Priorities for Restoration

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Introduction

The conceptual and spatial frameworks described on pages 132-33, along with the longitudinal pattern data described on pages 134-43, form the basis for this section of the Atlas. Together they are used to identify the potential for ecological benefit of floodplain restoration and to link it to the social and economic likelihood of restoration. The following paragraphs summarize Willamette River: 1) geomorphic patterns and potential for change, 2) floodplain forest properties of the river network, 3) human system patterns and structural development, and 4) economic values and processes that guide community choices. We first address each separately and then present a way to integrate these four key variables to prioritize areas for restoration at river reach and focal area extents, given a defined set of restoration purposes. We conclude this chapter by illustrating how conditions may change following restoration in a particular focal area.

Geomorphic Channel Complexity

Three major areas of the Willamette River exhibit high potential for restoration of channel complexity (Fig. 204 graph C). The reach between Corvallis and Eugene offers some of the highest remaining channel complexity and at the same time has lost more than most other sections of the river. It combines both existing qualities to be protected and high potential for additional recovery. This reach also includes some of the most extensive bank armoring and revetment outside the Portland metropolitan area. These structures could be strategically modified or removed to restore channel function. This is also true of the second area near Albany. A third important area for river restoration is the portion of the middle reach downstream of Salem. This section has lost channel complexity and includes substantial amounts of land in state parks and other public ownerships. This combination of recovery potential and public lands makes it well suited for restoration of channel complexity. The distribution of areas for restoration of channel complexity along the river also is an important flood storage design criterion for river managers and restoration planners.

Floodplain Forests

Forest restoration is simpler than channel restoration because of the ease and success of planting native tree species. Restoration could include natural reestablishment of wild floodplain forests, planting to regrow native forests, or cottonwood plantations. All provide some portion of natural floodplain forest functions and offer options for design of regional restoration efforts. The entire Willamette River has experienced extensive loss of floodplain forests, and the upper two-thirds above Newberg have lost the greatest total area. The middle reach between Newberg and Albany historically and currently contains the highest percent of the floodplain in forest cover, which gives it a higher priority for forest restoration. The upper river has greater area of floodplain and therefore has a high potential for forest area increase, even though the percent of the floodplain in forest might be lower. One of the largest blocks of floodplain forest historically was at the confluence of the Santiam and Luckiamute Rivers with the Willamette River. That forest has been greatly reduced, but it still contains one of the best examples of late-successional cottonwood forest in Luckiamute Landing State Park. This historical potential and intact remnant of floodplain forest on public land makes this reach another high priority for forest restoration.

Human Systems

The areas around urban centers—Portland metropolitan area, Salem, Albany, Corvallis, and Eugene—exhibit high population density and structural development. In general, Eugene has some of the highest densities of dwellings and people within the floodplain and Portland has some of the highest structural modification in its industrial areas. Road systems are a much greater constraint in the floodplains around Portland than any other section of the river. This means that pressures to continue to modify the river and biological communities will be highest in these areas. In terms of restoration within the floodplain, presence of roads, bridges and other structures gives these reaches lower potential due to the long-term human investment in maintaining a stable landscape pattern and the resistance this creates to allowing natural processes, e.g., floods, to operate across their full range of variation. At the same time, tributary junctions in these reaches should be recognized as critical nodes in the river that offer ecological value and are essential for the migration of aquatic and terrestrial organisms (e.g., coho salmon, winter steelhead, spring Chinook salmon) from the Willamette River into the upper watersheds of these tributaries. Examples of such tributary junctions in urban centers along the Willamette are the Clackamas, Tualatin, Mollala, Calapooia, Marys, and McKenzie Rivers. Another critical property of these urban areas is the potential for highly visible projects and educational opportunities in public areas. Important examples are Oak Bottoms in Portland, Minto-Brown Island in Salem, Baxter Park in Albany, Willamette Park in Corvallis, and Alton Baker Park in Eugene.

Public lands are particularly important opportunities for floodplain restoration because they are lands in common ownership and can be managed to meet the long-term needs of society without directly impacting private landowners. There are many types of public lands within the Willamette River floodplain: state, county, and city parks, rights-of-way for roads and bridges, grounds for public buildings and utilities—all exist along the length of the Willamette River. Several major holdings downstream of Salem, the Luckiamute River confluence, and municipal parks around Corvallis and Eugene offer substantial areas that could include both high-use park areas and functional components of native forests. These are readily accessible and well-distributed opportunities for regional restoration planners. A thoughtfully prioritized entire-river network of such restoration efforts could be a critical dimension of enhanced flood protection *and* a more naturally functioning river.

Economic Values and Commodity Production

Three major reaches of the river—downstream of Salem, downstream of Albany, and between Corvallis and Eugene—have lower land values, predominantly in agricultural uses (Fig. 201). The area downstream of Salem and the area between Corvallis and Eugene also have comparatively lower investments in land improvements. The area downstream of Albany also has a high proportion of flood-resistant crops. Such characteristics make these areas well suited for restoration because the land costs encountered in conservation easements, leases, or land acquisition with willing landowners would be less than in other reaches of the river. The need to protect these sections from flood damage would also be lower because of the lower land

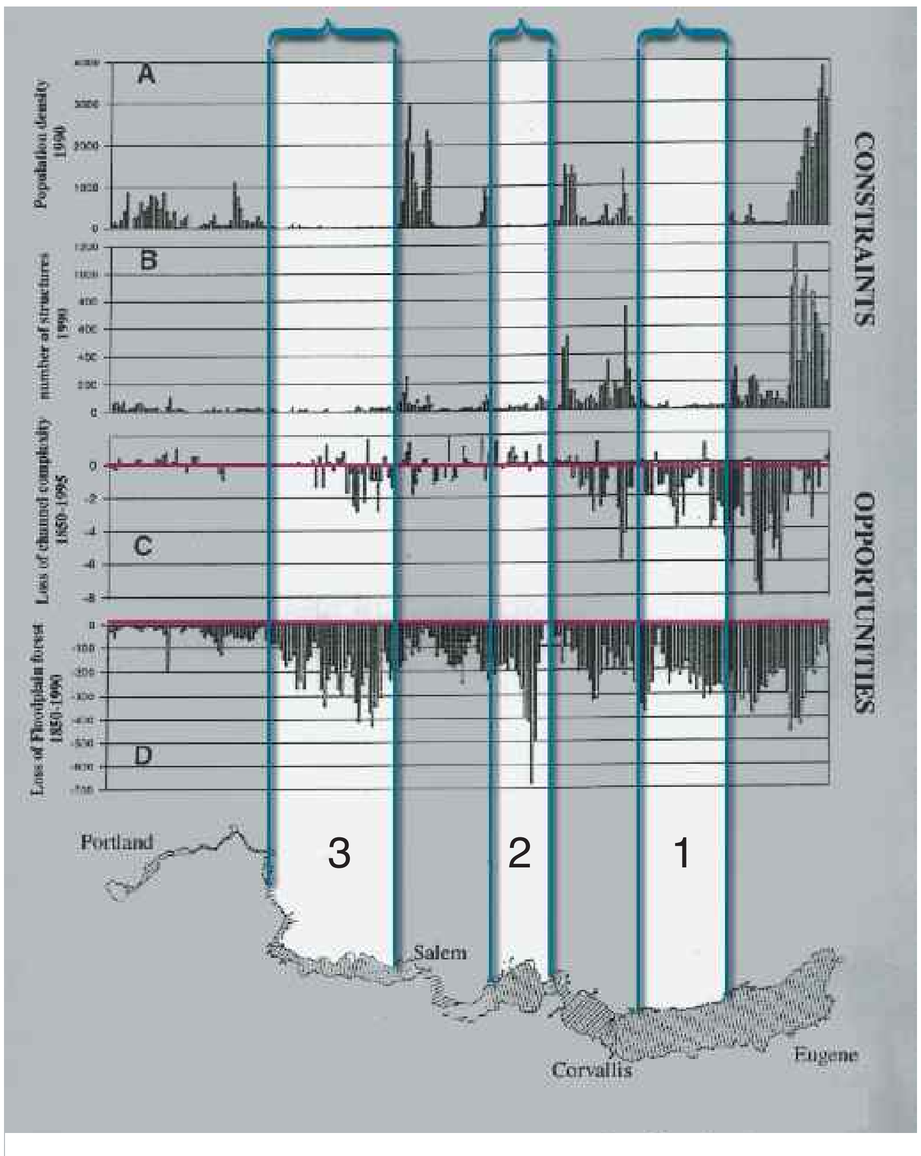

Figure 204. *Reaches with coincident low constraint and high opportunity to restore channel complexity and native floodplain forest.*[153]

values. These sections of the river coincide with areas of high potential for ecological benefits related to floodplain forest restoration and recovery of channel complexity.

Example Approaches to Prioritization

Restoration of ecologically significant processes in places where human population density and land use intensity are high may require reversal of long-standing investments in land form and water course alteration. If ecological restoration and the benefits of built environments are in opposition—gain in one necessarily causing loss of the other—then the conceptual model described on pages 132 and 133 expresses the nature of the prioritization task: at the network extent find those reaches where two conditions exist, investment in constructed conditions is low and the potential for increased ecological benefit is high. If potential ecological gain is high but the existing structural investment is as well, then future net gain is interpreted as small, as is the likelihood of community acceptance of large-scale restoration projects. While we choose to illustrate this particular conception of restoration priorities, it is important to note that there are many other valid sets of restoration priorities. Both the magnitude of human investment and potential restoration value refer to complex sets of factors whose definitions and relative importance may differ among reasonable people.

Figures 204 and 205 show two examples of how to make the conceptual model quantitative and spatially explicit.[152] Beginning with river kilometer zero at the confluence with the Columbia River, we use the spatial framework explained on page 132 to quantify key factors affecting both opportunities and constraints for restoration. These two approaches are not mutually exclusive, but may be used in concert by individuals or groups interested in choosing among available options for restoring riverine ecosystems. Again, note that either of these approaches may be applied with restoration priorities other than those we illustrate, given the necessary data for the relevant factors.

One approach for prioritizing locations of restoration actions is graphical inspection of multiple factors of a river network. In Figure 204, a single value is recorded for each factor for each river slice and the resulting single-factor linear graphs are stacked atop one another so that you may read the values for both opportunities and constraints for a chosen slice by visually scanning up or down the figure. In this graphical inspection approach, constraints on restoration are low where two factors, 1990 population density and 1990 number of structures per slice, are low. Conversely, ecological opportunity for restoration efforts to succeed is expressed in terms of change since pre-EuroAmerican settlement in channel complexity and in area of floodplain forest (pp. 18 – 25). This approach assumes that restoration potential is high where there has been a large loss of these factors since the mid 19th century. Thus these slices have the biophysical potential to recover what has been lost by employing natural processes as a restoration aid.

Highlighted vertical bands labeled 1 through 3 (outlined in blue in Figure 204) indicate reaches of the river where *both* desired conditions exist: constraint measures are low and opportunity measures are high. This example puts constraint in the controlling position (i.e., only look for opportunities where you know constraints are low) and shows the degree to which opportunity, as represented in Figure 204 by just two indicators, may also be available in these zones. This graphical inspection approach is a simple way to use the longitudinal pattern data from pages 134-43 to prioritize river reaches for restoration.

A more quantitatively and functionally detailed example of how data on longitudinal patterns can be used to identify areas with relatively high restoration potential is illustrated in Figure 205. In this example, the specific restoration objectives are to increase channel complexity and floodplain forest area (with associated beneficial effects on terrestrial and aquatic biodiversity and water quality, as discussed in preceding sections) and increase non-structural flood storage. The potential ecological benefits of restoration are represented by three biophysical factors and the social constraints are represented by five different demographic and economic factors.

Human factors and relative weightings (constraints)	
1. 1990 population density per 1 km slice	0.11
2. 1990 rural structure density per 1 km slice	0.11
3. 1990 road density per 1 km slice	0.22
4. 1990 area of private land per 1 km slice	0.22
5. 1990 percent of slice worth more than $2,500 / ac.	0.34

Biophysical factors and relative weightings (opportunities)	
1. change in length of forest per 1 km slice 1850-1990	0.4
2. change in length of channel per 1 km slices 1850-1995	0.4
3. percent of channel length in revetment 1995	0.2

These factors, and their weightings above, are then used to quantitatively rank each slice using two independent indices describing a) social constraints and b) biophysical opportunities. The former consists of five components - population, structure, road, private land ownership, and higher price taxlot areal densities within each slice. Biophysical opportunities are then described by three components - change in length of river bank woody vegetation, change in length of channel complexity, and percent of bank revetted per slice. Each component is assigned a number between 0 and 1, using a linear relationship between the minimum value (or, in the case of forest change and channel length change, a threshold) and the maximum value. Then, a weighted sum of these normalized components is computed to form each composite index. A restoration potential value is then defined for each slice using these two indices, and the median value of each index is used to divide the space into quadrants. Each slice falls into a single quadrant (Fig. 205).

The color-coded map of slices in Figure 205 shows the priority locations that emerge from these restoration purposes and their corresponding factors and weightings. Note the contiguous green slices, especially where such slices are adjacent to pale orange slices (e.g., slices 188, 189, and 190). These are locations where high potential for increased ecological benefit (green) occurs next to places that are already functioning relatively well ecologically and have less likelihood of future pressure for development (pale orange). The associated scatter plot at lower right identifies three slices of note (189, 190, 198) in the example to follow on pp. 146-47.

Analyses such as these provide a coarse-grained prioritization of candidate river reaches at the whole-river network extent. Such analyses are only the first step in a multi-scale process for prioritizing reaches and focal areas for restoration.

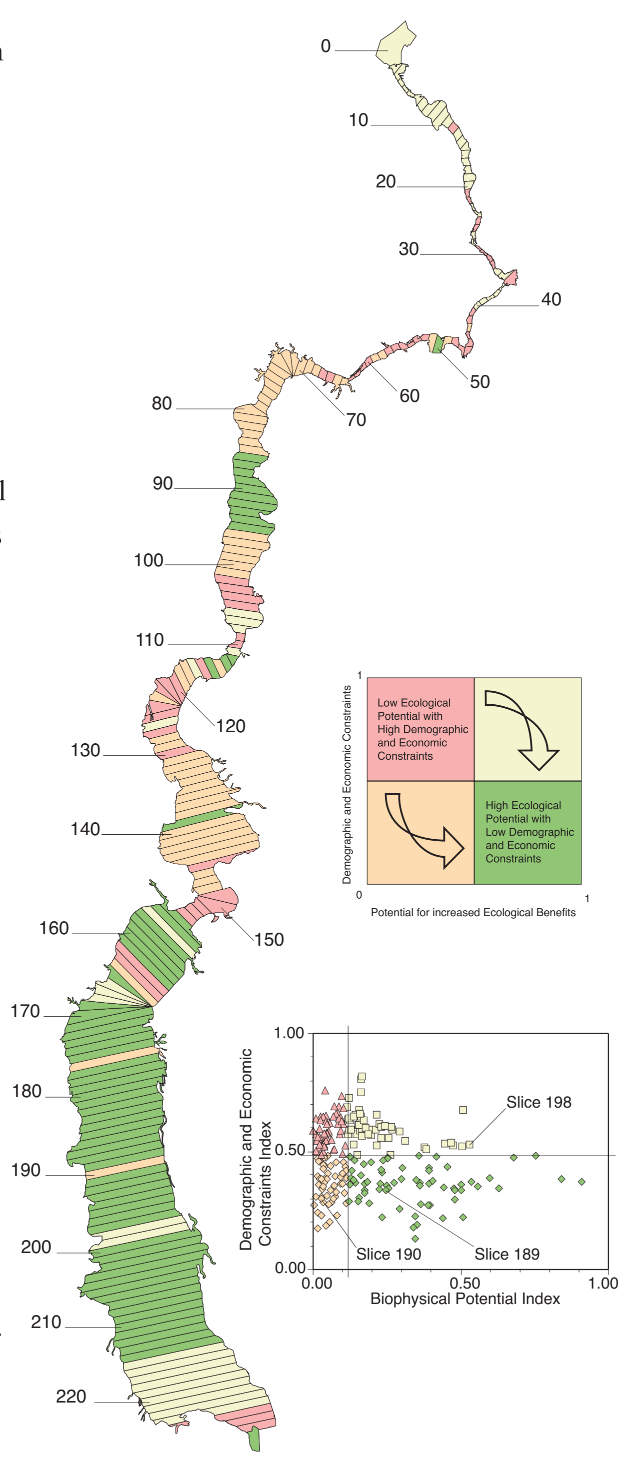

Figure 205. *Illustration of restoration priorities using the purposes of 1) increase channel complexity, 2) increase the area of floodplain forest, and 3) increase non-structural flood water storage, applied with the factors and weightings listed above. Note that other purposes may alter the spatial location of high priority areas and/or require data on other factors.*