

Forest Health Note

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The Effects of Thinning and Borax Application on *Heterobasidion annosum* infected stands on the Olympia Peninsula

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Summary

Heterobasidion is a common root and butt rotting pathogen on hemlocks in the Pacific Northwest. Forest management has increased the incidence of this fungus because *H. annosum* spreads via spores germinating on freshly cut stumps and stem wounds, as well as through root grafts between stumps and live trees. The objective of this study was to determine the effectiveness of borax stump treatment in preventing *H. annosum* spread following density management, or thinning. Two hundred and sixty-four stumps were sampled twice in over a two year period. 82.3% of the stumps contained *H. annosum* during the first year of sampling. The application of borax prevented the spread and infection of *H. annosum* on 75% of the 17.7% (40) stumps without *H. annosum* during the first year of sampling.

Introduction

Heterobasidion annosum is a common root and butt rotting pathogen on true firs and hemlocks in the Pacific Northwest. This fungus spreads by vegetative mycelia and airborne spores from perennial fruiting bodies, or conks. In the Pacific Northwest, spores are produced year-round and have the ability to germinate on cut stump surfaces and tree wounds when environmental conditions are favorable. *Heterobasidion annosum* may then spread to the root system following germination, crossing to living trees via root contacts and grafts. Infections can also occur when expanding root systems contact the roots of infected trees or stumps. *Heterobasidion annosum* can survive for 50 years in large root systems, but for a shorter time in smaller stumps.

Forest management has increased the incidence and damage caused by *H. annosum*. Thinning results in large numbers of cut stumps, which the pathogen can persist in and spread to uninfected trees for many years, depending on the size of the root systems.

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Mature trees with extensive decay caused by *H. annosum* are subject to windthrow. Windthrow results in the blowing over of trees and the root systems being exposed to the air and sunlight. The fungus is no longer able to spread from stump to stump or root system to root system following windthrow, which is a natural method of *H. annosum* control. Methods mimicking natural control methods are uncommon in current management practices, but stump treatment with borax, used to prevent spore infection on freshly cut stumps is an accepted and more-widely used treatment option.

Objectives

Control of *H. annosum* is important when density management is conducted on 30-60 year old western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) stands which have a 120 year or more rotation. Stands similar to these are generally managed with borax stump treatment in efforts to mitigate the spread of *H. annosum* through cut stumps, but the Washington Department of Natural Resources has not used this treatment method in the past. Preparation and compliance for such efforts is estimated at \$120 to \$170 per acre, resulting in total costs of \$24,000 to \$34,000 for a 200-acre unit. This study was designed to determine the effectiveness of borax stump treatment in preventing *H. annosum* spread following density management.

Methods

Forty-three plots were established on a 146-acre area on the west-central side of the Olympic Peninsula (T 27 N, R 12 W, Sec. 16, 21) in February, 2003 (Figure 1). Each plot was 0.1-acres in size, with a 37.2 ft radius and circular in shape. The plots were systematically selected and were linearly placed 400 ft apart along eleven transects, each 250 ft apart (Figure 1). In June, 2004, the western hemlock stand was thinned using traditional low stumping methods.

In June through September, 2004, the uppermost portion of each stump (a cookie, less than one inch thick) was removed using a chainsaw. Each cookie was immediately wrapped in newspaper and placed in a plastic bag. Stump wounds and decay were noted for each stump, followed by an even application of borax on the freshly-cut stump surface. The cookies were taken back to the Forest Health lab in Olympia, WA and incubated for ten days in plastic bags at room temperature. After ten days, each cookie was examined under 30X magnification for the presence of *Spiniger meineckellum* (A. Olson) Stalpers, the anamorph of *H. annosum*. Stumps were resampled during November, 2005 through February, 2006 following the same protocol described above.

In February, 2006, 24 cookies were removed from stumps outside of the forty-three plots, but inside the study area. The stumps were not treated with borax after the thinning operation in 2004. The cookies were processed following the same incubation and fungal identification protocol described above.

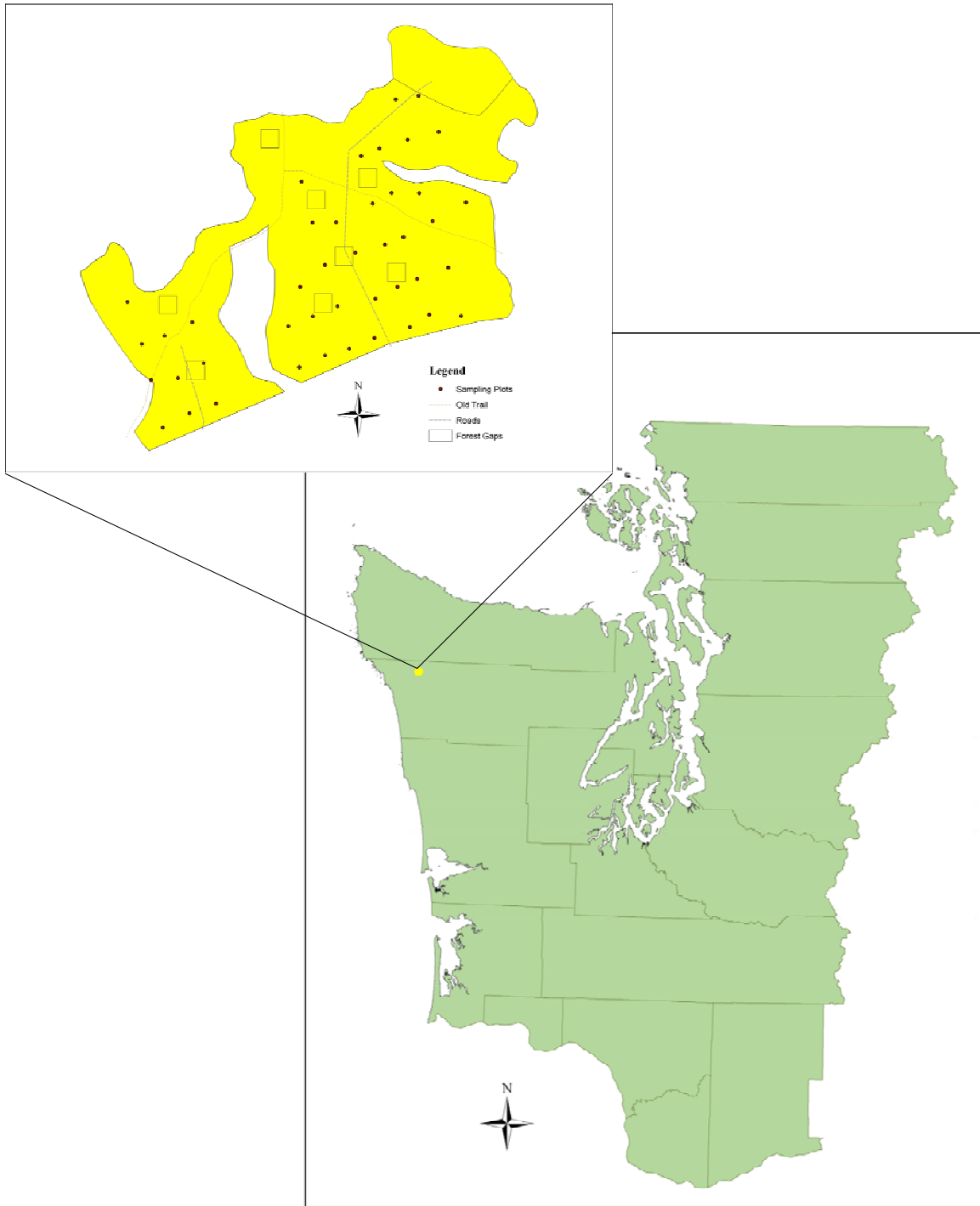


Figure 1. Location of study area and study plots.

Results and Discussion

Two hundred and sixty-four stumps were sampled in both the 2004 and 2005/2006 sampling periods. Thirty-eight stumps were removed from the study due to uncertain results, tree death, or unequal sampling. *Heterobasidion annosum* was identified in 186

stumps (82.3%) during the first year of sampling. Seventy of these stumps (37.6%) contained *H. annosum* during the second year of sampling, while 116 stumps (62.4%) did not. *Heterobasidion annosum* was not found in 40 stumps (17.7%) during the first year of sampling. Ten of these stumps (25%) contained *H. annosum* during the second year of sampling, while 30 (75%) did not. Of the 24 stumps sampled outside of the plots in 2006, 17 (70.8%) contained *H. annosum*, while 7 (29.2%) did not.

The incidence level of *H. annosum* in this study was relatively high (82.3% and 70.8%). Since only 17.7% of the stumps sampled did not have *H. annosum* during the first year of sampling, the sample size used to analyze the effectiveness of borax stump treatment was reduced from 264 to 40. Of these 40 stumps, the application of borax prevented the spread and infection of *H. annosum* on 75% of the stumps.

Borax may be an effective method used to prevent spore infection on freshly cut stumps, but if the baseline incidence level of *H. annosum* is relatively high, it is not cost-effective to treat the stumps with borax. If the incidence level of *H. annosum* is high, the incidence level will remain high until the susceptible species stumps and live trees are no longer on the site. Management alternatives may include planting non-susceptible host species or overturning the stumps, also known as stumping.