**THINNING AND DEAD WOOD:**

 **“BEST AVAILABLE SCIENCE”**

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Public input letters were reviewed from four timber sale EA’s on the WNF in FY09. The following statements are the primary areas of controversy raised in the letters.

The purpose of this white paper is to provide clarifying information related to these statements, and to help IDT’s with supportive information for use in NEPA analysis. This was requested by the Forest Leadership after receiving numerous comments on forest projects, all with similar issues.

**STATEMENT #1: Thinning from below in young stands followed immediately by snag creation promotes the development of larger diameter *snags* at a faster rate than in un-thinned stands of a similar age.**

**IT DEPENDS ON THE TIMEFRAME OF INTEREST AND THE MODEL USED.** Thinning in young stands does promote the development of larger diameter *green trees* faster over time than in un-thinned stands. (Davis and Puettman 2007, Harrington et al. 2005, Garman et al. 2003).

However, the reduced competition from the thinning and snag creation reduces density-dependent mortality in the residual trees, allowing them to be healthier and live longer before succumbing to competition, insects, or disease to become a snag.

Modeling this question results in different answers, depending on the model. Zelig modeling by Pabst et. al (figure below, unpublished 2003) has shown no difference in the cumulative number of large snags (>19.7” dbh) in un-thinned vs. thinned + snag creation treatments for the first 35 years. From 35 to 100 years post-treatment, there are slightly more large snags in the thinned +snag creation stands than in the un-thinned. But with review including error bars, the difference is negligible. After 100 years, large snags accumulated at a much higher rate in the un-thinned stands. Since most silvicultural prescriptions on the WNF include only one thinning entry, with plans for regeneration harvest between 40-80 years after treatment (~80-120 year rotations), thinning + snag creation at the densities modeled does provide a small benefit to large snag availability within that time frame.

Note that the snags created by artificially killing trees from the thinned understory in Prescription C were small diameter and did not contribute to the large snag totals over time.



**Prescription C = thin from below stands averaging 40 years old (Coast Range) 1 time, retaining 75 TPA of largest trees, and creating 6 created snags from trees in understory that would have been thinned.**

***(note: the snags in this graph are cumulative production over time without accounting for decay and fall down--hence the numbers/acre do not represent what you might see standing, but the trends are useful. Error bars are not displayed in this figure, but they can be found in the original paper).)***

FVS modeling shows a different but similar result. Leslie Elliot, a silviculturist now with the Sweet Home Ranger District, WNF, simulated thinning for the Curran Junetta project on the Umpqua National Forest (USDA Curran Junetta 2007). They handled the analysis under cumulative effects:

*“Large snag (≥20” DBH) densities within the stands are currently below the levels advised for in DecAID (4.7 snags/acre – 30% tolerance level). Under the no action alternative this level of snags would not be achieved for another two decades (Figure 15). The action alternatives would delay reaching this level by an additional 10 to 30 years (10 years for units thinned to 70 to 90 trees per acre, 30 years for units thinned to 40 to 60 trees per acre). However, the action alternatives would provide other ecological benefits by allowing trees to grow larger and faster, and to develop other suitable wildlife habitat characteristics (e.g., large limbs, crowns, etc.). The gray areas on the graphs below represent the 30 to 80% tolerance levels from DecAID.”* ***NOTE: artificially created snags are not shown in this chart.***

This example, using FVS, shows greater accumulation of large snags in un-thinned vs. treated stands when compared to the Pabst example above (which used Zelig). Two cautions should be made in the comparison. The Zelig graph is cumulative snags that have died over the time period, while the FVS graph is displaying the number of snags on the site through time (which includes decay and breakage). The graphs are also displaying two different stands, one on the Coast Range, the other on the Umpqua NF. The models differ in how they predict tree death. The West Cascade variant of FVS uses two equations and then weights them to get the overall mortality estimates. It first predicts individual tree mortality (just based on the trees characteristics (dbh, cr, - not based on stand density), and the second equation is based on how close the stand is the maximum stand density, and estimates a proportion of mortality from that. It then weights the two equations, so the more dense the stand is, the more weight is given to the second equation. If the stand has low densities, suppression has little to no effect and it is weighted more heavily toward the first equation. The Zelig model uses maximum density as the driver to predict mortality.

The bottom line is that a different answer will be found with different models and with different stands. It is important that projects site-specifically model their treatments to determine the extent of difference between a no-action and thinning treatment.

**STATEMENT #2 The short term loss of small diameter snag habitat from thinning is a reasonable tradeoff to meet the goal of getting larger trees, and hence, larger snags on the landscape in the future.**

**MIXED**: There is a trade-off, but hard to say if it is “reasonable.” Small diameter snags are used by wildlife, primarily for foraging (Hagar, 2008, Mellen et al 2009). Though the density of cavity-associated birds has been found to be greater in thinned vs. unthinned stands (Hagar 2009), very few birds were found actually nesting in the small snags available (Hagar 2008). The majority of wildlife species utilize larger snags >18” (Mellen et al. 2009), and these larger diameters meet multiple life cycle needs. Retention of hardwoods may be a possible mitigation measure. Hagar observed several nests in broken off limbs of hardwoods such as big leaf maple (Hagar 2008).

**STATEMENT #3 Most of the mortality in young stands comes from suppression.**

**IT DEPENDS**: Lutz (2005) found in sampled unthinned young stands on the HJA that suppression mortality was observed in >80% of plots and was more than 2.5 times as common as mechanical damage (windthrow, stem snap, and crushing). However, *biomass* lost to mortality via mechanical damage was nearly four times that lost via suppression because mechanical damage killed larger stems. The choice of metric — proportion of stems or biomass lost — yields different conclusions about the relative importance of different forms of mortality. More biomass, i.e. fewer but larger snags, will provide a different type of habitat than many small snags. The number and size of snags necessary to support snag-dependent species varies by habitat and by species. The model DECAID (Mellen et al. 2009) can help determine which species are benefited.

**STATEMENT #4: Artificially creating snags following thinning can mitigate for thinning effects.**

**MIXED**. Research has shown that artificially-created small snags (<18”) in thinned units will provide foraging habitat from year 5 (Hagar 2009). When the longevity of this habitat has been modeled, however, only short term improvements are noted. From Pabst (2009*) “ Thinning and snag creation led to a temporary (~ 35 yrs) increase in the number of large snags relative to the unthinned control, but beyond 100 years, large snags accumulated at a much higher rate in the unthinned stands.”* (See figure in Statement #1)

The Young Stand Thinning and Diversity Study included observations of artificially created snags in thinned units. After 15 years of monitoring, more than 50% of “snags” created by topping and topping w/inoculation (with no branches retained), were still alive. Over 50% of the “still alive” snags were in heavily thinned stands, implying that greater amounts of “opening” in the stand reduces mortality, perhaps due to epicormic branching. The dead snags received the vast majority of the foraging (Manning 2009).

**STATEMENT #5 Leaving “skips” can provide valuable snag habitat over time as a mitigation measure.**

**UNKNOWN**. Leaving “skips” where suppression processes can occur will produce snags (Lutz 2005, Pabst 2009), but there is no research currently available documenting the amount and placement necessary for the skips to provide a benefit. Wessell (2005) studied the retention of leave-islands in thinning units. Though the development of snags and snag-dependent species was not a focus of the study, they did find that un-thinned patches ranging from 0.25 to 1.0 acres in size appeared to provide refugia for some low-mobility, ecologically sensitive species in managed forests of the Pacific Northwest.

Units throughout the region are leaving skips of a variety of sizes and overall acreage.

 From the Siuslaw, as an example:

*We do not mark timber in our timbersales, because we can layout a lot more acres if we don't. About 99% of our commercial thinning is in old plantations, and with the density of our streams and other limitations, such as not building new roads and using smaller logging systems than original clearcut,* ***we 'skip' about 35%*** *of the old clearcut (Randell C Miller, Siuslaw NF, Central Coast RD – ODNRA)*

From the Olympic Habitat Study, as an example:

*Prescription installed: Variable Density Thinning, not planted, CWD clumped, slash dispersed (3a). Thinned 75% of stand to 75% of pretreatment basal area. Cut 15% of stand to create small gaps. Left* ***10% of stand as uncut patches ("skips").*** *Not planted. CWD clumped and slash dispersed. No other initial treatments (Harrington et al. 1996).*

Mitigation may best be analyzed at a landscape scale. Work by Ohmann (2009) displays the snags per acre throughout the range of the northern spotted owl (<http://www.fsl.orst.edu/lemma/nwfp>). This GNN analysis can be used to summarize snag habitat at a landscape scale, to provide context for stand-level effects.

**STATEMENT #6 Thinning in young stands accelerates the delivery of large diameter trees to the riparian system.**

IT DEPENDS: Thinning in young stands in riparian areas does promote the development of larger diameter *green* trees, but the reduced competition results in healthier residuals that may live longer before succumbing to insects and disease, dying, and falling into the stream. However, with thinning resulting in larger diameter green trees faster, those trees would be available to other processes (debris torrents, wind storms, etc.) for *live* delivery to the riparian system.

**STATEMENT #7 Small diameter material delivered to the stream from *suppression* processes is less beneficial to the aquatic system than fewer stems of larger diameter.**

IT DEPENDS: This statement has been made recently by the NMFS's as an argument to NOT thin in riparian reserves. It is supported by a paper by Beechie et al. (2000).

Beechie modeled wood recruitment on small streams on private industrial land in WA. As expected, thinning in riparian stands **did** result accelerate the availability of live trees of pool-forming size over time if the original treated stand was of **small diameter**. The benefits of thinning to diameter growth of live retained trees is well studies (see #1 above).

However, the paper also showed that thinning of riparian forests did not increase the abundance of pool-forming wood (i.e. larger diameter green trees) **if** the riparian area already contained trees large enough to form pools. If larger, pool forming trees were already present, thinning reduced their density and availability, reducing the overall population of potential inputs.

If pool habitat is limiting, and the riparian stand is of small diameter, the debate centers on how big a tree needs to be to stay in place long enough to form a pool. The size of the tree, distance to stream edge, width of stream, velocity of stream, and many other factors influence the characteristics of a “successful” pool-forming piece of wood. In the Cascades, small diameter trees break at varying heights depending on disease agent and type of mechanical damage, so some small diameter trees do fall in the channel in un-thinned stands (See Lutz above). However, without the large key pieces to hold them in place, they are generally moved from their immediate location during disturbance events (Gordie Reeves, personal communication 2009). This is a key difference between streams modeled by Beechie in Washington and streams in the western cascades. The model STREAMWOOD can be used to help quantify wood inputs over time in different stream types.

Gordie Reeves is working on resolving this issue by producing a decision support model that guides management options in different settings using NETMAP (Benda et al. 2007 <http://netmaptools.org/node/27>). NETMAP modeling aids in visualizing where wood may come from, which can include inputs directly from adjacent riparian zone or from tributaries that may or may not be inhabited by fish (ROD V-13). May and Gresswell (2003) found that in small colluvial channels draining steep hill-slopes, processes associated with slope instability dominated large wood recruitment. In larger alluvial channels, wind-throw was the dominant recruitment process from the local riparian area. Suppression mortality was not a major input mechanism.

Other recent references for sources of wood to streams can be found in Reeves et al. 2003 and Benda et al. 2003 and 2004.

FOOTNOTE ON THIS: Other ecological values should be considered when proposals to thin in riparian reserves are analyzed. The Density Management Study provides a good summary of short term affects from thinning with various no-harvest buffers (http://ocid.nacse.org/nbii/density/). Sherri Johnson, PNW Lab (personal communication) also reminds us we should also be thinking about other ecological inputs to streams besides wood. The NWFP states that riparian reserves should maintain and restore species composition and structural diversity of plant communities. Thinning tends to increase shrub cover and greatly increase within-stand variability where shrub cover is absent before treatment (Harrington et al., 2005).

Riparian thinning can also promote the development of late successional forest attributes of value to many riparian and upland-associated species (Pabst et al. 2009, Harrington et al. 2005). BIBLIOGRAPHY

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