

Management of Annosus Root Disease Caused by *Heterobasidion annosum* in Coniferous Trees in Yosemite National Park¹

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Abstract: Trees affected by the annosus root disease are easily windthrown or fall without visible symptoms that might warn forest recreation managers of impending failure. Some of the trees have struck cabins or campsites, causing death or destroying vehicles and recreational facilities. To prevent loss of life or property, and to save as many trees as possible for landscaping purposes, the management option of creating a buffer zone by removing the first line of trees from around each infection center was selected. However, the selection of buffer zone cutting resulted in removing 249 trees or nearly 90 percent of the overstory trees over a 3-year period. This effectively clear cut much of the area since many smaller centers had coalesced into a few large centers. As a result of the cutting, two other management concerns developed: 1) the need to revegetate the area, and 2) the need to remove a single line of trees that remained between some centers and were subject to windthrow. Revegetation is continuing with native trees and shrubs.

This paper presents a history and an accounting of the damages and cost that can be caused in established root disease infection centers within developed recreational sites, the specific management options available, and the problems encountered in removing trees and in revegetating the developed areas.

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HISTORY

For 40 years in Yosemite Valley the removal of both insect-killed trees and defective trees considered hazardous to visitors and property greatly increased the number of annosus root disease infection centers caused by *Heterobasidion annosum*. During that time it was not known that the cut stumps should have been treated with a fungicide or borax to prevent the establishment of new infection centers. The increasing number of infected stumps eventually led to many otherwise healthy trees being infected through contact with the roots of infected stumps.

In 1970 and 1971, 56 infection centers were identified in undeveloped areas throughout Yosemite Valley. Within developed sites 105 centers were identified. The Yosemite Lodge complex with 21 centers had the most dense concentration of centers and was the area of greatest management concern.

In Yosemite Valley, through a combination of root disease and easterly foehn (Mono) winds since 1982, the concessioner lost over \$500,000 dollars in property damage and an unknown amount of loss in revenue, while visitors lost at least \$100,000 in vehicles. The National Park Service suffered complete loss of a seasonal housing area, which required the building of an apartment complex outside of the park for nearly \$6 million. The recent fatalities in Yosemite have not been from rot-affected falling trees, but from wind storms.

The initial infection center was first identified in 1940, on the west end of the Lodge area. From that time on, the dying of trees scattered through the Lodge complex was attributed to bark beetle attacks on trees weakened by competition, compaction, or the paving over of their roots. It was not until about 1969 that some trees, usually incense cedar and white fir and occasionally a pine or two, began

falling unexpectedly on clear nonwindy days for no apparent reason. One look at the root ball, usually about 20 inches in diameter on an 18 inch DBH tree, provided visible evidence as to why the tree failed.

To determine the magnitude of the problem, we asked the Forest Service for assistance, and they contracted with the pathology department at University of California, Berkeley, for help in determining the extent of the "Fomes problem". The initial findings, since the search was limited to developed sites, implied that site development and tree failures were related. To clarify this implication, the survey was extended the following year into undeveloped areas where many infection centers were also found. We then recognized that tree removals without stump treatment for several years of beetle control also had contributed to the development of many infection centers.

One of the objectives in developed areas is to maintain tree cover for as long as possible for landscaping needs. Therefore, even though a tree has crown symptoms indicating poor health, these symptoms may not be caused by annosus root disease, and if it is not likely to fall unexpectedly and does not need to be removed as an immediate hazard, it can be retained for many years. However, trees in poor health and near a known infection center are assumed to have root disease and are removed. About 1976, a cooperative study was conducted with the Forest Service and the University of California, Berkeley, to develop criteria by which trees affected by annosus root disease could be identified by observing crown symptoms. A printed guide was developed for incense cedar but not for other coniferous species.

Since the printed guide did not totally solve the problem, existing options were reviewed and new options were sought. We rejected the existing options of: no action, clear cutting the area, or moving the entire Lodge complex to another location. For new options we again called upon the Forest Service. Their additional options included taking core samples from the root crown for culturing to identify infected trees, cutting a buffer zone around each infection center and seasonally closing various public use areas.

MANAGEMENT OPTIONS

The following is a review of the alternatives available to management and the reasons for their acceptance or rejection.

No Action

This alternative means do nothing, accept the risk, and continue to lose lives, equipment and facilities. It was rejected as morally unacceptable.

Remove the Target-of-Value

A target-of-value is either people or property. The removal of people and vehicles already is applied in part. People and vehicles are evacuated whenever high wind conditions either are present or are predicted and certain other risk criteria are met. Facilities cannot be moved since most of the trees on the Valley floor have some degree of root disease and areas outside the Valley have a limited water supply. Also moving the structures and adding the related infrastructure of underground utilities, roads, and parking areas in new locations would cause unacceptable resource damage.

Remove All the Trees

If all trees were removed, their aesthetic and landscaping value and their value as a sound barrier to vehicular traffic would be lost. Therefore, this alternative was not selected.

Buffer Zone Cutting

Buffer zone cutting involves removing the next line of trees surrounding the known infection centers. This line of trees, in theory, would most likely have a higher degree of root disease than the next line of trees and would be more likely to be windthrown. Although this alternative would enlarge the infection centers and openings in the canopy, it would not necessarily stop the spread of the annosus root disease and still leave some trees for cover. This alternative was selected as being the least manipulative, least costly, and least controversial.

Seasonal Closures

Areas with a record of damage by winter storms would be closed, and sites with low damage potential could still be operated. Storm damage is dependent on which site is struck by "Mono Winds". Because all developed site in the Valley are subject to wind damage, the units easiest to operate to the winter are left open and all others are closed. This alternative has also been selected for some other areas

We selected the buffer cutting option and applied it to the Yosemite Lodge area because it had the greatest number of tree failures and the largest dollar amount of property loss of any area in the Park. We were required to schedule tree removals at times least disruptive to the concessioner's operation, before the winter storms, and during periods of low visitation.

METHODS

Selecting the Area

Three criteria were used for selecting the infection centers for buffer cutting: unmapped centers with repeated blowdowns, mapped disease centers with blowdowns, and adjacent mapped disease centers without blowdowns.

Selecting the Trees

Maps made previously by Det Vogler from the Forest Service included boundaries of predicted rates of spread for 10-year and 20-year intervals. The first line of standing trees at the edge of the infection center and closest to the 10-year interval were selected for removal. Most of these tree were near where one would expect the 15-year interval to be. Root crowns of the next line of trees were sampled and inspected for symptoms of root disease, and tissue samples from them were cultured to detect the presence of H. annosum.

Sampling and Culturing Techniques for Detecting Annosus Root Disease

Two samples were taken from the root crown of each tree. One sample was from the side nearest the infection center and one was from the opposite

side. Though we were successful in culturing the pathogen from only 4 samples out of 200, the technique still has merit for identifying infected trees for immediate removal. By using greater care and better sampling techniques, the success rate in culturing for H. annosum from green trees can be improved.

Tree Removals and Disposal

Trees 180 feet tall are found between cabins at Yosemite Lodge. Most cabins are within 20 feet of one another, leaving minimal room for removal of trees. Many times we can simply pick up and move the cabin with a leader, drop the tree and then replace the cabin. In this treatment area many of the cabins could not be moved. When cabins are not involved the average cost of tree removal is \$638. However, often it was necessary to climb, limb, and top the trees which increased the cost of removal and cleanup up to \$3,000 per tree. Approximately 80 to 100 trees are removed each year from the Lodge area. The trees are sold as firewood from a local woodyard or by contract sale as merchantable timber to the highest bidder.

Currently, some of the logs are used for bumper logs, firewood, split rail fences, and benches within the park. Suggestions are needed for rapid, efficient, politically and philosophically sound ways to dispose of the rest of the 400 logs or 200,000 board feet of wood harvested nearly every year.

The need for a disposal method other than timber sales results from a philosophical point of view. National parks, especially Yosemite, are prime examples of a land management ethic for nonexploitive use of natural resources such as sales, minerals, livestock range management, or water power generating capacities. Authorizing logging trucks to enter and leave Yosemite weakens the basic philosophical concept of the purpose of national parks worldwide.

REVEGETATION

Approximately 60 to 70 percent of the trees (about 900) trees at Yosemite Lodge have been removed as part of our hazardous tree program. The concessioner has voluntarily started revegetation of the area. To date, 75 black oaks, 30 white alder, 12 big leaf

maple, 36 incense cedars, and various native shrubs have been planted. The cedars (which are susceptible to annosus root disease) are being used as nurse trees to provide shade to the young broadleaf and as a quick growing screen to landscape the buildings. As the cedars reach about 50 feet in height, and before they become hazardous, they will be removed if they have not already been killed by root disease. Successive plantings of the cedars will be made until the broadleaf trees provide the desired degree of shade and screening. The possibility of funding for revegetation through USDA Forest Service has not been investigated to date.

RESULTS AND CONCLUSIONS

Openings caused in the forest canopy by drought, insect kills, the infection centers, and enlargement of them by buffer cuttings have left the remaining trees subject to possible windthrow. To prevent further loss of life and property, 125 trees in one guest cabin area and an employee tent area were removed this past winter. The trees that were removed may or may not have been hazardous, but were removed because of the record of annual windthrow, the loss of one life, the

destruction of 15 or more cabins, and no guarantee that the area could be successfully evacuated prior to the next windstorm. The continuing removal of most of the trees from the Lodge area is inevitable.

The questions are: Is the protection of development to take precedence over resource protection? Should development be removed to protect resources? Should the resource be modified or altered to provide completely safe access by the user?

The majority of visitors who now enter natural areas do not recognize the inherent dangers. Is warning the visitor that use of an area may be dangerous and may have to be evacuated sufficient protection to continue use of an area? Should managers of natural areas consider developed forested recreation areas to be urban forests? Should they abandon the concept of naturalness and manage those areas as a planned environment for safe use and occupancy by uninitiated, and unaware urban dwellers? This would be a radical departure from present policies but it might be forced upon park management by population pressure and annosus root disease.