

## AN ABSTRACT OF THE THESIS OF

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The sensitive lichen *Usnea longissima* Ach., formerly a fairly common circumboreal species, has been extirpated from much of its range (e.g., Eastern Europe). Although the U.S. Pacific Northwest (PNW) remains a relative stronghold for the species, *U. longissima* faces increasing pressure in the region from habitat loss, air pollution, and commercial harvesting. *Usnea longissima* has a patchy distribution at both stand and landscape levels in the PNW, which may result from a lack of suitable habitat, dispersal limitations, or both. Although the species has been researched extensively in Scandinavia, no studies have examined its habitat associations or dispersal dynamics in the PNW. I used two approaches to assess the relative importance of habitat versus dispersal limitations as influences on the current distribution of *U. longissima* in the Oregon Coast Range. First, I collected environmental data from sites where *U. longissima* was present (n=75) and absent (n=75) to determine habitat associations for the species. In addition to identifying the variables that best predict habitat occupied by *U. longissima*, analysis of the data also yielded a statistical model that I combined with raster-based GIS modeling to assess the availability of apparently suitable habitat for the species across the study area. Second,

I placed 360 transplants among 12 sites in 4 habitats within the study area, and measured their growth (change in biomass) after one year. Habitats were determined from analysis of the environmental data described above, and represented a range of apparent suitability for the species, from sites of unlikely suitability where it did not occur (i.e., clear cuts on south-facing slopes), through highly suitable sites where the species was abundant (i.e., old stands on north-facing slopes). Statistical analysis of the environmental data from sites of presence and absence produced a model incorporating four of the environmental variables, in which the most significant variable (stand age) was positively associated with *U. longissima* presence. The spatial analysis results suggest that apparently suitable habitat is not limiting at the landscape level.

Additionally, the transplants grew well across all habitats, and gained the most weight in sites predicted to be the least suitable habitat. Overall, the results suggest that dispersal may play a more important role than habitat in limiting the distribution of *U. longissima* within the study area, although the potential influence of habitat on establishment of the species should be assessed to lend certainty to this suggestion.

Retention of remnant trees containing *U. longissima* will enhance its dispersal within regenerating stands, and preservation of intact stands harboring the species will increase its chances of spreading to uncolonized stands and persisting across the landscape.

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Factors Limiting the Distribution of the Sensitive Lichen *Usnea longissima* in the  
Oregon Coast Range: Habitat or Dispersal?

by

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Factors Limiting the Distribution of the Sensitive Lichen *Usnea longissima*  
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Chapter 1

Introduction

This research investigated factors that affect the current distribution of *Usnea longissima* Ach. (Fig. 1.1) across a section of the Oregon Coast Range. Specifically, I examined whether dispersal limitations or a lack of suitable habitat appear to play a greater role in limiting the distribution of *U. longissima* within the study area.

The epiphytic lichen *Usnea longissima* was once a fairly common, nearly circumboreal species (Ahlner 1948, Ahti 1977); however, its abundance has declined significantly throughout its global range, particularly in Scandinavia and Eastern Europe (Esseen et al. 1981, Pišút 1993, Tønberg et al. 1996, Thor 1999). Habitat loss due to timber harvesting is the most significant factor that has contributed to the demise of the species in these countries, although air pollution is also an important factor (Esseen et al. 1981, Trass and Randlane 1987, Kuusinen et al. 1990, Olsen and Gauslaa 1991). Although the species faces similar threats in North America, due to certain forestry practices, air pollution, and commercial harvesting, the northern Pacific coast of North America remains a relative stronghold for *U. longissima*, where its range extends from Northern California to Alaska (Noble 1982). In Oregon, *U. longissima* occurs throughout the Coast and western Cascade mountain ranges (McCune and Geiser 1997). In most of the U.S. Pacific Northwest (PNW), including our study area, *U. longissima* is currently listed as a Survey and Manage, Category F species under the

Northwest Forest Plan (USDA and USDI 2000, 2001). This classification requires that land managers conduct strategic surveys to determine whether *U. longissima* meets basic Survey and Manage criteria. Known *U. longissima* populations receive no protection under this classification.

Some epiphytic macrolichens are thought to have limited dispersal abilities, which result in their dependence upon old-growth forests (e.g., Dettki et al. 2000, Sillett et al. 2000). While *Usnea longissima* is thought to be dispersal-limited (e.g., Esseen 1985, McCune and Geiser 1997), relatively little is known about its habitat associations and dispersal limitations in the PNW, making it difficult to formulate specific recommendations regarding its management. I used two approaches to explore the probable roles of habitat availability versus dispersal limitations in influencing the distribution of *U. longissima* within the study area.

The second chapter presents results from a study of *Usnea longissima* habitat conditions at sites where the species occurs, and availability of apparently suitable habitat across the landscape. I collected environmental data from sites of *U. longissima* presence (n=75) and absence (n=75), and used discriminant analysis to compare habitat conditions in the two types of sites and indicate which environmental variables were most important in distinguishing between them. I obtained digital grids covering the study area, from which I derived grids representing the significant environmental variables, and used raster-based GIS analysis to model the availability of habitat across the study area.

The third chapter describes results from a transplant experiment. I placed 360 *Usnea longissima* transplants among 12 sites in 4 habitats of varying predicted

suitability within the study area, and measured their growth (change in biomass) after one year. Habitat suitability was determined from analysis of an initial set of the environmental data collected from sites of *U. longissima* presence and absence. Comparison of *U. longissima* growth rates among the varying habitats allowed inference as to whether the distribution of the species appears to be constrained by a lack of suitable habitat; if all transplants grew well in all habitats, I could infer that the species is probably more limited by dispersal than by lack of suitable habitat.

In chapter 4, I describe a fertile population of *Usnea longissima* that I discovered in the study area, and discuss how the species' reproductive methods affect its dispersal. This is the first published account of fertile *U. longissima* specimens in North America, although apotheciate specimens have been described in other continents (Krempelhuber 1853, Harmand 1905).

While the results of this project cannot be extrapolated beyond the Oregon Coast Range study area, they do provide useful information about the factors that appear to influence the distribution of *Usnea longissima* within the study area. These results may be useful as a starting point for further investigation of the species in other areas of the PNW, and should provide land managers with information they can use when planning strategic surveys for this species, and when determining the appropriate status for the species under the Northwest Forest Plan.

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