

MIXED HOST STRATEGIES FOR MOUNTAIN PINE BEETLE
CONTROL IN OREGON

Russel G. Mitchell

ABSTRACT: Lodgepole pine frequently grows in mixture with other tree species. Some of the associates may be other host species of the mountain pine beetle--ponderosa pine, sugar pine, western white pine, whitebark pine--and some may be non-hosts. These mixtures often present special management problems. Specific rules are impossible for all the various combinations that can occur, but some general strategies are possible.

Lodgepole pine is a tree that is rather common and is easily cultured on a wide variety of sites. It is also a tree that is very susceptible to mountain pine beetle attack. Accordingly, when lodgepole grows in mixture with other species, a good, general policy is to discriminate against lodgepole pine and manage the other species on the site. On a forest-wide basis, this is a step toward increased diversity. When combined with stocking-level control and management of age classes across the entire forest, the strategy becomes a two-fold management system--one for trees and one for the mountain pine beetle.

INTRODUCTION

The pattern of tree-killing in a mountain pine beetle outbreak is a tragedy sequence--like a Greek play. In the tradition of Greek tragedy, the central figure is a collaborator in its own misfortune; the very characteristic that makes the hero a hero is the same characteristic that ultimately propels him to a disastrous end. Also, once the plot is in motion, nothing--absolutely nothing--will keep it from moving to its fated climax. Here, the "hero" is a forest of mature, over-stocked lodgepole pine--sometimes mixed with other tree species and sometimes in nearly pure stands. The instrument of destruction is the mountain pine beetle.

The mountain pine beetle, unaware of its dramatic role, only does what all living things do--strives to convert as much of the environment as possible into itself and its progeny. A mature, overstocked lodgepole pine forest is ideal for that goal. The scene at the end of the outbreak is classic tragedy. The stage is covered with dead bodies; the lodgepole is dead (at least the larger trees),

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Russel G. Mitchell is Research Entomologist, Silviculture Laboratory, Pacific Northwest Research Station, Forest Service, U.S. Department of Agriculture, Bend, OR.

the beetles are dead, and a few associate tree species--like ponderosa pine, sugar pine, western white pine, and white bark pine--can also perish. Non-host species like larch and true fir, though, may profit from the outbreak. This paper describes some of the interactions of lodgepole pine growing with other tree species and discusses some considerations involved in managing these stands.

THE PROBLEM

In central Oregon, where I work, lodgepole pine often grows extensively in nearly pure forests and is considered climax forest, since little else grows there (Cochran and Berntsen 1973, Cochran 1984). But a large area that has been dominated by ponderosa pine will also support lodgepole pine. Accordingly, where and when conditions are right, lodgepole often invades the ponderosa pine stands. This pattern has increased in the last 75 years because of the effectiveness of the program to control wildfires. Before fire control, the fire frequency in ponderosa pine stands in central Oregon was 8 to 15 years (Bork 1984) and lodgepole pine, which is sensitive to even low-intensity fires, rarely survived long enough to produce seed.

Second-growth ponderosa pine is a well-documented host of the mountain pine beetle, mostly in over-stocked, poor-site (poorer than site III) stands (Sartwell and Stevens 1975). But lodgepole pine is relatively more susceptible. To date, the only significant beetle-kill in ponderosa pine in central Oregon has been where it is closely associated with lodgepole pine--most commonly where a concentration of beetles attracted to an individual lodgepole pine has been so great that the lodgepole pine could not accommodate all the beetles and the surplus killed a few adjacent ponderosa pines.

A more serious problem with ponderosa pine develops as outbreaks die out in local areas. When beetle populations are extremely high and the reservoir of preferred lodgepole pine is about exhausted, any associated ponderosa pine are in serious jeopardy of being attacked by a large number of beetles searching desperately for hosts. Most of the trees attacked are pole-sized ponderosa pine, but a few very large ponderosa pine may also be killed. The good news in this pattern (besides the fact that, usually, few large trees are killed) is that attacks on ponderosa pine signal the end of the outbreak in the area, usually within 2 years--a lot of beetles die in unsuccessful attacks and beetle survival is poor even in those trees that are killed. This pattern should not

be confused with over-stocked stands of pure, pole-sized ponderosa pine; such stands can generate outbreaks independently, particularly on poor sites.

Sugar pine and western white pine are part of a more complicated mixture. Both species are associated with ponderosa pine as well as lodgepole pine; true firs may also be found in the white-pine mixture. The difficulty in managing these stands is that beetles seem to attack both sugar and white pine almost as readily as lodgepole pine. Attacks have been observed on some very large sugar pine and white pine, and beetle survival--because of the very thick phloem in these trees (Amman 1969)--appears to have been quite good.

An uncommon association, occurring only at the top of a few mountains (above 7,000 feet in central Oregon), is lodgepole pine and whitebark pine. In these areas, the trees are often fairly large in diameter but usually quite stunted; most trees are less than 20 feet tall. Bark and phloem on these trees are typically thin and beetle survival is usually so low that populations probably could not persist if beetles were not being supplied from the infested forest below.

When mixed with larch, true fir, and spruce, lodgepole pine can dominate the forest type or it can be subordinate in the association. Growth rates are often good in this association, and some of the largest lodgepole pine are found on these sites. An interesting feature of beetle attack in these stands is that trees are found and killed by the mountain pine beetle in the same pattern followed in stands where lodgepole grows closer together; trees over 12 inches DBH are nearly all killed, and the probability of attack drops off as tree diameter declines. Often the beetle-kill in these stands proves beneficial. Many stands dominated by larch apparently started out as a mixture of larch and lodgepole pine; the beetle, in this case, is a useful thinning agent.

MANAGEMENT STRATEGIES

Decisions in mixed species management must factor in several considerations, principally beetle biology, tree biology, and economics. Then, evaluation shifts to such questions as impacts on wildlife, grazing, and esthetics. Finally, the decision becomes a local one when the need for diversity enters into the process. Considerations range from intervention with chain saws to benign neglect--and many choices in between. Some of the features to be considered when a given blend of tree species are to be managed for tree growth and beetle management are outlined below.

Lodgepole pine/ponderosa pine

Some factors that enter into the management decision for the lodgepole/ponderosa pine type are:

- Lodgepole pine is more susceptible to attack by the mountain pine beetle than is ponderosa pine when the two species are growing together.
- Ponderosa pine is most susceptible on the poorest sites; it is not very susceptible on sites better than site IV. Lodgepole pine, on the other hand, seems to be about equally susceptible across all sites, once the outbreak is in motion.
- In outbreak situations, thinning to stocking levels of 60 to 80 square feet per acre provides beetle protection for both ponderosa and lodgepole pine, but it works better in ponderosa pine.
- When both species are managed at the same stocking levels on the same site, lodgepole pine will outgrow ponderosa pine for about 50 years (Dahms 1983). Also, lodgepole will produce a tree with less taper, less bark, smaller branches, and less sapwood.
- For rotations longer than about 80 years, ponderosa pine will outgrow lodgepole pine in volume and will produce larger trees that are more valuable (on a board foot basis) than small trees (Barrett 1979).
- If both species are to be managed on the same site, ponderosa pine must be planted; relying on natural regeneration through shelterwood, seedtree, or selection systems would mean that lodgepole pine would eventually dominate the site because of its superior seeding characteristics. Site treatments to correct the imbalance, such as prescribed fire, may be possible but would likely require heroic efforts.

After contemplating these points, the forester needs to ask whether more lodgepole pine is wanted. In central Oregon, we already have more than 500,000 acres of topo-edaphic climax lodgepole pine--stands where we can grow nothing else but lodgepole pine. Accordingly, a choice to discriminate against lodgepole pine, in stands where it is mixed with ponderosa pine, is a choice for increased diversity because lodgepole eventually dominates these sites if left alone. It is also a choice for more beetle resistance under appropriate stocking control and for rotations longer than 80 years. Finally, encouraging ponderosa pine makes economic sense. According to a simulation analysis by Znerold (1988), which factored in growth response and reduced beetle susceptibility, stocking control in second-growth ponderosa pine will produce a benefit/cost ratio of about 3 to 1. In the current economic climate, achieving that kind of ratio with lodgepole pine is unlikely.

Lodgepole pine/sugar pine/ponderosa pine

Ponderosa pine is less susceptible to mountain pine beetle than either sugar pine or lodgepole pine. Also, sugar pine seems to be slightly less susceptible to beetle attack than does lodgepole pine. Accordingly, the management approach to this type is similar to the mixed forest just mentioned--that is, encourage ponderosa pine and sugar pine. The question then becomes how much sugar pine to save. Because of the risk with sugar pine, the safest approach would be to strive for minimum acceptable stocking with ponderosa pine, then add sugar pine. Sugar pine is a fine tree from several perspectives. It offers diversity, and susceptibility to beetle attack would likely be lowered if the trees were well spaced and lodgepole pine eliminated from the stand.

Lodgepole/western white pine/true fir

The association of lodgepole/western pine/true fir also has some problems similar to those in the ponderosa/lodgepole type. An important difference, though, is that this mixture occurs at higher elevations (above 6,000 feet in central Oregon) and usually contains true firs as well as a few fast-growing ponderosa pine. Again, the philosophy is to strive for diversity along with beetle resistance. Diversity with resistance is accomplished by maintaining white pine, ponderosa pine, and true fir, but with a serious attempt to remove all lodgepole from the stand. If larch is present, it would be used too. The response of western white pine within this mixture is unknown. White pine is rather susceptible to the mountain pine beetle, and the risk of managing a stand containing western white pine (aside from blister rust) is that the tree will attract beetles into the stand and become a threat to the residual ponderosa pine. The risk may be worth taking, however; western white pine is a magnificent tree in just about every respect. Further, the ponderosa pine on sites where true fir grows is usually less susceptible to beetle attack than when it grows at lower elevations.

Lodgepole/whitebark pine

Management within lodgepole/whitebark pine stands is probably impractical just about everywhere. The trees are too stunted to have commercial value, and they already grow so far apart that thinning would be meaningless. Because of poor beetle survival, the populations in these trees appear to be non-sustaining. Thus, the best chance to improve the beetle situation in these stands would be to manage the lower elevation stands that seem to be supplying the beetles.

Lodgepole pine/larch/true fir/spruce

Very often the best management policy in lodgepole/larch/true fir/spruce stands, from the standpoint of the mountain beetle, is benign neglect. If the amount of lodgepole in the stand is less than 50%, letting the beetle kill those trees for the thinning effect is usually beneficial. Keeping lodgepole in the mixture and managing at stocking levels that would avoid significant beetle problems is also possible. The problem with this strategy is that the stocking levels needed to avoid the beetle in lodgepole are so low that the strategy does not even come close to capturing the capacity of the site to produce wood if it were managed for one or more of the non-host species. Accordingly, the decision is usually to eliminate the lodgepole pine and manage for larch, true fir, and spruce.

DISCUSSION

The key management pattern described above is obvious; discriminate against lodgepole pine but also strive for diversity within stands and across the forest. That strategy is closely followed by stocking control. The focus on discrimination stems from the fact that lodgepole pine is the most susceptible of the native western pines. The other reason for discriminating is that we have so much lodgepole pine and more can easily be grown--if we want it. Lodgepole pine usually will produce more progeny than any of its neighbors and do it year after year; its rapid juvenile growth means it will compete during the establishment period with most other plants; and its huge ecological amplitude lets it grow on a very wide range of sites, including some where nothing else will grow.

But lodgepole pine may be wanted on some of those sites; if so, it can be grown by managing the stocking levels. In the worst-case situation (a small island of thinned lodgepole in a sea of unmanaged lodgepole), the mortality rate even of large trees can be cut in half during an outbreak. For trees in the 6- to 9-inch DBH classes, survival is improved 4 to 5 times by thinning. The problem as noted above, though, is that if we manage for lodgepole in the mixture, the spacing is so wide that we are failing to capture a significant part of the sites productive capacity. Also, we do not know how long a thinning in lodgepole pine will endure. A biological limit must certainly control how long we can grow lodgepole pine, and the mountain pine beetle will probably dictate that length. But that limit is certainly longer in a stand where stocking level is managed--maybe a lot longer.

The important thing to remember about managing beetle-susceptible forests is that the mountain pine beetle is a FOREST pest. "Forest" is emphasized because we cannot manage 40 acres here and 40 acres there and expect much protection from the mountain pine beetle. Beetles build up in unmanaged stands and can fly a long way. And when beetle populations are large, they expand their food supply; trees that would normally resist

beetle attack at low or moderate populations are often overwhelmed at high populations. We must manage nearly all our forests, pure stands of lodgepole pine as well as stands of mixed species. When we do that, we are managing beetle populations as well as the forest. Then, with reduced opportunity for beetle populations to grow, we can introduce a little flexibility in our management style--perhaps take a few chances and grow an overstocked stand here and there; maybe increase the mix of sugar pine or western white pine; or let something go for a few years while we take care of some other high-priority problem.

The mountain pine beetle is a real pain. If we did not have it, we could probably lengthen our rotations, grow some rather sizable lodgepole pine, and improve the volume increment on many of our sites where we now have pine. But consider another possibility: perhaps the mountain pine beetle is really not a curse from the gods but a gift, sent to give us some direction on how to manage a whole forest for growth, diversity, and the best possible mosaic of age distribution and species composition. The mountain pine beetle is, in fact, another one of those things that makes forestry anything but a schedule of routine prescriptions; it is this kind of a problem that adds excitement to our professional lives and makes it fun to go to work in the morning. So the tragedy may not be that we have the mountain pine beetle, but rather that through poor focus on management needs, we have let the beetle get out of control.

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