek (Tables 1-6 and 1-7). Six community types correspond with the types described in the preceding section, and will not be described again here. These six community types are: **ALNINC/POAPRA c.t., SALLAS/POAPRA c.t., ROSWOO c.t., SCIMIC c.t., CARLAN c.t.**, and **POAPRA c.t.**. One common community type, the **AGRSTO c.t.** is defined for both data sets due to differences in elevation and sample size. Three additional community types were found along Willow Creek and are described below.

Artemisia tridentata/Bromus tectorum c.t. (n=8) **ARTTRI/BROTEC**

Site -- The **ARTTRI/BROTEC c.t.** occupies terraces 0.8 to 1.3 m above the stream channel (Table 1-7). Typically, these terraces are immediately adjacent to the stream channel and have steep cutbanks. Soils on these sites have a deep silty surface layer with little rock content. These sites were once

Table 1-6. Constancy and average canopy cover of important plant species in riparian community types along Willow Creek.

SPECIES ABBREVIATIONS	ARTR/BRTE* N = 8	ARTR/POPR* N = 19	ROWO* N = 2	SALA/POPR* N = 12	ALIN/POPR* N = 4	POPR* N = 12	CALA* N = 16
***** SHRUBS *****	100(57)	100(41)	100(75)	100(66)	100(78)	83(15)	69(18)
Alnus incana	------	16(1)	------	33(5)	100(70)	42(3)	44(8)
Artemisia tridentata	100(39)	100(21)	50(3)	42(7)	75(t)	42(3)	6(t)
Chrysothamnus viscidiflorus	100(9)	68(2)	------	33(3)	------	25(1)	6(t)
Clematis ligusticifolia	13(t)	5(t)	50(10)	17(2)	------	8(t)	------
Ribes aureum	13(t)	------	50(t)	17(5)	------	17(t)	6(t)
Rosa woodsii	88(6)	84(8)	100(65)	83(12)	50(7)	42(5)	31(5)
Salix lasiandra	25(7)	63(10)	50(3)	100(44)	25(10)	67(7)	50(11)
Salix lemmonii	25(10)	21(11)	------	25(5)	------	25(4)	19(9)
Salix lutea	------	5(10)	------	8(10)	------	------	25(4)
***** GRASSES *****	100(34)	100(54)	100(31)	100(51)	100(33)	100(75)	100(75)
Agrostis exarata	------	------	------	------	------	42(1)	25(t)
Agrostis stolonifera	------	32(5)	------	33(11)	50(7)	92(10)	94(12)
Alopecurus aequalis	------	------	------	17(5)	------	17(t)	38(3)
Bromus tectorum	100(28)	95(11)	50(10)	67(26)	50(10)	17(t)	13(5)
Carex douglasii	13(t)	------	------	------	------	8(3)	------
Carex lanuginosa	13(t)	42(12)	100(t)	33(18)	25(3)	58(9)	100(34)
Elymus triticoides	50(5)	21(2)	------	25(7)	50(2)	25(7)	------
Glyceria grandis	------	------	------	8(10)	------	33(t)	25(2)
Hordeum brachyantherum	------	16(4)	------	------	------	25(t)	13(t)
Juncus balticus	------	26(3)	------	8(t)	------	75(9)	89(5)
Juncus ensifolius	------	11(t)	------	17(t)	------	50(1)	50(2)
Poa palustris	------	------	------	------	------	8(3)	------
Poa pratensis	50(4)	100(32)	100(25)	100(19)	100(25)	100(34)	88(11)
Scirpus americanus	------	------	------	------	------	8(3)	6(3)
Scirpus microcarpos	------	5(1)	------	25(t)	25(t)	100(5)	89(5)
***** FORBS *****	38(6)	95(6)	50(1)	100(11)	100(3)	100(22)	100(21)
Achillea millefolium	------	68(1)	------	25(t)	25(t)	75(1)	31(t)
Artemisia ludoviciana	13(3)	37(2)	------	17(5)	50(t)	50(3)	31(2)
Cirsium spp.	------	58(1)	------	50(4)	50(t)	83(2)	89(3)
Conyza canadensis	------	26(2)	------	17(t)	------	50(2)	56(1)
Epilobium glaberrimum	------	11(1)	------	17(t)	------	75(1)	63(1)
Epilobium paniculatum	------	------	------	------	------	8(t)	6(t)
Galium triflorum	------	------	50(t)	17(t)	------	8(t)	------
Geum macrophyllum	------	------	------	8(t)	------	17(t)	13(t)
Gnaphalium palustre	------	------	------	------	------	8(t)	13(t)
Heracleum lanatum	------	------	------	8(3)	25(t)	8(t)	6(t)
Lactuca serriola	13(t)	16(t)	------	25(t)	25(t)	42(t)	25(t)
Marrubium vulgare	13(t)	5(t)	------	25(2)	------	------	------
Mentha arvense	------	21(t)	------	8(t)	------	83(2)	81(4)
Mimulus guttatus	------	------	------	------	------	17(t)	13(t)
Plantago major	------	21(t)	------	8(t)	------	83(6)	81(6)
Potentilla biennis	------	5(t)	------	------	------	8(t)	6(t)
Ranunculus cymbalaria	------	------	------	------	------	------	6(t)
Ranunculus sceleratus	------	------	------	------	------	8(t)	6(t)
Rorippa obtusa	------	------	------	------	------	------	19(t)
Rumex spp.	------	21(1)	------	25(t)	25(t)	33(1)	56(2)
Sonchus asper	------	26(t)	------	------	------	33(1)	6(t)
Taraxacum officinale	------	37(t)	------	------	------	42(1)	44(2)
Trifolium cyantniferum	------	------	------	------	------	17(t)	6(t)
Trifolium wormskjoldii	------	5(t)	------	8(10)	------	8(3)	6(3)
Urtica dioica	25(t)	16(t)	------	67(4)	75(t)	42(t)	6(t)
Veronica americana	------	5(t)	------	8(10)	------	8([illegible])	31(2)
Xanthium strumarium	------	------	------	------	25(t)	8(t)	------
Equisetum laevigatum	------	16(t)	------	------	------	58(t)	38(1)

*ARTR/BRTE = Artemisia tridentata/Bromus tectorum c.t.. ARTR/POPR = Artemisia tridentata/Poa pratensis c.t.. ROWO = Rosa woodsii c.t.. SALA/POPR = Salix lasiandra/Poa pratensis c.t., ALIN/POPR = Alnus incana/Poa pratensis c.t.. POPR = Poa pratensis c.t.. CALA = Carex lanuginosa c.t..

Table 1-6. (cont.). Constancy and average canopy cover of important plant species in riparian community types along Willow Creek.

SPECIES ABBREVIATIONS	AGST* N = 30	ALAE* N = 9	SCMI* N = 5
***** SHRUBS *****	90(13)	33(12)	40(7)
Alnus incana	53(3)	11(10)	20(t)
Artemisia tridentata	30(1)	------	------
Chrysothamnus viscidiflorus	7(t)	------	------
Clematis ligusticifolia	3(10)	------	20(t)
Ribes aureum	3(t)	------	------
Rosa woodsii	20(3)	------	20(t)
Salix lasiandra	77(8)	33(8)	20(t)
Salix lemmonii	10(5)	------	------
Salix lutea	10(4)	------	20(10)
***** GRASSES *****	100(60)	100(38)	100(86)
Agrostis exarata	57(2)	22(2)	40(t)
Agrostis stolonifera	100(23)	79(4)	80(13)
Alopecurus aequalis	70(7)	100(20)	20(t)
Bromus tectorum	33(2)	------	------
Carex douglasii	13(t)	------	------
Carex lanuginosa	43(6)	22(t)	20(10)
Elymus triticoides	13(2)	11(t)	------
Glyceria grandis	37(3)	56(3)	20(t)
Hordeum brachyantherum	13(t)	11(t)	------
Juncus balticus	67(4)	22(5)	40(7)
Juncus ensifolius	83(2)	89(1)	------
Poa palustris	13(t)	------	40(t)
Poa pratensis	90(8)	11(t)	60(10)
Scirpus americanus	13(t)	------	------
Scirpus microcarpos	97(6)	89(3)	100(52)
***** FORBS *****	100(27)	100(29)	100(13)
Achillea millefolium	43(1)	------	20(t)
Artemisia ludoviciana	47(1)	------	20(3)
Cirsium spp.	57(4)	------	60(5)
Conyza canadensis	83(2)	44(t)	60(t)
Epilobium glaberrimum	87(2)	89(2)	80(1)
Epilobium paniculatum	10(t)	------	20(t)
Galium triflorum	3(3)	------	------
Geum macrophyllum	17(t)	------	40(t)
Gnaphalium palustre	17(t)	89(3)	20(t)
Heracleum lanatum	3(t)	------	------
Lactuca serriola	33(t)	11(t)	40(t)
Marrubium vulgare	------	------	------
Mentha arvense	80(2)	67(2)	80(1)
Mimulus guttatus	20(t)	33(t)	------
Plantago major	93(3)	100(4)	40(t)
Potentilla biennis	13(t)	56(1)	------
Ranunculus cymbalaria	43(t)	56(2)	20(t)
Ranunculus sceleratus	10(t)	33(t)	------
Rorippa obtusa	------	33(t)	------
Rumex spp.	80(4)	79(3)	60(1)
Sonchus asper	20(1)	------	20(t)
Taraxacum officinale	47(1)	------	------
Trifolium cyanthiferum	40(1)	11(3)	40(t)
Trifolium wormskjoldii	50(6)	11(t)	20(t)
Urtica dioica	10(t)	------	------
Veronica americana	50(1)	100(6)	40(t)
Xanthium strumarium	20(t)	11(3)	------
Equisetum laevigatum	50(2)	22(t)	------

*AGST = Agrostis stolonifera c.t., ALAE = Alopecurus aequalis c.t., SCMI = Scirpus microcarpos c.t..

part of the active flood plain as evidenced by the deep silt deposits. Surface soils were dry at the time of sampling.

Vegetation -- The shrub layer of this community type is dominated by *Artemisia tridentata* with an average cover of 40 percent. *Chrysothamnus viscidiflorus*, and *Rosa woodsii* are always present with low cover, where other shrub species may be present in minor amounts.

Bromus tectorum is the major herbaceous species with 28% cover. *Elymus triticoides* and *Poa pratensis* may be present in small amounts. The highly disturbed nature of this type is evidenced by the high cover of *B. tectorum* and bare ground.

Artemisia tridentata/Poa pratensis c.t. (n=19) **ARTTRI/POAPRA**

Site -- The **ARTTRI/POAPRA c.t.** occupies geomorphic positions similar to the **ARTTRI/BROTEC c.t.**. These terraces also are characterized by a deep silt deposit. Surface soils were dry at the time of sampling.

Vegetation -- *Artemisia tridentata* is the dominant shrub with 21% cover. *Rosa woodsii*, *Salix lasiandra*, and *Chrysothamnus viscidiflorus*, all have high constancy. The understory is fairly open with over 20% exposed bare ground. *Poa pratensis* is the dominant herbaceous species with 30% cover. *Bromus tectorum* has high constancy and an average of 10% cover. Other species which are associated with the **ARTTRI/POAPRA c.t.** include *Achillea millefolium*, *Cirsium* spp., *Carex lanuginosa*, *Taraxacum officinale*, and *Artemisia ludoviciana*. This community type provides some livestock forage.

Agrostis stolonifera c.t. (n=30) **AGRSTO**

Site -- The **AGRSTO c.t.** is found on low-lying gravel bars, depositional bars, and terraces in close proximity to the stream channel. These surfaces are about 0.4 m above the channel. Surface soil moisture was moist to dry at the time of sampling.

Vegetation -- This early successional community type has high species diversity, and a fairly open appearance with over 30% of the ground surface exposed. *Agrostis stolonifera* is the dominant herbaceous species with 23% cover. Several woody species occur in this type, but are primarily overhanging from adjacent land surfaces and have low cover. Commonly associated herbaceous species include *Poa pratensis*, *Plantago major*, *Scirpus*

Table 1-7. Means and standard deviations of important site variables for riparian community types along the lower reaches of Willow Creek.

SITE VARIABLES	ARTR/BRTE* N = 8	ARTR/POPR* N = 19	ROWO* N = 2	SALA/POPR* N = 12	ALIN/POPR* N = 4	POPR* N = 12	CALA* N = 16
HEIGHT OF SURFACE	1.1 (.4)	1.0 (.4)	.8 (.0)	.7 (.3)	.6 (.2)	.6 (.2)	.4 (.3)
BARE/GRAVEL COVER-%	16.4 (11.5)	21.4 (14.4)	2.0 (.0)	17.7 (10.6)	12.0 (13.2)	13.5 (11.4)	14.9 (12.7)
ROCK COVER (%)	2.1 (3.2)	1.1 (.5)	1.0 (.0)	1.2 (.6)	1.0 (.0)	1.8 (2.6)	1.6 (2.3)
ORGANIC COVER (%)	2.0 (.0)	2.0 (.0)	2.0 (.0)	2.0 (.0)	2.0 (.0)	2.8 (2.6)	2.6 (2.3)
LITTER COVER (%)	1.0 (.0)	1.0 (.0)	1.0 (.0)	1.0 (.0)	1.0 (.0)	1.0 (.0)	1.0 (.0)
DIST FROM STREAM	1.8 (1.0)	1.6 (1.3)	3.5 (2.1)	2.3 (1.7)	1.0 (.0)	1.3 (.6)	1.0 (.0)

SITE VARIABLES	AGST* N = 30	ALAE* N = 9	SCMI* N = 5
HEIGHT OF SURFACE	.4 (.3)	.1 (.1)	.3 (.1)
BARE/GRAVEL COVER-%	30.7 (18.3)	51.9 (15.8)	10.6 (17.0)
ROCK COVER (%)	2.3 (7.1)	1.0 (.0)	1.0 (.0)
ORGANIC COVER (%)	2.7 (2.3)	2.2 (.7)	2.0 (.0)
LITTER COVER (%)	1.0 (.0)	1.0 (.0)	1.0 (.0)
DIST FROM STREAM	1.1 (.4)	1.1 (.3)	1.4 (.9)

*ARTR/BRTE = *Artemisia tridentata/Bromus tectorum* c.t., ARTR/POPR = *Artemisia tridentata/Poa pratensis* c.t., ROWO = *Rosa woodsii* c.t., SALA/POPR = *Salix lasiandra/Poa pratensis* c.t., ALIN/POPR = *Alnus incana/Poa pratensis* c.t., POPR = *Poa pratensis* c.t., CALA = *Carex lanuginosa* c.t., AGST = *Agrostis stolenifera* c.t., ALAE = *Alopecurus aequalis* c.t., SCMI = *Scirpus microcarpos* c.t..

microcarpos, *Rumex* spp., *Epilobium glaberrimum*, *Juncus ensifolius*, *Mentha arvense*, *Juncus balticus*, *Alopecurus aequalis*, and *Conyza canadensis*.

Other -- This **AGRSTO c.t.** is similar to the type described in the preceding section. Geomorphic settings and overall species composition are similar. At lower elevations (here) the type has higher species richness reflecting the larger number of samples. This is an early seral community which colonizes newly formed depositional surfaces.

Alopecurus aequalis c.t. (n=9) **ALOAEQ**

Site -- This community type occupies low depositional surfaces including silt deposits, gravel bars, and terraces. These surfaces barely extend above the stream channel and have surface soils which are moist to saturated throughout the growing season. These surfaces mostly occur within one meter of the stream channel.

Vegetation -- This early successional community type has a very open aspect with over 50 % bare ground exposed. The dominant herbaceous species is *Alopecurus aequalis* with 20 % cover. Other important associated species are *Veronica americana*, *Plantago major*, *Gnaphalium palustre*, *Rumex* spp., *Epilobium glaberrimum*, *Scirpus microcarpos* and *Juncus ensifolius*. Canopy cover from woody species growing on adjacent landforms may contribute small amounts to the overstory.

Other -- This type has not been previously described.

SILT DEPOSITS AND GRAVEL BARS

Many of the depositional surfaces sampled had less than 25% vegetative cover, and were not included in the community type classification. Listed below are species which repeatedly occurred on these surfaces but with low cover.

Silt deposits and gravel bars -- *Salix lasiandra* (seedlings), *Agrostis stolonifera*, *Alopecurus aequalis*, *Carex athrostachya*, *Carex microptera*, *Deschampsia elongata*, *Eleocharis palustris*, *Glyceria grandis*, *Juncus balticus*, *J. bufonis*, *J. ensifolius*, *Scirpus microcarpos*, *Barbarea orthoceras*, *Epilobium glaberrimum*, *Epilobium watsonii*, *Gnaphalium palustre*, *Mimulus guttatus*, *Mentha arvense*, *Plantago major*, *Potentilla biennis*, *Ranunculus cymbalaria*, *Rumex* spp., and *Veronica americana*.

COMMUNITY TYPE RELATIONSHIPS

Detrended Correspondence Analysis

Ordination of stands and species using detrended correspondence analysis (DCA) is useful in examining vegetation patterns and environmental gradients. Relationships between community types were examined by plotting the ordination results in two-dimensional space (Figs. 1-2 through 1-6). Interpretation of the ordination axes is accomplished through consideration of environmental data along with vegetation information. Separate ordinations were performed for each of the two data sets.

First, results from the larger data set will be examined. Eigenvalues for the four axes were 0.809, 0.657, 0.554, and 0.458. The unit of ordination length is defined as the average standard deviation of species turnover, or SD (Gauch 1982). In a space of four SD, one can expect a full turnover in species composition of samples. Individual species show a similar pattern and will usually appear, rise to its mode, and disappear within four SD. Longer axes represent longer community gradients. For the stand ordination, Axis 1 is 5.3 SD long and Axis 2 is 4.5 SD long (Fig. 1-2). Axis 1 generally represents an elevational gradient moving from low elevation community types on the left and middle to higher elevation types on the right. Communities to the left of **AGRSTO c.t.** occur below 1700 meters elevation. Types to the right are above 1900 m (6200 ft) elevation. The **CARSCO c.t.** occurred above 2200 m (7200 ft) and was the highest elevation type sampled in the study area.

The second axis appears to generally follow a gradient of increasing moisture (Fig. 1-2). Types such as **SCIMIC c.t.** and **CARSCO c.t.,** with saturated and very moist soils throughout the growing season are positioned at the upper end of the axis. The drier community types represented by **POPTRE/ SALSCO c.t., ROSWOO c.t.,** and **SALLAS/ROSWOO c.t.** are located along the lower portion of this axis. The upper soil profile in these later community types is typically dry throughout most of the growing season. No readily interpretable relationships were determined from the third and fourth axes.

Several low elevation community types cluster together on the lower ends of both the first and second axes (Fig. 1-2). A separate DCA analysis was performed on a subset of these closely arranged community types, to further delineate their relationship (Fig. 1-3). In this ordination, the first axis appears to represent an increasing moisture gradient from left to right. The

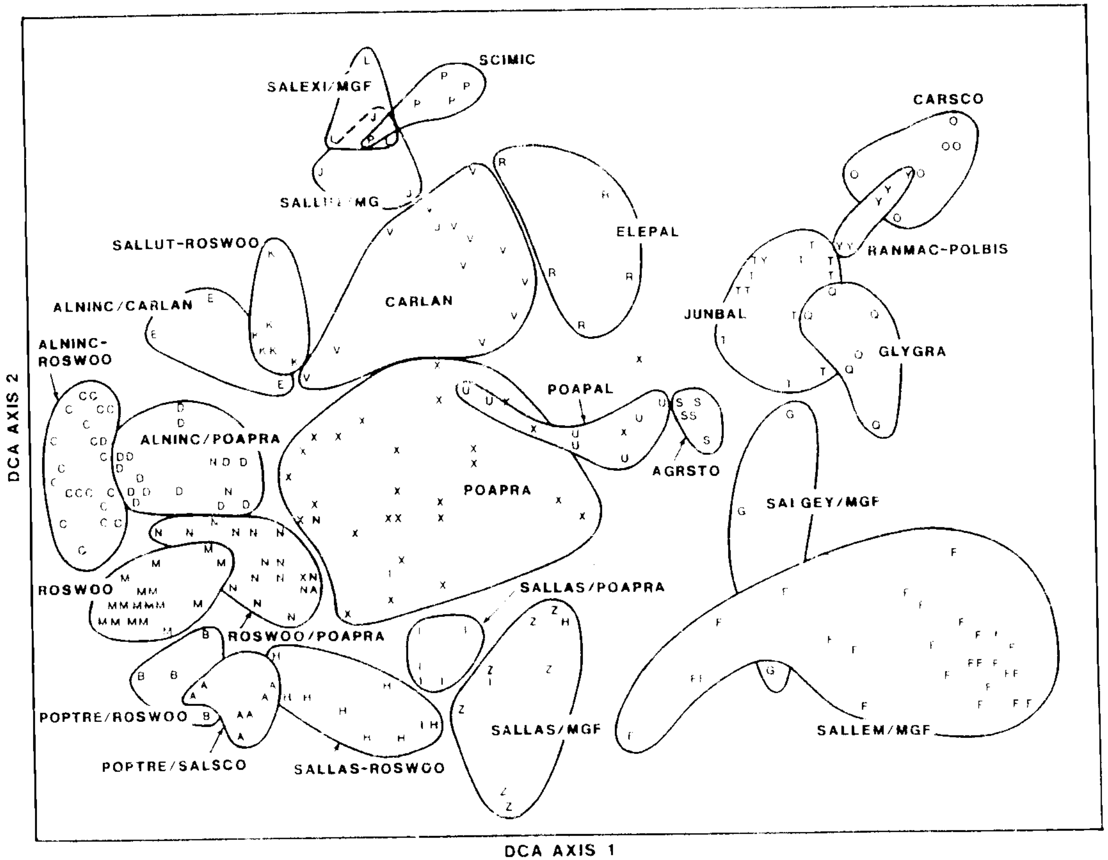

Figure 1-2. Detrended correspondence analysis ordination of samples. Letters indicate samples representing the same community type, as defined in Table 1-2. DCA Axis 1 represents a gradient of increasing elevation and DCA Axis 2 one of increasing soil moisture.

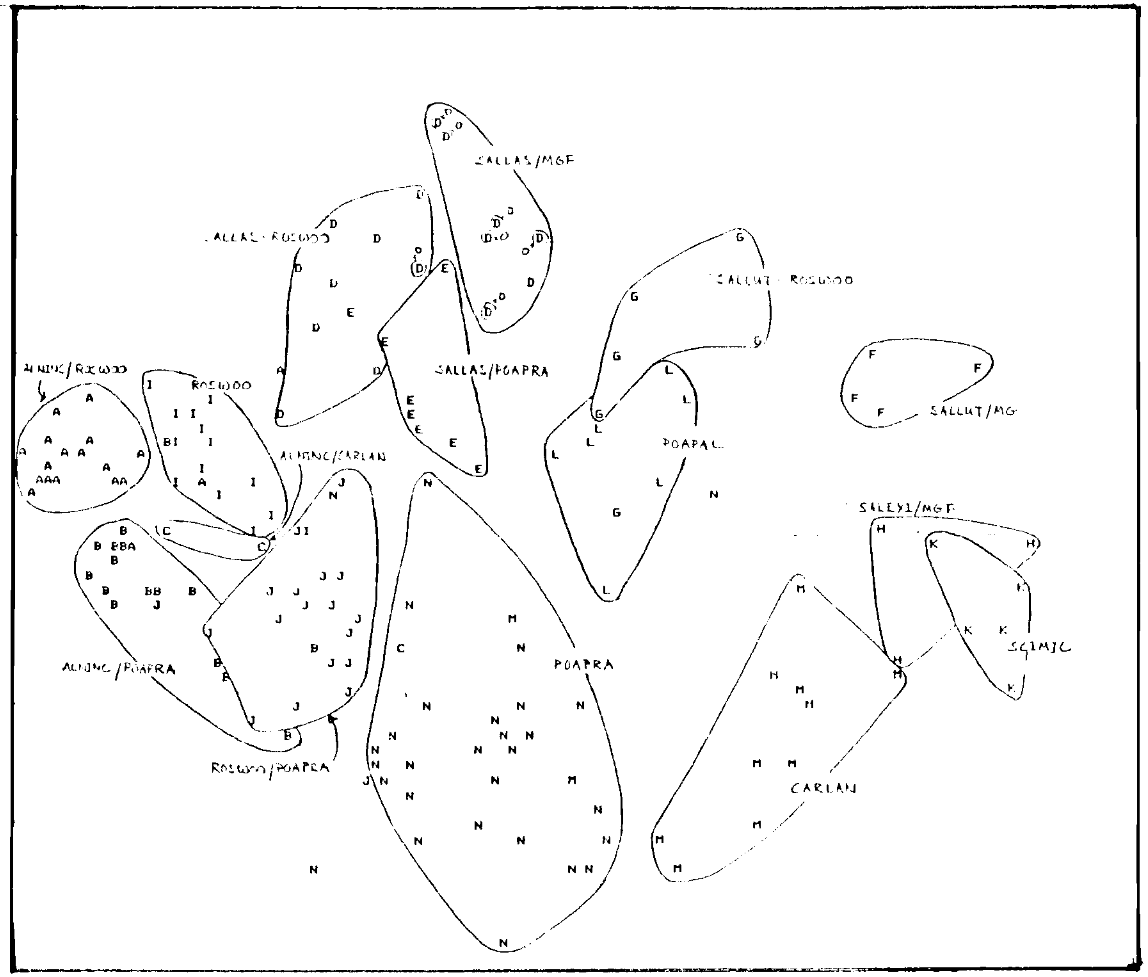

Figure 1-3. Detrended correspondence analysis ordination of samples for selected community types. Letters indicate samples representing the same community type, as defined in Table 1-2. DCA Axis 1 generally represents a gradient of increasing moisture.

POAPRA c.t. occupies a mid-position along Axis 1, which may reflect its intermediate successional position relative to other community types (Chapter 2). Axis 1 length (4.2 SD) reflects a moderate turnover in species composition within samples. As expected, community types sharing similar species composition are positioned closely to one another. For example, all the types dominated by *Rosa woodsii* and *Alnus incana* are located on the left side of Axis 1.

The species ordination scores may be similarly plotted and examined (Fig. 1-4). The ordination axes for the species tend to represent the same general gradients described for the stand ordination. Axis 1 appears to represent a gradient of increasing elevation, where Axis 2 is one of increasing moisture. Moisture loving, bank dwelling species such as *Scirpus microcarpos*, *Cicuta douglasii*, *Mentha arvense* and *Eleocharis palustris* are located at the upper end of Axis 2. Higher elevation species, represented by *Carex scopulorum*, *Phleum alpinum*, *Polygonum bistortoides*, *Juncus mertensiana* and *Salix lemmonii* are located on the right side of Axis 1. The spatial arrangement of species corresponds closely with the ordination of community types.

Finally, DCA was also applied to the data collected along the lower reaches of Willow Creek (Fig. 1-5). Eigenvalues for the first four axes were 0.645, 0.370, 0.240 and 0.195. The first axis of the stand ordination is 5.2 SD, nearly twice as long as the second axis at 2.7 SD. Axis 1 appears to correspond to a gradient of decreasing surface soil moisture. In addition, there is a correlation between Axis 1 and increasing geomorphic surface height. This is logical, since lower surface heights equate with closer proximity to the water table. The **ALOAEQ c.t.** was the wettest community sampled in this data set and typically occupies low depositional surfaces immediately adjacent to the stream channel. On the other end of the axis the **ARTTRI/BROTEC c.t.** represents the dry end of the communities sampled. These communities occur on terraces elevated a meter or more above the stream channel.

The turnover of species composition along the second axis is much smaller than the first. All but one of the nine community types are tightly clustered along the lower portion of this axis (Fig. 1-5). Only the **ALNINC/POAPRA c.t.** is spatially separated from the other types. Interpretation of this axis is difficult and the significance of the arrangement of community types along it could not be determined.

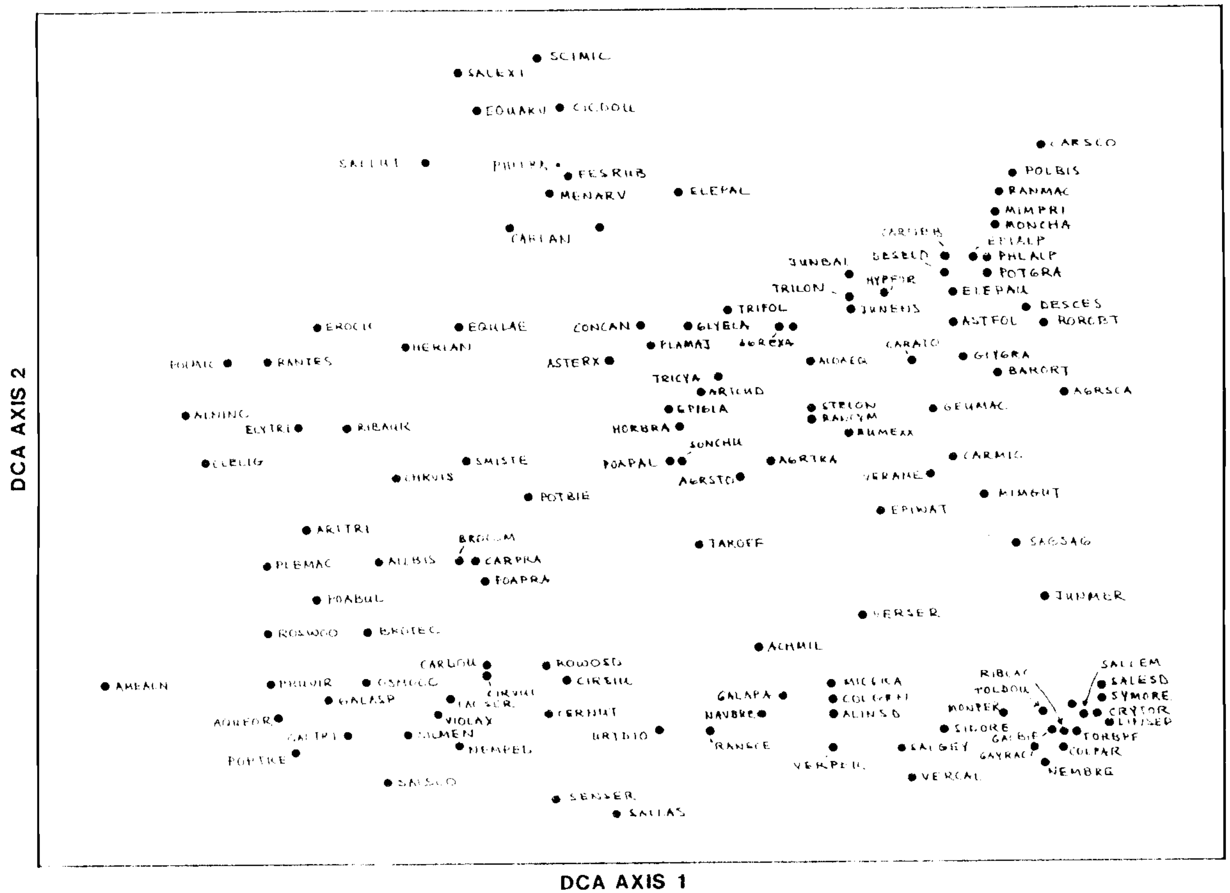

Figure 1-4. Detrended correspondence analysis ordination of species used to describe 25 community types portrayed in Figure 1-2. DCA Axis 1 represents a gradient of increasing elevation and DCA Axis 2 one of increasing moisture.

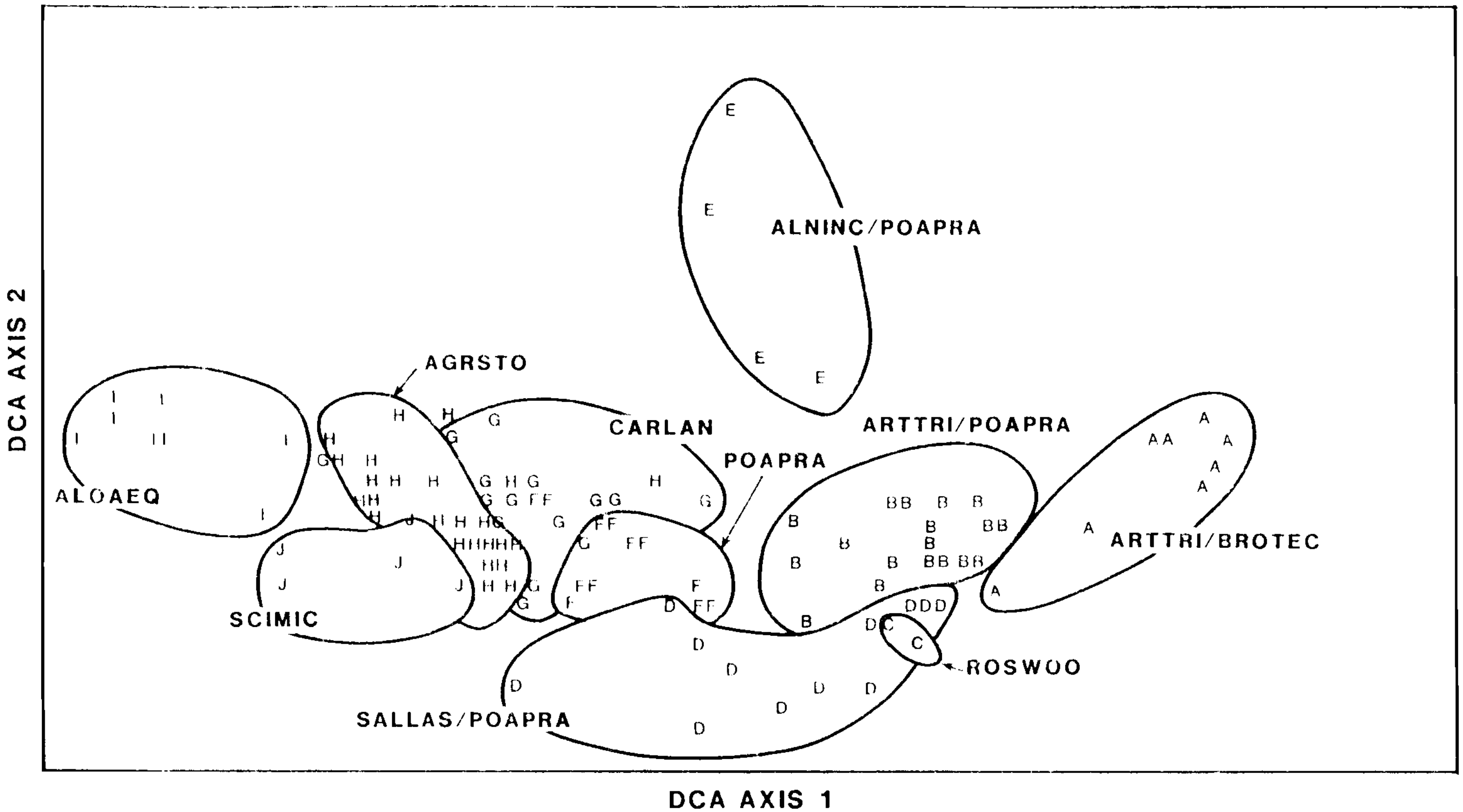

Figure 1-5. Detrended correspondence analysis ordination of samples for the Willow Creek data (Approach 2). Letters indicate samples representing the same community type. DCA Axis 1 represents a gradient of decreasing soil moisture.

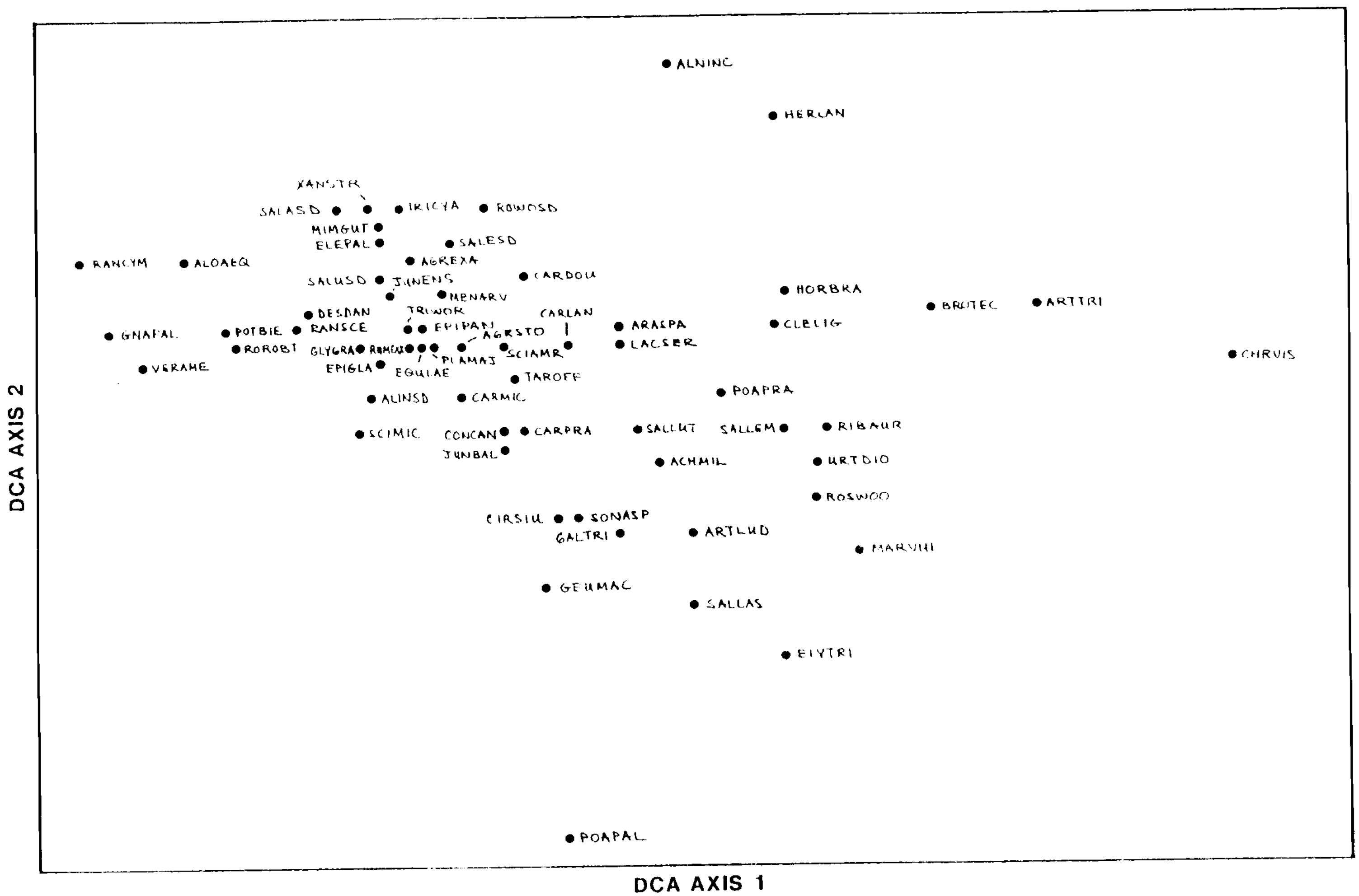

Figure 1-6. Detrended correspondence analysis ordination of species used to describe ten community types from the Willow Creek data (Approach 2). DCA Axis 1 represents a gradient of decreasing soil moisture.

Figure 1-6 portrays the DCA species scores in two-dimensional ordination space. Like in the analysis above, the ordering of species corresponded well with the community type (stand) ordination. Again, Axis 1 portrays a gradient of decreasing moisture. Mesic species, such as *Veronica americana* and *Alopecurus aequalis*, occur on the left side of the axis, where species tolerant of xeric conditions occur to the right.

CONCLUSION

This description of riparian plant communities in the Trout Creek Mountains complements other riparian classification efforts in the Intermountain West. All transects were set up as permanent sampling locations.

Twenty-eight floristically distinct riparian community types were identified and described. Most of these are disturbance types as indicated by the species composition and high species richness. The overall patch size of any given community is normally very small. In interpreting the ordination results, elevation and soil moisture appeared to be the most important variables explaining the distribution of community types.

Detailed description of community and species distribution relative to geomorphic and environmental variables, and successional relationships are addressed in Chapter 2.

CHAPTER 2

RIPARIAN VEGETATION OF THE TROUT CREEK MOUNTAINS: RELATIONSHIP TO LANDFORMS, ENVIRONMENTAL GRADIENTS, AND DISTURBANCE

ABSTRACT

Vegetation-environment relationships were studied in highly disturbed riparian ecosystems in the northern Great Basin. Six unique valley bottom settings were deliniated using a multifactor classification of site variables. A description of the physical setting and associated disturbance regime is presented for each valley bottom type.

Relationships of vegetation to environmental and geomorphic variables were analyzed at three levels; species, communities, and aggregations of communities. Contingency tables, Chi-square tests and correlation analysis were utilized in analyzing these relationships.

Riparian plant species and community type occurrence correlated well with valley bottom type. In addition, many community types were repeatedly associated and formed predictable clusters which correspond to the valley bottom type. Correspondence of vegetation occurrence and geomorphic surface was not as predictable, as many species or community types were observed to occur on multiple surfaces. Occurrence patterns of several species and community types were highly correlated with elevation or level of livestock grazing induced disturbance.

An analysis of size-classes of woody riparian species indicated that distributions are largely skewed toward large, mature individuals, with little representation in the seedling or smaller classes. Typical recruitment sites for many of the woody species, are low-lying gravel bars, wilt deposits and banks.

INTRODUCTION

The study of vegetation or other biotic components of riparian systems necessarily begins with consideration of the landscape (Forman and Godron 1986). Geology is an important factor in determining the nature of riparian systems. In a broad sense it controls the physical appearance and biotic potential through its relationship with geomorphic, hydrologic, and pedogenic processes.

Every landscape is comprised of landforms which influence the structure and function of ecosystems. Swanson and others (1988) suggest four categories in which to consider the effects of landforms on ecosystem patterns and processes: landforms and environmental gradients; landforms and movement of material, organisms, propagules, and energy; landforms and nongeomorphically induced disturbance; and landform and geomorphic processes as disturbance agents. Relationships between landform, physical processes and the biota occur on various temporal and spatial scales (Swanson 1980).

Distribution of vegetation along mountain streamside areas is complicated by the diversity of physical conditions. It is useful to examine riparian vegetation patterns at different scales along the stream axis and in cross-sections of valley floor landforms and associated vegetation.

In the context of the broader landscape, riparian plant distribution is regulated through environmental gradients created by the influence of large landforms. These gradients, primarily related to temperature and moisture, are brought about by differences in elevation, slope position, aspect, and steepness of side slopes (Whittaker and Niering 1965). Position along elevational gradients is an important factor in explaining the distribution of many woody riparian species in the Intermountain West (Brunsfeld and Johnson 1985, Harris and others 1984, Irvine and West 1979, Youngblood and others 1985).

Gradients of physical features may also be observed along a stream network. Physical conditions often change progressively downstream and in turn influence plant distribution (Haslan 1978). In general, moving down from the source, streams become larger, lateral channel shifts become more frequent and extensive, and channel gradient decreases with slower flow and finer-textured substrates.

On a smaller spatial scale, riparian vegetation occurrence patterns may be closely associated with valley bottom geomorphic surfaces (Hack and

Goodlett 1960, Harris 1985, Hupp 1986). Environmental gradients on this smaller scale are related to position of floodplain surfaces relative to the stream channel (Bliss and Canton 1957, Hupp and Osterkamp 1984, Teversham and Slaymaker 1978). Flooding regime, depositional sequence, substrate stability, and available moisture associated with each floodplain surface are important factors controlling plant distribution (Hupp and Osterkamp 1985, Zimmerman 1969). Landforms of the riparian zone therefore reflect past geomorphic and hydrologic processes, and vegetation present may be useful as an indicator of that history.

Valley bottom landforms and corresponding geomorphic processes may be interactive with the biotic component of these ecosystems. For example, well vegetated streambanks and floodplains slow flood waters, causing deposition of sediment (Beschta and Platts 1986). In this way, vegetation helps form floodplain landforms. In addition, these same geomorphic processes may be responsible for the creation of new establishment sites for riparian plant species (McBride and Strahn 1984), dispersal of propagules (Krasney 1986, Silverton 1985), and activation of vegetative reproduction in certain species (Everitt 1968, Lindsey and others 1961).

Riparian zones are disturbance driven systems which are continually reshaped through time by geomorphic and hydrologic processes such as flooding, deposition, and erosion (Morisawa 1968). The frequency and magnitude of both natural and human-related disturbance are guided and constrained by landforms. Substrate composition, configuration of stream valley and channel, and channel steepness may all influence the effect of hydrologic and geomorphic processes. In the northern Great Basin livestock grazing and beaver activity are two important biotic disturbances which interact with the physical disturbance regimes.

Concern for riparian system condition and management in the Great Basin has grown rapidly in recent years. These areas are valued for water supply, fish and wildlife habitat, recreation, forage production, erosion control and aesthetics (Brown and others 1978, Meehan and others 1977, Odum 1978, Thomas and others 1979). Riparian vegetation is the common denominator for each of these values. Knowledge of environmental limits on plant species and plant community distribution within riparian zones is essential for adequate management of these systems.

Management of riparian areas should be based on an understanding of the complex interactions of abiotic and biotic components of these ecosystems. Examination of riparian vegetation patterns and environmental relationships at different scales provides a foundation for understanding the complexities of these dynamic systems.

An area in the Trout Creek Mountains of southeastern Oregon was selected for a detailed study of riparian vegetation patterns and their relationship to geomorphic and environmental features, and disturbance regimes. The purpose of this study was to provide land managers with a basis for understanding the complex vegetation and environmental patterns of disturbed riparian ecosystems of the northern Great Basin. Specific objectives of this study were to (1) broadly characterize the geomorphic setting of the study area streams, and (2) relate occurrence patterns of riparian vegetation to valley bottom landforms, environmental gradients, and disturbance regimes.

STUDY AREA DESCRIPTION

Riparian investigations were conducted along four perennial streams in the Trout Creek Mountains of southeastern Oregon, located in the southern portions of Harney and Malheur Counties, (Fig. 2-1). Trout Creek and its tributaries (Little Trout Creek) form the largest perennial stream system draining this mountain range. It drains toward Alvord Lake, a large playa to the north. Water seldom makes it to the playa due to upstream irrigation use. The other perennial streams in the study area are Willow Creek and Little Whitehorse Creek. Both of these streams flow to the north and become intermittent in their lower reaches.

The Trout Creek Mountains are located in the northern portion of the Great Basin physiographic province. This region is characterized by numerous parallel north-south trending mountain ranges separated by broad, nearly level basins. These mountains have been sculpted from uplifted fault blocks, and the basins are depressions which have filled with alluvium and lake sediments (Russell 1883).

Geologically, the Trout Creek mountains are considered to be young (Fenneman 1931) and are comprised of a thick volcanic/pyroclastic sequence of rocks (Carlton 1968). Lower layers of this sequence have been correlated with the Steens Basalt originating in the late Miocene age (Minor 1986). Upper

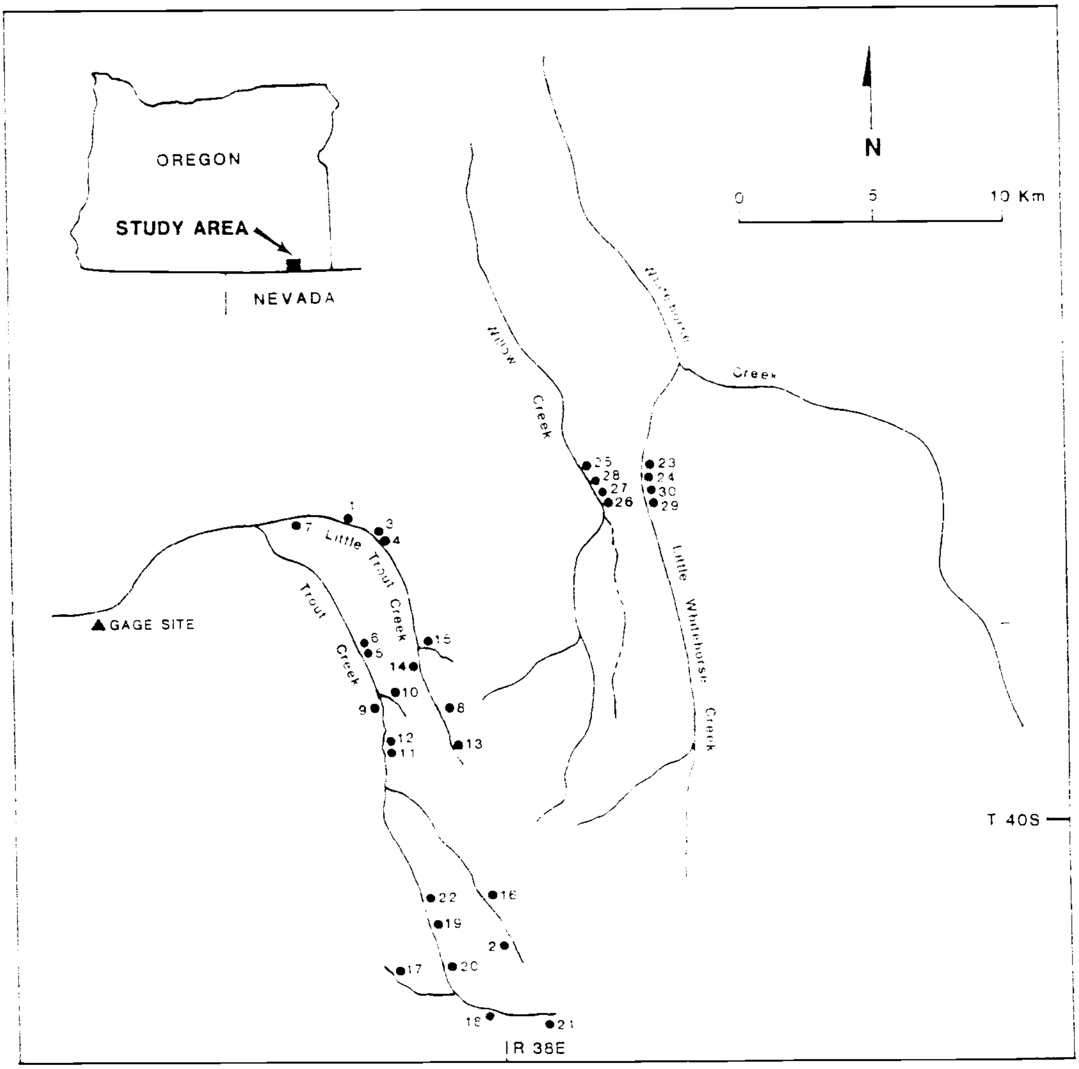

Figure 2-1. Location map for streams of the Trout Creek Mountain study area. Numbers indicate locations of the 30 sample reaches.

layers contain ash-flow tuff sheets derived from nearby calderas. Except for Quaternary basin-fill and surficial deposits, much of the study area is underlain by middle to late Tertiary volcanic rocks (Walker 1977).

An upthrown block on the east side of the Pueblo Valley (graben) forms the Trout Creek Mountains, which are characterized by mesas, buttes, and tilted fault blocks with steep scarps (Carlton 1968). The main part of the Trout Creek Mountains forms a gently northward-tilted plateau with elevations reaching from 1300 m (4500 ft) at the basin edge to over 2400 m (8000 ft) on the south-end. This plateau is dissected by narrow north, northwest-trending stream canyons with depths as great as 300 meters. Mahogany Ridge is the largest fault block, forming a mesa along the western boundary of the study area, and paralleling the mid-reaches of Big Trout Creek.

The natural upland vegetation of the study area is predominantly comprised of sagebrush-bunchgrass communities, the *Artemisia tridentata/Agropyron spicatum* and *Artemisia tridentata/Festuca idahoensis* associations described by Franklin and Dyrness (1973). At high elevations *Artemisia tridentata* ssp. *vaseyana* is dominant, where at lower elevations *A. tridentata* ssp. *wyomingensis* is common. Several bunchgrasses are associated with these communities, including *Festuca idahoensis* on moist aspects and *Agropyron spicatum* on drier aspects. Isolated patches of *Cercocarpus ledifolius* and *Ceanothus velutinus* are found at higher elevations. Also at high elevations on north and east facing slopes are numerous groves of *Populus tremuloides* associated with sidehill springs. Conifers are conspicuously absent. At lower elevations where the mountains give way to the low-lying basins one will find salt desert shrub communities, characterized by such species as *Atriplex confertifolia*, *Grayia spinosa*, *Artemisia spinescens*, *Sarcobatus vermiculatus* and *Distichlis spicata*.

The semiarid climate of this area is characteristic of the Great Basin, with hot summers and cool winters. Precipitation occurs largely in the mountains in the form of winter snow. Total annual precipitation is much lower in the valleys. Annual moisture patterns are extremely variable, and the extent of specific precipitation events are often localized. Streamflows peak closely following the larger rainfall and snowfall events. Flooding principally occurs with springtime melting of mountain snowpacks between April and June (Fenneman 1931), and with severe summer thunderstorms in July and August.

Long-term climatic records are available for locations in nearby basin bottoms including Denio at 1277 m (4190 ft) and Whitehorse Ranch at 1281 m (4200 ft). The period of record is from 1952 to 1984 at Denio, and from 1965 to 1987 at Whitehorse Ranch. Average annual precipitation at Denio is 220mm (8.5 in) and 230 mm (8.6 in) at Whitehorse Ranch. Precipitation is fairly evenly distributed throughout the year except for July and August when it is very dry. Snowfall averages 47 cm (18 in) per year and mostly comes during December and January. Average minimum temperatures range from -7 C (20 F) in January to 11 C (52 F) in July, where average maximum temperatures range from 6 C (42 F) in January to 34 C (92 F) in July.

Twenty-eight years of data from a snow depth marker at the head of Trout Creek indicate that early April snow packs average 749 mm (28 in) (U.S. Soil Conservation Service 1989). The water equivalent is estimated to by 275 mm (10.3 in).

Most of the study area is administered by the Bureau of Land Management. Study sites along Little Trout Creek and Big Trout Creek fall within the boundaries of the Burns BLM District. The Willow Creek and Little Whitehorse Creek watersheds are administered by the Vale BLM District. Small private inholdings account for a substantial portion of the riparian areas associated with Trout Creek.

Livestock grazing has been the dominant land use in the study area during the past century. The Trout Creek Mountains were extensively grazed by sheep during the late 1800s. Ranches were established in the nearby valleys by the 1870s resulting in the importing of large numbers of cattle and horses. The nomadic lifestyle of sheepherders was challenged by the increasing competition for limited forage resources and the expanding reign of permanently situated cattle ranchers. After the turn of the century sheep were eventually replaced by cattle as the preferred stock on these mountain rangelands. Feral horse populations originated with white settlement and in periods of population growth also exert considerable pressure on upland forage resources. Riparian condition surveys conducted along Little and Big Trout Creek revealed no areas in excellent condition (USDI/BLM 1988). Seventy percent of the riparian zones were rated poor, 12% fair and 19% in good condition.

Willow Creek and Little Whitehorse Creek are the habitat for the endemic Whitehorse cutthroat trout (*Salmo clarki* subsp.). During the past half century population numbers of this rare trout have declined substantially, primarily due to habitat degradation brought about by livestock grazing (Trotter 1988). In 1973, as part of implementing a habitat management plan for the Whitehorse Cutthroat, a series of livestock exclosures were constructed in the Whitehorse Creek watershed. Only one of these exclosures, along the lower reaches of Little Whitehorse Creek, was maintained. Today it serves as testimony to the potential for riparian recovery. In 1980 and 1981, several more exclosures were built along Willow Creek and Little Whitehorse Creek to protect trout habitat. Three of these exclosures were partially maintained and excluded cattle most of the time since construction. Extremely steep stream reaches, these four exclosures, and one special management pasture along Little Trout Creek, provided reference areas, ungrazed or lightly grazed by livestock.

METHODS

Thirty reaches, along four streams were selected for intensive study of vegetation and environmental relationships (Fig. 2-1). Sampling was designed to cover much of the range of riparian vegetation and valley bottom settings found within the study area. Sampling locations along Willow Creek and Little Whitehorse Creek were located in the livestock exclosures discussed in the previous section. All other sample reaches are part of the present forage base within cattle grazing allotments.

Along each reach a 50 to 100 meter line parallel to the stream axis and along the edge of the riparian zone was established. From this base line, three to six points were randomly selected to become the starting point for vegetation transects. Each transect extended from one edge of the riparian zone to the other. Riparian zones were defined by the area hydrologically connected to the stream as evidenced through the presence of moisture dependent vegetation. Along the transect, at 1 to 1 1/2 m intervals, a 0.5 by 1 meter quadrat was placed for purpose of recording vegetation and site data. A total of 3109 quadrats were sampled. Of these 484 occurred over the channel and were not included in this analysis. The remaining 2535 quadrats were subject to analysis.

Vegetation data for each quadrat included a complete species list with visual estimates of projected crown cover. Important woody species were classified into six size classes based on basal diameter.

Size Class	*Diameter*	
0	< .3 cm	seedling (1st yr)
1	.3-1 cm	very young sapling
2	1-3 cm	sapling
3	3-9 cm	intermediate
4	9-18 cm	mature
5	> 18 cm	very mature

Members of the largest size class were usually several meters in height and canopies characteristically contained dead branches.

Cover estimates were also made for exposed bare ground, gravel, rock, bedrock, moss and litter. These data were used to classify and describe 25 riparian plant community types (Chapter 1). For purposes of the present investigation the cover data was converted to presence-absence data. Proportional cover of riparian community types for each reach was calculated from the distance intercepted along each line transect.

Environmental information for each quadrat includes type of geomorphic surface, height of surface above stream channel, distance of surface from edge of channel, surface soil texture class, coarse fragement content class, and surface soil moisture class. Additional information was collected for each reach and included elevation, drainage area, valley width, channel gradient, width and depth, and riparian zone width. Sketch maps of each reach showing the transect locations and major riparian features were also completed.

Identification of valley bottom landsurfaces incorporated existing definitions where possible (Mitsch and Gosselink 1986, Leopold, Wolman, and Miller 1964, U.S. Soil Conservation Service 1986). Active floodplain surfaces bordering the channel bed (CH) include; depositional bars (gravel bar (GB) and silt deposit (SD), point bar (PB)), bank (BA), lower terrace (LT) and side channel (SC). The perennial stream channel contains surface water flow more or less continuously which transport, erode and deposit sediment. Banks are inclined surfaces immediately bounding the stream channel. High and steep vertical banks located at the cutting edge of a stream are referred to as cutbanks. Silt deposits and gravel bars are elongated land surfaces located within the active stream channel. Gravel bars are primarily composed of coarse textured materials. The fine textured silt deposits are located either along the edges of the stream channel where water flow is slow or mid-stream where they have developed behind beaver dams. After abandonments by beaver, these dams breach resulting in exposed silty surfaces. Point bars are locations of sedimentation on the convex sides of stream curves. Lower terraces are fairly level surfaces adjacent to the banks which rise .25 to .50 m above the stream channel. These low-lying surfaces receive subsurface water from the stream and are subject to periodic inundation. Secondary channels are a minor feature of the active floodplain and contain surface water only in periods of high flow.

The active floodplain is bordered by terraces (TE). This generally level landsurface represents the former position of an alluvial plain. Typically terraces are elevated a meter or more above the active channel.

The upper 10 cm of surface soils were inspected in the field. Each sample was assigned to one of three texture categories, silty (SI), silty-sand (SS), and sandy (SA). Surface soil moisture was characterized as dry, moist, or saturated. Rock content by volume was estimated and assigned to one of the following categories; trace, <35%, 35-50% and >50%.

Valley width was defined as the area extending from the base of one valley side-slope to the other. Width of the riparian zone encompassed the area hydrologically connected to the stream channel, as evidenced through the vegetation. Channel gradient was determined by use of a clinometer.

DATA ANALYSIS

Physical Setting -- Canonical discriminant analysis (Williams 1983) was applied to reach level variables in order to examine the distinctness of the sampled reaches. This multivariate pattern analysis was accomplished utilizing the CANDISC program (SAS 1988). Total canonical structure was computed using Pearson product-moment correlations between the canonical variables and the original variables. Pearson coefficients were also calculated to examine correlations between original reach variables.

Vegetation-Environment -- Relationships of vegetation to environmental and geomorphic variables were analyzed at three levels; species, communities and aggregations of communities. Species level evaluations were conducted utilizing the original quadrat data. The combined quadrat data (361 samples) utilized for the classification of riparian community types (see Chapter 1 methods) were used for examination of community relationships.

A combination of techniques was used in analyzing these relationships. Contingency tables were utilized to examine relationships among species, communities, and the categorical geomorphic and environmental variables. Chi-square tests and correlation analysis were conducted to determine the strength and direction of relationships.

A separate analysis was performed on size class data of prominent woody species. Cover data for each woody species were used to calculate total relative cover across all samples. In addition, for each species the proportion of total cover in each size class was calculated and plotted. Seedling presence-absence data were used to examine in relationships in further detail using contingency tables.

RESULTS AND DISCUSSION

Vegetative and environmental relationships of Trout Creek Mountain riparian ecosystems are extremely complex. In an effort to clarify these relationships these results are organized in the following manner. First, the analysis of physical features of these systems, and a classification of valley bottom settings is presented. Included is a description of the physical environment and associated disturbance regimes for each of the six identified valley bottom types.

The next section deals with riparian vegetation distribution and successional patterns in relation to the physical environment and disturbance regimes. This section progresses through different levels of organization, from species (herbaceous and woody), to community types, to complexes of community types. At each level, distribution patterns of vegetation relative to environment (eg. elevation, geomorphic surface, valley bottom type) will be addressed first, followed by a discussion of successional relationships. Discussion of successional patterns of riparian community types is incorporated into the last section which examines community type mosaics and successional relationships within each of the six valley bottom settings.

PHYSICAL SETTING

Positions of sample reaches along the longitudinal profile of each stream are indicated by Figure 2-2. These reaches span an elevational range from

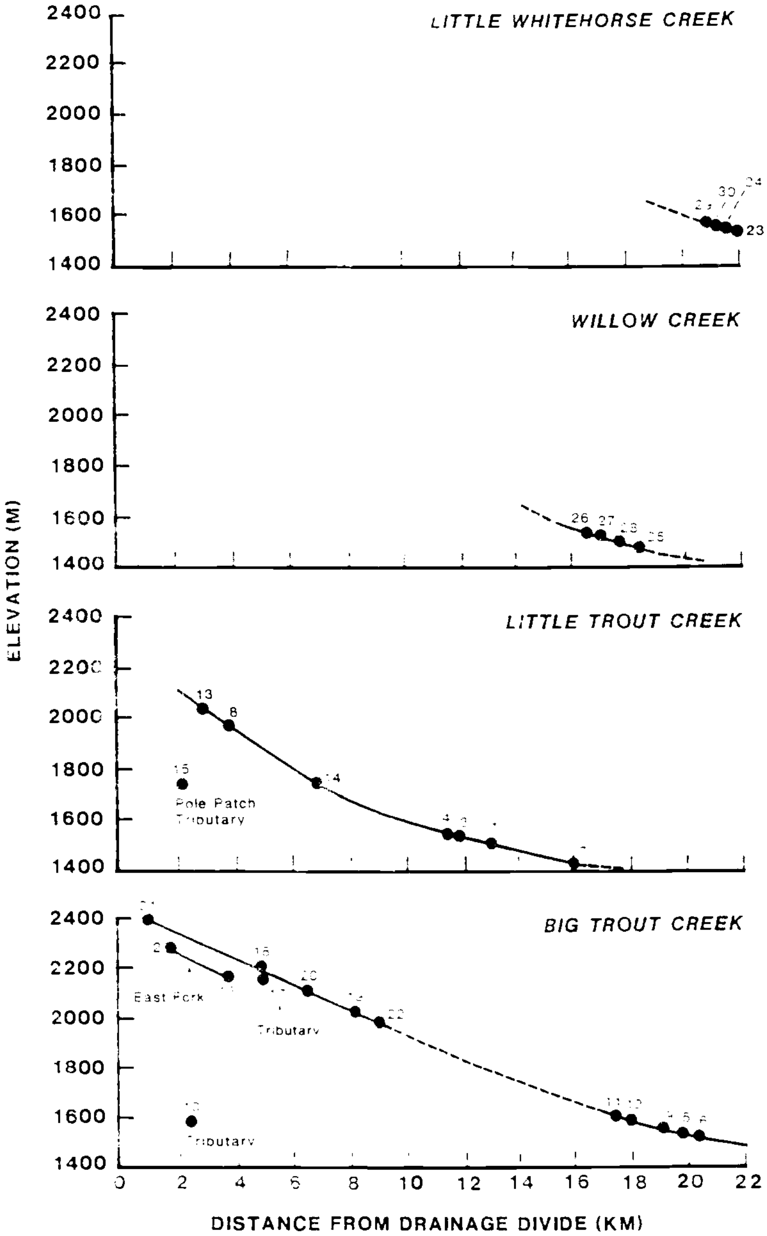

Figure 2-2. Longitudinal profiles of the four study area streams, showing the locations of the 30 sample reaches.

1400 m to over 2400 m at the headwaters. With increasing drainage area, notable changes in physical features occur (Table 2-1). Channel width and depth show a strong positive correlation with increasing drainage area. Stream channel gradient is less strongly correlated with drainage area (r=-0.44), and tends to decrease in a downstream direction. Small steep tributaries at mid and low elevations probably account for the moderate negative correlation between gradient and drainage area. If data from each stream were analyzed separately this relationship would be much stronger. However, local breaks in topography may also reverse this trend.

A strong positive association was observed between riparian zone width and valley bottom width. Surprisingly weak relationships were observed between elevation and valley width (r=0.01), and channel width and valley width (r=0.147). Narrow, bedrock lined stream canyons originate in the upper elevations of the mountains and extend down to the basin edges. The canyon bottoms average 30 to 40 meters in width for a substantial portion of their length. This would explain the lack of correlation between elevation and valley bottom width.

The relatively low correlation between channel gradient and valley bottom width (r=-0.36) and riparian width (r=-0.28) was weaker than expected. One would expect steeper channel gradients to result in more concentrated flows and narrower riparian zones. Channel width and depth are moderately correlated with channel gradient, and show a tendency to decrease with increasing gradient.

Channel width and channel depth are strongly correlated (r=0.82). In considering stream channel configuration it is useful to examine the ratio of channel width to depth. For instance channel width has been observed to increase and channel depth to decrease with vegetation removal by livestock (Platts and others 1985). This pattern is also reflected in the Trout Creek data. Along reach 23, where livestock grazing has been excluded for 13 years, the channel width:depth ratio is 5.0 (Table 2-2). The stream channel is approximately one meter wide and 20 cm deep. In a grazed area immediately below this exclosure the stream channel becomes nearly twice as wide and much shallower. The literature suggests that poor condition riparian systems which are allowed to recover from livestock grazing may move from a higher to a lower channel width:depth ratio (Elmore and Beschta 1987). Ratios in our study range from a low of 5.0 to a high of 33.0, and average 17.2.

Table 2-1. Correlation matrix with Pearson correlation coefficients for riparian reach variables for thirty locations.

	ELEV	GRAD	RWID	VWID
Elevation	1.0000			
Gradient	0.1667	1.0000		
Riparian Width	-0.1792	-0.2815	1.0000	
Valley Width	0.0107	-0.3669	0.5987	1.0000
Channel Width	-0.2823	-0.4065	0.1898	0.1477
Channel Depth	-0.5140	-0.4554	0.1680	0.0317
Valley Floor Width Index	-0.0108	0.1665	0.6078	0.3072
Drainage Area	-0.7097	-0.4413	0.2829	0.1865

	CWID	CDPTH	VFWI	DAREA
Elevation				
Gradient				
Riparian Width				
Valley Width				
Channel Width	1.0000			
Channel Depth	0.8241	1.0000		
Valley Floor Width Index	-0.4099	-0.1854	1.0000	
Drainage Area	0.6167	0.6224	-0.1488	1.0000

Table 2-2. Characteristics of 30 sample reaches along riparian zones of the Trout Creek Mountains. (ELEV = Elevation; GRAD = Gradient: RWID = Riparian Width; VWID = Valley Width; CWID = Channel Width; CDPTH = Channel Depth; CW:CD = Channel Width:Channel Depth; BANK = Bank Condition (Eroding/Stable); DAREA = Drainage Area; TYPE = Valley Bottom Type Code; G = Grazing Status (G = Grazed by livestock, X = Livestock grazing excluded)). (** Reach LTC 7 grazed lightly in Fall only).

	ELEV (m)	GRAD (%)	RWID (m)	VWID (m)	CWID (m)	CDPTH (cm)	CW:CD	BANK	DAREA (km^2)	TYPE	G
Broad Headwater Valley (HB)											
EFTC 2	2268	7	45	45	1.5	5	30.0	E	1.81	HB	G
BTC 21	2438	4	19	50	1.1	4	27.5	S	0.52	HB	G
High-Elevation V-Shaped Valley (HV)											
LTC 8	1975	8	9	10	1.0	3	33.0	E	5.70	HV	G
LTC 13	2036	4	4	6	0.6	6	10.0	E	3.37	HV	G
LTC 14	1737	5	10	11	1.7	10	17.0	E	10.88	HV	G
EFTC 16	2170	5	8	65	1.7	7	24.3	E	7.51	HV	G
BTC 17	2170	4	9	12	0.7	10	7.0	E	2.59	HV	G
BTC 18	2219	4	9	12	1.9	9	21.1	E	9.07	HV	G
BTC 19	2036	6	10	45	3.5	13	26.9	E	20.46	HV	G
BTC 20	2109	4	12	20	2.5	10	25.0	E	2.59	HV	G
BTC 22	1987	5	9	35	2.4	15	16.0	E	23.31	HV	G
Steep-Narrow V-Shaped Valley (SV)											
BTC 10	1585	14	12	12	0.5	4	12.5	S	1.81	SV	G
PP 15	1743	14	8	8	1.1	10	11.0	S	2.33	SV	G
Low-Elevation Moderate V-Shaped Valley (LV)											
LTC 1	1506	1	20	20	5.0	40	12.5	S	26.68	LV	G
LTC 3	1555	4	20	25	1.7	14	12.1	E	24.09	LV	G
LTC 4	1567	4	17	20	1.7	13	13.0	S	24.09	LV	G
BTC 5	1555	4	12	30	5.0	25	20.0	E	76.41	LV	G
BTC 6	1530	4	13	15	4.5	25	18.0	E	80.03	LV	G
BTC 12	1615	5	10	12	5.0	26	19.2	E	69.93	LV	G
LWC 24	1500	4	17	35	1.6	12	13.3	S	53.10	LV	X
WC 25	1469	2	17	20	1.7	12	14.2	S	52.58	LV	X
WC 26	1524	4	9	30	2.3	13	17.7	S	50.25	LV	X
WC 27	1512	3	7	30	2.0	13	15.4	S	50.76	LV	X
WC 28	1506	3	21	60	2.0	13	15.4	S	51.54	LV	X
LWC 29	1554	7	10	10	1.1	10	11.0	S	51.54	LV	X
LWC 30	1554	4	18	18	1.2	12	10.0	S	51.80	LV	X
Low-Elevation Broad V-Shaped Valley (LB)											
LTC 7	1433	2	32	65	1.9	13	14.6	S	30.30	LB	G**
BTC 11	1628	2	29	45	4.1	24	17.0	E	69.67	LB	G
LWC 23	1494	4	38	50	1.0	20	5.0	S	53.61	LB	X
Braided Valley (BR)											
BTC 9	1555	2	60	60	4.4	17	25.8	E	74.07	BR	G

As the discussion above indicates, the riparian setting varies along the stream system. In an effort to characterize this variation, six broadly defined valley bottom settings were identified through examination of the reach level data (Table 2-2) and field observations. Each of the 30 sample reaches was assigned to one of the following valley bottom setting types; broad headwater valley (HB), high elevation moderate v-shaped valley (HV), steep-narrow v-shaped valley (SV), low elevation moderate v-shaped valley (LV), low-elevation broad v-shaped valley (BV), or braided valley (BR) (Table 2-2).

Six reach level variables -- elevation, channel gradient, width of riparian zone, valley width, channel width, and drainage area were subjected to discriminant analysis. The relationship among sample reaches portrayed in the dimensional space of the first two canonical variates is shown in Figure 2-3. As indicated by the overlay of valley bottom types, this ordination supports the distinctness of the identified types.

The first two canonical variates (CAN1 and CAN2) account for 82% of the among-group variation, and have eigenvalues of 12.16 and 6.74, respectively (Table 2-3). Interpretation of the two axes is relatively straightforward and supported by the correlations of the original variables with the canonical variates. Along the first axis, reaches with low channel gradient are generally situated to the left side, where the reaches with steep channel gradient are on the right. Riparian width and valley width are negatively correlated with this axis. The second axis separates reaches along a gradient of increasing elevation, with the headwater valleys located at the top and the low elevation v-shaped valleys at the bottom. Drainage area shows a strong negative correlation with the second axis. The position of each reach in ordination space reflects the contribution of all variables entered into the analysis. Interpretation of axes is most useful in identifying important discriminating variables.

The physical setting and general disturbance regimes are described for the six valley bottom types below. Each is listed by the order in which they are encountered, beginning at the headwaters and moving in a downstream direction. Vegetation features will be mentioned only briefly here and discussed in detail later.

Broad Headwater Valley (n=2). These sites are situated above 2200 m at the headwaters of Big Trout Creek and drain areas less than two square kilometers (Table 2-2). Multiple small spring-fed channels, and a few ephemeral

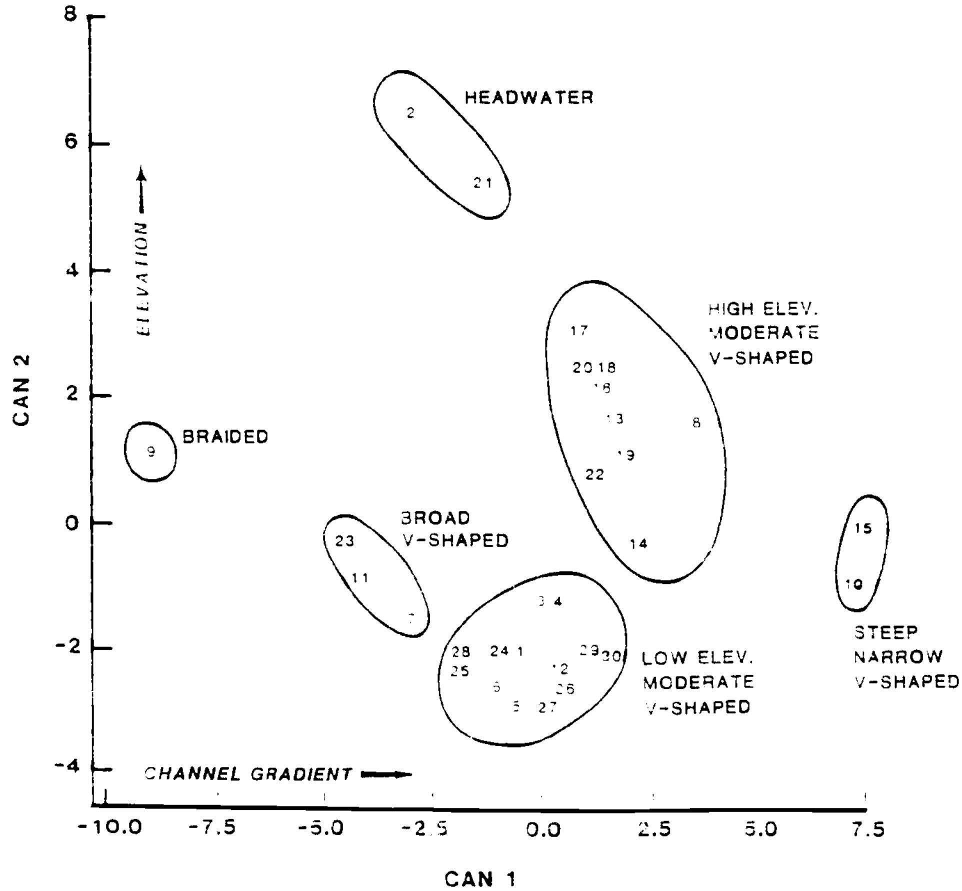

Figure 2-3. Ordination of 30 sample reaches along the first two canonical discriminant variates in an analysis of physical reach data. The six valley bottom type groups are superimposed over the ordination.

Table 2-3. Summary of canonical discriminant analysis of stream reach characteristics.

CANONICAL DISCRIMINANT FUNCTIONS

Canonical Variate	Cannonical Correlation	Eigenvalue	Proportion	Cumulative Percent
1	0.9613	12.1664	0.5289	0.5289
2	0.9332	6.7440	0.2932	0.8221
3	0.8878	3.7223	0.1618	0.9839
4	0.4112	0.2035	0.0088	0.9928
5	0.3522	0.1417	0.0062	0.9990
6	0.1532	0.0241	0.0010	1.0000

TOTAL CANONICAL STRUCTURE

Variable	CAN 1	CAN 2	CAN 3	CAN 4	CAN 5	CAN 6
Elevation	0.2183	0.9205	-0.2550	0.1482	0.0542	0.1226
Gradient	0.7607	0.1509	0.5790	-0.1480	0.0421	0.1987
Riparian Width	-0.7919	0.1846	0.5459	-0.0916	-0.0270	-0.1774
Valley Width	-0.6283	0.1434	0.2552	0.5082	-0.4896	0.1463
Channel Width	-0.3913	-0.3515	0.0013	0.5346	0.6563	-0.0815
Drainage Area	-0.5750	-0.6843	0.0481	0.0396	0.2863	0.3393

snow fed channels merge within these broad valleys which support diverse meadow vegetation (Fig. 2-4). The streambanks, channel, and the lower slopes of the sidehills are the principal landforms occurring in this riparian setting. Channels have a moderate gradient and are lined with a bed of cobbles and large gravels. Occasional boulders are scattered across these valleys and along the stream channel.

A constant and high moisture supply has supported lush vegetation, resulting in the development of a thick organic layer in the soil. Although the water table may be well below the soil surface, these organic soils are typically saturated throughout the growing season. The wettest portion of these valleys are dominated by the **Carex scopulorum c.t.**.

Streamflow comes from two sources; snowpacks and springs. Winter snowpacks occasionally occupy these sites until early summer. Although the likelihood of large floods is low due to the small drainage area, the potential for fluvial disturbance is present as evidenced by mineral layers buried in the organic soil and eroding banks. Snowmelt events occur seasonally, and result in opportunities for fluvial disturbance events which may reset the system. Rapid and substantial snowmelt, such as that which occurred in May of 1984 (Table 2-4), results in severe bank erosion. Summer thunderstorms may occasionally generate erosive forces on these sites, however, this disturbance is thought to play more of a role downstream. Ice is another important disturbance agent which may have erosive effects when combined with exposed and unvegetated banks. Fire is not thought to play a significant role in these high elevation riparian meadows, or on adjacent uplands.

Livestock congregate in these meadows by mid-summer and are present until mid-September. Trampling of streambanks and the soft organic soils has been extensive in these valleys. Woody species are mostly absent from these valley bottoms. With the lack of woody material, beaver are not presently associated with these sites. Their historical role here is unknown and no signs of their presence were observed.

High-Elevation Moderate V-shaped Valley (n=9). These valleys occur from 2200 m down to 1900 meters in elevation (Table 2-2) and occupy the upper portion of narrow canyons which extend down to the basin edges. Streams enter these canyons just below the broad headwater valleys at an approximate elevation of 2100 meters along Big Trout Creek. Little Trout Creek,

Figure 2-4. Example of the Broad Headwater Valley Bottom Type. Along East Fork Trout Creek at 2300 m elevation. The meadow vegetation mosaic shown here is comprised of *Carex scopulorum c.t., Juncus balticus c.t., and Ranunculus macounii - Polygonum bistortoides c.t.*. Aspen (*Populus tremuloides*) groves are seen in the distance.

Table 2-4. Streamflow data for Trout Creek gage station (USGS 1984). Drainage area is 228 sq km (88 sq mi).

Average Monthly Discharge (CFS)	Water Year (Oct. - Sept.) 1932-1982	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986 1987
JAN	7.3	7.2	8.1	21.2	9.0	17.0	7.1
FEB	8.8	28.5	11.7	18.8	10.4	26.6	8.1
MAR	14.0	24.6	39.7	36.9	17.3	56.6	10.4
APR	33.0	70.4	56.6	95.5	64.0	68.9	21.3
MAY	60.0	72.4	135.0	204.0	56.6	38.9	17.0
JUN	33.0	32.0	109.0	127.0	22.3	34.3	9.3
JUL	9.7	18.0	32.7	32.6	8.6	9.4	5.3
AUG	3.7	5.6	12.7	12.2	6.2	5.0	3.4
SEP	3.5	6.0	11.0	9.8	8.1	6.4	3.5
OCT	5.0	5.6	8.1	9.2	12.3	7.3	7.6
NOV	6.2	8.1	9.6	9.7	13.8	-	7.9
DEC	6.4	11.4	8.5	15.8	10.9	-	7.1
ANNUAL	15.7	24.0	37.0	49.4	20.0	-	8.9

MAXIMUM DISCHARGE

1932-1982	470 cfs on 8/1/33. gage height 5.26 ft. from rating curve extended above 230 cfs
Prior to 1932	maximum stage 6 ft caused by cloudburst probably occurred in 1924 or 1925
1982 to present	450 cfs on 4/11/82 (100 yr event) 300 cfs on 4/12/82 (50 yr event) 314 cfs on 5/13/84 (50 yr event)
Flood Return Interval	100 year return interval >346 cfs 50 year return interval >301 cfs

MINIMUM DISCHARGE

1932-1982	0.10 cfs on 8/4/30, 9/12/34, 9/28/34 probably no flow at times Sept. 1-19, 1931

however originates at the head of a canyon in a v-shaped valley. Valley bottoms range from 6 m to 45 meters in width and have steep valley walls often exceeding 45 percent slope. The riparian zones form narrow corridors in this setting and commonly occupy most of the valley bottom. Dense growth of *Salix lemmonii* dominate six of these stream reaches (Fig. 2-5). *Populus tremuloides*, *Alnus incana*, and *Salix geyeriana* were the dominant cover on the three other reaches.

Stream channels average 1.6 meters wide and 10 cm deep (Table 2-2). Channel gradient is moderate and averages 5%. Sinuosity of channels is greater in this valley bottom type when compared to the headwater reaches. A greater diversity of valley bottom landforms are associated with this type including streambanks and channels, secondary channels, gravel bars and terraces. Channel bed substrates are composed of large materials including gravels, cobbles and boulders. All streambanks in these locations were in a severely eroded condition. Shade cover to the stream channel from overhanging vegetation was extremely variable and ranged from 5 to 90%.

The upland sideslopes are a mosaic of sagebrush-bunchgrass communities and aspen groves. *Symphoricarpos oreophyllis* is often an important component of these upland communities. Large stands of aspen are particularly prominent on north and east facing slopes and are supported by a multitude of small springs. Beaver play an important role in shaping stream systems in these valleys and rely on the woody material within and immediately adjacent to the riparian zone. Both present and considerable past beaver activity was evident. Particularly noteworthy dams were observed along the upper reaches of the East Fork of Trout Creek. Remnants of several old dams revealed that these structures were often several meters in height and resulted in the accumulation of massive amounts of sediment upstream. The largest of these abandoned dams breached during the heavy runoffs in 1984 (Hall, personal communication, Table 2-4). The beaver have since moved downstream a few hundred meters where they have constructed a series of new dams. Accumulations of streamside debris along these reaches are dominated by beaver cut materials.

Livestock are another significant disturbance agent in this valley bottom type. The long narrow canyons serve as corridors for the movement of livestock up through the mountains and down again. Although water developments have been installed on adjacent plateaus, the cattle seem to prefer both the

Figure 2-5. Example of the High-Elevation Moderate V-Shaped Valley Bottom Type. The upper photograph shows a stream reach dominated by Lemmon's Willow (*Salix lemmonii*) at 2000 m elevation. Highly eroded stream banks are common in this valley bottom type, as seen in the lower photograph.

moisture, forage and shade of the valley floor. Grazing occurs in these reaches between early July and mid-September.

Fluvial processes are active in this valley bottom type. Flooding primarily occurs with the melting of snowpacks in late spring, but may also occur with summertime freshets. In typical years low-lying geomorphic surfaces such as gravel bars and lower terraces are inundated for a period of several days to a few weeks. Rapid runoff of large magnitudes, such as that which occurred during 1983 and 1984 (Table 2-4), are sufficient to cause substantial erosion and channel migration. The effects of biotic disturbance agents mentioned above interact with fluvial mechanisms in configuring these riparian settings.

Steep Narrow V-shaped Valley (n=2). First order tributaries flow through these steep and narrow valleys (Fig. 2-6). Stream channels are shallow and a meter or less in width (Table 2-2). Channel substrate is predominantly gravel, although a number of boulders are present on the Pole Patch site. The riparian zone totally occupies the valley bottom on these sites which average 10 m in width. These tributaries drain areas less than 2.5 square kilometers, and merge with the main streams at mid elevations. The valley walls are very steep and exceed 50% slope. Landform diversity in this valley bottom type is limited to the channel and its banks.

Narrow riparian areas are dominated by *Populus tremuloides* communities. Dense vegetative growth on these sites results in well protected banks and shaded stream channels.

These spring-fed channels are characterized by a fairly constant flow. Snowpacks do accumulate at the upper end of these tributaries and may result in periods of slightly higher flow. Large flooding events are not likely to occur on these sites due to the small size of the drainage areas.

Livestock grazing is not a serious threat to riparian communities in these valley bottom locations, primarily due to the steepness of the sites. In addition, dense vegetative growth prevents access to the stream. Signs of beaver activity were not observed on the two sample reaches.

Low-Elevation Moderate V-shaped Valley (n=13). This valley bottom type was sampled between 1400 and 1600 m in elevation. Reaches between 1600 m and the lower 1900 m limit of the high elevation v-shaped valley (HV)

Figure 2-6. Example of the Steep-Narrow Valley Bottom Type. Aspen (*Populus tremuloides*) dominates this steep, small spring-fed tributary of Trout Creek.

were not sampled in this study. This unsampled zone was dominated by *Salix* spp. and one small stand of *Populus trichocarpa*.

The dominant overstory cover along low elevation moderate v-shaped valleys is comprised of *Salix lasiandra* and *Alnus incana* (Fig. 2-7). *Salix* overstories are fairly open and shade less than half the stream channel. Reaches dominated by *Alnus* have stream channels which are mostly shaded. *Rosa woodsii* is a prominent component throughout this valley type.

Accompanying the larger valley bottom (Table 2-2) in this setting is increased complexity of the riparian zone. Streambanks, channels, and terraces are the principle geomorphic surfaces. Gravel bars and silt deposits are also prominent components of these valley floor environments. Channels are much larger in this valley bottom type. Along Little Whitehorse Creek, Willow Creek and Little Trout Creek channels average 1-2 m wide and drain areas between 25 and 50 square kilometers. Drainage area on sites along Big Trout Creek are nearly twice as large (80 sq. km) resulting in stream channels 5 m wide. Channel substrates are varied but have a much larger component of finer materials, including more gravel, sand and silt. Channels occasionally flow over exposed bedrock along the lower reaches of Willow Creek and Little Whitehorse Creek.

Valley slopes are steep (30 to 65%), and are commonly lined with bedrock outcrops, especially along Little Whitehorse and Willow Creek. The moist, aspen-covered sideslopes observed at higher elevations are mostly absent from these reaches. Small alluvial fans created by side drainages are common features along this valley bottom type. Fans encroach upon the valley bottom and commonly result in constriction of the stream channel and its associated floodplain. These constrictions may result in flows being concentrated within a narrow passage making it difficult for the establishment of riparian vegetation (BTC 6 and BTC12). Riparian zones on these sites are restricted to the immediate channel banks. Flooding, erosion and deposition are important agents of disturbance in this valley bottom setting. Annual flooding occurs between April and June with the melting of winter snowpacks. In average years the low-lying geomorphic surfaces are inundated for short periods of time. In addition, summer thunderstorms may result in torrents which pass rapidly through these systems. The reworking of these valley floor environments is a continual and dynamic process. The large spring runoff occurring in 1983 and again in 1984 resulted in pronounced changes in valley bottom landforms

Figure 2-7. Example of the Low-Elevation Moderate V-Shaped Valley Bottom Type. Aerial view of Willow Creek showing alder (*Alnus incana*) and willow (*Salix lasiandra*) dominated riparian communities. Steens Mountain is visible in the distance.

along these reaches. Although the specific impact of ice in these reaches is not known, it is presumed that it too would play an important role. Signs of wildfire were observed in these canyons.

The biotic disturbance agents, beaver and livestock are also important components of this valley bottom type. Signs of past or present beaver activity are everywhere. Half of the sample reaches for this type are grazed and half are presently ungrazed (Table 2-2). As mentioned earlier, these narrow canyons with moderate gradients serve as natural corridors for the movement of livestock through the mountains. Harvest of large willow and cottonwood for firewood and building material occurred with early settlement of nearby landscapes. Minor amounts of willow are presently harvested by campers. Cottonwood has been completely eliminated from this valley bottom type.

Low-Elevation Broad V-shaped Valley (n=3). This valley type is distinguished from the moderate v-shaped type by the greater valley floor width (Table 2-2). The average riparian zone width on these sites is 33 m and covers approximately two-thirds of the valley bottom. This broader valley type is found along the same canyons as the previously described type, but tends to occur on flatter positions with lower channel gradients. Two of these reaches occur immediately above obvious constriction points in the stream valley (LTC 7 and BTC11).

The lower channel gradients in this valley type result in the deposition and retention of sediment. This is reflected in the composition of channel substrates which is dominated by gravel with a high proportion of silt and sand. Sinuosity of stream channels is greater than the previously described types and secondary channels are present. Each of the three sample reaches has a sidehill spring associated with it, which subirrigates outer portions of the valley floor.

These broad mesic valleys support a diverse mosaic of herbaceous communities (Fig. 2-8). Overstories are dominated by members of the genus *Salix*.

The fluvial disturbance processes discussed in the previous section also apply to this valley bottom type. Livestock grazing and beaver are the principal biotic disturbance agents operating in this setting.

Figure 2-8. Example of the Low-Elevation Broad V-Shaped Valley Bottom Type. Lush riparian vegetation along a lightly grazed reach of Little Trout Creek. The vegetation mosaic in this photo is comprised of the *Scirpus microcarpos c.t., Salix lutea/Mesic Graminoid c.t., and the Carex lanuginosa c.t.*.

Braided Valley (n=1). One braided reach occurred within the study area and represents the most unconstrained reach sampled. Similar settings occur downstream on private land.

The valley bottom is 60 m wide and totally worked by the stream. The riparian zone extends from one valley edge to the other (Fig. 2-9). This low gradient, depositional reach is located immediately above a major constriction in the valley floor where two tributaries enter the stream from opposite sides. The valley floor is bounded on either side by steep valley walls, exceeding 50% slope. The stream channel is relatively sinuous, about 4 m wide and 17 cm deep. The aquatic plant *Ranunculus aquatilis* is abundant within the stream channel. Bed substrate is predominantly comprised of small cobbles and gravel. Several secondary channels dissect point bars, and a large abandoned channel is located along the base of one valley sideslope. In addition to streambank, channel and terraces, gravel bars and point bars are an especially prominent component of this valley bottom environment. Backwater areas and levees are also present along this reach.

Several debris jams were observed in this reach. Each jam appears keyed to at least one very large willow. These structures apparently have diverted the course of the channel. A very large jam occurs at the point where the abandoned channel is cut off from the main channel. Woody materials in these jams varies from large pieces of willow trunks to many smaller beaver-cut pieces.

Woody vegetation along this reach is dominated by *Salix lasiandra* and *Rosa woodsii*. The largest willows are over 11 m in height and are located along the abandoned stream channel which has now silted in. The present channel is lined by gravel bars and point bars and no large trees. Regeneration of two species of willow was observed to be abundant on some of these surfaces.

Beaver have been active on this site in the past, but there were no signs of present occupation. Cattle grazing occurs during the summer growing season. A recent change in grazing patterns results in this site being grazed late in the summer; previously it was grazed early and late in the season.

The evidence of fluvial action is great in this reach. The stream at this point, drains an 75 sq. km area. Streamflow is supplied from abundant high elevation springs, and seasonal snowpacks. Large flooding events generated by rapid spring runoff or summer thunderstorms can generate considerable

Figure 2-9. Example of Braided Valley Bottom Type. This photo shows an area along the mid-reaches of Big Trout Creek above Cove Canyon. The tree willow, *Salix lasiandra*, is the most prevalant overstory species along this reach.

power by the time they reach this braided reach. The relatively flat valley floor allows for a dissipation of the streams energy over the broader floodplain. Through this action finer stream sediment is deposited and new floodplain surfaces are created.

VEGETATION

Herbaceous Riparian Species Patterns

Distribution Patterns. Data showing occurrence patterns of important riparian plant species of the study area, in relation to elevation, geomorphic surface, height of surface above stream channel, soil moisture class and valley bottom type are presented in Table 2-5a through Table 2-5e.

Distribution patterns in several species are closely related to elevation. For example, species restricted to the lowest elevations (between 1400 and 1600 m) include *Carex lanuginosa*, *Scirpus microcarpos*, *Equisetum arvense*, and *Equisetum laevigatum*. Only one herbaceous species, *Carex scopulorum*, is found entirely above 2000 m (Table 2-5b). Other species were less restricted to specific elevational zones. *Deschampsia caespitosa* was observed at all elevations along Big Trout Creek, although it primarily occurs above 2000 m. On the other hand, *Poa pratensis* also occurred at all elevations but was most common below 1600 m.

In many cases, type of geomorphic surface and height of surface above the stream channel did not appear to be as useful in explaining species distributions (Table 2-5a). However, a few unequivocal relationships appear. For example, over 70% of the *Poa pratensis* and *Smilacina stellata* occurrences are located on terraces. Most species, however, are not closely tied to a specific geomorphic surface but are prevalent on two or three surface types. *Epilobium watsonii*, for example, is common on banks, gravel bars and lower terraces. Similar findings apply to species distributions across geomorphic surface height classes (Table 2-5c).

Occurrence patterns of many species appear to be closely related to valley bottom type. The six valley bottom types are highly correlated with elevational position. Therefore, distribution patterns observed along elevational gradients are to some extent mirrored in the valley bottom types. For example, the highest elevation types, the Headwater Valley and High Elevation v-shaped

Table 2-5a. Percent frequency of important riparian plant species by geomorphic surface. (Frequency value is based on total number of occurrences for each species). (Geomorphic surfaces: BA = Bank; CB = Cutbank; GB = Gravel Bar; PB = Point Bar; SC = Side Channel; SD = Silt Deposit; LT = Lower Terrace). (*n=the number of quadrats in which species was recorded, from a total of 2535).

	Geomorphic Surface								
Species	BA	CB	GB	PB	SC	SD	LT	TE	n*
TREES & SHRUBS									
Alnus incana	18	2	10	-	-	-	15	55	349
Cornus stonlonifera	76	-	-	-	-	-	-	24	21
Ribes lacustre	35	-	23	-	2	-	2	38	40
Rosa woodsii	13	3	2	1	T	-	8	73	749
Salix exigua	12	-	-	-	-	-	9	79	76
Salix geyeriana	26	-	22	-	-	-	7	45	27
Salix lasiandra	23	1	10	5	1	7	15	38	417
Salix lemmonii	23	2	33	-	4	-	13	25	246
Salix lutea	19	-	14	8	1	1	10	47	196
Salix scouleriana	55	-	-	-	-	-	-	45	60
Populus tremuloides	43	1	1	-	-	-	2	53	111
GRAMINOIDS									
Agrostis stolonifera	18	3	6	3	1	-	28	41	147
Carex lanuginosa	15	2	2	1	2	1	17	60	336
Carex nebrascensis	3	-	8	3	11	-	19	56	37
Carex scopulorum	13	-	10	-	2	-	50	25	99
Deschampsia caespitosa	15		32	1	2	-	34	16	151
Deschampsia elongata	15	-	38	3	-	-	11	33	72
Eleocharis palustris	16	-	5	3	8	-	10	58	145
Glyceria grandis	29	1	13	-	3	3	21	30	117
Juncus balticus	13	1	7	1	3	-	24	51	504
Poa palustris	29	1	14	2	3	1	13	38	476
Poa pratensis	10	3	3	1	T	T	11	72	1044
Scirpus microcarpos	22	T	5	2	1	-	26	44	221
FORBS									
Artemisia ludoviciana	20	-	19	16	-	-	20	25	79
Epilobium watsonii	30	2	30	-	2	7	17	12	287
Geum macrophyllum	29	-	21	3	3	-	2	42	66
Heracleum lanatum	29	-	6	-	-	-	3	62	31
Mentha arvense	29	2	7	1	1	4	23	33	163
Montia chamissoi	44	3	19	-	9	-	13	12	105
Plantago major	15	1	13	3	1	4	18	45	252
Ranunculus cymbalaria	19	1	18	5	2	-	20	35	134
Smilacina stellata	15	1	1	1	-	-	12	70	166
Taraxacum officinale	16	2	10	2	T	T	12	58	499
Veronica americana	30	2	24	1	2	1	12	28	308
Equisetum arvense	27	2	2	-	2	3	1	63	129
Equisetum laevigatum	10	2	6	-	2	-	17	63	325

Table 2-5b. Percent frequency of important riparian plant species by elevation class. (Frequency value is based on total number of occurrences for each species). (*n=the number of quadrats in which species was recorded, from a total of 2535).

Species	Elevation (Meters) 1400-1600	1600-1800	1800-2000	2000-2200	2200+	n
TREES & SHRUBS						
Alnus incana	82	5	9	4	-	349
Cornus stolonifera	100	-	-	-	-	21
Ribes lacustre	2	21	-	67	10	40
Rosa woodsii	89	11	T	-	-	749
Salix exigua	100	-	-	-	-	76
Salix geyeriana	-	-	-	100	-	27
Salix lasiandra	81	8	-	1	10	417
Salix lemmonii	2	2	16	60	20	246
Salix lutea	94	6	-	-	-	106
Salix scouleriana	-	100	-	-	-	60
Populus tremuloides	39	58	1	-	2	111
GRAMINOIDS						
Agrostis stolonifera	71	-	9	-	20	147
Carex lanuginosa	99	-	-	1	-	336
Carex nebrascensis	68	5	-	27	-	37
Carex scopulorum	-	-	1	14	85	99
Deschampsia caespitosa	5	1	6	18	70	151
Deschampsia elongata	18	8	16	29	29	72
Eleocharis palustris	88	7	1	1	3	145
Glyceria grandis	29	12	5	23	31	117
Juncus balticus	58	T	1	15	26	504
Poa palustris	63	18	10	7	2	476
Poa pratensis	80	3	2	9	6	1044
Scirpus microcarpos	100	-	-	-	-	221
FORBS						
Artemisia ludoviciana	67	11	4	18	-	79
Epilobium watsonii	31	2	8	39	20	287
Geum macrophyllum	20	-	3	44	33	66
Heracleum lanatum	65	32	-	3	-	31
Mentha arvense	94	4	2	-	-	163
Montia chamissoi	18	4	4	30	44	105
Plantago major	97	3	-	-	-	252
Ranunculus cymbalaria	60	12	11	10	7	134
Smilacina stellata	70	15	12	2	1	166
Taraxacum officinale	51	12	5	15	17	499
Veronica americana	39	11	8	27	15	308
Equisetum arvense	100	-	-	-	-	129
Equisetum laevigatum	100	-	-	-	-	325

Table 2-5c. Percent frequency of important riparian plant species by height class. (Frequency value is based on total number of occurrences for each species). (Height classes 1=<.25m, 2=.25-.5m, 3=.5-1m, 4=1-1.5m, 5=1.5-2m). (*n=the number of quadrats in which species was recorded, from a total of 2535).

Species	Height Class 1	2	3	4	5	n
TREES & SHRUBS						
Alnus incana	16	32	33	15	4	349
Cornus stolonifera	19	33	24	14	10	21
Ribes lacustre	7	48	35	10	-	40
Rosa woodsii	6	26	48	18	2	749
Salix exigua	11	33	56	-	-	76
Salix geyeriana	7	44	19	30	-	27
Salix lasiandra	29	41	23	7	-	417
Salix lemmonii	25	47	20	6	2	246
Salix lutea	18	46	30	6	-	196
Salix scouleriana	17	28	48	7	-	60
Populus tremuloides	14	37	32	12	5	111
GRAMINOIDS						
Agrostis stolonifera	17	50	32	-	1	147
Carex lanuginosa	16	41	36	7	T	336
Carex nebrascensis	24	49	27	-	-	37
Carex scopulorum	7	73	20	-	-	99
Deschampsia caespitosa	15	67	16	2	-	151
Deschampsia elongata	16	47	25	12	-	72
Eleocharis palustris	30	48	20	2	-	145
Glyceria grandis	52	36	9	3	-	117
Juncus balticus	18	49	31	2	-	504
Poa palustris	34	49	13	3	1	476
Poa pratensis	9	35	42	12	2	1044
Scirpus microcarpos	19	56	25	T	-	221
FORBS						
Artemisia ludoviciana	9	61	27	3	-	79
Epilobium watsonii	46	39	15	T	-	287
Geum macrophyllum	20	47	33	-	-	66
Heracleum lanatum	6	68	23	3	-	31
Mentha arvense	31	49	20	T	-	163
Montia chamissoi	50	43	7	-	-	105
Plantago major	44	41	15	-	-	252
Ranunculus cymbalaria	30	48	20	2	-	134
Smilacina stellata	7	34	43	15	1	146
Taraxacum officinale	12	50	32	5	1	499
Veronica americana	51	38	8	3	-	308
Equisetum arvense	37	48	15	-	-	129
Equisetum laevigatum	8	39	45	7	1	325

Table 2-5d. Percent frequency of important riparian plant species by soil moisture class. (Frequency value is based on total number of occurrences for each species). (n*=the number of quadrats in which species was recorded, from a total of 2535).

Species	Dry	Moist	Saturated	n
TREES & SHRUBS				
Alnus incana	58	34	8	349
Cornus stolonifera	76	19	5	21
Ribes lacustre	63	37	-	40
Rosa woodsii	72	25	3	749
Salix exigua	51	34	15	76
Salix geyeriana	81	15	4	27
Salix lasiandra	40	40	20	417
Salix lemmonii	37	47	16	246
Salix lutea	37	49	14	196
Salix scouleriana	52	45	3	60
Populus tremuloides	63	34	3	111
GRAMINOIDS				
Agrostis stolonifera	55	38	7	147
Carex lanuginosa	42	39	19	336
Carex nebrascensis	15	24	61	37
Carex scopulorum	13	43	44	99
Deschampsia caespitosa	21	55	24	151
Deschampsia elongata	44	51	5	72
Eleocharis palustris	9	41	50	145
Glyceria grandis	3	30	67	117
Juncus balticus	35	39	26	504
Poa palustris	26	50	24	476
Poa pratensis	67	25	8	1044
Scirpus microcarpos	15	59	26	221
FORBS				
Artemisia ludoviciana	65	31	4	79
Epilobium watsonii	19	52	29	287
Geum macrophyllum	35	59	6	66
Heracleum lanatum	23	77	-	31
Mentha arvense	23	57	20	163
Montia chamissoi	7	47	46	105
Plantago major	25	45	30	252
Ranunculus cymbalaria	24	49	27	134
Smilacina stellata	62	36	2	166
Taraxacum officinale	52	41	7	499
Veronica americana	12	44	44	308
Equisetum arvense	9	51	40	129
Equisetum laevigatum	54	38	8	325

Table 2-5e. Percent frequency of important riparian plant species by valley bottom type. (Frequency value is based on total number of occurrences for each species). (Valley Bottom Codes: HB = Broad Headwater; HV = High-Elevation V-Shaped; SV = Steep-Narrow V-Shaped; LV = Low-Elevation Moderate V-Shaped; LB = Low-Elevation Broad V-Shaped; BR = Braided). (*n=the number of quadrats in which species was recorded, from a total of 2535).

	Valley Bottom Type						
Species	HB	HV	SV	LV	LB	BR	n
TREES & SHRUBS							
Alnus incana	-	13	10	72	5	-	349
Cornus stolonifera	-	-	43	52	5	-	21
Ribes lacustre	-	98	-	2	-	-	40
Rosa woodsii	-	3	11	58	18	10	749
Salix exigua	-	-	-	-	100	-	76
Salix geyeriana	-	100	-	-	-	-	27
Salix lasiandra	-	12	4	45	20	19	417
Salix lemmonii	1	97	-	2	-	-	246
Salix lutea	-	-	4	32	45	19	196
Salix scouleriana	-	80	20	-	-	-	60
Populus tremuloides	-	39	54	7	-	-	111
GRAMINOIDS							
Agrostis stolonifera	-	29	-	63	9	-	147
Carex lanuginosa	-	1	-	56	42	T	336
Carex nebrascensis	-	27	-	-	68	5	37
Carex scopulorum	70	30	-	-	-	-	99
Deschampsia caespitosa	45	49	-	2	1	3	151
Deschampsia elongata	26	48	-	7	15	4	72
Eleocharis palustris	-	5	1	33	57	3	145
Glyceria grandis	29	31	-	8	31	1	117
Juncus balticus	26	16	-	21	30	6	504
Poa palustris	-	24	6	27	31	12	476
Poa pratensis	6	12	2	48	22	11	1044
Scirpus microcarpos	-	-	-	38	62	-	221
FORBS							
Artemisia ludoviciana	-	21	-	42	13	24	7
Epilobium watsonii	5	63	-	16	16	-	287
Geum macrophyllum	29	52	-	9	5	6	66
Heracleum lanatum	-	3	29	26	39	3	31
Mentha arvense	-	4	-	52	41	3	163
Montia chamissoi	28	51	12	2	7	-	105
Plantago major	-	-	-	39	46	15	252
Ranunculus cymbalaria	7	22	-	17	32	22	134
Smilacina stellata	-	22	10	51	17	1	166
Taraxacum officinale	13	28	5	31	14	9	499
Veronica americana	10	41	2	25	25	6	308
Equisetum arvense	-	-	-	24	76	-	129
Equisetum laevigatum	-	-	-	41	50	9	325

Valley, support all of the *Carex scopulorum*, and almost all of the *Deschampsia caespitosa* sampled in this study. Similarly, the species restricted to low elevations are found almost exclusively in the Low-elevation v-shaped and Low-elevation Broad valley types. Valley bottom type is potentially a better predictor of vegetation occurrence patterns since it reflects the interaction and cumulative effects of several environmental factors, of which elevation is one. In addition to elevation, available soil moisture (water table) is an important environmental variable explaining species distributions. In this study, soil moisture levels were broadly characterized. More specific information on depth to water table, periods of inundation and frequency is needed to comprehend these relationships.

When considering vegetation as indicators of environment, it is important to focus on the herbaceous species in the riparian setting. Trees and shrubs often exhibit a wide ecological amplitude, which diminishes their indicator value (Jeglum 1971). In addition, the tolerance of a species to environment may change with age (Becking 1968). Although a woody species is well established on a surface, the appropriate conditions for seedling recruitment may no longer exist (Wiken and Wali 1974, Bell 1974), and for this reason some herbaceous species or communities may be appropriate as indicators of the present environment.

Successional Relationships. It is useful to consider the types of species inhabiting the landscape. Criteria defining types of species may include life history strategies, grazing tolerance, or whether a species is native vs. introduced, annual vs. perennial, or woody vs. herbaceous. Examination of species in this manner often yields information about associated environments.

For example, species which inhabit areas recovering from severe disturbance are colonists, also known as r-species (Harper 1977). These species occupy open environments, and share life history traits which favor early reproduction, and production of large numbers of small seeds which are easily dispersed. More stable environments are occupied by K-species which specialize in competition for limited resources. Life history traits of this group favor survival, and include perenniality, clonal growth, and structural development. In addition to later reproduction, these species tend to produce fewer seeds which are larger and are more restricted in dispersal. Species in the r-type group are typically shade intolerant where K-species are usually shade tolerant.

Of the 227 vascular plant species encountered in this study, 39 (17%) are introduced species (Appendix A). Colonizing species are common throughout the study area on disturbed open surfaces.

Many of the introduced annual and biennial species are aggressive colonizers on the elevated more xeric terraces and include *Bromus tectorum*, *Erodium cicutarium*, *Poa bulbosa*, *Cirsium vulgare*, *Lactuca serriola*, *Tragopogon dubius*, and *Ranunculus testiculatus*. Native annuals colonizing dry sites include *Gayophytum racemosum*, and *Polygonum douglasii* at high elevations, and *Plectritis macrocera*, and *Epilobium paniculatum* at lower elevations. The short-lived introduced perennial, *Taraxacum officinale*, is a conspicuous invader on terraces, and was the most frequently sampled forb in this study (Table 2-5b).

Native species are common colonizers of freshly exposed, low-lying depositional surfaces which have high levels of surface soil moisture. Common native annuals on these sites include *Gnaphalium palustre*, *Barbarea orthoceras*, *Rorippa obtusa*, *Sagina saginoides*, *Ranunculus sceleratus*, *Mimulus guttatus*, *Juncus bufonis*, and *Potentilla biennis*. The introduced perennial *Plantago major*, and native perennials *Rumex crispus*, *Ranunculus cymbalaria*, *Mentha arvense*, *Veronica americana* and *Salix* spp. are also active colonizers of depositional surfaces.

Seventy percent of all species encountered in the study are longer lived perennials and 30% are obligate riparian species. Perennial riparian obligates are of great interest to the land manager since these are the species which provide forage, structural and habitat diversity, and soil stabilization. These K-type species are both native and introduced and are characterized by different life history strategies. Species in the study area have responded variously to the rapidly changing riparian environment brought about by the interaction of human-related and natural disturbance regimes during the past century.

Deschampsia caespitosa is an example of a species which declines in abundance with heavy livestock grazing (Reid and Pickford 1946). This cespitose species, which reproduces only by seed, is not tolerant of heavy defoliation and is replaced by rhizomatous competitors (Rahman 1976). Severe erosion associated with riparian vegetation removal has resulted in lower streamside watertables and altered growing conditions. It is not abundant along any of the sample reaches, and constitutes less than 10% canopy cover in the *Carex scopulorum* c.t. and *Juncus balticus* c.t. with which it is associated.

D. caespitosa is well known for its wide ecological amplitude, both geographically and in its tolerance to a range of moisture conditions. Along Trout Creek it appears that this species has mostly survived on the mesic high elevation *Carex scopulorum* sites. In most years these locations remain saturated during the growing season precluding livestock access. Grazing may occur in dry years or late in the season after seedset. Prior to livestock grazing, *D. caespitosa* was likely to have been one of the most prevalent herbaceous species along the mid to high reaches of Trout Creek. Early observers noted *D. caespitosa* was the most widely distributed western range grass and that in moist meadows it often grew in nearly pure stands (USDA 1937). More competitive species, however, have taken its place.

The most prominent of these is the rhizomatous *Poa pratensis*, which was essentially unknown in the west a hundred years ago (Sampson 1923). *Poa pratensis* was the most frequently encountered species in the study, occurring in 41% of the sample quadrats (Tables 2-5).

The native rush, *Juncus balticus*, with its prolific network of sturdy rhizomes is also an effective competitor and increases under heavy grazing pressure. Other than early in the growing season this species has low palatability and is avoided by grazing animals. *J. balticus* is a minor component in many communities, but high cover values of this species usually indicates heavy grazing use. This was the second most frequently sampled species in the study.

Rhizomatous species are common in the riparian setting and are well adapted to fluvial disturbance. These species survive burial by regrowth from extensive rhizome networks. Both the rhizomatous species and deeply rooted fibrous species such as *Deschampsia caespitosa* are important soil stabilizers. Several native rhizomatous species appear to have declined under heavy grazing use in the Trout Creek Mountains, including the sedges *Carex lanuginosa*, *Carex nebrascensis*, *Carex microptera*, *Carex praegracilis*, and *Scirpus microcarpos*. These declines are related to direct and indirect effects of grazing. As a result of substantially lowered water tables much of the moist habitat needed to support these species has been lost. All of these species have requirements for higher soil moisture, and have more extensive root systems than the shallowly rooted *Poa pratensis*.

Carex nebrascensis was observed in only one percent of the sample plots. It primarily occurs on moist to saturated low-lying floodplain surfaces (Table 2-5). The combination of lower water tables and high palatability of this species (Hermann 1970) has resulted in its restriction to a few locations along Trout Creek.

Another important native sedge is *Carex lanuginosa*. Approximately 90% of the occurrences for *C. lanuginosa* occurred within the cattle exclosures along Little Whitehorse Creek and Willow Creek. Luxuriant growth of *C. lanuginosa* dominates the streambanks along the length of the 13-year old exclosure on Little Whitehorse Creek. On comparable grazed riparian settings along the lower reaches of Little Trout Creek only occasional patches of this species were observed. On the excluded sites, the presence of dead sagebrush indicates rising water tables. On these sites it appears that *C. lanuginosa* is replacing *P. pratensis*. The later species grows best on well drained loamy soils and does not survive on waterlogged soils (USDA 1937). *Carex lanuginosa* produces large amounts of above-ground and below-ground biomass which provide effective armor to the banks. The dense foliage of this species helps slow floodwaters, resulting in the deposition of sediment and building of banks. Within the exclosures, this species provides shades the stream channel and is associated with overhanging banks.

A group of rhizomatous graminoids was observed to colonize wet silty substrates in the low elevation depositional reaches. Included in this group are *Eleocharis palustris*, *Alopecurus aequalis*, *Scirpus microcarpos* and *S. americanus*. Occurrence of *S. americanus* was incidental in the study plots but was observed to be more common downstream of the study area. *Scirpus microcarpos* was sampled only within the exclosures along Willow Creek, Little Whitehorse Creek and within the special management pasture on Little Trout Creek (LTC7). All four of these species provide vertical structure which interacts with streamflows encouraging deposition of sediments.

Woody Riparian Species Patterns

Woody plants provide much of the structural diversity along streams in the Trout Creek Mountains, and are especially important in providing fish and wildlife habitat (Appendix B). These species tend to be important in stabilizing streambanks, and through their structure interact with fluvial processes in shaping the valley floor environment. Salicaceous species are an important food source and provide building materials for resident beaver.

A total of 21 woody species were recorded in study plots (Appendix A). Six members of the *Salicaceae* (willow family), *Alnus incana*, *Rosa woodsii*, and *Cornus stolonifera* are among the more important woody riparian species present (Figure 2-10). These nine species are dependent on high moisture levels associated with the riparian zone.

Distribution Patterns. Woody riparian species distribution also corresponded well with elevation (Table 2-5b) and valley bottom type (Table 2-5e). Several woody species are mostly or entirely found at the lowest elevations, and include *Alnus incana*, *Cornus stolonifera*, *Salix exigua*, *S. lasiandra*, *S. lutea* and *Rosa woodsii*. *Salix exigua* was found exclusively in the low-elevation broad v-shaped valley type. Low-elevation v-shaped valleys were the principal locations for *A. incana* and *S. lasiandra*. *Populus tremuloides* and *S. scouleriana* were sampled along steep-narrow v-shaped valleys between 1400 and 1800 m. Although *P. tremuloides* was not sampled at higher elevations, it is a prominent species in these locations and occupies steep, seepy sideslopes adjacent to the riparian zone.

Occurrence patterns in a few woody species correspond fairly well to geomorphic surface. For example, *Rosa woodsii* and *S. exigua* are mostly found on terraces. More often, however, species are common on two or more surfaces.

Woody species distribution does not appear to correspond well to surface soil moisture class (Table 2-5d), although relatively few occurrences were recorded on sites with saturated surface soils. Whether surface soil is dry or moist is not likely to be important to well established woody species which obtain water from deep in the soil profile.

Seedling Distribution Patterns. Table 2-6 shows the distribution of seedling occurrences by valley-bottom type, geomorphic surface and height class. Seedlings of *P. tremuloides* and *S. scouleriana* were not observed within the study area and are therefore omitted from this table. The sample size for all species is very small and ranges from a minimum of two sample

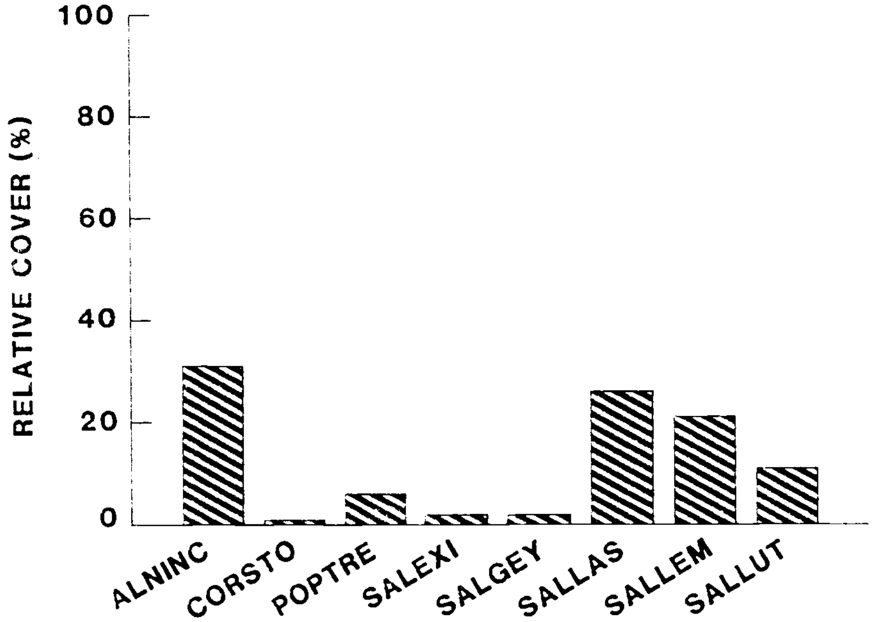

Figure 2-10. Relative percent cover of woody riparian species across all samples.

Table 2-6. Summary of seedling occurence patterns by valley bottom type, geomorphic surface, and height class. Values indicate percent frequency based on total number of sample quadrats for each species.

	-- Seedlings --					
	ALNINC	CORSTO	SALGEY	SALLAS	SALLEM	SALLUT
n*	7	2	5	22	28	5
Valley-bottom Type						
HB	-	-	-	-	-	-
HV	42	-	100	14	96	-
SV	-	-	-	-	-	-
LV	42	100	-	40	4	80
LB	-	-	-	14	-	20
BR	14	-	-	32	-	-
Geomorphic Surface						
BA	14	-	20	41	33	60
CB	-	-	-	-	8	-
GB	29	50	40	14	33	40
LT	43	-	-	27	4	-
SC	14	-	-	-	15	-
SD	-	-	-	-	-	-
TE	-	50	40	14	7	-
Height Class						
1	14	-	60	32	43	60
2	86	50	40	50	50	40
3	-	50	-	18	4	-
4	-	-	-	-	3	-

(*n= number of quadrats in which seedlings were recorded, from total of 2535).

quadrats for *C. stolonifera* to a maximum of 28 for *S. lemmonii*. Occurrence patterns of seedlings and of mature individuals correspond closely for most species (Table 2-6). The would expect this overall close correspondence of mature plants and seedlings, due to increased proximity of available seed. Gravel bars appear to be an important recruitment location for seedlings of all six species. Although seedlings are absent on silt deposits in this data set, they have been observed on silt deposits outside the study plots. Seedlings are also present on banks and terraces usually less than 0.5 m in height. Surface soils of these seedling sites were predominantly moist at the time of sampling. Our sample size is too small to determine more specific aspects of association.

Successional Relationships. The size class structure of all woody species populations is heavily skewed toward large, mature and very mature individuals (Fig. 2-11). Specific ages were not determined for each species in each size class. The only exception to this is for the smallest class (0) which includes only the current year seedling recruits. Even in the absence of specific age-size relationships the lack of small (young) size classes is particularly notable in all species.

The tree-like *Salix lasiandra* was the largest willow in the study area. The biggest individuals observed for this species occurred along Big Trout Creek and exceeded 10 m in height and 50 cm in diameter. Observations made of *S. lasiandra* at similar elevations in central Oregon indicate individuals with diameters between 20 and 50 cm are approximately 45 years old (Busse 1988). Medium stature willows within the study area include *S. lemmonnii*, *S. geyeriana*, and *S. lutea*. These species reach maximum heights of 5 to 6 m, and are characterized by multiple stems arising from a central base.

S. exigua, a relatively short-lived willow, occurred infrequently within the study area. This willow is a colonial shrub which forms dense thickets through spreading rootstocks which sprout at frequent intervals. Height of this species averages between 2 and 3 m. It is an excellent colonizer in sandy soils. Individuals stems of *S. exigua* fall in the second and third size class, and maximum diameters do not exceed 4 cm. It appears that size class 3 is the maximum one attainable for this species within the study area.

Alnus incana is an arborescent shrub attaining heights of 6 to 8 m in the study area. The only tree represented in sample plots is *P. tremuloides*.

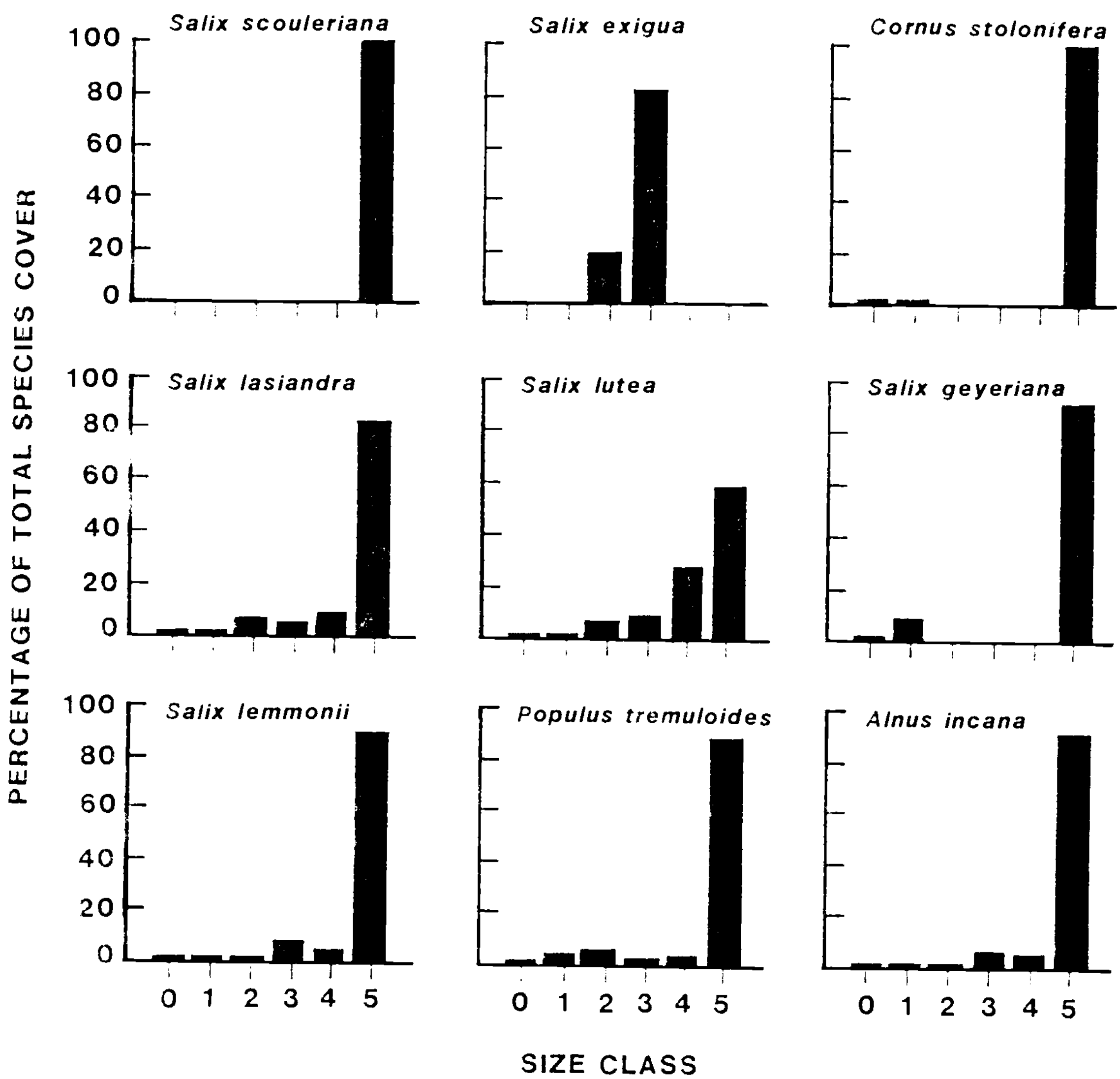

Figure 2-11. Size class distribution for selected woody riparian species. (Size Classes (Diameter): 0=<.3 cm seedling (1st yr.); 1=.3-1 cm very young sapling; 2=1-3 cm sapling; 3=3-9 cm intermediate; 4=9-18 cm mature; 5=>18 cm very mature).

For six of the woody species over 80% of the total species cover occurred in the largest size class (Fig. 2-11). The lack of representation in smaller size classes is of grave concern to the land manager interested in maintaining self-perpetuating populations of these species. An understanding of the regeneration requirements of these species will be of great importance.

One species which appears to be almost completely eliminated from the study area is *Populus trichocarpa*. One isolated stand was observed along the mid-reaches of Trout Creek with another individual about a half-mile downstream. Only one other (barely alive) tree was observed along Little Whitehorse Creek about a mile above the lowest exclosure. If the present trend continues, the lack of seed source and adequate recruitment sites will result in its total disappearance from these drainages.

Reproduction by seed is a major means of regeneration in several of the woody riparian species of the study area. In an effort to understand the extent and location of recruitment, current year seedling data were examined. Less than 3% of the total number of sample quadrats contained seedlings of woody riparian species. In addition, seedlings account for less than 1% of total species cover (Fig. 2-11).

Salicaceous species have extremely small seed that are wind dispersed in late spring and early summer of each year (Sudworth 1934). Seed are typically nondormant. Abundant seed is produced in most years, but establishment opportunities are limited by extremely short viability, lasting a few days to a few weeks (Brinkman 1974, Moss 1938, Fenner and others 1984). Establishment requires that the seed encounter a suitable moist substrate shortly after dispersal. Studies in other areas have determined that typical recruitment sites for similar species are newly deposited alluvium (McBride and Strahn 1984), and that sustained moist surface conditions of a week or more are required for seed germination and initial seedling growth (McLeod and McPherson 1973). As a group, willows prefer open areas with plenty of light, and these conditions are satisfied by the typical mineral soil recruitment site (Sudworth 1934).

Riparian Community Type Patterns

Distribution Patterns. Twenty-five community types were identified along the four study area streams and are described in detail in Chapter 1. Distribution of the dominant woody and herbaceous species of these types was discussed in the previous section. The distribution of community types and associated dominant species correspond closely along environmental gradients (Table 2-5C). However, individual species (eg. *S. lemmonii*) are often present along a greater elevational gradient than its associated community type (**SALLEM/ MGF c.t.**), as indicated by the tails of the distribution curve.

Of particular interest, is the association between community type and valley bottom type, and community type and geomorphic surface. Several community types are associated with only one valley bottom type (Table 2-7a). Broad headwater valleys (HB) are the only locations of the **CARSCO c.t.** and **RANMAC-POLBIS c.t.**. Similarly, the **SALLEM/MGF c.t.** and **SALGEY/MGF c.t.** occurred solely in the high elevation moderate v-shaped valleys (HV). Other community types showed close but not strict association with valley bottom type. For example, community types dominated by *A. incana*, *S. lasiandra*, and *R. woodsii* mostly occurred in the low elevation moderate v-shaped valleys.

Occurrence patterns are less obvious when examining the relationship of community types and geomorphic surface (Table 2-7b). Substantial proportions of all of the community types occur on banks and/or terraces. Eight community types occur on gravel bars, but this surface appeared to be most important to the **SALLEM/MGF c.t.** and **SALGEY/MGF c.t.**.

Community types with large coverages of *P. pratensis* and *R. woodsii* appear to be largely, but not exclusively, associated with terraces. Included in this group are **ALNINC-ROSWOO c.t.**, **ALNINC/POAPRA c.t.**, **SALLAS-ROSWOO c.t.**, **SALLAS-ROSWOO c.t.**, **SALLAS/POAPRA c.t.**, **SALLUT-ROSWOO c.t.**, **ROSWOO c.t.**, **ROSWOO/POAPRA c.t.**, and **POAPRA c.t.**. The **ALNINC/CARLAN c.t.** is more closely associated with streambanks.

The lack of close correspondence between geomorphic surface and community type occurrence may be due to microsite variation on any given surface. For example, the **SCIMIC c.t.** occurs on banks, lower terraces and terraces. *Scirpus microcarpos* requires high levels of surface soil moisture. It is logical to assume that low-lying banks and lower terraces adjacent to the stream channel could provide such an environment. However, these moist conditions may also exist on the more elevated terraces. In some locations, water inputs from sidehill springs may result in saturated surface soils on this

Table 2-7a. Percent frequency of riparian community types by valley bottom type. (Frequency value is based on total number of occurrences for each community type). (Valley Bottom Types: HB = Broad Headwater; HV = High-Elevation V-Shaped; SV = Steep-Narrow V-Shaped; LV = Low-Elevation Moderate V-Shaped; LB = Low-Elevation Broad V-Shaped; BR = Braided). (*n=number of stands representing community type).

Community Type	HB	HV	SV	LV	LB	BR	n*
WOODY TYPES							
POPTRE/SALSCO c.t.		63	37				8
POPTRE/ROSWOO c.t.			100				4
ALNINC-ROSWOO c.t.			20	80			21
ALNINC/POAPRA c.t.			14	86			16
ALNINC/CARLAN c.t.				100			3
SALLEM/MGF c.t.		100					28
SALGEY/MGF c.t.		100					3
SALLAS/MGF c.t.				86	14		7
SALLAS-ROSWOO c.t.			23	44	11	22	9
SALLAS/POAPRA c.t.				75	12	13	8
SALLUT/MG c.t.					100		4
SALLUT/ROSWOO c.t.			17	66	17		6
SALEXI/MGF c.t.					100		3
ROSWOO c.t.			10	70	15	5	17
ROSWOO/POAPRA c.t.				50	33	17	19
HERBACEOUS TYPES							
CARSCO c.t.	100						6
SCIMIC c.t.				29	71		5
GLYGRA c.t.	83	17					6
ELEPAL c.t.				50	50		5
JUNBAL c.t.	46	54					16
POAPAL c.t.		17		17		66	7
CARLAN c.t.				45	55		12
POAPRA c.t.		7		56	30	7	31
AGRSTO c.t.		100					5
RANMAC-POLBIS c.t.	100						7

Table 2-7b. Percent frequency of riparian community types by geomorphic surface. (Frequency value is based on total number of occurrences for each community type). (Geomorphic Surface: BA = Bank; CB = Cutbank; GB = Gravel Bar; PB = Point Bar; SC = Side Channel; SD = Silt Deposit; LT = Lower Terrace; TE = Terrace). (*n=number of stands representing community type).

Community Type	BA	CB	GB	PB	SC	SD	LT	TE	n*
WOODY TYPES									
POPTRE/SALSCO c.t.	50							50	8
POPTRE/ROSWOO c.t.								100	4
ALNINC-ROSWOO c.t	16	4					16	64	21
ALNINC/POAPRA c.t.	7						7	86	16
ALNINC/CARLAN c.t.	67							33	3
SALLEM/MGF c.t.	28	7	28		4		4	29	28
SALGEY/MGF c.t.	33		33					34	3
SALLAS/MGF c.t.	43					43		14	7
SALLAS-ROSWOO c.t.	22			11				67	9
SALLAS/POAPRA c.t.							25	75	8
SALLUT/MG c.t.	20							80	4
SALLUT/ROSWOO c.t.	17						17	66	6
SALEXI/MGF c.t.	67							33	3
ROSWOO c.t.	20	20	5					55	17
ROSWOO/POAPRA c.t.		17	6				11	66	19
HERBACEOUS TYPES									
CARSCO c.t.	29						42	29	6
SCIMIC c.t.	14	14					14	58	5
GLYGRA c.t.	50						33	17	6
ELEPAL c.t.	50				17			33	5
JUNBAL c.t.	23		8				38	31	16
POAPAL c.t.	33		17		17		17	16	7
CARLAN c.t.	36		9				10	45	12
POAPRA c.t.	22		3				8	67	31
AGRSTO c.t.	40	20						40	5
PANMAC-POLBIS c.t.								100	7

higher terraces. Other explanations for poor correspondence may include wide ecological amplitudes of riparian species, and stochastic events.

Community Type Mosaics and Successional Relationships

Most riparian settings are composed of a mosaic of riparian community types. In the study area, the patch size within this mosaic is generally very small. The concept of a 'riparian complex' was introduced recently by Winward and Padgett (1987). A riparian complex represents a unit of land which supports or may potentially support a similar grouping of community types. It is defined on the basis of its overall geomorphology, substrate and general vegetation patterns. The location of individual community type patches within a given riparian complex may vary over time as valley bottom environments change. On-going fluvial processes, including stream channel migration and shifts in water table, result in continually changing environments.

Associations among riparian community types were examined for the study area streams. The average number of community types per sample reach is 7, with a low of 1 in the steep narrow v-shaped valley type and a high of 11 in the low-elevation broad valley type (Table 2-8). Higher elevation valleys generally had fewer community types compared to lower elevations. This pattern may be related to increasing complexity of valley bottom settings as one moves downstream. Recurring patterns of community type groups were observed throughout the study area. These associations between community types and successional relationships are discussed below.

Headwater Valley. The **CARSCO c.t.** and **JUNBAL c.t.** are the main components of the vegetative mosaic in this setting (Table 2-8) and their association is highly correlated (Table 2-9). Although no riparian reference areas exist in this valley bottom type, successional relationships may be inferred from present species composition and knowledge of autecological relationships.

The **JUNBAL c.t.** and **RANMAC-POLBIS c.t.** are grazing induced types which have replaced communities dominated by *Deschampsia caespitosa*, and associated sedges *C. scopulorum* and *C. microptera*. These species are present in minor amounts in both community types. Locations presently occupied by the **RANMAC-POLBIS c.t.** on the edges of the riparian zone likely supported dense stands of *D. caespitosa* prior to livestock grazing.

Table 2-8a. Relative cover of riparian community types in broad headwater valleys, high elevation moderate v-shaped valleys, and steep narrow v-shaped valleys. Community types are defined in Chapter 1. (*Grazing status: G=grazed, X=ungrazed).

	Headwater			High Elev-V							Steep-V		
Reach	2	21	8	13	16	17	18	19	20	22	14	10	15
Community Type													
POPTRE/SALSCO c.t.											100		53
POPTRE/ROSWOO c.t.												18	
ALNINC/ROSWOO c.t.												27	
ALNINC/POAPRA c.t.								19		60		12	
SALLEM/MGF c.t.				26	46	80	97	75	66				
SALGEY/MGF c.t.			34										
SALLAS/MGF c.t.												6	
SALLAS/ROSWOO c.t.												9	
SALLUT/ROSWOO c.t.												7	
CORSTO													21
ROSWOO c.t.												7	26
CARSCO c.t.	19	43											
GLYGRA c.t.	7								12				
AGRSTO c.t.				40									
JUNBAL c.t.	23	57	46										
POAPAL c.t.						9							
POAPRA c.t.				22		8							
RANMAC/POLBIS c.t.	41												
MISC BANK	8				26	3	3	3		4			
DISTURBED/UNCL	2		20	12	25							14	
GRAVEL BAR					3			3	22	36			
*GRAZING STATUS	G	G	G	G	G	G	G	G	G	G	G	G	G
NUMBER OF CTs	6	2	3	4	4	4	2	4	3	3	1	7	4

Table 2-8b. Relative cover of riparian community types in low elevation moderate v-shaped valleys. Community types are defined in Chapter 1. (*Grazing status: G=grazed and X=ungrazed).

	Low Elev Moderate V-Shaped (LV)												
Reach	3	1	5	6	25	28	12	29	30	4	24	26	27
Community Type													
ALNINC/ROSWOO c.t.							15		63	43	37	23	
ALNINC/POAPRA c.t.							6	13	20	8		30	21
ALNINC/CARLAN c.t.										2	9	16	4
SALLEM/MGF c.t.					11								
SALLAS/MGF c.t.		38											
SALLAS/ROSWOO c.t.			35	26	32	30							
SALLAS/POAPRA c.t.		3			22	18	27						15
SALLUT/ROSWOO c.t.	34				7								
CORSTO				30									
ROSWOO c.t.	7	3	28		4		6	4		16	17		4
ROSWOO/POAPRA c.t.	2		19					33	17	11	12	5	
ARTTRI/POAPRA c.t.	32				7	1		12			18	14	
SCIMIC c.t.					3	5							
ELEPAL c.t.					3	7							
POAPAL c.t.												5	6
CARLAN c.t.		1				12							30
POAPRA c.t.	20	27		13	11	18		38		18	7		11
ELYTRI		5											
MISC BANK	2	8	13	22		5	13					7	9
DISTURBED/UNCL		15		9			33						
GRAVEL BAR	3		5			4				2			
*GRAZING STATUS	G	G	G	G	X	X	G	X	X	G	X	X	X
NUMBER OF CTs	7	8	5	5	9	9	6	5	3	7	6	7	8

Table 2-8c. Relative cover of riparian community types in broad v-shaped valleys and braided broad valley. Community types are defined in Chapter 1. (*Grazing status: G=grazed, X=ungrazed, **site grazed briefly in fall).

	Broad- V (BV)			Braided (BR)
Reach	11	7	23	9
Community Type				
SALLAS/ROSWOO c.t.	19			19
SALLAS/POAPRA c.t.		5		14
SALLUT/MG c.t.		18		
SALLUT/ROSWOO c.t.	8			
SALEXI c.t.		7		
ROSWOO c.t.	13		16	1
ROSWOO/POAPRA c.t.	23		19	24
ARTTRI/POAPRA c.t.			3	
CARNEB			6	
SCIMIC c.t.		13	17	
ELEPAL c.t.	19	6		
POAPAL c.t.				13
CARLAN c.t.		24	3	
POAPRA c.t.		7	8	9
ELYTRI		4	26	
MISC BANK	6	5	2	
DISTURBED/UNCL		5	3	
GRAVEL BAR	12		3	20
*GRAZING STATUS	G	G**	X	G
NUMBER OF CTs	7	11	10	7

Slightly lower positions, now dominated by the **JUNBAL c.t.** would have contained a mixture of *D. caespitosa* and *C. scopulorum*.

The **CARSCO c.t.** is a stable type on deep organic soils. Very small areas of this community type are relatively intact. Boggy conditions preclude grazing animals during most of the growing season in most years. The fringes of the **CARSCO c.t.** and adjacent disturbance types have been extensively damaged by livestock trampling. During a series of drought years this normally boggy community is accessible to livestock and the potential for damage is great. As mentioned earlier, these boggy sedge areas are one of the few refugia where *D. caespitosa* survives and reproduces.

Vegetation removal and trampling by livestock has resulted in open channels, raw banks, and lowered water tables in these broad valleys. The smaller spring fed channels are nearly a meter wide with shallow water supporting dense growths of *Montia chammisoi* and isolated pockets of *Glyceria grandis*. Prior to livestock grazing, banks were probably densely sodded and confined the channel to a much narrower course.

Willows are conspicuously absent when viewing these meadows. Although on the Sherman Field Site (BTC 21) two small browsed *S. lemmonii* were observed. Neither of these individuals exceeded the height of the herbaceous vegetation. In the absence of grazing, both *S. lemmonii* and *S. geyeriana* would likely be present along the snow-fed channels and on raised hummocks within the meadows. Anaerobic conditions associated with the very wet **CARSCO c.t.** appear to preclude *Salix* spp. on these positions. Harsh growing conditions on these high elevation sites may slow development of *Salix* spp., but are not thought to limit their occurrence.

High-Elevation Moderate V-shaped Valley. The **SALLEM c.t.** comprises the dominant cover on six of the sample reaches (Table 2-8). Other communities are associated with this type, but do not occur in tight repeatable units (Table 2-9). The **POAPRA c.t.** was associated along two reaches. The only occurrence for the disturbance induced **AGRSTO c.t.** was with the **SALLEM c.t.**. There is a high occurrence of unclassified disturbed surfaces and gravel bars along these reaches.

Successional relationships in the **SALLEM c.t.** are poorly understood. High species diversity and varied composition within this community type are indicative of disturbance. The highly disturbed present day conditions in this

Table 2-9. Correlation matrix showing association between riparian community types.

	POPTRE SALSCO	POPTRE ROSWOO	ALNINC ROSWOO	ALNINC POAPRA	ALNINC CARLAN	SALLEM MGF	SALGEY MGF	SALLAS ROSWOO	SALLAS POAPRA	SALLUT MG	SALLUT ROSWOO	SALEXI MGF	ROSWOO	ROSWOO POAPRA	ARTTRI POAPRA	CARSCO	SCIMIC	GLYGRA	ELEPAL	AGRSTO	JUNBAL	POAPAL	CARLAN	POAPRA	RANMAC POLBIS
POPTRE/SALSCO	1.00																								
POPTRE/ROSWOO	0.03	1.00																							
ALNINC/ROSWOO	0.07	0.44*	1.00																						
ALNINC/POAPRA	0.08	0.42*	0.75*	1.00																					
ALNINC/CARLAN	0.67	-0.08	0.53*	0.49*	1.00																				
SALLEM/MGF	0.64	-0.08	-0.18*	-0.07	-0.17*	1.00																			
SALGEY/MGF	0.03	0.03	-0.08	-0.08	-0.07	0.07	1.00																		
SALLAS/ROSWOO	0.09	0.37*	-0.00	-0.12	-0.23	-0.02	-0.09	1.00																	
SALLAS/POAPRA	-0.09	0.34*	0.03	0.17*	-0.07	-0.02	-0.10	0.63*	1.00																
SALLUT/MG	0.04	-0.03	0.11*	-0.11*	-0.09	-0.09	-0.04	-0.12*	0.38*	1.00															
SALLUT/ROSWOO	-0.06	0.55*	0.15*	0.13*	-0.15*	-0.15*	-0.06	0.49*	0.28*	-0.09	1.00														
SALEXI/MGF	-0.04	-0.05	-0.11*	-0.11*	-0.09	-0.09	-0.04	-0.12*	-0.38*	1.00*	-0.09	1.00													
ROSWOO	-0.03	0.28*	0.34*	0.29*	0.41*	-0.08	-0.12*	0.37*	0.27*	-0.17*	0.51*	-0.17*	1.00												
ROSWOO/POAPRA	0.10	0.12*	0.44*	0.24*	0.50*	0.24*	-0.10*	0.08	-0.18*	-0.14*	0.10	-0.14*	0.59	1.00											
ARTTRI/POAPRA	0.08	-0.10	0.16*	-0.06	0.36*	0.05	-0.08	0.13*	0.08	-0.11*	0.27*	-0.11*	0.36*	0.43*	1.00										
CARSCO	0.04	0.05	-0.12*	-0.13*	-0.11*	-0.11*	-0.05	-0.14	-0.16*	-0.06	-0.09	-0.06*	-0.19*	-0.16*	0.13*	1.00									
SCIMIC	-0.07	-0.08	-0.19*	-0.19*	-0.17*	0.12*	-0.07	0.23*	0.52*	0.56*	0.14*	0.59*	0.06	-0.09	0.46*	-0.11	1.00								
GLYGRA	0.04	-0.05	-0.12*	-0.13*	-0.11*	0.12*	-0.05	-0.14	-0.16*	-0.06	-0.09	-0.06	-0.19*	-0.16*	-0.13*	0.69*	-0.11	1.00							
ELEPAL	0.07	0.09	-0.21*	-0.22*	-0.19*	0.08	-0.08	0.53*	0.63*	0.50*	0.29*	0.50	-0.02	-0.14*	0.22	-0.12*	0.70*	0.12*	1.00						
AGRSTO	0.03	0.03	-0.07	-0.08	-0.07	0.40*	-0.03	-0.09	-0.09	-0.40	-0.06	-0.04	-0.12*	-0.09	-0.08	-0.04	-0.07	0.04	-0.07	1.00					
JUNBAL	0.05	0.07	-0.15*	-0.16*	-0.14*	0.13*	0.52*	-0.18*	0.19*	-0.07	-0.12*	-0.07	-0.23*	-0.19*	-0.16*	0.83*	-0.13*	0.56*	-0.15*	-0.05	1.00				
POAPAL	0.06	0.06	0.08	0.29*	0.36*	0.02	0.06	0.09	0.25*	-0.08	-0.13*	-0.08	0.18*	0.25*	0.05	0.09	-0.14*	0.09	-0.16*	-0.06	-0.11*	1.00			
CARLAN	0.07	-0.09	0.21*	0.03	0.02	0.18*	-0.08	0.18*	0.60*	0.50*	-0.17*	0.50*	-0.03	-0.13*	0.17*	0.12	0.64*	-0.12*	0.62*	0.07	-0.15*	0.08	1.00		
POAPRA	0.12	0.16	-0.14	-0.02	0.19	0.14	0.13*	0.29*	0.54*	0.29*	0.08	0.29*	0.35*	0.21*	0.34*	-0.20*	0.52*	0.21*	0.47*	0.21*	-0.25*	0.26*	0.58*	1.00	
RANMAC/POLBIS	0.04	0.05	-0.10	-0.11	-0.09	0.09	0.04	0.12*	0.13*	-0.05	-0.08	-0.05	-0.16*	-0.14*	-0.11*	0.83*	0.09	0.83*	0.10	-0.04	0.69*	0.08	0.10	-0.17*	1.00

valley bottom setting, and the absence of reference areas make interpretation of successional relationships difficult. Studies in Nevada indicate that *S. lemmonii* may be associated with dense graminoid layers composed of *C. scopulorum C. lanuginosa*, and *P. pratensis* (Padgett and Manning, 1988). There is an overall lack of graminoid cover and a high dominance of forbs associated with this community type in our study area. Cutbanks and raw eroding streamside terraces are commonplace in these reaches.

In pre-settlement times these reaches were likely characterized by well armored, vegetated banks. Herbaceous species which could have fulfilled this stabilizing role are present in minor amounts and include, *D. caespitosa*, *C. scopulorum*, *C. lanuginosa*, and *C. microptera*. *C. nebrascensis* was also likely to have occupied more significant areas on moist portions of the floodplain.

The combined effects of livestock and beaver have been extremely detrimental in these reaches. During the past century, vegetation removal and trampling by livestock have resulted in riparian ecosystems less resilient to disturbance. Although, the historic role of beaver is unknown in this mountain range, these animals were reintroduced in the early 1950s (Kindschey, personal communication). Remnant beaver dams, several meters in height, are scattered up and down these reaches. All stream reaches in this valley bottom type showed signs of present or past beaver activity. The potential for erosion associated with the breaching of these dams and subsequent release of water and sediments is great. With the lack of well vegetated banks to mitigate this cutting force, stream channels have eroded and water tables have been lowered. During initial phases of deterioration, native species intolerant of heavy defoliation were likely replaced by more effective competitors, such as *P. pratensis*. As erosion continued these environments became inhospitable even to the adaptable *P. pratensis*.

Another negative result of the interaction of cattle and beaver is the combined effect on the population structure of many woody species. Many stream reaches in the Trout Creek Mountains are now devoid of woody plant structure. During occupation of a given reach, beaver often harvest most or all of the large woody materials before they move on to a new location. Subsequent to abandonment, successful recruitment of new individuals has been limited by direct or indirect effects of cattle grazing. Either young shrubs are directly consumed and trampled, or adequate establishment sites are no longer present. Available propagules are now limited along many reaches. In natural ecosystems, it has been documented that the activities of beaver can result in the proliferation of woody species through the creation of new establishment sites (Ives 1942). Patterns of beaver occupation, and trends in populations number along these streams are not well documented. Natural predators are limited, and harvest of beaver by trappers is cyclic and unpredictable.

Three sample reaches in this valley bottom type were dominated by other community types. Along one reach the **POPTRE/SALSCO c.t.** accounted for the total riparian cover. Another reach is dominated by **ALNINC/POAPRA c.t.** with no other closely associated community types. The last reach is characterized by a mosaic to **SALGEY/MGF c.t.**, **JUNBAL c.t.**, and disturbed areas. This particular reach is transitional to the broad headwater valleys and shares similar vegetation. Prior to livestock grazing, the understory on this site was probably dominated by *D. caespitosa* and *C. scopulorum*.

Steep-Narrow V-shaped Valley. Communities dominated by *P. tremuloides* and *A. incana* dominate the narrow riparian corridors (Table 2-8). The Pole Patch tributary (PP 15) is dominated by the **POPTRE/SALSCO c.t.** and associated *C. stolonifera* and *R. woodsii* communities. Vegetation along the other tributary was composed of the **POPTRE-ROSWOO c.t.** and a mixture of communities with *A. incana*, *R. woodsii*, and *P. pratensis*.

Plant communities along these reaches are stable and represent the best riparian conditions within the Trout Creek basin. Dense shrubby thickets and the steep terrain preclude access to most of the stream channel. Only minor disturbance from livestock grazing was observed along the edges of the riparian zone in small open areas large enough to accommodate animals.

Low-Elevation Moderate V-shaped Valley. Of the 13 reaches sampled in this valley bottom type, seven are dominated by *S. lasiandra* or *S. lutea*, and six by *A. incana*. Four were located within the seven-year old exclosures along Willow Creek and three others within the 13-year old Little Whitehorse Creek exclosures. The mean number of community types is greater in this valley bottom setting than in higher elevation reaches (Table 2-8). This corresponds with the increasing complexity of valley bottom landforms.

Several community types are repeatedly associated across sample reaches. On alder dominated reaches the **ALNINC-ROSWOO c.t., ALNINC/POAPRA c.t., ALNINC/CARLAN c.t., ROSWOO c.t., ROSWOO/POAPRA c.t.**, and **POAPRA c.t.** are commonly associated (Table 2-8, Table 2-9). The proportional occurrence of each type varies, and not all community types may be present on all reaches. Similar associations occur in the *Salix* dominated areas. Here the commonly co-occurring community types include **SALLAS-ROSWOO c.t., SALLAS/POAPRA c.t., ROSWOO c.t.**, and the **POAPRA c.t.**.

Factors distinguishing between sites dominated by *Alnus* or *Salix* are not clear. Geomorphic and environmental features are very similar for both overstory types, and no significant differences were detected which might explain distributional differences. Mature individuals and seedlings of *A. incana* and *S. lasiandra* were observed growing together in mixed populations.

Chance events may determine whether *Alnus* or *Salix* colonize and eventually occupy a site. The sequence of events in disturbance driven riparian ecosystems is unpredictable. Climatic cycles influence the patterns and magnitude of fluvial disturbance. Flooding events often are responsible for the creation of the open moist surfaces necessary for seed germination in members of the Salicaceae, including *Salix* spp. and *Populus* spp. (Everitt 1968, McBride and Strahn 1984). The timing of suitable microsites for establishment must coincide with available propagules. Autecological and phenological differences in species also contribute to the potential scenarios of chance events.

Salix spp. typically reproduce by seed or vegetatively by sprouting. The small seed has a pappus which enables the wind to disperse it over great distances. Beaver play an important role in the vegetative spread of willow in these reaches. Small stems cut for dams are commonly carried downstream by the channel, where they become lodged in a gravel bar or along the banks. Many of these vegetative propagules sprout and give rise to new individuals. In addition, many *Salix* spp. are well known for their ability to resprout following cutting by beaver or burial (Krasney 1986).

Reproduction of *A. incana* may be in the form of seed, winter buds, or viable vegetative fragments. Seed reproduction appears to be the most important form of recruitment in our study area. The seed of *A. incana* mature in the fall and are slowly dispersed from the strobiles through the fall and winter period (Schopmeyer 1974). Many of these seeds fall directly into the water and are transported downstream. In some locations *Alnus* seedlings were observed to grow on the same sites as *Salix* seedlings. In addition, *Alnus* seedlings were commonly observed along gently sloping banks at a level equivalent to high water flows (Fig. 2-12)

Plant age is also important in survival, and seedlings are often more susceptible to widely fluctuating environmental conditions than older individuals. In general, life history strategies for the common riparian species in the Trout Creek Mountains are poorly understood

The livestock exclosures in this valley bottom type provide an excellent opportunity to examine successional pathways. The most advanced stages of riparian recovery are present in the 13-year old Little Whitehorse Creek exclosure. The eight-year old exclosures along Willow Creek are in intermediate stages of recovery, between the older exclosure and presently grazed sites. The **CARLAN c.t.** was prominent in all of the exclosures. Within the oldest exclosure the **CARLAN c.t.** provides the dominant streambank cover (Fig. 2-13). The rhizomatous *C. lanuginosa* provides the structure necessary for rebuilding of banks. This sedge is present in grazed areas but with very low cover.

It appears that as water tables are restored on the excluded sites that *C. lanuginosa* is replacing *P. pratensis* in moist positions. Rising water tables in the oldest exclosure are evidenced by the presence of dying *A. tridentata* on streamside terraces. Communities dominated by *Elymus triticoides* and *P. pratensis* are beginning to replace sites formerly occupied by *A. tridentata* and *B. tectorum*. *Poa pratensis* is likely to continue as an important component on recovering sites. *Deschampsia caespitosa* was probably more abundant along these reaches at one time, but presently occurs in trace amounts.

Beaver presently occupy the lower reaches of Willow Creek and play an important role in succession. It appears that beaver have been absent for several years within the Little Whitehorse Creek exclosure, but were recolonizing the area again in 1987. Dam construction by beaver regulates water table levels in these reaches and influences vegetation patterns.

The numerous beaver dams inside and outside the exclosures along Willow Creek cause silt accumulation. These deposits become exposed surfaces when the dams are abandoned, and serve as establishment sites for *Salix* (Fig. 2-14). The **SCIMIC c.t.** and **ELEPAL c.t.** are early successional communities occupying these silt deposits. Although these two community types were only sampled inside the exclosures, they occur in minor amounts along the

Figure 2-12. Seedlings of alder (*Alnus incana*) which established in dense vegetation along the high water line of Willow Creek.

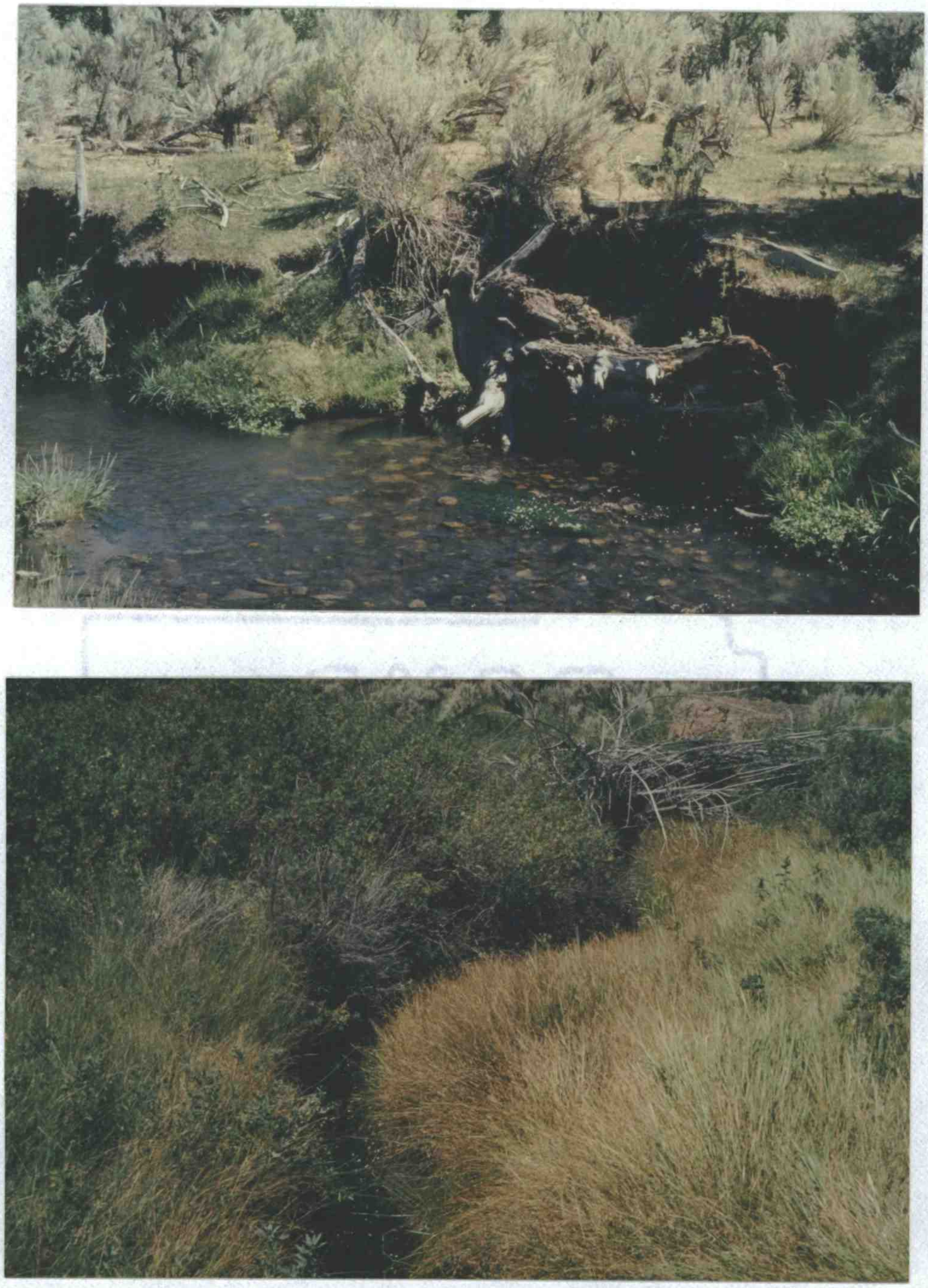

Figure 2-13. The upper photograph shows an example of highly eroded stream banks, dominated by Kentucky bluegrass (*Poa pratensis*), along grazed section of Willow Creek. The lower photograph shows recovered streambanks along a section of Little Whitehorse Creek, excluded from livestock grazing for 13 years. Dominant bank vegetation shown here is the *Carex lanuginosa c.t.*, with the *Rosa woodsii c.t.* in the background.

grazed reaches. Along the grazed reaches succession on these fragile silt deposits is interrupted by extensive trampling. Inside the exclosures, in the absence of trampling these communities are allowed to develop. For the same reason, *Salix* seedlings are also more likely to survive on these surfaces along ungrazed reaches. Another bank species which appears to increase with advancing stages of succession is *Cicuta douglasii*, which was observed in the oldest exclosure.

At the lower end of the oldest exclosure where beaver have been absent for many years, few open areas suitable for colonization by *Salix* exist. Although several old dead willow are present few living ones were observed, and *A. incana* is the main overstory species increasing on this site. Possible explanations for the dominance by *Alnus* are many. Perhaps propagules for *Salix* were unavailable when open establishment sites were present. If the herbaceous cover closed in during an early stage of succession *Salix* may have been precluded in this manner. Seed of *Alnus* do not appear to have the same strict requirements for non-shady, open surfaces like *Salix*, and may have been successful finding microsites for establishment (Fig. 2-14).

Many willows, for example *S. lasiandra*, are extremely long-lived and do not need to reproduce frequently in order to survive. These species have developed many strategies to survive in the unpredictable riparian environment. This includes a low investment of resources in seed production. Large numbers of extremely small, short-lived seed are produced every year. Perhaps this strategy increases the chance of seed encountering suitable substrates.

One woody species which has not been successful in maintaining regenerating populations along these reaches is *Populus trichocarpa*. Remnants of old cottonwood were observed along all four streams in this valley bottom setting, although few living trees were observed. Their historical extent in this area is unknown, but there is no question that they occupied the lower stream reaches. It is likely that early settlers utilized thee trees as a source of wood, greatly depleting their numbers. The lack of available propagules and possibly the lack of appropriate establishment sites has been responsible for its decline. Successful recruitment of similar species of cottonwood are dependent on flooding sequences. Bradley and Smith (1986) found that recruitment leading to long-term survival of cottonwood along the Milk River in northern Montana was related to flow patterns during seed dispersal. Flood events attaining a

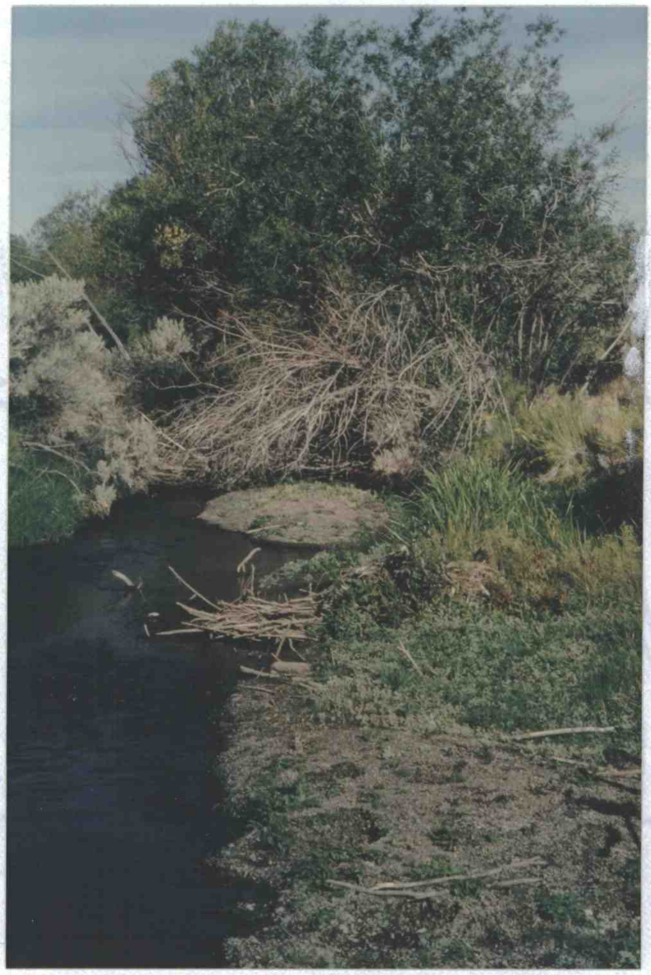

Figure 2-14. View of Willow Creek inside a livestock exclosure. A breached beaver dam, located at the base of the large willow (*Salix lutea*) has exposed sediment upstream. When combined with adequate soil moisture, this sediment provides important sites for willow (*Salix* spp.) establishment.

stage greater than the 2-year return flood, during the dispersal period correlated with cottonwood recruitment.

The diversification of age class structure in *Alnus* and *Salix* populations was evident throughout the exclosures along Willow Creek and Little Whitehorse Creek. Individuals representing younger age classes are prevalent of these sites. Similar trends were not observed along the grazed reaches which were comprised almost entirely of old individuals. A study of *Salix* and *Populus* in central Oregon riparian exclosures document significant differences in population structure between pre-exclusion and post-exclusion populations (Busse 1988). This study concluded that exclusion of livestock grazing is the only proven method of maintaining the habitats necessary to support the continued existence of these Salicaceous species.

Communities dominated by *Rosa woodsii* are also prevalent in this valley bottom setting and occur in both the grazed and ungrazed setting. Drier microsites brought about by grazing disturbances tend to favor this species. The **ROSWOO c.t.** may have been a component of the vegetative mosaic in pre-settlement times. Its extent, however, is likely to have increased with livestock grazing.

Low-elevation Broad V-shaped Valley. Wider valley bottoms associated with this type support wider riparian zones and more mesic environments than the narrower types. Sidehill springs were associated with all three sample reaches and result in high soil moisture levels on the floodplains. One sampled reach is grazed and another is located in the Little Whitehorse Creek Exclosure. The third is located in a special management pasture along Little Trout Creek from which hay is harvested and in which light grazing occurs during the fall.

The drier portions of these reaches support community type aggregations similar to the low-elevation moderate v-shaped valleys. Included in this group are the **SALLAS/ROSWOO c.t.**, **SALLAS/POAPRA c.t.**, **ROSWOO c.t.**, and **POAPRA c.t.**. More mesic positions support the **ELEPAL c.t.**, **SCIMIC c.t.**, **CARLAN c.t.**, and stands of *Elymus triticoides*, or *Carex nebrascensis*. This valley bottom type was the only location where the **SALEXI/MGF c.t.** and the **SALLUT/MG c.t.** were sampled.

Successional relationships in this valley bottom setting would be similar to the low-elevation moderate v-shaped valleys just discussed. Streambanks in the ungrazed and lightly grazed reach were again densely sodded with *C.*

lanuginosa, *S. microcarpos*, and *Cicuta douglasii*. Dense bank vegetation has resulted in aggrading floodplain features and the channel is confined to a narrow course through these meadows. Neither the **CARLAN c.t.** nor the **SCIMIC c.t.** occurred along the grazed reach.

Signs of past beaver occupation are evident along all three reaches. Current activity was not observed in the protected reach, but a recently abandoned dam was present along the grazed reach.

Braided Broad Valley. Community types occurring in this valley bottom setting are similar to the two previously discussed low elevation types (Table 2-8). *Salix lasiandra* forms the dominant overstory in this reach. The **POAPAL c.t.** is also an important component of the vegetation mosaic.

Gravel bars and point bars are an especially prominent feature in this valley. Active recruitment of *S. lasiandra* and *S. lutea* were observed to be associated with these surfaces. If propagules of *P. trichocarpa* were available, these point bars would likely serve as excellent establishment sites.

In the absence of livestock grazing, it is thought that the complexity of this low gradient reach would increase. Structure provided by increasing cover in woody and herbaceous species would interact with fluvial processes, and reshape the floodplain. Changes might include creation of more backwater areas, and a more diverse community mosaic. Past beaver activity was evident along this reach and such activities are an important component of reach complexity.

On moist and protected portions of gravel bars isolated bunches of *D. caespitosa* were observed. It is likely that this species was much more prominent in this valley bottom setting in the past.

CONCLUSION

The identification of valley bottom types in the riparian setting of the Trout Creek Mountains provides a useful framework for analyzing the composition, structure, and function of these ecosystems. Distinct patterns of vegetation occurrence were documented within valley bottom types. These vegetation patterns are in turn related to unique physical environments and disturbance regimes associated with each valley bottom type. Although some patterns of association between vegetation and geomorphic surface were observed, these relationships were not as predictable as with valley bottom types. Management implications of this study are discussed in the following section.

MANAGEMENT IMPLICATIONS AND CONCLUSION

This study describes riparian vegetation ecology of the Trout Creek Mountains. Identification of valley bottom types is a useful way of stratifying the complex and variable floodplain setting and associated vegetative mosaics along the study area streams. Distinct patterns of riparian plant species and community type distribution were observed within and across these types.

The goal of riparian management in the Trout Creek Mountains should be to restore riparian ecosystems. The functions of vegetation in these systems are many. One example of vegetation function is the aboveground plant biomass present at the end of the growing season and when runoff occurs in the spring. The physical structure of this vegetation provides resistance during periods of high flow, and results in the deposition of sediment. Through this process, banks are constructed and the stream channel becomes narrower and deeper. As these environments change, so does the vegetation. Water table levels rise as banks are rebuilt, and vegetation composition moves toward more mesic species and communities. Values which may be derived through this recovery process include improved fish and wildlife habitat, erosion control, increased retention of water in streambanks, and better water quality.

The highly degraded condition of riparian areas was evident in all but one of the valley bottom types described. Only the very steep-narrow v-shaped valleys support riparian areas were judged to be in good condition. These steep tributaries represent a very small proportion of the total riparian areas found in this mountain range. All other stream reaches are gentler and more accessible to livestock and beaver.

Along grazed reaches, highly disturbed conditions were evidenced by the abundance of eroding, unvegetated streambanks, and by the frequent occurrence of disturbance induced riparian plant communities. Many plant species classed as introduced, invaders, and increasers are also characteristic of these reaches.

Size class distribution of woody riparian species is heavily skewed toward the largest and oldest individuals. Smaller size classes and younger individuals are conspicuously under-represented. Regeneration and recruitment of new individuals presently appears to be inadequate to maintain self-perpetuating populations for many of the woody species. This trend is particularly evident in *Populus trichocarpa*.

The ability of disturbed riparian settings to recover wnen excluded from livestock grazing has been demonstrated by the vegetation development inside the exclosures along Willow Creek and Little Whitehorse Creek. Natural functions of riparian vegetation have been restored with rest from livestock grazing.

Recruitment of woody species is also improved with exclusion of grazing. Gravel bars and silt deposits are typical establishment sites for salicaceous species. These surfaces are especially susceptible to trampling and grazing damage due to their close proximity to the stream channel. Although the combined effects of beaver and cattle have been observed to be detrimental to woody species development, beaver alone may benefit the perpetuation of woody plant populations. Silt accumulations behind dams become future establishment sites for willows. In addition, vegetative propagules of willow and other species are made available for dispersal downstream.

Land managers are faced with the challenge of improving riparian condition in these areas. To succeed in this endeavor, they will need to understand the complexity and dynamic nature of these ecosystems. Goals, such as the restoration of woody species cover along stream channels, are admirable, but are doomed to failure if they are not addressed within an ecosystem context. The extremely high failure rate of artificial plantings of willow and other riparian species may be attributed to a lack of knowledge concerning individual species ecology and an understanding of the ecosystem. More autecological studies, such as one recently conducted on willows and cottonwood in central Oregon (Busse 1988) are greatly needed.

Total exclusion of livestock, as evidenced by the exclosures, is an effective means of restoring natural functions to the riparian ecosystem. It is realized, however, that this method of management is not often feasible. In order to meet the goal of improved riparian condition, natural functions of these ecosystems will need to be restored. This will require significant changes in management strategies and ones that will include flexibility and periods of rest. The complex nature of the riparian setting will naturally require more complex management and therefore larger commitments of time and resources from the land manager.

Due to the highly degraded riparian condition along streams in the Trout Creek Mountains, it is recommended that significant periods of rest be incorporated into into the management scheme for all areas. Some areas may require several years of rest to restore natural processes to the point that controlled grazing systems may be implemented without adverse effects.

Vegetation management is the key to the recovery of riparian ecosystems. Woody and herbaceous species are equally important since they fulfill different functional roles. Aboveground biomass of herbaceous species must be present at the end of the growing season to provide the physical structure necessary for filtering sediments during spring runoff. Management schemes must incorporate adequate periods of regrowth or restrict levels of utilization to meet this function.

Fluvial processes in these systems are inherently tied to climatic patterns. This results in variable and unpredictable sequences of events. If grazing is to continue as part of the management scheme in these riparian areas, then flexibility in management is absolutely critical.

For example, studies have documented that recruitment cycles of long-lived species of willow and cottonwood are correlated with large flooding events. It appears that large floods, such as those which occurred in spring of 1983 and again in 1984 are important to the recruitment of woody species along streams of the Trout Creek Mountains. These large magnitude floods were sufficient to reset the valley bottom floor along many reaches resulting in many exposed low-lying gravel bars and mineral surfaces. The creation of these new surfaces coincided with seed dispersal in *S. lasiandra* and *S. lutea* and adequate moisture for germination. Many young willow saplings were observed on such surfaces, especially in the braided reach along Big Trout Creek (BTC 9). The age of these willow correlated with the floods of 1984. A series of years with below average snowfall followed this 100-year flood event. This sequence provided favorable environments for willow establishment. Very young willow are susceptible to extended periods of anaerobic conditions brought about by inundation. The absence of devastating spring runoff following recruitment of these willows provided the necessary conditions for establishment. Tolerance to flooding and anaerobic conditions increase with age in many woody riparian species.

Managers interested in improving the population structure of woody riparian species need to key into these natural cycles. Periods of rest should be implemented when these naturally occurring recruitment cycles are in effect. Flexibility to provide this rest at appropriate times needs to be part of the management scheme.

Planting of willows, cottonwood, or other woody riparian species is not highly recommended, as most of these efforts meet with failure. If planting is to occur, periods of rest from grazing should be provided to allow increased chances of establishment. Care should be taken in considering species adaptability to the site, and the appropriate locations to plant in relation to streamflow and water tables. If artificial planting is to be implemented this study provides distributional information which can serve as guidelines for selection of appropriate species.

The riparian exclosures of the study area serve as valuable reference areas, demonstrating site potential and providing opportunities to understand the natural processes operating in these ecosystems. It is strongly recommended that exclosures or special management pastures be established for each of the valley bottom types, particularly at higher elevations. Such reference areas are invaluable to the land manager and scientist alike, and are necessary to further understanding of the structure and function of riparian ecosystems.

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APPENDICES

APPENDIX A

RIPARIAN PLANT SPECIES LIST FOR THE TROUT CREEK MOUNTAIN RIPARIAN STUDY AREA

Appendix A. Riparian plant species list for the Trout Creek Mountain Study Area. (*species with an asterix were present in study plots).

Scientific Name	Common Name	Alpha Code
APIACEAE (Parsley Family)		
*Cicuta douglasii (DC.)Coult.&Rose	Douglas' water-hemlock	CICDOU
*Heracleum lanatum Michx.	Cow parsnip	HERLAN
*Ligusticum grayi Coult.&Rose	Gray's Licorice-root	LIGGRA
*Osmarhiza chilensis H.& A.	Mountain Sweet-root	OSMCHI
*Osmarhiza occidentalis (Nutt.)Torr.	Sweet Anise	OSMOCC
ASTERACEAE (Sunflower Family)		
*Achillea millifolium L.	Common yarrow	ACHMIL
*Agoseris glauca (Pursh)Raf.	Pale Agoseris	AGOGLA
*Antennaria microphylla Nutt.	Rosy Pussytoes	ANTMIC
Arnica amplexicaulis Nutt.	Clasping Arnica	ARNAMP
*Arnica longifolia D.C. Eat.	Longleaf Arnica	ARNLON
*Artemisia ludoviciana Nutt.	Western Mugwort	ARTLUD
*Artemisia tridentata Nutt.	Big Sagebrush	ARTTRI
*Aster foliaceous Lindl.	Leafy Aster	ASTFOL
*Aster spp.	Aster	ASTERX
Chaenactis douglasii (Hook.)H.& A.	Douglas Chaenactis	CHADOU
*Chrysothamnus nauseosus (Pall.)Britt.	Gray Rabbitbrush	CHRNAU
*Chrysothamnus viscidiflorus (Hook.)Nutt.	Green Rabbitbrush	CHRVIS
*Cirsium sp.	Thistle	CIRSIU
*Cirsium vulgare (Savi)Tenore	Bull Thistle	CIRVUL
*Conyza canadensis (L.)Cronq.	Horseweed	CONCAN
*Gnaphalium palustre Nutt.	Lowland Cudweed	GNAPAL
Haplopappus hirtus Gray	Sticky Goldenweed	HAPHIR
*Iva axillaris Pursh	Deep-root Povertyweed	IVAAXI
*Lactuca serriola L.	Prickly Lettuce	LACSER
*Madia spp.	Tarweed	MADIAX
*Microseris troximoides Gray	False Agoseris	MICTRO
*Senecio canus Hook.	Woolly Groundsel	SENCAN
*Senecio hydrophilus Nutt.	Alkali-marsh Butterweed	SENHYD
*Senecio integerrimus Nutt.	Western Groundsel	SENINT
*Senecio serra Hook.	Tall Groundsel	SENSER
*Solidago canadensis L.	Meadow Goldenrod	SOLCAN
*Sonchus asper (L.)Hill	Prickly Sowthistle	SONASP

*Sonchus spp.	Sowthistle	SONCHU
*Taraxacum officinale Weber	Common Dandelion	TAROFF
*Tragypogon dubius Scop.	Goatsbeard	TRADUB
Xanthium strumarium L.	Cocklebur	XANSTR

BETULACEAE (Birch Family)

*Alnus incana (L.)Moench	Mountain Alder	ALNINC

BORAGINACEAE (Borage Family)

*Asperugo procumbens L.	Madwort	ASPPRO
*Cryptantha echinella Greene	Prickly Cryptantha	CRYECH
*Cryptantha torreyana (Gray)Greene	Torrey's Cryptantha	CRYTOR
*Mertensia ciliata (Torr.)G.Don	Mountain Bluebell	MERCIL
*Mertensia cusickii	Bluebell	MERCUS
Myosotis micrantha Pall.	Blue Scorpion-grass	MYOMIC
*Plagiobothrys scouleri (H.& A.)Johnst.	Scouler's Popcorn Flw.	PLASCO

BRASSICACEAE (Mustard Family)

*Alyssum desertorum Stapf	Desert Alyssum	ALYDES
*Arabis glabra (L.)Bernh.	Towermustard	ARAGLA
*Arabis sparsiflora Nutt.	Sicklepod Rockcress	ARASPA
*Barbarea orthoceras Ledeb.	Wintercress	BARORT
*Camelina microcarpa Andrz.	Littlepod Falseflax	CAMMIC
*Capsella bursa-pastoris (L.)Medic.	Shepherd's-purse	CAPBUR
*Cardamine breweri Wats.	Brewer's Bittercress	CARBRW
*Cardamine pensylvanica Muhl.	Fewseeded Bittercress	CARPEN
*Chorispora tenella (Pall.)DC.	Blue Mustard	CHOTEN
*Descurania pinnata (Walt.)Britt.	Pinnate Tansy-mustard	DESPIN
*Erysimum inconspicuum (Wats.)MacM.	Smallflowered Rocket	ERYINC
*Lepidium perfoliatum L.	Clasping Pepperweed	LEPPER
*Rorippa nasturtium-aquaticum (L.)Schinz &Thell.	Watercress	RORNAS
Rorippa curvisiliqua (Hook.)Bessey var. lyrata (Nutt.)Peck		RORCUV
*Rorippa obtusa (Nutt.)Britt.	Bluntleaved Yellowcress	ROROBT
*Sisymbrium altissimum L.	Tumble Mustard	SYSALT
Thlaspi arvense L.	Field Pennycrest	THLARV

CAPRIFOLIACEAE (Honeysuckle Family)

Sambucus cerulea Raf.	Blue Elderberry	SAMCER
*Symphoricarpos oreophilus Gray	Mountain Snowberry	SYMORE

CARYOPHYLLACEAE

*Arenaria laterifolia L.	Bluntleaf Sandwort	ARELAT
*Arenaria serphillifolia L.	Thymeleaf Sandwort	ARESER
*Cerastium nutans Raf.	Chickweed	CERNUT
*Sagina saginoides (L.)Britt.	Pearl Wort	SAGSAG
*Silene menziesii Hook. var. viscosa (Greene)Hitchc. & Mag.	Menzies' Silene	SILMEN
*Stellaria jamesiana Torr.	Sticky Starwort	STEJAM
*Stellaria longipes Goldie.	Longstalk Starwort	STELON
*Stellaria spp.	Starwort	STELLA
*Stellaria umbellata Turcz.	Umbellate Starwort	STEUMB

CHENOPODIACEAL (Goosefoot Family)

Atriplex spp.	Atriplex	ATRIPL
Chenopodium fremontii Wats.		CHEFRE
*Chenopodium spp.	Goosefoot	CHENOP

CORNACEAE

*Cornus stolonifera Michx.	Red-osier dogwood	CORSTO

CYPERACEAE

*Carex athrostachya Olney	Slender-beaked Sedge	CARATO
*Carex aurea Nutt.	Golden Sedge	CARAUR
*Carex douglasii Boott	Douglas' Sedge	CARDOU
*Carex lanuginosa Michx.	Woolly Sedge	CARLAN
*Carex microptera Mack.	Smallwinged Sedge	CARMIC
*Carex nebrascensis Dewey	Nebraska Sedge	CARNEB
*Carex praegracilis W.Boott	Silver Sedge	CARPRA
*Carex scopulorum Holm	Rocky Mountain Sedge	CARSCO
*Eleocharis palustris (L.)R.& S.	Creeping Spikerush	ELEPAL
*Eleocharis pauciflora (Lightf.)Link	Few-flowered Spikerush	ELEPAU

*Scirpus americanus Pers.	Three-square Bulrush	SCIAMR
*Scirpus microcarpos Presl.	Small Fruit Bulrush	SCIMIC

ELAEAGNACEAE (Oleaster Family)

Elaeagnus angustifolia L.	Russian Olive	ELAANG
Sheperdia argentea (Pursh)Nutt.	Buffalo-berry	SHEARG

EQUISETACEAE (Horsetail Family)

*Equisetum arvense L.	Field Horsetail	EQUARV
*Equisetum laevigatum A.Br.	Smooth Scouring-rush	EQULAE

EUPHORBIACEAE (Spurge Family)

Euphorbia glyptosperma Engelm.		EUPGLY

FABACEAE (Pea Family)

*Lupinus spp.	Lupine	LUPINU
*Thermopsis montana Nutt. v. montana	Mountain Thermopsis	THEMON
*Trifolium cyanthiferum Lindl.	Cup Clover	TRICYA
*Trifolium longipes Nutt.	Long-stalked Clover	TRILON
Trifolium repens L.	White Clover	TRIREP
*Trifolium spp.	Clover	TRIFOL
*Trifolium wormskjoldii Lehm.	Springbank Clover	TRIWOR
*Vicia villosa Roth	Hairy Vetch	VICVIL

GERANIACEAE

*Erodium cicutarium (L.)L'Her.	Filaree	EROCIC
*Geranium carolinianum L.	Carolina Geranium	GERCAR
*Geranium oreganum Howell.	Oregon Geranium	GERORE
*Geranium spp.	Geranium	GERANI
Geranium viscosissimum F.& M.	Sticky Geranium	GERVIS

GROSSULARIACEAE (Currant Family)

*Ribes aureum Pursh	Golden Currant	RIBAUR
*Ribes cereum Dougl.	Wax Currant	RIBCER
*Ribes hudsonianum Richards.	Hudson Bay Currant	RIBHUD
*Ribes lacustre (Pers.)Poir.	Swamp Currant	RIBLAC
*Ribes spp.	Currant	RIBESX

HYDROPHYLLACEAE (Waterleaf Family)

*Hydrophyllum capitatum Dougl.	Ballhead Waterleaf	HYDCAP
*Hydrophyllum fendleri (Gray)Heller	Fendler's Waterleaf	HYDFEN
*Nemophila breviflora Gray	Great Basin Nemophila	NEMBRE
*Nemophila pedunculata Dougl.	Meadow Nemophila	NEMPED
*Phacelia inconspicua	Phacelia	PHAINO

HYPERICACEAE

*Hypericum formosum H.B.K.	Western St. John's-wort	HYPFOR

IRIDACEAE

Iris missouriensis Nutt.	Rocky Mountain Iris	IRIMIS

JUNCACEAE (Rush Family)

*Juncus balticus Willd.	Baltic Rush	JUNBAL
*Juncus bufonis L.	Toad Rush	JUNBUF
*Juncus confusus Cov.	Colorado Rush	JUNCON
*Juncus ensifolius Wikst.	Swordleaf Rush	JUNENS
*Juncus mertensianus Bong.	Merten's Rush	JUNMER

LABIATAE (Mint Family)

*Agastache urticifolia (Benth.)Kuntze	Horsemint	AGAURT
Marrubium vulgare L.	Horehound	MARVUL
*Mentha arvensis L.	Field Mint	MENARV
*Scutellaria antirrhinoides Benth.	Snapdragon Skullcap	SCUANT

LEMNACEAE (Duckweed Family)

*Lemna minor L.	Duckweed	LEMMIN

LILIACEAE

*Allium bisceptrum Wats.	Palmer's Onion	ALLBIS
*Smilacina stellata (L.)Desf.	Starry Solomon-plume	SMISTE
*Veratrum californicum Durand	False Hellebore	VERCAL

LIMNANTHACEAE (Meadow-foam Family)

*Floerkea proserpinacoides Willd.	False-mermaid	FLOPRO

LOASACEAE (Blazing-star Family)

*Mentzelia dispersa Wats.	Bushy Mentzelia	MENDIS

MALVACEAE

*Sildalcea oregana (Nutt.)Gray var. maxima (Peck)Hitchc. Sidalcea		SIDORE

ONAGRACEAE (Evening primrose Family)

*Boisduvalia densiflora (Lindl.)Wats.	Dense Spike-primrose	BOIDEN
*Circaea alpina L.	Enchanter's Nightshade	CIRALP
*Epilobium alpinum L.	Alpine Willow-herb	EPIALP
*Epilobium glaberrimum Barbey	Smooth Willow-herb	EPIGLA
*Epilobium minutum Lindl.	Small-flw Willow-herb	EPIMIN
*Epilobium paniculatum Nutt.	Autumn Willow-herb	EPIPAN
*Epilobium watsonii Barbey	Watson's Willow-herb	EPIWAT
*Gayophytum racemosum T.& G.	Racemed Groundsmoke	GAYRAC
*Oenothera tanacetifolia T.& G.	Tansy-leaf Evening Primrose	OENTAN
Oenothera spp.	Evening Primrose	OENOTH

OPHIOGLOSSACEAE (Adder's-tongue Family)

**Botrychium simplex* E.Hitchc.	Little Grape-fern	BOTSIM

PLANTAGINACEAE (Plantain Family)

**Plantago major* L.	Rippleseed Plantain	PLAMAJ

POACEAE (Grass Family)

Agropyron caninum (L.)Beauv.	Bearded Wheatgrass	AGRCAN
Agropyron cristatum (L.)Gaertn.	Crested Wheatgrass	AGRCRI
**Agropyron repens* (L.)Beauv.	Quackgrass	AGRREP
**Agropyron trachycaulum*	Slender Wheatgrass	AGRTRA
**Agrostis oregonensis* Vasey	Oregon Bentgrass	AGRORE
**Agrostis stolonifera*	Redtop	AGRSTO
**Agrostis scabra* Willd.	Rough Bentgrass	AGRSCA
**Agrostis* spp.	Bentgrass	AGROST
**Agrostis exarata* Trin.	Spike Bentgrass	AGREXA
**Alopecurus aequalis* Sobol.	Short-awn Foxtail	ALOAEQ
**Alopecurus pratensis* L.	Meadow Foxtail	ALOPRA
**Arrhenatherum elatius* (L.)Presl.	Tall Oatgrass	ARRELA
**Bromus anomalus* Rupr.	Nodding Brome	BROANO
**Bromus carinatus* H.& A.	Mountain Brome	BROCAR
**Bromus commutatus* Schrad.	Meadow Brome	BROCOM
**Bromus tectorum* L.	Cheatgrass	BROTEC
**Deschampsia cespitosa* (L.)Beauv.	Tufted Hairgrass	DESCES
Deschampsia danthonoides (Trin.)Munro	Annual Hairgrass	DESDAN
**Deschampsia elongata* (Hook.)Munro	Slender Hairgrass	DESELO
Elymus glaucus Buckl.	Blue Wildrye	ELYGLA
**Elymus cinereus* Scribn.& Merr.	Basin Wildrye	ELYCIN
**Elymus triticoides* Buckl.	Creeping Wildrye	ELYTRI
**Festuca idahoensis* Elmer.	Idaho Fescue	FESIDA
**Festuca microstachys* Nutt.	Small Fescue	FESMIC
**Festuca rubra* L.	Red fescue	FESRUB
**Glyceria elata* (Nash)Jones	Tall Mannagrass	GLYELA
**Glyceria grandis* Wats.	American Mannagrass	GLYGRA
**Glyceria striata* (Lam.)Hitchc.	Fowl Mannagrass	GLYSTR
**Hordeum brachyantherum* Nevski	Meadow Barley	HORBRA
**Muhlenbergia asperifolia* (Nees & Meyen)Parodi	Alkali Muhly	MUHASP
**Muhlenbergia filiformis* (Thurb.)Rydb.	Pullup Muhly	MUHFIL
**Muhlenbergia richardsonis* (Trin.)Rydb.	Mat Muhly	MUHRIC
**Phleum alpinum* L.	Alpine Timothy	PHLALP

*Phleum pratense L.	Timothy	PHLPRA
*Poa annua L.	Annual Bluegrass	POAANN
*Poa bulbosa L.	Bulbous Bluegrass	POABUL
Poa nevadensis Vasey	Nevada Bluegrass	POANEV
*Poa palustris L.	Fowl Bluegrass	POAPAL
*Poa pratensis L.	Kentucky Bluegrass	POAPRA
*Poa sandbergii Vasey	Sandberg's Bluegrass	POASAN
Poa trivialis L.	Roughstalk Bluegrass	POATRI
Polypogon monospeliensi (L.)Desf.	Rabbitsfoot Grass	POLMON
*Sitanion hystrix (Nutt.)Smith	Squirreltail	SITHYS
Stipa commata Trin.& Rupr.	Needle-and-thread Grass	STICOM
*Stipa occidentalis Thurb.	Western Needlegrass	STIOCC
*Stipa thurburiana Piper	Thurber Needlegrass	STITHU
*Trisetum spp.	Trisetum	TRISET

POLYGONACEAE (Knotweed Family)

*Polygonum aviculare L.	Prostrate Knotweed	POLAVI
*Polygonum bistortoides Pursh	American Bistort	POLBIS
*Polygonum confertifolium Nutt.	Close Flowered Knotweed	POLCOF
*Polygonum douglasii Greene	Douglas' Knotweed	POLDOU
*Polygonum majus (Meisn.)Piper	Wiry Knotweed	POLMAJ
*Rumex acetosella L.	Sheep Sorrel	RUMACE
Rumex crispus L.	Curl Dock	RUMCRI
*Rumex spp.	Dock	RUMEXX

POLEMONIACEAE

*Collomia grandiflora Dougl.	Large-flowered Collomia	COLGRN
*Collomia linearis Nutt.	Narrow-leaved Collomia	COLLIN
*Linanthus septentrionales Mason	Northern Linanthus	LINSEP
*Microsteris gracilis (Hook.)Greene	Pink Microsteris	MICGRA
*Navaretia breweri (Gray)Greene	Brewer's Navarretia	NAVBRE
*Polemonium micranthum Benth.	Littlebells Polemonium	POLMIC

PORTULACACEAE

*Montia chamissoi (Ledeb.)Robins.& Fern.	Water Montia	MONCHA
*Montia perfoliata (Donn)Howell	Miner's Lettuce	MONPER

PRIMULACEAE (Primrose Family)

*Glaux maritima L.	Saltwort	GLAMAR

RANUNCULACEAL (Buttercup Family)

*Aconitum columbianum Nutt.	Monkshood	ACOCOL
*Aquilegia formosa Fisch.	Sitka Columbine	AQUFOR
*Clematis ligusticifolia Nutt.	White Virgin's Bower	CLELIG
*Ranunculus aquatilis L.	Water Buttercup	RANAQU
*Ranunculus cymbalaria Pursh	Shore Buttercup	RANCYM
*Ranunculus macounii Britt.	Macoun's Buttercup	RANMAC
*Ranunculus sceleratus L.	Blister Buttercup	RANSCE
*Ranunculus testiculatus Crantz	Bur Buttercup	RANTES
*Thalictrum occidentale Gray	Western Meadowrue	THAOCC

ROSACEAE (Rose Family)

*Amelanchier alnifolia Nutt.	Serviceberry	AMEALN
*Geum macrophyllum Willd.	Large Leaved Avens	GEUMAC
Holodiscus dumosus (Hook.)Heller	Ocean-spray	HOLDUM
*Potentilla biennis Greene	Biennial Cinquefoil	POTBIE
*Potentilla glandulosa Lindl.	Sticky Cinquefoil	POTGLA
*Potentilla gracilis Dougl.	Northwest Cinquefoil	POTGRA
*Prunus virginiana L.	Choke-cherry	PRUVIR
*Rosa woodsii Lindl.	Wood's Rose	ROSWOO
*Sibbaldia procumbens L.	Creeping Sibbaldia	SIBPRO

RUBIACEAE (Madder Family)

*Galium aparine L.	Goose-grass	GALAPA
*Galium asperrimum Gray	Rough Bedstraw	GALASP
*Galium bifolium Wats.	Twinleaf Bedstraw	GALBIF
*Galium triflorum Michx.	Sweetscented Bedstraw	GALTRI

SALICACEAE (Willow Family)

*Populus tremuloides Michx.	Aspen	POPTRE
Populus trichocarpa T.& G.	Black Cottonwood	POPTRI
*Salix boothii	Blueberry Willow	SALBOO
*Salix exigua Nutt.	Coyote Willow	SALEXI

*Salix geyeriana Anderss.	Geyer's Willow	SALGEY
*Salix lasiandra Benth. var. caudata (Nutt.)Sudw.	Pacific Willow	SALLAS
*Salix lemmonii Bebb	Lemmon's Willow	SALLEM
*Salix lutea	Yellow Willow	SALLUT
*Salix scouleriana Barratt	Scoulers' Willow	SALSCO

SAXIFRAGACEAE

Lithophragma parviflorum (Hook.)Nutt.	Smallflower Fringecup	LITPAR
*Saxifraga arguta D.Don	Brook Saxifrage	SAXARG

SCROPHULARIACEAE (Figwort Family)

*Collinsia parviflora Lindl.	Blue-eyed Mary	COLPAR
*Mimulus guttatus DC.	Common Monkeyflower	MIMGUT
Mimulus floribundus Lindl.	Purple-stem Monkeyflower	MIMFLO
*Mimulus primuloides Benth.	Primrose Monkeyflower	MIMPRI
Penstemon rydbergii A.Nels.	Rydberg's Penstemon	PENRYD
*Scrophularia lanceolata Pursh	Lance-leaf Figwort	SCRLAN
*Veronica americana Schwein.	American Speedwell	VERAME
*Veronica peregrina L.	Purslane Speedwell	VERPER
*Veronica serpyllifolia L.	Thymeleaf Speedwell	VERSER

SOLANACEAE (Nightshade Family)

*Solanum triflorum Nutt.	Cut-leaved Nightshade	SOLTRI

TYPHACEAE (Cattail Family)

*Typha latifolia L.	Cattail	TYPLAT

URTICACEAE (Nettle Family)

*Urtica dioica L.	Stinging Nettle	URTDIO

VALERIANACEAE

*Plectritis macrocera T.& G.	White Plectritis	PLEMAC

VIOLACEAE (Violet Family)

*Viola nephrophylla Greene	Northern Bog Violet	VIONEP
*Viola nuttallii Pursh	Yellow Prairie Violet	VIONUT
*Viola spp.	Violet	VIOLAX

Seedling Codes

*Alnus incana	ALINSD
*Salix lutea	SALUSD
*Salix lasiandra	SALASD
*Salix lemmonii	SALESD
*Populus tremuloides	POTRSD
Prunus virginiana	PRVISD
*Salix geyeriana	SALESD
*Cornus stolonifera	COSTSD
*Rosa woodsii	ROWOSD

Other

Grass annual	GRASSA
*Grass perennial	GRASSP
*Forb annual	FORBAN
*Forb perennial	FORBPE

APPENDIX B

AVIFAUNA OF SELECTED RIPARIAN SAMPLE REACHES

Appendix B. Avifauna of Trout Creek Mountain riparian sample reaches.

	REACH NUMBER																
SPECIES NAME	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Killdeer	x																
Brewers Blackbird	x			x	x					x	x						
Tree Swallow	x																
Violet-green Swallow	x			x	x	x		x		x	x						
Robin	x	x	x	x	x	x		x		x	x		x				
Yellow Warbler	x			x	x	x		x		x	x		x				x
Red-Shafted Flicker	x							x		x	x		x		x		
House Wren	x							x					x				
Dipper	x	x	x	x	x			x		x	x						
Starling	x																
Vireo	x																
Raven	x							x									
White-crowned Sparrow	x														x		x
Northern Oriole	x			x	x			x		x	x						
Mountain Bluebird	x																
Empidonax Flycatcher	x	x	x														
Hairy Woodpecker	x																
Chukar		x	x	x	x	x							x				
Song Sparrow		x	x	x	x	x		x		x	x				x		x
Orange-crowned Warbler		x	x														
Meadowlark		x	x	x	x												
Rock wren		x	x														
Western Wood Peewee		x	x														
Yellow-breasted Chat		x	x	x	x	x		x		x	x						
Brewers Sparrow		x	x														
Poor-will		x	x														
Nighthawk				x	x												
Red-winged Blackbird				x	x	x											
California Quail				x	x												
Spotted Sandpiper				x	x			x									
Barn Swallow				x	x	x											
Rough-winged Swallow				x	x												
Lazuli Bunting				x	x								x		x		
Goldfinch				x	x												
Bush Tit				x	x			x		x	x		x				
Teal				x	x												
Cliff Swallow						x				x	x						
Golden Eagle								x									
B-C Night Heron								x									
Magpie								x									
Kingfisher								x		x	x						
Swainson's Thrush										x	x		x		x		
Green-tailed Towhee										x	x		x				
Western Tanager													x				
Rufous Humingbird													x				x
Pine Siskin																	x