Projected Ecosystem Change

Introduction

The preceding pages describe the alternative futures in terms of land use and land cover. The pages that follow evaluate the likely effects of these land use / land cover patterns on four environmental resources of concern (Fig. 132):

1. *Willamette River* — projected changes in river channel structure and streamside vegetation, and the implications of these changes for fish communities in the main river (pp. 112-13).

2. *Water Availability and Use* — projected changes in the demand for water for irrigation, municipal and industrial supplies, fish protection, and other uses, and the degree to which these demands can be satisfied by the finite water supply in the basin (pp. 114-17).

3. *Aquatic Life in Streams* — projected changes in the quality and quantity of stream habitat and in the composition and diversity of native fish and benthic invertebrate communities in streams (pp. 118-23).

4. *Terrestrial Wildlife* — projected changes in the amount of habitat for amphibians, reptiles, birds, and mammals in the basin, and the abundance and distribution of selected wildlife species (pp. 124-27).

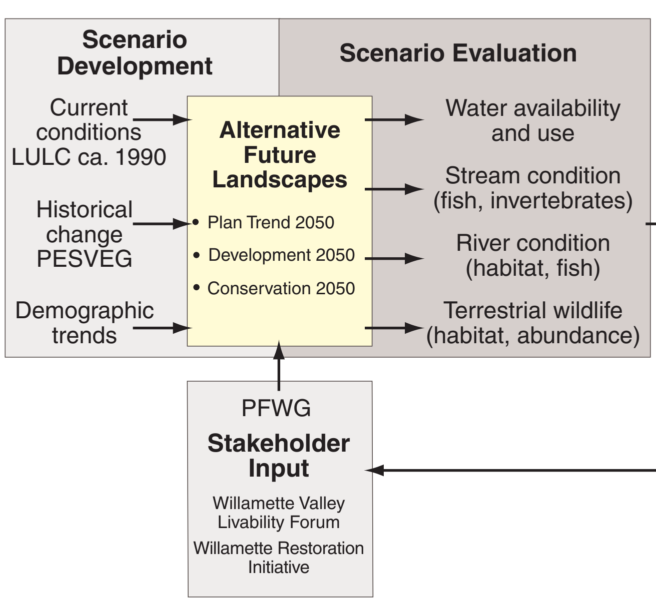

Figure 132. *Process for developing and evaluating the alternative futures, noting the four resources addressed in the alternative future evaluations on pages 112–27.*

These resources were chosen for several reasons. They represent a broad spectrum of ecosystem attributes—both aquatic and terrestrial, and measures of both habitat quality and biotic communities. They address issues of societal concern as expressed in federal and state laws, such as the Endangered Species Act and Clean Water Act, and in deliberations of citizen-based groups, including the Willamette Valley Livability Forum and Willamette Restoration Initiative. They also reflect areas in which expertise and information were available to evaluate the alternative futures.

The objective of the alternative future evaluations is to supply information that will assist in decision-making about future land and water policies in the Willamette Basin. Clearly, there are many more environmental, social, and economic issues that are considered in such deliberations than just the four we evaluate. Our research on ecosystem responses complements work being done by others. For example, the Oregon Department of Environmental Quality (DEQ) is evaluating effects of land use and point sources of pollution on water quality, as part of Total Maximum Daily Load analyses in the Willamette Basin (http://waterquality.deq.or.us/wq/Willamet/Will_hom.htm). The Willamette Valley Livability Forum, with funding from the Federal Highway Administration, is evaluating interactions between land development and transportation policies in the basin, and potential impacts on traffic congestion and costs (http://www.wvlf.org/atf.html). Effects of future land use scenarios on the cost of urban services and farm and forest productivity are being assessed in a project organized by 1000 Friends of Oregon (http://www.econw.com/wvaf/index.html). Each of these efforts is using data, and in some cases the explicit scenarios, generated by the PNW-ERC. Taken as a group, these various studies begin to provide the broad scope of information needed for informed decision-making.

Methods Overview

Estimates of resource condition for the Willamette River, water availability and use, aquatic life, and terrestrial wildlife were generated for each of the five scenarios of land use / land cover: Pre-EuroAmerican scenario (PESVEG), LULC ca. 1990, Plan Trend 2050, Development 2050, and Conservation 2050. Most results are presented, however, as projected changes in condition relative to circa 1990. For example, the estimated number of Blue Grouse in the basin is 39% higher for Conservation 2050 than circa 1990 (Fig. 133). In general, we have greater confidence in estimated differences between scenarios than in our estimates of absolute values for any given scenario. We choose 1990 as the reference for these comparisons for two reasons: (1) readers are more familiar with and can best relate to conditions in 1990 and (2) among all the scenarios, the estimates for LULC ca. 1990 are the most reliable.

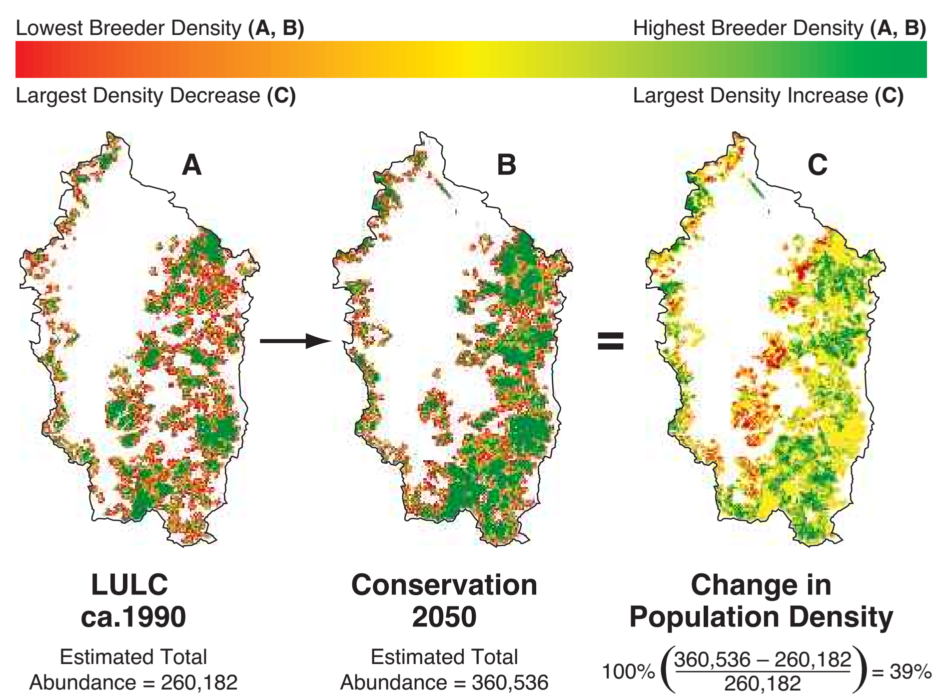

Figure 133. *Illustration of the use of 1990 conditions as reference in comparison of scenarios. Results are expressed in terms of percent change relative to LULC ca. 1990, as illustrated here for the estimated number of Blue Grouse in the Willamette Basin for LULC ca. 1990 and Conservation 2050, derived from the wildlife population evaluation model described on pages 126-27.*

Estimates of change in natural resources are based on quantitative evaluation models developed specifically for this purpose by PNW-ERC scientists. In each case, the form of the evaluation model was designed to reflect the nature of the problem, our understanding of the mechanisms of response, and the data available for model calibration. It is not surprising, therefore, that the different resource evaluations involved different modeling approaches (described in more detail on subsequent pages). Some of these approaches are empirical, while others are more mechanistic. Some were calibrated with recently collected field data, while others relied on data from relevant scientific literature or expert judgment. For both aquatic life and terrestrial wildlife we employ multiple modeling approaches, to enhance the robustness of our conclusions.

Major Assumptions and Uncertainties

One of the major challenges was the very large geographic extent (entire Willamette Basin) and long time frame (circa 1850 to 2050) for which estimates of resource condition were required. Estimates could be based, therefore, only on data feasible to obtain over this entire area and time span, that is, fairly coarse resolution data. Thus there are many phenomena of potential concern that operate at scales of space or time too fine for our information. For example, Oregon slender salamanders require large pieces of dead wood on the forest floor to successfully survive and reproduce, but we could not quantify such a fine-scale habitat feature across the entire Willamette Basin. Instead, we had to infer salamander habitat quality from maps of land use/land cover derived from remote sensing. Large pieces of dead wood on the forest floor occur mostly in closed-canopy forests, and the amount of dead wood increases with forest age. Thus, a land cover of older forest serves as a surrogate for high-quality habitat for Oregon slender salamander. Because of the fairly coarse nature of these habitat characterizations, the wildlife models provide reasonably accurate estimates of overall basin patterns and trends, but are not appropriate for estimating conditions at specific sites. Similar caveats apply to results for the river, water availability and use, and aquatic life evaluation models.

The five scenarios are representations of land use / land cover that result from explicit assumptions about the past, the present, and future social trends and management policies and priorities. They do not capture all aspects of changes that have occurred in the Willamette Basin since EuroAmerican settlement, nor all those that may occur through 2050. Thus, we are not predicting actual changes over time, but instead are evaluating the sensitivity of the evaluated resources to the types of land use / land cover changes, and associated assumptions, represented in each scenario. Global climate change and invasions of non-native species are examples of two factors expected to have major ecosystem impacts that are outside the scope of our analyses. We also assume that the fine-scale features of each land use / land cover class remain fairly constant over time. Thus, large pieces of dead wood on the forest floor occur predominately in old forests not just today, but also did in the past and will in the future. Likewise, an acre of row crops in the future is assumed to have essentially the same influence on aquatic and terrestrial wildlife as an acre of row crops today. We recognize that major changes in management practices could occur that would alter such relationships, but data limitations and basic constraints on project scope prevent us from addressing such issues.

Finally, our understanding of how ecosystems function in the Willamette Basin is derived largely from observing resource responses to current and past human and natural processes. It is possible that future changes, resulting from the cumulative effects of human alteration of land, water, and biotic resources, will be outside the bounds of previous experience and thus, impossible to predict. Likewise, if there are major time lags between landscape change and ecosystem responses, our predictions of future change may be underestimated. We also assume that ecosystem responses are reversible and elastic. Thus, if we restore natural habitats and functions, aquatic and terrestrial wildlife will recover to levels near those that occurred prior to disturbance. Sufficient data on recovery are not available to confirm this assumption.

While the above uncertainties and assumptions seem substantial, they are inherent in almost all model projections of large-scale environmental change. Even given these limitations, the results provide valuable insight into the overall resource patterns and trends likely to occur.

Detroit, Oregon before inundation by Detroit Reservoir. 1912.
Photo: Salem Public Library Historic Photograph Database, Salem Public Library, Salem, Oregon.

North Santiam River, before building of Detroit Reservoir, 1946.
Photo: Salem Public Library Historic Photograph Database, Salem Public Library, Salem, Oregon.

Detroit Dam, 1953.
Photo: Salem Public Library Historic Photograph Database, Salem Public Library, Salem, Oregon.

Sternwheeler "RELIEF" trapped in ice on Willamette River, Salem, 1924.
Photo: Salem Public Library Historic Photograph Database, Salem Public Library, Salem, Oregon.