

# Patterns in understory vegetation distribution across gap openings in a variable-density thinned stand in western Oregon

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## INTRODUCTION

Canopy gap formation may be an important tool in creation of understory habitat heterogeneity in thinned second-growth (40-50 year old) forest stands in western Oregon, but the opportunities and implications of this practice are not well understood.

We investigated the role of gap openings in creation of understory habitat heterogeneity, in a variable density thinned stand on the east slope of the Oregon Coast Range.

Findings were assessed against the gap-partitioning and gap size partitioning hypotheses, which state that:

- Variation in resource levels across gaps may result in formation of distinct areas of vegetation composition in different positions relative to the gap (Denslow 1980).
- This effect may differ with gap size (Busing and White 1997).

Results will be used to assist in evaluation of the effectiveness of variable density thinning treatments in creating understory heterogeneity in stands and will help guide future management efforts.



Figure 1 – Map of western Oregon showing DMS sites, OS Hubbard site is circled.

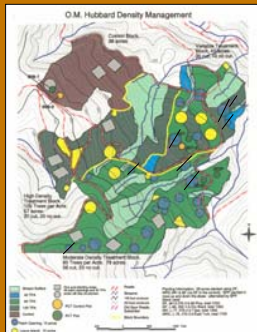


Figure 2 – Map of OM Hubbard DMS site showing treatment layout and transect locations.



Figure 3 – Moderate Density Thinning treatment, the "forest matrix" surrounding gap openings.



Figure 4 – Schematic of transect layout, all elements are to scale. Green squares are subplots, each set of five subplots is a mini-transect.

## METHODS

### Study Design

- Vegetation and canopy data were collected at the OM Hubbard Bureau of Land Management Density Management Study site (Figures 1 and 2), data from three additional sites is in preparation for further analyses.
- The DMS consists of variable density thinning treatments with three sizes (¼ acre, ½ acre and 1 acre; 0.1, 0.2, and 0.4 hectare) of gap openings interspersed (all stems removed) (Figure 2).
- Transects were established in ¼ and 1 acre (but not ½ acre) gap openings on a general northeast-southwest bearing (Figure 4).
- Sub-plots were sampled along the transects. At each sub-plot, absolute percent cover of all vascular vegetation was recorded and canopy cover was estimated using fisheye photography (example in Figure 5).
- Subplots were grouped into sets of five (mini-transects) by transect positions: Gap Center, Gap Interior, Gap Edge, and Forest Matrix (all except Gap Center had North and South iterations).



Figure 5 – Examples of fisheye canopy photographs. Left – gap center, center – gap edge, right – forest matrix.

### Data Analysis

- Non-metric multi-dimensional scaling (NMS) ordination was used to evaluate gradients in community composition from gap centers into the surrounding forest matrix.
- Multiple-response permutation procedure (MRPP) was used to test for difference in vegetation community between transect position groups.
- Indicator species analysis (ISA) was used to test species "faithfulness" (high abundance and frequency) to transect positions.
- Analysis of variance (ANOVA) was used to test differences in species richness, diversity, and beta-diversity among transect positions.
- Multivariate analyses were carried out using PC-ORD v4.33 and univariate analyses were carried out using SAS v9.1.

## RESULTS

### Understory Community Composition

- Plant community composition was highly correlated with canopy openness, total transmitted radiation and leaf area index, which corresponded to the transect positions (Figure 6). Early seral species dominated open sites (i.e., gap centers) while forest understory species were more abundant in the forest matrix and along the gap edge.
- Species composition differed significantly among transect positions (MRPP: A = 0.05, indicating relatively high within-group heterogeneity,  $p = 0.001$ ).
- Several species were found to be indicative of transect positions in both the 1 acre and ¼ acre gaps. Early seral and invasive species were indicators of gap interior positions, while forest understory associated species were indicative of edge and forest matrix positions (Figure 7).

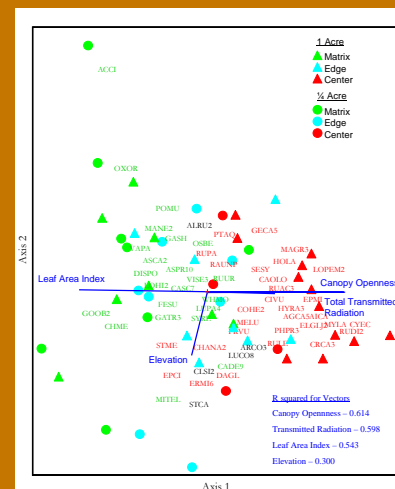


Figure 6 – NMS ordination of mini-transects in species space. Vectors represent environmental variables correlated with the ordination axes, where the strength of the length of the vector corresponds to the strength of the correlation (all variables with  $R^2 > 0.2$ ). Ordination explained 82.7 % of variation in the original data, had a 3-D solution, and was rotated to maximize correlation of canopy openness with Axis 1. Understory species acronyms are shown, where red represents early seral/open site-associated species, green represents forest understory species, and black represents species not generally associated with one or the other exclusively.

### Understory Species Diversity

- Species richness differed strongly between positions ( $F_{4,112} = 9.15$ ,  $p < 0.0001$ ), with highest richness in gap interior positions.
- Shannon's diversity index ( $H'$ ) ( $F_{4,112} = 3.92$ ,  $p = 0.0137$ ) and Simpson's diversity index ( $D$ ) ( $F_{4,112} = 2.37$ ,  $p = 0.0568$ ) also differed to some degree between positions.  $H'$  is more affected by low abundance species than  $D$  (which is a dominance index).
- Whittaker's beta diversity did not differ between positions ( $F_{4,112} = 1.94$ ,  $p = 0.1089$ ).

## CONCLUSIONS

- Understory vegetation composition differed among positions along transects.
- Species richness and Shannon's diversity index differed strongly with respect to transect positions but two other diversity measures did not.
- Diversity of dominant species is similar between positions, differences are related to numbers of low-abundance species, many of which are early seral species.
- Early seral and invasive species occupied gap interior positions, while forest understory and late-successional associated species were more strongly associated with gap edge and forest matrix positions.
- Results indicate that gap-partitioning may be occurring in these communities over a relatively short time span.
- Future management efforts in these and other similar stands should consider gap creation as a method of enhancing understory habitat heterogeneity, however, implications for late-successional habitat development are not yet clear.

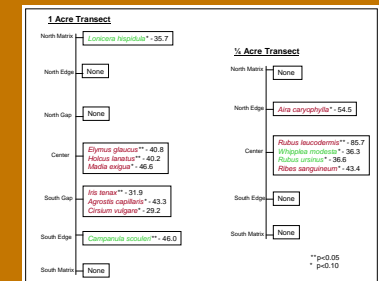


Figure 7 – Results of indicator species analysis of transect positions, indicator values for each species are included. Red type indicates early seral/open site associated species and green type represents forest understory species.

## REFERENCES

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