Mainstem River

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Introduction

Over the last 150 years, fish in the mainstem Willamette River have been influenced by alteration of the river channels and floodplain, floodplain forests, hydrologic regimes, and riverbanks. These biophysical changes are likely to continue and have been represented in the alternative future scenarios. In this section, we evaluate the future and historical potential for the mainstem river to support the number of fish species observed in the Willamette River today. Observations of fish species distributions and relationships between habitat conditions and fish species richness have been used to project changes in fish species richness from historical conditions to the present and from the present to 2050 under the three future scenarios.

The geographic focus of this evaluation of trajectories of ecological change is the 227-km floodplain of the mainstem Willamette River. Over the last 150 years, the Willamette River has meandered across its floodplain. Governmental agencies and communities along its banks have tried to straighten and confine the channel. As a result of these and other changes, we believe the best context for evaluating changes from 1850 to 2050 in the Willamette River is provided by the floodplain. As reported in the sections on Historic Willamette River Channel (pp. 18-25), Riparian Vegetation (pp. 40-43), and River Restoration (pp. 131-47), we use the boundaries of historical floods on the Willamette River to define the natural floodplain, segmenting it into 1-km "slices." The potential for the river to support fish species is evaluated for each 1-km slice of the floodplain and illustrated longitudinally (Figs. 135-39 on facing page).

The assemblage of fish species in the Willamette River has been modified through introduction of exotic fish species from other regions, and currently almost half of the number of fish species in the Willamette River are introduced species (pp. 44-45). Fish assemblages of the Willamette River circa 1990 offer a point of reference for change in the potential of the river to support aquatic life. We sampled fish species in different habitats within the Willamette River to evaluate the consequences of changes in land use / land cover and river channel modifications on fish assemblages (Note the diamond symbols denoting locations of field observations in Figure 136). The three major relationships used for this evaluation of fish assemblages are influence of channel complexity (pp. 18-25), influence of floodplain forests (pp. 40-43), and influence of revetments (pp. 138-39).

Evaluating Alternative Future Effects on Willamette River Fish

To evaluate each alternative future, the total number of fish species was predicted for each 1-km slice of the floodplain for each scenario based on channel complexity, riparian forest extent, and revetment lengths. Fish species numbers were predicted from a multiple regression model based on observed fish species richness from 33 sites in the Willamette River in 1998 and 1999. Numbers of fish at a site were related to the length of the main channel axis represented by 1) single channel, multiple channels, and tributary junctions, 2) forest on no banks, one bank, and both banks, and 3) revetments on both banks, one bank, and no banks within a 1-km slice of the floodplain. The regression model based on 1-km reaches accounted for 26% of the variance (r^2) in numbers of observed fish species in the sites. See the inset box on p. 120 for a discussion of sources of aquatic model uncertainty.

For each scenario, we estimated the length of mainstem river of each 1-km slice of floodplain that was represented by these classes of channel complexity, forest, and revetment. It is important to note that these projections are based on the current richness of fish species in the Willamette River. These numbers include both native and introduced fish species and these species are represented in all five scenarios and potential number of fish species do not differ for either past or future scenarios. Therefore, the evaluation of the Pre-EuroAmerican Scenario does not eliminate fish species that were introduced after 1850, and future alternatives do not include addition of new fish species. As such these projections represent the potential of the habitat to support fish species relative to 1990 conditions, and are not true estimates of the numbers of fish species that existed in the past or may exist in the future. For example, habitat for fish in 1850 had the potential to support more numbers of fish species based on observations from the late 1990s. These predictions include both native and exotic species, and most of the exotic species were not present in the Willamette River in 1850. Thus, the comparison reflects the quality of the habitat in terms of its ability to support fish species observed in the 1990s and does not attempt to predict the actual number of fish that would be present in either historical or future periods.

Historical Conditions

In 1850, the Willamette River was physically more complex, particularly in the upstream reaches between Albany and Eugene, and more than 85% of its length was forested. Riprap and revetments had not been constructed. Fish species richness would be expected to be higher along most of the length of the Willamette River (Fig. 134), averaging a projected richness of 18.9 species per 1-km of floodplain. Current projections of fish richness for LULC ca. 1990 are 17.4 species per 1-km of floodplain, with most of the decrease occurring in the more heavily modified downstream reaches near Portland (Figs. 135, 136). Based on these assessments, we believe that the habitat of the Willamette River ca. 1850 had the potential to support more fish species within a 1-km section than in today's Willamette River. Readers must note that this analysis focuses on the relative ability of the habitat to support fish species (based on 1990 fish assemblages and conditions) and does not account for changes in fish richness related to introduction of species from other geographic regions.

Alternative Futures

The future scenarios quantify the continued simplification or restoration of the Willamette River channels and their floodplain forests. Based on the same relationships used to evaluate the potential fish habitat ca. 1850 and 1990, fish richness in the mainstem Willamette River shows patterns that are similar to the overall patterns observed for fish and invertebrates in smaller streams (pp. 118-23). Numbers of fish species stay the same or decline slightly for Plan Trend 2050 (17.4 species per 1-km of floodplain) and Development 2050 (17.1 species per 1-km of floodplain) (Figs. 134, 137, 139). The changes in floodplain forests and channel complexity in Conservation 2050 cause fish richness to increase to 18.1 species per 1-km slice of floodplain. This indicates that almost half of the loss of the ability of the river habitat to support fish species that may have occurred over the last 150 years could be recovered though plausible restoration efforts over the next 50 years while human populations are doubling.

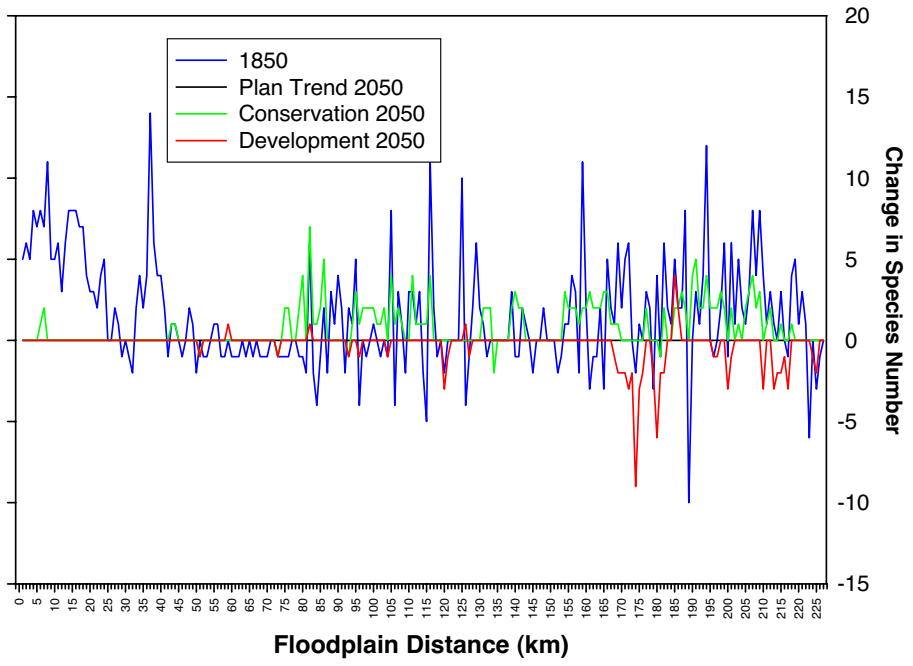

Figure 134. *Differences in numbers of fish species in the Willamette River in 1-km slices of floodplain between LULC ca. 1990 (baseline) and past and future scenarios.*

Figures 135-139 (facing page). *Predicted numbers of fish species in the Willamette River in 1-km slices of floodplain for the five scenarios, based on channel complexity, floodplain forests, and revetments.*

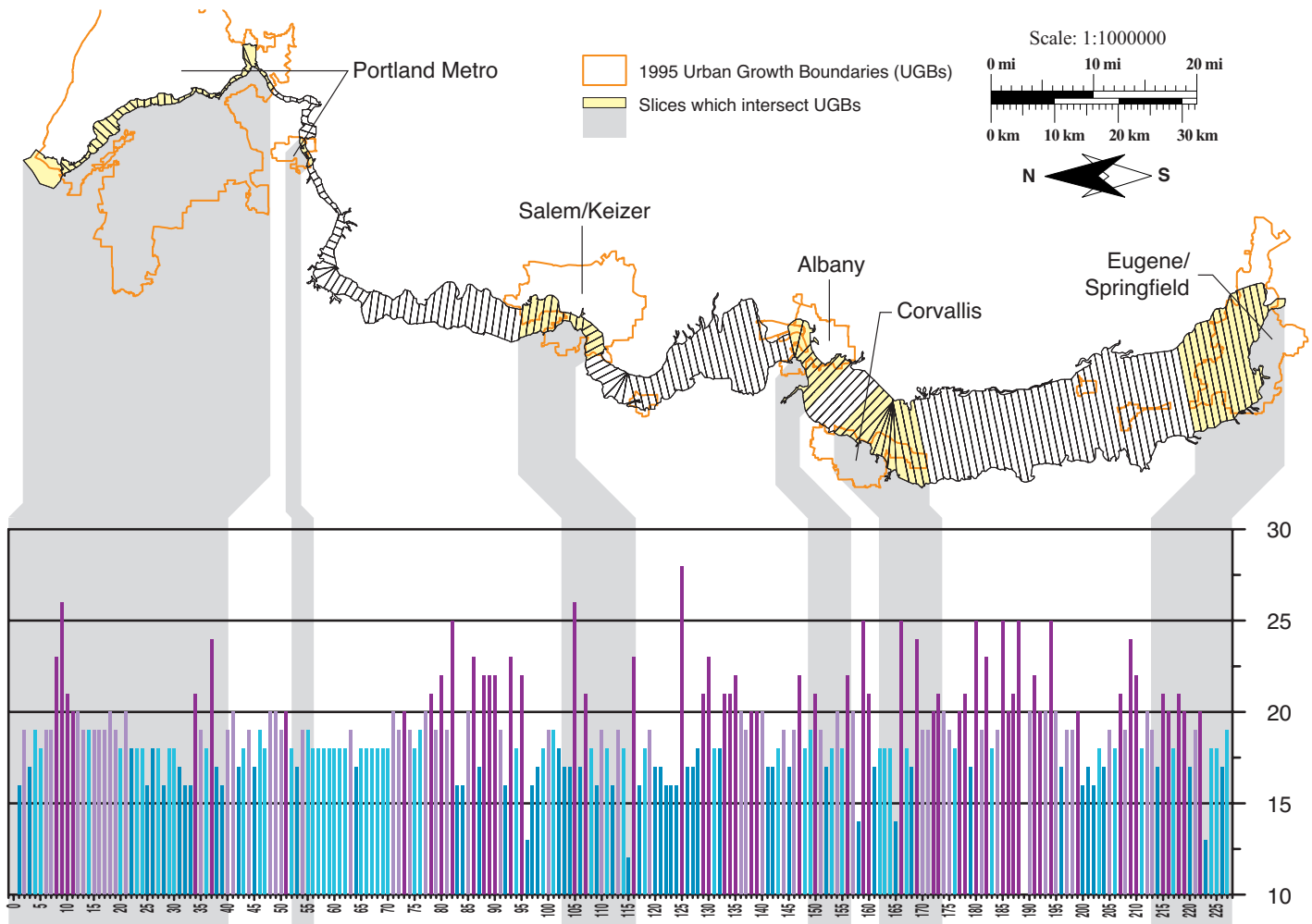

Figure 135. *Pre-EuroAmerican predicted fish assemblage*

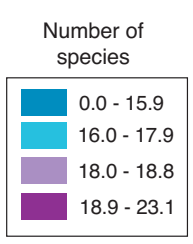

Figure 136. *Circa 1990 predicted fish assemblage*

◆ = *locations of field-observed values*

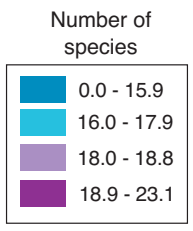

Figure 137. *Plan Trend 2050 predicted fish assemblage*

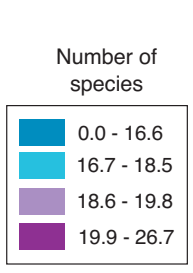

Figure 138. *Conservation 2050 predicted fish assemblage*

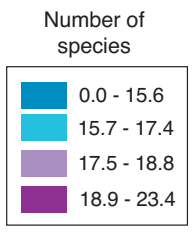

Figure 139. *Development 2050 predicted fish assemblage*

Note: *see pp. 132-33 for description of spatial framework used in these figures.*