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Introduction

Riparian plant communities are critical ecological features of terrestrial and aquatic ecosystems in the Willamette Basin. Most commonly, resource managers and the public consider riparian areas as the structure and function associated with riparian vegetation along rivers and streams. Ecological conditions are considered for spatially explicit bands on both sides of a stream. This perspective is described for the alternative futures in the following assessment of riparian change. Conversely, riparian areas can be viewed from a policy perspective, as described on page 40. Interpreting what follows requires the recognition that both scientific and policy perspectives have value in considering and managing riparian resources.

Models of habitat and abundance of fish and invertebrates used in this study to evaluate trajectories of change incorporate major influences of riparian systems. The stream evaluation models used measures of older conifer forests (80 to >200 yr), closed forests, and riparian zones along with other measures of land use and riparian conditions. This section on trajectories of change in riparian systems for the five scenarios (past, present, and three alternative futures) also presents data on composition of riparian systems expressed as percent of the riparian area composed of conifer forests, hardwood forests, mixed forests, natural shrublands, natural grasslands, wetlands, agriculture, and development. These categories represent the dominant overstory vegetation or dominant land use. As such, they reflect broad vegetation conditions and should not be misinterpreted as fine resolution delineation of small habitats, such as certain types of wetlands. Small wetlands can exist under the overstory of a hardwood forest, for example. Also, these data have not been separated by vegetation age classes. Categories add up to approximately 100%, with minor categories not reported. Specific practices and assumptions of each scenario are summarized in Table 26, p. 85.

Classification of land use/land cover from satellite spectral data (pp. 78-81) was used as the basis for this riparian analysis. Riparian zones were evaluated as both 30 m widths and 120 m widths on each side of the channel. Data presented in this section are based on 120 m widths because they were used in evaluation modeling of fish and aquatic invertebrate responses, but patterns of vegetative composition were similar for both riparian zone widths. We estimated riparian composition for 120 m riparian widths for 1) 1-4th order streams, 2) major tributaries larger than 4th order, 3) the mainstem Willamette River, and 4) items 1-3 combined. These estimates are presented separately for the Lowlands (Willamette Valley Ecoregion), Uplands, and total Willamette Basin.

Lowlands

Small Streams — In the Lowlands of the Willamette Basin in the Pre-EuroAmerican scenario, conifer and hardwood forests each accounted for approximately 25% of the riparian areas along small streams, and these forest types account for less than 10% of the ca. 1990 riparian areas (Table 30). Wetlands decreased from 14% to 1% of the riparian area. Agriculture and development along small streams occupy roughly 40% and 10% of ca. 1990 Lowland riparian areas, respectively. Proportions of most major vegetation classes do not change greatly in future alternatives. However, under Conservation 2050, urban components of riparian areas increase slightly relative to 1990 conditions and agriculture in riparian areas decreases by 35%. Hardwood forests, natural shrublands, and natural grasslands increase in the Lowlands under Conservation 2050, and wetlands increase to more than 3%.

Major Tributaries — Riparian areas along major tributaries exhibit patterns of composition and trajectories of change similar to those observed for small streams (Table 30). Hardwood forests make up a greater proportion of these riparian areas and conifer forests are a smaller fraction, but the general trends in loss of forests relative to pre-EuroAmerican conditions are similar to the trends and proportional loss observed for the riparian areas along small streams. The wetland category made up less of the riparian systems along major tributaries, and Conservation 2050 projects distributions that slightly exceed historical amounts for the major tributaries.

Willamette River — Along the mainstem Willamette River, riparian vegetation within a 120 m zone represents a small portion of the total area of historical floodplain forest (Table 30). Within this 120 m zone, hardwood forests historically made up two-thirds of the riparian area and conifer forests were less than 10% of the riparian area. By 1990, approximately 88% of these forest types had been converted to other land uses and vegetation types, had been modified, or passively allowed to reestablish as shrublands or non-woody species. Agriculture now occupies more than a third of the riparian areas, and urban or rural development occupies roughly one-quarter of the riparian lands. By 1990, development had modified riparian forests along the Willamette River to a greater extent than in the smaller streams and tributaries. These forest types are projected to increase under all future alternatives, with the greatest recovery in Conservation 2050. Under that scenario, development will remain the same as 1990 and agricultural land in riparian areas will decrease by 50% within 120 m of the Willamette River, allowing for recovery of hardwood and mixed forests.

All Streams — Across all streams and rivers in the Lowlands, trajectories of change in riparian systems are very similar to the patterns projected for 1-4th order streams (Table 30). Small streams in the Lowland region account for 93% of the total riparian area within 120 m of the streams and rivers, thus trends in these areas dominate the overall regional patterns. While this is an important characteristic of the riparian areas as a whole, particular species or habitats may be distributed differently in streams and rivers of different size and in different network locations. Therefore, patterns in all riparian areas have implications for particular biotic communities, ecological processes, or land uses.

Historically, older conifer forests (>80 yr.) made up almost one-third of the riparian areas in the Lowlands (Fig. 107). As of 1990, these forests now make up only 5% of the riparian systems. This loss of older conifer forests has been greater than the change in area of conifer forests of all ages (Fig. 106). Under Plan Trend 2050 and Development 2050, these proportions remain less than 5% and increases under Conservation 2050 are slight. The percent of riparian area in woody vegetation has decreased by roughly 30-40% of 1850 extents (Table 30). There is little improvement in these conditions in either Plan Trend 2050 or Development 2050. In Conservation 2050, approximately half the riparian area in wooded vegetation that was lost between 1850 and 1990 is restored to wooded vegetation.

LOWLAND ECOREGION - 120 METER RIPARIAN AREA: 1- 4th ORDER STREAMS

		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	467693	0.0	0.0	16.8	13.9	24.7	5.1	25.4	14.2
LULC90	470071	10.3	41.6	1.0	12.7	9.9	13.2	9.6	1.1
PT2050	470072	12.7	40.5	0.9	12.1	9.7	12.5	9.9	1.1
CON2050	469072	11.7	26.7	5.7	15.4	11.9	14.9	9.9	3.5
DEV2050	470089	15.8	36.8	1.0	13.5	9.3	12.1	9.8	1.1

LOWLAND ECOREGION - 120 METER RIPARIAN AREA: MAJOR TRIBUTARIES

		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	22986	0.0	0.0	11.3	8.6	47.4	21.4	8.0	3.3
LULC90	22690	10.0	45.4	0.8	13.5	15.1	10.0	1.5	2.6
PT2050	22668	12.1	43.4	0.7	13.2	16.1	9.0	2.3	2.6
CON2050	22672	10.3	25.9	4.3	18.2	21.4	12.7	1.9	4.8
DEV2050	22661	16.2	38.4	0.8	15.2	15.3	8.6	2.3	2.5

LOWLAND ECOREGION - 120 METER RIPARIAN AREA: WILLAMETTE RIVER

		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	13300	0.0	0.0	8.9	8.0	67.1	8.9	5.0	1.4
LULC90	12531	24.6	37.6	0.8	8.6	8.0	14.7	0.9	1.1
PT2050	12531	25.7	37.0	0.8	8.4	14.5	5.8	3.1	1.1
CON2050	12140	24.6	18.2	5.0	12.2	22.6	10.2	1.7	2.6
DEV2050	12531	27.5	34.1	0.8	10.1	14.3	5.5	3.0	1.1

LOWLAND ECOREGION - 120 METER RIPARIAN AREA: ALL STREAMS

		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	503979	0.0	0.0	16.3	13.5	26.8	6.0	24.0	13.3
LULC90	505292	10.6	41.7	2.5	12.6	10.1	13.1	9.0	1.2
PT2050	505271	13.0	40.6	0.9	12.1	10.1	12.2	9.4	1.2
CON2050	503884	11.9	26.5	5.6	15.4	12.6	14.7	9.3	3.5
DEV2050	505281	16.1	36.8	0.9	13.5	9.7	11.8	9.3	1.2

Table 30. *Percent composition of riparian vegetation and land use within a 120 m (393 ft) zone in Lowland streams of the Willamette Basin. Data are presented for each of the five scenarios. Panels represent the three classes of streams (small 1st-4th order, major tributaries, and mainstem Willamette River), and the total for all classes of streams combined. Vegetation classification is described in the text and in Table 17, Riparian Vegetation on page 40).*

Uplands

In the Uplands of the Willamette Basin, conifer forests historically dominated the riparian forests of both small streams and major tributaries, accounting for approximately 98% and 93% of the riparian areas respectively (Table 31). Riparian areas along small streams make up 99% of the total riparian area in the Uplands. Conifer forests ca. 1990 comprise 52% of the riparian vegetation along these streams and rivers. Most of that change has been a result of conversion to mixed forests as a result of timber harvest. Agriculture makes up a small portion of the riparian systems, accounting for less than 1% of the area along small streams and 2% along major tributaries. Development is a greater influence, comprising 14% of the area along major tributaries but only 1% along small streams. Overall vegetation types do not change greatly under any of the alternative futures. As would be expected from their spatial extent, patterns for riparian resources along all streams and rivers in the Uplands reflect the patterns of the small streams (Table 31).

UPLAND ECOREGION - 120 METER RIPARIAN AREA: 1 - 4th ORDER STREAMS									
		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	590522	0.0	0.0	0.4	0.7	0.1	0.3	98.2	0.1
LULC90	587954	0.9	0.7	0.0	0.6	9.0	36.6	52.1	0.0
PT2050	587959	0.9	0.7	0.0	0.6	9.0	36.3	52.4	0.0
CON2050	588012	0.9	0.5	0.0	0.6	9.1	36.6	52.2	0.0
DEV2050	587912	1.0	0.6	0.0	0.6	9.0	36.2	52.5	0.0

UPLAND ECOREGION - 120 METER RIPARIAN AREA: MAJOR TRIBUTARIES									
		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	5521	0.0	0.0	0.0	3.8	0.0	3.4	92.8	0.0
LULC90	5539	14.4	2.2	0.0	2.5	6.3	31.5	41.5	0.0
PT2050	5533	14.9	2.2	0.0	2.4	6.1	30.9	43.4	0.0
CON2050	5533	14.4	1.5	0.1	2.8	6.3	32.0	42.8	0.0
DEV2050	5500	15.7	2.0	0.0	2.5	6.0	30.4	43.4	0.0

UPLAND ECOREGION - 120 METER RIPARIAN AREA: ALL STREAMS									
		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	596043	0.0	0.0	0.4	0.7	0.1	0.4	98.1	0.1
LULC90	593493	1.0	0.7	0.0	0.6	9.0	36.5	52.0	0.0
PT2050	593492	1.0	0.7	0.0	0.6	9.0	36.2	52.3	0.0
CON2050	593544	1.0	0.5	0.0	0.7	9.1	36.6	52.1	0.0
DEV2050	593411	1.1	0.6	0.0	0.6	9.0	36.1	52.4	0.0

Table 31. *Percent composition of riparian vegetation and land use within a 120 m (393 ft) zone in Upland streams of the Willamette Basin. Uplands include both Cascade and Coast Ranges. Data are presented for each of the five scenarios. Note that the Willamette River does not extend into the Uplands, so the "all streams" panel represents the total of small streams and major tributaries.*

In the Uplands, decline in the amount of older conifer forests in riparian areas from past to present has been greater than the change in area of closed forests of all ages (Fig. 107). Older conifers circa 1990 make up approximately one-third of their historical distribution in riparian systems in the Uplands. Under Plan Trend 2050 and Development 2050, these proportions continue to decline, but there is a slight increase in older conifers under Conservation 2050. Closed forests and riparian area in the Uplands show little change under future scenarios relative to 1990.

Upland portions of the Willamette River Basin are dominated by public and private forests. Current riparian management practices differ between public lands and private lands, with no-harvest zones required within 400 ft. of perennial streams in federal forests, 20- to 100-ft zones with partial harvest on private forest lands, and no zones required on most agricultural and residential lands. As a result, trajectories of change for public and private forest lands differ for the future alternatives (pp. 104-5). As discussed in greater detail on pages 122-23, habitat conditions for trout improve under all future alternatives for public lands in the Uplands of the Willamette Basin, but habitat conditions overall continue to decrease for Plan Trend 2050 and Development 2050. The only future alternative indicating an improvement of trout habitat conditions on private lands in the Uplands of the Willamette Basin is Conservation 2050, which has less conversion to agricultural and developed lands and provides greater measures for riparian recovery (Fig. 158, p. 123). This difference in future alternatives for public and private lands in the Uplands of the Willamette River Basin illustrates the potential effectiveness of regional conservation strategies, such as the Northwest Forest Plan on public lands within the range of the Northern Spotted Owl.

WILLAMETTE BASIN (LOWLAND & UPLAND ECOREGIONS COMBINED) 120 METER RIPARIAN AREA: 1- 4th ORDER STREAMS									
		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	1058215	0.0	0.0	7.7	6.5	11.0	2.5	66.0	6.3
LULC90	1058025	5.0	18.9	0.5	5.9	9.4	26.2	33.2	0.5
PT2050	1058031	6.1	18.4	0.4	5.7	9.3	25.7	33.5	0.5
CON2050	1057083	5.7	12.2	2.6	7.2	10.3	27.0	33.4	1.5
DEV2050	1058001	7.6	16.7	0.4	6.3	9.1	25.5	33.5	0.5

WILLAMETTE BASIN (LOWLAND & UPLAND ECOREGIONS COMBINED) 120 METER RIPARIAN AREA: MAJOR TRIBUTARIES									
		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	28507	0.0	0.0	9.1	7.6	38.2	17.9	24.4	2.6
LULC90	28230	10.9	37.0	0.6	11.4	13.4	14.2	9.3	2.1
PT2050	28200	12.6	35.3	0.6	11.1	14.1	13.3	10.4	2.1
CON2050	28205	11.1	21.1	3.4	15.2	18.4	16.5	9.9	3.8
DEV2050	28161	16.1	31.3	0.6	12.7	13.5	12.9	10.3	2.1

WILLAMETTE BASIN (LOWLAND & UPLAND ECOREGIONS COMBINED) 120 METER RIPARIAN AREA: WILLAMETTE RIVER									
		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	13300	0.0	0.0	8.9	8.0	67.1	8.9	5.0	1.4
LULC90	12531	24.6	37.6	0.8	8.6	8.0	14.7	0.9	1.1
PT2050	12531	25.7	37.0	0.8	8.4	14.5	5.8	3.1	1.1
CON2050	12140	24.6	18.2	5.0	12.2	22.6	10.2	1.7	2.6
DEV2050	12531	27.5	34.1	0.8	10.1	14.3	5.5	3.0	1.1

WILLAMETTE BASIN (LOWLAND & UPLAND ECOREGIONS COMBINED) 120 METER RIPARIAN AREA: ALL STREAMS									
		Percent composition							
	Acres	Devlp	Ag	NatGrass	Natshrub	Hdwd	Mix For	Conif For	Wetlands
PESVEG	1100022	0.0	0.0	7.7	6.5	12.4	2.9	64.2	6.1
LULC90	1098786	5.4	19.6	0.5	6.1	9.5	25.7	32.2	0.6
PT2050	1098763	6.5	19.0	1.8	5.9	9.5	25.2	32.6	0.6
CON2050	1097428	6.0	12.5	2.6	7.4	10.7	26.5	32.5	1.6
DEV2050	1098693	8.0	17.3	0.4	6.5	9.3	24.9	32.6	0.5

Table 32. *Impacts of different scenarios on riparian land use and land cover in the Willamette Basin for both ecoregions by stream type. The lowest panel represents all stream types combined.*

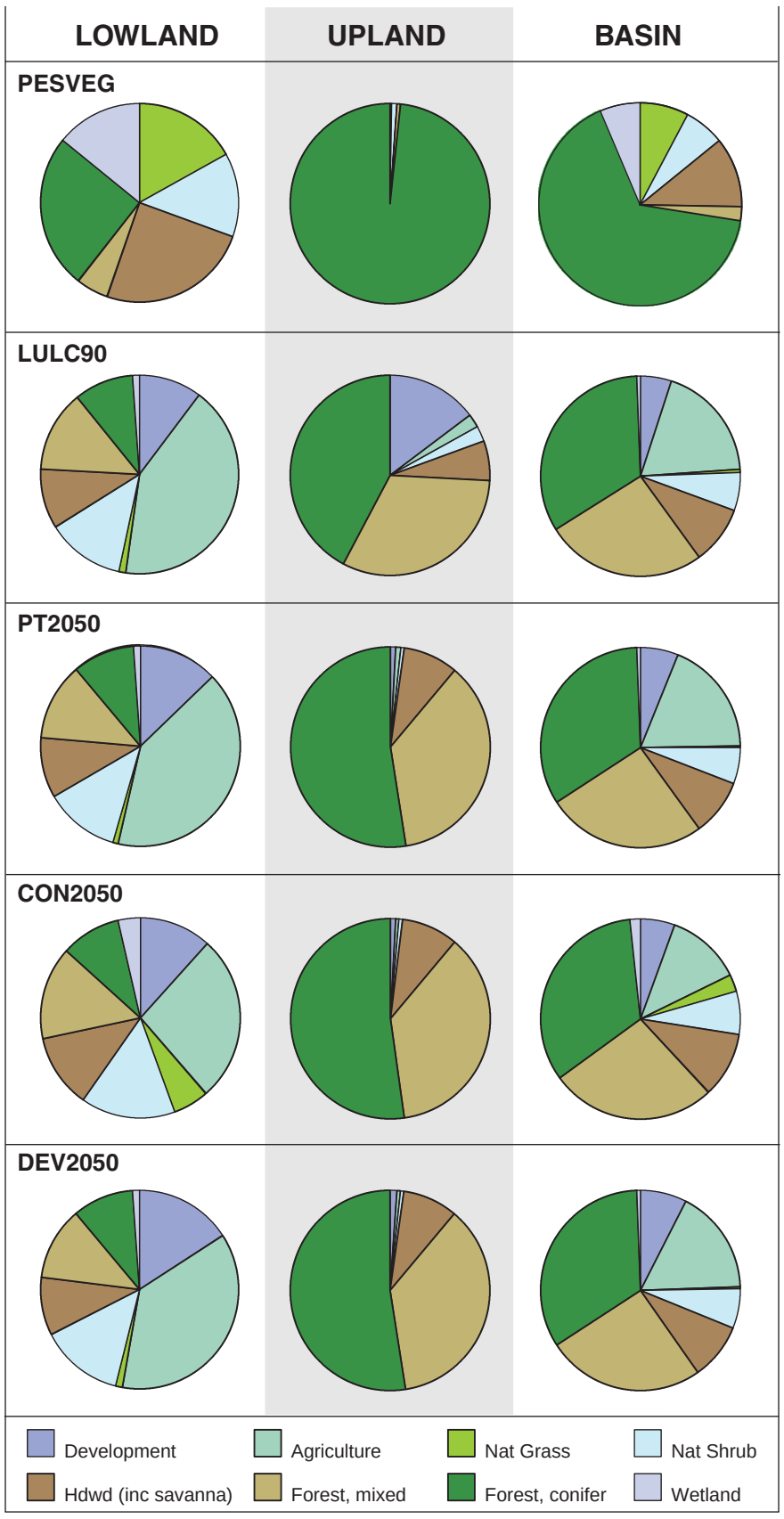


Figure 106. *Percent composition of 120 m riparian zones for all streams under the five different scenarios. "Basin" refers to both Lowland and Upland ecoregions combined.*

Basin

Total riparian areas are roughly equal in the Lowland and Upland regions of the Willamette River Basin with 46% of the total riparian area located in Lowlands and 54% of the total riparian area located in Uplands, respectively (Tables 30, 31). As a result, the overall basin trends represent an average of the properties observed in these two regions (Table 32). Conifer forests historically accounted for two-thirds of the riparian systems, half of which have been converted to other forest types or land uses over the last 150 years. Mixed forests have increased, reflecting the conversion to other uses. Over the Willamette Basin as a whole, agriculture circa 1990 occupies 20% of the riparian area and development occupies 5% of the riparian area. Two of the three future alternatives depict relatively minor changes from 1990 to 2050 in riparian conditions for the Willamette River Basin as a whole. This reflects the major changes that have occurred over the last 150 years and the limited changes that would be possible on converted lands over the next 50 years.

This analysis of riparian conditions along all streams in the WRB illustrates the potential to evaluate riparian resources at a landscape scale. The coarse resolution of the land cover data (30 m x 30 m pixels) makes regional riparian assessment possible but limits the application of the information at local scales. The strength of this analysis is the broader context it creates for riparian conservation and management. Riparian vegetation has been greatly modified in the Lowlands. The age of riparian forests in the Uplands may have changed by land use, but the overall composition of vegetation type has not changed as greatly as in the Lowlands. In the Lowlands, both the type and extent of riparian vegetation have been greatly altered, and a major fraction of the Lowland riparian area has been converted to fields, homes, or industrial use. Regional assessments of riparian systems create a rigorous framework for asking better land and water management questions and applying tools at finer scales for local resource and habitat management.

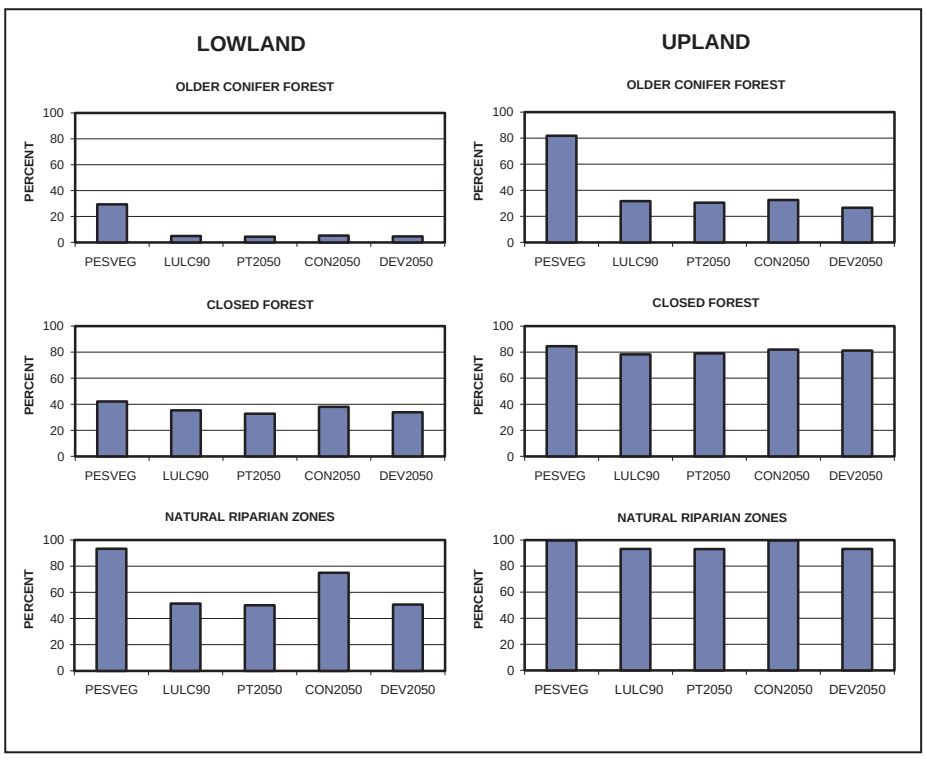


Figure 107. *Percent of riparian area in major forest components by scenario in Willamette Basin Lowland and Upland ecoregions. Older conifer forest is greater than 80 years of age; closed forest has greater than 70% canopy closure, but may be coniferous, deciduous, or a mix of the two; and natural riparian zones may contain forest (closed, semi-closed or open), savanna, natural grassland, natural shrubland, or wetland.*

Conclusions

- Riparian plant communities have been greatly altered by land use over the last 150 years.
- More than 60% of the conifer and hardwood riparian forests in the Lowlands have been converted to some other cover type or land use.
- More than 85% of the riparian forests along the Willamette River have been converted to other vegetation types or land uses.
- Approximately half of the conifer forests in the Uplands have been converted to other land cover types, primarily mixed forest.
- Under policies represented in Plan Trend 2050, future losses of riparian forests will not be as great as the changes observed over the last 150 years. Riparian conditions on public lands are projected to improve under all future alternatives.
- Older conifer forests have decreased more than change in the area of conifer forests would indicate in both the Lowlands and Uplands. More than 80% of the older conifer forests have been converted in the Lowlands, and more than 60% of the older conifer forests have been converted in the Uplands.
- Area of woody vegetation will increase in Conservation 2050, but recovery of older forests will require longer than the next 50 years.

Figure 108. *Riparian vegetation along small streams in agricultural land in the Willamette Valley.*

Figure 109. *Willamette River riparian vegetation upriver from Corvallis. Additional examples are shown on facing page.*

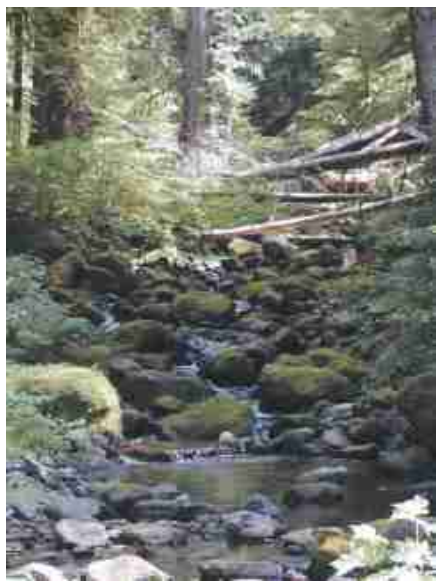
Cottonwoods and revetment along the Willamette River near Harrisburg.

A mixture of willow and ash trees along the Willamette River, between Corvallis and Harrisburg.

Mature riparian vegetation along an alcove of the Willamette River.

Himalayan Blackberry growing on revetment along Willamette River.

Riparian vegetation along Mack Creek in the Uplands of the WRB.

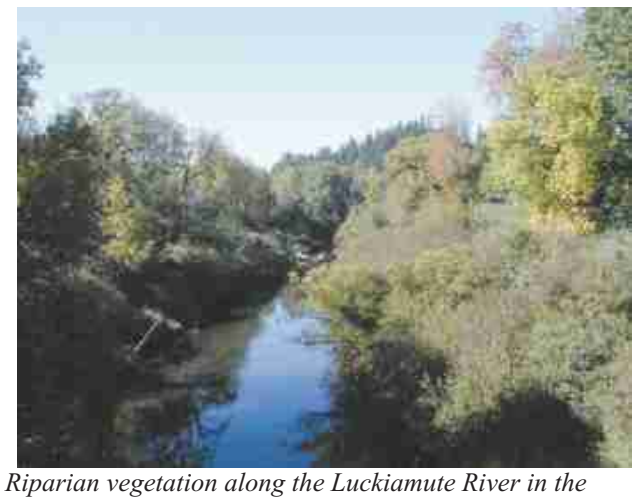


Riparian vegetation along a montane stream in the Uplands of the WRB.

A mature stand of willows along the Willamette River.

Recruitment of different age classes of cottonwood trees at Snagboat Bend, Willamette River.

Bank erosion, loss of older cottonwoods with recruitment of young cottonwoods along the Willamette River.



Riparian vegetation along the Luckiamute River in the Lowlands of the WRB.