Distribution of Vegetation Biodiversity Across a Continuum of Management Emphasis in Coastal Oregon

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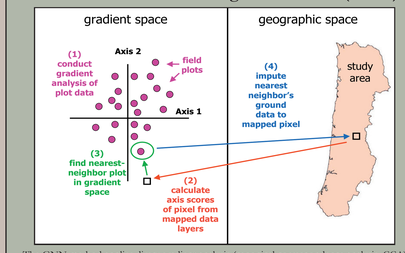
Introduction

In large forested regions, patterns of vegetation biodiversity are inextricably linked to land ownership and associated management policies. Whereas conservation planning often focuses on reserves, in this study we illustrate how biodiversity protection varies along a continuum of management emphasis from biological conservation to commodity production. Semi-natural managed forests contribute to overall conservation efforts while simultaneously producing commodity values. We also demonstrate how key elements of vegetation biodiversity such as species composition, canopy structure, and dead wood can be represented in "coarse filter" assessments. In this study we used GIS and vegetation maps created with the Gradient Nearest Neighbor method to analyze the distribution of variability in forest vegetation across ownerships and land allocations in coastal Oregon.

Objectives

- Define and map key elements of current vegetation biodiversity using spatial predictions from the Gradient Nearest Neighbor method.
- Define and map forest use classes, defined by land ownership and allocation, that span a continuum of management emphasis from biological conservation to commodity production.
- Quantify and map the distribution of vegetation biodiversity across ownerships and forest use classes.

The Gradient Nearest Neighbor Method (GNN)



The GNN method applies direct gradient analysis (canonical correspondence analysis, CCA) and nearest neighbor imputation to ascribe detailed ground attributes of vegetation to each patch in a regional landscape. Steps are: (1) Quantify relations between ground and mapped data for plots using CCA. (2) For each mapped pixel, predict scores on the first eight CCA axes from the mapped explanatory variables. (3) For each pixel, identify the single plot that is nearest in 8-dimensional gradient space (Euclidean distances with scores weighted by eigenvalues). (4) Impute the ground attributes of the nearest-neighbor plot to the pixel. Maps then can be constructed for any vegetation attribute measured on the plots.

Methods

We mapped current (1996) vegetation using GNN (see box). Explanatory variables were from 19 GIS grids representing topography, geology, climate, and Landsat imagery (fig. 1). Vegetation data were collected on 823 field plots (fig. 2). Response variables were basal area by tree species and size-class. We calculated several summary vegetation measures from the tree-level data for analysis.

We classified GIS maps of land ownership (fig. 3) and allocation into five forest use classes that span a continuum of management emphasis from ecological to commodity goals (Table 1, fig. 4). We quantified the distribution of vegetation variability among ownerships and forest use classes by intersecting the GIS layers.

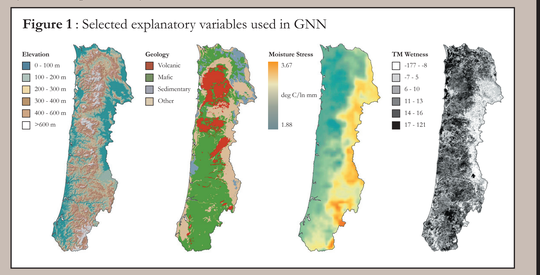


Figure 1: Selected explanatory variables used in GNN

Table 1. Forest use classes in coastal Oregon along a continuum of management objectives from ecological to timber production

Forest use class and management objectives	Ownerships and allocations	Annual timber harvest (MBF/yr)	Forest area in hectares (percent)
No-harvest reserves	Congressionally designated wilderness, state and county parks, city watersheds, The Nature Conservancy land	None	38,916 (2)
Ecological objectives only	Federal Late Successional Reserves, federal riparian reserves, state lower-slope riparian buffers	Uncertain	487,501 (22)
Ecological objectives primary, timber production objectives secondary	Federal matrix lands, state matrix lands, state upper-slope riparian buffers, state spotted owl clusters, some county and city areas, riparian buffers on private land	0 - 300 (uncertain)	374,323 (17)
Timber production and other objectives under environmental constraints	Private nonindustrial land	400 - 500	445,945 (20)
Timber production objectives under environmental constraints	Forest industry land	600 - 700	886,942 (40)

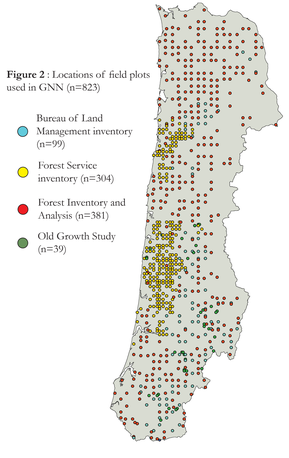


Figure 2: Locations of field plots used in GNN (n=823)

- Bureau of Land Management inventory (n=99)
- Forest Service inventory (n=304)
- Forest Inventory and Analysis (n=381)
- Old Growth Study (n=39)

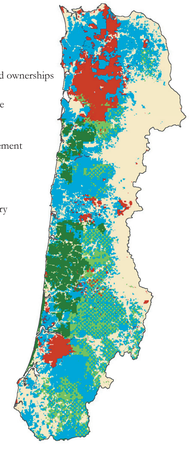


Figure 3: Major land ownerships

- Forest Service
- Bureau of Land Management
- State
- Forest industry
- Private nonindustrial

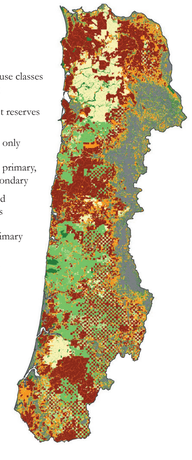


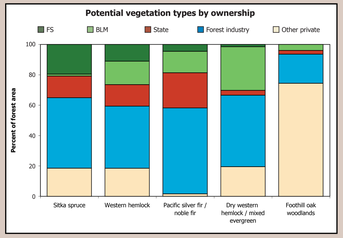
Figure 4: Forest use classes (See Table 1)

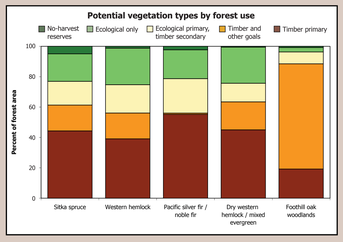
- No-harvest reserves
- Ecological only
- Ecological primary, timber secondary
- Timber and other goals
- Timber primary
- Nonforest

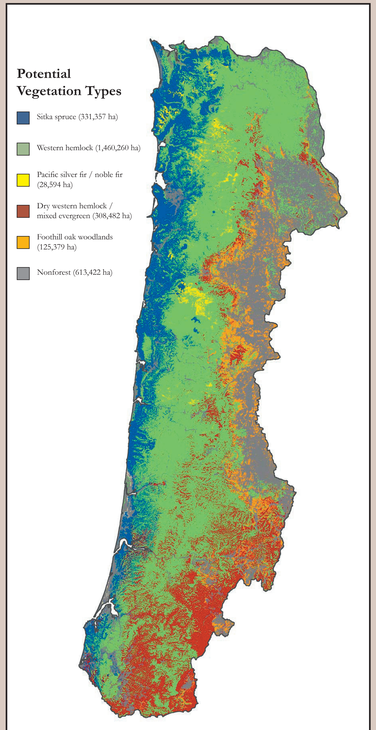
Key Findings

Potential Vegetation Types ►

- Species gradients are associated with environment and relatively insensitive to forest management practices. Conservation strategies need to consider environmental gradients.
- Vegetation types are well represented in areas managed for ecological objectives, except foothill oak woodlands.
- Foothill oak woodlands and river valleys occur primarily on nonindustrial private lands.
- No-harvest reserves are a small portion of the landscape and concentrated in Sitka spruce.

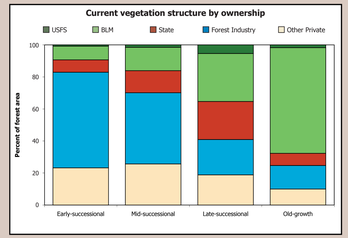


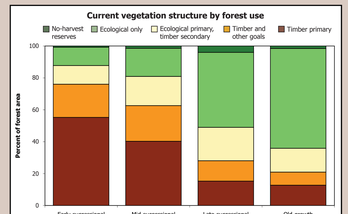


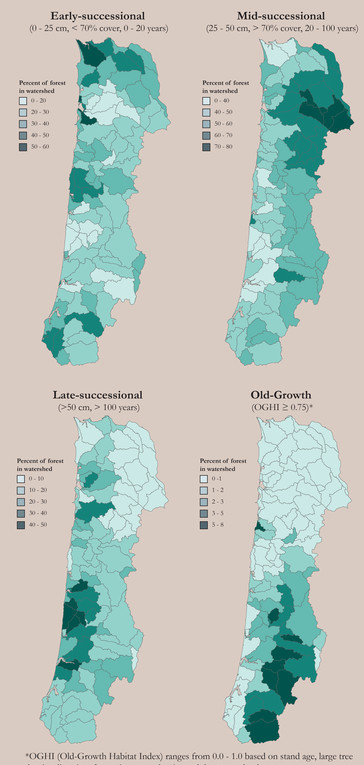


Current Vegetation Structure ►

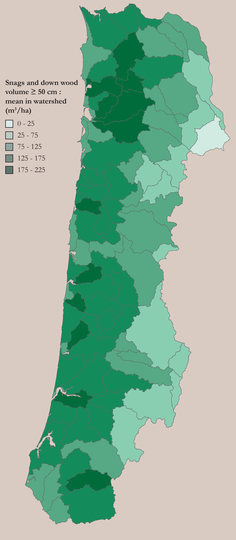
- Forest structure is strongly influenced by past disturbance and thus ownership.
- Old forests are a small part of the current landscape, below the historical range of variability, and concentrated on federal lands.
- Structurally diverse, early successional forests are rare on all ownerships and receiving little policy attention.





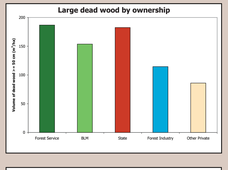


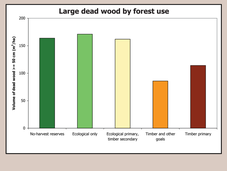
*OGHI (Old-Growth Habitat Index) ranges from 0.0 - 1.0 based on stand age, large tree density, diversity of tree sizes, snag density, and down wood volume

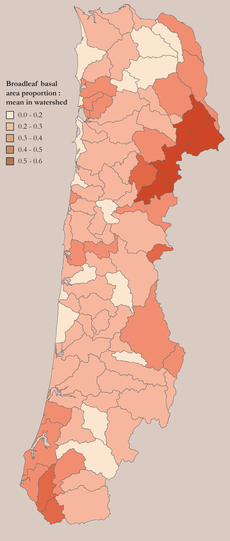


◄ Large Dead Wood

- Has been diminished by fire suppression and forest management
- Most abundant in older forest and on public lands
- Current wood is 'legacy' with uncertain future

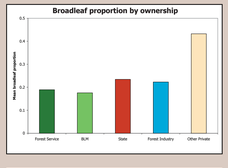


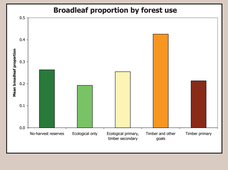




◄ Broadleaf Vegetation

- Occurs in coastal, riparian, foothill, and disturbed habitats
- Most abundant on nonindustrial private lands
- Reduced by intensive forest management favoring conifers





Forest Policy Implications

- The GNN maps create unprecedented opportunities for detailed spatial analysis of vegetation biodiversity across broad, multi-ownership regions. The maps can be used to assess forest sustainability, evaluate forest policies, and provide context for local management.
- In multi-ownership landscapes consisting of semi-natural managed forest, all lands contribute to biodiversity. Biodiversity goals cannot be met by wilderness or federal lands alone.
- The multi-ownership and forest dynamics perspectives reveal biodiversity threats that are not readily visible in an analysis of single ownerships.

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For More Information...

- E-mail: janet.ohmann@orst.edu
- See: Ohmann, J.L.; Gregory, M.J. 2002 (in press). Predictive mapping of forest composition and structure with direct gradient analysis and nearest neighbor imputation in coastal Oregon, USA. Canadian Journal of Forest Research.
- Visit : www.fsl.orst.edu/clams/gnn