FIA BioSum: A Tool to Evaluate Financial Costs, Opportunities and Effectiveness of Fuel Treatments

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FIA BioSum, a tool developed by the USDA Forest Service's Forest Inventory and Analysis (FIA) Program, generates reliable cost estimates, identifies opportunities and evaluates the effectiveness of fuel treatments in forested landscapes. BioSum is an analytic framework that integrates a suite of widely used computer models with a foundation of attribute-rich, statistically representative sample data for forested landscapes. The framework builds the analysis using comprehensive forest condition data collected by the FIA Program and GIS transportation layers that represent the costs of moving harvested material to processing sites. The analysis predicts gross revenues for delivered merchantable wood based on current product prices and "dirty chips" derived by chipping whole-tree-harvested small trees and the tops and limbs of larger trees. The dirty chips are suitable as feedstock for wood-fired electrical generating facilities, with an assumed value of $18 per green ton. FIA BioSum also predicts harvest costs, hauling costs, and the amount of wood and dirty chips that could be accumulated at each processing site.

Scientists in the Pacific Northwest Research Station's FIA, Human and Natural Resources Interactions, and Focused Science Delivery programs initiated the collaborative development of BioSum to respond to questions posed by policymakers, Washington, D.C. office staff, and resource managers charged with implementing the Healthy Forest Restoration Act of 2003. The ongoing, three-year collaboration involves scientists and analytic staff from these PNW Station programs, fire and fuel experts, silviculturists, and forest engineers from agencies and universities outside the PNW Station who generously contributed expertise, recommendations for prescriptions and critical review to help ensure a technically sound design and analysis.

The FIA BioSum design addresses a broad array of questions such as:

- How many acres need treatment?
- Which prescriptions would be effective?
- How much would treatments cost?
- How much woody material would be produced?
- How much of the material would be suitable for merchantable wood products?
- When would it be feasible to recover submerchantable-sized wood and use it for electricity generation?
- How many acres could be treated at no net cost and/or could negative revenues be offset by treating adjacent areas with positive revenues?
- How would a subsidy help?

The nature of the management question determines the direction of analysis. For example, the model can estimate the effectiveness of treating an entire area for the greatest reduction in fire hazard regardless of cost, or alternatively, to estimate effectiveness of a treatment that maximizes revenue and minimizes cutting of larger trees. The different management questions and assumptions behind the analysis lead to quite different results.

Analyses have been conducted for a four-ecoregion area in northern California and western Oregon, and for the entire states of Arizona and New Mexico. These two study areas differ significantly in terms of merchantability and amounts of standing trees, climate, transportation network connectivity, spatial distribution of forest resources, and existing infrastructure for processing both biomass and merchantable-sized wood. However, for both study areas, key assumptions strongly influence analysis results. The extent to which fuel treatments include the harvest of merchantable trees to offset the higher cost of removing small trees significantly affects the area treated. The allowance of treatments that incur net costs (i.e., requiring subsidy) rather than generating net revenues also affects how many acres can be treated.

Model results for the Oregon and California study area indicate that less than half of the forested acres are suitable for treatment due to access, reserved status or a lack of sufficient basal area to apply treatments. On the nearly four million acres that could be effectively treated (out of 17 million acres at risk), treatment costs were high when the harvest of large trees was minimized. If treatments are restricted to areas where they would generate positive net revenue, the potential area for treatment dropped to about two million acres.

Preliminary results for Arizona and New Mexico are somewhat comparable, albeit involving quite different treatments and hazard and effectiveness criteria. About 5.5 million acres can be treated effectively for a net cost of about three billion dollars. When imposing the positive net revenue criterion, the effectively treated area dropped under a million acres, with a net revenue of around $300 million. In this case, introducing a subsidy that would ensure treatment where costs run as high as $200 per acre (after accounting for revenues from selling harvested wood) resulted in doubling the treated area.

In both cases, these results represent upper-bound estimates and depend on the willingness of private landowners and agency managers to use cost-minimizing, fuel treatment-inspired prescriptions rather than profit-maximizing treatments. The driving factors of high treatment costs are relatively low product values, particularly for dirty chips. Maximizing the area treated leads to net costs rather than revenues, even before considering the cost of transporting harvested materials and even when relying on the use of the most cost-efficient prescription for each acre treated. Transportation costs account for about a third of the total cost when considering treatable acres. These costs are simulated using a representation of the real road network that accounts for varying speeds and the often circuitous routing required to move material to a mill. If the haul cost to the processing site is calculated as a crow flies, cost estimates drop to only half of the real road value. A railroad transportation option in Arizona and New Mexico reduced net costs there by 20 percent over a road-only transportation system.

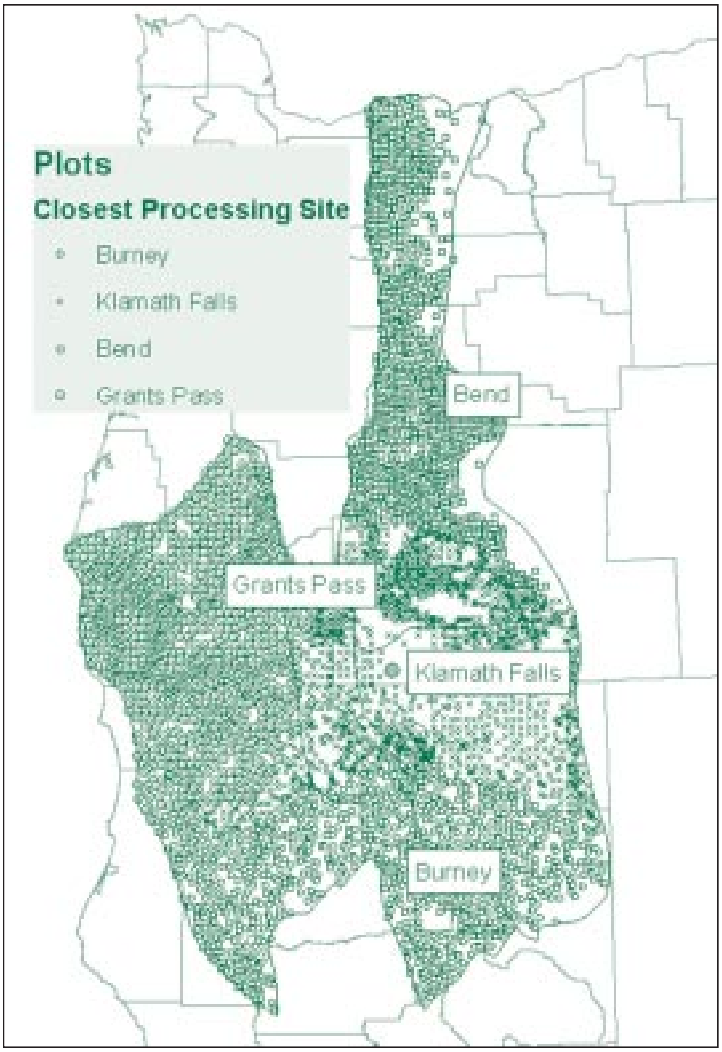

Figure 1. Locations of FIA field plots and potential processing sites (large circles) for wood and dirty chips. Field plots are attributed by the processing site to which they are closest in haul-cost space.

With four well-distributed processing sites in western Oregon and northern California (see figure 1) and six in Arizona and New Mexico, some of the treatable areas were still too far away from the processing sites to feasibly transport dirty chips, because the expected haul cost would be greater than the expected value of the material. One apparent solution might be to simply create more processing sites, yet even for the best of the limited number of sites included in the model to date, available material, without subsidy, would be exhausted in less than 10 years depending on study area and location, and in less than 20 years with considerable subsidy. Another option would be to treat the small-diameter material, from which dirty chips are derived, at the landing. The new technology of air curtain destructor burners that consume the material while generating very little smoke is being used more frequently and costs about the same as chipping the material, but avoids the costs of transport out of the woods.

One key finding from BioSum modeling efforts is that the extent of the fuel treatment challenge is, in some ways, much smaller than some of the area estimates that have circulated in the policy arena. Although most of the forest in the areas studied is currently in a condition of high fire hazard, less than half of this area is accessible and effectively treatable by silvicultural prescription, and only a fraction of this can be treated at no net cost. In both study areas, federal land comprises by far most of the area that could potentially benefit from fuel treatments, while private lands account for 50-90 percent of the treatable acres in the wildland-urban interface. These findings have important policy implications if the wildland-urban interface remains a high priority for fuel treatment.

If fire hazard reduction is to occur at anything approaching a landscape scale, a diverse range of treatments will likely be considered. Where high costs limit mechanical thinning of ladder and crown fuels, as they do in much of the study area considered here, prescribed fire may be a viable option. A range of funding and incentive mechanisms may be employed to expand the area treated beyond what would be treated if treatments had to pay for themselves, from selling harvested timber to stewardship contracting to direct subsidies in some cases. Besides being unrealistic, requiring that all fuel treatments pay for themselves may well be short-sighted—especially given the potentially significant benefits such treatments may produce in the form of reduced fire hazard and firefighting costs over the broader landscape.

Work is needed to develop reliable economic approaches that can be used to estimate likely reductions in firefighting costs, property losses and the depressive effects of fire on recreation, tourism and timber revenues that could be attributable to fuel treatments. It is quite possible that costs and losses avoided may well justify wider deployment of fuel treatments. ◆

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