An Analysis of the Potential Supply of Small-Diameter Ponderosa Pine for the Flagstaff, Arizona Region

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Introduction

One of the key elements of the Greater Flagstaff Forests Partnership (GFFP) is working to encourage development of community based businesses that utilize forest treatment by-products. The Partnership model seeks to separate economic interests from project design and implementation to ensure that ecological objectives are not influenced by economic motivations. However, the Partnership firmly believes that small diameter trees, the renewable resource by-products of restoration, can and should be used in appropriately-scaled economic enterprises to create jobs and offset the high costs of restoration. A considerable amount of resources and effort have been invested in small diameter tree utilization and economic development, including direct grants to existing or start-up businesses. The Partnership has also funded projects to evaluate the potential supply of timber and woody material available to potential wood users, such as development of the Coordinated Resource Offering Protocol (CROP). Still, as a collaborative Partnership representing many, but not all, social, economic and conservation perspectives, the GFFP is constantly investigating and evaluating information and data sets that can facilitate enlightened discussion of key issues. These have included the concepts of appropriately scaled, community based, and sustainable business activity.

Faced with the proposal for development of a high volume wood fiber user, an oriented strand board (OSB) plant in Northern Arizona, the Partnership Advisory Board (PAB) in mid-2006 asked the Utilization and Economics Team to address the issues of appropriately-scaled and sustainable businesses based on the supply of woody material that would be removed under fuels reduction and forest restoration treatments implemented in the Flagstaff area. The UET decided that the terms “appropriately-scaled” and “sustainable” were heavily value laden terms that required broader debate than that represented by the UET. It did however conclude that discussion within the broader collaborative would be informed by any data the UET could provide on the volumes of wood that exist in the region and how much of that volume could be considered available to supply local businesses. To this end, the UET has developed this analysis of the potential supply of small diameter ponderosa pine to inform ongoing discussions within the PAB.

Examining the potential regional supply of wood fiber available for industrial processing is a conditional exercise. Supply numbers are highly dependent upon the type of fuel reduction or restoration treatments employed, diameter caps, accessibility, ownership rights, available processing capabilities, markets, etc. The type of prescription to be used, diameter caps, and "appropriate" utilization often involve value judgments concerning how our forests should be managed. Therefore, there is no exact supply number. The following is an information source for this discussion and is based on Utilization and Economics Team meetings and member input.

Key assumptions, which affect output numbers, include:

1) a defined study area with a 60-mile radius from Bellemont, AZ and a twenty year time span;

2) 50% of all non-reserved ponderosa acres within the defined study area require mechanical thinning;

3) accumulating annual net growth is accounted for only on the 50% of acres deemed appropriate for mechanical thinning, and then only until those acres are treated;

4) and estimates of potential supply have been made with the assumption of a 16" diameter cap.

This paper does not reflect a policy of or position taken by the GFFP, but rather should be considered a source of information for consultation during collaborative discussion regarding what businesses are considered community based, appropriately scaled and sustainable.

Methods

Using numbers collected by Snider and Daugherty—based primarily on FIA data (Preliminary Report for ERI, 2006) and Larson and Mirth (1998), a coarse examination of the current supply available from harvests resulting from forest restoration treatments can be conducted. In this case, strictly ponderosa pine on non-reserved land is analyzed, excluding areas with administrative removals (including wildlife habitat removals), unproductive site indices, and regions with slopes >40%. Pinyon/juniper supply estimates are needed as well, but are not considered here. The supply question is approached with an understanding that restoration and fuels reduction prescriptions are the driving force for wood and biomass harvests, and that the economic supply should be a result of by-product utilization. There is the potential for fire, both prescribed and wildland fire use, to play a greater role in fuels reduction and forest restoration efforts, particularly as a maintenance tool. We recognize that a significant portion of ponderosa forests surrounding Flagstaff would likely benefit from some level of restoration-based mechanical thinning as a means of reducing fire hazard (Covington et al. 1997), and that small diameter tree thinning in those areas could support significant restoration-centered industries. As such, our intent here is to focus primarily on supply characteristics in a portion of the landscape where mechanical thinning (possibly followed by maintenance burning) is likely to be used significantly, rather than focus on fire management approaches (including prescribed burning and/or Wildland Fire Use) that might be used in the remainder. Finally, the analysis is also approached with the recognition that trees are growing, and continue to grow at a much greater rate than removals.

A circular region surrounding Bellemont, AZ, with a 60-mile radius, is the defined study area. Bellemont, AZ is used because it represents the closest area to Flagstaff with the greatest potential for the development of wood processing facilities. A 60-mile radius is used because it is the generally accepted economically feasible hauling distance for low-valued wood fiber and keeps the supply discussion germane to the GFFP area. Intermediate to large-scale industries would most likely require material from an area larger than the 180,000 acres focused on by the Partnership. Incorporating railways and increasing the value added of products may allow processors to go further than 60 miles to transport logs, but for this exercise a 60-mile radius is used. As seen in Table 1, there are approximately 1.24 million acres of non-reserved ponderosa within a 60 mile radius from Bellemont, of which 1.08 million acres are on national forest lands. These 1.24 million acres contain approximately 20.3 million ccf (hundred cubic feet) of ponderosa growing stock (>5" dbh), giving each acre an average of 16 ccf growing stock. Half of this volume is in trees less than 17" dbh (Snider and Daugherty 2006). Average volume per acre should be considered low because most of the estimates are based on FIA inventory data from 1999. Assuming that the annual net growth rate of 35 cf (cubic feet) per acre (of which _, or 26 cf, occurs in trees less than 17") (Snider and Daugherty 2006) has remained the same, and multiplying this annual rate by seven years, would provide an extra 2.45 ccf/acre, bringing the current average volume per acre to approximately 18.5 ccf/acre.

Larson and Mirth (1998) estimated the amount of ponderosa fiber needing to be removed from southwestern ponderosa forests during restoration treatments. They found that a conservative restoration treatment with a 16" diameter cap would yield an average of 6.55 ccf of fiber per acre from trees between 5"-16" dbh, with a range from 3 ccf-18 ccf/acre (based on a study area of seven national forests in Arizona and New Mexico). While their estimates are based on data points from 10-20 years old, this provides us with a low range of economic supply. Adjusting this number for recent growth would conservatively add 1.5 ccf/acre, giving us an average removal of approximately 8 ccf/acre. A removal of approximately 8 ccf/acre has been verified as an average for current fuels reduction efforts by the Coconino National Forest (Pers. Comm. - Kim Newbauer, Timber Program Manger CNF on 10-18-06).

Results

The total supply of small diameter material that could be available for industrial processing is comprised of the existing backlog needing to be thinned and accumulating net growth that continually adds to the existing backlog. Accumulating net growth has to be considered due to the fact that major restoration of surrounding ponderosas forests will take many years. For a 20-year projection, we can assume that annual net growth estimates for treated acres can be removed from the short-term analysis (i.e. no re-entry for 20 years).

The first step in estimating available supply is an examination of the current backlog. Under a scenario that involves a one-time, mechanical thinning of the backlog on all acres, there is:

1) An existing "harvestable" volume for backlog in a 60-mile radius surrounding Flagstaff of:
   1.24 million acres x 8 ccf/acre = 9.9 million ccf
2) Over a ten-year period:
   9.9 million ccf / 10 years = 990,000 ccf/year
3) Over a twenty-year period:
   9.9 million ccf / 20 years = 495,000 ccf/year
4) Over a thirty-year period:
   9.9 million ccf / 30 years = 330,000 ccf/year

However, we have seen that for most fuels reduction projects, not all acres require mechanical thinning due to varying tree density, wildlife habitat concerns, and other management objectives. Under a scenario where only 50% of the 1.24 million acres require mechanical thinning, there is:

1) An existing "harvestable" volume for backlog in a 60-mile radius surrounding Flagstaff of:
   620,000 acres x 8 ccf/acre = 4.96 million ccf
2) Over a ten-year period:
   4.96 million ccf / 10 years = 496,000 ccf/year
3) Over a twenty-year period:
   4.96 million ccf / 20 years = 248,000 ccf/year
4) Over a thirty-year period:
   4.96 million ccf / 30 years = 165,000 ccf/year

Thinning of accumulated backlog should be combined with efforts of thinning annual net growth. Currently, annual net growth is approximately 0.35 ccf/acre (O'Brien 2002). As backlog is thinned, annual net growth on treated acres will shift accordingly to remaining larger trees, and is assumed to be less of a fuels reduction priority for the next 20 years (i.e. no re-entry for 20 years). A conservative estimate of mechanically thinning only 50% of acres, or 620,000 acres, over a 20-year time span would necessitate the thinning of approximately 31,000 acres annually for the defined study area. Annual net growth on all 620,000 acres in year one is approximately 217,000 ccf, and annual net growth for 31,000 acres is approximately 10,850 ccf. Thus, for each year of the 20-year time span, there would be an annual net growth reduction of 10,850 ccf for the defined study area (that is not a real reduction, but a reduction in fuels priorities). Summing and averaging annual net growth *on un-treated acres* over the 20 year time span results in average accumulation of approximately 114,000 ccf annually.

Looking much further beyond a twenty year time horizon introduces too much variability as we will not know the condition of the forest (fires, beetle kill, etc.), markets, and processing infrastructure. We feel our per-acre yield estimates are on the conservative side, as case studies have shown yields of trees less than 17" averaging 12.8 ccf/acre (Larson and Mirth 1998) and 13.48 ccf/acre (Larson and Mirth 2004) in thinning treatments around Flagstaff. Additionally, a strong case can be made that an average removal of 8 ccf/acre may neither sufficiently reduce fire risk, nor substantially enhance restoration. From Table 3, we can assume that the diameter class distribution of trees to be removed would resemble the following volume percentages: 5"-9" dbh (20%), 9"-13" dbh (40%), and 13"-17" dbh (40%).

If it is deemed that 50% of the surrounding non-reserved acres need mechanical treatment, the current and potential industries for the Flagstaff area should collectively aspire to process approximately 362,000 ccf (248,000 ccf of annual backlog plus 114,000 ccf of average annual net growth during backlog harvest) of small diameter ponderosa annually for the next 20 years. To put that in perspective, fuels reduction efforts on the Coconino and Kaibab National Forests combined to harvest less than 10,000 ccf in Fiscal Year 2005 (Hjerpe and Kim, In Preparation). Put yet another way, the Coconino NF is cutting less than 2% of its annual net growth. A significant portion of this annual net growth would be accounted for by thinning activities occurring at the scale described above.

Discussion

This is a very rough analysis of the potential supply of ponderosa fiber from trees between 5"-16"dbh that would be available for processing under the specified restoration and fuels reduction parameters for the area surrounding Flagstaff and within an economically feasible hauling distance (60-mile radius). Certainly, treatments should be completed by certified professionals receiving livable wages, and drawing from local populations as much as possible. However, we cannot expect the harvest/supply rates of prospective industries to remain steady in perpetuity. Ideally, this region would have industries capable of thinning and utilizing annual small diameter net growth, as well as industries capable of a one-time thinning of accumulated backlog, where regional ponderosa forests will be heavily thinned to get the fire regime closer to its natural trajectory. If this happens, the economic supply of small diameter ponderosa will dwindle, and should be able to be maintained through fire and much smaller, periodic thinning. At this point, a smaller wood processing industry would be required.

All estimates of potential supply have been made with the assumption of a 16" diameter cap. This analysis has not dealt with the accumulating effects of annual net growth on the 50% of land assumed to not receive mechanical treatments. If 620,000 acres in the defined study area were actually mechanically thinned in the next twenty years, the other half of acres not treated will have most likely transitioned into tree densities greater than desired future conditions, requiring further mechanical thinning and prescribed burning.

A remaining ***major question*** involves determining the amount and distribution of acres needing mechanical thinning. Estimates of existing stand volumes and average removals based on past fuels reduction prescriptions appear to converge with greater consensus than the question of which acres get which treatments (no treatment, light burning, heavy burning, and light, medium, and high-intensity thinning).

A ***major concern*** of this scenario is that some industries may need volumes of wood fiber that go beyond the volume that will be removed under NEPA approved ecological restoration and fuels reduction programs. These industries would most likely look to a much larger supply area, such as within a 200 mile radius.

A ***major operational obstacle*** to this scenario, besides the inherent low economic value of small diameter ponderosa pine, is whether or not the Forest Service could ramp up NEPA analysis, prescription designs, cruising, marking, and other preparation.

References

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Tables taken from Snider and Daugherty Preleminary Report (referenced above).

Table 1. Area (acres) of nonreserved ponderosa pine timberland

	Arizona	Coconino Co.	Coconino NF	60-mile radius
Total	2,880,000	1,400,000	650,000	1,240,000
N.F.	1,980,000	1,300,000	650,000	1,080,000

Table 2. Net volume (million ccf) of ponderosa pine growing stock on nonreserved timberlands

	Arizona	Coconino Co.	Coconino NF	60-mile radius
Total	45.8	22.5	10.8	20.3
N.F.	31.9	20.9	10.8	16.4

Table 3. Total net volume (million ccf) of ponderosa pine growing stock on nonreserved timberlands in Coconino County, by diameter class

	Diameter class (inches at breast height)				
	5.0-8.9	9.0-12.9	13.0-16.9	17.0-20.9	21+
Million ccf	2.39	4.64	4.52	3.70	7.27
Percent	10.6	20.6	20.0	16.4	32.3

Table 4. Annual net growth (ccf) of ponderosa pine growing stock on nonreserved timberlands

	Arizona	Coconino Co.	Coconino NF
Total	1,020,000	486,600	230,000
N.F.	722,000	460,000	230,000

Table 5. Annual net growth (ccf) of ponderosa pine growing stock on nonreserved timberlands in Coconino County, by diameter class

	Diameter class (inches at breast height)				
	5.0-8.9	9.0-12.9	13.0-16.9	17.0-20.9	21+
ccf	123,730	141,812	94,221	57,916	68,920
Percent	25.4	29.1	19.4	11.9	14.2

Figure 1. Potential PP utilization areas within 60-mile radius
Source: Haydee Hampton, ForestERA

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