Grassland, Shrubland, and Woodland Plant Assemblages in Relation to Landscape-Scale Environmental and Disturbance Variables, Applegate Watershed Southwest Oregon

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Abstract

Multivariate techniques were used to investigate how environmental and disturbance factors affect the distribution and species composition of grassland, shrubland, and woodland plant assemblages at the landscape-level. Thirteen plant assemblages based on species composition were defined and modeled across the landscape. Ordination and modeling found variables related to moisture and soils most important to plant distribution. Vegetation patterns appear to be determined by a complex combination of edaphic, topographic, and climatic variables in addition to site history.

Introduction

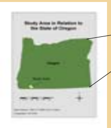
Grassland, shrubland, and woodland vegetation types are a major component of the landscape in the Applegate Valley of southwest Oregon. The Ashland Resource Area of the Medford Bureau of Land Management is currently implementing thousands of hectares of fuels reduction treatments annually, however, there is a paucity of data regarding these vegetation types and how they are affected by fuel reduction treatments. The objectives of this study were to gain a better understanding of these vegetation types and the factors responsible for their distribution.

Methods

The author collected species composition, woody plant structure (age and size classes and form), and site characteristics for 425 non-conifer stands using a reconnaissance or releve style methodology. Thirteen plant assemblages based on species composition were classified using clustering techniques in conjunction with Indicator Species Analysis. Nineteen environmental and ten disturbance variables were regressed against ordination axes and used to model assemblages based on landscape characteristics.

Keywords: Hierarchical agglomerative cluster analysis, Indicator Species Analysis (ISA), Nonmetric Multidimensional Scaling (NMS), Nonparametric Multiplicative Regression (NPMR)

Figure 1. Study Area Lands within the Ashland Resource Area of the Medford District Bureau of Land Management in the Applegate watershed of southwest Oregon.



Results

Table 1.

Plant Assemblage Summary

Association name	Typical Species (common names)	Group #	Association type
Fescue grassland	Fescue/ St. Johns wort/ balsamroot	Group 1	Grassland/ bald
Buckbrush chaparral	Buckbrush/ soft brome	Group 3	Shrubland
Rabbitbrush/ buckwheat bald	Rabbitbrush/ mountain mahogany/ arrowleaf and naked buckwheat/ cheatgrass/ Vulpia spp./ oat grass	Group 4	Grassland/ bald
Manzanita/ white oak	Whiteleaf manzanita/ Oregon white oak	Group 5	Shrubland/ woodland
Oak woodland	Oregon white oak/ Chinook brome/ hedgehog dogtail/ spreading hedgeparsley	Group 10	Woodland
Oat grass grassland	Oat grass/ medusa head/ Lemmon's needlegrass/ California poppy/ lupine	Group 14	Grassland/ bald
Mountain mahogany/ Brewer's oak	Mountain mahogany/ Brewer's oak/ serviceberry/ seablush/ yarrow/ lambstongue ragwort	Group 15	Shrubland
White oak/ buckbrush/ mountain mahogany	Oregon white oak/ buckbrush/ mountain mahogany/ grand collomia/ California brome/ hedgehog dogtail	Group 19	Woodland
Black oak woodland	California black oak/ blue wildrye/ yellowleaf iris/ beaked hazelnut	Group 22	Woodland
Disturbance mediated woodland/ chaparral	Madrone/ white oak/ buckbrush/ manzanita/ cheatgrass/ madia	Group 39	Shrubland/ woodland
Madrone woodland	Madrone/ black oak/ deerbrush/ blacksnakeroot	Group 43	Woodland
Manzanita chaparral	Whiteleaf manzanita/ ponderosa pine/ white oak/ blue dicks	Group 47	Shrubland
Canyon live oak woodland	Canyon live oak/ Douglas-fir/ bearbrush/ Oregon grape/ honeysuckle	Group 102	Woodland

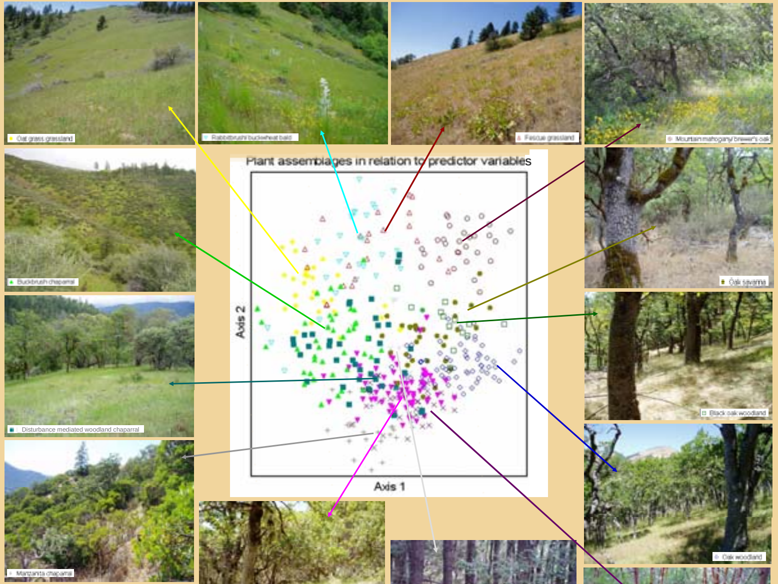
* Poison oak is found in all associations

Table 2. Variables associated with moisture (elevation, summer evapotranspiration, and annual precipitation) are related to axis 2, while soil variables (upper soil horizon depth, pH, cation exchange capacity and total silt, sand, and clay) are most strongly associated with axis 2. Heatload and years since fire were less important, but were directly related to axis 1.

Correlations (r-squared) of predictor variables by ordination axis

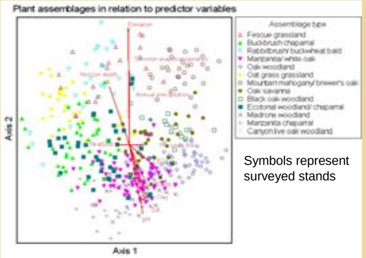
Variable	Axis 1	Axis 2	Axis 3
Elevation	0.004	0.478	0.08
Summer actual evapotranspiration	0.001	0.302	0.081
pH	0.054	0.285	0
Annual precipitation	0	0.251	0.108
Total silt	0.076	0.237	0
Upper soil horizon depth	0.08	0.235	0.004
Total clay	0.062	0.23	0
Annual actual evapotranspiration	0.01	0.181	0.044
Total sand	0.071	0.168	0.016
Cation exchange capacity (CEC)	0.096	0.082	0.013
Fire frequency	0.035	0.008	0.003
Fire interval	0.017	0.005	0.027
Slope Shape (e.g. concave)	0	0.002	0.001
Years since last fire	0.055	0	0.008
Heatload	0.055	0	0.006

Figure 2. Ordination based on species composition of 425 stands grouped into thirteen plant assemblages. Pictures are from a representative stand of each assemblage.



Oat grass grassland
Rabbitbrush/ buckwheat bald
Fescue grassland
Mountain mahogany/ brewer's oak
Buckbrush chaparral
Oak savanna
Disturbance mediated woodland chaparral
Black oak woodland
Manzanita chaparral
Oak woodland
Plant assemblages in relation to predictor variables
Axis 2
Axis 1

Disturbance appears responsible for increasing species composition variability within assemblages. Site data indicated that many of the outlying stands in the assemblages had evidence of relatively recent wildfire or fuel treatments. Some assemblages were clearly delineated in ordination space, while other assemblages with more common species and/or habitats tended to overlap considerably.



Plant assemblages in relation to predictor variables
Assemblage type
Fescue grassland
Buckbrush chaparral
Rabbitbrush/ buckwheat bald
Manzanita/ white oak
Oak woodland
Oat grass grassland
Mountain mahogany/ brewer's oak
Oak savanna
Black oak woodland
Ecotonal woodland/ chaparral
Madrone woodland
Manzanita chaparral
Canyon live oak woodland
Axis 2
Axis 1

Symbols represent surveyed stands

Figure 3.
Ordination from figure 2. with regression results of environmental and disturbance variables overlaid as vectors showing direction and amount of influence of the variables on species composition. Higher elevation, higher moisture sites with typically less developed, lower pH and low nutrient soils exhibiting soil catena occur at the top of the diagram (grasslands). Lower moisture sites with more moderate pH and more developed soils are at the bottom (chaparral). Heatload (aspect and slope) and associated fire history appear to distribute plants from more open chaparral and grassland sites on the left to higher canopy woodland sites on the right in the diagram, however, low explanation values (r^2) suggest that other factors are also responsible.

Main Conclusions

- Variables related to moisture (elevation, summer evapotranspiration, and annual precipitation) and soils (pH, soil horizon depth, and total silt and clay) were found to be the most important determinants of non-coniferous vegetation distribution.
- Disturbance (wildfires and fuel reduction treatments) appears responsible for increasing the variability of species composition within assemblages.
- Regression results indicate that heatload (aspect and slope) and fire history are associated, yet neither are highly correlated to plant distribution.
- The use of classification and ordination in addition to Indicator Species Analysis produced ecologically realistic assemblages. Site information elucidated factors for dispersed assemblages in ordination space.
- Predictive habitat models of assemblages based on ordination scores produced mixed results. This is possibly due to assemblages occupying multiple ecological sites, individual species responding independently to predictor variables, inaccuracies in base data, limited site history information, unmeasured biotic processes, and variation within stands and associations.

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