# VEGETATION CHARACTERIZATION OF THREE CONTRASTING RIPARIAN AREAS, WILLAMETTE VALLEY, OREGON

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ABSTRACT: Much of the native riparian vegetation of the Willamette Valley, Oregon, has been replaced with agricultural crops or invasive non-native plant species. Detailed information about current Willamette Valley riparian vegetation is generally lacking. Plant species composition data are useful in a variety of applications, including condition assessment, environmental monitoring, and restoration planning. The objective of this study was to characterize the vegetation of three contrasting riparian sites occurring in the Willamette Valley. We determined plant species composition and abundance at a non-cultivated herbaceous site and a cultivated site, both located along Lake Creek, an intermittent stream, and at a forested site located along the Calapooia River, a perennial stream. All sites were adjacent to intensively-managed perennial ryegrass seed production fields. Crop agriculture strongly encroached on the Lake Creek sites, whereas the Calapooia site had received little encroachment from agriculture beyond the forest edge. Seasonal flooding via a system of backwater sloughs made the forested site less suitable for agricultural conversion. At Lake Creek, we inventoried 32 species at the non-cultivated herbaceous site and 18 species at the cultivated site, most of which were non-native. The cultivated site was dominated by wetland-adapted species in the area closest to the creek where perennial ryegrass was absent. Approximately half of the species at the non-cultivated herbaceous site were facultative upland or upland species, and the site was dominated by introduced pasture grasses. In contrast, the 53 species inventoried at the forested site were mostly native and wetland-adapted. The forested site was dominated by *Populus balsamifera* ssp. *trichocarpa* T. & G., *Pseudotsuga menziessii* (Mirbel) Franco, and *Acer macrophyllum* Pursh, with extensive shrub and herbaceous strata. Results show a range of vegetative conditions found in riparian areas of the Willamette Valley and reflect the influence of differing hydrologic regimes and agricultural impacts.
KEY TERMS: riparian area; Willamette Valley; Oregon; agriculture; plant species composition.

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## INTRODUCTION

The vegetation of the Willamette Valley, Oregon, has undergone extensive alteration since the mid-nineteenth century. Prior to European settlement, the Willamette Valley was dominated by extensive and diverse wetland plant communities (Johannessen et al., 1971). In the last 150 years, large areas of the Valley have been cleared and drained for agriculture, and the hydrology of the Willamette River and its tributaries has been drastically modified (Seddell and Froggatt, 1984). Today, non-agricultural plant communities comprise only about 10% of the Willamette Valley (Titus et al., 1996). Titus et al. (1996) estimate that 98.6% of prairie wetlands and 71.8% of bottomland forested wetlands in the Willamette Valley have been lost since 1850.

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Detailed information about plant species composition in the remaining riparian areas of the Willamette Valley is generally lacking, particularly on privately-owned land. Plant species composition data are useful for condition assessment, environmental monitoring, and restoration planning. The objective of this study was to characterize the plant species composition and abundance at three riparian sites located in the Willamette Valley (Linn County), OR, that contrast in soil drainage class and hydrologic regime.

## METHODS

### Study Sites

Three riparian sites were sampled in the central Willamette Valley of western Oregon: two herbaceous sites, one non-cultivated and one cultivated, and a forested site. The herbaceous sites (Lat. 44°32' N, Long. 123°03 W) were located approximately 250 m apart on Lake Creek, an intermittent stream. The area of each Lake Creek site was approximately 0.2 ha. The non-cultivated riparian site had not been cultivated since 1974, whereas the cultivated site was plowed, prepared for planting, and sowed in perennial ryegrass in 1994. Soils are in the Dayton series, which is considered marginally productive for most agricultural crops except for species such as perennial ryegrass that tolerate waterlogged conditions (Griffith et al., 1997). Both sites are variably flooded during winter months, depending upon the amount and intensity of rainfall. The forested site (Lat. 44°32' N, Long. 123°08' W), approximately 1.1 ha, was located on the Calapooia River, a perennial stream. With the exception of a low bench along the river, most of the riparian area is infrequently flooded. However, an incised swale, which floods during periods of high discharge, extends perpendicular to the stream through the forest. Soils are in the Chehalis series, which consists of deep, well-drained soils on nearly level to gently undulating flood plains. All sites bordered perennial ryegrass (*Lolium perenne* L.) seed fields.

### Plant Sampling

Vegetation was sampled at the Lake Creek sites in June 1995 and at the Calapooia site in May 1996. Sampling was conducted along transects perpendicular to the stream. Data on species composition and percent cover were collected at sampling points located along transects. Sixteen, twenty, and eighteen sampling points were established at the non-cultivated herbaceous, cultivated, and forested sites, respectively. Herbaceous vegetation was sampled within a 1 $m^2$ plot, and shrub and overstory vegetation was sampled within a 10 x 5 m plot centered on the sampling point (adapted from Daubenmire, 1968). Replication of the herbaceous vegetation plots was done at the non-cultivated site only, resulting in a total of 64 1-$m^2$ plots. Percent cover of each plant species and bare ground within each 1 $m^2$ plot were visually estimated to the nearest 5%. An additional category of 1% was used to represent cover when very few individuals were present. To assure measurement precision, all cover estimates were performed by the same person who was experienced in taking visual cover estimates; accuracy of the estimates was not evaluated via more rigorous measurements. Canopy cover estimates were made for all species combined (thus only one estimate was made for each plot). Diameter at breast height (DBH) measurements were taken on each tree ($\geq$ 4 cm DBH) bole at 1.4 m above the ground. Stems less than 4 cm DBH were counted by species.

Plants were identified to species when possible; taxonomy follows Hitchcock and Cronquist (1973) and Hickman (1993). A native-introduced status (Hitchcock and Cronquist, 1973; Guard, 1995) and a U.S. Fish & Wildlife Service (USFWS) Wetland Indicator (Reed, 1988; 1993) were assigned if plants were identified to species. Average percent cover was calculated for each understory species at each site. Dominance of herbaceous plant taxa was determined based on average percent cover. Overstory dominance at the forested site was determined from tree basal area, which was calculated on a per hectare basis using a total sampling area of 900 $m^2$ (18 plots, each 50 $m^2$).

## RESULTS

### Lake Creek Non-cultivated and Cultivated Riparian Sites

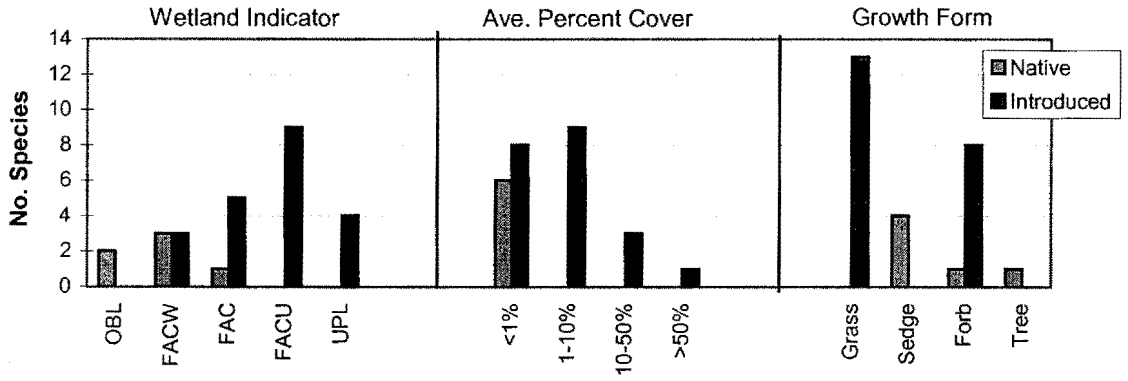
Thirty-two plant taxa at the non-cultivated site and 18 taxa at the cultivated site were observed in sampling plots. The non-cultivated herbaceous site was dominated by introduced grass species (Table 1, Figure 1). The dominant species at the cultivated site, aside from *Lolium perenne* L. (60% average cover), were *Lythrum hyssopifolia* L., a native forb, and introduced grasses (Table 1). *Fraxinus latifolia* Benth. was the only overstory species at the site. It occurred along the creek and was present in only one plot at the non-cultivated herbaceous site (<1% average cover) and one plot at the cultivated site (2% average cover). Vegetation was very dense at the non-cultivated herbaceous site, where the average percent bare ground was less than 1%. Most

Table 1. Species with average percent cover ≥2% (with standard deviation) or basal area ≥2 $m^2$/ha, listed in decreasing order of dominance for each site. United States Fish and Wildlife Service (USFWS) wetland indicator codes: UPL=obligate upland; FACU=facultative upland; FAC=facultative; FACW=facultative wetland; OBL=obligate wetland (Reed, 1988; 1993).

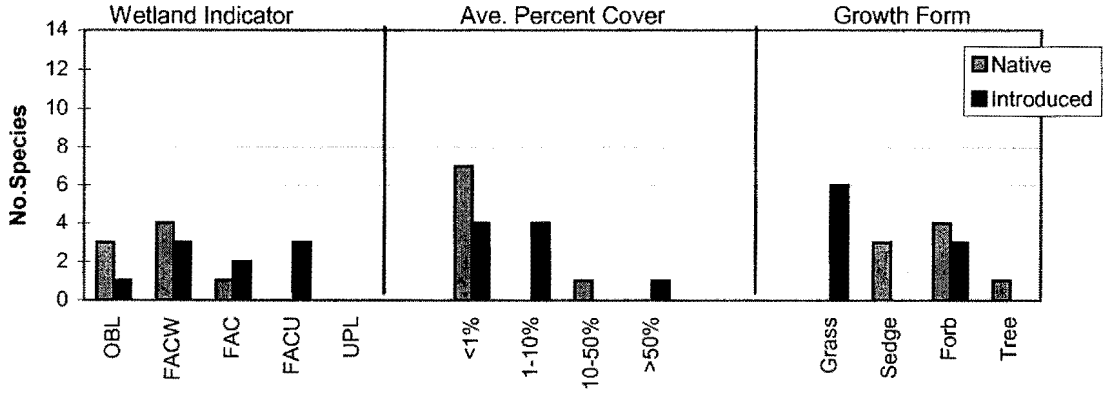
| Species | Average cover (%) +/– Standard Deviation | USFWS Wetland Indicator | Native(N) Introduced (I) |
|---|---|---|---|
| **Non-cultivated Herbaceous Site:** (N=64) | | | |
| *Alopecurus pratensis* L. | 53 ± 29 | FACW | I |
| *Festuca arundinacea* Schreb. | 25 ± 28 | FACU | I |
| *Holcus lanatus* L. | 21 ± 21 | FAC | I |
| *Agrostis tenuis* Sibth. | 19 ± 25 | FAC | I |
| *Agrostis alba* L. | 9 ± 21 | FAC | I |
| *Hypocharis radiata* L. | 6 ± 8 | UPL | I |
| *Vulpia bromoides* (L.) Gray | 5 ± 8 | FACU | I |
| *Trifolium dubium* Sibth. | 5 ± 10 | UPL | I |
| *Solanum dulcamara* L. | 4 ± 15 | FAC | I |
| *Cirsium vulgare* (Savi) Tenore | 2 ± 6 | FACU | I |
| *Parentucellia viscosa* (L.) Caruel | 2 ± 6 | FAC | I |
| **Cultivated Site:** (N=20) | | | |
| *Lolium perenne* L. | 60 ± 50 | FACU | I |
| *Lythrum hyssopifolia* L. | 18 ± 32 | OBL | N |
| *Cynodon dactylon* (L.) Pers. | 9 ± 25 | FACU | I |
| *Echinochloa crusgalli* (L.) Beauv. | 8 ± 18 | FACW | I |
| *Agrostis alba* L. | 6 ± 22 | FACW | I |
| *Veronica peregrina* L. | 2 ± 6 | OBL | I |
| **Forested Site:** (N=18) | | | |
| Understory | | | |
| *Hydrophyllum tenuipes* Heller | 11 ± 21 | FAC | N |
| *Heracleum lanatum* Michx. | 6 ± 17 | FAC | N |
| *Symphoricarpos albus* (L.) Blake | 5 ± 17 | FACU | N |
| *Acer circinatum* Pursh | 4 ± 7 | FACU | N |
| *Rubus parviflorus* Nutt. | 4 ± 18 | FACU | N |
| *Dicentra formosa* (Andr.) Walp. | 3 ± 8 | FACU | N |
| *Smilacina stellata* (L.) Desf. | 3 ± 12 | FAC | N |
| *Urtica dioica* L. | 3 ± 7 | FAC | I |
| *Carex* sp. L. | 2 ± 5 | OBL | N |
| *Oemleria cerasiformis* (Hook and Arn.) J.W. Landon | 2 ± 5 | FACU | N |
| *Phalaris arundinacea* L. | 2 ± 7 | FACW | I |
| *Tellima grandiflorum* Pursh | 2 ± 4 | UNK | N |

| | Tree Basal Area ($m^2$/ha) | USFWS Wetland Indicator | Native (N) Introduced (I) |
|---|---|---|---|
| **Forested Site:** | | | |
| Overstory | | | |
| *Populus balsamifera* spp. *trichocarpa* T. and G. | 24 | FAC | N |
| *Pseudotsuga menziessii* (Mirbel) Franco | 14 | FACU | N |
| *Acer macrophyllum* Pursh | 10 | FACU | N |
| *Quercus garryana* Dougl. | 6 | UPL | N |
| *Fraxinus latifolia* Benth. | 4 | FACW | N |
| *Alnus rhombifolia* Nutt. | 4 | FACW | N |

**Non-cultivated Herbaceous Site (Lake Creek)**




**Cultivated Site (Lake Creek)**




**Forested Site (Calapooia River)**

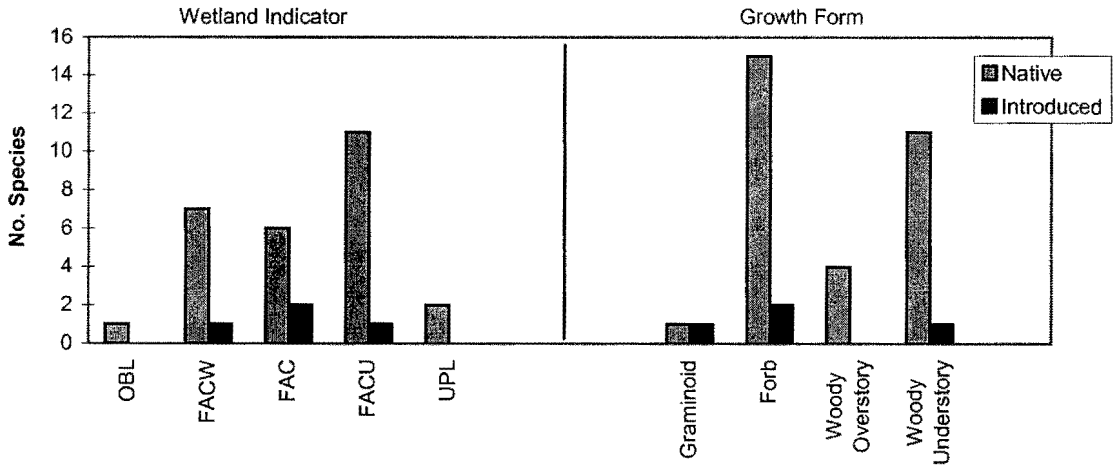



Figure 1. Number of native and introduced species by USFWS Wetland Indicator and growth form for three riparian sites in the Willamette Valley, OR. Average percent cover is shown for the Lake Creek sites. USFWS Wetland Indicators: UPL = obligate upland; FACU = facultative upland; FAC = facultative; FACW = facultative wetland; OBL = obligate wetland (Reed, 1988; 1993).

species at the cultivated site occurred within eight meters of the creek, where bare ground averaged 15%; perennial ryegrass thrived on the remaining area of the site.

Of the taxa with an assigned USFWS Wetland Indicator (27 of 32 at the non-cultivated herbaceous site and 17 of 18 at the cultivated site), 52% at the non-cultivated herbaceous site and 82% at the cultivated site were in the categories of facultative (FAC), facultative wetland (FACW) or obligate wetland (OBL). Of the taxa identified to species, 78% at the non-cultivated herbaceous site and 53% at the cultivated site were introduced. At the non-cultivated herbaceous site, all grass and most forb species were introduced, whereas sedge and rush species were native (Figure 1). Native species tended to be more wetland-adapted; all species categorized as facultative upland (FACU) or obligate upland (UPL) were introduced (Figure 1). All dominant species were introduced, while the average percent cover of all native species was less than 1% (Figure 1). The patterns were similar but not as pronounced at the cultivated site, which had a higher proportion of native to introduced forbs.

### Calapooia Forested Riparian Site

A total of 46 taxa were sampled at the forested site on the Calapooia River. The streamside zone was dominated by a continuous stand of *Salix sitchensis* Sanson, while a mixed hardwood community occupied the higher ground comprising most of the site. *Hydrophyllum tenuipes* Heller (11% average cover) was the dominant understory species (Table 1), although most species had average percent cover <2%. Of the understory taxa identified to species, 82% were native species, most of them forbs (Figure 1). With the exception of *Rubus discolor* Weihe and Nees, which had a low average percent cover, all woody species were native. In contrast to the Lake Creek sites, graminoids comprised a small percentage of the total species (Figure 1). The majority of species for which a USFWS Wetland Indicator could be assigned were FACW, FAC, or FACU, indicative of a moist soil, variably-flooded setting capable of supporting a diversity of species.

Canopy cover averaged 73%. The most dominant overstory species, based on basal area, was *Populus balsamifera* ssp. *trichocarpa* T. and G. Only a single tree occurred at the site; its DBH was 152 cm, and the species basal area was 24.1 $m^2$/ha, almost twice as high as the next most dominant species–*Pseudotsuga menziessii* (Mirbel) Franco and *Acer macrophyllum* Pursh (Table 1). Stem density in the willow stand (3467/ha) along the creek was twice as high as for the mixed hardwood community. (1707/ha) Trees in the willow stand had an average DBH of only 6 cm.

## DISCUSSION

Our results describe plant species composition and cover at three riparian sites in agricultural settings of the Willamette Valley, OR. The original wet prairies of the Willamette Valley have been altered by agricultural practices, grazing, periodic mowing, and invasion by numerous exotic plant species (Franklin and Dyrness 1988). Prior to European settlement, Native Americans used fire to create and maintain prairies. Although some of these lands converted back to forest lands after burning stopped about 1855 (Johannessen et al., 1971), much of the Willamette Valley was already being developed for agriculture, and many of these maintained grasslands were cultivated. The sites at Lake Creek appear to constitute the remains of what was once an ash swale. Swales occurred in the Willamette Valley away from the main stem of the Willamette River and likely supported dense vegetation, as the early explorers referred to them as "thickets" (Sedell and Froggatt, 1984). The non-cultivated herbaceous site represents the altered condition of wet prairies and grasslands in the Valley as described by Franklin and Dyrness (1988) and Habeck (1961). Our results show that this site was dominated by many of the same introduced grasses reported by earlier researchers. At the cultivated site, wetland plants existed on wet soil within 8 m of the stream. In this transition area, the dominant species was a native forb, while several subdominant species were introduced. With the exception of *Agrostis alba* L., the composition of the most dominant species differs between the non-cultivated and cultivated sites. The difference in plant communities, as well as plant density, may reflect differences in disturbance at the two sites. The cultivated site had been plowed eight months prior to sampling; thus the species listed in Table 1 are the early colonizers. In contrast, the non-cultivated herbaceous site had not been cultivated since 1974, and the plant community that has become established may be more typical of what develops in the absence of cultivation. The creek banks at the non-cultivated site are steeper, whereas at the cultivated site the banks are plowed through, creating a shallow-sloping, wet bank suitable for establishment of wetland species. The longer time period for community establishment and the larger unplanted area are likely reasons for a greater species diversity at the non-cultivated herbaceous site.

Overstory vegetation at the forested site appears to be representative of the pre-settlement bottomland forests in the Willamette Valley as described by Habeck (1961) and Johannessen et al. (1971). In contrast to the Lake Creek sites, the majority of species we sampled were native (Table 1, Figure 2). Although some portions of the Calapooia River are channelized, the river is not dammed for flood control, as are most of the rivers draining the Willamette Valley. Many of the forested segments along

the Calapooia River contain rare natural communities and are believed to be some of the highest quality remnants of forested riparian land remaining in the Willamette Valley (Titus et al., 1996). A dynamic hydrologic regime was evident at the forested site. At high water level, water was transported onto the site via a slough, which maintained the forest in a mesic condition, as shown by the mix of USFWS Wetland Indicators for species listed in Table 1. The hydrologic conditions at the forested riparian site make agricultural cultivation difficult; therefore this riparian site has not been altered to the degree that the Lake Creek sites have. The result has been an inadvertent preservation of the native plant community.

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16. ABSTRACT

Much of the native riparian vegetation of the Willamette Valley, Oregon, has been replaced with agricultural crops or invasive non-native plant species. Detailed information about current Willamette Valley riparian vegetation is generally lacking. Plant species composition data are useful in a variety of applications, including condition assessment, environmental monitoring and restoration planning. The objective of this study was to characterize the vegetation of three contrasting riparian sites occurring in the Willamette Valley. W determined plant species composition and abundance at a non-cultivated herbaceous site and a cultivated site, both located along Lake Creek, an intermittent stream, and at a forested site located along the Calapooia River, a perennial stream. All sites were adjacent to intensiveily-managed perennial ryegrass seed production fields. Crop agriculture strongly encroached on the Lake Creek sites, whereas the Calapooia site had received little encroachment from agricultural conversion. At Lake Creek, we inventoried 32 species at the non-cultivated herbaceous site and 18 species at the cultivated site, most of which were non-native. The cultivated site was dominated by wetland-adapted species in the area closest to the creek where perennial ryegrass was absent. Approximately half of the species at the non-cultivated herbaceous site were facultative upland or upland species, and the site was dominated by introduced pasture grasses. In contrast, the 53 species inventoried at the forested site were mostly native and wetland-adapted. The forested site was dominated by *Populus balsamifera* ssp, *trichocarap T. & G.,* Pseudotsuga menziessii*(Mirbel) Franco, and Acer macrophyllum* Pursh, with extensive shrub and herbaceous strata. Results show a range of vegetative conditions found in riparian areas of the Willamette Valley and reflect the influence of differing hydrologic regimes and agricultural impacts.

| 17. KEY WORDS AND DOCUMENT ANALYSIS | | |
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