United States Department of Agriculture | Forest Service | Blue Mountains Pest Management Service Center Wallowa-Whitman NF | 1401 Gekeler Lane La Grande, OR 97850-3456 (541) 963-7122

File Code: 3420

Date: January 26, 2004

Area Manager
Three Rivers Resource Area
Thru: Burns District Manager
Bureau of Land Management
U. S. Department of Interior
28910 Hwy 20 West
Hines, Oregon 97738

Dear Ms. Suther:

This letter documents a visit we made to the Lake Creek/Boone Canyon Forest Restoration project north of Burns, in the Three Rivers Resource Area, on June 30, 2003. We scheduled the visit in response to a request from the Burns District Manager on January 30, 2003 (ref. letter 5000 (025) P, dated January 30, 2003). The purpose of the visit was to review stand conditions in the Lake Creek/Boone Canyon Forest Restoration project and make recommendations regarding insect and disease concerns we observed. Jim Buchanan, Jon Reponen, and Nick Miller of your staff accompanied Lia Spiegel (entomologist), Craig Schmitt (pathologist), and Don Scott (entomologist) with the Blue Mountains Pest Management Service Center in La Grande, Oregon, to the field where we made five stops (see attached map for locations) to evaluate several resource concerns within the project area.

The Lake Creek/Boone Canyon Forest Restoration project is located approximately 6 miles north of Burns, Oregon. The area consists of about 1,500 acres of mostly steep, inaccessible, and overstocked mixed-conifer forest stands containing ponderosa pine and Douglas-fir, riparian aspen communities, and another 500 acres of juniper encroachment into mountain big sage/bitterbrush/mountain mahogany sites.

The stated main objectives of this project (personnel communication with Jon Reponen), are as follows: (1) Reduce overstocked conifer stands to improve forest health by increasing growth and vigor of retained trees; (2) maintain and enhance late and old structural stand components; (3) reduce hazardous fuels and the risk of stand replacement fires; (4) maintain or enhance special habitats such as aspen stands, mountain mahogany stands, and mountain big sage/bitterbrush sites; (5) protect areas of high resource value from catastrophic wildfires, insects, and diseases; (6) improve and restore important wildlife habitats for migratory birds and large mammals (elk winter range); (7) begin reintroducing fire into the area to mimic natural processes; and (8) increase cover and density of sagebrush, grass, and forbs.

The Resource Area is currently in the process of writing the environmental assessment for the project. The Resource Area has identified the locations of approximate units but will conduct further fieldwork to refine layout of specific units geared toward specific prescriptions, based on consideration of specialist reports, operating conditions, and various other factors.

Background

The area has had no management in the past other than fire suppression. Most of the stands of this area are in mature ponderosa pine and contain a younger stratum of Douglas-fir, as well as younger ponderosa pine. Many of the Douglas-firs in these stands are the result of invading sites historically dominated by ponderosa pines over the course of many decades of natural fire suppression and exclusion. Douglas-firs have also invaded quaking aspen stands within some of the drainage bottoms of the project area.

A deep accumulation of duff around the bases of the large-diameter, overstory pine is evidence that many of these sites have missed several natural fire-return cycles once common in stands that developed under the low-severity natural fire regimes in warm-dry biophysical environments of the Blue Mountains. In the absence of frequent, low-intensity surface fires that naturally thinned stands by removing smaller trees and prevented the accumulations of combustible fuels, these stands have now become overcrowded and susceptible to insects and diseases that are operating outside their historic natural range of variability (NRV). In addition, they are now at greater risk of wildfire for several reasons. Some of these are: (1) development of ladder fuels from in-growth of Douglas-firs and suppression-related tree mortality; (2) an increasing surface fuel profile from insect-killed trees that fall down; and (3) the absence of regularly recurring fuel reduction events that frequent ground fire once provided through the low-severity natural fire regime. We surmise the steep slopes of this area would exacerbate wildfire conditions in that if an ignition were to occur, rate of fire spread would be high, fire severity also would be high, “crowning out” would be common, and possibly the fire would behave erratically within the canyon, making it more difficult to control.

When we can contrast these present stand conditions with fire-influenced historic stands, we see a quite different forest today. Historically, stands were greatly influenced by frequently occurring low-intensity surface fires that thinned stands and maintained stocking levels that were considerably lower than those found in today’s. Mutch and others (1993) have described historic pine stands in the Blue Mountains as being open park-like stands with grassy undergrowth. They contend that fires that frequently burned in the understory perpetuated these conditions on drier sites. In contrast to this, today’s stands on the Lake Creek/Boone Canyon Forest Restoration project area are now excessively dense and contain many more dead and dying trees than the stands of the historic past. It is likely, too, that the frequency of natural occurring understory burning on these steep slopes helped maintain such low accumulations of woody fuels that surface fires rarely became crown fires. Conversely, there is greater probability of ground fire becoming a crown fire in these stands today.

The present assessment of this area is to evaluate potential treatment needs and determine ways to begin to reverse the trends in stand development that have occurred during on era of aggressive fire suppression, and little or no vegetation management. In the paragraphs that follow we will describe some of the stand conditions we observed, their relationship to insect and disease risks, and the consequences of various treatment options to address insects and diseases, as well as risk of wildfire.

Observations and Discussion

Stop 1

We reviewed the first area by walking down a portion of the canyon along Lake Creek after parking our vehicles in an area that interfaces with private lands in the SE of the NW ¼ of Section 22, T.21S., R.29E. Most of the stands at this stop were located on the steep east or northeast aspects of the canyon. Stands ranged from areas of pure ponderosa pine to areas dominated by mature and overmature ponderosa pines with Douglas-fir in-growth of various diameter classes (i.e., 3-10-inches dbh) in the mid-stratum or understory. In addition, a smaller ponderosa pine pole- and small sawlog-size class of trees had developed in the understory and mid-stratum over the years because of fire exclusion and no thinning or harvesting (fig. 1). Stands in the location where we parked the vehicles were nearly pure ponderosa pine but became mixed with an understory of Douglas-firs and suppressed ponderosa pines beneath the large-tree pine overstory as we proceeded northeasterly through the canyon. Besides the project objectives stated above, the Resource Area will manage the area just south of the location where we parked our vehicles for northern goshawks, given that this site contains the only goshawk nest observed in the area, so far.

Figure 1. Encroachment of Douglas-fir and understory ponderosa pine around large old ponderosa pines. Note the aspen stem.

Nearly all locations contain stands that are overstocked, and in some cases, bark beetles are actively killing trees. The location where we parked the vehicles, for example, had several large-diameter pines that had been killed by bark beetles. Farther down the canyon, we encountered small groups of tree mortality where bark beetles recently killed pines in the 10-12 inch diameter class. These trees had growth rates of 22 rings per inch. We measured stand basal areas that ranged from 160-240 ft.^{2}/acre in and around these beetle-killed trees.

In general, when ponderosa pine basal area stocking reaches 150 ft.^{2}/acre, susceptibility of trees to mountain pine beetles (*Dendroctonus ponderosae*) is considered high (Sartwell and Stevens 1975). Some high quality sites can carry higher levels of stocking than other sites of lower quality without becoming susceptible to bark beetles. Cochran and others (1994) have developed a set of stocking level guidelines for the Blue and Wallowa Mountains that is based on plant associations. This system identifies an upper and lower management zone (UMZ and LMZ, respectively) based on Stand Density Index (SDI), which is appropriate for managing a specific tree species in stands within differing plant associations. The UMZ and LMZ vary by the plant association. Managing a given species such as ponderosa pine between the UMZ and LMZ ensures that species will maintain generally low levels of risk to bark beetles, achieve optimal growth, and fully occupy the site. Periodic thinnings are required to keep stocking below the UMZ. Lack of stocking level control will allow SDI increases and the upper management zone will be exceeded. As a result, the species will become increasingly at risk to bark beetles. This management system is now widely applied by Forest Service districts in northeastern Oregon and southeastern Washington, and we recommend its use by BLM, as well.

The Douglas-fir in-growth and the smaller diameter ponderosa pines in these stands are competing with the mature and overmature ponderosa pine overstory for growing space and site resources. These conditions stress essentially all trees when stocking levels are excessive, and the stress on trees often worsens during periods of drought. Weakened trees growing under dense stand conditions have lowered natural defenses against insects, and they become attractive to bark beetles that are able to successfully attack them and produce brood in these trees with weakened defenses. The large-diameter overstory pines in these stands especially are facing increased risk of attack by western pine beetles (*Dendroctonus brevicomis*) as tree competition increases and the understory continues to develop in the Old Forest Multi-Strata structural stage (see O'Hara and others 1996) of the Lake Creek/Boone Canyon Forest Restoration project area.

Ungulate wildlife species oftentimes favor these structural stages because they offer higher quality "cover" of various kinds than can be found in many other structural stages. Unfortunately, the same densely stocked conditions that make stands of ponderosa pines desirable habitat for elk also make them desirable habitat for bark beetles. For example, an increased crown closure in ponderosa pine stands that would satisfy optimum thermal cover for elk (see Dealy 1985), occurs when a stand density measured by basal area stocking reaches the high susceptibility level for mountain pine beetles (see Sartwell and Stevens 1975). We begin to see individual trees, and small, scattered groups of trees, killed by bark beetles when these stand conditions prevail. Without silvicultural treatment to reduce competitive stress, this situation often worsens in time and bark beetle populations begin to build up in stands.

Clearly, there are some trade-offs to be considered when managing stands for various resources. Taking a "no-action" approach to managing stands characteristic of those of the Lake Creek/Boone Canyon Forest Restoration project may well meet certain management objectives for wildlife, but these same stand conditions are also predisposing trees to attack by mountain pine beetles, western pine beetles, and pine engravers (*Ips pini*). Ultimately, under this scenario, as fuel conditions increase due to suppression tree mortality and the actions of bark beetles, wildfire will have its influence on these stands, and it is highly probable that the outcome will not be ecologically acceptable nor meet any current resource management objective.

There were scattered clones of aspen primarily along the riparian stream course. Most of these clones were small and showed evidence of declining in vigor. We also found evidence of several clones that completely died out, as well as others nearly gone. Severely declining clones were characterized as having remnant dead and down stems without viable sprouting. Aspen clones deprived of disturbance, being detrimentally effected by conifer encroachment, lacking in younger stems and being subjected to heavy browsing by ungulates characterize many of these clones here as well as elsewhere in the Blue Mountain Province.

When we reached an old cabin site near the canyon bottom, we began an eastward ascent up the steep slope to the juniper/sage plateau at the top. A portion of this slope was stocked with 40-80 year-old Douglas-firs that ranged in diameter from 3-8 inches (fig. 2). These trees represent excessive stocking for these sites, and may well be competitively excluding pine that is better adapted to drier conditions. Few of these Douglas-firs have economic value due to their small sizes; yet, they need to be removed to ease competitive stress on more desirable site-adapted tree components. On the other hand, any vegetation management treatment on these steep slopes will generate a sizable amount of debris from thinning that could become a horrific fuels disposal problem.

Figure 2. Heavy stocking of predominantly pure small diameter Douglas-fir on the lower slope.

Ponderosa pine, including large old individuals, became increasingly common on the upper slopes (fig. 3). We also noted that mountain pine beetles recently killed other 16-18 inch ponderosa pines in these upper slope positions within the canyon. Hence, bark beetles are becoming more active throughout the Lake Creek/Boone Canyon project area. It is likely that bark beetles will increase activity in these stands in the next several years because of competitive stress from overstocking

Photo 3. Large old ponderosa pine with fires scars, thick accumulations of debris at their base and encroaching understory Douglas-fir. Fire-scarred ponderosa pines provide evidence of historic frequent light ground fires prior to exclusion of these fires about 120 years ago.

and successful brood production coupled with high survival. These factors will sustain a bark beetle population increase because the environmental conditions that enable successful brood production are favorable, we believe brood survival will be high, and an abundant food source *vis-a-vis* a large area of stressed overstocked pines, is available to the beetle.

Now is the time to begin proactively dealing with an increasing beetle population and the stand conditions that are sustaining and promoting insect population growth. Hence, we recommend thinning stands according to guidelines suggested by Cochran and others (1994) to achieve stocking level control and reduce competitive stress on the larger overstory pines. This will result in improved growth and vigor on larger residual trees and will lower the susceptibility of stands to bark beetles, and will reduce the current rate of accretion of fuels resulting from suppression-caused and insect-caused tree mortality.

However, the treatment of fuels on these steep slopes will be problematic. Carrying out the vegetation treatments, and addressing the fuel reduction/disposal situation, may occur in a variety of ways, but some traditional treatments will likely pose greater risk to the residual stand than others would. For example, the high amounts of non-commercial thinning debris that could result from contiguous widespread treatments on these steep slopes would preclude any usual type of landscape-scale burning. Accordingly, we believe one of the viable approaches that will lessen the risk of damage or loss to the residual stand during disposal of slash under these conditions would be a staged, multi-year treatment. This approach would center on creating small openings, and thinning relatively small areas around them in stages over the course of two or three years. The small openings would be areas where small amounts of the debris from thinning could be hand piled, safely burned, and contained. This approach avoids having a moving flaming front that otherwise would likely develop in intensity and rapidly move upslope, with high probability of crowning-out. We believe the Resource Area could safely employ this treatment approach given the site and stand conditions throughout much of the Lake Creek/Boone Canyon Forest Restoration project area.

Stop 2

Next, we traveled to a site located in the middle-west portion of the SE ¼ of Section 14, T.21S., R.29E. The area is the site of a lightning strike that happened in mid July of 2002, and started a small fire that burned an area of probably less than an acre. We were interested in determining the extent of damage to several fire-injured, large diameter ponderosa pines on the site. We first examined pines that were on the upper edge of the burn. We noted these trees had exposed roots and a lack of deep duff before the fire, and as a result, injury to root cambium was only light to moderate. The soil conditions in which these trees were growing seemed quite rocky, especially in lower slope positions. We have noted in certain other fires that roots growing under or among the cobble in the soil are sometimes protected from heat injury by the fire. However, we are uncertain as to how this rocky soil condition may affect survival of these trees given the pre-fire duff depth was low. One would suspect that due to lower moisture holding capability of rocky soil, these trees may have been under some degree of moisture stress prior to the fire, and that may influence their survival.

In the riparian area just up from the drainage bottom, we observed a large ponderosa pine (>30 inches dbh) with dead cambium at the root collar or on roots, on three sides of the tree. The crown of this tree was still green when we observed it. Woodborers were actively laying eggs in the bark as we observed the tree. Based on our observations on other fires, we generally see trees with this amount of root injury begin to fade within about 1-3 years of the injury, and at most, it is doubtful this tree will survive more than 3 years.

We observed that the fire had killed the densely stocked smaller diameter pines on the area, and while this lessens the competition with larger trees that survive, when they begin to fall to the ground there will be an increased amount of woody fuels on the ground that could increase risk of re-burning in the future. However, this area is small so the overall consequence to stand in the event of a future ignition, is probably small.

Stop 3

We made our next stop at a site located in the middle-west portion of the SW ¼ of the SE ¼ of Section 23, T.21S., R.29E. At this stop, we examined the condition of an aspen stand that extended part way down the drainage toward the Silvies River.

This aspen clone was interesting from the standpoint that it was relatively young compared to many of our aspen clones in the Blue Mountains. We surmised this stand originated from an older stand that probably burned in a fire 50 or 60 years ago. This stand was relatively healthy overall, and the only insect or disease damage we noted was from the Bronze Poplar Borer, *Agrilus granulatus liragus*, which leaves its telltale sign by forming zig-zagging larval galleries beneath the bark on the wood surface of branches and stems. The zig-zag pattern is common in vigorous trees, whereas larvae that develop in severely weakened trees usually meander without forming any distinct gallery pattern (Soloman 1995). The relatively tight zig-zag pattern we observed on one or two branches indicated a moderately healthy stand of aspen.

The numbers of larvae infesting branches and stems relative to the size of the infested part often determine whether the infested part will be killed. In our experience, we usually see branches killed more often than entire stems in younger trees. However, even relatively few successful larval mines may serve to hasten the death of stems that are in already in decline and predisposed from various other causes. The borer is most likely to become established in overmature or injured trees and in young trees released from the dominance of other trees (Soloman 1995). We noted only a small amount of inconsequential infestation in this clone; hence, other than periodic monitoring, no other course of action is necessary in this case.

Wounding of trees by fire are reported to predispose trees to attack by this insect as well as create portals for entry for spores of *Phellinus tremulae*, the fungus disease known as white trunk rot (Ostry and others 1989). Exposure of aspen stands to underburning in the Lake Creek/Boone Canyon Forest Restoration project would be expected to emulate natural fire conditions, and consequences to these hardwood communities most likely would be beneficial overall in helping to restore aspen, especially in any declining clones. Hence, injuries to aspen that might occur during underburning, though it may introduce the opportunity for entry of white trunk rot spores, is not in our view an unexpected outcome that should be avoided entirely. It is best to minimize severe bole injuries during underburning, and this may be possible by allowing a light-intensity fire with short flame-lengths to back into these riparian areas from underburned upland stands. By contrast, where *Populus* is commercially grown, Ostry and others (1989) recommend that clones damaged by fire or weather (wind, ice, and other agents) should be considered for early harvest because such stands are susceptible to infection by this fungus, and delays could result in considerable volume damaged by hidden decay.

Cavity excavators very frequently use aspen with white truck rot. These trees will be used when alive as well as after they die.

Stop 4

Our fourth stop was located in the NE ¼ of the NE ¼ of Section 26, T.21S., R.29E. At this location, we stopped to inspect the upper portion of a stand of second growth Douglas-firs that had top-kill.

The unusual thing about this top-kill was that it appeared to be occurring at roughly 10-year intervals, and had occurred multiple times. Unable to reach the tops of any of these trees to examine them close up, we could only surmise as to the cause. Several possibilities exist that could have caused this top-kill. Conifer defoliators such as western spruce budworm, *Choristoneura occidentalis*, and Douglas-fir tussock moth, *Orgyia pseudotsugata*, both of which occur periodically and have been in outbreak in the Blue Mountains (sometimes multiple times) during portions of the last 20 or 30 years, will cause top-kill that resembles what we observed at this site.

Another possible cause of top-kill could be from a couple of bark beetles: the hemlock engraver, *Scolytus tsugae*, and the Douglas-fir engraver, *Scolytus unispinosus*. Both beetles attack the tops of Douglas-firs. However, the Douglas-fir engraver more commonly attacks tops of trees infested with Douglas-fir beetles than attacking trees alone. This engraver beetle assists Douglas-fir beetles in killing the tree. The Douglas-firs we observed were not large enough to be of risk from Douglas-fir beetles, and there were no signs of current beetle attacks on the boles, so it seems less likely the Douglas-fir engraver was involved in the top killing, than was the hemlock engraver. A comparison of larval gallery patterns of the hemlock engraver and Douglas-fir engraver will usually enable the determination of the causal beetle agent, but in this case, we were not able to examine the tops to determine if either of these beetles was responsible for the top-kill we observed.

Another possible cause of top-kill is woodborers, particularly, the flatheaded fir borer, *Melanophila drummondi*. We have observed this insect attacking and killing the tops of Douglas-firs and other conifers during periods of protracted drought. As with bark beetles, population increases or outbreaks of flatheaded fir borers oftentimes are associated with disturbance events: drought stress, wildfire, windthrow, defoliator outbreaks, etc. These perturbations in population level typically subside once the disturbance event has ended; and populations then return to normal levels.

Regardless of the cause of the periodic recurring damage to tops of Douglas-firs at this location, management options are limited. If the cause is from feeding by defoliators, the Resource Area could consider insecticide treatments to reduce the impact of damage to trees, depending on how severe and widespread the damage. However, if the objective were to manage for primarily other conifer species in this area, insecticide treatments would not be justified from either a cost or an ecological perspective. Although insecticides also are available to prevent infestation by certain bark beetles, the lack of access to the area with ground based hydraulic spray equipment would preclude any treatment for beetles in these stands.

Without knowing the exact cause of the damage, it is hard to prescribe a pest management recommendation other than to manage stand conditions that ensure thrifty stands. It is advisable to maintain stocking in species that are best adapted to the site and at levels that will generally ensure resistance to insect and disease pests. In most cases, thinning stands that are overstocked will reduce tree competition and improve growth and vigor of individual trees to help keep them thrifty and more resistant to insects and diseases.

We are curious as to the cause of this damage. If the Resource Area selects an alternative to thin out the trees with this damage in the future, we would be interested in examining their tops closer in a return visit to the area.

Stop 5

Our final stop was located in the SE ¼ of the NW ¼ of Section 25, T.21S., R.29E. At this stop, we examined an aspen stand that was being encroached by Douglas-firs.

The aspens in this stand were a little older than at stop 3. The clone appeared to be moderately healthy, but competition with the encroaching Douglas-firs stresses the trees in the clone. Continued stress on the stand could result in increasing susceptibility of the weakened aspens to insects and diseases, and the possibility of eventual mortality of some of the trees.

Aspen is a shade-intolerant species (Baker 1949) that usually grows in seral ecosystems (Duchesne and Hawkes 2000). Conifers growing in the understory of aspen stands in the Blue Mountains eventually will overtop the aspen canopy in the absence of disturbance agents such as fire or wind, causing the aspens to disappear from that location in the landscape (Shirley and Erickson 2001). Fire suppression and exclusion from these stands likely have contributed to the encroachment problem by Douglas-firs, and precluded the stimulation of root sprouting in the clone. In aspen stands like this throughout the Blue Mountains, browsing by ungulates typically eliminate new suckers that might appear in stands to regenerate them or reinvigorate the clone. In the past, fire not only served to remove conifers that may have encroached on these stands, but also stimulated the surviving aspen root systems to send up thousands of suckers to reoccupy the site. Exclusion of fire from ecosystems where plants have adaptations to ensure their occupancy of sites, their abundance, and their survival has promoted their near disappearance from the landscape in some instances.

Our recommendation for this stand would be to remove preferentially the encroaching Douglas-firs and try using fire to stimulate aspen regeneration to increase site dominance by aspen and expansion of the clone into areas were it has declined or disappeared. If ungulate browsing is problematical in this project area, the Resource Area should consider constructing buck-and-pole exclosure fences to keep domestic livestock or large game wildlife from browsing the new suckers until they are established and tall enough to avoid browse damage. These exclosures have been effective in protecting aspen stands in aspen restoration projects elsewhere in the Blue Mountains (Shirley and Erickson 2001).

Summary and Conclusions

The Lake Creek/Boone Canyon Forest Restoration project is clearly going to be an intricate, but not impossible, undertaking. The steep slopes, difficult accessibility, discontinuity of fire cycles and need to restore natural fire regimes, need for management and protection of inclusions of scare and declining hardwood communities, encroachment of juniper into sage/bitterbrush/mahogany savannas, wildlife habitat concerns, and other issues and concerns adds great complexity to this project.

Disruption of natural fire regimes has been the most significant factor in defining the successional trajectory and forest stand dynamics of this area. Under the natural fire regimes, these stands were more open and less densely stocked than today. Stands were predominately stocked with large, mature or overmature ponderosa pines, and maintained in an Old Forest Single-Stratum structure by frequent fire return cycles. We suspect Douglas-firs, while they were present, were historically less common in these stands than they are today due to the frequent fire-return interval of the low-severity fire regime.

In the current environment where fire suppression and exclusion have disrupted the natural fire cycles, a younger age class of shade-tolerant Douglas-firs (and ponderosa pines when able to germinate and re-establish in canopy openings or small clearings) has developed in the understory, resulting in the overstocked conditions of the Lake Creek/Boone Canyon area stands of today. The stands of this area have changed from an Old Forest Single-Stratum structure to an Old Forest Multi-Strata structural stage. The consequences of taking no action to restore and manage these stands will result in continuing a trend toward overstocking leading to greater competitive stress on all trees. Understory trees will begin to develop suppression mortality, and bark beetle activity will increase, resulting in mortality of small scattered groups of the suppressed pines, and leading to gradual loss to bark beetles and woodborers of some of the mature and overmature overstory pines. Stands will develop increased fuel loads when trees killed by insects, and from suppression related mortality, fall to the ground; fire intensity is highest when these conditions exist within a fire. Tree mortality from bark beetle outbreaks alters fuel profiles by layering fallen and standing fuel, and by opening the forest to wind and sunlight (Canadian Forest Service 2003). Concomitant with the increase in fuels will be increased risk of catastrophic stand-replacing wildfire.

Aspen stands were more expansive under natural fire regimes, and probably regenerated under less frequent stand-replacement events. Aspen stands are not particularly characteristic of the shrub-steppe (Franklin and Dyrness 1988), but in the Lake Creek/Boone Canyon Forest Restoration project area, they are relatively common on moist sites near the forest-steppe ecotone. Aspen stands develop towards climax succession when fire is not present to rejuvenate them. Left undisturbed for many decades, aspen clones begin to decline in vigor and eventually reach a decadent condition with an abundance of dead and dying stems, and dead broken branches caused by increased incidence of boring insects, white trunk rot, and other agents. Additionally, the clones diminish in size, begin to lose dominance due to encroachment and overtopping by various conifer species like pines, Douglas-firs, white firs, and others, and eventually disappear from these sites. We observed evidence of some small clones having already died out in the Lake Creek/Boone Canyon area, and additional clone degradation and losses will likely occur without management and restoration treatments to maintain site occupancy and dominance by aspen.

Thinning or removing the excess stocking in the understory and applying careful underburning treatment prescriptions will have several results. These treatments will reduce stocking and relieve competitive stress on larger trees, reduce insect risk and lower incidence of beetle infestations, reduce fuel loads and fire risk, and focus site resources on the development of larger trees that remain, enabling the stands to continue to develop towards late and old forest structure.

We have interspersed various recommendations to address insect, disease, and fire risk in the discussion section above. We believe these recommendations will help achieve the project objectives while minimizing adverse outcomes. However, we make a couple additional cautionary points concerning underburning treatments. Pure aspen stands are particularly susceptible to mortality of aboveground stems from fire of low intensities (Duchesne and

Hawkes 2000). Young stands of aspen generally lack fuel loads of older stands, and consequently burn under low intensity surface fires. Felling of encroaching conifers into these stands will add to current fuel loads. Burning the natural and management-created fuels may create fire intensities that could kill all stems above ground. Depending on the project objectives, this may prove detrimental. Hence, it may be necessary to pull out some of these fuels, and pile and burn them in locations that will not contribute to the injuries of the residual aspen clone.

The other point of caution has to do with underburning around the large, mature and overmature overstory ponderosa pines that have accumulated decades of duff, bark scales, and litter such that the depths of this material may range from 4 inches to over a foot. Root hairs often grow up into the accumulated duff, and underburning will consume them along with the duff. In addition, when deep layers of duff are ignited, it typically burns slowly with glowing or smoldering combustion. The long-residence time of heat over the root system of these large trees to consume duff completely to mineral soil often kills root cambium. Trees experiencing these injuries undergo delayed mortality that may take 3 or 4 years. During this time, root mortality gradually occurs and the remaining live roots are insufficient to provide enough uptake of water to supply the needs of the transpiring crown, and the tree undergoes moisture stress. These trees then attract bark beetles and woodborers, and they are attacked and killed. Accordingly, we recommend taking several precautions to avoid injuring the roots of these large, old trees as follows: (1) Pull back large debris from the trunks of these trees before igniting. (2) Rake away some, but not all, of the duff from the bole. Because of the stress created by loss of root hairs during raking, this action will necessitate delaying the underburning for a year or two to give the roots time to recover from this trauma. (3) The percent duff moisture content should be high (> 100 percent) at the time of ignition to avoid complete duff consumption down to mineral soil. (4) Some claim that "foaming" the duff around these big trees before the unit is ignited will prevent complete consumption of the duff; this is another option to protect root systems. The report by Scott and others (1996) (available at www.fs.fed.us/pnw/lagrande/bmpmsc.htm) contains other recommendations to minimize fire injuries to conifers during landscape burning.

These recommendations will result in adding some time and expense to the underburning treatments, but in our opinion, they are necessary steps to avoid injuring the sensitive root systems of the large pines, and hastening tree mortality. To recapitulate, the key points are two-fold: (1) avoid the consumption of heavy fuels that are against, or close to, the boles of large pines to avoid injuring the cambium on the lower bole and root crown; and (2) avoid the complete consumption of deep duff which will cause trauma to root systems by loss of fine roots and killing of root cambium. It is advisable to remove deep accumulations of duff in stages over several light fire entry cycles to allow roots to recover from trauma during the intervals between underburns. After gradually reducing the duff in this manner, we believe the resumption of frequent intervals of underburning beneath these large trees will not cause any untoward effects. From this point onward, periodic underburning these stands should begin to emulate the natural fire cycles in the low-severity fire regimes of the past. Avoiding injuring of the lower bole and root systems of large pines is also necessary to avoid buildup of western pine beetles, which are highly attracted, to large diameter pines when roots are injured by fire.

Please contact any of us if you have any questions on this report or desire additional information.

We are available to assist your Resource Area with any insect or disease management needs.

Sincerely yours,

DONALD W. SCOTT
Entomologist

LIA H. SPIEGEL
Entomologist

CRAIG L. SCHMITT
Plant Pathologist

cc: Jim Buchanan, Three Rivers Resource Area
Jon Reponen, Three Rivers Resource Area
Nick Miller, Three Rivers Resource Area
Bob Rock, WAW
Lia Spiegel
Craig Schmitt
Don Scott

Literature Cited

Baker, F. S. 1949. A revised tolerance table. Journal of Forestry 47: 179-181.

Canadian Forest Service. 2003. Fire and beetles: how forest disturbances affect stand dynamics. Information Forestry-December 2003. Victoria, BC: Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Pp. 6-7.

Cochran, P. H.; Geist, J. M.; Clemens, D. L.; Clausnitzer, R. R.; Powell, D. C. 1994. Suggested stocking levels for forest stands in northeastern Oregon and southeastern Washington. Research Note PNW-RN-513. Portland, OR: U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 21 p.

Dealy, J. Edward. 1985. Tree basal area as an index of thermal cover for elk. Research Note PNW-425. Portland, OR: U. S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 6 p.

Duchesne, L. C.; Hawkes, B. C. 2000. Fire in northern ecosystems. *In*: Brown, J. K.; Smith, J. K., eds. 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U. S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 35-52. Chapter 3.

Franklin, J. F.; Dyrness, C. T. 1988. Natural vegetation of Oregon and Washington. Oregon State University Press, Corvallis, OR. 452 p.

Mutch, R. W.; Arno, S. F.; Brown, J. K.; Carlson, C. E.; Ottmar, R. D.; Peterson, J. L. 1993. Forest health in the Blue Mountains: a management strategy for fire-adapted ecosystems. Gen. Tech. Rep. PNW-GTR-310. Portland, OR: U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 14 p. (Quigley, T. M., ed; Forest health in the Blue Mountains: science perspectives).

O'Hara, K. L.; Latham, P. A.; Hessburg, P.; Smith, B. G. 1996. A structural classification for Inland Northwest forest vegetation. Western Journal of Applied Forestry 11(3): 97-102.

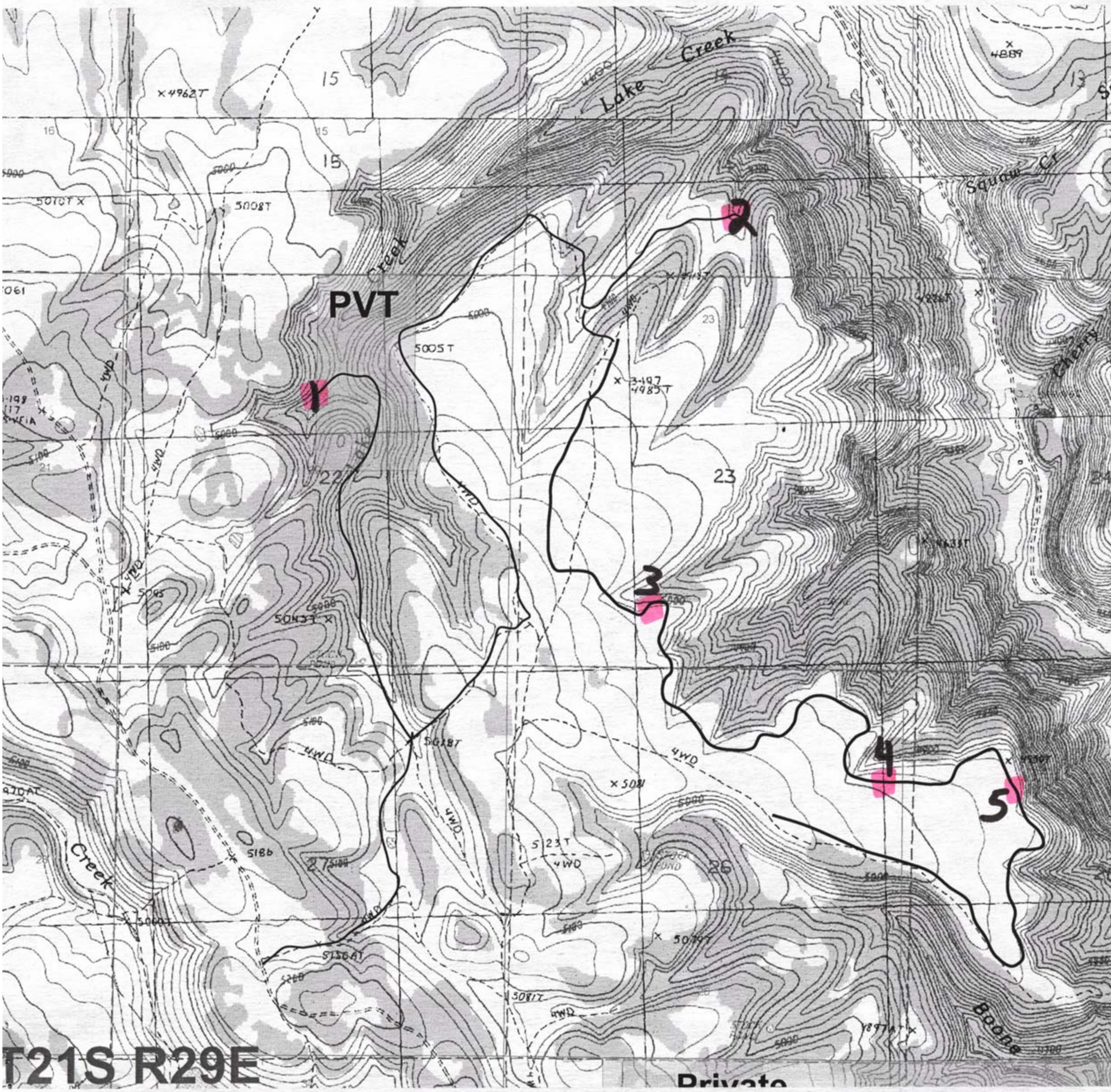
Ostry, M. E.; Wilson, L. F.; McNabb, Jr., H. S., Moore, L. M. 1989. A guide to insect, disease, and animal pests of poplars. Agricultural Handbook 677. Washington, DC: U. S. Department of Agriculture. 118 p.

Sartwell, Charles; and Stevens, Robert E. 1975. Mountain pine beetle in ponderosa pine, prospects for silvicultural control in second-growth stands. Journal of Forestry 73: 136-140.

Scott, Donald W.; Szymoniak, John; Rockwell, Victoria. 1969. Entomological concerns regarding burn characteristics and fire effects on tree species during prescribed landscape burns: burn severity guidelines and mitigation measures to minimize fire injuries. Report No. BMZ-97-1. La Grande, OR: U. S. Department of Agriculture, Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest, Blue Mountains Pest Management Zone. 50 p.

Shirley, D. M.; Erickson, V. 2001. Aspen restoration in the Blue Mountains of northeastern Oregon. pp. 101-115 *in* Shepperd, W. D. and others (compilers). 2001. Sustaining aspen in western landscapes: Symposium proceedings; 13-15 June 2000; Grand Junction, CO. Proceedings RMRS-P-18. Fort Collins, CO: U. S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 460 p.

Soloman, J. D. 1995. Guide to insect borers in North American broadleaf trees and shrubs. Agriculture Handbook AH-706. Washington, DC: U. S. Department of Agriculture, Forest Service.735 p.


PVT
Lake Creek
Squaw Cr
Creek
Boone
1
2
3
4
5
15
22
23
26
27
4WD
5005T
5018T
T21S R29E
Private