INTRODUCTION

Forest landscapes in the Douglas-fir region of western North America have changed considerably since the early 20th century. Fires and timber harvesting have reduced the amount of old-growth in the landscape, leading to concern for the survival of native species associated with late-successional habitats. Quantitative assessments of these landscape transformations are needed to measure the amount of change, and to elucidate the processes that drive landscape dynamics. We integrated historical forest survey data with modern vegetation maps derived from satellite imagery to examine spatial patterns of forest landscape change in the Oregon Coast Range from 1936 to 1996. Our major objectives were to:

1. Quantify changes in the distribution of major forest types by landowner class and ecoregion
2. Examine the influences of land ownership, topography, and climate on landscape change over a range of spatial scales

STUDY AREA

The Oregon Coast Range encompasses over 30,000 km² in western Oregon. Climate is relatively mild, with cool wet winters and warm dry summers. Physiography is characterized by deeply dissected terrain with steep slopes and high stream densities. Douglas-fir (Pseudotsuga menziesii) is the major tree species across most of the region, with Sitka spruce (Picea sitchensis) and western hemlock (Tsuga heterophylla) dominating many of the wetter coastal sites. The land base is a mosaic of federal, state, private industrial, and private non-industrial ownerships.

METHODS

- Forest patterns in 1936 were obtained from a historical Forest Survey map developed from field data and aerial photographs by the USDA Forest Service.
- Forest patterns in 1996 were mapped using the Gradient Nearest Neighbor (GNN) method. Landsat TM imagery and environmental GIS layers were used to produce a digital map in which each grid cell was associated with a forest inventory plot and its detailed tree-level measurements.

1936 Vegetation Map
Reclassify to 400 m Grid
1996 Forest Type Map

Recalibrated and Rescaled Forest Type Maps

- Based on documentation of the 1936 Survey, pixels in the 1996 map were assigned to 1936 vegetation classes based on stand age, stand density, and volume by species and size class.
- The vector coverage of the 1936 map was converted to a 16 ha (400 m) grid, and the 25 m resolution 1996 map was rescaled to a 400 m grid to match the spatial resolution of the 1936 map.
- 1936 and 1996 forest type maps were integrated into a GIS database to examine changes in forest type distribution by landowner class and ecoregion.
- Correlations between change in late-successional forest cover and potential explanatory variables were examined at three spatial scales: 4th field watersheds (mean size = 240,000 ha), 5th field watersheds (mean size = 25,000 ha), and 7th field watersheds (mean size = 2000 ha).
- Explanatory variables included the percentage of private land, mean slope, and the mean moisture stress index (MSI) computed as mean summer temperature divided by mean summer precipitation.

RESULTS

- Distributions of forest types on private and public lands were similar in 1936.
- Large shifts occurred on private lands between 1936 and 1996, with considerable decreases in the large conifer classes and increases in the small conifer, hardwood, and open classes.
- Decreases in the large conifer classes were less pronounced on public lands.
- Decreases in open areas on public lands reflect regeneration of areas burned in the early 20th century.

- Landscape change by ecoregion:
- In the coastal ecoregion, open, hardwood, and small spruce-hemlock forests increased while large spruce-hemlock and all Douglas-fir forest types decreased.
- In the interior ecoregion, hardwood, and small conifer forests increased while large Douglas-fir and increases in small Douglas-fir.

- Landscape change by ownership:
- Results of this historical analysis corroborate previous findings

METHODS

Map classes used in the analysis

<table>
<thead>
<tr>
<th>1936 Vegetation Class</th>
<th>1996 Forest Type Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Forest (Nf)</td>
<td>Misc</td>
</tr>
<tr>
<td>&lt; 50% Sitka spruce</td>
<td>Small</td>
</tr>
<tr>
<td>&gt; 50% Sitka spruce</td>
<td>Medium</td>
</tr>
<tr>
<td>&gt; 50% Western Hemlock</td>
<td>Large</td>
</tr>
<tr>
<td>&gt; 50% Western Redcedar</td>
<td>Lg S/H (10)</td>
</tr>
<tr>
<td>&gt; 50% Douglas-fir</td>
<td>Large</td>
</tr>
<tr>
<td>&gt; 50% Douglas-fir</td>
<td>Large Lg Df (7)</td>
</tr>
<tr>
<td>&gt; 50% Douglas-fir</td>
<td>Large Df</td>
</tr>
<tr>
<td>&gt; 50% Douglas-fir</td>
<td>Large S/H</td>
</tr>
<tr>
<td>&gt; 20% Douglas-fir</td>
<td>Lg S/H (10)</td>
</tr>
</tbody>
</table>

RESULTS

Landscape Change by Ecoregion

Coastal Ecoregion

- In the coastal ecoregion, open, hardwood, and small spruce-hemlock forests increased while large spruce-hemlock and all Douglas-fir forest types decreased.

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KEY FINDINGS

- The predominant trend was a shift from late-successional to small conifer forest of the coastal landscape mosaic.
- Decreases in late-successional forests were greater on private than on public lands, reflecting different histories of forest management and natural disturbances.
- Rates of timber harvest on private lands increased rapidly after the World War II, and current management practices on many private industrial ownerships involve clearcut harvests at 50-year or shorter rotations.
- Although significant cutting also occurred on public lands, rates of harvest were generally lower than on private lands.
- Public lands also included large areas burned in the early- to mid-20th century that were too young to have occurred most of the study period.
- With the exception of mean slope at the 4th field watershed scale, topographic and climatic variables were poor predictors of change in late-successional forest cover.
- Forest fuels were assessed as potential hazards arising from reclassification and rescaling of the 1996 map, and develop multistate statistical models of landscape change over a range of spatial scales.

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Spatial Patterns of Forest Landscape Change in the Oregon Coast Range Between 1936 and 1996

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