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Introduction

Many biological and ecological factors act in concert to create the spatial distributions of wildlife species found within a landscape. As a result, the geographic distributions of terrestrial vertebrate species are often more complex than the patterns of habitat they occupy. Good quality habitats may go unused when fragmentation inhibits a species' ability to disperse throughout a landscape. Or individuals may respond to high population densities in good areas by moving into neighboring sites having low habitat quality. A long-lived species may persist for some time in a landscape, even when habitat loss and degradation ensure its eventual demise.

This study extends the analysis of the previous section by accounting for the effects of habitat quality, quantity, and pattern on species' survival rates, reproductive output, and movement patterns. We evaluate the ability of the LULC ca. 1990 and Pre-EuroAmerican (PESVEG) landscapes, and the Plan Trend 2050, Conservation 2050, and Development 2050 futures to support 17 wildlife species, expressed in terms of estimated population abundance and spatial distribution. This analysis does not account for interactions between species such as predation, competition, or mutualism.

Methods

A computer model called PATCH [147] (a Program to Assist in Tracking Critical Habitat) was developed for this study and used to generate the results described below. PATCH was designed for territorial terrestrial species, and the data required for it to run include estimates of habitat use, territory size, survival and reproductive rates, and movement ability. An extensive literature search was conducted to obtain these parameter values, but complete data were found only for the 17 species listed in Table 47. Fortunately, this list of species includes both birds and mammals, habitat generalists and specialists, and a wide range of territory sizes, survival and reproductive rates, and movement abilities.

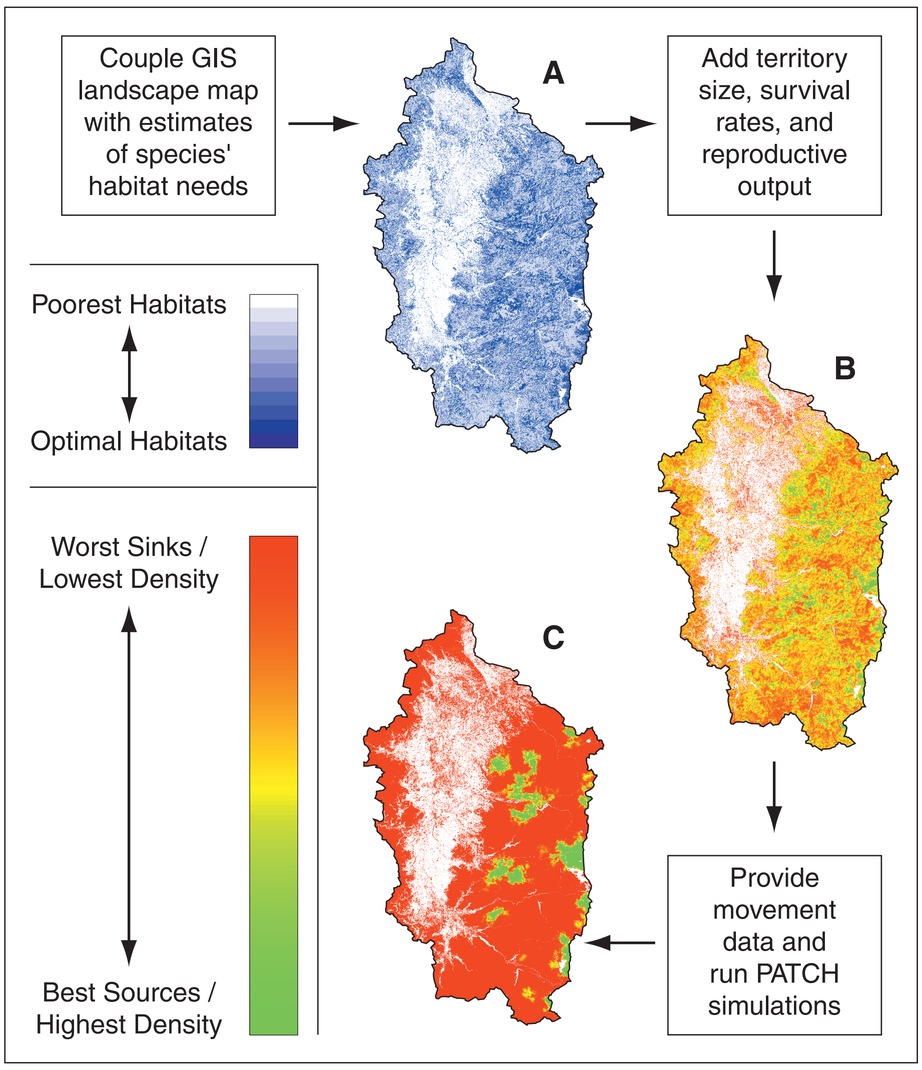

Figure 165. *Example application of PATCH. PATCH converts estimates of habitat quality into maps of population density, as shown here for the Cooper's Hawk. GIS imagery is merged with wildlife species' habitat needs to construct maps of landscape quality (A). These are linked with basic life history data to identify sink and source areas (B), and with movement data to estimate population density (C). Areas shown in white have a habitat quality of zero, and as such cannot support breeding for this species.*

The PATCH model simulates a wildlife population by following every individual's growth and survival, reproductive output, and movement. These rates and behaviors are influenced by the quality, quantity, and patterns of habitat found in a landscape. Habitat quality is a numeric measure of the importance of a habitat to a particular species (pp. 124-25). As illustrated in Figure 165, the modeling process begins by merging habitat quality specifications and an image of the landscape under study. The resultant map of habitat quality is combined with estimates of territory size, survival rates, and reproductive output to quantify the source/sink nature of the landscape. Sources are sites where reproduction exceeds mortality; in sinks, mortality surpasses reproduction. Finally, estimates of species' movement ability are supplied, and PATCH demographic simulations are conducted. Model outputs include projections of where, and at what densities, wildlife species are likely to occur. Populations in this study ranged from 300 to 3 million individuals in size.

Results

Our results are displayed both numerically (Fig. 166), and in map format (Fig. 167). These figures illustrate the extent to which conditions in the Pre-EuroAmerican or three alternative future landscapes differ from LULC ca. 1990 conditions. Figure 166 presents, on a species-by-species basis, the changes from LULC ca. 1990 in aggregate habitat quality and estimated population abundance. Aggregate habitat quality is a sum of the habitat qualities present throughout the entire Willamette River Basin (pp. 124-25).

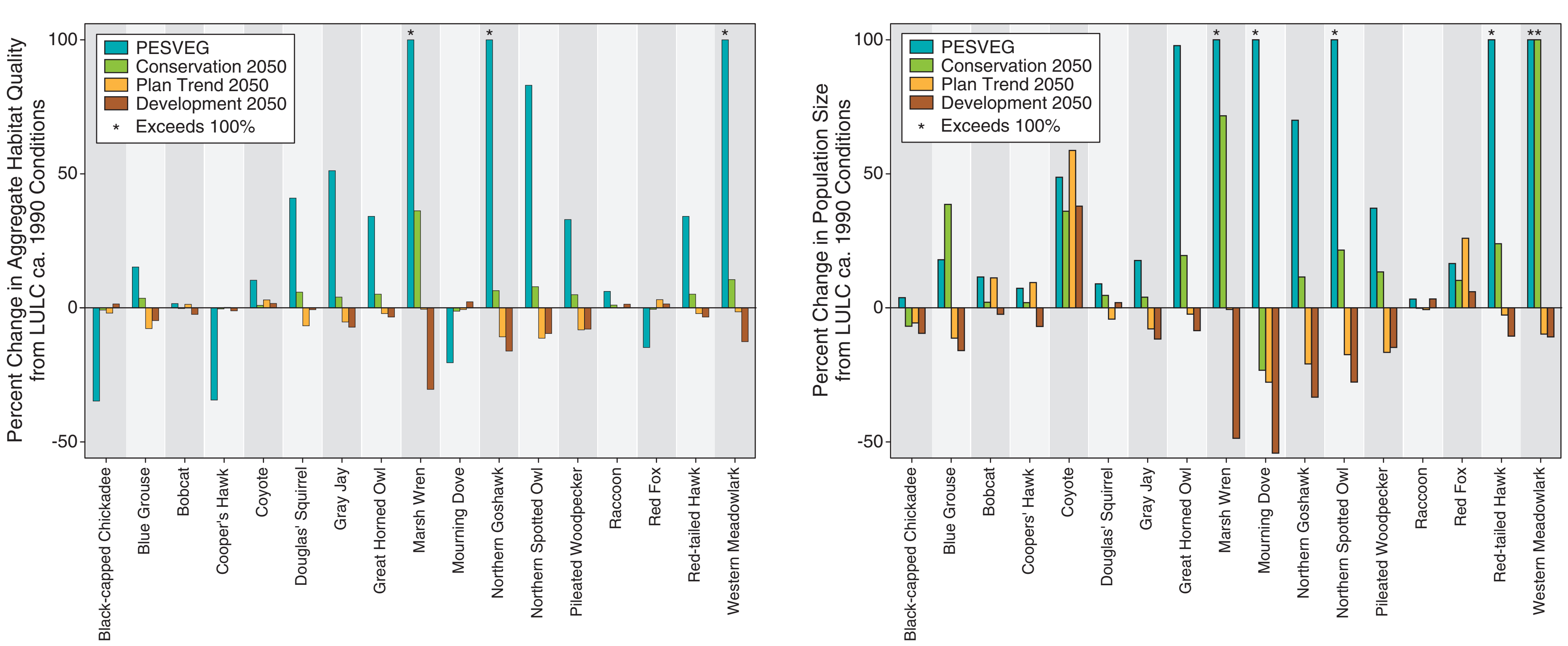

Figure 166. *Numerical results showing both the changes in overall habitat quality (left) and changes in population size (right) for each of the 17 wildlife species used in the analysis. Aggregate habitat quality was computed by summing the quality, for a given species, of every pixel present in a landscape. Population size was projected using the PATCH model. The percent change in a value was computed as 100 x (value in landscape – value in ca. 1990) / value in ca. 1990. The off-scale data points, indicated with asterisks, range from 111 to over 30,000 %. The values reported here are for the entire WRB.*

Species	Habitat Requirements
Black-capped Chickadee	Common permanent resident of cities, conifer forests and other woodlands.
Blue Grouse	Permanent resident of conifer forests from the Coast Range to the Cascades.
Bobcat	Ubiquitous dweller of most habitats from sea level to above timberline.
Cooper's Hawk	Secretive and uncommon occupant of most forests and woodlands.
Coyote	Highly adaptable occupant of nearly all habitats, especially open areas.
Douglas' Squirrel	Resident of conifer forests and some mixed forests and oak woodlands.
Gray Jay	Common permanent resident of conifer forests above 2000 feet in elevation.
Great Horned Owl	Permanent resident of most habitats other than large tracts of mature forest.
Marsh Wren	Summer resident of aquatic vegetation bordering ponds, marshes, and rivers.
Mourning Dove	Common summer resident of the valley and adjacent foothills.
Northern Goshawk	Uncommon permanent resident of dense forests in the Cascades.
Northern Spotted Owl	Permanent resident requiring large tracts of old-growth coniferous forest.
Pileated Woodpecker	Uncommon permanent resident that prefers mature conifer forests containing large trees and snags.
Raccoon	Common permanent resident of most habitats including woods and brush.
Red Fox	Ubiquitous occupant of most habitats other than dense forests and cities.
Red-tailed Hawk	Common summer resident of most habitats except dense forests and cities.
Western Meadowlark	Once common resident of meadows, pastures, and grasslands that has been nearly extirpated from the valley.

Table 47. *A list of the 17 wildlife species used in the analysis. Each species is paired with a brief description of its overall habitat requirements. All of the species listed here are native to the Willamette River Basin.*

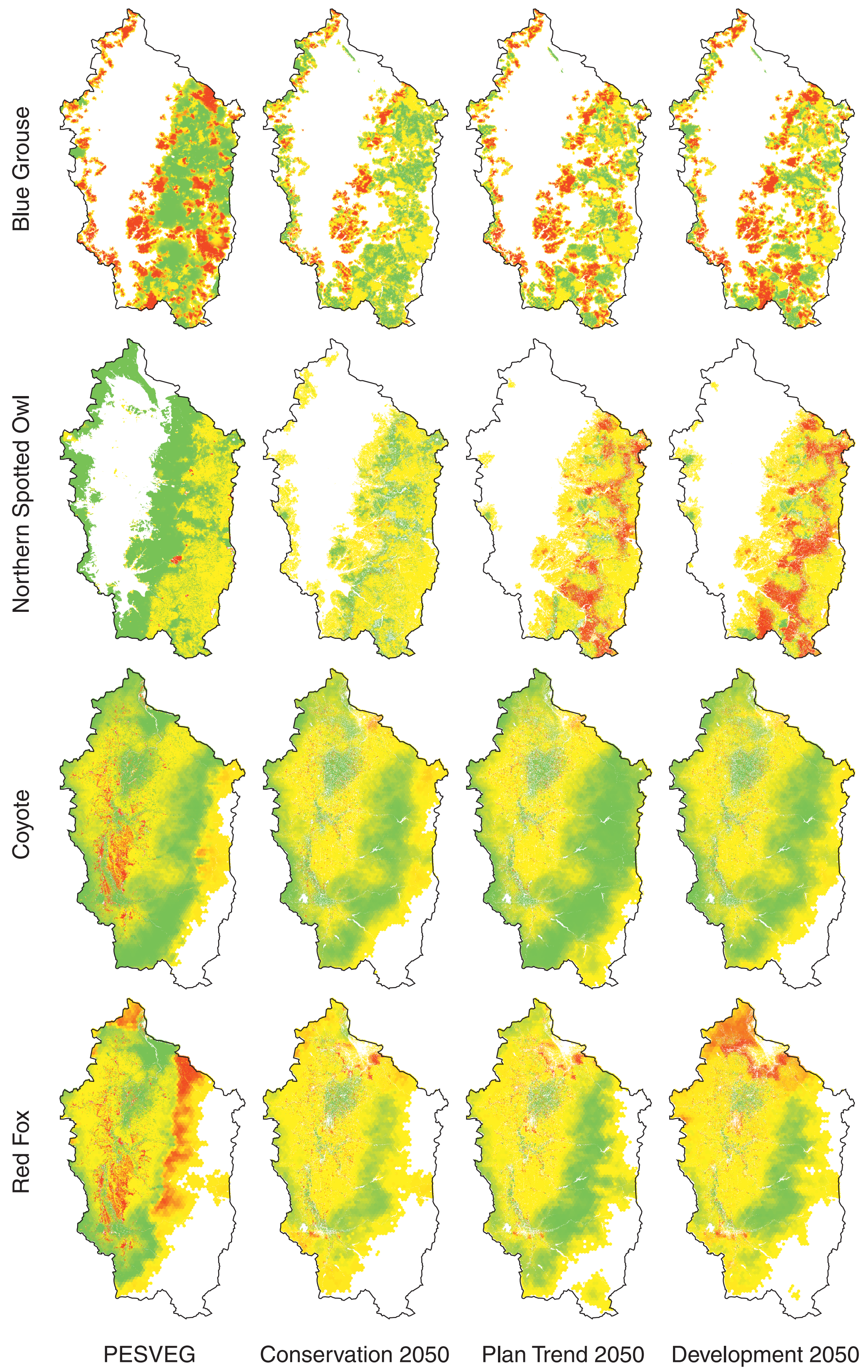

Figure 167. *Changes in population density projected to occur under the transitions between LULC ca. 1990 and each of the other scenarios. Red, yellow, and green indicate a population decrease, little or no change, and a population increase, respectively. The color spectrum used here is the same as the lower one in Figure 165. White areas were unused by the populations.*

Small gains in habitat quality frequently drove large increases in population size, as illustrated by the Western Meadowlark under the transition from LULC ca. 1990 to Conservation 2050. In other cases an increase in aggregate habitat quality was accompanied by a decrease in population size, as in the Mourning Dove's response to the shift from LULC ca. 1990 to Development 2050. Such counter-intuitive results are explained by changes in the amount and patterns of habitat fragmentation. For some species the response to landscape change was dramatic. For example, Conservation 2050 and Pre-EuroAmerican supported 28 and 311 times as many Western Meadowlarks, respectively, as were projected for LULC ca. 1990.

All 17 simulated wildlife species had larger populations under the Pre-EuroAmerican landscape than in LULC ca. 1990, with seven increasing by more than 50% (Fig. 166). While populations tended to be larger (14 of 17 species) under Conservation 2050 than in LULC ca. 1990, they were usually smaller than under the Pre-EuroAmerican scenario. Ten species increased more than 10% (relative to LULC ca. 1990) under Conservation 2050, compared to three under Plan Trend 2050 and one under Development 2050. Four species increased more than 25% under Conservation 2050. Just one species declined by more than 10% under Conservation 2050, compared to five and nine under Plan Trend 2050 and Development 2050, respectively. The transition from LULC ca. 1990 to Development 2050 caused four species to decline by more than 25%, and one to drop by more than 50%.

Figure 167 illustrates the complex spatial patterns of population gain and loss that result when LULC ca. 1990 changes into the Pre-EuroAmerican and three alternative futures. The figure suggests, for example, that landscape changes proving detrimental to the Northern Spotted Owl tend to be desirable for the red fox. The Blue Grouse exhibits intricate patterns of loss and gain, with good areas closely interspersed among bad ones. The generalist nature of the coyote is reflected in its remarkable ability to succeed (it increased substantially) in each landscape change scenario.

Summary

From a wildlife population viability perspective, the Pre-EuroAmerican and three alternative futures represent significant departures from today's landscape conditions. The wildlife populations responded in remarkably similar ways to Plan Trend 2050 and Development 2050; both resulted in declines for a majority of the study species. In contrast, Conservation 2050 enhanced all but three of the populations. For wildlife species already stressed by habitat loss and fragmentation, this work suggests the choice between alternative futures may be critical to their long-term likelihood of persistence.