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Provisional Riparian and Aquatic Wetland Plant Communities of the Columbia Plateau, Washington

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PREFACE

The attached report concerns riparian and aquatic wetland vegetation in eastern Washington's Columbia Plateau Province. It represents an initial attempt to describe what the vegetation of these areas may have looked like prior to European settlement. European settlement brought extensive agricultural development to the region, and long-term human use has resulted in extreme alteration or elimination of most native riparian and aquatic habitats. As a result, most low elevation riparian areas are so disturbed that their pre-settlement condition can only be guessed at.

In 1988, four months of reconnaissance level surveys were conducted to try and locate riparian areas that had been relatively undisturbed by humans or domestic livestock. A small number were found, and valuable experience and a regional geographic perspective were gained in the process. With the field experience to provide the focus, it was possible to review the scientific literature for information on similar communities around the American West. This report attempts to synthesize the results of the field surveys with the perspective of the literature search to derive a list of provisional dominance type vegetation communities that may have occurred in the Region's riparian and aquatic habitats.

In the report, each dominance type vegetation community is discussed. A description for each is provided, and if possible is based on sites visited in the field. Since high quality examples of native vegetation communities are rare, some descriptions are necessarily sketchy. Historical evidence for the occurrence of each community is provided if available. The distribution and description of similar communities is also provided. Where particular environmental factors appear to have a role in determining dominance, they are brought out. A separate dominance type list is provided of communities resulting from human-induced disturbance. The report concludes with a brief discussion on the distribution of riparian communities along the major and minor waterways of the region.

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INTRODUCTION

Riparian zones occur along the terrestrial edge of freshwater aquatic features like lakes, ponds, potholes, streams, springs and seeps. Riparian zones are often narrow strips, but their small size is disproportionate to their overall importance in the landscape. Their proximity to water provides higher soil moisture than would otherwise be available through local precipitation (Warner and Hendrix 1984). As a consequence of higher moisture availability, riparian zones generally support a more mesic, and often more productive, vegetation than adjacent upland communities.

The term wetland is a term which can describe both riparian and aquatic environments. Wetlands range from areas that are only periodically inundated to those which are permanently flooded by water. Aquatic wetlands are more frequently inundated than their riparian counterparts which are infrequently to rarely inundated (Warner and Hendrix 1984). Aquatic wetlands support hydrophytic plants that have specific adaptations for living in saturated soils.

The two terms, "riparian" and "wetland" have been used in various ways in different parts of the United States (Hansen 1988). This has led to some confusion about how the terms should be applied. In the east, the term "riparian" is restricted to wetlands along streams and rivers, but in the west, the term is more broadly applied. The definition employed in this report conforms with the western usage. For the purposes of this report, the term aquatic wetland applies to those that are permanently flooded and have water depths of 2m or less (Warner and Hendrix 1984).

Wetlands, whether riparian or aquatic, provide many important and necessary resources for living organisms. They provide critical habitat for both fish and wildlife. Plants that grow in or adjacent to wetlands are often distinct from the species found in upland communities. The human organism is another organism that makes use of the high biological productivity of these areas. Wetlands have traditionally been a focus of homesteading activity and a source of water, fish, game, timber and fuel. The comparatively more productive plant communities have been used to provide forage for livestock. Because these areas often contained some of the most fertile soils for crop production and water for irrigation, they have also been cleared or filled to meet the needs and purposes of the agricultural economy.

THE 1988 RIPARIAN INVENTORY

In 1988, The Nature Conservancy in cooperation with the Washington Natural Heritage Program, Washington Department of

Natural Resources, initiated an ecological inventory of streamside riparian habitats in the Columbia Plateau Physiographic Province of eastern Washington. The inventory emphasized vegetation characteristics and sought to identify sites that had been relatively unmodified by humans or domestic livestock. The purpose of the inventory was to locate the best remaining riparian vegetation sites and to formulate a preliminary vegetation classification that would describe the range of diversity of streamside riparian ecosystems on the Plateau. Both permanent and ephemeral streams were included in the inventory. Permanent streams resulting from increased stream flow due to irrigation were not inventoried.

Field surveys were conducted at the reconnaissance level. Field notes were taken on a combination of physical and biological features at each site. The notes were primarily descriptive in nature.

Where possible, notes on the physical environment included the length of the site, its topography, the direction of stream flow, stream gradient, number of channels, size and depth of the channel(s), type of substrate, whether or not a channel contained water, and whether the stream was a permanent, intermittent or ephemeral stream Since 1988 was a drought year in a succession of three drought years, considerable judgement was used in assigning water permanence.

To describe the biological features at each site, notes were kept on which plant species were present, particularly dominants and regularly recurring species. Where vegetation indicated little disturbance, communities were selected and sampled based on dominant species. Data were collected on both composition and cover. Written descriptions were made to convey a visual image of each community.

As a rule, the ecological quality of a site was judged proportional to a lack of evidence for human-related disturbances. Decisions on site quality were based on three main criteria: 1) the condition of the native vegetation based on composition and structure, 2) the presence and abundance of exotic plant species, and 3) the physical condition of the stream channel. Varying emphasis was placed on these criteria depending on the historic and present conditions of a site.

STUDY AREA

LOCATION

All surveyed sites were confined to the portion of eastern Washington known as the Columbia Plateau or Columbia Basin Physiographic Province (Franklin and Dyrness 1973, Easterbrook and Rahm 1970, McKee, 1972) (Figure 1). The Province extends

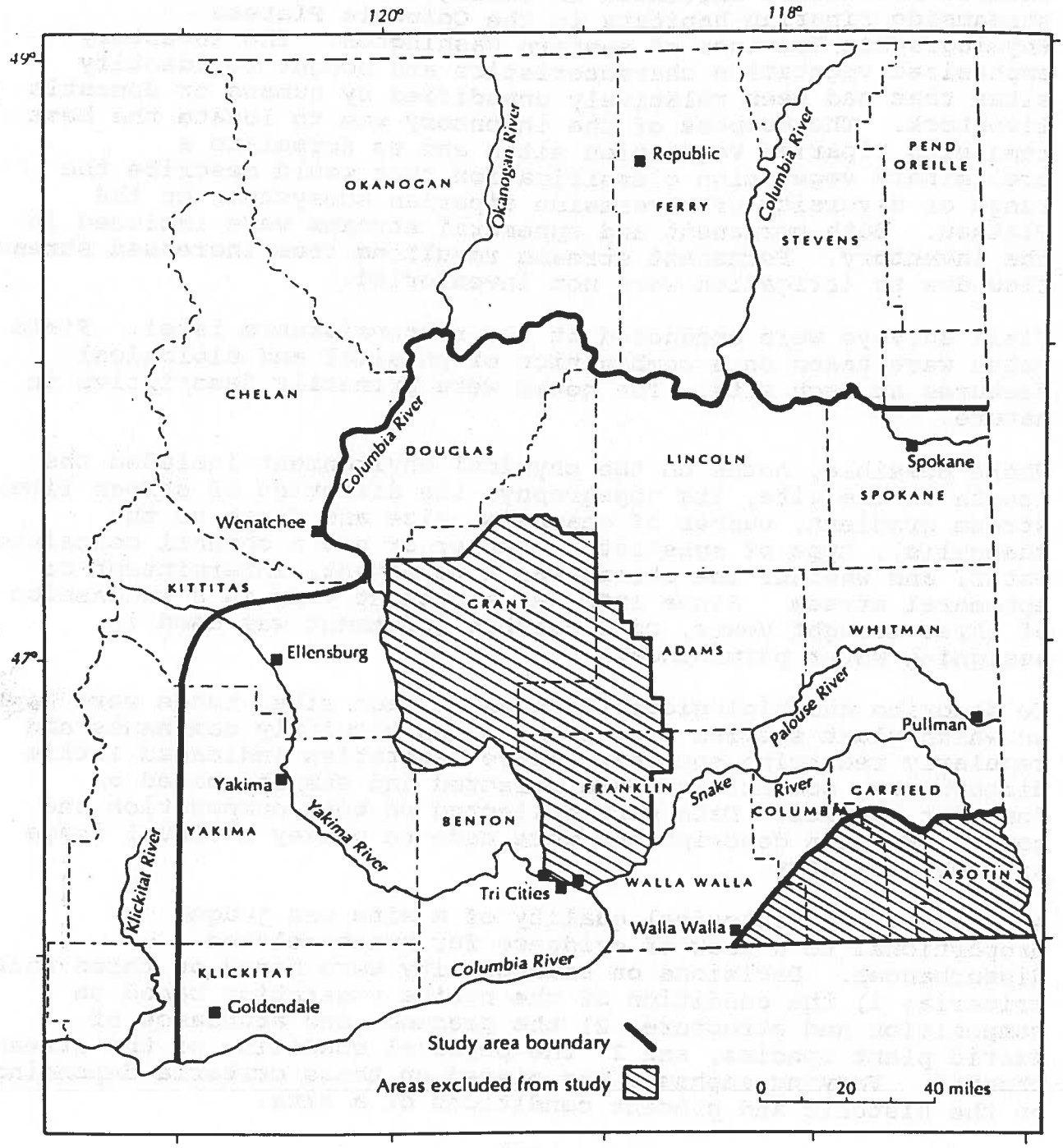

Figure 1. Approximate boundary of the 1988 Riparian Inventory and excluded areas.

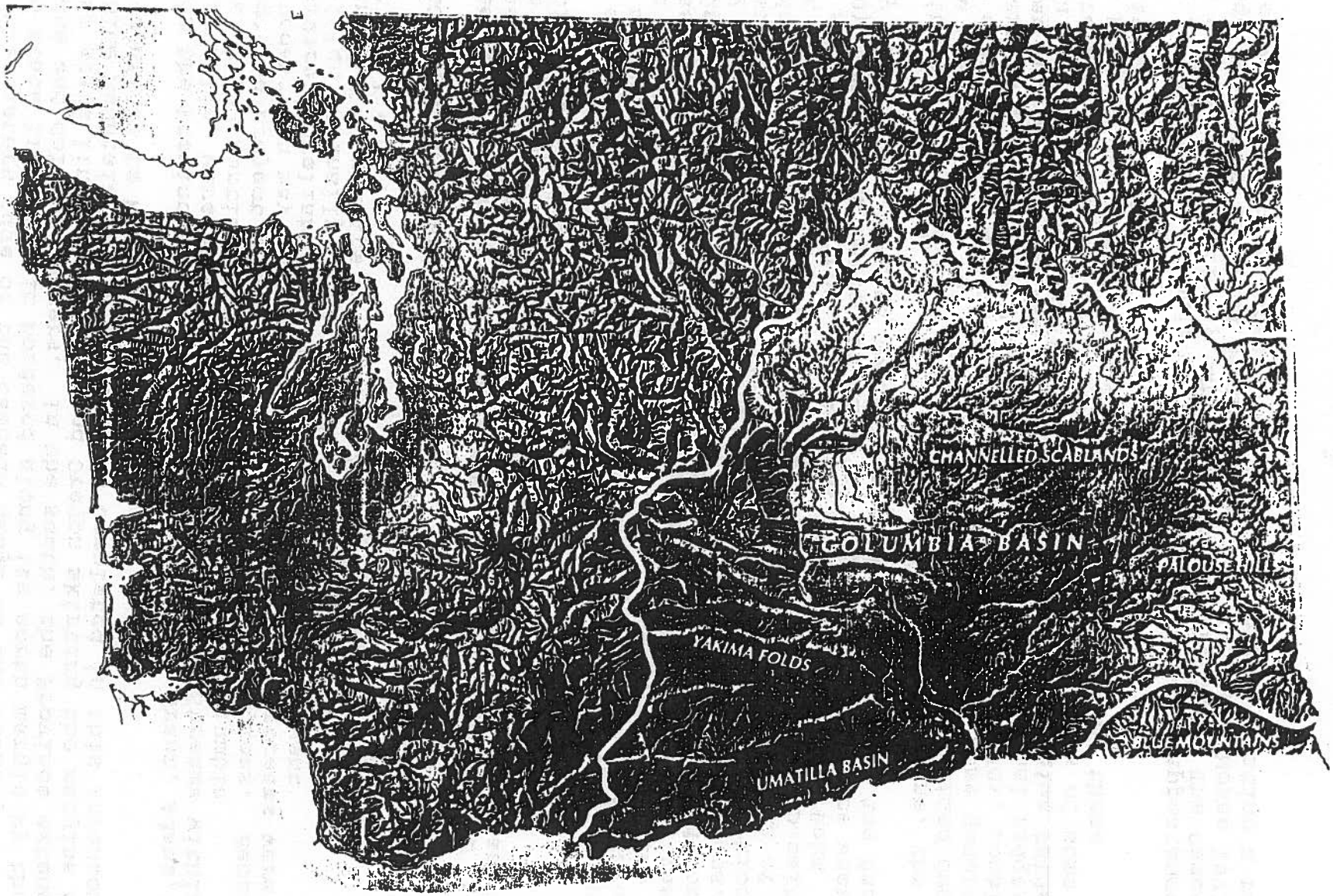

Figure 2. Physiography of the Columbia Plateau Province and some subregions.

from the eastern edge of the Cascade Range to the Washington-Idaho state line. It is bordered along its north margin by the Spokane and Columbia Rivers. In the south, the Province extends across state lines into Idaho and Oregon skirting the margins of the Blue Mountain Province. Surveys completed in this Inventory were confined to Washington.

Within the Province, portions of three counties, Grant, Adams, and Franklin, were excluded from the Inventory. Streams within the excluded portions have been affected by the Columbia Irrigation Project which has altered their flow regimes. Because the vegetation may also have been affected, these streams were considered unreliable as indicators of a pre-settlement condition. Finally, Asotin County was excluded from the Inventory because its remoteness presented logistical difficulties.

GEOLOGY AND PHYSIOGRAPHY

Three major geologic events have contributed to the present appearance of the Basin: the eruption of the basaltic lavas that form the Plateau, the uplift of the Cascade Range, and continental glaciation.

The eruption of basaltic lavas onto the surface of the Plateau is the most distant of these events. The multiple layers of lavas that cover the Plateau erupted during the Miocene Epoch. The lavas erupted from fissures and spread horizontally across the landscape. Because the lava was so fluid, it often spread for very long distances forming layers with remarkably level tops. Repeated eruptions eventually buried most evidence of pre-Miocene landscapes. In some areas these layers built to thousands of feet thickness. Below Pasco in the Tri-Cities area the basalts are said to be ten thousand feet thick (Easterbrook and Rahm 1970). The lavas spread to edges of the present Province where they abutted the various mountain ranges that surround the Basin.

Beginning in the Miocene but extending into the Pliocene, the area was deformed. The central part of the Basin subsided due to the eruption of the basaltic lavas while there was some general upwarping along the margins (Easterbrook and Rahm 1970). Locally, other portions of the Basin were folded into anticlinal ridges such as those along the Yakima River known as the Yakima Folds. Easterbrook and Rahm (1970) attribute the deep gorges of some of the present day rivers to the stimulating effects of these altitudinal changes.

The affect of the Cascade uplift on the present-day appearance of the Province is partially expressed in its aridity. The Cascade Range which was uplifted beginning in the Pliocene (McKee 1972), intercepted moisture laden winds from the oceans creating a rain

shadow east of the mountains. This resulted in a shift from a warm wet near-tropical climate to a much cooler and drier one.

While continental glaciation never directly affected most of the Province, its indirect affects are widespread. During the Pleistocene Ice Ages, a lobe of the continental ice sheet extended down the Okanogan Valley. It overrode the channel of the Columbia River near the present town of Bridgeport and moved south across the Waterville Plateau. Today, typical glacial features -- moraines, drumlins, kame terraces, kettles and erratics -- provide evidence for the maximum extent and eventual stagnation of the ice.

The more profound effects of glaciation were due to the blockage of the Columbia River by the ice sheet in several places along its channel. Dammed by ice, the river waters were ponded into several huge lakes. One huge lake formed in Montana and eastern Idaho. On seven separate occasions the ice dams broke releasing unimaginable volumes of water that rushed across the Plateau (Easterbrook and Rahm 1970, McKee 1972). The volume of water involved far exceeded the capacity of existing drainages, and many new channels were carved into the basalts to accommodate the flow. These channels are the coulees that criss-cross the surface of the present-day Plateau. They have been worn clean by the erosive action of the Spokane Floods, and characteristically have thin stony soils which make them unsuitable for farming. Today many are dry, but others provide channels for present-day underfit streams.

The Miocene basalt flows are the unifying feature of today's Plateau landscapes, but the Plateau can also be viewed as a series of distinct sub-regions (Figure 2). Each of these is characterized by a somewhat different geologic history. Three sub-regions have already been discussed: the Waterville Plateau, the Channeled Scablands, and the Yakima Folds. Yet one of the better known and more notable of the sub-regions has yet to be discussed. This is the Palouse sub-region.

The Palouse sub-region is characterized by very deep, wind-deposited silts called loess. The loess has been deposited on top of the basalts sometimes reaching one hundred feet in depth (McKee 1972). These soils are very well suited for farming. For the most part present day streams of the Palouse region have not cut channels through the loess to the basalt below. One author has characterized them as flowing mostly on the surface of the deep soil mantle, "sluggishly winding through alluvial flats or bottomlands, broadening and smoothing rather than breaking the rolling surface" (Meinig 1968).

The present-day configuration of the Basin is roughly saucer shaped. The Pasco Basin, surrounding Tri-Cities, is the low point and the terrain gradually rises toward mountainous margins

on the west, north, and east. Most of the topography is gently rolling. Elevations range from 300 to 600m over most of the Province except near the Columbia River where they may dip to 150m (Franklin and Dyrness 1973).

CLIMATE

The climate of the Columbia Basin is influenced by both maritime and continental weather patterns, so it is not as mild as in the western half of the state. Winters are cold and summers are hot and dry. January mean minimums vary between -5 degrees C and -9 degrees C, the coldest temperatures occurring in the northwest and southeast corners of the Province. July mean maximums vary between 27 and 33.5 degrees C, the warmest temperatures occurring in the central part of the Basin around the Tri-Cities (Franklin and Dyrness 1973).

Mean annual precipitation varies from 20cm to 60cm. The central portion of the Basin around the Tri-Cities receives the lowest average rainfall. Beyond this area is another zone which receives between 20 and 30cm. Areas of highest rainfall occur along the margins of the Basin in a narrow zone near the base of the east Cascades and again over in the eastern third of the Province in Lincoln, Spokane, and Whitman Counties and in the counties at the foot of the Blue Mountains. Most precipitation falls from October through March. A high proportion of annual precipitation falls as snow (Franklin and Dyrness 1973).

EUROAMERICAN SETTLEMENT AND ITS EFFECTS ON NATIVE VEGETATION

Alterations to native vegetation communities in the Columbia Basin Province have been extensive. The subject of vegetation disturbance and its relationship to European settlement has been reported on by many other authors. Some of the most notable are Daubenmire (1970), Franklin and Dyrness (1973), Mack (1984, 1986, 1988) and Buechner (1953). A brief summary of some of the major historical events is provided as context for a later discussion on present-day vegetation in riparian and aquatic wetlands.

One of the effects of European influence on vegetation in the Columbia Basin was occurring well before any settler appeared on the scene. This effect was due to the introduction of the horse which probably took place in the mid- (1730 according to Daubenmire 1970) to late 1700's (Meinig 1968). Acquisition of the horse fundamentally changed the lifestyle of some aboriginal tribes to a much more mobile one, affecting hunting and trading patterns in particular. Daubenmire (1970) notes that there must have been some heavy but localized grazing damage from horses at Indian encampments along rivers. These effects were probably not uniformly spread along all the rivers in the Basin because some

tribes did not incorporate the use of the horse into their way of life to the extent that others did (Meinig 1968).

The first whites to enter the region were those accompanying the Lewis and Clark Expedition of 1805. Their explorations opened the way for development of a fur trade which flourished through the 1820's (Meinig 1968). There were four posts established during this era: Spokane House, Okanogan, Colville, and Nez Perce. A substantial number of beaver are believed to have been harvested during this period (Friedman 1987, J. Thompson pers. comm. 1989). Historic overtrapping may have effects which are still manifest in present-day Columbia Basin streams.
Until the late 1850's further settlement occurred only slowly. Several Christian Missions were established near the present day town sites of Walla Walla and Spokane. The missionaries raised livestock and agricultural produce. Their operations met with enough success that agriculture was proven possible east of the Cascades (Lindeman and Williams 1985, Meinig 1968). Their activities would eventually attract the interest of other prospective homesteaders.

There was considerable debate over whether the Columbia Plain was suited to any means of making a livelihood. Little information was available on the region, and what reports there were, varied widely in their assessments of it. Many of these reports characterized the area as a harsh desert that presented few if any opportunities to interested settlers. According to Meinig (1968), there was no previous standard by which the American colonists could judge the potentialities of this land; all their experience was based on their encounters with the eastern forests.

Several other impediments held back the pace of settlement. Because of the activities of the Hudson Bay Company, the Columbia Plain was primarily the domain of the British . Until a treaty between the United States and Britain was signed moving the boundary between American and British territory north to the 49th parallel, American settlers were few (Lindeman and Williams 1985). Disputes with the Indians also impeded the pace of settlement. The government did not encourage settlement until after 1858 when treaties were finally signed and many tribes were moved onto reservations (Meinig 1968).

Once the treaties were signed, a steady flow of settlers began moving into the Basin. The primary settlements were at The Dalles and in the nearby Umatilla Basin, at Walla Walla and in the Yakima Basin (Meinig 1968). Settlers established farms and ranches especially along the streams and rivers in the area.

The livestock industry grew with the demands of the mining communities that became established in the various mountain ranges adjoining the Basin and in some as far away as Canada and

Montana. Cattle were raised at the early settlements and then driven to their destination. The years of greatest prosperity, and greatest increase in the herds, extended from the late 1850's to the mid 1860's (Meinig 1968). Other breeds of livestock were also being raised including sheep, hogs, horses, mules and burros but these stock were not maintained on open range to the same extent as cattle which were semi-feral (Meinig 1968, Mack 1984). A large sheep industry did eventually develop, but its heyday did not begin until the late 1800's.

In agriculture, the 1860's were a period of experimentation when both new crops and new agricultural methods were being tried. Around Walla Walla, one experiment involved growing wheat on the elevated river terraces above the main valley floor. It met with some success and would eventually lead to the realization that the hills were as good as or better than the bottomlands for raising wheat (Meinig 1968). Another spur to the growth of agriculture was the discovery of outside markets for agricultural products. As the mining and cattle industries declined, the expansion of agriculture stepped in to fill their places in the economy of the region.

Developing a means of transporting goods was instrumental to developing outside markets. Steamboats were used along the Columbia below The Dalles beginning in 1851. Their use was expanded upriver to Wallula in 1859 (Meinig 1968). Eventually routes were extended all the way to Lewiston, at least during high water when the rivers were navigable for that distance. No figures were found indicating how much wood was burned to power the steamships along the Columbia and Snake but apparently anything that burned was used (T. Thompson, pers. comm., 1989). Figures for the Upper Missouri River in Montana are staggering. Three hundred thousand (300,000) cords of wood were removed from the cottonwood stands along its banks, and the stands were denuded of usable trees by the turn of the century, a period of 30 to 40 years (Damone pers. comm. 1989).

Agriculture continued to expand and was given a big boost by the installation of a railway system, but by the 1920's, most of the good lands were taken and expansion had reached a plateau. A fairly recent change has allowed a new expansion of agriculture into the most arid portion of the Basin by way of the Columbia Irrigation Project. This Project began with the construction of Grand Coulee Dam which was started in 1933. Since Grand Coulee, another nine dams have been constructed along the Columbia and Snake Rivers flooding former riparian habitats. While there was apparently some hope that vegetation would re-establish along the new reservoir margins, present indications are that water level fluctuations are too extreme for most plants to tolerate (T. Thompson pers. comm, 1989).

PRESENT VEGETATION

Todays economy is chiefly agricultural, and most of the present-day appearance of the vegetation reflects this. Orchards and cultivated fields alternate with open sagebrush plains. But even the sagebrush plains are not unmarked by the activities of man for these areas have been used intensively for rangeland since earliest settlement. Domestic animals alter the composition of the vegetation by consuming the most palatable species and leaving behind the least. These unpalatable species have more opportunity to increase their numbers relative to the others, and eventually come to dominate many communities. The introduction of exotic species has further altered the vegetation composition of these areas. Many of these are aggressive invaders like Bromus tectorum which is very well adapted to local conditions, and for a variety of reasons can out-compete native species (Mack 1984, 1986).
A few relatively undisturbed remnants of native vegetation communities have provided the best clues as to the appearance of vegetation in uplands prior to EuroAmerican settlement. Dr. Rexford Daubenmire began classifying Columbia Basin natural vegetation communities in the 1940's and continued this work into the 1970's. He described the vegetation in the region as being dominated by a combination of meadow steppe and shrub steppe communities which he further divided into nine zones (1970). Unfortunately, the years of work Daubenmire devoted to describing native vegetation communities in the Basin did not include the riparian communities.

Daubenmire (1970) described what he considered the best defined of the riparian forest and woodland types. Beyond this he notes the considerable variety in riparian vegetation communities and more importantly, the complicating effects of widespread disturbance to any vegetation analysis of them.

RESULTS AND DISCUSSION

In the following section, a group of provisional riparian and aquatic wetland vegetation communities is discussed. The unit of classification used is the dominance type. Each unit listed is based on existing vegetation; no successional status is implied. The items on the list fall into one of two categories: those derived from the 1988 Riparian Survey, and those derived from the technical literature. The wet meadow and aquatic wetland vegetation types are based solely on the literature and in this sense are much more hypothetical. For each type, supporting evidence is provided.

The desirability of additional field work cannot be stressed enough. The Riparian Inventory is in a very early stage with less than four months of actual field time completed. Additional field work will undoubtedly point out refinements to the types

currently on the list and there will almost certainly be additions. It is extremely important to note that, to date, no systematic field work has been done at non-streamside riparian sites such as lakes, ponds, potholes and vernal pools. What information is offered on conceivable non-streamside vegetation communities is largely based on speculation and therefore needs field confirmation.

TREE AND SHRUB DOMINATED COMMUNITIES

Trees and shrubs have been combined in this section because many of the species listed below are not consistantly characterized as trees or shrubs and have been alternately described in both ways. Some species seem to assume a tree growth form in one situation and a shrub form in another. Many Basin species never attain great height but will still develop a single woody trunk. Alnus incana and Crataegus douglasii are good examples.

Nomenclature follows Hitchcock and Cronquist (1973). Acronyms denoting species names are provided with each name. The abbreviations, d.t., c.t., and h.t. are used to denote dominance type, community type and habitat type respectively. Dominance types are based on species dominance in the tallest vegetation layer. A community type is an abstraction which refers to an aggregation of stands having similar floristic and structural characteristics in both overstory and understory vegetation layers. When a community type represents a stable or potential climax condition it is called a plant association. The dominant species of each vegetation layer comprise the name of the plant association. All of the land area capable of supporting a particular plant association is called a habitat type (Franklin et al 1988).

Pinus ponderosa-Pseudotsuga menziesii d.t. (PIPO-PSME)
Ponderosa pine - Douglas-fir

This type is recognized by the occurrence of widely scattered trees, usually a mix of both species, superimposed over a broadleaf riparian community. For example, these species occur in the riparian zone over water birch and red osier dogwood in parts of the Northrup Creek drainage. Conifers have also been noted in riparian zones along the Columbia River Breaks and near the Blue Mountains (Crawford pers. comm., 1989), in Spring Creek Canyon (Lincoln Co.), and in the Yakima River Canyon between Ellensburg and Yakima. Ponderosa pine occurs on the outer part of the flood plain at Lewis and Clark Trail State Park. Most places where conifers occur today are canyons or valleys with steep rocky walls along mid- to high gradient streams. This may be attributable to the inaccessibility of these sites and the difficulties they presented to settlers who might have wished to remove trees from them. Steep-sided, narrow canyons are also likely to be partly protected from the dessicating effects of

prolonged insolation, and therefore could provide more hospitable microenvironments for tree establishment.

Historically, conifers may have been more common (but not necessarily more abundant) in riparian zones throughout the Basin. If present, they would have been a likely target of early settlerment activities. In 1893 conifers were noted by Sandberg and Leiberg in the central part of the Basin between eastern Lincoln County and the Columbia River. Although they were described as rare and confined to the bottoms of coulees, talus slopes and pond margins (Mack 1988), the fact that they were noted at all indicates they may have been more common than today.

By contrast, in the eastern portion of the Province along the forest-steppe boundary, Sandberg and Leiberg found Abies grandis and Pseudotsuga menziesii commonly associated with Betula occidentalis, Populus trichocarpa, Populus tremuloides, and Salix lasiandra var. caudata. In the shrub layer, especially along stream edges, they noted Ribes aureum, Salix spp., Sambucus cerulea, and Symphoricarpos albus. They also reported that Pinus ponderosa occurred with mesic shrubs along stream courses in this area (Mack 1988).

In some studies of riparian vegetation communities, the occurrence of conifers in broadleaf dominated stands has been interpreted to mean that, barring large scale disturbance, conifers will eventually displace broadleafs as stand dominants (Kovalchik 1988, Youngblood et al. 1985a). In most of the Columbia Basin, however, it appears that stands which support low conifer densities will continue to do so over time without significant changes in tree dominance.

Alnus incana d.t. (ALIN)
mountain alder

One site in eastern Lincoln County may represent a formerly more widespread occurrence of this type in the Basin. ALIN dominates the overstory with Populus tremuloides in the same layer at 6% canopy cover. Cornus stolonifera dominates a dense shrub layer. All the herbaceous species are low in cover (less than 5%) and the understory is sparse. Several understory species suggest a history of past understory disturbance including: Phalaris arundinacea, Solanum dulcamara, and Arctium minus.

This Lincoln County community occurs as a narrow band along the banks of a low gradient stream. There appeared to be other riparian communities present, but these were not easily characterized. Beaver were actively working this site which, in combination with the grazing disturbance, complicated an interpretation.

There appears to be a fairly widespread occurrence of ALIN dominated riparian communities in the western United States. Communities of this type have been listed in classifications for Idaho, Oregon, Utah and Wyoming. They have been described by Kovalchik (1987), Padgett (1981), Hansen et al. (1988a, 1988b), and Youngblood et al. (1985a, 1985b). Although these communities were not specifically described by Miller (1976), he noted the replacement of Alnus rhombifolia (ALRH) by ALIN and by hybrids near the upper elevational range of his ALRH types in Idaho. Communities with Cornus stolonifera in the understory are described from Idaho, Montana and Utah.

During the Sandberg and Leiberg Expedition of 1893, ALIN was described from streamside communities in the eastern portion of a district that extended from east Lincoln County to the Columbia River (Mack 1988). It occurred with Crataegus douglasii, Cornus stolonifera, Ribes aureum, Rosa woodsii, and Salix scouleriana. The last three species were apparently not restricted to the eastern part of the district.

In Utah and Nevada (Manning and Padgett 1989), ALIN is described from sites with coarse alluvial soils, at least in the subsurface horizons, suggesting that soil aeration may have a role in its distribution. Their observations also indicate ALIN may occur on colder sites than Betula occidentalis.

Alnus rhombifolia d.t. (ALRH)
white alder

Four sites supporting white alder were surveyed during the 1988 Riparian Survey. The condition of these sites varied greatly and ranged from widely spaced trees over an understory of Bromus tectorum to stands with intact vegetative structure in all layers. In all stands, the ALRH seemed to be confined to a narrow band immediately adjacent to the stream or river channel, although understory composition varied. At a Natural Area Preserve in Klickitat County, Philadelphus lewisii appeared to be the dominant understory member. Symphoricarpos albus, Rosa woodsii, and Prunus virginiana were also important species in the understory. Scattered small groups of Populus trichocarpa occured in the stand and overtopped the ALRH where they occured.

Populus trichocarpa is also scattered over white alder along the Touchet River at Lewis and Clark Trails State Park in Columbia County. In this case the understory was dominated by Symphoricarpos albus but Prunus virginiana and Philadelphus lewisii were also important.

Along a high energy, high gradient stream in Klickitat County, white alder bordered a stream with virtually no understory. The channel was choked with very large boulders and it appeared that the lack of understory development could be related to frequent

flooding events and an absence of rooting substrate. Miller (1976) demonstrated a correlation between the occurrence of white alder and poor stream channel stability along tributaries of the Snake, Salmon, and Clearwater Rivers in Idaho.

Miller (1976) described ten separate community types dominated by white alder along these drainages in Idaho. White alder dominated riparian communities are also reported in eastern Oregon (Kagan, no date) but are more common to the south in California (Holstein 1984). In California white alder is an obligate riparian tree that forms gallery forests along streams in the Sierra Nevada and Coast Ranges from sea level up to 1600m. Its distribution may be related to the need for continual saturation of its root zone by cool, well-aerated water (Holstein 1984).

White alder has a limited distribution in Washington State where it occurs in the southeast corner of the Columbia Basin and in a disjunct population in south central Washington. Daubenmire (1975) described it as a h.t. found in narrow valleys emptying into the Snake in Whitman and Asotin Counties.

Betula occidentalis d.t. (BEOC)
water birch

Water birch was probably at one time a common species dominating riparian zones in the Columbia Basin. A total of 14 sites were surveyed where water birch was evident. Several of these sites appeared to be in relatively good condition.

Water birch may have dominated a variety of dominant undergrowths but the best remaining examples known have an understory dominated by Cornus stolonifera. The shrub layer is usually quite dense and the herbaceous layer is not well developed. Although the tree layer is dominated by BEOC, Alnus incana is sometimes present as a co-dominant. Willows can occasionally occur in these stands. The canopy ranges from fairly open to closed.

Birch communities seem to occur along both low and mid-gradient streams with a perennial water source. (One surveyed site had no water in the channel at the end of July, 1988, which was a drought year.) These communities have also been observed to occur at seeps. One community is reported to occur along the margin of a small pond in Grant County (Kratz field notes 1981. In-house document on file at WA Natural Heritage Program, Olympia, WA).

Water birch dominated communities have been described in Idaho by Miller (1976) and by Youngblood and others (1985b). Youngblood and others (1985b) also describe birch dominated communities from northern Utah, and Padgett and Youngblood (1986) have described

them from southern Utah. Hansen and others (1988a, 1988b) have described these communities from western, southwestern and south-central Montana. Water birch communities are described in several natural areas in southern British Columbia (Roemer pers. comm. 1989). Kagan (no date) lists a birch dominated riparian community from eastern Oregon.

Only a very few examples of birch dominated communities are known to occur in Oregon, and these are all in poor condition (Kagan pers. comm. 1989; Elmore pers. comm. 1989). Whether this implies communities dominated by BEOC were historically rare in Oregon or whether their scarcity is due to disturbance is unknown.

Although BEOC is a widespread tree in the Cordillera, it's distribution is limited to a few parts of California primarily in the Klamath Mountains and along the east slope of the southern Sierra Nevada (Holstein 1984). Holstein suggests that summer thundershowers which are unusual in most areas of California help sustain the southern populations of this species and that this is a condition they share with the larger populations of BEOC found to the east in the Great Basin. In the Klamath Mountains, BEOC's persistance may be due to a more northerly latitude and an abbreviated period of summer drought.

In Utah and Nevada, Manning and Padgett (1989) note that BEOC typically occupies sites on coarse textured soils (at least in the sub-surface layers) immediately adjacent to streams where well-aerated water flows through the soil profile. In Montana, Hansen and others (1988a) have noted birch communities on silts and sands overlying rocky substrates and typically absent from clay soils.

Celtis reticulata d.t. (CERE)
western hackberry

No sites were visited during the 1988 Riparian Inventory that were dominated by hackberry. However, individuals or small groupings of trees were noted to occur along some streams including portions of the Columbia River in the Gorge, along the Palouse River and also along a tributary to the Columbia in Klickitat County.

A Celtis-Bromus (tectorum) h.t. has been described in Washington by Daubenmire (1970). The h.t. extends from the Palouse River up the Snake River Valley to at least the Oregon border. It shows up again to the west in the Agropyron-Poa zone along the Columbia River. In the Snake River watershed, this h.t. does not appear to extend very far up any of its tributaries. Stands occur near the valley floor on colluvial cones and aprons. Apparently no stands with a native understory remain in Washington, except in the southeast corner of the state (Crawford pers comm. 1989).

Although Daubenmire (1970) considers the Celtis-Bromus community as a terrestrial community, he also states that the trees may grow so close to the waters edge that the base of the trunk may be inundated at high water. This is one of the reasons a Celtis d.t. has been included as part of this discussion. Two other points may support the designation of a riparian d.t. in Washington. First, Miller (1976) described a CERE riparian c.t. along the Snake River in Idaho. CERE is described as the dominant tree occurring with an occasional Prunus virginiana var. melanocarpa, Sambucus cerulea, or Crataegus douglasii. Understory shrubs may include Lonicera utahensis, Symphoricarpos albus and Ribes irriguum. Second, in the Botanical Report from the 1853-1855 Railroad Surveys, the author states that CERE and Salix lasiandra are the only trees seen along the Columbia for hundreds of miles above The Dalles, Oregon (Cooper 1860).

Crataegus douglasii d.t. (CRDO)
black hawthorn

Three sites visited during the 1988 Riparian Inventory had communities dominated by CRDO. In this community the CRDO forms dense narrow bands or irregular patches. At one site, it clusters along channel banks and is associated with occasional individuals of Prunus virginia, Acer glabrum, and Holodiscus discolor. The understory may include Elymus cinereus, Symphoricarpos albus, or Rosa woodsii. A rich variety of forbs occur in the understory. This site is located high in a drainage basin along an ephemeral stream. At another site, the community occurred at the outer margins of a floodplain and bordered another riparian community positioned closer to the stream.

Daubenmire (1970) described two associations in Washington that are dominated by CRDO: a Crataegus douglasii/Symphoricarpos alba association and a Crataegus douglasii/Heracleum lanatum association. In the former, the distinguishing features are a complete cover of woody plants 5-7m tall dominated by CRDO, the presence of Symphoricarpos albus and frequently Spiraea betulifolia in the shrub layer, and a rich forb layer. Diagnostic herbaceous species include Achillea millefolium, Besseya rubra, Galium boreale, Geranium viscosissimum, Iris missouriensis, Lithophragma parviflora, Potentilla arguta, and P. gracilis. In the latter association, CRDO dominates a nearly complete cover of woody plants between 5-7m tall with an understory of Heracleum lanatum, Hydrophyllum fendleri, and Urtica dioica which can occur singly or together. Neither type is restricted to the immediate riparian zone but can occur across a valley floor and extend up the adjacent slopes. Where the types occur along a valley floor, they can border either intermittent or permanent creeks. The CRDO/HELA type is usually found on wetter sites than the CRDO/SYAL type. Daubenmire (1970) believed both types to be restricted to the Festuca-Symphoricarpos and Festuca-Rosa zones of eastern Washington.

Crataegus dominated communities are also described from other western states. The two Daubenmire h.t.'s are listed in the Idaho Natural Heritage Classification (Caicco 1988). Kagan (no date) lists several Crataegus dominated communities in Oregon including a CRDO/Symphoricarpos albus type and a CRDO-Salix/Elymus cinereus type. Kovalchik (1987) described a Crataegus association from east-central Oregon along the Metolius River in the Deschutes National Forest and in scattered occurrences on the Ochoco National Forest. In Montana (Hansen et al. 1988a), CRDO is described as a rare d.t. at low elevations on alluvial terraces along streams and rivers in the western part of the state. It occurs most often as an understory species, but where it is dominant, it tends to develop small dense impenetrable thickets that form narrow bands or patches.

There appears to be some similarity between the d.t. observed during the 1988 Riparian Inventory and Daubenmire's Crataegus douglasii/Symphoricarpos albus h.t. At this time however, differences in composition, physiognomy and geography seem to warrant their continued separation. The future identification and sampling of little-disturbed stands will hopefully help resolve the issue.

Populus tremuloides d.t. (POTR)
quaking aspen

Quaking aspen dominated stands were noted at eight sites during the Riparian Inventory but most of these were in only poor to fair condition. At the best site, there were two distinct understories. In one assemblage, the understory consisted of both tall and short shrub layers. The tall layer was dominated by Prunus virginia var. melanocarpa. The short shrub layer was dominated by Symphoricarpos albus, with small amounts of Philadelphous lewisii present. In the herb layer there were small amounts (usually less than 1%) of Osmorhiza occidentalis, Smilacena stellata, Galium sp., Elymus glaucus, and Clematis ligusticifolia. Cornus stolonifera occurred in this stand but only as a narrow band along the channel. In the other assemblage, the overstory was also dominated by POTR but the understory consisted of Cornus stolonifera. Below the Cornus there was little other plant cover except for small amounts of Symphoricarpos albus, Clematis ligusticifolia, Rubus parviflora, and Smilacina stellata.

In Oregon, three quaking aspen dominated riparian communities have been described by Kovalchik (1987): POTR/Symphoricarpos albus/Elymus glaucus c.t., POTR/Elymus glaucus c.t. and a POTR-Pinus contorta/Spiraea dougalsii/Carex eurycarpa c.t. In addition, Kagan (no date) lists a POTR/Amelanchier alnifolia-Prunus virginiana type that occurs around seeps in the Wallowa Mountains and on Steens Mountain. He also described another riparian type as a POTR/Symphoricarpos albus/Carex-Deschampsia

caespitosa community. Padgett (1981) described a POTR riparian d.t. from the Silvies River area on the Malheur National Forest which Kovalchik (1987) thought might, in part, represent disturbed phases of his POTR/SYAL/ELGL c.t.

In Washington, Daubenmire (1970) described Populus tremuloides phases for both the CRDO/Symophoricarpus alba and CRDO/Heracleum lanatum associations. In these phases, the POTR overtops the CRDO and in a sense becomes the dominant species in these communities until a period of dieback which allows the CRDO to reassume dominance. This process is cyclic. Caicco (1988) lists both phases in the Idaho Heritage Classification and adds a third community dominated by POTR with a Salix scouleriana understory. In eastern Washington and adjacent Idaho, Daubenmire (1970) noted that POTR dominates moist depressions and pond margins.

In Montana, communities dominated by POTR are common throughout the state at low to mid elevations (Hansen et al. 1988a). These communities can occur on relatively dry sites but may also dominate riparian sites such as valley bottoms, seeps, moist slopes and basins. Further sampling has led to a refinement of the communities described for southwest Montana. A POTR/Salix geyeriana riparian site type is described as a minor type occurring along streams and rivers in this region of the state. The second type is a type resulting from animal disturbance and is described as a POTR/Poa pratensis c.t. The native understory has been lost in this community (Hansen et al. 1988b).

Populus trichocarpa d.t. (POTR 2)
black cottonwood

Friedman (1987) suggests that Populus trichocarpa may have been a widespread dominant in the dry central portion of the Columbia Basin. However, the Riparian Inventory only located one stand where black cottonwood was the dominant overstory tree. The understory had been grazed and the overstory was about all that remained of the stand. A few other black cottonwood stands have been noted along the Yakima River, but these were only casually observed.

Daubenmire (1970) has described a POTR 2/Cicuta douglasii habitat type from the Festuca/Symphoricarpos and Festuca/Rosa zones that also extended west into the Agropyron-Festuca zone of south-central Washington. He locates an example of this type on Lapwai Creek, Idaho, but states that the type is only provisional in light of the virtual absence of undisturbed stands to sample.

In drier portions of the steppe, Daubenmire (1970) noted that Populus trichocarpa and Salix spp. form linear strips in riparian habitats and were joined by birch and white alder in deeper ravines (Daubenmire 1975). Much earlier in the century, Weaver (1917) described a Populus Consocies that was frequently found on

flood plains especially in the less arid regions of his southeast Washington study area. Although P. tremuloides was the more commonly encountered species, P. trichocarpa was also part of this consocies. Sandberg and Leiberg mention both Populus species in their discussion of stream communities in the transition zone between forest-steppe along the eastern edge of the Province (Mack 1988).

A POTR 2/Cornus stolonifera community is listed in the Idaho Natural Heritage Classification (Caicco 1988). In the east-central part of the state, a typical low elevation community is said to consist of POTR 2 in the overstory with several understory layers below. The tallest of these layers includes Salix lasiandra var. caudata and frequently also includes Betula occidentalis and/or Alnus incana. In the shorter layer is usually a dense mixture of Salix lutea, S. exigua, Cornus stolonifera, Rosa woodsii, and Ribes setosum (Brunsfeld and Johnson 1985). In the Oregon Heritage Classification, Kagan (no date) lists two similar sounding communities found at low elevation sites in Wallowa, Union, and Umatilla Counties. In one, POTR 2 combines with Alnus sp., Betula occidentalis, Cornus stolonifera and Salix sp.; in the other, the B. occidentalis and C. stolonifera are absent. Kovalchik (1987) described four c.t.'s from east-central Oregon: POTR 2/Carex eurycarpa, POTR 2/Alnus incana/Carex lanuginosa, POTR 2-Picea engelmanii/Alnus incana-Cornus stolonifera, and POTR 2/Symphoricarpos albus/Poa pratensis. All four community types are considered successional to conifer dominated communities.

In Montana, POTR 2 communities are a major d.t. in the central and western part of the state where they occur on alluvial terraces along major streams and rivers and around lakes and ponds (Hansen et al. 1988a). In southwest Montana, two c.t.'s have been described: POTR 2/Cornus stolonifera and POTR 2/Poa pratensis (Hansen et al. 1988b).

Populus trichocarpa also occurs in riparian habitats in California. It's distribution is reportedly related to July mean maximum temperatures of less than 25 degrees celsius which limits it to the cooler and wetter parts of the state. Populus fremontii is the more important riparian Populus in that state (Holstein 1984).

Prunus virginia var. melanocarpa d.t. (PRVIM)
common chokecherry

In 1988, two disturbed sites were visited in the southwest portion of the Basin that supported stands of Prunus virginiana. Both sites were in the Rattlesnake Hills. The PRVI was small tree-size and dominated a shrubby understory. At one site, the tree cover was sometimes broken into patches over a more continuous shrub layer of primarily Symphoricarpos albus. PRVI

has also been reported elsewhere in this portion of the Basin by Crawford (pers. comm. 1989) who says it occupies draws in the Horse Heaven Hills. These examples support provisional recogniton of a type which occurs along ephemeral creeks in steep, narrow bottomed canyons. POTR may be important in some phases of this d.t. because several small aspen clones were observed at one site.

There is some evidence from adjacent states that PRVI comprises a separate dominance type. In Montana, a PRVI d.t. is said to be common at low to mid-elevations along streams, rivers, lakes and ponds throughout the state (Hansen et al. 1988a). In Oregon, Kovalchik (1987) described a mixed shrub canyon bottom association in which PRVI shares the tall shrub layer with Amelanchier alnifolia, Rosa woodsii, Cornus stolonifera, various willows, "Klamath plum", and/or Alnus incana. In general, this association was found to occur in low elevation canyons below National Forest boundaries. Kagan (no date) lists a Prunus virginia-Salix/Rosa woodsii type that occurs in Hell's Canyon, on Steens Mountain and in the Trout Creek Mountains. According to the account of Hansen and others (1988a), the PRVI d.t. is intolerant of poor drainage and prolonged flooding.

The species is an important associate in many different riparian communities.

Quercus garryana d.t. (QUGA)
Oregon white oak

In his 1987 review of streams and riparian wetlands in the Columbia Basin, Friedeman suggests that Q. garryana may dominate a unique riparian type found in gulches east of the Columbia Gorge. He cites a stand within the Badger Gulch Natural Area Preserve in Klickitat County as an example. After surveying this site, I would agree that a riparian community dominated by oak does occur here. Q. garryana and Acer macrophyllum occupy the outside edge of the floodplain and surround an Alnus rhombifolia community which occurs immediately adjacent to the stream. A description of the understory cannot be provided for the oak community because of the late season of visit. Species listed by Friedman (1987) as associates of the oak community are primarily associated with the Alnus rhombifolia.

A few points of additional evidence support the inclusion of Q. garryana in the list of riparian types. In a report on the National Natural Landmark designation of the Cleveland Shrub-Steppe Natural Area Preserve, Dunwiddie (1984) described a woodland draw containing an ephemeral creek co-dominated by Q. garryana and Pinus ponderosa. QUGA has been noted to dominate the riparian zone at Catherine Creek, Klickitat County (Schuller pers. comm. 1989). In casual observation, I have noted it along Rock Creek, also in Klickitat County. A Q. garryana/Elymus

glaucus community is described on the Yakima Indian Reservation (John et al. 1987) in Yakima County. Finally, a small population of white oak has been reported to occur as far north as Kittitas County at the confluence of Swauk Creek and the Yakima River. The associated species include Populus trichocarpa, Alnus incana, Prunus demissa, Crataegus douglasii, Salix amygdaloides, Cornus stolonifera, Rosa gymnocarpa, R. nutkana, Purshia tridentata, and scattered Pinus ponderosa and Pseudotsuga menziesii (Wiberg, unpubl. letter, 1974. On file at the WA Natural Heritage Program).

In California, Q. lobata is the only species of oak that regularly dominates riparian communities, although there are several other oak species that may do so on occasion. Q. lobata is not strictly a riparian tree and is slightly more common in uplands than in riparian zones (Holstein 1984). On the upland sites, it is generally found on heavy, poorly aerated soils with a high water-holding capacity. Similar conditions are found where it dominates riparian zones. It occurs on soils that are too heavy and poorly aerated to support Populus freemontii and some other riparian trees.

At lower elevation sites on the Yakima Indian Reservation, oaks show up first in draws and spread to upland sites as the elevation increases (Tart pers. comm. 1989). This general pattern appears to have also been the case in the 1850's. In a journal entry from the 1853 to 1855 Railroad Surveys, oaks were noted to occur in bottomlands well out onto the Columbia Plain:

> Fifty-five miles up (the Yakima River from its junction with the Columbia), on the branch called Ahtanum (Creek) occurs the first oaks met with west of the Missouri River at Fort Union.

This puts oak onto the Columbia Plain as far east as present-day Yakima. As this area is in one of the early areas to be settled, there may have already been some types of disturbance taking place at the time of this writing. To what extent, if any, this activity may have been affecting the riparian communities is unknown.

Rhus glabra d.t. (RHGL)
smooth sumac

No sites were visited during the 1988 Riparian Inventory that were dominated by RHGL. In casual observation it was noted along the lower valley sides of several streams in southeast Washington.

The only described type is an upland community type described by Daubenmire (1970). According to Daubenmire, its distribution is restricted to the eastern extremity of the Agropyron-Poa zone and

to portions of the Artemisia-Agropyron zone in the Okanogan Valley. It is limited to sandy or stony soils, usually on talus slopes and toe slopes, in canyons. Based on a limited number of samples, Daubenmire described RHGL communities with three distinct, grass-dominated understories but also indicated that, for all intensive purposes, the only remaining stands in Washington had an understory dominated by Bromus tectorum.

While RHGL communities are probably not true riparian communities, several accounts do lend some support to the idea that they may have occasionally occurred in riparian zones. For example, they might be found along rocky shorelines and/or along ephemeral streams. They might also be found in the transition zone between an upland community and the immediate riparian community. Grable reported RHGL thickets on south facing slopes adjacent to the Touchet River (Grable 1974). In Mack's (1988) account of the Sandberg and Lieberg Expedition of 1893, he reports that RHGL was common on rocky slopes along the Columbia River in Douglas County. It was also common along the Spokane River. He points out that RHGL was therefore more common than Daubenmire believed. Notes from the 1850's Railroad Surveys indicate that RHGL was one of several woody species that grew along the higher river banks (Cooper 1860). RHGL has been observed along stream channels in some of the tributaries (Tekison Creek, for example) to the Columbia between Wenatchee and Ellensburg (Schuller pers. comm. 1989). During the 1988 Riparian Inventory, it was seen in this same general area growing around a fenced-in spring.

Salix d.t.'s

Trees in the genus Salix are very important components of riparian communities in the North Temperate Zone (Holstein 1984). They often share dominance with trees in the genus Populus (Daubenmire 1975, Brunsfeld and Johnson 1985, and Holstein 1984). In the Columbia Basin, willow communities seem to develop where there has been disturbance along the streambanks. The disturbance can be natural or man-caused. In some areas, willows appear to be "relatively stable seral communities maintained by the nature of the habitat including high water tables, flooding or other regular disturbances" (Brunsfeld and Johnson 1985). Three provisional d.t.'s are proposed below. Due to difficulties in willow taxonomy and the early stage of the Riparian Inventory, it is likely that this section will require modification in the future.

Salix exigua d.t. (SAEX)
coyote willow

Two sites were visited were SAEX seems to dominate distinct communities. At one site along Crab Creek (Lincoln County), SAEX occurs both along the banks and on cobble bars in a braided

channel. The understory is dominated by Phalaris arundinacea with a ring of Eleocharis palustris around the lower edge of each bar. Along the Palouse River, the community occurs on river bars having a sandy substrate. SAEX forms dense narrow bands or irregular patches, sometimes mixed with other shrubs, over a relatively well developed herbaceous layer. Along the Palouse, this community occurs back from the waters edge usually upslope from a Spartina pectinata band.

The occurrence of SAEX dominated communities, especially on sand bars, seems to be well documented throughout the western United States. According to Holstein (1984), SAEX is one of the first woody species to colonize sandbars and other newly-formed riparian habitats in California when the substrate is fine-grained and the water table is close to the surface.

In Oregon, Padgett (1981) described a SAEX riparian d.t. along streams and rivers in the Malheur National Forest. Kovalchik (1987) described a SAEX association from several locations in the Ochoco National Forest and comments that the association is abundant at lower elevations and does not usually extend far into the National Forests. Kagan (no date) lists two SAEX dominated communities in Oregon: a SAEX/Elymus cinereus community and a SAEX-Salix rigida/Juncus-Scirpus acutus community. The former occupies seasonal drainages in Oregon's Columbia Plateau Province.

In Idaho, Miller (1976) described a SAEX c.t. along the Snake, Salmon, and Clearwater drainages. It occurs at the mouths of tributary canyons. These sites had very poor stream channel stability ratings. Brunsfeld and Johnson (1985) cite SAEX ssp. exigua as a constant and often abundant member of low elevation riparian communities throughout east-central Idaho.

Youngblood and others (1985a, 1985b) describe two SAEX community types. The SAEX/Equisetum arvense community described from Idaho, Wyoming, and northern Utah occurs at low to mid-elevations. A SAEX/Poa pratensis c.t. is described from Idaho, Wyoming, Utah and Oregon.

In Montana, SAEX is a common d.t. at low to mid-elevations along all types of watercourses (Hansen et al. 1988a). In southwest Montana where a refinement of an earlier riparian classification is in progress, a SAEX c.t. is said to be a major type that is widespread at low to mid-elevations (Hansen et al. 1988b).

Salix amygdaloides d.t. (SAAM)
peach-leaf willow

A number of small stands were observed in 1988 in which SAAM was the dominant woody species. Most seemed to be young stands that were heavily disturbed. The only exception was at the Hanford

Nuclear Reservation along the creek formed by Rattlesnake Springs. SAAM achieves tree size here but the understory is still disturbed. This site has undergone a vigorous recovery since livestock were excluded from the site in 1963. When it was fenced, only a few widely scattered SAAM still stood and now the stream is dominated by a continuous narrow band of trees (Rickard and Cushing 1982).

Similar stands are to be expected elsewhere in the Columbia Plateau Province. Brunsfeld (pers. comm. 1989) stated that SAAM was likely to be the most common willow in the Basin. In Idaho it replaces Salix lasiandra var. caudata below the 3,000 foot elevation mark (Brunsfeld in Friedman 1987). In Montana, a SAAM d.t. is described at low elevations in the eastern part of the state. It occurs along rivers, lakes, and ponds.

Salix lasiandra var. caudata d.t. (SALAC)
whiplash willow

No sites were visited during the 1988 Riparian Inventory in which this species was dominant. It has been observed as a component of riparian communities, but these were all in poor condition. This species seems to become more common along the eastern margin of the Basin.

Communities of this type could be expected to occur in the Columbia Basin based on the following evidence. In a typical community of the low elevation zones in east-central Idaho, SALAC forms the mid-story layer of a community including Populus trichocarpa, Alnus incana and/or Betula occidentalis, and a dense layer of low shrubs (Brunsfeld and Johnson 1985). In Oregon, SALAC is a member of a community described by Kagan (no date) as a Prunus virginiana-Salix/Rosa woodsii type. It occurs in Hells Canyon, on Steens Mountain, and in the Trout Creek Mountains. SAEX is also a member of this community.

In Montana, the SALA d.t. is a minor d.t. at low to mid-elevations primarily in the western and central portions of the state (Hansen et al. 1988a). In southwest Montana where it has been described as a c.t., it occurs in the same elevational range but it is only incidental (Hansen et al. 1988b). At low elevation sites, SALA achieves the stature of a medium size tree and overtops other shrubs. It is usually associated with Salix exigua, S. lutea, Cornus stolonifera, and Rosa woodsii. Stands of this nature are usually found on fairly coarse alluvial deposits along streams and rivers with frequent flooding regimes (Hansen et al. 1988b). It can occur as part of a matrix involving stands of Populus trichocarpa where it grows in the midst of open stands or as a fringe along the edges if the cottonwood become dense.

There is some historical evidence that SALAC may have had a role

in some riparian communities in Washington. For hundreds of miles above The Dalles, the only two trees encountered along the Columbia River were SALAC and Celtis reticulata (Cooper 1860). In the forest-steppe transition zone in the eastern portion of the Basin, Sandberg and Leiberg listed SALAC as an associate of other riparian trees like Populus trichocarpa, P. tremuloides, and Betula occidentalis (Mack 1988).

Sarcobatus vermiculatus/Distichlis stricta h.t. (SAVE 2/DIST)
black greasewood/alkalai saltgrass

This community was described by Daubenmire (1970) as a habitat type. In it, scattered bushes of SAVE 2 occur over a Distichlis sward. In Washington, it is restricted to saline and alkaline habitats within the Artemisia tridentata-Agropyron spicatum and ARTR-Festuca zones. Daubenmire also reports that this association occurs in Oregon, Wyoming, Utah and Nevada.

In Montana, Hansen and others (1988a) report a SAVE 2 d.t. to be a common riparian d.t. at low to mid-elevations throughout the state. It occurs on old alluvial terraces along rivers and streams and along broad flat lake margins. Associated species in undisturbed stands include Agropyron smithii, A. dasystachyum, Elymus cinereus, and Distichlis stricta.

Although the site was not visited in 1988, an example of the Daubenmire association is found at the Lower Crab Creek Natural Area Preserve in Grant County, Washington. The community occurs along the southern bank of Crab Creek, an underfit, low gradient stream (Schuller 1985, in-house document on file with the WA Nat. Heritage Program, Olympia, WA). A distinct but related community to the Daubenmire type includes Elymus cinereus. It occurs on the Yakima Indian Reservation on bottomlands and floodplains on poorly drained alkaline soils that are high in sodium (Tart 1987). Tart considers it part of the riparian ecosystem where it occurs near streams.

GRAMINOID DOMINATED PLANT COMMUNITIES

For the most part, the plant communities on the list below have not been observed in the Columbia Plateau Province and may or may not occur there. Most of the types are listed because they have been described in adjacent states. Because they have not been seen in the field, no descriptions are provided. Associated species in these communities usually included other grasses, sedges, or rushes and/or forbs.

In general, many of these types would be expected to occur at sites that are too wet to support woody species. Examples of such habitats would include marshes, wet meadows, and pothole ponds. While marshes and pothole ponds are not an uncommon feature in the Basin, wet meadows are rarely observed. This does

not mean, however, that they were not once more common than they are today. Many types of disturbance may have reduced the amount of this habitat. For example, the removal of beaver from Basin streams may be one factor in the elimination of such habitats. The dam building activity of beaver effectivly slows runoff and raises the water table. Removal of beaver populations increases runoff and may lead to lowering of the water table. Livestock grazing can also contribute to increased runoff and lowered water tables through removal of bank cover (Elmore and Beschta 1987). Man may have also intervened directly by filling low spots. In 1883, the north half of the town of Colfax, located near the confluence of the north and south branches of the Palouse River, was described as:

> cut into intricate figures in islets, bayous and bogs, due to the meanderings of the river. Many of those channels, some of them ten to fifteen feet deep, have been filled, first with saw dust and then covered with five or six feet of earth mostly hauled from considerable distances. Three times in fifty years, the entire town has been inundated and greatly damaged when the spring flood waters of both rivers chance to occur at the same time (Roberts no date).

Although largely distinguished by its aridity, the Columbia Plateau still offers a diverse array of local environments. While the communities listed below may never have occupied large expanses of the landscape, they may have played important ecological roles and contributed disproportionately to the biological diversity of the Columbia Basin.

Carex lanuginosa d.t. (CALA)
woolly sedge

This species is a dominant in communities described from Oregon and from Montana. In central Oregon, it occurs at low to moderate elevations. It is most commonly found in the Basin and Range and Ochoco Mountains Physiographic Provinces on floodplains of low gradient streams with active fluvial surfaces (Kovalchik (1987). Kovalchik believes it may have once been common at lower elevations in Oregon. In Montana, it occurs at mid-elevations in meadows, basins and along streambanks in the western and central part of the state (Hansen et al 1988a).

Although there is no record of it being a community dominant in Washington, it is fairly common in the Basin (Mastroguiseppe pers. comm. 1989). It is described as "common" at Moxee Bog outside Yakima (Rapp 1981). It was an associate of a community dominated by C. douglasii and Juncus balticus in the Potholes area prior to the construction of O'Sullivan Dam (Harris 1954). It was an associate of a Carex-Juncus Mictium described by Weaver in 1917. Piper's 1906 Flora of Washington lists a number of collection localities scattered around the Basin.

Carex nebrascensis d.t. (CANE)
Nebraska sedge

This species has been described as a community dominant in Idaho, Wyoming, Utah, Montana and Oregon. In eastern Idaho, western Wyoming and northern Utah, a CANE c.t. was described by Youngblood and others (1985a, 1985b). Typically, this type is found in broad meadows or as narrow stringers on stream terraces with lateral subirrigation rather than flooding.

In Montana, a CANE d.t. is a minor component at low to mid-elevations throughout the state (Hansen et al. 1988a). It occurs in basins and along streambanks and stock ponds. In southwest Montana, a CANE c.t. is found in meadows and on stream banks but its occurrence is incidental in this region (Hansen et al. 1988b).

On the National Forest lands of central Oregon, a CANE c.t. is found on a wide variety of landforms at low to mid elevations (Kovalchik 1987). CANE is an increaser with disturbance, especially with season-long grazing, and replaces other sedges and grasses under such conditions. It is apparently tolerant of trampling.

While no record has been found indicating CANE was a community dominant in Washington, it is still a common species in the Basin (Mastroguiseppe pers. comm. 1989). It is abundant at Moxee Bog and dominates the moist fen portion of the Preserve (Rapp 1981). It was listed as an associated species in Weaver's Carex-Juncus Mictium (1917). Piper's 1906 flora lists collections at Wilbur, Union Flat, Pullman, and Cow Creek. For CANE var. ultriformis, now synonomized with CANE, he gives collection locations at Ritzville and Union Flat. CANE will grow in alkaline situations and tolerates dry air and intense insolation if "its feet are wet" (Cronquist et al. 1977).

Carex praegracilis d.t. (CAPR)
field sedge

One site was visited during the 1988 Riparian Inventory in which CAPR appeared to dominate a narrow band a few meters back from a stream. Adjacent communities on both sides were graminoid dominated.

Documentation of communities dominated by CAPR was not reflected in the literature. In Montana, it is a minor d.t. at low to mid-elevations throughout the state (Hansen et al. 1988a). Sites where it is found include wet meadows, seep, springs, open moist slopes, and alkaline bottomlands. In eastern Idaho and western Wyoming, Youngblood and others (1985a) mention that some of their sample data suggested communities dominated by CAPR as well as

several other sedges, but because the data were limited, they include CAPR under a section on miscellaneous Carex c.t.'s. A CAPR community has been observed at one site in Idaho and is listed as a palustrine element in the Idaho Heritage Classification (Caicco pers. comm. 1989). In portions of Sycan Marsh in central Oregon, it is a co-dominant with C. simulata (Cornelius pers. comm. 1989).

Indications are that the species is common species in the Basin. Barrett (pers. comm. 1989) said it was "the most common Carex out there", and Mastroguiseppe (pers. comm. 1989) said it is "pretty dominant where it occurs". Piper (1906) cites numerous collections from many locations around the Basin (under synonym, C. marcida). This species tolerates both alkali and salt (Mastroguiseppe pers. comm. 1989). Although Kovalchik describes no CAPR dominated communities in central Oregon, he does indicate that the species is found in some vegetation types and increases with disturbance.

Carex rostrata d.t. (CARO)
beaked sedge

CARO has been described as a community dominant in Idaho, Wyoming, Utah, Montana, and Oregon. In eastern Idaho, western Wyoming and northern Utah, it is described as a major type with a wide distribution. Stands occur on level benches or flats and gentle toe-slopes. They occur in wide valley bottoms along low gradient streams, alongside seeps and at margins of open lacustrine systems. Stands also occur on silted-in beaver ponds. Adjacent communities are widely varied and include both wetland types dominated by Eleocharis palustris and upland types dominated by Artemisia tridentata ssp. vaseyana and Elymus cinereus. Other researchers are cited which extend the range of this type into Colorado and central Idaho (Youngblood et al. 1985a, 1985b).

In Montana, the CARO d.t. is a major component at mid-elevations in western and central Montana (Hansen et al. 1988a). It occurs in the same physical settings described above. Species diversity within this type is often very low and CARO frequently forms monotypic stands. A Carex rostrata site type is described as a major type in southwest Montana, and three phases are distinguished (Hansen et al. 1988b).

In Oregon, CARO communities also appear to be widespread. Padgett (1981) described a CARO riparian d.t. from his study area in the Malheur National Forest. Kovalchik (1987) described an association that is widespread in central Oregon at low to moderate elevations. There is widespread agreement among all researchers that CARO communities constitute one of the wettest riparian types.

Several points are relevant to the question of its distribution in the Basin. Hitchcock and others (1969) indicate the species occurs from lowland to moderate elevations in mountains throughout the range of the Flora. However, according to Mastroguiseppe (pers. comm 1989) CARO is not likely to occur at the heart of the Basin but could be expected to circle the edges. There are collections from Spokane, Whitman, Yakima and Klickitat Counties. I found it in northern Douglas County. Although not common, it occurs at Moxee Bog north of Yakima (Rapp 1981).

Deschampsia cespitosa d.t. (DECA)
tufted hairgrass

This species appears to dominate communities that are widespread throughout the western United States. Communities are described from Idaho, Wyoming, Montana, Oregon and possibly Utah. In eastern Idaho and western Wyoming, Youngblood and others (1985a) describe a DECA c.t. that is a major riparian type in that area. It occurs on nearly level stream terraces and in broad meadows. Their publication also indicates that similar communities occur in central Idaho and in Colorado. In southern Idaho it is a minor type. Reconnaissance data indicates that it might occur in northeastern Utah (Youngblood et al. 1985a).

In Montana, a DECA d.t. occurs in all but the southeastern portions of the state from mid to high-elevations (Hansen et al. 1988a). In southwest Montana, a DECA riparian site type varies from a minor to a major type (Hansen et al. 1988b). Both types are found in similar situations including level stream terraces, moist meadows, basins and around seeps. These environments range in their moisture availability from wet to relatively dry (Hansen et al. 1988a).

In central Oregon, Kovalchik (1987) describes a DECA association that occurs in all but the Grassland Physiographic Province in his study area. In addition to it's broad geographic distribution, the association also has a broad elevational range. Kagan (no date) lists a DECA community in the Oregon Heritage Classification under "Alkali Grassland Types" and strongly believes that DECA communities should be expected to occur in the Washington Columbia Plateau Province.

Several pieces of evidence indicate historic occurrence within the Province. DECA is described as an associated species in wet meadows now dominated by Phalaris arundinacea at Turnbull Pines and Pine Creek Research Natural Areas (Franklin et al. 1972). The Whitman County Soil Survey Manual (Donaldson 1980) indicates that DECA is the native vegetation on the Caldwell, Latah and Covello soil types. In 1917, Weaver described a DECA consocies dominated by DECA. He writes, "this characteristic grass... often occurs as nearly pure growths". Piper (1906) lists collection localities at "Wenache" River, Spokane, Pullman,

Steptoe, Waitsburg, and Lake Chelan. It has been observed in the Yakima Valley (Cornelius pers. comm 1989), and it is listed as an associated species in a moist meadow disclimax described on the Yakima Indian Reservation (Tart et al. 1989).

Distichlis stricta d.t. (DIST)
alkalai saltgrass

This type is well documented within the Columbia Plateau Province. It was described as a habitat type by Daubenmire (1970) and is characterized by a pure sward of Distichlis stricta. It occurs in saline and alkaline areas within the Artemisa tridentata/Agropyron, Artemisia tridentata/Festuca, Agropyron-Poa, Agropyron-Festuca, and Artemisia tripartita/Festuca zones. An example of it occurs at Lower Crab Creek Natural Area Preserve (Schuller 1985, in-house document on file with the WA Nat. Heritage Program, Olympia, WA). Other examples occur in the Grand Coulee and near Dusty, Washington. The species is generally more tolerant of livestock grazing than are the native perennial bunchgrasses in the Columbia Basin (Schuller pers. comm. 1989).

In Montana a DIST d.t. is found at lower elevations throughout the state. It is a minor type, but occasionally is locally abundant (Hansen et al. 1988a). In southwest Montana, a DIST riparian site type is incidental at low to mid-elevations (Hansen et al. 1988b). Both types are found in basins, swales, at the margins of lakes and ponds, and around saline or alkaline seep areas. DIST communities will withstand prolonged seasonal flooding (Hansen et al. 1988a).

Eleocharis palustris d.t. (ELPA)
common spike-rush

Communities dominated by ELPA have been described in Idaho, Montana and Oregon. Youngblood and others (1985b) describe one site in Idaho surrounding a small lake in the Gibson Basin in 1 to 3cm standing water. An ELPA d.t. is common at low to mid-elevations throughout Montana (Hansen et al. 1988a). It occurs along the margins of large rivers, lakes, reservoirs, stock ponds and in internally drained basins. In southwest Montana, an ELPA riparian site type is a minor type at low to mid-elevations. It occurs in wet basins and along stream and lake margins at sites which tend to be flooded annually (Hansen et al. 1988b).

In Oregon, Padgett (1981) described an ELPA riparian community that was uncommon in his study area in the Malheur National Forest of eastern Oregon. Kovalchik (1987) also described an ELPA association which he encountered throughout his central Oregon study area. It occurred at a wide range of elevations and on a wide range of riparian landforms. Their common attributes were low valley gradient and standing water, either seasonally or

permanently. This type occurs around natural as well as man-made features.

In Washington, ELPA dominates narrow zones along portions of Crab Creek and the Palouse River. Some historical evidence (Weaver 1917) indicates ELPA dominated a community in southeast Washington that "sometimes covers considerable areas with pure growth".

Elymus cinereus d.t. (ELCI)
giant wildrye

Communities dominated by ELCI are well documented in Washington. Daubenmire described an ELCI-Distichlis stricta h.t. that occurs in saline and alkaline areas in the Basin. A very similar community is documented on the Yakima Indian Reservation (Tart et al. 1988).

Daubenmire (1970) also notes that ELCI can extend beyond the boundaries of the ELCI-DIST communities and thus beyond the limits of salinity. Pure sward of ELCI were noted by Dean (1960) adjacent to willow riparian stands in the Owyhee Canyon of Oregon. In Washington, Huschle (1975) noticed ELCI swards near the mouth of the Palouse River.

An ELCI d.t. is reported as common and locally abundant at low to mid-elevations in western and central Montana (Hansen et al. 1988a). Associated species include Sarcobatus vermiculatus, Artemisia tridentata, Agropyron smithii, and Poa pratensis. An ELCI-DIST association extends as far north as Kamloops, B.C. and as far south as Nevada (Daubenmire 1970).

Glyceria striata d.t. (GLST)
fowl mannagrass

GLST was seen at two sites during the 1988 Riparian Inventory. At one site, it dominated the understory beneath a small stand of birch and aspen surrounding a small seep. At the other site, it dominated the banks of a small pool and stream. It was also growing in an area that looked like a silted-in pool. This second site was inaccessable to cattle and was probably too small to have ever been heavily used by sheep. It is assumed that communities of this type were once more common or widespread and have disappeared because GLST is an extremely palatable species (Hansen et al. 1988a).

A GLST d.t. is described as a minor type throughout much of Montana. It occurs from low to high elevations along streambanks, in marshes, seeps, bogs and in wet meadows (Hansen et al. 1988a). It can form nearly pure stands or be mixed with other graminoids.

Juncus balticus d.t. (JUBA)
Baltic rush

JUBA communities have been described in Idaho, Wyoming, Montana, and Oregon. Youngblood and others (1985a, 1985b) describe a JUBA c.t. as a minor type in southern and eastern Idaho and western Wyoming, but note that it also occurs outside their study area in central Idaho. It occurs in meadows, around seeps, and on alluvial terraces. It often occupies moist depressions within other c.t.'s. In Montana, a JUBA d.t. is well represented at low to mid-elevations in all parts of the state. It usually occurs as scattered pockets in broad valleys or meadows (Hansen et al. 1988a). In southwest Montana a JUBA c.t. is a minor type at low to mid-elevations (Hansen et al. 1988b).

In Oregon, Padgett (1981) described a JUBA riparian d.t. that was common in all parts of his study area in the Malheur National Forest. It usually formed small communities in or near other riparian types. Kovalchik (1987) described a JUBA c.t. in central Oregon that occurs in moist portions of disturbed meadows. The association of JUBA communities with disturbance by livestock grazing is consistant through all these studies. In many cases it is thought JUBA types replace other riparian types.

In Washington, Weaver (1917) described JUBA as locally dominant in the southeast portion of the Plateau. Harris (1954) described the species as very abundant in the Potholes Area prior to their inundation by O'Sullivan Dam. He described JUBA and Carex douglasii as the dominant plants below the Distichlis stricta zone. In many potholes, JUBA was the only cover. The Potholes were actively grazed at the time of Harris' study.

Scirpus acutus d.t. (SCAC)
hardstem bulrush

Scirpus acutus communities are reported in Idaho and Montana. Youngblood and others (1985a, 1985b) describe them as infrequent in their study area in eastern Idaho, but note they are more common at lower elevations within the Great Basin. In Montana, the SCAC d.t. is common at low to mid-elevations throughout the state (Hansen et al. 1988a). The type occurs in marshes, basins and at the margins of lakes and ponds. Persistent standing water is a customary feature of its habitat, although the species has some tolerance for drought and can also occur at sites where water levels drops below the soil surface. It is somewhat more tolerant of brackish and saline conditions than Typha latifolia. In southwestern Montana, a SCAC riparian site type is a minor type within the same elevational range (Hansen et al. 1988b). These communities are characteristically impoverished and have few other species occurring in them. These occur in low amounts.

There appear to be numerous examples of SCAC communities in the Columbia Basin today, although many of these may have been altered by disturbance. In 1917, Weaver described a Scirpus consocies in southeast Washington. He indicates two species are dominant: Scirpus occidentalis (synonym for SCAC) and S. microcarpus. Harris (1954) also mentions SCAC. At the Potholes, SCAC stands occurred in a zone of standing water to three feet deep.

Scirpus americanus d.t. (SCAM)
three-square bulrush

Little documentation of SCAM communities has been found in the literature. However, an in-house document on file at the Oregon Natural Heritage Program does indicate SCAM dominates some lake associated wetland systems in eastern Oregon (Baker no date). In Death Valley, SCAM occurs at the edge of open water at remnant springs and marshes of pluvial Lake Manly (Minckley and Brown 1982).

In the Columbia Basin, casual observation indicates this species may be a dominant at least locally. A community of this type was observed on the North Columbia Basin Wildlife Area, Gloyd Seeps Unit. This area is highly disturbed. However Harris (1954) describes it from the same general area at the Potholes. It was one of his six principal cover types which was locally common in some of the potholes prior to their inundation by the waters of Potholes Resevoir.

Scirpus microcarpus d.t. (SCAM)
small-fruit bulrush

Scirpus microcarpus communities are reported in Oregon and in the southern Idaho-northern Utah area. Kovalchik (1987) reports a SCMI-Carex amplifolia association is common in all the National Forests in central Oregon except the Winema. It occurs at low to moderate elevations on a variety of landforms including overflow channels, active channel shelves, active floodplains and wet meadows and basins. It is a seral type that will be replaced by other types as the fluvial surfaces mature. The association is dominated by either or both SCMI and Carex amplifolia. In southern Idaho-northern Utah, a single stand of SCMI was sampled on a wet terrace adjacent to the Blacksmith Fork (Youngblood et al. 1985b). In southeast Washington, Weaver (1917) indicates it was one of two dominants in his Scirpus consocies.

Scirpus validus d.t. (SCVA)
softstem bulrush

SCVA communities are documented in Montana, Oregon and Idaho. In Montana the SCVA d.t. is a minor type at lower elevations throughout the state. It is usually found growing in standing

water in marshes, at the margins of lakes and ponds, in oxbow lakes, and in backwater areas of rivers and streams. The species withstands alkaline conditions. As a rule, it forms monotypic stands (Hansen et al. 1988a). In southeastern Oregon around 1924, SCVA was an important dominant in the extensive tule marshes in the Klamath Lake area (Shantz and Zon 1924 in Franklin and Dyrness 1973). A SCVA community is an element in the Idaho Natural Heritage Plant Community Classification (Caicco 1988).

SCVA has a broad distribution in North America. Hitchcock and others (1969) indicate it should be found in appropriate habitats throughout the Pacific Northwest. Because SCVA and S. acutus are very similar in appearance, it would be difficult to say how important SCVA communities are in the Columbia Basin. Hitchcock and others (1969) indicate that, although colonial, it seldom grows in the extensive colonies formed by S. acutus.

Spartina gracilis d.t. (SPGR)
alkali cordgrass

Little documentation of SPGR communities has been found in the literature. A SPGR d.t. is described as a rare type in central and eastern Montana (Hansen et al. 1988a). It occurs at lower elevations in wet areas like swales, meadows, and the edges of marshes and ponds. It tolerates alkali and often forms nearly pure stands.

Harris (1954) reported that SPGR occurred at the Potholes area prior to O'Sullivan Dam. It grew in a higher zone than Distichlis stricta on the semi-stable dunes that surrounded some of the ponds. Weaver (1917) also reported it in drier portions of the Palouse Region in low areas. Piper (1906) cites collections at Coulee City, Wilson Creek, and Grand Coulee.

Spartina pectinata d.t. (SPPE)
prairie cordgrass

Less information was found on communities dominated by SPPE than on S. gracilis. Like S. gracilis, a SPPE d.t. is also found in central and eastern Montana (Hansen et al. 1988a). It is a minor type at low elevations and occupies the same habitats. It apparently does not have the same tolerance for saline-alkaline situations that S. gracilis does. Reed (1988) indicates its wetland indicator status in the Pacific Northwest Region is "obligate" while that of S. gracilis is "facultative wet". Although tolerant of high water tables, both species are intolerant of prolonged flooding (Hansen et al. 1988a). In the Columbia Basin, Piper (1906) lists one collection from Almota. However, Rex Crawford and Shelley Evans found the species to be quite common within a six mile section of the Palouse River Canyon. It formed a two to three meter wide band adjacent to the river. An Eleocharis palustris community sometimes occurred

along its lower edge and a Salix exigua community occurred along its upland side. Miller (1976) describes SPPE as a rare species along the Snake River in Idaho. Padgett (pers. comm. 1989) encountered it infrequently along the Silvies River in Oregon.

FORB DOMINATED COMMUNITIES

Sparganium eurycarpum d.t. (SPEU)
broadfruited bur-reed

This type is based on personal observations from the 1988 Riparian Inventory. No mention of any similar community has been found in the literature although an in-house document on file at the Oregon Natural Heritage Program suggests that Sparganium-dominated wetlands occur in eastern Oregon (Baker no date).

In the Columbia Basin, Sparganium-dominated wetlands have been observed at two sites. In Lincoln County, S. eurycarpum dominates a fairly extensive area in a broad valley bottom along a portion of Sinking Creek. It was virtually a monotypic stand except for small amounts of a Polygonum species. There was no standing water at the site, but it may be wet in other years. At the second site in Spokane County, the moist bottom of a seasonal pothole pond was dominated by an unidentified Sparganium and Polygonum species (Cornelius, Field Notes 6/23/87. In-house document on file at The Nature Conservancy, Seattle, WA). A rare to minor Sparganium emersum d.t. is documented at low to mid-elevations in Montana. It occurs in marshes and along pond and lake margins (Hansen et al. 1988a).

Typha latifolia d.t. (TYLA)
common cattail

Communities dominated by TYLA are reported from Idaho, Wyoming, Utah, Montana and Oregon and are likely to be found elsewhere because the species occurs throughout North America. In eastern Idaho and western Wyoming, Youngblood and others (1985a) occasionally encountered dense stands of TYLA throughout their study area. They did not sample these because of their small size. In the southern Idaho-northern Utah area, TYLA stands were noted along the major rivers (Youngblood et al. 1985b).

In Montana, it is a common d.t. at low to mid-elevations throughout the state (Hansen et al. 1988a). It occurs in marshes, along the margins of lakes and ponds, in oxbow lakes, and backwater areas of rivers and streams. Persistent standing water is a customary feature of its habitat. TYLA usually forms dense monotypic stands which can cover extensive areas, and it is intolerant of saline conditions. In southwest Montana, a TYLA riparian site type is described as a minor to "possibly major" type at low to mid-elevations. In addition to occurring in the habitats mentioned above, it is also found in drainage ditches

(Hansen et al. 1988b). In Oregon, TYLA is a co-dominant with Scirpus acutus at Sycan Marsh (Cornelius 1981).

Today, casual observation indicates that TYLA is one of the most common species in the Basin at sites with standing water. Historically there are also some records of its occurrence. In 1906, Piper wrote that it was exceedingly common around lakes and marshes in western Washington and was scarcely less so in eastern Washington. However this opinion was not necessarily shared by others. Pertaining to southeast Washington, Weaver (1917) wrote that in consideration of the region as a whole that it (a Scirpus-Typha consocies) is found covering only limited areas, that the two dominants rarely occur together, and that Typha is not abundant or as widely represented as Scirpus. TYLA comprised one of Harris' six principle cover types at the Potholes, but he too states that it is relatively uncommon (1954).

In Montana, Hansen and others (1988a) note that Typha and Scirpus stands can occur adjacent to each other in the same marsh, but where they do, ecotone boundaries are often distinct and abrupt. It is also noted that stands of Typha and Scirpus switch their relative positions with respect to deep water.

Vernal Pond Vegetation

Vernal ponds are scattered throughout the channeled scablands especially in Grant, Douglas and Lincoln counties (Schuller pers. comm. 1989). They are dominated by distinct assemblages of native annuals and perennials which are found solely in these habitats in eastern Washington (Schuller 1984). Three or four separate phenological stages occur over the growing season in which one or a few species dominate each phase. These phases were monitored for one year at the Marcellus Shrub-Steppe Preserve and were characterized in the following way (Schuller 1984):

1) April to early May
   Lomatium greyii, Montia linearis
2) mid-May to mid-June
   Allium geyeri, Navarettia intertexta var. propinqua, and Polygonum confertifolium
3) mid-June to mid-July
   Downingia elegans, Poa juncifolia, and Eleocharis palustris
4) July to early August
   Grindelia nana

A second preserve site in Grant County also has a vernal pond. In a mid-June visit, the vegetation was dominated by Eleocharis palustris. The associated species included Myosurus sp., Downingia elegans, Lappula echinata (exotic), Polygonum watsonii (possibly confertifolium), and Ranunculus aquatilis var.

capillaceous (in the pool) (Kratz, field notes 1980. In-house document on file at the WA Nat. Heritage Program, Olympia, WA).

MISCELLANEOUS COMMUNITIES

The following is a list of miscellaneous communities which may or may not deserve recognition as dominance types. In general, less is known about them than about those on the preceeding lists. The reasons for including them are varied and are discussed below.

Carex simulata-Carex interior (CASI-CAIN)
short-beaked sedge-inland sedge

These two sedges occur at Moxee Bog near Yakima (Rapp 1981). This fresh water spring is dominated by C. simulata in drier portions of the fen. C. interior is a minor, but constant associate.

Hitchcock and others (1969) indicate that C. interior occurs in marshes, swamps and bogs from lowlands, in moist regions, to mid-elevations in the mountains. C. simulata occurs in wet meadows from foothills to mid-elevations in mountains.

Carex simulata-dominated communities are reported in Idaho, Wyoming, Montana, and Oregon. Youngblood and others (1985a) describe a c.t. that occurs sporadically through parts of their study area in eastern Idaho and western Wyoming. Their reconnaissance data indicates that it extends into forested zones of southcentral Oregon. They have also observed similar communities in central Idaho. A CASI riparian site type is described from southwest Montana at mid- to high elevations (Hansen et al. 1985b). Kovalchik (1987) describes a CASI association at low to moderate elevations in central Oregon.

A Carex interior-Hypericum anagalloides community is an element in the Idaho Heritage Classification (Caicco 1988).

Carex vesicaria (CAVE)
inflated sedge

Although not as common as C. rostrata, C. vesicaria has a similar distribution in Washington (Mastroguiseppe pers. comm. 1989), so this species possibly formed minor communities around the margins of the Basin. Communities dominated by C. vesicaria are well documented in other states although usually at higher elevations. Youngblood and others (1985a) briefly mention dense stands of C. vesicaria that occur along the margins of shallow lakes and ponds in 20 to 50cm of standing water. These "wetland" communities are especially common northeast of Ashton, Idaho. In Montana, a CAVE d.t. is reported as minor to locally common at mid-elevations throughout the state (Hansen et al. 1988a). It is found in poorly

drained basins, along pond, lake, and stream margins and on alluvial terraces. In central Oregon, it occurs from low to moderate elevations on a wide variety of low gradient landforms (Kovalchik 1987). Moist to semi-saturated soils or seasonal flooding seem to be important factors in the maintenance of these communities (Kovalchik 1987, Hansen et al. 1988a).

Phragmites communis (PHCO)
common reed

Small colonies of this species were observed infrequently during the 1988 Riparian Inventory. Barrett (pers. comm. 1989) has observed the species in Klickitat County, the Grand Coulee, and the Yakima Valley and remarked that once it gets established, it often becomes dominant. Piper's flora (1906) indicates some relatively early collections in the Basin along the Columbia River, Crab Creek in Douglas County, and between Yakima and Ellensburg.

In Montana, it is a common d.t. at lower elevations in the central and eastern portion of the state. It occupies swales, pond and lake margins, oxbow lakes, backwater areas, and banks of rivers (Hansen et al. 1988a).

Poa nevadensis-Puccinellia lemmonii-Sitanion hystrix (PONE-PULE-SIHY)
Nevada bluegrass-Lemon's alkaligrass-bottlebrush squirreltail

This community is an element in the Oregon Natural Heritage Plant Community Classification (Kagan no date). It is an alkaline wet grassland type that can occur in riparian habitats (Kagan pers. comm. 1989). All three species occur in Washington, but Puccinellia lemmonii is restricted to southeast Washington (Hitchcock et al 1969). If a community of this description were to be found, it would be expected in the southeast.

Camassia quamash (CAQU)
common camas

Daubenmire (1970) writes about dense stands of CAQU that grew in seasonal marshes in the meadow steppe zone and whose demise he attributes to pig grazing. In Weaver's 1917 study of the vegetation of southeast Washington, CAQU is described as one of the principal wet meadow species of a wet meadow associes. Schuller (pers. comm. 1989) indicates that CAQU is a co- or sub-dominant in seasonally wet depressions throughout all but the most arid parts of the Columbia Basin. A wide variety of species occur as major and minor associates in these areas. All known sites have been grazed by livestock in the past; most continue to be today.

Hesperochiron pumilus (HEPU)
dwarf hesperochiron

This is included on the basis of Mack's account (1988) of the 1893 expedition of Sandberg and Leiberg. According to Mack, the explorers found alkaline ponds invariably fringed by HEPU. At times it was so abundant that its flowers gave the appearance of a blanket of snow.

DOMINANCE TYPES RESULTING FROM HUMAN-INDUCED DISTURBANCE

The following list is based primarily on personal observation during the 1988 Riparian Inventory and subsequent review by biologists who have done work in the Columbia Basin. The list is an initial attempt to summarize these observations and will undoubtedly need refinement in the future. Some species on the list are introduced in our area; others are native species that increase with disturbance. Many "weedy" species that occur in the Basin occupy a broad range of habitats and occur in both uplands and wetlands; most of these do not occur on this list.

Acer negundo (ACNE)
Origin: Introduced
Abundance: Uncommon. This species occurs sporadically in the Columbia Basin and with one exception, has not been dominant. At a Columbia County site, it is a prominent species in the overstory occurring primarily with POTR 2, SALAC, and CRDO. Sambucus cerulea occurs as a minor associate in this stand.

Elaeagnus angustifolia (ELAN)
Origin: Introduced
Abundance: Infrequent. This species was infrequently encountered during the Riparian Inventory. It was most often observed in Benton County where it occasionally appeared to be dominant or co-dominant. These observations may not represent its true abundance in the Basin.

Schuller (pers. comm. 1989) says the species is common around Yakima and the Tri-Cities. It is also proving to be a persistant problem and future threat to the Lower Crab Creek Natural Area Preserve in Grant County. Two unpublished letters from Chuck Perry to Mark Quinn (9/9/86 and 5/14/87; on file at the WA Natural Heritage Program, Olympia, Wa) document an active invasion of the species despite efforts to eliminate it from the preserve.

This species is also causing concern in other parts of the west. Not only is it proving difficult to control, but it also has the potential for displacing native

riparian species and for forming monotypic stands (Hansen et al. 1988a, Knopf and Olson 1984, Olson and Knopf 1986).

Juglans sp.- either black walnut or Japanese walnut (F.D. Johnson, pers. comm. 1989)
Origin: Introduced
Abundance: Rare. This species was observed at two sites in Klickitat County where it is abundant and appears to be spreading. One of the sites is dominated by white alder which is comparable to the communities along the Snake and Salmon Rivers in ID in which walnut has naturalized (Miller 1976).

Robinia pseudoacacia (ROPS)
Origin: Introduced
Abundnace: Infrequent. This species has been planted as a shade tree. It is widespread in the Columbia Basin, but only occasionally persists as a stand dominant (Schuller, pers. comm. 1989).

Amorpha fruiticosa (AMFR)
Origin: Introduced
Abundance: Infrequent. This species occurs as scattered individuals at a few sites, primarily along larger rivers such as the Touchet and the Columbia. However, at one site in Garfield County, it is the dominant species over a five mile stretch of stream where it appears to form a monotypic stand to the exclusion of any native species. Johnson (pers. comm. 1989) said it occurs upstream from Hell's Canyon in southern ID where it grows along rivers and resevoirs. He also said it is very aggressive, becoming dominant, and it is migrating toward Washington.

Bromus inermis (BRIN)
Origin: Introduced
Abundance: Relatively common. This species appears to colonize the channel bottoms of ephemeral and/or intermittent streams where little or no native vegetation remains. It occurs in patches, and it never seems to extend over very large areas.

In MT it comprises a minor d.t. at low to mid-elevations throughout the state. It is found on previously cultivated areas in addition to other disturbed sites (Hansen et al. 1988a). Its distribution corresponds with precipitation amounts of 40-50cm (16-20") but it also occurs on sub-irrigated sites in lower rainfall zones (Wasser 1982 cited by Hansen et al. 1988). Because this species occurs along ephemeral stream channels in Washington, this may imply these sites also receive sub-irrigation.

Carex nebrascensis (CANE)

Origin: Native

Abundance: Unknown. Nebraska sedge is a known increaser. In central Oregon it dominates sites where disturbance has caused the decrease or elimination of normal climax dominants within the Deschampsia caespitosa, Carex rostrata, C. vesicaria, C. eurycarpa, Salix/C. lanuginosa, and C. lanuginosa associations (Kovalchik 1987). It may also replace C. aquatilis at lower elevation sites dominated by the C. aquatilis association. If sites are found in the Columbia Basin where CANE is a dominant, some consideration should be given to the possibility that its dominance originates from disturbance.

NOTE: CANE appears on both the list of natural vegetation communities and on the current list because its historical role is unknown and because of its tendency to increase with disturbance. Other native species that appear on this list and also have a tendency to increase with grazing have been dealt with in a similar fashion.

Carex praegracilis (CAPR)

Origin: Native

Abundance: Occasional. This species was encountered at only two sites in 1988. Barrett (pers. comm. 1989), however, says it's the most common species of Carex in the Basin.

This species, like Nebraska sedge, is an increaser (Kovalchik, pers. comm. 1989). Consequently, it has been placed on both this list and the list of presumed natural vegetation communities.

Distichlis stricta (DIST)

Origin: Native

Abundance: Rare. The DIST h.t. is the least common of the saline-alkaline vegetation communities in Washington; only a small number sites are dominated by it. Because D. stricta is so tolerant of grazing, the pure swards of DIST that characterize the type may actually result from the elimination of associated species. Daubenmire (1970) stated that it was hard to say with any confidence that an area supporting this h.t. had not experienced at least some alteration by domestic animals. Distichlis stricta types appear on both lists for this reason.

Eleocharis palustris (ELPA)

Origin: Native

Abundance: Occasional. This species, like several others

on this list, is a native species that also colonizes disturbed sites. For instance, it often occurs along shorelines of reservoirs and stockponds (Kovalchik 1987, L. Cornelius, pers. comm. 1989). During the 1988 Riparian Inventory, it was observed both at sites that appeared to have been disturbed as well as at sites that appeared in relatively good condition.

balticus (JUBA)
Origin: Native
Abundance: Common. This is another species known to increase with grazing. It was not a particularly common species at 1988 Inventory sites but, casual observation indicates it is common in or adjacent to areas with standing or slow moving water. Harris (1954) states it was abundant at the Potholes prior to the construction of O'Sullivan Dam. Schuller (pers. comm. 1989) says it common and widespread in coulee bottoms and potholes around Cheney and in Lincoln, Adams, Grant, and Douglas Counties.

arundinacea (PHAR)
Origin: Introduced
Abundance: Extremely common and widespread. This species was encountered more frequently on disturbed riparian sites than any other species.

ratensis (POPR)
Origin: Introduced
Abundance: Occasional. This species was not particularly common at 1988 Inventory sites, however, in one case it was the dominant graminoid in a dry meadow. At several other sites, it was the dominant understory species below trees. One of these sites surrounded a seep, but the mosts prevalent habitat was along streams. Schuller (pers. comm. 1989) stated that POPR is a widespread and pervasive increaser in the Palouse and higher precipitation areas within the Basin. All the important riparian classifications done in adjacent states include Poa pratensis types. The widespread occurrence of these types undoubtedly represents the displacement of many different native vegetation communities.

arvense (CIAR)
Origin: Introduced
Abundance: Common. This is not really a d.t., but the species does seem to be a persistant invader in riparian and sub-irrigated areas and can sometimes form some rather extensive patches.

Equisetum arvense (EQAR)

Origin: Native

Abundance: Uncommon. This type was observed at a few sites. In most cases it occurred in an understory setting below trees, but at one site it grew in the open. It usually formed a dense continuous stand. All the sites where it occurred appeared to be fairly severely disturbed by past grazing. It is, however, a native understory dominant in some forested communities outside of the Province.

Lythrum salicaria (LYSA)

Origin: Introduced

Abundance: Unknown. This species was not encountered in the 1988 Riparian Inventory. However a short article which appeared in the Washington Farmer-Stockman (Anon. 1988) indicates that as many as 55,000 acres in Grant Co. alone may be affected by this species. Although the discussion in the article is focused on the problems LYSA may create within the irrigation system of the Columbia Irrigation Project, the article also indicates that its recent expansion into the west has been rapid and that it has the capacity for dominating wetlands. Schuller (pers. comm. 1989) indicated that it is a problem in Yakima and Okanogan Counties as well.

Rorippa nasturtium-aquaticum (RONA)

Origin: Introduced

Abundance: Relatively common. This emergent appears to be an in-stream dominant at disturbed sites. It appears occurs in springs, seeps, and streams with slow moving water.

Solidago canadensis var. salebrosa (SOCAS)

Origin: Native

Abundance: Unknown, probably infrequent. This is an important species at one site in Grant County where it occurs along a disturbed stream supporting vegetation in an early stage of recovery. At this site, young Salix amygdaloides (Height=2 to 3m) occurs intermittently and the SOCA forms dense stands between trees. Associated species include: Rumex salicifolius var. triangulavalvis, Epilobium watsonii and Veronica sp.

Tanacetum vulgare (TAVU)

Origin: Introduced

Abundance: Relatively common. While this may not comprise an actual dominance type, this species is a fairly frequent invader along disturbed streams and often co-occurs with Cirsium arvense and/or Urtica dioica. According to Schuller (pers. comm. 1989), it occurs

with Phalaris arundinacea at certain sites in Lincoln County.

Typha latifolia (TYLA)

Origin: Native

Abundance: Common to abundant in appropriate habitats. At 1988 Inventory sites, this species was occasionally encountered along disturbed streams. Stands were usually quite small. However casual observation indicates that TYLA is extremely common along lake margins, in potholes, drainage ditches and other marshy habitats throughout most of the Columbia Basin. Some stands in these habitats are extensive.

There is some indication that TYLA may have greatly increased its importance in the Basin. A 1917 report on the vegetation of southeast Washington states that TYLA was not common at that time (Weaver 1917). Scirpus was the more abundant of the two. TYLA is a prolific seed producer and it requires a moist bare substrate for seed germination (Hansen et al. 1988a). TYLA also increases with nutrient loading (L. Kunze, pers. comm. 1989). With the long history of cattle grazing in the Basin and a limited water supply, cattle undoubtedly concentrated on wet sites enriching the water with their manure and trampling the vegetation along the shoreline. It is likely that this combination of factors in part accounts for the present distribution and abundance of the species in the Basin.

Urtica dioica (URDI)

Origin: Native

Abundance: Common and widespread along disturbed streams where it can form dense impenetrable patches. This species apparently increases with disturbance.

Vernally Wet Herbaceous Communities Occurring along Disturbed Ephemeral Streams

Description: These streams dry up by early summer. They may be dominated by any number of short-lived herbaceous species. One or more of the following typically occur in such areas: Melilotus alba, M. officinalis, Mimulus guttatus, Rumex crispus, Veronica catanata, V. anagalis-aquatica, and Xanthium strumarium.

LARGE SCALE PATTERNS OF COMMUNITY DISTRIBUTION

There are numerous indications that many of the smaller streams and rivers in the Columbia Basin supported diverse communities of woody species. Many examples have been cited throughout this report. However, this does not seem to be the case along most of

the larger rivers like the Palouse, Snake and Columbia. Although the evidence for this is fragmentary, the indications are there.

Most of the earliest reports on the region are consistent in their depiction of a vast treeless plain where the Columbia River crosses the interior. Perhaps significantly most of the early routes used by explorers followed the courses of the major rivers. Because these rivers are frequently confined to steep valleys and canyons, the use of river valleys as transportation corridors may have often prevented the early visitors from viewing most of the plateau (Meinig 1968). The harsh landscape the explorers portrayed may have been as much a reflection of the river valleys themselves as it was of the plain beyond.

Descriptive accounts begin in 1805 with Lewis and Clark, the first white men to enter the region. In their journals, scarcity of fuel is a persistent theme. More telling perhaps is an entry made at an encampment somewhere near the confluence of the Snake and Columbia. It was near the end of the salmon spawning season, the date Thursday, October 17, 1805:

> The number of dead salmon on the shores and floating in the river is incredible to say--and at this season they have only to collect the fish, split them open and dry them on their scaffolds on which they have great numbers. How far they have to raft their timber they make their scaffolds of I could not learn; but their is no timber of any sort except small willow bushes in sight in any direction (DeVoto 1953).

On their return trip over the Columbia Plain, they took a shortcut eastward to the Clearwater Valley which took them through the Walla Walla Valley. They found the lower plains of the Walla Walla poor and sandy, but encountered good timber further upstream. The species including cottonwood, birch, haw and willow were said to line the stream (Meinig 1968).

The 1853 to 1855 Railroad Survey expeditions are another source of information on early vegetation patterns. Perhaps most valuable are the set of lithographs that accompany the narrative. Most of the lithographs (the original paintings by John Mix Stanley) depict settings along the Columbia and Palouse River, and all of them indicate the banks are treeless. While some allowance must be made for artistic licence, these were scientific expeditions in which the artist would be expected to faithfully portray his observations of the region.

Although a complete reading of the narrative was never accomplished by this author, several entries support the idea of treeless river banks. Isaac Stevens (1860) wrote the following description based on an account given to him by John Mix Stanley who saw the Palouse Falls in 1847.

> The Pelouse River flows over three steppes, each of which is estimated to have an ascent of a thousand feet. The falls descend from the middle of the lower of these steppes. There is no timber along the course of this stream, but a few willows and other bushes.

Another entry describes the environs along the Yakima River.

> The lower part of the Yakima Valley is less fit for cultivation than higher up, but contains much good grassland. It is wide open and destitute of timber except in the bottom lands and even there few trees are found for forty miles up. Fifty-five miles up, on the branch called Ahtanum occurs the first oaks met with west of the Missouri River at Ft. Union.

Later in the entry, the author continues:

> Yellow pine appears, and gradually increases in amount on the banks of the streams, and about ninety miles from its mouth begins to appear on the mountain slopes, marking with rather a sudden and sharp line the border of the unwooded plain.

Various other journal entries and paintings by other artists seem to confirm the pattern described above (Meinig 1968, Stenzel 1975) and the same pattern may still be present today. Consider the Spartina and willow communities found along the Palouse. Along the last free-flowing section of the Columbia River at Hanford Reach, Rickard and others (1982) write

> The most striking feature of Columbia River shoreline plant communites is the paucity of tree corridors, willows and cottonwoods, that characteristically border most streams and rivers. Instead the streamside vegetation consists of a narrow zone of shrub-willows and various species mixtures of rushes, grasses, and forbs that have the capacity to become established and grow in a rooting substrate consisting mostly of water-worn cobbles and assorted gravels.

CONCLUSIONS

While the information contained in this report may provide some insight into past patterns of vegetation composition and distribution, the limitations of this approach deserve some mention. Even with a reasonably complete field inventory, the effects of historical and contemporary land use, in combination with the scarcity of undisturbed sites, have irretrievably obscured the pre-settlement vegetation patterns. After all, even the best remaining native vegetation sites are typically small and are being affected by activities and ecological processes originating upstream and upslope. At an optimum, a partial

reconstruction of natural riparian and wetland vegetation patterns and processes is all that can be hoped for.

Within these constraints however, continuation of field inventory and periodic review of the literature should be undertaken. Vegetation is a key component in the complex set of interactions which govern riparian and wetland ecosystems. Its understanding is essential to an understanding of some other issues in riparian and wetland ecosystems management like water quality, water quantity, fisheries, wildlife, and flood and erosion control. Comprehension of these interrelationships is integral to the development of a sound stewardship ethic which can guide the future management and preservation of these environments.

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Shelley Evans

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LIST OF 1988 and 1989 RIPARIAN SURVEY SITES

Counties	Site Name	Quad Code
Adams	McElroy Creek	4711718,28
Adams	Lind Coulee P	4611885
Adams	Cow Creek	4711821
Adams	Bauer Coulee	4711826
Adams	Rocky Coulee	4711828
Benton	Cold Creek, Site 2	4611957,58
Benton	Cold Creek, Site 1	4611957
Benton	Snively Springs	4611946
Benton	Rattlesnake Springs P	4611956
Benton	10N 25E S9,16	4611936
Benton	Yakima River, Grosscup Rd.	4611933,34
Benton	Corral Creek P	4611936
Benton	Knox Road	4611935
Benton	Snipes Creek	4611946
Benton	Owl Springs	4611936
Benton	Maiden Creek	4611947
√Benton	Matney Springs	4611947
Benton	12N 24E S6	4611957
Benton	Snipes Creek 10N 25E S11	4711936
Benton	McWhorter/Lonesome Springs	4611935,36
Columbia	Toucannon River	4611748
Columbia	North Fork, Touchet River	
Columbia	Wolf Fork, Touchet River	
Columbia	Kellogg Creek P	4611841
Columbia	Lewis and Clark Trails SPK P,EOF	4611831
Douglas	East Foster Creek	4711985,86
Douglas	West Foster Creek	4711986,4712016
Douglas	Rattlesnake/Mineral Springs P,EOF	4711947
Douglas	McCartney Creek P,EOF	4711956 ✓
Douglas	Beaver Creek, Site 1	4712042
Douglas	Barkers Canyon	4711982
Douglas	Cold Springs Basin	4711987
Douglas	Little Rattlesnake Springs P	4711947
Douglas	McNeil Canyon P	4711978
Douglas	Titchenal Canyon P,EOF	4711958,4712051 ✓
Douglas	Central Ferry Canyon	4811917-8,27-8
Douglas	Long Canyon P	4711965
Douglas	Middle Foster Coulee	4711975-6,85-6
Douglas	Beaver Creek, Site 2	4712042,52
Douglas	Rock Island Creek, Site 1	4712051
Douglas	Sulphur Springs	4711956
Douglas	Earthquake View P	4712062
Douglas	Spring Canyon P	4712051
Douglas	Strahl Canyon	4811912
Douglas	Dutch Henry Draw P,EOF	4711966
Douglas	Middle Foster Coulee	4711975,76
Douglas	Deep Crk (Deer Crk) P,EOF	4711984 ✓
Douglas	Long Canyon P	4711965

Douglas	McNeil Canyon P	4711978
Douglas	Central Ferry Canyon	4811917,18
Douglas	Trefry Canyon	4811913
done Franklin	Palouse River P,EOF	4611862
Garfield	Deadman Creek	4611756
Garfield	Meadow Creek P	4611756
Garfield	Pataha Creek P	4611744,45
Garfield	New York Gulch	4611757
Grant	Petrified Canyon P	4711947,48
Grant	Hunters Canyon	4711935
Grant	Black Rock Coulee	4711931
Grant	Whitney Canyon P	4711971
Grant	Sagebrush Flat P	4711946
Grant	Chase Draw	4711962,63
Grant	Northrup Creek P,EOF	4711971
Grant	Ladds Creek (Hanging Valley) P,EOF	4711972
Grant	Paynes Gulch P	4711972
Grant	Beanie Springs	4711962
Kittitas	Ryegrass Coulee	4612081
Kittitas	Yakima River Canyon	4612084
Kittitas	Brushy Creek	4712022
Kittitas	Johnson Creek P	4712071,81
Klickitat	Upper Juniper Canyon	4512072
Klickitat	Alder Creek	4512081
Klickitat	Pine Creek	4512071
Klickitat	Spring Canyon, Site 2	4512081
Klickitat	Rock Creek P,EOF	4512075,85
Klickitat	Six Prong Creek P	4512071
Klickitat	Badger Gulch NAP	4512075
Klickitat	Spring Canyon, Site 1	4512082
Lincoln	Sheep Creek P	4711831
Lincoln	Hawk Creek	4711863,73
Lincoln	Sagebrush Springs P	4711845
Lincoln	Wilson Creek	4711867
Lincoln	Sinking Creek, Site 2	4711866
Lincoln	Sinking Creek, Site 1	4711866
Lincoln	Crab Creek, Odessa Site	4711836,37
Lincoln	Waterfall Springs P	4711847
Lincoln	Canniwai Creek	4711857
Lincoln	Coal Creek	4711834
Lincoln	Sinking Creek	4711861
Lincoln	Lake Creek	4711854
Lincoln	Wilson Creek, Tracy's Cave	4711868
Lincoln	Bluestem Creek	4711852
Lincoln	Spring Creek NAP P,EOF	4711768,78
Lincoln	Wilson Creek, Lewis Bridge	4711867
Spokane	Rock Creek (Babb Rd.)	4711735
Spokane	Pine Creek (Babb Rd.)	4711733,34
Walla Walla	Touchet River, Conrad Rd.	4611816
Walla Walla	Walla Walla River Delta	4611817,18
Walla Walla	Lake Wallula Site	4611828
Walla Walla	Walla Walla River (E of Touchet) P	4611816
Walla Walla	Walla Walla River (Byrnes Rd) P	4611817
Whitman	Rock Creek (Revere Rd)	4711717,18

Whitman	Union Flat Crk (Wawawai-Pullman Rd)	4611763 P
Whitman	Rose Creek Preserve P,EOF	4611772
Whitman	South Fork Palouse River	4611762,72,73
Whitman	Rock Creek (Hole in the Ground)	4711725
Whitman	Upper Almota Canyon P,EOF	4611763
Whitman	Imbler Creek (Revere Rd)	4711718
Whitman	Kamiache Creek P	4711726
✓Whitman	Imbler Creek	4711727
Whitman	Wawawai Canyon P	4611753,63
Whitman	Pine Creek (Squaw Rd)	4711724,34
Whitman	Almota Creek P	4611763
Whitman	Unnamed Crk (Siegal Rd)	4711725
Yakima	Fort Simcoe P,EOF	4612037
Yakima	Sulphur Creek	4611948

P = Photos

EOF = Element Occurrence Form