WHITE PAPER

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Active Management of Quaking Aspen Plant Communities in Northern Blue Mountains: Regeneration Ecology and Silvicultural Considerations[1]

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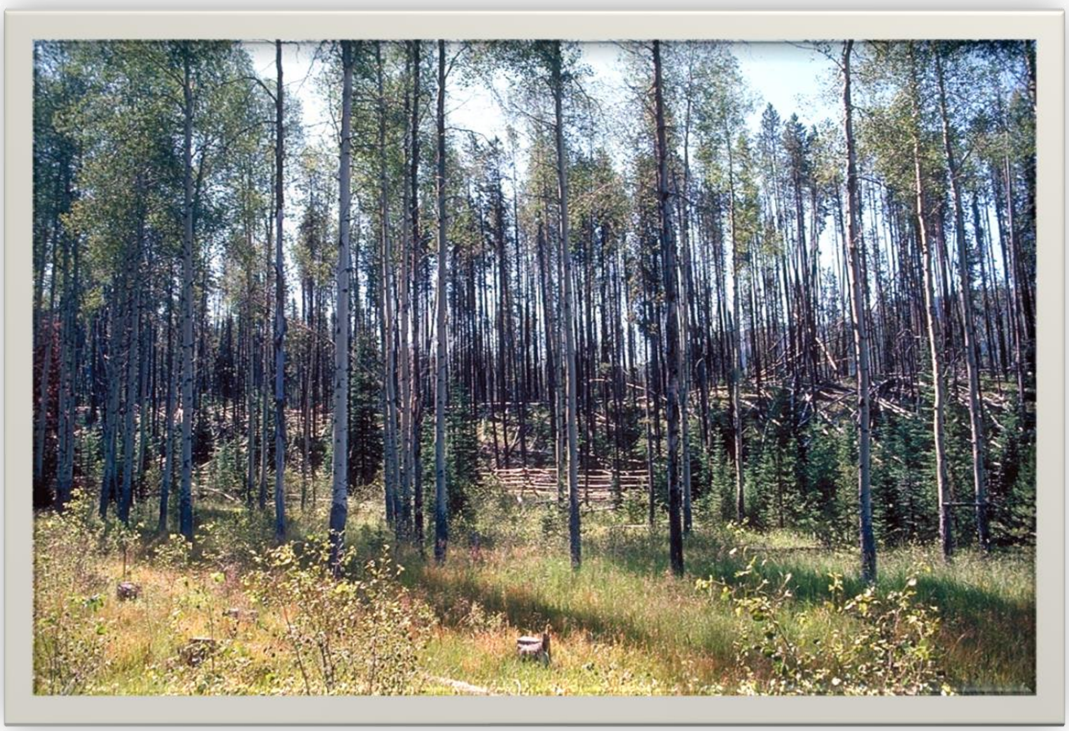

[1] White papers are internal reports; they receive only limited review. Viewpoints expressed in this paper are those of the author – they may not represent positions of USDA Forest Service.

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INTRODUCTION

On September 20, 2007, I accompanied a Walla Walla Ranger District interdisciplinary team (IDT) when it reviewed aspen plant communities in the Elk Flat area. The IDT visited Elk Flat during field reviews for Cobbler II Timber Sale and Fuels Reduction Project (USDA Forest Service 2010). Aspen plant communities at Elk Flat have special significance as perhaps the single largest concentration of aspen in the Blue Mountains.

This white paper provides specific observations about aspen communities at Elk Flat, aspen ecology and management in general, and it elaborates on comments I made during the September 2007 field trip. The white paper has three objectives:

1. After returning home from the field trip, I was able to locate reports from ecologists, entomologists, and a pathologist; they were prepared after previous field reviews of the Elk Flat aspen area. I scanned this material and included it here as enclosures.
2. In many instances, biology and ecology of quaking aspen is quite different from that of our conifer species, and I would like to discuss how these differences could influence our future stewardship of the Elk Flat area and its aspen communities.
3. I would like to make readers aware of historical mapping sources offering clues about what the Elk Flat area used to be like; these sources could help land managers decide whether Elk Flat aspen communities have been deteriorating through time.

ASPEN DISTRIBUTION

Aspen (*Populus tremuloides* Michx.) is the most widely distributed forest tree species in North America; it occurs in temperate and boreal forests ranging from northeastern Canada west to northwestern Alaska, and then south in montane and subalpine vegetation zones of the Rocky Mountains. Outlier populations of quaking aspen are found as far south as northern Mexico (Howard 1996, Jones 1985).

In the United States, we refer to *P. tremuloides* as quaking aspen, but the same species is called trembling aspen in Canada.

When considering the range of its close relative from Asia, Europe, and North Africa – the European aspen (*Populus tremula*) – aspen undoubtedly has the broadest distribution of any tree species in the world (Perala 1990).

Although aspen's global distribution is impressive, the Blue Mountains occur near the periphery of its range in western North America (Perala 1990). When consulting "Atlas of United States Trees" (Little 1971), aspen's Blue Mountains distribution is shown as four discrete concentrations bearing little semblance to its actual distribution or extent in our local area (fig. 1).

Umatilla National Forest compiles and maintains a geographic information system database and associated geospatial layer depicting known occurrences of aspen on the Forest. For the Umatilla NF, a GIS analysis would undoubtedly show that the average size of aspen-dominated stands is half an acre or less.

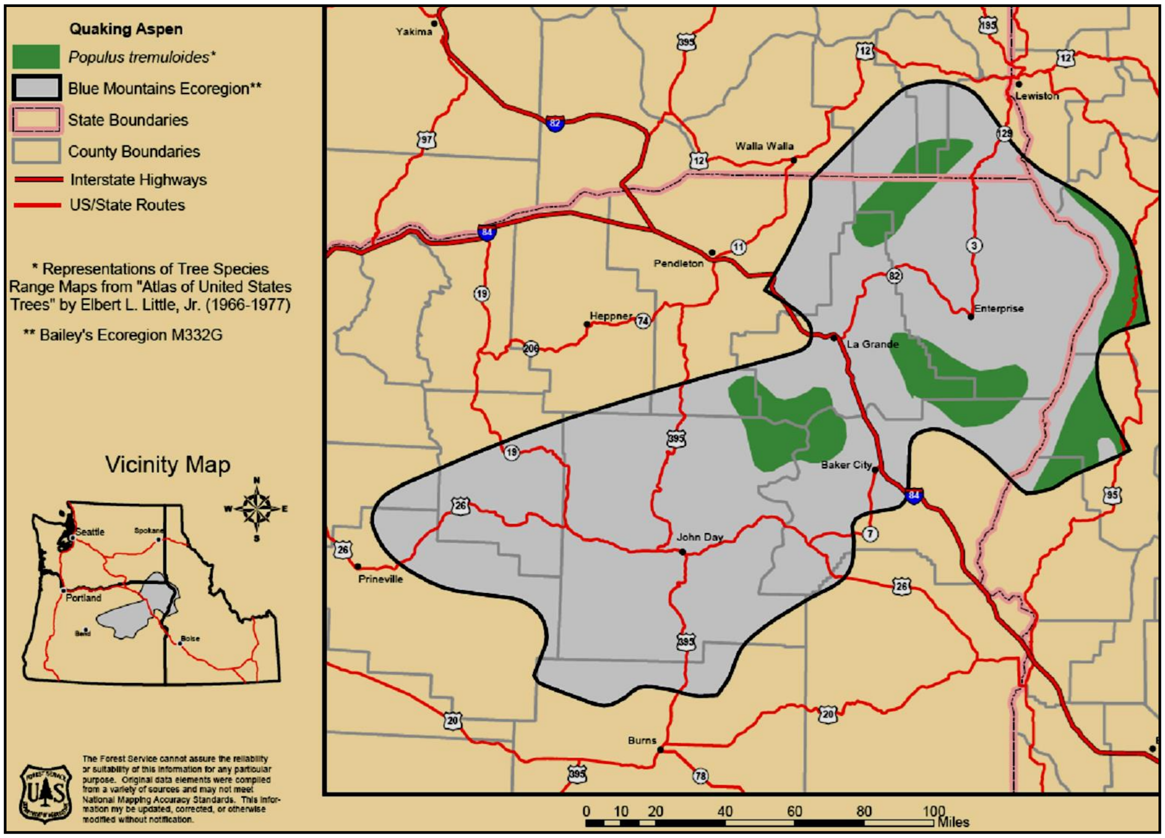

Figure 1: Distribution of quaking aspen for the Blue Mountains section, as shown in the "Atlas of United States Trees" (Little 1971). Little's atlas was prepared for the entire United States,[2] so its broad-scale information is likely to be inaccurate for fine-scale areas such as the Blue Mountains.

This presents a dramatic contrast with aspen elsewhere in the western United States, particularly for Utah, Colorado, southeastern Idaho, and northwestern Wyoming, where aspen forest frequently occurs in large stands and occupies substantial portions of the landscape on occasion.

In central or northwestern Colorado, for example, an aspen stand covering 50 acres is considered normal or even smaller than average (fig. 2), and yet the spatial extent of aspen in the Elk Flat area (estimated to be 50 acres) is traditionally characterized as the largest aspen stand in the Blue Mountains province.

A typical reaction to the Elk Flat aspen communities is provided by Elizabeth Crowe, a previous associate Area Ecologist, when she noted that "Elk Flats has the largest extended collection of aspen stands I've seen on National Forest land in the Blue Mountains" (enclosure 2).

Although we don't know for certain why aspen currently occurs as such small stands in the Blue Mountains, I suspect our contemporary aspen communities have retreated to their moist-site refugia in response to a century of ungulate browsing, fire exclusion, and conifer invasion.

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[2] Digitized tree range maps from Elbert Little's "Atlas of United States Trees" are provided for 35 species occurring in the Blue Mountains section at this website: http://www.fs.fed.us/r6/uma/nr/silv/range-maps.shtml

Figure 2: Large aspen stand in the East Williams Creek area, Wet Mountains, San Carlos Ranger District, Pike and San Isabel National Forests. For many areas in Utah, Colorado, and northwestern Wyoming, quaking aspen occurs in large stands, although an individual stand commonly contains more than one clone. In the Blue Mountains, aspen tends to occur as very small stands covering a fraction of an acre (Swanson et al. 2010).

Recent concerns about a possible decline in quaking aspen forests identified that "aspen clones in the southwestern United States, as well as in other areas on the edge of aspen's range, are of particular concern to forest managers because drastic reductions in aspen acreage have occurred (Bartos 2000) in these areas" (Guyon 2006). Since the Blue Mountains also occur near the edge of aspen's range, Guyon's (2006) statement applies equally well to our aspen stands.

ASPEN BIOLOGY

Aspen is a deciduous, broadleaved tree species, a group often referred to as hardwoods. Aspen is unique among the major western tree species, and even among our native broadleaves, in that it reproduces almost exclusively from root sprouts called suckers.

Unlike many other broadleaved species, mature aspen trees do not produce "true sprouts" from stumps or stem bases, although small aspen trees occasionally produce basal stem sprouts. When clumped aspen occur, this is often their genesis – small aspen trees were wounded early in life, and they responded to the injury by producing basal stem sprouts.

This regeneration trait is a major difference between aspen and other common broadleaved species – black cottonwood, water birch, mountain alder, and bitter cherry reproduce vegetatively using **sprouts** produced from the lower stem area of mature trees, whereas vegetative reproduction for aspen occurs almost exclusively as **suckers** from the root system.

Reproducing primarily from root suckers results in another unique situation for aspen: a clonal life history allowing a very long potential age for any individual clone. For this interesting evolutionary strategy, the genetically unique organism consists of a root system called the genet, and it produces successive generations of root suckers called the ramets, which then develop into mature trees (Perala 1990).

Although an individual cohort of aspen ramets is relatively short-lived (60 to 100 years), especially in contrast to the multi-century longevity of many of its conifer associates, the underground genet may be thousands of years old.

Some clones in the intermountain west might approach 10,000 years of age (and perhaps more than a million years according to Barnes 1975), thus producing a hundred or more generations of ramets from one root system.

It is believed that an ancient aspen clone has existed for perhaps thousands of years in the Morsay Creek drainage of the North Fork John Day Ranger District (Shirley and Erickson 2001).

Since aspen trees are a clone connected by a parent root system, a clone is male or female, but not both. Aspen is a dioecious species with clones being either male or female, rather than being monoecious with both reproductive structures produced on the same tree (or clone). This illustrates another difference between aspen and conifers because all major conifers of the Blue Mountains are monoecious.

Another clonal feature is that many tree characteristics vary markedly from one clone to another, such as leaf shape and size, bark color, branching habit, autumn leaf color, disease resistance, and so forth.

Since clones intermingle, variations in one or more of these characteristics can often be used to accurately identify different clones in the field, and to do so without incurring the cost of genetic testing such as isoenzyme analysis (fig. 3).

Figure 3: Genetic variation in quaking aspen. Stems in a clone will exhibit a relatively consistent expression of any trait under genetic (rather than environmental) control. Leaf shape and size, bark color, branching habit, autumn leaf color, and disease resistance are examples of traits for which genetic control has been described (Barnes 1975, Cottam 1954). The clone above exhibits poor self-pruning of dead branches, and this trait is obvious enough to separate this clone from adjacent ones in the same area. Note that self-pruning and live branching are separate traits: some clones have short live branching (upper third of stems only) and good self-pruning of dead branches, while others exhibit short live branching and poor self-pruning of dead branches. Bark color is supposedly an indicator of clone vigor (Shepperd 1981), but my experience is that bark color is often a genetic trait, with yellow-barked clones (upper right) easily separated from white- or green-barked clones (lower right) in stands where different clones intermingle. Delineation of clones on the basis of phenotypic traits is not foolproof; isoenzyme analysis is generally more reliable (Morgenstern 1996).

ASPEN REGENERATION

Hopefully, an aspen biology discussion (page 3) successfully communicated that aspen is a uniquely interconnected tree species, and that sharing a common root system results in above-ground stems exhibiting a remarkable degree of uniformity when compared with high amounts of phenotypic variation typically observed for our conifer species.

The interconnectedness of aspen results in some unusual considerations when attempting to promote or enhance aspen regeneration. Sucker production from a clone's root system is suppressed by a plant growth hormone called auxin (Schier 1973). Auxin is produced by the aerial parts of the tree, including the stem. In forestry terminology, the hormonal control exerted by a stem over the root system is called 'apical dominance' (Schier et al. 1985).

When auxin movement into roots is halted or reduced by cutting, burning, girdling, killing, or defoliating the stems, auxin levels in the roots decline rapidly. Auxin acts to suppress sucker production, whereas another growth hormone called cytokinin is produced by the root system and it acts to promote sucker initiation and development. High ratios of cytokinin to auxin favor sucker initiation, but low ratios inhibit it (Schier 1973, 1975; Schier et al. 1985).

This constant tension between two growth hormones, one inhibiting suckers and the other stimulating them (fig. 4), has an important influence on the circumstances under which we can expect to obtain a new cohort of aspen trees. In fact, a research silviculturist suggested that successful aspen regeneration is best obtained by using an aspen regeneration triangle – hormonal stimulation, proper growth environment, and sucker protection (Shepperd 2001).

After a change in hormone balance triggers a new aspen cohort, carbohydrate reserves stored in the root system (starches, etc.) supply the energy needed for sucker initiation and early development. An elongating sucker is entirely dependent upon the parent root system until it emerges from the soil and can begin photosynthesizing on its own (Schier and Zasada 1973, Tew 1970).

Low carbohydrate reserves allow fewer root buds to initiate into suckers, or it results in some of the elongating suckers not being able to reach the soil surface, and either outcome contributes to a sparse stand of aspen regeneration (Schier et al. 1985).

A land manager could decide to actively intervene in a stand's development by killing the overstory aspen trees, thus preventing further auxin production, in order to promote a new cohort of young aspen stems. This approach involves risk, however, because carbohydrates produced by overstory trees nourish the root system, so if killing the overstory aspen trees does not promote suckering, then both the root system and the clone might be lost from this tactic.

An extensive root suckering discussion is provided because aspen seldom regenerates from seed. Even when male and female clones occur in close proximity, which is not a foregone conclusion in the Blue Mountains where aspen occurs in isolated stands and a stand does not always contain more than one clone, the seed catkins are produced in early spring when snow is still on the ground, and aspen seeds deteriorate rapidly after being dispersed (McDonough 1985).

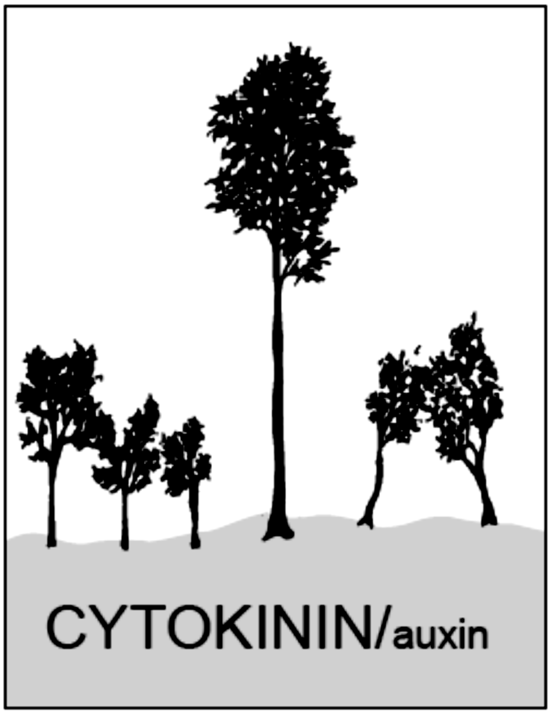
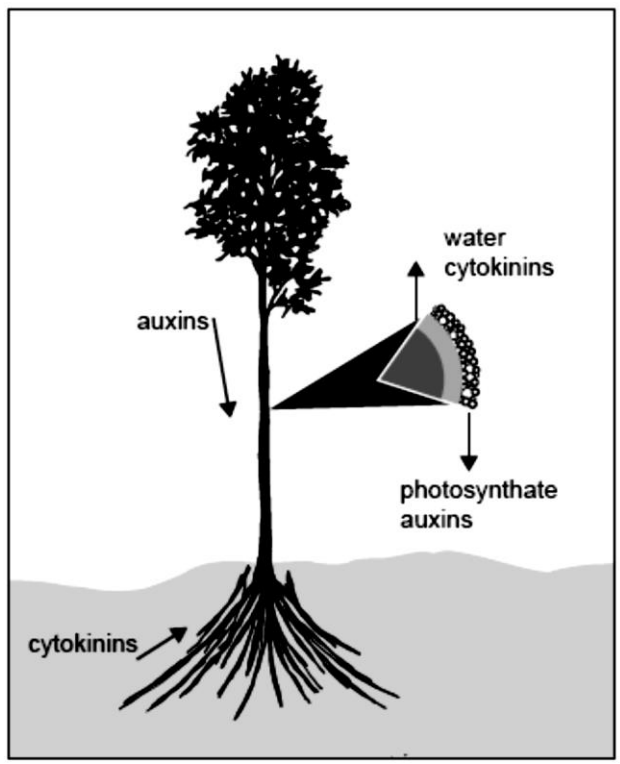


Figure 4: Auxin and cytokinin relationships for quaking aspen ecosystems (diagrams reproduced from Miller 1996). Many aspects of the regeneration ecology of quaking aspen are controlled by plant growth hormones. Auxin appears to have a predominant regulating role, although gibberellin, cytokinin, abscisic acid, ethylene, and other hormones are also involved (Kozlowski and Pallardy 1997). Auxins, which are produced by aerial parts of the tree, exert control over the root system. Photosynthate, consisting of carbohydrates and other organic compounds created during photosynthesis, moves downward with auxins toward the root system through a tree's phloem. Plant growth hormones called cytokinins are produced by the root system. Cytokinins and water move upward toward the foliage through a tree's xylem (lower image). The ratio of auxins to cytokinins controls sucker production in aspen stands: high ratios of cytokinins to auxins favor sucker initiation (upper left), whereas high ratios of auxins to cytokinins inhibit aspen suckering (upper right).



In western Canada where seed viability has been studied, aspen seeds remained viable for only 2 to 4 weeks (McDonough 1985), and this short viability period provides another difference between aspen and our native conifers, all of which have much longer seed viability than aspen. This means that aspen seed dispersed onto a snowpack might not remain viable long enough for conditions to change in favor of seed germination (unless wind moves it off the snowpack).

ASPEN ECOLOGY

At Elk Flat, aspen is primarily associated with three ecological settings:

1. A riparian setting located in wet basins or on wet flats (this is the quaking aspen/bluejoint reedgrass plant community type)
2. A transitional 'fringe' setting found along the edges of meadows, and
3. An upland setting where existing conifer density typically exceeds aspen density (fig. 5).

In many examples of the aspen/conifer type at Elk Flat, aspen occurs solely as skeletons (down gray stems clearly recognizable as aspen) because living aspen is no longer present in these stands. [If aspen surveys are conducted, I suggest that presence of aspen skeletons be recorded because this information can be helpful for deciding where to reestablish (plant) aspen.]

Throughout the western United States where aspen and conifers coexist, the vegetation pattern often features a mosaic of forest and small meadows (fig. 6). The succession in these areas is generally from meadow to forest, but destruction of a forest stand by wildfire frequently sets the area back to meadow (Daniel et al. 1979, page 284; Schimpf et al. 1980). I believe the Elk Flat area might fit this successional model.

"Where aspens occur on the margins of a stand, they advance into the meadow by means of root suckers, provide shade, reduce gopher concentrations, and give a favorable seedbed and growing conditions for the establishment of the conifers" (Daniel et al. 1979; pages 284, 286). Many conifers exist in Elk Flat aspen stands, having invaded from adjacent sites in the Cool Wet, Cool Very Moist, and Cool Moist plant association groups (Powell et al. 2007).

"Tolerance is a forestry term for expressing the relative capacity of a tree to compete under low light and high root competition. Tolerant trees reproduce and form understories beneath canopies of less tolerant trees or even beneath their own shade. Intolerant trees reproduce successfully only in the open or where the canopy is greatly broken. A knowledge of tolerance and its implications for competitiveness and growth is fundamental to good silviculture and should support every management decision" (Daniel et al. 1979).[3]

When considering how the tree species at Elk Flat have been rated according to tolerance, we find that subalpine fir is classed as very tolerant, Engelmann spruce and grand fir are tolerant, Douglas-fir and western white pine are intermediate, ponderosa pine and lodgepole pine are intolerant, and western larch and quaking aspen are very intolerant (Daniel et al. 1979, table 13-2).

[3] Daniel et al. (1979) use tolerance in a broader sense than just shade tolerance. After root-trenching studies described by Zon (1907), tolerance was used to refer to a species' ability to tolerate both shade and root competition.

These tolerance ratings support my contention that Elk Flat aspen communities owe their existence to two ecosystem processes:

1. Stand-initiating disturbance events such as wildfire, which function as ‘destruction’ agents and initiate a new plant succession beginning with meadow (fig. 7); and
2. Forest stand dynamics, where succession and other life history traits of individual tree species control how post-disturbance plant communities evolve through time.

As an intolerant species, aspen will only regenerate and develop successfully in open environments. Aspen’s suckering ability allows it to quickly produce a profuse amount of reproduction ideally suited for exploiting meadows or open, early-successional conditions. But to thrive or just develop acceptably, aspen suckers require an environment relatively free of competition from other tree species,[4] particularly from conifers and other species more tolerant than aspen.

Since all of the conifers in the Elk Flat aspen communities are more tolerant than aspen (including western larch), they represent a significant competition risk to the long-term health and vigor of the Elk Flat aspen stands (fig. 8). This means that as plant succession progresses, aspen’s initial competitive advantage wanes because shading, soil acidity, and other environmental conditions gradually evolve in favor of the tolerant conifers (Bartos and Amacher 1998, Cryer and Murray 1992).

Although human society has decided to suppress the primary disturbance process responsible for maintaining aspen communities at Elk Flat (stand-initiating wildfire), we could choose to mimic a fire effect by removing conifers from successionally advanced aspen stands. If we decide to pursue this course of action, it should be implemented before aspen is completely lost from the Elk Flat area.

Intervening to sustain aspen at Elk Flat acknowledges that for the evergreen-dominated forests of western North America, aspen provides far more value for aesthetics and biological diversity than would be expected from its relatively minor abundance on the landscape. When considering inventory information compiled for the Umatilla National Forest (Christensen et al. 2007), which shows the Forest supporting at least a billion conifer stems and broadleaf/hardwood stems numbering only in the thousands, special management effort and emphasis for aspen (and cottonwood, birch, alder, and cherry) is clearly warranted.

Some have suggested that aspen functions as a keystone species, providing essential ecosystem services for a very large suite of plants and animals (Rogers et al. 2007, Shepperd et al. 2006). It is my opinion that aspen stands at Elk Flat provide ecosystem services and values that are disproportionately greater than aspen’s limited abundance on the Walla Walla Ranger District (fig. 9).

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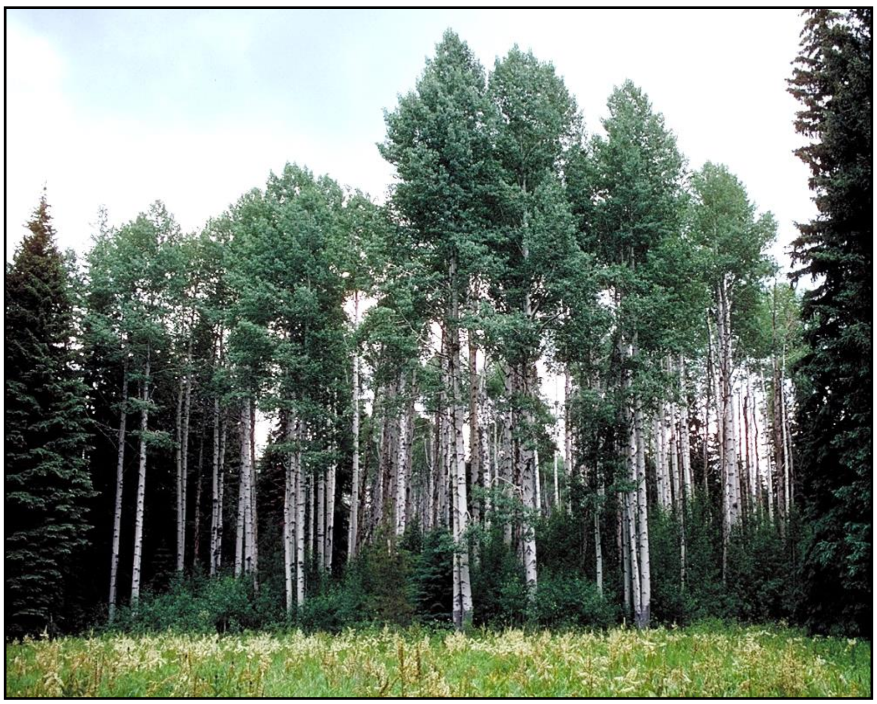
[4] Note that competition between aspen suckers seems to have little inhibitory effect on stand development. As a very intolerant species, aspen is an effective self-thinner, and research has shown that manual thinning of dense aspen regeneration is not only unnecessary but might actually be counterproductive by contributing to disease spread. This is another difference between aspen and conifers because early thinning of young conifer stands can be very important, particularly for intolerant conifers with high susceptibility to stagnation. Stagnation seldom, if ever, occurs in aspens (Perala et al. 1999), and in other intolerant western broadleaved tree species.

Figure 5: At Elk Flat, aspen occurs in three ecological settings representing a continuum of soil moisture conditions: a riparian type on wet flats (upper); a meadow fringe type (right); and an upland aspen/conifer type. The riparian setting is a quaking aspen/bluejoint reedgrass (POTR/CACA) plant community type (Crowe and Clausnitzer 1997). In the upper image, lush herbaceous cover includes sedges adjacent to a shallow, meandering stream channel, with bluejoint reedgrass just beyond the sedge zone. POTR/CACA sites have fine-textured soils and are often saturated for some of the growing season (Crowe and Clausnitzer 1997). Aspen and bluejoint reedgrass tolerate poorly drained soils because they are shallow-rooted and regenerate vegetatively (Powell 2008). Although aspen tolerates poor drainage for short periods, it prefers unsaturated conditions (Comeau et al. 1996). Poor drainage is a primary factor causing low aspen density on POTR/CACA sites (as shown above), although bluejoint reedgrass is known to suppress tree regeneration. A meadow fringe type (right, with Lia Spiegel and Bill Collar pictured) may also be relatively lush, but it is not dominated by wet-site indicators such as riparian sedges, rushes, or bluejoint reedgrass. An upland aspen/conifer type is not shown here.

An aspen clone on the Bear Valley (now Blue Mountain) Ranger District of the Malheur National Forest. Note that this aspen stand occupies a relatively small acreage, as is typical for the Blue Mountains, and that it occurs as a fringe type around a meadow where the plant composition consists of graminoids and willow clumps.



An aspen clone in the Jarboe Meadow area of the Walla Walla Ranger District, Umatilla National Forest. Once again, this aspen stand occupies a small acreage and occurs primarily as a meadow fringe type. In this instance, the meadow is wetter than the Bear Valley example, with the plant composition featuring wet-site plants such as California false hellebore (*Veratrum californicum*) and common cowparsnip (*Heracleum maximum*).

Figure 6: Aspen communities in the Blue Mountains tend to occur most often as a meadow fringe type, suggesting that plant succession in these areas is generally from meadow to forest, and that destruction of a forest stand by wildfire frequently sets the area back to meadow (Daniel et al. 1979, Schimpf et al. 1980). Aspen's affinity for meadow margins is at least partly due to its soil tolerance: although aspen can tolerate heavy soils with high water tables or anaerobic conditions for short periods (see fig. 5; Comeau et al. 1996, Landhausser et al. 1998, Perala 1990), it prefers meadow margins because they tend to have lighter soils and better drainage than meadow interiors. For proper root function, aspen requires unsaturated soils at least seasonally.

At Elk Flat, conifer communities adjoining aspen stands tend to consist of moist plant associations such as grand fir/Pacific yew/queencup beadlily, grand fir or subalpine fir/false bugbane, and grand fir or subalpine fir/queencup beadlily. Mound topography in these conifer sites often supports slightly drier, conifer-dominated microsites featuring big (black) huckleberry (*Vaccinium membranaceum*).

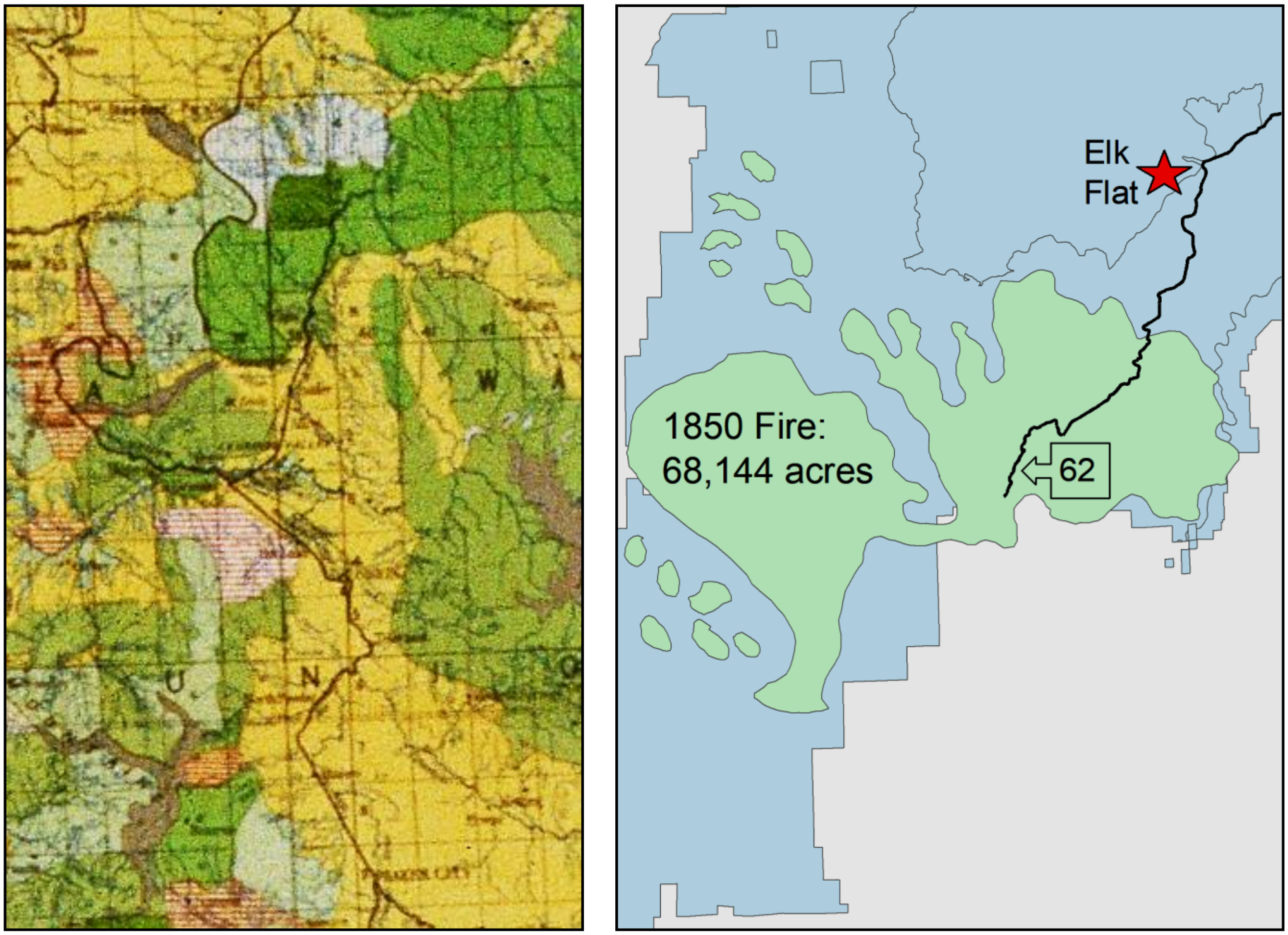


Figure 7: Maps showing geographical extent of a large forest fire occurring about 1850 (in the map to the right, the 62 road, the Wenaha-Tucannon Wilderness boundary, and Elk Flat are shown for orientation purposes). The fire perimeters (right) were digitized from a map compiled by Thompson and Johnson 1900 (left), and included with a report called “The Forests of Oregon” by Henry Gannett in 1902. A large fire of more than 68,000 acres is shown in white on the original map (left, upper center) and in green on the GIS map (right). Calculated fire size (68,144 acres) includes only the large, contiguous fire area; adjacent smaller fires, also depicted with green shading, are not included in the total. A large fire in this vicinity was described in an early examination report for a proposed Wenaha Forest Reserve (Kent 1904): “Practically every portion of the reserve has suffered more or less from fire. The largest and most important of these was one which came from the present Umatilla Indian Reservation about fifty years ago, burned up the river Umatilla, into the reserve, then turned north along the west slope across the heads of the Walla Wallas, and reached as far as the head of the Wenaha.” The large fire depicted here (right) apparently occurs within the area Kent described, but it is obviously smaller than what would be expected from his narrative.

I believe the large fire described in Kent’s report might have been responsible for the last significant episode of aspen regeneration at Elk Flat, more than 160 years ago now. If my assumption is correct, then the advanced degree of deterioration exhibited by Elk Flat aspen stands is not surprising because this fire-free interval (160 years) exceeds the upper limit of a 20-130 year fire frequency proposed by Noble and Slatyer (1980) as being necessary for maintaining aspen plant communities in the northern Rocky Mountains. Fire-free periods exceeding 130 years result in quaking aspen becoming inconspicuous in mixed forests containing both aspen and conifers, and this result is expected because aspen’s competitive advantage over conifers (vegetative reproduction) is lost without moderately frequent disturbance events of stand-initiating intensity (Noble and Slatyer 1980, Shepperd and Smith 1993). [Note that abundant down logs found in conifer stands adjoining the aspen communities also suggests a long, fire-free interval.]

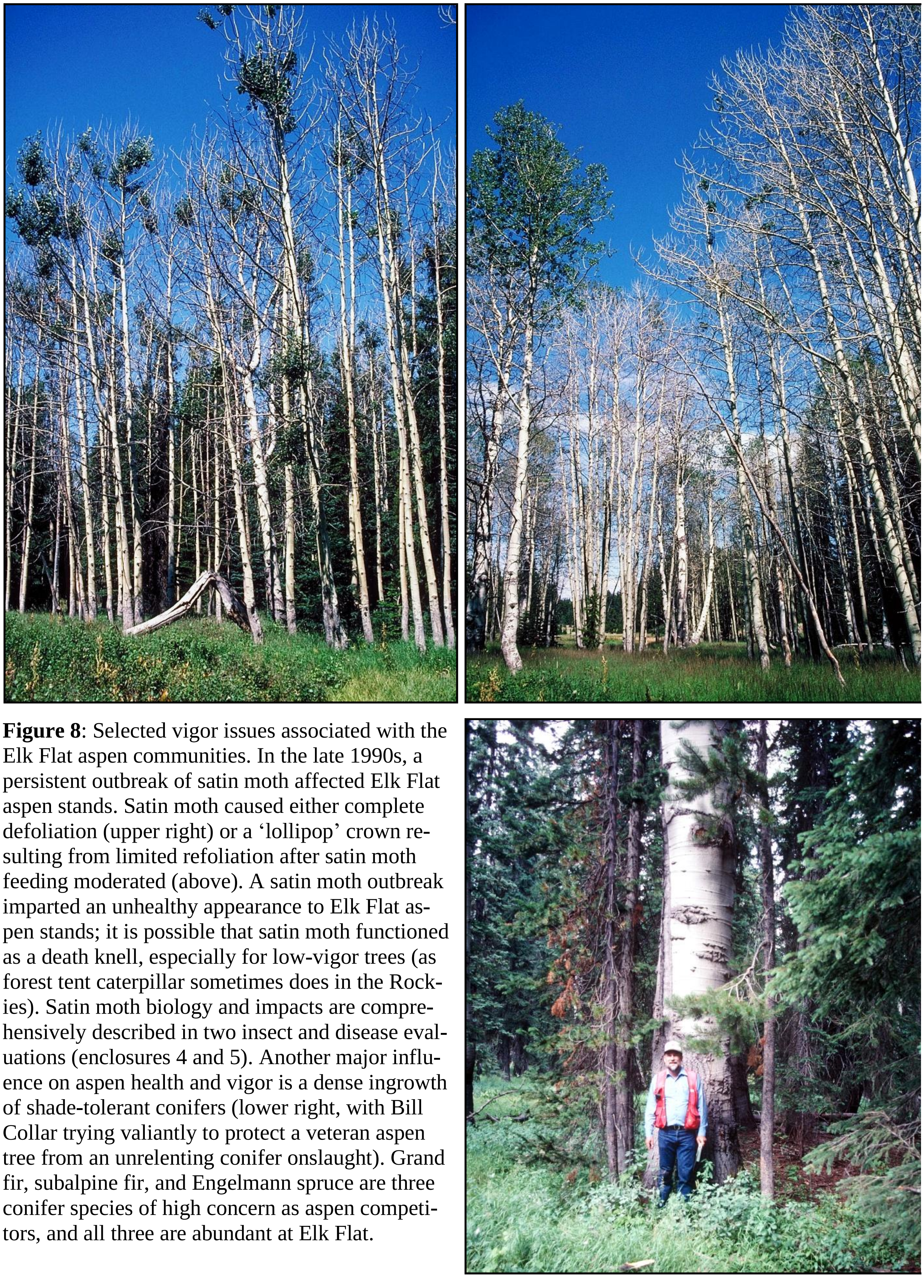


Figure 8: Selected vigor issues associated with the Elk Flat aspen communities. In the late 1990s, a persistent outbreak of satin moth affected Elk Flat aspen stands. Satin moth caused either complete defoliation (upper right) or a 'lollipop' crown resulting from limited refoliation after satin moth feeding moderated (above). A satin moth outbreak imparted an unhealthy appearance to Elk Flat aspen stands; it is possible that satin moth functioned as a death knell, especially for low-vigor trees (as forest tent caterpillar sometimes does in the Rockies). Satin moth biology and impacts are comprehensively described in two insect and disease evaluations (enclosures 4 and 5). Another major influence on aspen health and vigor is a dense ingrowth of shade-tolerant conifers (lower right, with Bill Collar trying valiantly to protect a veteran aspen tree from an unrelenting conifer onslaught). Grand fir, subalpine fir, and Engelmann spruce are three conifer species of high concern as aspen competitors, and all three are abundant at Elk Flat.

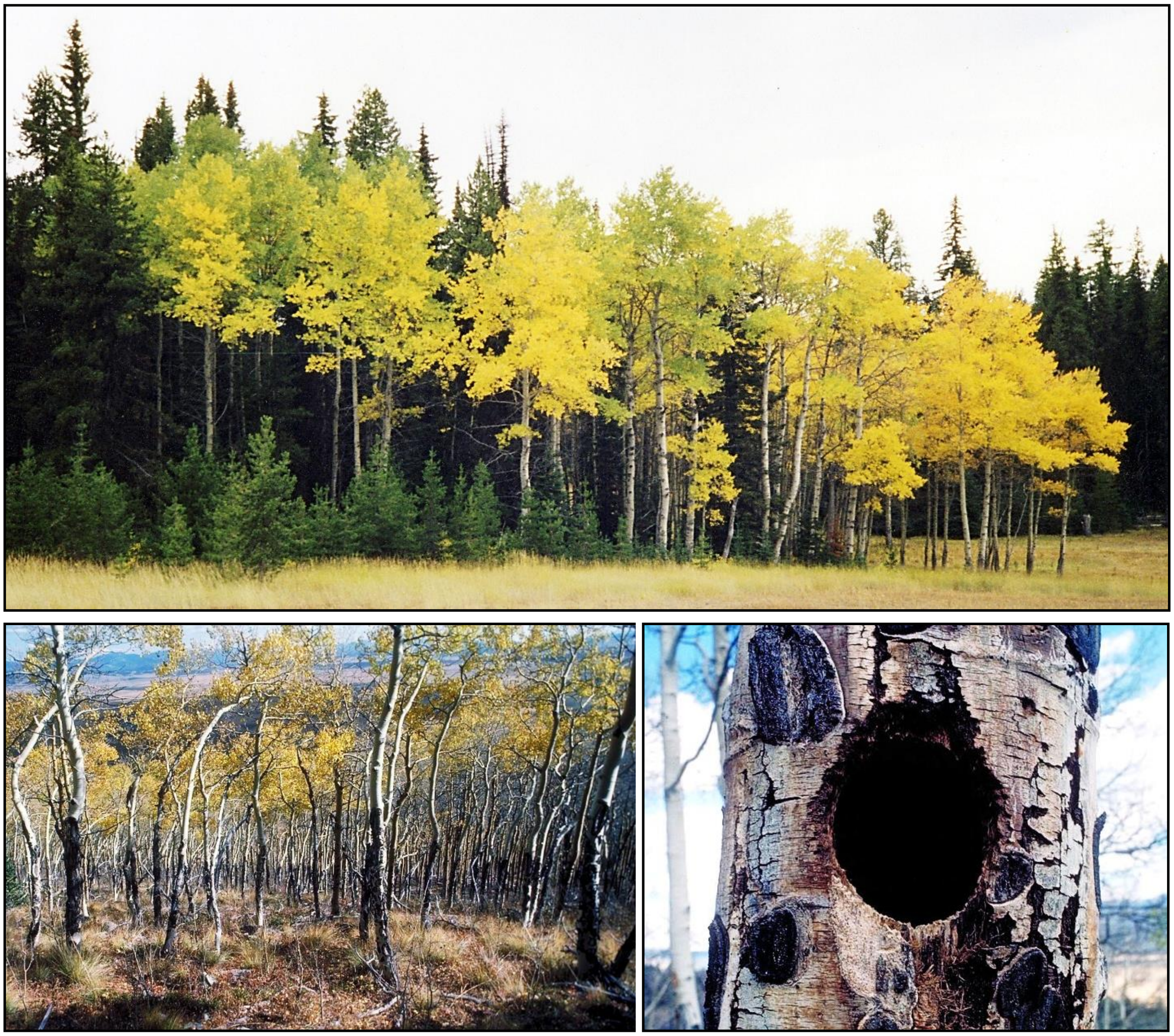


Figure 9: Aspen provides a variety of ecosystem services. Quaking aspen is aesthetically attractive (upper half: Elk Flat area on September 30, 1997), particularly since it occurs in an evergreen-dominated region where limited amounts of fall color from shrubs, broadleaf trees, and a deciduous conifer (western larch) are widely appreciated. Aspen provides many values for wildlife and biodiversity – elk use aspen's bark as a food source during winter (lower left, showing a distinctive stem pattern caused by chronic elk barking injuries) and to rub velvet off their antlers; cavity-nesting birds make extensive use of aspen because of its thin bark and high frequency of stem decay caused by white trunk rot (*Phellinus tremulae*) (see fig. 13), thus making cavity excavation easier (lower right).

This white paper provides an extensive bibliography of aspen literature; many items in an "Aspen References and Literature Cited" section describe aesthetic, wildlife, and biodiversity characteristics and values associated with aspen ecosystems.

ASPEN MANAGEMENT

My comments in this Aspen Management section apply only to ‘meadow fringe’ and ‘upland aspen/conifer’ types described in an Aspen Ecology section (and see fig. 5). I assume that no active management activities would occur in a ‘riparian’ type at Elk Flat, although *removing conifers from riparian stands (winter log?) would greatly improve aspen longevity and vigor*.

As discussed during a Cobbler II field trip, auxin produced by overstory aspen not only controls whether new suckers are produced by a clone’s root system, but it also influences vigor of any existing suckers, and this occurs primarily by suppressing sucker height growth rates.

As an example of this situation, it is common in the Blue Mountains to see two-layer aspen stands featuring an open cohort of overstory aspen, and a relatively sparse cohort of short aspen suckers. This two-layer structure demonstrates that the auxin/cytokinin ratio is a continuum, and that the amount of aspen suckering varies in response to overstory mortality because it controls how much auxin is produced (fig. 4). As overstory mortality causes reduced auxin production, limited amounts of aspen suckering occur and this ultimately results in a two-layer structure.

The suckers in a two-layer stand generally have low vigor, and although some of the reduced vigor is caused by chronic ungulate browsing or conifer encroachment, much of it reflects continuing influence from auxin produced by overstory aspen trees (fig. 4).

In light of the fact that overstory aspen trees use auxin to suppress aspen suckers, some Blue Mountain land managers have considered root-trenching treatments as one option for releasing aspen reproduction, so it can grow more quickly to a resilient size class. When used elsewhere, trenching was accomplished using a crawler tractor with a ripper attachment (Shepperd 1996).

Trenching is an intuitively attractive treatment option for at least four reasons:

- By severing the connection between parent roots and the suckers, it would release the understory aspen from auxin suppression without having to kill the overstory trees to do so;
- It would allow the live overstory aspen trees, which are valuable for aesthetics, wildlife habitat, and other benefits, to coexist with an understory cohort of aspen suckers;
- Removing auxin suppression would allow sucker height growth to approach its ecological site potential (3 to 6 feet per year is not unrealistic for ideal conditions); and
- If high rates of sucker height growth could be promoted, then young aspen stems would move more quickly into a height zone where they are immune to ungulate herbivory.

Trenching was occasionally discussed as a possible aspen rejuvenation treatment at meetings of the Hardwoods Network (an ad hoc group of hardwoods devotees), but I am unaware if it was actually implemented in the Blue Mountains and, if so, whether it was successful.

Although auxin production from overstory aspen is one factor affecting sucker vigor (fig. 4), and I believe its influence is often overlooked, it is by no means the only constraint on sucker development. Encroachment by conifers (Jones et al. 2005, Kaye et al. 2005) and browsing by ungulates (McCain et al. 2003, Ripple and Beschta 2005, White et al. 1998) are two other factors influencing aspen sucker vitality (Shepperd 2001).

CONIFER REMOVAL

Options need to be considered for removing encroaching conifers from Elk Flat aspen communities! How much conifer removal would be enough? This issue may not have been examined specifically for the Blue Mountains (but see "Aspen Management in the Blue Mountains" section of Swanson et al. 2010), but when aspen-to-conifer succession was studied in central Utah, it was found that "conifers can make up at least half of the stocking in mixed stands without apparent harm to the aspen clonal root system" (Shepperd et al. 2001a).

I believe a 50% conifer threshold described by Shepperd et al. (2001a) should function as an upper bound because aspen in central Utah is more abundant, and has better overall integrity, than Blue Mountains aspen. Since Blue Mountains aspen is relegated to small stands at an edge of aspen's North American range, it has less resilience than aspen in Utah or Colorado, and I believe it is less tolerant of conifer encroachment here than there.

And why is conifer removal even necessary? This question has at least two answers. An earlier ecology section described how aspen is a very intolerant tree species, and it will eventually be out-competed by other species with more tolerance. *For Elk Flat, every other tree species has more tolerance than aspen, so they all represent a significant risk to aspen's long-term viability*.

The physiological reason for removing conifers is demonstrated by a research study, which found that small conifers exhibit greater water stress (midday xylem water potential) when growing under a conifer overstory than an aspen overstory. In this study, small conifers functioned as water-stress indicators, and they clearly showed that large conifers use more soil moisture than large aspens (Schimpf et al. 1980).

The Schimpf et al. (1980) study also suggests that *allowing conifers to continue to encroach at Elk Flat will result in less available soil moisture than if the area supported other plants, including aspen*. This is one reason for why the undergrowth of aspen stands is generally lusher than for conifer communities. A lush, floristically diverse undergrowth results in aspen stands having high value for livestock forage, wildlife browse, and wildflower enjoyment.

Conifer removal should occur as soon as possible to prevent further deterioration of aspen root system vigor. If root system vigor is lost, aspen itself will be lost (fig. 10), and experience elsewhere suggests we would then need to plant aspen to reestablish it at Elk Flat. [An "Aspen References and Literature Cited" section provides sources describing experience in the West about removing conifers to benefit aspen, such as Di Orio et al. 2005 and Krasnow et al. 2012.] Perhaps the most recent event contributing to impaired clonal vigor was an intense outbreak of satin moth, imparting an unhealthy appearance to aspen communities (fig. 8 and enclosures 4-5).

Some people believe that a viable aspen root system will continue to exist underground where an aspen grove once stood. This is a fallacy, and it ignores a physiological reality that aspen roots are living tissue: to remain alive, their respiration demands require carbohydrate replenishment from photosynthesizing foliage. Once aspen is gone from a site, it is gone – there is no slumbering root system underground, waiting for a future wildfire to awaken it!

Figure 10: Deteriorated aspen clone on the Heppner Ranger District. This clone was burned in the Wheeler Point wildfire in 1996, and most of the overstory trees died as a result of their fire-caused injuries (occasional trees survived, as shown at far right). When this image was acquired a year or two after the fire, there were no aspen suckers under the dead overstory trees, indicating that (1) clonal vigor had declined to a point where the root system could no longer produce any suckers, or (2) any limited amount of suckering was immediately removed by ungulate herbivory. In most instances, aspen responds to fire by producing a profusion of suckers, but this image shows that fire can kill clones when their pre-fire vigor was at very low levels. If an objective is to reestablish a viable aspen clone on sites such as this one, it would be necessary to fence the area and then outplant aspen seedlings or rootstock.

I recommend that conifers be removed for a distance of 1 to 1½ tree heights beyond the current extent of aspen root system to allow sunlight to reach the soil surface, helping promote aspen suckering and subsequent sucker development. Conifer removal was also recommended by Charlie Johnson, Craig Schmitt, Don Scott, and Lia Spiegel: see enclosures 1 and 3-5.

As noted in a Forest Supervisor letter of September 5, 2003 (Blackwood 2003), it might be necessary to amend the Forest Plan to remove conifers over 21" dbh because retaining them is emphasized by the Eastside Screens (Jeff's letter is provided as Enclosure 7; aspen restoration is example #5 in the letter). If an amendment is needed to remove conifers, perhaps it could be coordinated with changing Elk Flat's management designation (see Forest Plan Context section).

It was clear during various field trips that some reluctance to consider timber harvest for conifer removal is related to perceived risk to soil and water associated with harvest equipment. I wonder if the District could address this reluctance by considering a fuelwood option where felled conifers are cut into short bolts, and then removed from an area by hand or ATV? Or, better yet, why not consider a winter-logging operation, or horse logging during mid to late fall?

PLANTING ASPEN

If living aspen are completely gone from an area, then planting would need to occur to reestablish it (figure 10 provides an example of a situation where aspen planting is apparently needed to restore an aspen clone killed by stand-replacing wildfire). Aspen planting has occurred on the Walla Walla RD since at least the early 1990s when Larry Frank tried it along Oregon Highway 204 after a January 1990 windstorm.

More recently, Betsy Kaiser has been planting a variety of broadleaved tree and shrub species while experimenting with alternative stock types, mulch mats for vegetation control, and fencing options to mitigate ungulate herbivory (fig. 11).

I commend this experimentation because we should not only continue to monitor our traditional approaches (such as buck-and-pole fencing to exclude primarily elk), but when presented with opportunities to evaluate new options that might be more cost effective or persist longer than contemporary practices, I believe we should enthusiastically embrace them.

ASPEN FENCING

Elk and deer use aspen forest in different ways. Elk obtain much of their summer food supply from grasslands and mountain parks, while deer typically feed in shrublands and forested stands, including aspen (Turner and Paulsen 1976). In the Rockies, elk will use aspen stands in much the same way as meadows when meadows aren’t present.

Although elk feed extensively on grasses and forbs, they will switch to woody browse (including aspen) after herbaceous plants have cured in late summer or in winter when snowpack depths exceed 20 inches (DeByle 1985). Deer consume browse throughout much of the year, but they will switch to succulent herbaceous forage in spring and early summer (Kufeld 1973, Kufeld et al. 1973).

Buck-and-pole, A-frame-style fencing has been widely used on the Umatilla National Forest for more than 15 years now to mitigate impacts from ungulate herbivory of aspen suckers (Shirley and Erickson 2001). Fencing has also been recommended by Area Ecologists for the Blue Mountains (enclosure 2).

Fencing is often included with other activities in an integrated aspen restoration plan. When conifers need to be removed from aspen stands such as the ones at Elk Flat, selling them for wood products could generate enough revenue to pay for the ungulate-exclusion fencing. If some of the conifers that need to be removed are suitable as buck-and-pole fencing material (such as pole-sized lodgepole pines), they could obviously be retained onsite for this purpose.

Another possible mitigation measure is to cut conifers and concentrate their stems in such a way as to form barriers, thus discouraging ungulate access to aspen suckers. This measure has worked well in some areas of the western United States to create temporary aspen refugia, allowing enough suckers to escape herbivory and thereby successfully perpetuate the clone (de Chantal and Granström 2007, Forester et al. 2007, Ripple and Larsen 2001).

Figure 11: Example of a fencing alternative being evaluated on the Walla Walla Ranger District for establishment of broadleaved tree and shrub species (individuals included in the photograph are Kathy Campbell, Betsy Kaiser, and Vicky Erickson, from left to right). Although buck-and-pole fencing has traditionally been used on the Umatilla National Forest, the Walla Walla Ranger District is currently evaluating alternative materials such as steel wire and plastic mesh. Landscape fabric, mulch mats from recycled plastic, and other options for mitigating the effects of competing vegetation are also being evaluated in these establishment trials.

During a September 20, 2007 field trip, Bill Collar commented that use of wood concentrations (jackstraws) has been tried on the Walla Walla Ranger District as a way to protect aspen suckers, but with limited success.

Slash piles, natural accumulations of woody debris, or conifer trees felled with a 'hinge' technique have been somewhat effective at protecting aspen suckers on the North Fork John Day Ranger District. These treatments or techniques were most effective when they were kept small, encouraging native ungulates to go around them rather than through them (Shirley and Erickson 2001).

Regardless of which mitigation measures are implemented, *it is important to address ungulate herbivory*. In the southwestern United States, another region where aspen clones are small and isolated, aspen is quite vulnerable to herbivory, particularly when animals can converge in small, highly stressed clones (Guyon 2006). This caution about herbivory demonstrates that to be successful, mitigation measures must be closely aligned with the aspen regeneration triangle – hormonal stimulation, proper growth environment, and sucker protection (Shepperd 2001).

POTENTIAL FUEL LOADING

During a September 2007 field trip, a discussion ensued about cutting or girdling conifers and leaving them onsite as an option for avoiding potential timber harvest risks to soil and water resources. Although this strategy is compatible with an objective of killing conifers to help sustain aspen at Elk Flat (figure 13 in Enclosure 7 shows a conifer girdling treatment to benefit aspen), it could result in fuel loadings that are problematic in terms of future wildfire risk.

To evaluate the fuel loading issue, we took two stand examinations completed in the immediate vicinity of Elk Flat, and then used the Fire and Fuels Extension of the Forest Vegetation Simulator to calculate their standing wood biomass in tons per acre. I compared the calculated biomass for four levels of conifer felling with an optimum range of coarse woody debris (CWD) reflecting acceptable risks of fire hazard and fire severity. Biomass amounts occurring within the optimum range represent acceptable wildfire risk; amounts outside the range would be viewed as problematic from a fuel loading perspective.

For a fuels analysis, two stands were used because they reflect a range of stand density, and stand density is an important consideration because it dictates how much CWD would ultimately be created by either of the non-harvest treatments discussed during a September 2007 field trip:

- Conifer felling in place, assuming no removal by either commercial timber harvest or fuelwood cutting, resulting in immediate creation of down wood.
- Conifer girdling resulting in rapid creation of standing dead trees, and delayed production of down wood after girdled trees topple over.

Table 1 presents results of a fuel loading analysis. Four percentages of standing biomass were selected to reflect a range of conifer felling or girdling. To be consistent with published values for an optimum range of CWD (Brown et al. 2003), only the biomass values associated with live and dead wood greater than 3 inches in diameter were used for this analysis.

Table 1 shows that for an Elk Flat stand with relatively low conifer density (a basal area of 132 square feet per acre), up to half of the conifers could be felled or girdled and the resulting CWD (woody fuel) would remain within an optimum CWD range for 'cool moist' forests (Powell et al. 2007).

Table 1 shows that for an Elk Flat stand with relatively high conifer density (a basal area of 283 square feet per acre), only about 25% of the conifers could be felled or girdled and have resulting CWD (woody fuel) remain in an optimum CWD range for 'cool moist' forests (Powell et al. 2007).

Table 1 indicates that for Elk Flat, *conifer felling or girdling at levels greater than 50 percent of the existing basal area would result in fuel loadings that present unacceptable risks of fire hazard and fire severity* (Brown et al. 2003).

Results in table 1 suggest that if conifer removal by timber harvest or fuelwood cutting is not considered to be a viable alternative, then fuels treatment (such as hand piling and burning) could be needed to mitigate additional fuel loadings created by conifer felling or girdling.

FOREST PLAN CONTEXT FOR ASPEN MANAGEMENT

The aspen communities at Elk Flat were an important reason for the area's allocation as a proposed Research Natural Area (RNA) in the Forest Plan (USDA Forest Service 1990), but it was suggested by Charlie Johnson, a previous Area Ecologist, that a 'special interest area' designation might provide more options to sustain aspen on this site (enclosure 1).

Table 1: Estimated amounts of standing dead and live woody biomass (greater than 3 inches in diameter) for two forest stands located in the vicinity of aspen communities at Elk Flat.

Conifer Amount Felled or Girdled (percentage)	Biomass of Felled or Girdled Trees (tons/acre)	Optimum Range of CWD (tons/acre)	Comparison Result (Biomass Felled vs. Optimum Range)
Stand 6880281 (basal area=132 ft^2/acre; total fuel biomass=115 tons/acre)			
25%	15.5	10-30	Within the range
50%	31.0	10-30	Just above the range
75%	46.6	10-30	Above the range
100%	62.2	10-30	Well above the range
Stand 6950788 (basal area=283 ft^2/acre; total fuel biomass=105 tons/acre)			
25%	23.4	10-30	Within the range
50%	46.8	10-30	Above the range
75%	70.3	10-30	Well above the range
100%	93.7	10-30	Well above the range

Sources/Notes: based on two Walla Walla stand examinations extracted from FSVeg database. Biomass amounts (second column) pertain to standing dead or live wood greater than 3 inches in diameter, as reported in 'All Fuels Report' from Fire and Fuels Extension to the Forest Vegetation Simulator (Reinhardt and Crookston 2003). An optimum range of coarse woody debris (CWD) is derived from Brown et al. (2003; see figure 2b for cool forest types on page 7 in that source). 'Total fuel biomass' reported for each analysis stand reflects all fuel biomass, including both standing wood and surface fuel components.

Charlie Johnson provided at least three reasons for why an RNA designation might be inappropriate for Elk Flat (enclosure 1). Charlie's reasons involve biological or ecological concerns only; none of his reasons relate directly to whether RNA standards and guidelines from the Forest Plan (management area D2, specifically) are compatible with aspen restoration.

Timber standards for RNAs state that "timber management use and practices are excluded. Cutting and removal of vegetation is prohibited, except as part of an approved scientific investigation. Firewood cutting is not permitted" (USDA Forest Service 1990, page 4-176).

In the absence of an approved research project with a study plan allowing or requiring vegetation manipulation, I believe RNA timber standards will significantly constrain the active management alternatives you could consider for restoring, and then sustaining, Elk Flat aspen communities.

I believe that RNA fuels standards constrain aspen restoration options to a similar extent as the RNA timber standards.

I recommend you amend the Forest Plan so it allocates the Elk Flat aspen communities to something other than an RNA (D2) designation. If this happens, I hope you select a replacement allocation permitting a wider range of aspen restoration alternatives than is currently available.

ELK FLAT HISTORY

Not only is Elk Flat considered to have special significance as perhaps the largest aspen stand in the Blue Mountains, but a review of historical references indicates that it might always have been that way (enclosure 6 provides historical mapping sources pertaining to Elk Flat).

Elk Flat area was administered by the Wenaha National Forest, headquartered in Walla Walla, until November of 1920 when the Wenaha and Umatilla National Forests were combined into a present Umatilla National Forest.

When George A. Bright completed an extensive reconnaissance of Wenaha National Forest in 1913, he included a photograph of the Elk Flat meadow and its associated aspen communities (Bright 1914). The plate and caption from Bright's report is reproduced on the next page (Bright and Powell 1994).

It is interesting that close scrutiny of Unser's 1913 photograph could suggest that clonal vigor was higher in 1913 than it is now: note that the middleground clone on the right side is relatively dense, has very little obvious conifer invasion, and has many aspen stems with what appear to be relatively dense crowns having normal shapes and long crown ratios of 50 percent or more.

Also in the 1913 image, note the presence of pointed conifer crowns in the far background portion, indicating that aspen was occurring as a meadow fringe type in this particular locality (as is the case today), that fringe-type aspen seems to have high vigor (as based on its crown characteristics), that ungulate browsing appears to have been limited because aspen trees along the meadow fringe have long, full crowns, and there appears to be a relatively high amount of size-class diversity because intermediate-size aspen trees are obvious in this portion of the photograph.

I took a photograph in September 2001 from approximately the same location as Unser's image in 1913 (fig. 12). Differences between the 1913 and 2001 photographs are apparent:

1. The small grove of mature aspen in the foreground of Unser's image are now gone.
2. Most of the middleground aspen now seem to be mature and had been defoliated by satin moth as of 2001 (although the small area of aspen regeneration in this portion of the image was not defoliated).
3. Conifers seem to be closer to the meadow edge in 2001 than they were in 1913.

“Plate 21: Elk Flat. A typical meadow in Sec. 5, T. 5 N., R. 41 E., W. M. Note the large size and abundance of quaking aspen” (photograph taken by M.N. Unser in 1913; quoted portion is taken verbatim from Bright’s report).

Figure 12: Contemporary photograph apparently providing a similar perspective as Unser’s 1913 photograph (taken by Dave Powell, September 2001). Note how mature aspen stems in the foreground of Unser’s image are now gone; most of the middleground aspen are now mature (as would be expected after 80 years for a short-lived tree species such as quaking aspen – refer to fig. 13); much of the middleground aspen was defoliated and possibly killed during a recent satin moth outbreak; and conifers growing behind the aspen appear to be closer to the meadow fringe now than they were in 1913.

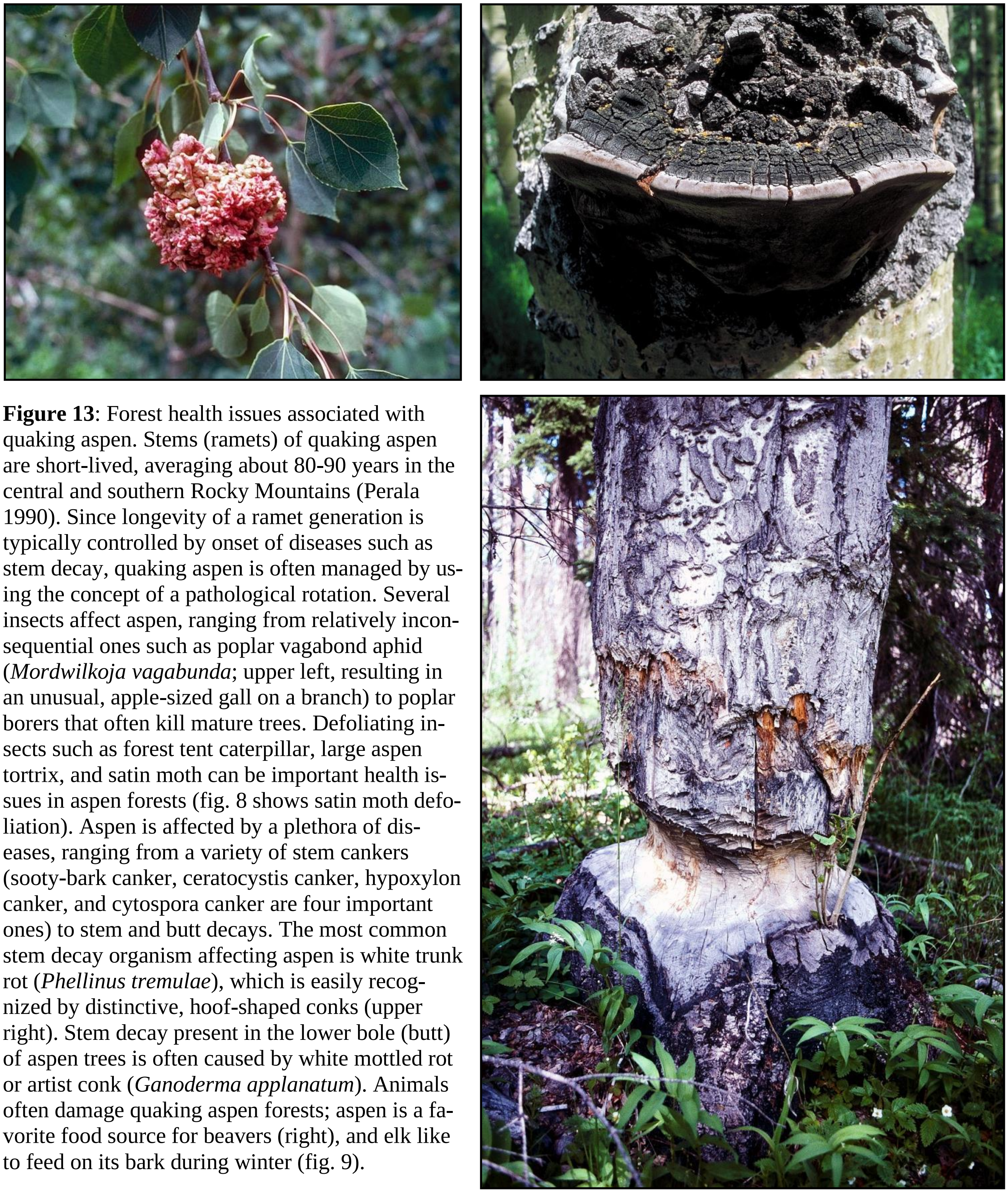


Figure 13: Forest health issues associated with quaking aspen. Stems (ramets) of quaking aspen are short-lived, averaging about 80-90 years in the central and southern Rocky Mountains (Perala 1990). Since longevity of a ramet generation is typically controlled by onset of diseases such as stem decay, quaking aspen is often managed by using the concept of a pathological rotation. Several insects affect aspen, ranging from relatively inconsequential ones such as poplar vagabond aphid (*Mordwilkoja vagabunda*; upper left, resulting in an unusual, apple-sized gall on a branch) to poplar borers that often kill mature trees. Defoliating insects such as forest tent caterpillar, large aspen tortrix, and satin moth can be important health issues in aspen forests (fig. 8 shows satin moth defoliation). Aspen is affected by a plethora of diseases, ranging from a variety of stem cankers (sooty-bark canker, ceratocystis canker, hypoxylon canker, and cytospora canker are four important ones) to stem and butt decays. The most common stem decay organism affecting aspen is white trunk rot (*Phellinus tremulae*), which is easily recognized by distinctive, hoof-shaped conks (upper right). Stem decay present in the lower bole (butt) of aspen trees is often caused by white mottled rot or artist conk (*Ganoderma applanatum*). Animals often damage quaking aspen forests; aspen is a favorite food source for beavers (right), and elk like to feed on its bark during winter (fig. 9).

A set of paired photographs on page 24 (fig. 12) can help us decide whether aspen clones at Elk Flat are in a deteriorated condition. Five criteria have been used to assess aspen deterioration (Bartos and Campbell 1998, Schier and Campbell 1980), and they can be readily evaluated for Elk Flat aspen communities:

Aspen Deterioration Criteria	Result for Elk Flat Aspen Communities
1. Is conifer canopy cover > 25%?	For most of the 50 acres that historically supported aspen at Elk Flat, current conifer canopy cover exceeds 25%.
2. Is aspen canopy cover < 40%?	For most of the 50 acres that historically supported aspen at Elk Flat, current aspen canopy cover is less than 40%.
3. Are dominant aspen trees > 100 years old?	As shown in fig. 8, some dominant aspen trees at Elk Flat likely exceed 100 years, although others seem to be less than 100 years; stand age easily exceeds 100 years if my assumption about fire history is correct (see fig. 7).
4. Is density of aspen regeneration (5-15' tall) < 500 trees per acre?	Although some areas of aspen regeneration exist, much of it is hedged to less than 5' tall, and density of aspen regeneration is often less than 500 trees per acre.
5. Is aspen mortality occurring at high levels?	Much recent aspen mortality exists in the Elk Flat area, some of which presumably resulted from an intense satin moth outbreak. Without objective criteria for what qualifies as a 'high level,' I am uncertain if this level of recent mortality qualifies as high (but I suspect it does).

I believe the aspen deterioration criteria described above can provide a basis for establishing a desired future condition for aspen stands in the Elk Flat portion of Walla Walla Ranger District.

Desired conditions contributing to a sustainable composition and structure for aspen stands include these five characteristics:

1. Conifer canopy cover is less than 25 percent.
2. Aspen canopy cover is greater than 40 percent.
3. Dominant aspen trees are less than 100 years old (less than 80 years is preferable).
4. Density of aspen regeneration (5-15' tall) is greater than 500 trees per acre.
5. Aspen mortality is occurring at no more than moderate levels.

I hope these comments can make a positive contribution to ongoing discussions about options for rejuvenating Elk Flat aspen communities, and then sustaining them into the future.

Enclosures I've included with this white paper demonstrate that long-standing concern about Elk Flat aspen communities has been wide ranging (spanning several disciplines). This concern is warranted when considering that Elk Flat is perhaps the largest aspen stand in the Blue Mountains. Unfortunately, long-held concerns have not yet resulted in comprehensive aspen restoration actions at Elk Flat (including removal of encroaching conifers), but I am confident that the Cobbler project can finally accomplish this elusive objective!

ENCLOSURE 1: CHARLES JOHNSON EMAIL MESSAGE

Charles G Johnson
06/03/00 05:44 PM

To: Edwin V Pugh/R6/USDAFS@FSNOTES, Delanne B Ferguson/R6/USDAFS@FSNOTES, Mary Gibson/R6/USDAFS@FSNOTES, David C Powell/R6/USDAFS@FSNOTES, Randy Dohrmann/R6/USDAFS@FSNOTES, Nancy P Berlier/R6/USDAFS @ FSNOTES, Susan E Beall/R6/USDAFS@FSNOTES, Craig R Busskohl/R6/USDAFS@FSNOTES

cc: Angelica G Johnson/R6/USDAFS@FSNOTES, Jeff D Blackwood/R6/USDAFS@FSNOTES, Sarah Greene/PNW/USDAFS@ FSNOTES

Subject:

Hi everybody – I reflected on questions posed to me about the successional status of the aspen at Elk Flats as I drove home. I frankly give better answers on reflection instead of instantaneously after a question is posed. So hopefully you will accept this response as a better one than that which I gave in the field.

The aspen at Elk Flats meadow is ecotonal (transitional) between forest and wetland (meadow) ecosystems. All ecotones are "tension zones" where plants are in ecological transition between the neighboring plant communities. So we can speculate that the aspen here once was more extensive (connected) and was not being overtaken by the forest as it now is. The aspen is not seral to forest here – nor is it a part of the sedge-grass meadow community. It is unto itself as an ecotonal community. When a disturbance or a set of climatic conditions give it a nudge – it may respond with increased vigor – or conversely – be further deteriorated toward loss from the site.

I was happy with the group's decision. I was not very pleased with what I saw on the ground. I was arriving with a 15-year old memory of how it once appeared. Some of the memory was weak and I'd glamorized the setting over time! I believe what we want for an RNA is an area that is about 300-500 acres (minimum) and encompasses aspen that is not ecotonal, not successional to a forest plant association, and which provides a balanced age/structure in the clones within the "area". I will seek, with other helpers, potential RNAs which contain aspen as part of the southern Blue-Ochoco sage-grass ecosystem, as part of the northern Blue-Wallowas shrub-grassland ecosystem, and hopefully a place where aspen is part of a forested ecosystem and can be maintained by disturbances which have allowed it to persist.

I think Mary may have suggested the key to the Elk Flats aspen. It makes sense to me to manage this small area to retain and re-invigorate the clones. This could then carry a "special interest area" designation. I support that concept rather than to "force" the RNA designation.

I'd like to acknowledge that the group was well prepared for the discussions we had. I was singularly impressed with the "new" Ranger. Mary not only had been provided with good staff work but had a total grasp of the situation and delivered. I've seen a lot of Rangers defer to staff help to be the deliverers. I think its the job of the Ranger to make the suggestions and then be timely with presentation of viewpoints and finally with the decision. You did that Mary – and you did it well. I look forward to our next interaction. I'm off to Mill Creek.... Charlie

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<u>ENCLOSURE 2</u>: ELIZABETH CROWE STAND REVIEW

Cottonwood and Aspen Stand Review
Walla Walla Ranger District

Elizabeth A. Crowe
October 26, 1998

On September 14 and 15, 1998 Pattie Bosch and I visited numerous black cottonwood *(Populus trichocarpa)* and quaking aspen *(Populus tremuloides)* stands on the Walla Walla Ranger District to examine and discuss concerns about the stands including: the possibility for regeneration of black cottonwood stands, the low rate of survival of black cottonwood rooted cuttings that had been planted on known or suspected black cottonwood sites, and possible stand treatments to encourage regeneration and vigor of aspen stands that have not yet been treated. Attached is a chapter from <u>Biology of *Populus*</u> (Stettler and others, 1996) on the life history, ecology and conservation of cottonwoods that contains good information on how cottonwood stands are initiated and populations perpetuated.

The cottonwood stands generally occurred in three different environmental settings and conclusions about them were based on these settings and current stand development.

1. On Phillips Creek there was some concern about cottonwood regeneration along a stream reach within a historic clearcut. We looked at the stream channel itself which has a moderate gradient and a gravel-cobble bed substrate and the tendency to form some overflow channels. This is a stream system on which I would expect to see some regeneration of cottonwood so long as there is adequate sunlight for germination and growth of seedlings. The regeneration we saw looked very vigorous and quite abundant given the extent of establishment sites along the creek.

2. In the headwaters of Sheep Creek we looked at a site within a buck-and-pole exclosure that had been planted with cottonwood cuttings. There was very little survival of these cuttings, probably because of the prolonged soil saturation on the site through the growing season. Although cottonwood roots are adapted to standing in water during the normal spring flooding period, the root systems are not adapted for poorly aerated and wet soil conditions throughout the growing season. On sites where cottonwood usually establishes, the substrate is generally coarse textured (a mix of coarse sand, gravel and/or cobble), and allows for aeration of the roots as spring floodwaters recede. The soil on this site appears to be fairly fine-textured and would hold a lot of water even after snowmelt and springs rains are finished. Although there are a couple of older cottonwood trees growing in a couple of sites up the drainage from this exclosure, they appear to have become established during a geomorphic event that either scoured or deposited material on microsites allowing for the establishment of some cottonwood seedlings. Without another event of this nature, it is unlikely that there will be a self-perpetuating population of cottonwood in this headwater area.

3. In the upper reaches of a tributary to Proctor Creek are extended stringers of black cottonwood stands that have little regeneration. Most of the younger aboveground stems appear to be suckers from the root systems of older trees and are heavily browsed. Stream channels associated with these sites are interrupted and intermittent or non-existent. I believe that these stringer stands were established after a large fluvial geomorphic event occurred in these drainages that

deposited a lot of sediment through overland flow and that cottonwood seeds subsequently colonized the site. There doesn't appear to be any regular flooding or disturbance in this small stream system that would perpetuate the establishment of new stands. New stand establishment is necessary for the population to be sustained without human intervention. I don't think that suckers from the roots of older trees will sustain the population indefinitely, especially as conifers become more abundant on the site and shade the cottonwoods.

The two aspen sites that we looked at were:

1. The "above the road site" in which the stand appears to be expanding down the slope away from its point of origin and has a great deal of shrub cover, primarily common chokecherry *(Prunus virginiana)* and Sitka alder *(Alnus sitchensis)*. The aspen trees may be stressed not only by competition from the shrubs but also by being "forced" to the lower part of the slope which is drier than the upper part. The recommendation here is to remove some of the shrub competition through fire and/or cutting to try to increase aspen regeneration in this stand. POTR-018

2. The other site we visited was Elk Flats which has the largest extended collection of aspen stands I've seen on National Forest land in the Blue Mountains. The survival of this population does not appear to be in jeopardy, but if the District decides to increase successful regeneration from the clones, fencing would seem to be a good option. There is a lot of suckering from the stands that we examined, but the suckers are being heavily browsed by ungulates. POTR-001

References

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<u>ENCLOSURE 3</u>: 1992 ASPEN VIABILITY REVIEW

United States Department of Agriculture | **Forest Service** | **Forestry and Range Sciences Laboratory** | **1401 Gekeler Lane, La Grande, OR 97850, (503) 963-7122**

Reply To: 3420 **Date:** July 13, 1992

Subject: Aspen Viability, Umatilla NF

To: District Ranger, Walla Walla RD

On June 25, I met with Leona Brown and Christina Bauman to assess health of a number of aspen *(Populus tremuloides)* clones around the District, as well as a single stand containing Northwest paper birch *(Betula papyrifera* var: *subcordata)*. This memo will report on the aspen condition. Most stands visited were in the northeast portion of the District.

Aspen communities in the northern Blue Mountains are relatively common but are usually quite small; possibly prior to the changes which have occurred this last 100 years, aspen was more common and consisted of larger stands. Aspen is almost always found associated with seeps, riparian, and other wet sites where subsurface moisture is available throughout most of the growing season. There is a wide-range of viability of these specific communities. Many seem to be relatively healthy, while others are dying with little or no regeneration becoming established. The sites that we visited on the Walla Walla RD were in comparatively good condition, although regeneration was marginal in one area.

Silviculture of aspen in the Blue Mountains has not received much attention. For the most part this is because aspen is rarely, if ever, managed as commercial timber in this area. Most knowledge of aspen silvics and stand silviculture comes from the Lake States and the central and southern Rocky Mountains.

Judging from the very limited microsites that currently support aspen in the Blue Mountains, it is probable that any significant disturbance which alters the site will have a potentially detrimental impact on the trees. In areas where aspen occupies a wider range of sites we would expect much more resiliency. The suppression of natural fire in the Blue Mountains in the last century probably has probably adversely affected aspen viability. Grazing by sheep and cattle and browsing by elk certainly also caused a substantial impact during this last century. The following specific factors need to be considered in aspen management:

1. While aspen is intolerant of fire, burning does simulate sucker production; thus while a burn may kill residual trees in a clone, sucker production will give rise to a new stand of stems. Light burning is known to reduce competition, especially from conifer ingrowth. Fire is especially valuable in rejuvenating deteriorating stands.

2. Aspen occurrence is closely related to the moisture regime of the site. Management activities which alter the water table or availability of water will affect clone health. Increased stocking of conifers in and adjacent to aspen clones probably contributes to decreased availability of moisture. This is a direct result of fire suppression.

3. Aspen is a relatively short-lived tree, although individual clones which are maintained as biomass below-ground may survive for thousands of years. As stands of stems die, regeneration, in the form of suckers, must become established for the clone to survive. Grazing, suppression by conifer ingrowth, lack of disturbance, etc. may hinder sucker development and survival.

4. In the Blue Mountains, aspen is considered site permanent, while in other parts of its range it plays an early successional role and is transient with the absence of disturbance.

5. Cutting is known to promote the production of suckers, especially when used with fire. To be effective, cutting needs to be heavy.

6. Introduction of cattle and sheep into the system, as well as the building of large elk herds, has had considerable impact on clone viability, especially with regard to sucker survival. Protection of certain sites by excluding animals may be needed. It may even be possible to protect established/reestablished aspen on wet sites by fencing.

Pests and Pest-Caused Damage

Aspen is prone to a variety of insect-caused damage, and canker and decay diseases. Considerable differences in susceptibility is observed between clones with some of these pests. Although we didn't see evidence of aspen trunk rot, caused by *Phellinus tremulae*, on this trip, I have seen this stem decay in other locations in the Blue Mountains. I'm sure it occurs on the Walla Walla District.

Ink spot, caused by *Ciborinia whetzelii*, is a leaf disease of aspen that was found at one of the visited sites. A low level of infection was seen; this disease being annual and dependent upon spring temperature and moisture for level of severity. During years of severe infection, trees will lose affected leaves prematurely.

Shepherd's crook, caused by *Pollaccia radiosa*, was also seen at at least one site. This disease causes a leaf and shoot blight that usually kills or deforms the terminal growth.

Aspen leaf rust, *Melampsora medusae*, was seen at at least one stop. This rust alternates between aspen and various conifer hosts. Damage to aspen is infrequent and only occurs when unusually severe infection occurs. Leaves may prematurely drop.

Some unidentified cankers were found that were predisposing trees to windbreak and decay in one area.

Insect pests are quite common on aspen. Some leaf-roll damage was seen. While not found on this trip, we have confirmed Mourningcloak butterfly *(Nymphalis antiopa)* infestation in some Blue Mountain aspen this year. Infestations result in rapid defoliation which can kill trees.

Recommendations

While pests of aspen are affecting some trees, not all impacts are detrimental. Cavity-nesting birds use aspen with stem decay. In relative terms, the majority of the aspen stands I'm familiar with in the Blue Mountains are healthy from an insect and disease perspective. Of more significant concern is the lack of regeneration in some stands, sometimes coupled with advanced degradation of the mature aspen on the site. We have largely ignored aspen communities in the past; use of silvicultural treatments including cutting and/or fire and protection from grazing, should be initiated and monitored so we will know what treatments work best in this region for maintaining and rejuvenating these valuable stands.

Several options should be investigated for managing stands/sites in need of treatment. Conifer ingrowth should be removed in most situations. On most sites conifers are young, indicating they are invaders, probably due to lack of recent fire activity. These conifers should be completely thinned out. Where aspen regeneration is lacking, light fire should be used to simulate sucker sprouting and fencing done to exclude grazing/browsing animals. Excess fuels need to be removed from around trees to be saved. Declining trees could purposely be killed by fuel placement. In stands in need of complete rejuvenation, a combination of clearcutting and light fire should provide maximum sprouting. Cutting of aspen over a large area should be avoided since in some communities it's been shown to allow the water table to excessively rise, retarding regeneration.

While I've taken a shot at some silviculture options; Dave Powell, Forest Silviculturist, should be consulted prior to any planning/action. He has extensive experience in aspen ecology and silviculture from his tenure in Region 2.

Craig Schmitt
Zone Pathologist

cc: Leona Brown, Walla Walla RD
Dave Powell, UMA
Charlie Johnson, WAW
Don Scott
Bruce Kaufman, WAW

ENCLOSURE 4: 1999 INSECT AND DISEASE EVALUATION

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**

Reply To: 3420 **Date:** October 4, 1999

Subject: Technical Assistance: Elk Flat Aspen, Walla Walla RD, Umatilla NF

To: District Ranger, Walla Walla RD

On September 30, 1999, we visited the District to review insects, diseases, and general conditions in the large aspen community adjacent to Elk Flats, which is about 4 miles northeast of Lookout Mountain, west of the 62 Road. There were preliminary reports of defoliation and excessive mortality of aspen in this area. Aspen are common over several hundred acres in and adjacent to the meadows and seasonal stream courses near Elk Flats. We walked through a representative portion of this community to determine the condition of the vegetation as well as the various biotic disturbance agents and their incidence.

Aspen older than 80 years usually hosts ever-increased levels of insect and disease incidence and associated mortality. While there are differences between the longevity of clones, a variety of factors contribute to the life span of stems. Biotic mortality-causing agents most often are canker diseases, wood borers, stem decays, and root diseases. Aspen communities in the Blue Mountains host seemingly high levels of these assorted insects, diseases, and their related activities.

Community conditions and disturbance activity

Judging from the different habits, phenology, etc., there are an abundance of different clones, most of which are fairly small, which comprise this entire aspen community. While most of the stems are mature, there are some smaller 1 to 4" diameter stems, usually in even-age groups. While we did not bore any individuals to determine age, several trees scarred with carved dates indicate that larger/older individuals date to the 1800's. Scattered mortality to individual stems has been occurring for a long time. There are standing as well as dead/down aspen stems throughout this area. There is no evidence of any cultural work done in any of the portions of this community that we visited. The last fire was likely in the 1800's, as there is no evidence of fire scars on residual trees.

Epidemic defoliation by satin moth (*Leucoma salicis*) was observed throughout this area. Various clones, and to a lesser degree, individuals within clones had dramatically different degrees of defoliation; ranging in loss of foliage from none to complete, and everything in between. At the time of our visit, first instar larvae were seen on foliage and bark where they were preparing to overwinter. While there was some feeding by this current generation, nearly all of the 1999 foliage damage had been done earlier this season by the previous generation of larvae. We also observed rather abundant braconid wasp cocoons (probably *Apanteles solitarius*, which is a particularly effective biological control for satin moth), which indicate an active population of parasites. These insects will likely control the population of the satin moth within the next several years. We do not know how long this outbreak has been occurring, but the number of braconids indicate that they have had an ample supply of hosts (satin moth larvae) for awhile.

<u>ENCLOSURE 4</u>: 1999 INSECT AND DISEASE EVALUATION

The satin moth is a foreign insect that was introduced into the United States and Canada in the early 1900's from Europe. It has one generation per year. The adult moth flies in July and deposits its eggs in flattened oval masses, covered with a white satiny secretion, on the boles of host trees and various other objects. The larval stage feeds on both poplars and willows. In the Blue Mountains, certain locations or clones of our quaking aspen resource are periodically partially, or completely, defoliated by the larval feeding. The young larvae that hatch from egg masses feed for a short time on aspen leaves, then spin silken hibernacula in bark crevices where they pass the winter. With spring leafing-out of aspen, the larvae become active and continue to feed, and cause essentially the bulk of defoliation during this spring and early summer feeding period, eventually reaching maturity and pupating in June. They pupate in loosely woven cocoons attached to leaves, twigs, or other objects.

Satin moth populations are largely brought in check by a combination of introduced and native parisitoids that build up in the population over the course of a few years. Although some trees in the Elk Flats clone were completely defoliated this season, they will most likely survive and refoliate next year. While tree mortality can occur when high populations severely damage trees in new, outlying areas for several years in a row, we have not seen examples of this level of damage in the Blue Mountains. Natural enemies typically bring about the collapse of outbreaks, and maintain populations in check for a period of years. Satin moth infestations develop periodically in most of our aspen stands, but are usually soon brought into check and regulated by these parasitoids.

A rather high proportion of stems in most clones had white trunk rot, as indicated by *Phellinus tremulae* conks on boles of infected trees. Affected trees will have a soft white stem decay throughout most of the length of the bole. Such trees are often excavated by cavity nesters and serve as wildlife trees. Additionally, excavation by birds weakens the stem and such trees often break mid-bole. Since decayed, broken and dead and down trees contribute to stand diversity and provide for wildlife habitat, such disease activity is desirable at endemic levels and should be encouraged.

Blue Mountain aspen frequently has a rather high incidence of various stem cankers caused by several different pathogens. These often eventually result in girdling of the stem, killing the top and causing stem breakage. While some cankering was observed at Elk Flat, the incidence was considered relatively low.

Root diseases increase in severity as stems become older. Shoestring root rot, caused by *Armillaria mellea*, was suspected as causing some of the mortality in this area. Dead and down trees with signs of Armillaria infection, especially emerging honey mushrooms in the fall of the year, are good indicators of infection. Older aspen generally have a rather high incidence of root disease, and the level observed here at Elk Flats was not excessive.

Most of the aspen mortality in the Elk Flat area was believed due to the bronze poplar borer (*Agrilus granulatus liragus*). These insects prefer overmature individuals, stems weaked by site or other biotic factors (including stem decay). Borers will mine the cambium, causing girdling and death of large branches, or the entire crown; thus the tree. Most of the dead stems had cambium killed by galleries of the bronze poplar borer that had been etched into the sapwood. Mortality levels are probably slowly increasing as the age of stems in this community continues to increase. There does not appear to be any dramatic recent increase in tree mortality.

Discussion on community health and future management

We are unsure of the history of the satin moth epidemic in this community. We have seen very little similar activity this year in other aspen communities in the Blue Mountains, although satin moth hot-spots were noted in several other areas in 1997 and 1998. Although this is a non-native insect, natural parasites have become established and are present in this stand. Hopefully this outbreak will end in the next year or two. Damage is mostly temporary, although continually weakened trees will host other opportunistic agents such as wood borers, which readily cause mortality. We do not believe that much of this type of damage has yet happened in this community.

Healthy aspen communities have full diversity in age classes of stems. Disturbance associated with fire and removal/or death of old overstory is often needed to allow abundant suckering. This community is probably somewhat deficient in recruitment of younger age classes of stems. Sprouting was abundant in many areas, but browsing damage has been rather heavy. Fencing or other methods of protecting sprout development might be considered and well suited for this site.

If there are any questions regarding this evaluation, please contact either of us.

Craig L. Schmitt
Service Center Pathologist

Donald W. Scott
Service Center Entomologist

cc: Bill Collar, Walla Walla RD
Dave Powell, Umatilla NF
Suzanne Rainville, Wallowa-Whitman NF
Vicki Erickson, Umatilla NF
Jane Hayes, PNW La Grande
Don Scott
Craig Schmitt

ENCLOSURE 5: 2003 INSECT AND DISEASE EVALUATION

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:** December 29, 2003
Route To: Silviculture

Subject: Elk Flat Aspen Technical Assistance

To: District Ranger, Walla Walla RD, Umatilla NF

September 30 I visited Elk Flat with Bill Collar to evaluate the health of the aspen clones there. Over the past 13 years both Craig Schmitt and Don Scott with the Pest Management Service Center have reviewed the Elk Flat aspen but this was my first visit. The most recent visit by Craig and Don was in September 1999 and is documented in a technical assistance letter dated October 4, 1999. During this visit epidemic defoliation by the satin moth *(Leucoma salicis)* was observed throughout this area. My visit was prompted by concern from several district folks that the aspen were declining much more quickly now than in years past. This area of aspen is one of the largest in the Blue Mountains and contains the largest clone in the Blue Mountains. There is widespread concern for these aspen due to their contributions to vegetative diversity and their importance to wildlife.

We walked through various pure aspen clones, noting damage and mortality, and we also walked through stands that included mixed conifers with scattered aspen and aspen clumps present. There were pure aspen clones of various sizes. There were some areas with thick aspen regeneration about 3-4 feet tall. One stand comprised trees no taller than 15 feet, another was uniformly 10" diameter trees, and there were stands with mature trees of various sizes, including a few over 25" diameter. The mixed species stands were comprised of mainly lodgepole pine, Engelmann spruce, grand fir, aspen, and a few cottonwoods. The species in these mixed stands were very similar in size and both stumps and large trees were lacking. Although we have no information on tree age, it appeared that much of the stand had originated at about the same time. Much of the area with aspen was obviously very wet periodically, with mudflats and very deep hoof tracks dried in the mud.

Throughout the Elk Flat area there was evidence of damage from several insect and disease agents. We found evidence of some leaf feeding earlier in the summer, presumably by satin moth. There were also Cytospora cankers, sooty bark cankers *(Encoelia pruinosa)*, and white trunk rot *(Phellinus tremulae)* on several dead, dying, and apparently healthy trees. Aspen are frequently host to many insects and diseases but if stands are kept vigorous by repeated recruitment of young trees into the overstory, aspen stands can be maintained. While no agent appeared of primary importance, dead and dying mature aspen were evident throughout. These various agents along with the past several years of drought and continuing conifer encroachment into these stands are all combining to stress the aspen trees in this stand. Because no single biological agent is responsible for this widespread decline, I recommend removing the conifer competition throughout this area to increase the vigor of the aspen.

<u>ENCLOSURE 5</u>: 2003 INSECT AND DISEASE EVALUATION

I found very little evidence of current satin moth damage in any of the trees. The time of the visit should have coincided with the presence of first instar larvae. Yet we found no larvae on foliage or bark. The first instars skeletonize leaves. This damage is visible as gaps in the green, upper layers of the leaves. These gaps appear as holes in the leaves but on close examination the lower leaf layer remains as a thin, transparent layer along with the leaf veins. Some of the leaves had begun to fall and we found very little evidence of feeding on the leaves on the ground. Some of the leaves had some earlier feeding damage, but it was restricted to ¼ or 1/3 of any given leaf. Trees that still retained most of their leaves showed no evidence of defoliation earlier in the season. Leaves appeared full-sized and crowns were not thin.

Satin moth is known to cause top-kill and mortality after repeated severe infestations. Many of the overstory trees had clumpy or lollipop-like foliage, almost like a brooming effect where the leaves in the canopy appeared to originate from one area. One of these trees so affected had recently fallen down. An examination of the broomed area yielded few clues. There was a slight swelling on the branch, no insect feeding damage either on the foliage or the branches and bole. While not precisely the type of damage recorded from previous satin moth infestation, we tentatively have attributed this branch brooming to chronic satin moth defoliation in years past.

Satin moth is an exotic insect introduced into the United States and Canada in the early 1900's from Europe. The larval stage feeds on native and planted poplars and willows during the early summer and fall. Many areas are periodically partially or completely defoliated. Several parasitic insects have been introduced to control the satin moth and frequently contribute to population collapses. Although top-kill and mortality can result from repeated infestations, this has not been known to happen in the Blue Mountains. This insect continues to expand its range into eastern British Columbia and now regularly defoliates native aspen communities when earlier it was only known on park, shade, and windbreak trees.

Many living trees with no symptoms, and dead trees, had cankers, probably Cytospora, on their main stems. Frequently, obvious canker margins running vertically up the bole for several feet could be seen discoloring the bark a reddish brown. Some cankers covered nearly 50% of the circumference of the bole. Cytospora is an opportunistic pathogen, attacking plants predisposed to infection by stressors such as flooding, drought, or other pathogens. This fungus overwinters in cankered bark and spreads via spores dispersed by wind, rain, insects, or birds. Infection occurs only through bark wounds, dead tips, or branch stubs. Because it is opportunistic, it has probably increased in this stand following the past several drought years.

Sooty bark canker and *Phellinus* decay are scattered throughout this stand, although not at alarming levels. These are common diseases of aspen, becoming more prevalent in older trees (>60 yrs). Sooty bark canker is probably responsible for some of the mortality here, while Phellinus is responsible for much of the aspen breakage. Infection occurs through wounds and it is generally believed that older trees are more susceptible.

Trees smaller than 5 inches in diameter had no evidence of insects or diseases yet. However, the larger trees showed quite a lot of damage from antler rubbing. These wounds provide infection sites for cankers and decay and if the wounding continues it can cause girdling. Action to protect some of these younger trees should be taken before they are lost to wildlife damage. Much of the

3-5 foot tall regeneration showed very little browsing damage. Current losses in the younger aspen age classes are very small and these replacement trees look good.

However, there was quite a bit of mortality in trees around 10" dbh. Some of these trees had visible cankers, a few trees had some insect borer activity. This mortality did not occur as a patch of contiguous trees, but rather as individual trees in this mature size class, scattered throughout several stands. In many of these stands, the dying trees were nearly the largest trees in the stands. The lack of larger trees or stumps here suggests larger trees have not occupied this site in any numbers for some time.

As no single factor could be implicated in the deaths of these overstory trees, a combination of factors is probably responsible. The Blue Mountains have experienced below normal precipitation for the past 5-6 years. In addition, the past few winters have been warmer than average. These weather changes in combination with the conifer competition in these stands are considerable stressors on these aspens. The aspen cankers and decays present here are causing elevated mortality due to the drought and conifer competition. In addition, some of these trees may be dying outright from drought. Removing the conifer competition will allow more moisture for the aspens and should alleviate some of the drought stress. In addition, protecting some of the replacement immatures from antler rubbing and browsing will ensure future stands of aspen in this area.

If you have any questions regarding this evaluation, please contact me.

Lia H. Spiegel
Service Center Entomologist

cc: Su Meredith, Walla Walla RD
Betsy Kaiser, Walla Walla RD
Bill Collar, Walla Walla RD
Bob Rock, WAW
Dave Powell, UMA
Don Scott
Craig Schmitt

<u>ENCLOSURE 6</u>: HISTORICAL MAPPING SOURCES

Early in the 1910s, District (Regional) Forester issued instructions and an outline for how an extensive reconnaissance was to be completed for Pacific Northwest national forests (USDA Forest Service 1912). An extensive reconnaissance process was designed to produce a report, and a map atlas, for every national forest in Pacific Northwest District (Region).

An extensive reconnaissance report describes both the physical characteristics (topography, climate, minerals, etc.) and the natural resources of a national forest, such as forage, timber, and water resources, and their possibilities for development. An extensive reconnaissance report can be thought of as an historical analogue of our current Forest Plan, although it was not prepared by an interdisciplinary team and it did not include any explicit public participation.

Most extensive reconnaissance reports included photographs to illustrate key features of a Forest by depicting scenes of general interest and showing springs, telephone lines, trails, ranger stations, and other improvements.

One requirement of the reconnaissance process was to prepare a map, which could then help support future development of a national forest. Since the mapping requirement was mandatory, each reconnaissance map was prepared by using a consistent legend and color scheme.

Although early examples of range-oriented mapping are common, the most accessible map for the northern half of Umatilla National Forest has a timber emphasis. This limits our potential use of this early mapping because its classification scheme utilizes timber volume instead of forest type or some other vegetation taxonomy allowing a more direct comparison of current and historical conditions.

Contemporary Umatilla National Forest boundaries were previously contained within three national forests: Umatilla, Wenaha, and Whitman. Extensive reconnaissance maps were located for all three national forests at the National Archives in College Park, Maryland, and copies were made and subsequently digitized so that thematic data from the maps would be available in GIS.

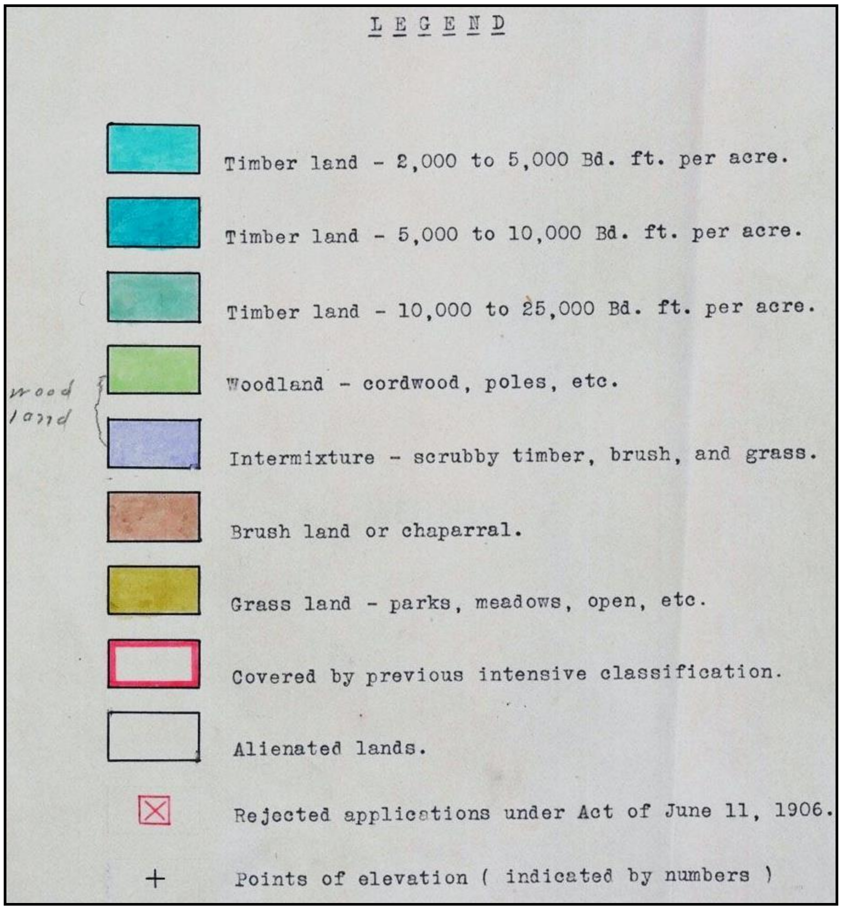
Note that base map data – elevation of known points, names and approximate locations of old ranger stations, locations of homesteads (including homesteader names), names of watercourses, range (livestock) driveways, and other interesting map annotations were not digitized.

To provide full spatial coverage for contemporary Umatilla National Forest, a total of 27 hand-colored Atlas Folio sheets, each measuring 18 inches by 21 inches, were copied and digitized (not counting legends, which were always provided on separate sheets).

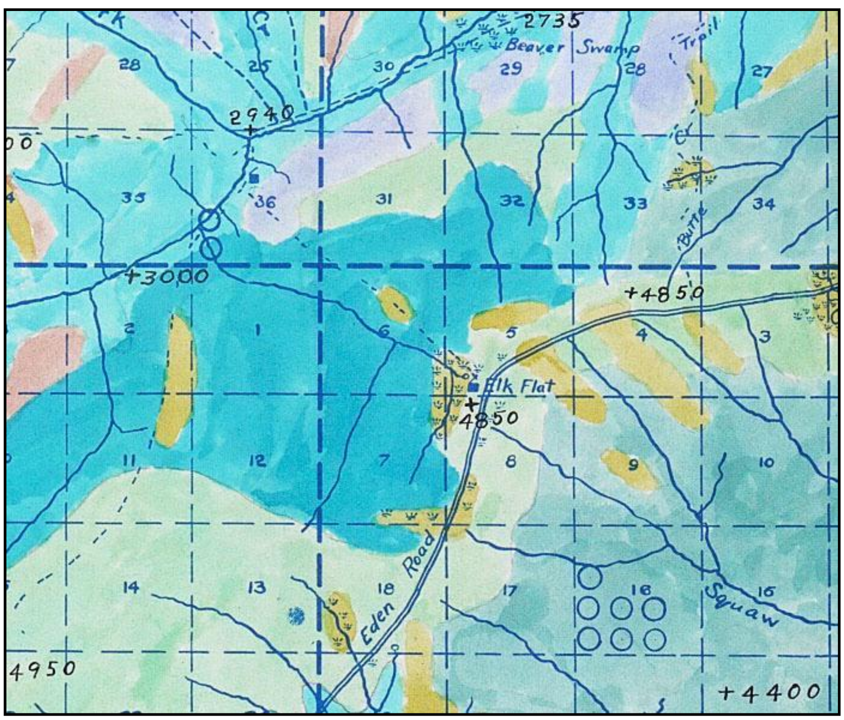
Elk Flat area is clearly depicted as a forested meadow on a 1914 map sheet for Wenaha National Forest (Kendall 1914). The legend from Kendall's 1914 map, a vicinity portion showing Elk Flat area, and an entire map sheet containing Elk Flat and its vicinity are provided on the next two pages.

Vicinity maps for Elk Flat area were also clipped from Wallowa County forest type maps published in 1936 (Buell et al. 1936) and 1957 (Spada et al. 1957), and they are provided after the 1914 map sheet.

General Land Office (GLO) survey notes were recently analyzed for Umatilla National Forest (Powell 2013). A map is provided after the 1936/1957 vicinity maps showing areas where aspen abundance and size were great enough for GLO surveyors to select it as a bearing tree at section corners or quarter-corners.

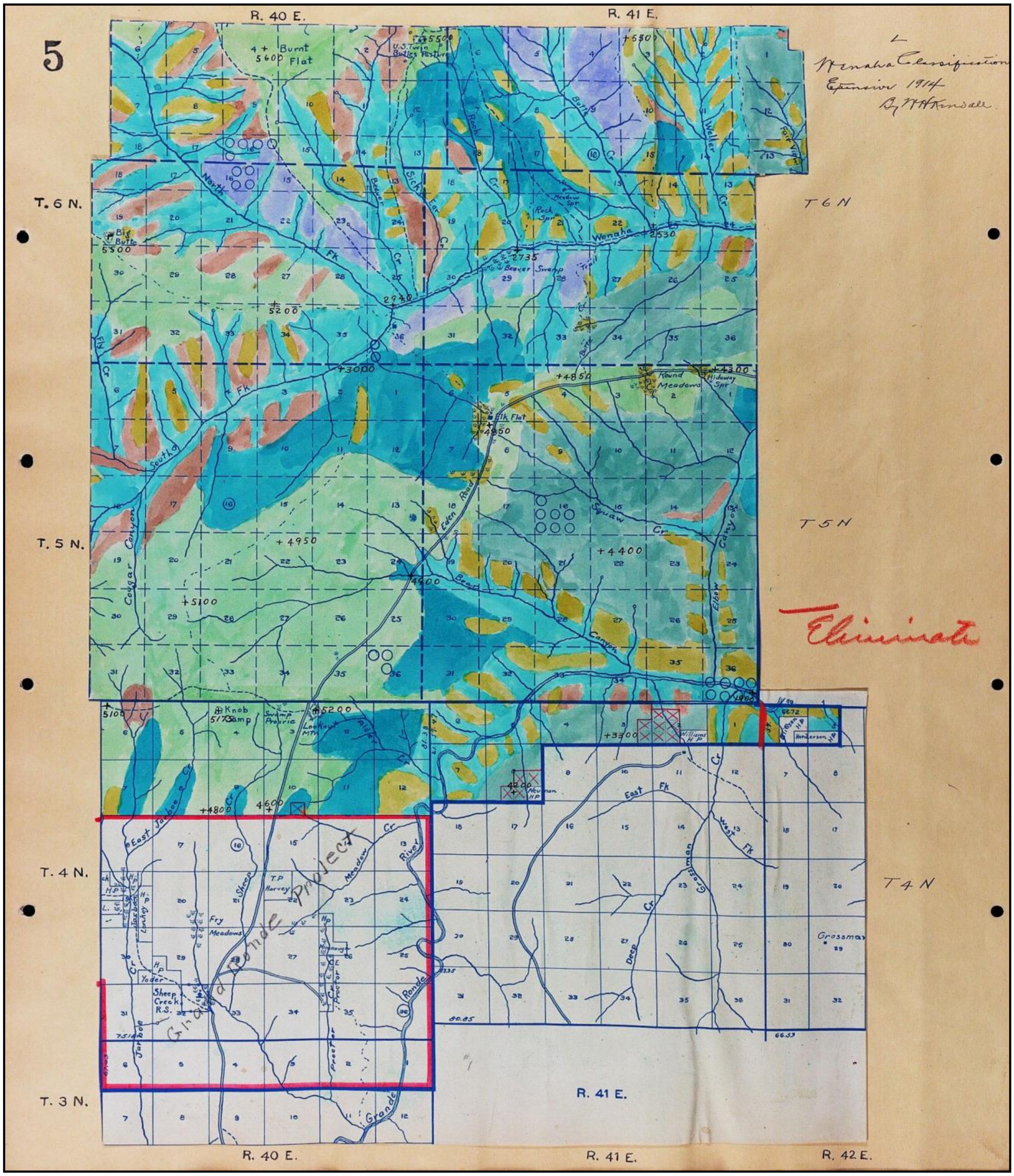


Legend for an extensive reconnaissance map for Wenaha National Forest by W.H. Kendall (Kendall 1914). Kendall's map includes 11 folio sheets, each measuring 18 inches by 21 inches. One map sheet was the legend shown here; the other ten sheets depict a timber volume classification for Wenaha National Forest (note: current Umatilla National Forest ranger districts of Pomeroy and Walla Walla were contained in Wenaha National Forest prior to November 1920).



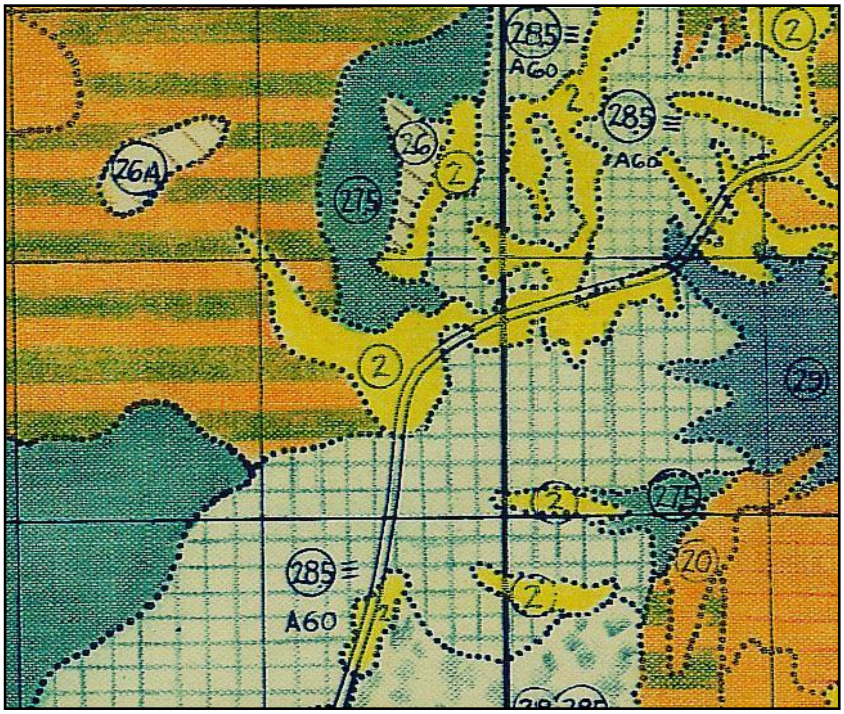
Portion of map sheet #5 showing Elk Flat and vicinity. Note that an Elk Flat meadow system is clearly shown on Kendall's 1914 map, and he added tree symbols to yellow meadow shading to denote that Elk Flat also contained quaking aspen communities (Kendall does not definitely state that tree crown squiggles shown on his map are for aspen, but we know it to be quaking aspen from Bright's reconnaissance report and Unser's photography (Bright 1914)).

ENCLOSURE 6: HISTORICAL MAPPING SOURCES

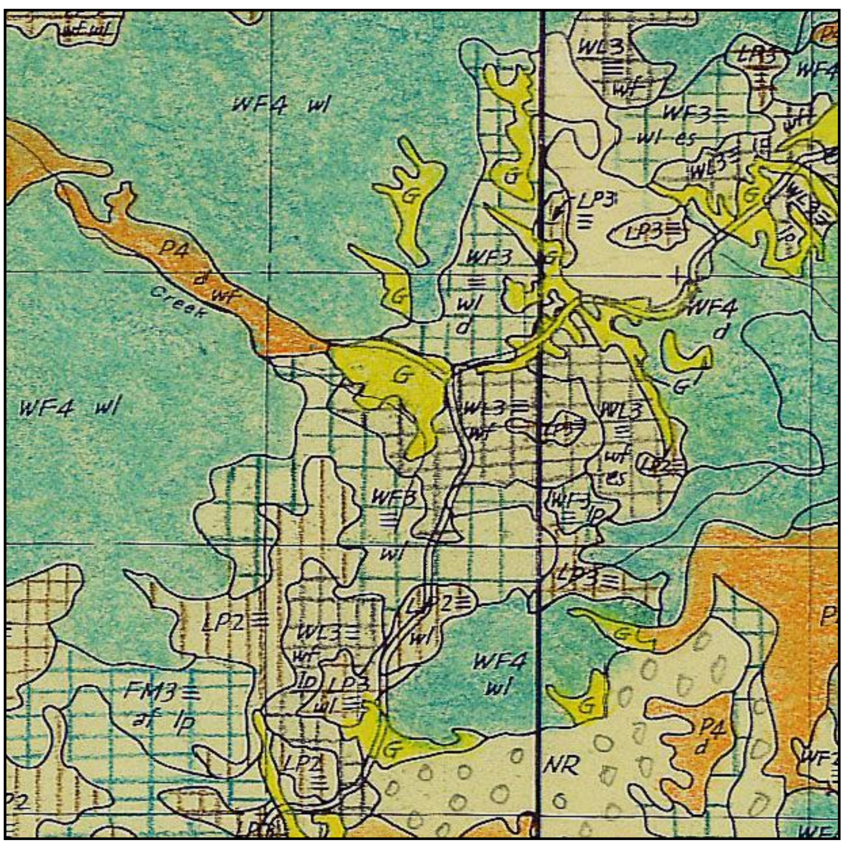


Map sheet #5 from W.H. Kendall's extensive reconnaissance mapping for Wenaha National Forest (Kendall 1914). These folio sheets were punched along their edges for use with an atlas system containing sheets for roads and trails, grazing, timber, land ownership, and other features or resources.

ENCLOSURE 6: HISTORICAL MAPPING SOURCES

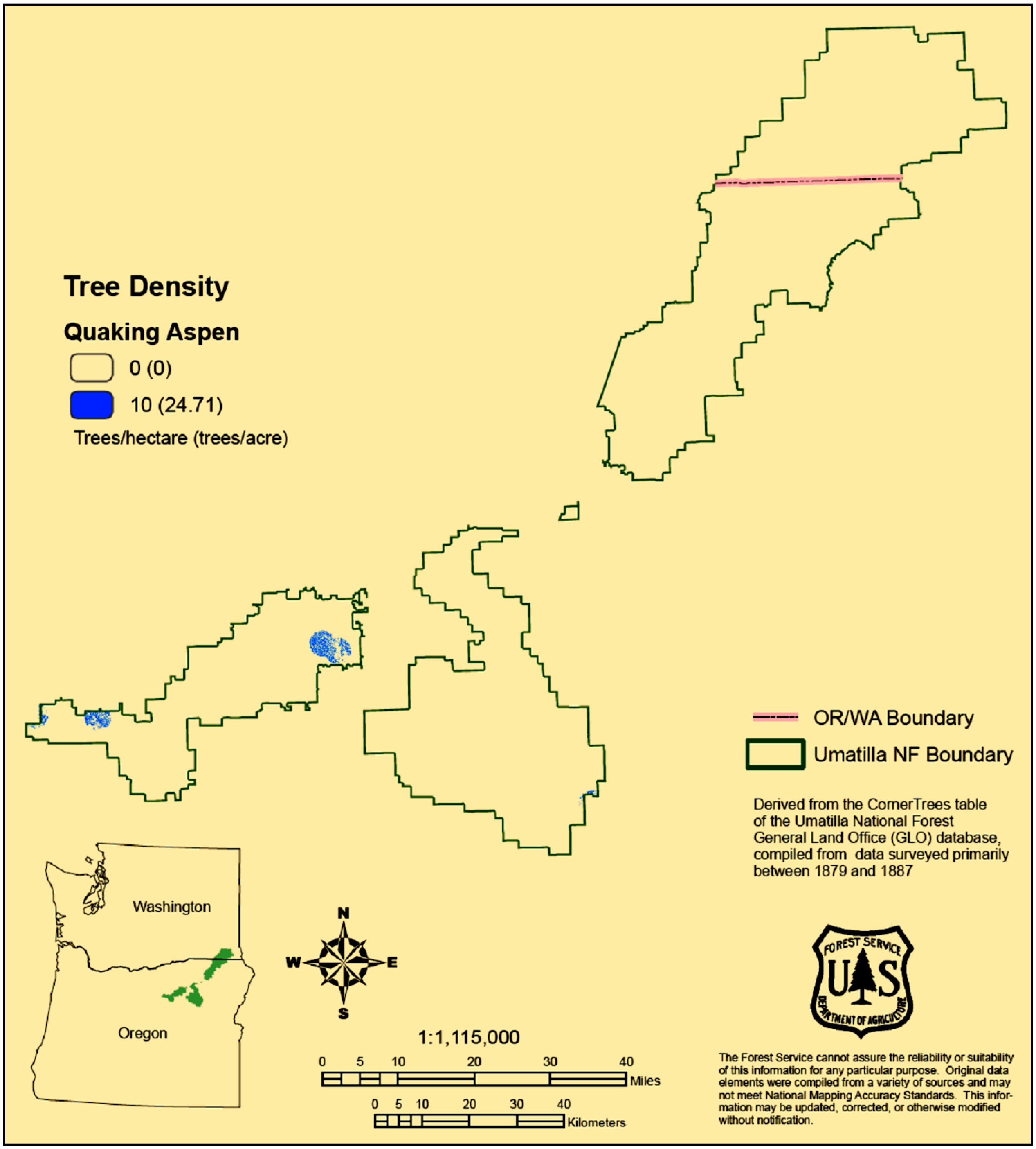


Elk Flat area on 1936 forest type map for north part of Wallowa County, Oregon (Buell et al. 1936). Elk Flat is located approximately in the center of this vicinity excerpt from a larger map (entire map sheet measures 36 inches by 82 inches). Elk Flat occurs in type number 2 denoted by a yellow color; definition for this type from the map's legend is: "Other non-forest land; cultivated pasture, grass, grass swamp, sagebrush, and brush lands."



Elk Flat area on 1957 forest type map for Wallowa County, Oregon (Spada et al. 1957). Once again, Elk Flat and its vicinity are located approximately in center of this excerpt from a larger map sheet. Elk Flat occurs in a yellow area with a map symbol of G, which is shown in the map legend as a non-forest type (grass and brush) with a definition of: "grass or brush non-forest land, not a part of a farm unit."

Elk Flat area as depicted on 1936 and 1957 forest type maps. Although these maps were cropped from larger map sheets and are not to the same scale, there are obvious differences between how an Elk Flat meadow system is depicted on these two images. Legends for these 1936 and 1957 maps are described in Powell 2012 (see appendixes A and C in that source).



Quaking aspen distribution as estimated from General Land Office (GLO) surveys completed on Umatilla National Forest between 1879 and 1887. This map shows that quaking aspen was selected as a bearing tree by GLO land surveyors for several areas on Heppner and North Fork John Day Ranger Districts, but apparently it was not selected for this purpose on north-end ranger districts of Umatilla National Forest.

Note: GLO survey maps are available for birch, black cottonwood, bitter cherry, and a total of 18 tree species; they are available from the Forest's history website and are presented as appendix D in white paper #41: "Using General Land Office Survey Notes to Characterize Historical Vegetation Conditions for Umatilla National Forest."

<u>ENCLOSURE 7</u>: FOREST MEMO ABOUT SCREENS GUIDANCE

United States Department of Agriculture | **Forest Service** | **Umatilla National Forest** | **2517 S.W. Hailey Avenue Pendleton, OR 97801 541-278-3716**

File Code: 2430 **Date:** September 5, 2003
Route To: (2600)

Subject: Guidance for Implementing Eastside Screens

To: S.O. Staff and District Rangers

OPTIONAL REPLY DUE SEPTEMBER 19, 2003

We recently received a letter from the Regional Office (R.O.) providing guidance about implementing the Eastside Screens (see R.O. 2430 memo of June 11, 2003; copy enclosed). Note that the Eastside Screens are Regional Forester's Forest Plan Amendment #2 and Umatilla National Forest Land and Resource Management Plan Amendment #11. What did the R.O. letter of June 11th intend to accomplish? Basically, it set aside two previous direction letters (R.O. letters of October 2 and December 23, 1997) relating to scenario A of the Eastside Screens.

Scenario A is part of the wildlife screen; it refers to situations where one or both of the late-old structure (LOS) components are below their historical range of variability (HRV). Note that table 1 of the Eastside Screens refers to LOS components as "multi strata with large trees" (MSLT) and "single stratum with large trees" (SSLT).[5] Scenario A prohibits any timber harvest activity in an LOS component *that is below HRV*.

Scenario A does allow timber harvest activity in LOS under two circumstances: 1) to transform some portion of an LOS component that is within or above HRV into an LOS component that is deficient (transforming MSLT into SSLT, for example), and 2) to maintain or enhance existing conditions in LOS stands that are within or above HRV.

Scenario A objectives for non-LOS situations is to "maintain all remnant late and old seral and/or structural live trees ≥ 21″ dbh that currently exist" (see item 2 a under scenario A), and to move non-LOS stands toward an LOS condition as appropriate to meet HRV.

The 1997 direction letters clarified that site-specific Forest Plan "amendments to cut 21-inch trees, in scenario A, should be done only where there is a biological urgency and unusual circumstance dictating the need for cutting large trees" (quote from R.O. letter of December 23, 1997). The net effect of these letters was to prohibit amendments for scenario-A situations where large trees were proposed for removal, regardless of whether or not they occurred within LOS.

By rescinding the 1997 direction letters, the R.O. letter of June 11th encouraged us to once again consider site-specific Forest Plan amendments in situations where active management treatments could help meet the LOS objectives of the Eastside Screens. In particular, the June 11th letter

[5] After version 2 of the Eastside Screens (Regional Forester's Forest Plan Amendment #2) was released, the names for these structural classes changed: "multi strata with large trees" is now called "old forest multi strata" and "single stratum with large trees" is now called "old forest single stratum."

provided five examples of situations for which site-specific Forest Plan amendments might be appropriate.

The intent of the accompanying enclosure is to elaborate on the Region's five examples by providing guidance about their potential application on the Umatilla National Forest.

To help implement site-specific Forest Plan amendments consistently, I am establishing a Forest screens team to review amendments as they are developed; team membership is as follows: Screens Coordinator (currently the Forest Silviculturist), Forest Planning Staff Officer, and Forest Wildlife Biologist.

If you have examples of situations where a site-specific Forest Plan amendment would now be considered, when it would not have been prior to the June 11^{th} letter, please let us know by the optional reply due date and arrangements will be made to have them reviewed by the screens team.

Please contact Dave Powell (278-3852) with any questions or clarifications about anything mentioned in this letter or its enclosures.

/s/ Jeff D. Blackwood
JEFF D. BLACKWOOD
Forest Supervisor

Enclosures
cc: Charles F Gobar, David C Powell

ENCLOSURE 7: FOREST MEMO ABOUT SCREENS GUIDANCE

ENCLOSURE: Umatilla National Forest Guidance for Implementing Eastside Screens

1. First example from R.O. June 11th letter: "Moving multiple-layered ponderosa pine stands towards LOS of a single layer where the pine are competing with grand fir or other shade-tolerant species historically held in check by wildfire."

   This example refers to situations where fire suppression and other factors promoted development of multi-layered old forest (MSLT) on dry sites instead of the single-stratum condition (SSLT) produced by a properly functioning fire regime (surface fires occurring every 5-20 years).

   Recent mid-scale vegetation assessments (primarily at the watershed or project scales) indicate that the Region's first example is widely applicable on the Umatilla National Forest, so it is discussed in considerable detail. First, consider these four examples pertaining to LOS components (MSLT and SSLT) on dry-forest sites, and their relationship to HRV:[6]

Analysis Area	**Multi Strata With Large Trees MSLT** (HRV: 5-20%)	**Single Stratum With Large Trees SSLT** (HRV: 15-55%)	**Interpretation**
Umatilla Watershed	Current Percentage: 25%	Current Percentage: 4%	MSLT is above HRV; SSLT is below HRV
Tucannon Watershed	Current Percentage: 16%	Current Percentage: 10%	MSLT is at high end of HRV; SSLT is below HRV
Grande Ronde-Rondowa Watershed	Current Percentage: 18%	Current Percentage: 10%	MSLT is at high end of HRV; SSLT is below HRV
Bologna Basin Analysis Area	Current Percentage: 29%	Current Percentage: 13%	MSLT is well above HRV; SSLT is just below HRV

   According to the Eastside Screens, these examples fall under scenario A because at least one LOS component is below HRV (SSLT was below HRV in every instance). Note that a situation where all of the LOS in a biophysical environment is within or above HRV is addressed as scenario B in the wildlife screen (for scenario B: if one LOS component occurs in a biophysical environment, it must be within or above HRV; if both LOS components occur in a biophysical environment, each of them must be within or above HRV).

   Vegetation assessments for dry-forest sites have shown that the SSLT component is almost always below HRV, as illustrated in the examples above. Often, the problem is not a lack of large trees; it is that many small trees now coexist with the large trees in a "multi strata" arrangement rather than the "single stratum" configuration maintained by a short-interval fire regime.

   To help recover the SSLT component, understory thinning, either alone or in combination with prescribed fire, is often recommended as a restoration treatment; the objective is to remove or kill enough of the understory trees (in an MSLT stand) to restore a single-layer condition featuring large

[6] By definition, dry-forest sites occur in the "warm dry" or "hot dry" plant association groups, or in the "dry upland forest" potential vegetation group. On the Umatilla National Forest, plant association groups or potential vegetation groups are used as the "biophysical environments" referred to in the Eastside Screens.

trees. If timber harvest is needed to help accomplish this objective, and if the MSLT component being considered for treatment is within or above HRV, then a site-specific Forest Plan amendment is not needed *unless large trees (those ≥ 21 inches dbh) are planned for removal*.

Consider the Umatilla watershed example in the table above: depending upon the management objectives, it might be appropriate to use understory thinning to transform 11% of the MSLT condition to SSLT. After completing this treatment, the watershed's MSLT percentage would be 14% (well within the historical range of 5-20%) and its SSLT percentage would have increased to 15% (at the low end of the historical range of 15-55%, but at least it is within the range now).

This thinning proposal for the Umatilla watershed meets Eastside Screens direction to have "NO NET LOSS OF LOS" in a biophysical environment: total LOS was 29% before treatment and 29% afterward (this "no net loss of LOS" requirement is the main reason that regeneration harvest prescriptions are not permitted when moving stands from multi-strata LOS to single-stratum LOS under scenario A). A site-specific Forest Plan amendment would not be needed for this thinning treatment *unless large trees (≥ 21 inches dbh) are planned for removal*.

If the recommended treatment were understory thinning, then why would large trees be identified for removal anyway? Depending upon stand conditions, understory thinnings may also prescribe that trees of undesirable species or condition[7] be removed from the upper canopy, although such removals would comprise a minor or incidental portion of the total treatment.

Large trees with insect or disease issues limiting their capability to contribute to an area's desired future condition, or late-seral species occurring in proportions exceeding HRV with respect to species composition, are two examples of situations where minor numbers of large trees may be designated for removal within the context of an overall thinning prescription.

If incidental removal of large trees occurs, however, it is assumed that the post-treatment stand will contain a large-tree component sufficient to qualify it as LOS (in other words, the stand was LOS before treatment and it is still LOS after treatment), *and that a site-specific Forest Plan amendment will be processed to disclose that some portion of the large trees are proposed for removal, and to develop the rationale for their removal*.

Depending upon the objectives established for an area, understory thinning might also be an appropriate treatment recommendation for other multi-layer structural classes: multi strata without large trees (now called "young forest multi strata" or YFMS) and understory reinitiation (UR). The Screens recommends that vegetation manipulation occur in the YFMS and UR condition "in a manner that moves it towards these (LOS) conditions as appropriate to meet HRV" (see item 2 b under scenario A).

For YFMS and UR stands, understory thinnings are permissible without a site-specific Forest Plan amendment because neither condition qualifies as LOS, and because it is assumed that understory thinning would not remove any trees whose diameter is 21 inches or more.

Note that a Forest Plan amendment would be necessary if large trees (≥ 21 inches dbh) are planned for removal under scenario A, regardless of whether or not the treatment occurs in LOS.

[7] A determination of desirable or undesirable trees is based on the land management objectives for an area. Trees whose existing characteristics contribute to meeting the objectives of an area are desirable; undesirable trees lack such characteristics. This means that when local management objectives (including desired future conditions from the Forest Plan) change from one area to another, then the result could be a different outcome with respect to which trees are desirable or undesirable.

2. Second example from R.O. June 11th letter: "Maintaining shade-intolerant desirable trees < 21 in dbh where their recruitment into the > 21 inch class is reasonably foreseeable in the near future, and when giving preference to them better meets LOS objectives."

   This example refers to situations where tree size may not be an issue (enough large trees are present in an area to qualify as LOS), but species composition is viewed as a problem in the context of HRV.

   Historical data sources for the Umatilla National Forest show that generally 70% or more of the tree composition on dry sites consisted of ponderosa pine (see Munger 1917). Selective timber harvest of the largest, most valuable pines; killing of stressed pines in overcrowded, multi-strata stands by bark beetles; and other factors have contributed to a reduction of ponderosa pine on these sites.

   Fire suppression allowed Douglas-fir, grand fir and other species with low fire resistance to invade dry-forest sites. A fire history study for the Tucannon watershed, for example, showed that 40 individual fire events occurred in the study area, with the first fire occurring in 1583 and the last one in 1898 (Heyerdahl 1997). In the Tucannon watershed, it is definitely possible for fast-growing (dominant) grand firs and Douglas-firs to reach or exceed the large-tree class (≥ 21″ dbh) during this 105-year fire-free interval (between 1898 and 2003).

   HRV information indicates that the historical tree species composition associated with dry-forest sites was as follows: ponderosa pine, 70-90%; Douglas-fir, 8-14%; and grand fir, 1-5%. These HRV ranges reflect the tree species composition associated with a properly functioning fire regime.

   Some dry-forest sites currently have "shade-intolerant desirable trees" (primarily ponderosa pine with perhaps minor amounts of western larch) occurring in a diameter class ranging between 15 and 21 inches; many of these trees will grow into the large-tree size class (≥ 21 inches dbh) in the near future, depending upon forest (tree) density levels and other factors affecting their growth rate and survival potential.

   On dry-forest sites, a treatment proposal may be to remove minor or incidental numbers of large grand fir and Douglas-fir trees to accomplish three objectives: (a) reduce inter-tree competition so that medium ponderosa pines and western larches (trees from 15 to 21 inches dbh) can continue to grow into the large-tree class; (b) to begin to move the species composition toward appropriate percentages as based on HRV (grand fir, 1-5% and Douglas-fir, 8-14%); and (c) to remove late-seral species with low fire resistance so that surface fire, an important ecosystem process, can be reintroduced in the near future.

   A site-specific Forest Plan amendment would not be needed to implement this treatment proposal for non-LOS stands or for LOS stands that are within or above HRV, *unless large grand fir and Douglas-fir trees (≥ 21 inches dbh) were planned for removal.*

   A site-specific Forest Plan amendment would be needed *if commercial thinning or other timber harvest activity were proposed for an LOS component that is below HRV*, even if the treatment does not result in removal of large trees.

3. Third example from R.O. June 11th letter: "Harvesting > 21 inch dbh mistletoe-infected trees when doing so best meets long-term LOS objectives and does not eliminate currently important wildlife habitat."

   This example refers to situations where scenario A precludes removing large, mistletoe-infected trees when their presence interferes with accomplishing land and resource objectives (desired future conditions) for an area.

Dwarf mistletoes are parasitic plants that derive their nourishment (primarily water and nutrients) from host trees; they can eventually kill their host. Dwarf mistletoes often predispose host trees to attack or mortality from other disturbance agents such as pathogens or wildfire. On dry sites, for example, Douglas-fir trees with long mistletoe brooms often function as ladder fuels, increasing the probability that surface fire will transition to crown fire. These characteristics of dwarf mistletoe infection often result in forest health concerns, particularly when existing mistletoe occurrence exceeds historical levels (i.e., mistletoe is above HRV).

Dwarf mistletoes and other insects, pathogens, and parasites are important components of biodiversity and wildlife habitat. Not only do they contribute to nutrient cycling, productivity, and other ecosystem processes, but they also create wildlife habitat (dead trees and cavities in living trees) and serve as a direct food source for many wildlife species.

Several studies found that bird diversity and abundance was greater in forests infected with dwarf mistletoe. In general, it was found that dwarf mistletoe was not being used as food – its berries are small and hard – but the "witches brooms" it caused provides nesting and roosting sites, and serves as habitat for butterflies, moths, and for some of the other insects that birds feed on. Another study found that both bird abundance and species richness was positively correlated with the level of dwarf mistletoe infection, and that this pattern was consistent among 24 of 28 avian species.

A treatment proposal may be to remove some proportion of the mistletoe-infected trees when their retention would interfere with accomplishing the land and resource objectives established for an area (including its desired future condition). It is assumed that mistletoe-infected trees would be retained, in proper places and at appropriate times, to provide ecosystem benefits.

A site-specific Forest Plan amendment would not be needed to implement this treatment proposal for non-LOS stands or for LOS stands that are within or above HRV, *unless large mistletoe-infected trees (≥ 21 inches dbh) were planned for removal.*

A site-specific Forest Plan amendment would be needed for mistletoe-treatment projects *if any timber harvest activity were proposed for an LOS component that is below HRV*, even if the treatment does not result in removal of large trees.

4. Fourth example from R.O. June 11th letter: "Fuel reduction when in scenario A to protect older trees (e.g., removal of smaller 'ladder' fuels)."

   This example refers to situations where fire suppression and other factors allowed small trees to become established beneath an overstory of large trees. The need to remove smaller ladder fuels is particularly pressing for sites in the "wildland-urban interface" where homes and other developments are at risk from uncharacteristic wildfire behavior.

   Understory thinning is frequently recommended to remove ladder fuels. Understory thinnings can be implemented in at least two ways: on an area basis, or around individual trees. In the first method, understory trees are thinned across an entire stand with relatively uniform composition and structure. Area-wide understory thinning can be especially useful before initiating a prescribed fire program.

   The second method of understory thinning involves removing small trees from around individual overstory trees to prolong their survival by decreasing inter-tree competition, and by addressing their proximity to ladder fuels. Trees growing under reduced competition have high vigor and increased longevity because they are better able to ward off insect and disease attacks, mainly by producing elevated levels of phenols, terpenes and other defensive chemicals.

A site-specific Forest Plan amendment would not be needed to implement this understory thinning proposal for non-LOS stands or for LOS stands that are within or above HRV, *unless large trees (≥ 21 inches dbh) were planned for removal.*

A site-specific Forest Plan amendment would be needed for ladder-fuel reduction projects *if any timber harvest activity were proposed for an LOS component that is below HRV*, even if the treatment does not result in removal of large trees.

5. Fifth example from R.O. June 11th letter: "Overstory removal of shade tolerant species to protect rare or declining understory elements, such as aspen or rare herbaceous plants."

This example refers to situations where conifers have invaded remnant and declining aspen clones, further contributing to their high stress and low vigor. Some proportion of the conifer component would be retained for biodiversity, snags, and as replacement trees, but removing many of the conifer trees (including some that are over 21″ dbh) is necessary and ecologically appropriate in order to restore the resilience and integrity of a rare landscape component (quaking aspen clones).

This issue may also apply to other deciduous vegetation, such as black cottonwood, that is declining due to suppression of fire or other disturbance processes.

Some of this aspen work was already occurring before the R.O. letter of June 11th because a compelling case could be made for biological urgency and ecological uniqueness, which allowed some site-specific Forest Plan amendments to go forward even under the restrictive guidance of the 1997 direction letters (Burns Ranger District, Malheur National Forest).

Aspen and other hardwood communities present unusual complexity because they often occupy areas of an acre or less. This means that aspen tends to occur as inclusions within larger conifer stands, and this limits the opportunity to consider aspen as a separate biophysical environment and to determine whether any individual aspen clone is LOS or not (from the perspective of the Eastside Screens).

Due to aspen's status as a limited vegetation component at a landscape scale, it has generally not been feasible to analyze it in the context of its own biophysical environment; this means that aspen has generally been handled as a non-LOS component with respect to scenario A of the Eastside Screens.

In situations where an aspen clone is declining due to conifer invasion, a restoration proposal may be to remove some proportion of the invading conifers, along with associated practices such as fencing to protect aspen regeneration from ungulate browsing. It is assumed that appropriate numbers of conifers would be retained as snags and green replacement trees during these treatments.

A site-specific Forest Plan amendment would not be needed to implement this aspen restoration proposal *unless large conifer trees (≥ 21 inches dbh) were planned for removal*.

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<u>ENCLOSURE 7</u>: FOREST MEMO ABOUT SCREENS GUIDANCE

[**Author's comments:** As author of this white paper, I offer these background comments regarding "Enclosure 7: Forest Memo about Screens guidance."

When an Umatilla NF Forest Plan was approved in June of 1990, the concept was that it would be a dynamic resource – the Plan would function as a 'living' document, being updated frequently. During training sessions and workshops about how to use and implement the new Forest Plan, for example, employees were advised that Forest Plan amendments would occur often and were expected, and frequent amendments should not be viewed as 'failings' or 'weaknesses' of the Plan.

As new science was released, and as employees gained experience with standards and guidelines during Forest Plan implementation, Plan amendments would be used to keep the Plan current and up to date.

But, within five years of its release, broad-scale, Regional amendments to the Forest Plan were approved – Eastside Screens were approved in 1994 (Regional Forester's Forest Plan Amendment #1) and 1995 (Regional Forester's Forest Plan Amendment #2), and PACFISH was approved in March 1994 (which became Umatilla NF Forest Plan Amendment #10).

This Enclosure 7 provides Forest-level guidance about responding to Regional Office direction, received as a June 11, 2003 memorandum, regarding site-specific Forest Plan amendments to the Eastside Screens portion of Forest Plan, especially for the Wildlife Screen or standard, which is item #6 of the Screens.

Since the Eastside Screens are sub-Regional in nature (they amend Forest Plans for all national forests in eastern Oregon and eastern Washington), any site-specific Forest Plan amendments involving an Eastside Screen standard tend to elicit more scrutiny, and potential litigation (especially from special interest groups), than non-Screens amendments. For this reason, and to whatever extent they can, *line officers tend to avoid Forest Plan amendments involving Screens standards*.

Fifth example in the RO's memo of June 11, 2003 deals specifically with removing conifers to benefit ('protect') aspen communities. Forest Supervisor Jeff Blackwood's letter to Umatilla NF personnel, dated September 5, 2003 (this memo is Enclosure 7), encourages employees to consider removing 'invading conifers' whenever an aspen clone is deteriorated or in decline due to conifer invasion (encroachment), and to implement this tactic even if a Forest Plan amendment is necessary.

Unfortunately, Forest Supervisor Blackwood's encouragement to arrest aspen decline by removing intermingled conifers was not widely followed, especially for situations where conifers to be removed are greater than 21-inches in diameter at breast height.

Removing trees that are 21" dbh or greater generally requires a site-specific Forest Plan amendment related to scenario A of the Wildlife Standard (item #6 of the Screens), and line officers are reluctant to propose Screens-related Forest Plan amendments for reasons described above.

Eastside Screens pertain to timber sales only, however, so killing conifers over 21" dbh is permissible by using alternatives other than a timber sale. Therefore, some land managers decide to kill large conifers, and leave them in place, by using a technique called girdling (e.g., removing a ring of bark and cambium (phloem and xylem) around the full circumference of a stem, which disrupts transport of water and carbohydrates within a tree), in lieu of removing trees by using a timber sale.

Girdling also offers a benefit of providing additional snags, and since many landscapes are snag-deficient, girdling, and the conifer snags it creates, is sometimes viewed as a 'win-win' situation.

Figure 14 shows how girdling was implemented for a project area (Wildcat) on south end of Umatilla National Forest, Heppner Ranger District.]

Figure 14: Conifer girdling to favor (benefit) relict aspen trees. This stand in the Wildcat project area, Heppner Ranger District, had conifer trees that needed to be removed to address aspen decline issues. The conifers, however, were too large (greater than 21" dbh) to be removed in a timber sale, unless a site-specific Forest Plan amendment was approved to permit deviation from scenario A standards associated with a Wildlife Screen (Wildlife Screen is item #6 of the Eastside Screens Forest Plan amendment).

An original Wildcat decision notice included a FP amendment to remove large conifers from aspen stands. But, after a Wildcat decision was withdrawn (following litigation), the line officer decided that a prudent course of action was to girdle large conifers competing directly with aspen and, after they died, they would function as snags, helping address a snag deficit for the Wildcat landscape.

For situations where conifers encroach into aspen stands (a common circumstance), and yet some of the conifers are too large to remove with a timber sale because of Eastside Screens requirements (unless authorized by a site-specific, Forest Plan amendment), girdling can be a viable treatment alternative.

Note that girdling can be effective, but it is not a common practice and without prior experience, it can be difficult to implement correctly (if girdle ‘bands’ are too narrow, then prompt tree death may not result from a girdling treatment). For this reason, post-treatment effectiveness monitoring should occur to ensure that girdling outcomes are similar to what is anticipated.

ASPEN REFERENCES AND LITERATURE CITED

This section includes literature cited in the text, along with other references having relevance to ecology and management of aspen forests in the Blue Mountains of northeastern Oregon, southeastern Washington, and west-central Idaho.

Cautionary note about aspen references: users of literature in this section should consider that aspen is a wide-ranging species and that aspen research spans all of western North America, including a broad geographical area ranging from British Columbia to Black Hills of South Dakota, Colorado's Front Range, southwestern U.S. (Arizona and New Mexico), and Sierra Nevada Mountains of California.

I believe it is useful for practitioners to be aware of a wide breadth of aspen research, and I have attempted to provide a relatively diverse array of sources in this section.

With few exceptions, sources contained in this References section are available from the World Wide Web in digital form, and a Digital Object Identifier (doi) is included for these items whenever possible.

[Digital object identifier is an international system used to uniquely identify, and link to, electronic versions of scientific information, primarily journal articles. A doi can be thought of as a 'catalog number' for journal articles and other non-book sources.]

All doi links pertain to formally published sources only; local analysis protocols, white papers (like this one), monitoring reports, and similar items will not have a doi.

For recent USDA Forest Service research reports (general technical reports, research papers, research notes, conference proceedings, etc.), a doi may also be available. But most reports do not yet have a doi, so a doi is <u>not</u> included for reports in this References section.

For FS research items, however, this section provides a weblink for the online Treesearch system, because most FS research reports are available for download there.

When preparing a white paper, one of my objectives is to help users locate any of its references or literature citations. For journal articles or books, I provide a doi or isbn number whenever one is available. For other reference materials, a weblink is provided, although I realize that weblinks have not been stable and tend to have a disturbingly short lifespan (USDA Forest Service Treesearch links, however, have been quite stable thus far).

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APPENDIX: SILVICULTURE WHITE PAPERS

White papers are internal reports, and they are produced with a consistent formatting and numbering scheme – all papers dealing with Silviculture, for example, are placed in a silviculture series (Silv) and numbered sequentially. Generally, white papers receive only limited review and, in some instances pertaining to highly technical or narrowly focused topics, the papers may receive no technical peer review at all. For papers that receive no review, the viewpoints and perspectives expressed in the paper are those of the author only, and do not necessarily represent agency positions of the Umatilla National Forest or the USDA Forest Service.

Large or important papers, such as two papers discussing active management considerations for dry and moist forests (white papers Silv-4 and Silv-7, respectively), receive extensive review comparable to what would occur for a research station general technical report (but they don't receive blind peer review, a process often used for journal articles).

White papers are designed to address a variety of objectives:

(1) They guide how a methodology, model, or procedure is used by practitioners on the Umatilla National Forest (to ensure consistency from one unit, or project, to another).

(2) Papers are often prepared to address ongoing and recurring needs; some papers have existed for more than 20 years and still receive high use, indicating that the need (or issue) has long standing – an example is white paper #1 describing the Forest's big-tree program, which has operated continuously for 25 years.

(3) Papers are sometimes prepared to address emerging or controversial issues, such as management of moist forests, elk thermal cover, or aspen forest in the Blue Mountains. These papers help establish a foundation of relevant literature, concepts, and principles that continuously evolve as an issue matures, and hence they may experience many iterations through time. [But also note that some papers have not changed since their initial development, in which case they reflect historical concepts or procedures.]

(4) Papers synthesize science viewed as particularly relevant to geographical and management contexts for the Umatilla National Forest. This is considered to be the Forest's self-selected 'best available science' (BAS), realizing that non-agency commenters would generally have a different conception of what constitutes BAS – like beauty, BAS is in the eye of the beholder.

(5) The objective of some papers is to locate and summarize the science germane to a particular topic or issue, including obscure sources such as master's theses or Ph.D. dissertations. In other instances, a paper may be designed to wade through an overwhelming amount of published science (dry-forest management), and then synthesize sources viewed as being most relevant to a local context.

(6) White papers function as a citable literature source for methodologies, models, and procedures used during environmental analysis – by citing a white paper, specialist reports can include less verbiage describing analytical databases, techniques, and so forth, some of which change little (if at all) from one planning effort to another.

(7) White papers are often used to describe how a map, database, or other product was developed. In this situation, the white paper functions as a 'user's guide' for the new product. Examples include papers dealing with historical products: (a) historical fire extents for the Tucannon watershed (WP Silv-21); (b) an 1880s map developed from General Land Office survey notes (WP Silv-41); and (c) a

description of historical mapping sources (24 separate items) available from the Forest's history website (WP Silv-23).

The following papers are available from the Forest's website: Silviculture White Papers

Paper #	Title
1	Big tree program
2	Description of composite vegetation database
3	Range of variation recommendations for dry, moist, and cold forests
4	Active management of Blue Mountains dry forests: Silvicultural considerations
5	Site productivity estimates for upland forest plant associations of Blue and Ochoco Mountains
6	Blue Mountains fire regimes
7	Active management of Blue Mountains moist forests: Silvicultural considerations
8	Keys for identifying forest series and plant associations of Blue and Ochoco Mountains
9	Is elk thermal cover ecologically sustainable?
10	A stage is a stage is a stage…or is it? Successional stages, structural stages, seral stages
11	Blue Mountains vegetation chronology
12	Calculated values of basal area and board-foot timber volume for existing (known) values of canopy cover
13	Created opening, minimum stocking level, and reforestation standards from Umatilla National Forest Land and Resource Management Plan
14	Description of EVG-PI database
15	Determining green-tree replacements for snags: A process paper
16	Douglas-fir tussock moth: A briefing paper
17	Fact sheet: Forest Service trust funds
18	Fire regime condition class queries
19	Forest health notes for an Interior Columbia Basin Ecosystem Management Project field trip on July 30, 1998 (handout)
20	Height-diameter equations for tree species of Blue and Wallowa Mountains
21	Historical fires in headwaters portion of Tucannon River watershed
22	Range of variation recommendations for insect and disease susceptibility
23	Historical vegetation mapping
24	How to measure a big tree
25	Important Blue Mountains insects and diseases
26	Is this stand overstocked? An environmental education activity
27	Mechanized timber harvest: Some ecosystem management considerations
28	Common plants of south-central Blue Mountains (Malheur National Forest)
29	Potential natural vegetation of Umatilla National Forest
30	Potential vegetation mapping chronology
31	Probability of tree mortality as related to fire-caused crown scorch
32	Review of "Integrated scientific assessment for ecosystem management in the interior Columbia basin, and portions of the Klamath and Great basins" – Forest vegetation
33	Silviculture facts

Paper #	Title
34	Silvicultural activities: Description and terminology
35	Site potential tree height estimates for Pomeroy and Walla Walla Ranger Districts
36	Stand density protocol for mid-scale assessments
37	Stand density thresholds related to crown-fire susceptibility
38	Umatilla National Forest Land and Resource Management Plan: Forestry direction
39	Updates of maximum stand density index and site index for Blue Mountains variant of Forest Vegetation Simulator
40	Competing vegetation analysis for southern portion of Tower Fire area
41	Using General Land Office survey notes to characterize historical vegetation conditions for Umatilla National Forest
42	Life history traits for common Blue Mountains conifer trees
43	Timber volume reductions associated with green-tree snag replacements
44	Density management field exercise
45	Climate change and carbon sequestration: Vegetation management considerations
46	Knutson-Vandenberg (K-V) program
47	Active management of quaking aspen plant communities in northern Blue Mountains: Regeneration ecology and silvicultural considerations
48	Tower Fire…then and now. Using camera points to monitor postfire recovery
49	How to prepare a silvicultural prescription for uneven-aged management
50	Stand density conditions for Umatilla National Forest: A range of variation analysis
51	Restoration opportunities for upland forest environments of Umatilla National Forest
52	New perspectives in riparian management: Why might we want to consider active management for certain portions of riparian habitat conservation areas?
53	Eastside Screens chronology
54	Using mathematics in forestry: An environmental education activity
55	Silviculture certification: Tips, tools, and trip-ups
56	Vegetation polygon mapping and classification standards: Malheur, Umatilla, and Wallowa-Whitman National Forests
57	State of vegetation databases for Malheur, Umatilla, and Wallowa-Whitman National Forests
58	Seral status for tree species of Blue and Ochoco Mountains

REVISION HISTORY

March 2014: This revision implemented the new white-paper template format, and minor formatting and editing changes were made throughout the document.

August 2018: Additional aspen references and literature were added, a new enclosure (#7) providing guidance about Forest Plan amendments to support aspen restoration was added, and minor formatting and editing changes were made throughout the document.