An Old-Growth Index for Regional Assessments

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Introduction

Characterizations and definitions of old-growth forests are needed for conservation planning and to help set management objectives. Definitions of old growth have been developed but these simplify the high diversity of forests into just two types: old growth and not old growth. Old-growth forests and forests of any age are far more diverse and complex than a two-type classification justifies. For example, research on forest structure and dynamics indicates that some elements of old-growth structure can be found in much younger forests (Spies and Franklin, 1988), and conversely, some old-growth forests have been subject to frequent natural disturbances such as partial fires that remove old-growth structures and move stands toward earlier developmental conditions (Goslin, 1997). We developed an index of old growth for the Coast Range that better captures the diversity of all forest types than black-and-white definitions, and provides flexibility for managers in setting definitional and mapping thresholds.

The old-growth habitat index (OGHI) incorporates these generally accepted elements of old-growth forests:

- Trees > 100 cm dbh (number/ha)
- Diversity of tree sizes
- Standing dead trees > 50 cm dbh and > 15 m tall (number/ha)
- Down wood (volume in m^3/ha)
- Age of dominant trees in the upper canopy

While other distinctive structural features of old-growth exist such as spatial heterogeneity, these five elements are readily available in forest inventory data sets. They are also generally correlated with other attributes of complex forest structure such as broken-topped crowns, presence of shade-tolerant tree species, and large down logs.

Methods and Ecological Basis of the OGHI

To develop OGHI, we used existing data (Spies and Franklin, 1991) from 25 natural reference stands in the Coast Range whose canopy dominants ranged in age from 200 to over 500 years. For each of the five elements, we developed single or multi-segmented linear relationships ('curves') to generate an 'element score' that ranges from 0 to 100. OGHI is calculated as the average of the five element scores.

Trees, Snags, and Logs
The curves for large trees, large snags, and down wood reach an asymptote at a score of 100, which corresponds to the maximum value observed in the reference stands. A score of 75 corresponds to the median, and 50 corresponds to the minimum value. In the reference stands, the numbers of large snags and volumes of dead wood on dry sites were somewhat less than on mesic and wet sites, probably because of age differences, fire history, and perhaps higher decomposition rates. Consequently, separate curves were developed for these two elements based on site type.

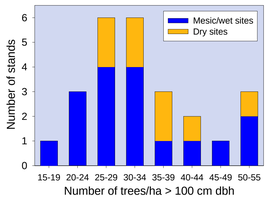
Diversity of tree sizes
Size diversity is expressed as an index which is a surrogate for tree height diversity. It is based on the density of trees in each of four dbh classes: 5-24 cm, 25-49 cm, 50-99 cm, >=100 cm. Threshold values for each dbh class corresponds to median tree density in the reference stands, under the assumption that maximum structural diversity occurs when crowns in a particular tree layer cover about 50% of the ground surface. Individual scores for each dbh class are combined into the size diversity index using weighting factors based on the relative height of trees among the classes. The rationale here is that a greater variety of forest environments (e.g. bark area, crown volume, and microclimates) exists in tall forests than in short forests for the same level of size diversity. The element score for size diversity is determined from a straight-line relationship.

Age of Canopy Dominants
Age is not a structural feature but is included because some of the biological diversity of old growth, such as low-mobility species, require a long time to colonize and accumulate after stand-replacement disturbance. The score for stand age on mesic and wet sites is 80 at 200 years and 100 at 450 years. This relationship is based on the finding that community similarity between old-growth stands and mature stands (80-200 years) was at least 80% for plant species, amphibians and small mammals (Hansen et al. 1991). For dry sites, scores of 80 and 100 are reached at 100 and 225 years, respectively, to reflect the shorter fire-return intervals on these sites and the low likelihood of finding very old stands in these locations.

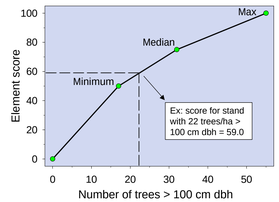
Reference Stand Characteristics

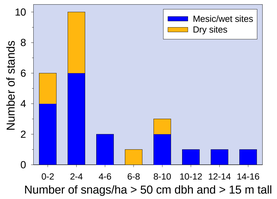
Curves for OGHI Elements Based on Reference Stand Characteristics

(Note: single line indicates one curve for mesic/wet and dry sites)

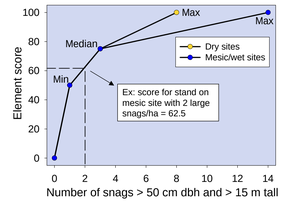


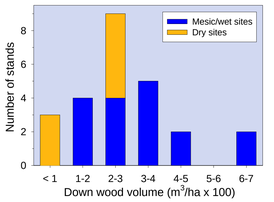
Large trees



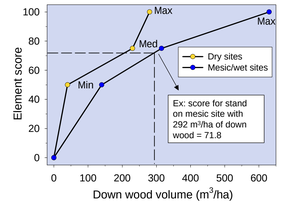


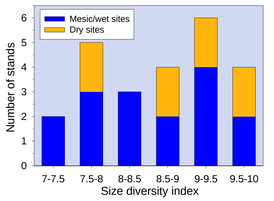
Large snags



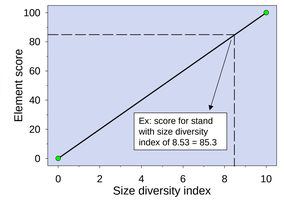


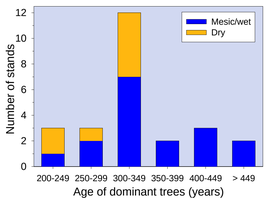
Down wood



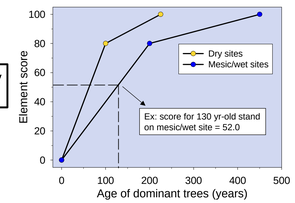


Size diversity





Age of Canopy Dominants

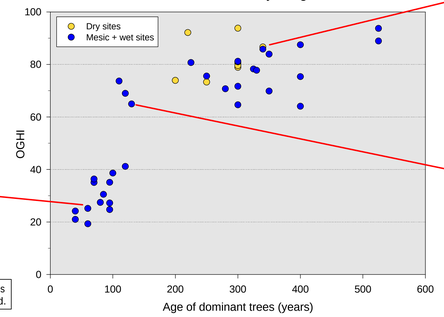


Example of OGHI calculation:
OGHI = Σ element scores / 5
OGHI = (59.0 + 62.5 + 71.8 + 85.3 + 52.0) / 5 = 66.1

OGHI vs Stand Age

for 25 reference stands and 16 younger natural stands

Even-aged stand with a single canopy layer of trees and low amounts of standing and down dead wood.

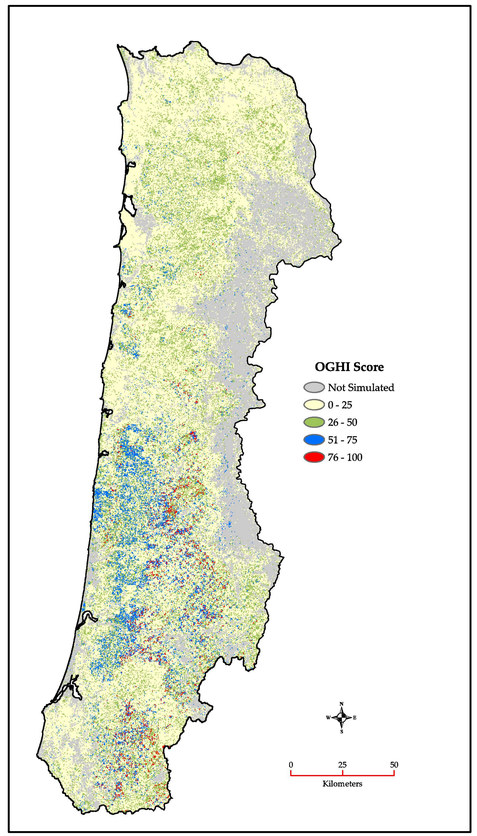


Old-growth stand characterized by large trees, down wood, and a diversity of tree sizes.

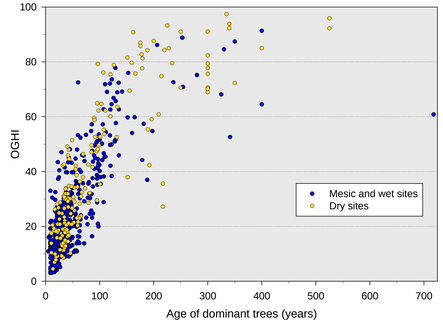
Mature stand with snags, logs, and canopy differentiation.

OGHI in the CLAMS Study Area

(based on 1996 data)



OGHI vs Stand Age for Inventory Plots in the Coast Range (n=629)



Summary

✓ The Old-Growth Habitat Index (OGHI) integrates five elements of stand structure and successional status into a single measure that recognizes the complexity and diversity of forest habitats across a range of ages.

✓ OGHI elements can be examined individually or in different combinations suited to management needs. For example, age of canopy dominants could be left out of the calculation of OGHI to make the index purely structural.

✓ OGHI provides flexibility in how old growth is defined.

✓ OGHI can be tailored to account for coarse differences in site conditions that may affect species composition and disturbance history, thus stand structure.

✓ OGHI can be extended to landscape-level analyses to project forest structure and the extent of old growth across the Oregon Coast Range.

References

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Goslin, M.N. 1997. Development of two coniferous stands impacted by multiple, partial fires in the Oregon Cascades. M.S. thesis, Oregon State University.

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