

Improving Forest Vegetation Simulator (FVS) Estimates of Logging Residues

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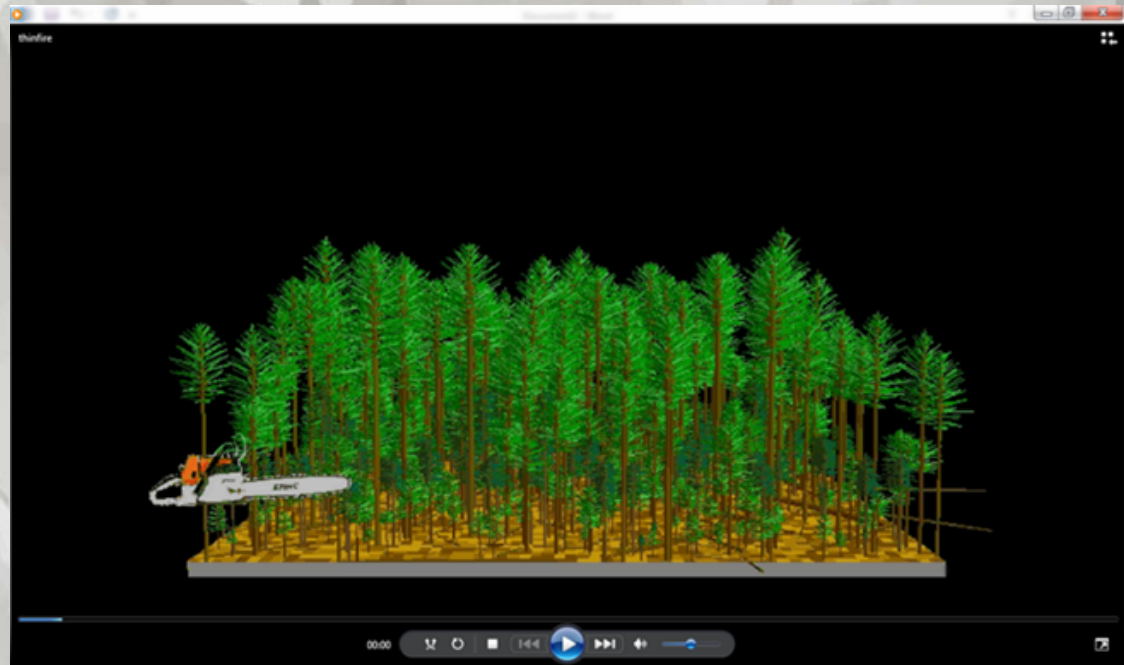
The need: Land managers seek to characterize changes in post-logging woody residue through time

- **Residue info. uses**
 - **Biomass for energy production**
 - **Nutrient recycling**
 - **Carbon dynamics**
 - **Fuels management**
 - **Fire behavior**
 - **Wildlife habitat**
 - **Operational efficiency**



Land managers can predict changes in forest residues with the Forest Vegetation Simulator (FVS)

- FVS dovetails with a litany of post processors, extensions, and fuels and fire prediction tools.
- FVS is supported by full time staff.



Changes in forest residues can be modeled in FVS with the YARDLOSS keyword

- YARDLOSS parameters:
 - Cut stems left in the stand
 - Left stems that are down
 - Branch wood left in stand

Base FVS system: YardLoss

Name: Base FVS system: YardLoss

Schedule by Year/Cycle Schedule by Condition

2014 Select Year 0 years after Condition is met

Proportion of cut stems left in the stand. 0.

Proportion of left stems that are down. 0.

Proportion of branchwood left from removed stems. 1.

Description:

YardLoss allows the user to designate a portion of a harvest to be left in the woods. It is used in conjunction with the Fire and Fuels Extension to compute fuel loadings and dead tree statistics.

You create a YardLoss keyword followed by a Thin keyword or management action. The YardLoss applies to "cuts" that follow and are scheduled for the same year.

Using this keyword, you change the model's assumptions regarding the amount of "cut" that is left in the stand. For example, if you specify that all of the cut stems are left, then the cut trees will be removed from the live tree list, those trees will be reported as "removed trees", and "removed total volume", but they will not count as "removed merchantable volume".

Of trees that are not removed, you can specify the proportion that are felled. If none are felled, then the trees are deemed snags. Therefore, you can create snags by "cutting" trees, leaving them in the stand, and then specifying that they are not "down".

You can control the proportion of branchwood that is left in the stand. This crown biomass becomes fine fuel for the Fire and Fuels Extension.

Ok Use Editor Reset Cancel

The problem: how can land managers estimate the proportion of cut stems that are not removed from the stand during logging?

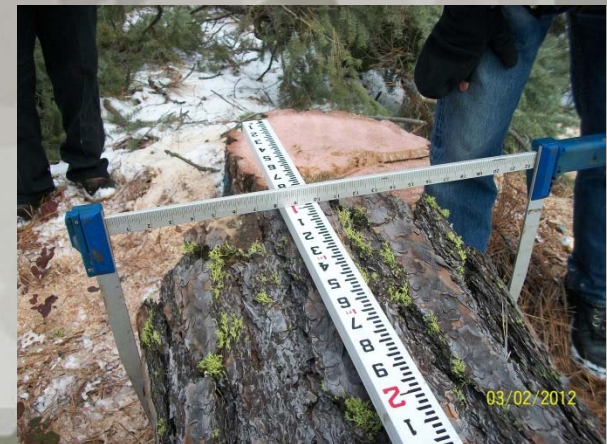
- Rule of thumb, e.g. 5 percent
- Published literature guides
- Previous experience
- Ignore residues in FVS
- But most estimates of cut stems not removed are based on anecdotal information and **could be in error and bias FVS projections; could create problems with carbon dynamics, fuels management, and fire behavior predictions!**



One solution to obtaining sound estimates of trees not removed during logging: logging utilization research results

- Logging utilization research characterizes changes in growing stock; discriminates between residue versus mill delivered volumes
- Based on measurements of sample felled trees on active “green harvest” logging sites
- Nuances of residue versus mill delivered volumes are a function of the cutting card supplied by the logger

Logging utilization research results can give FVS users sound estimates of logging residues



The tie between FVS and logging utilization research:

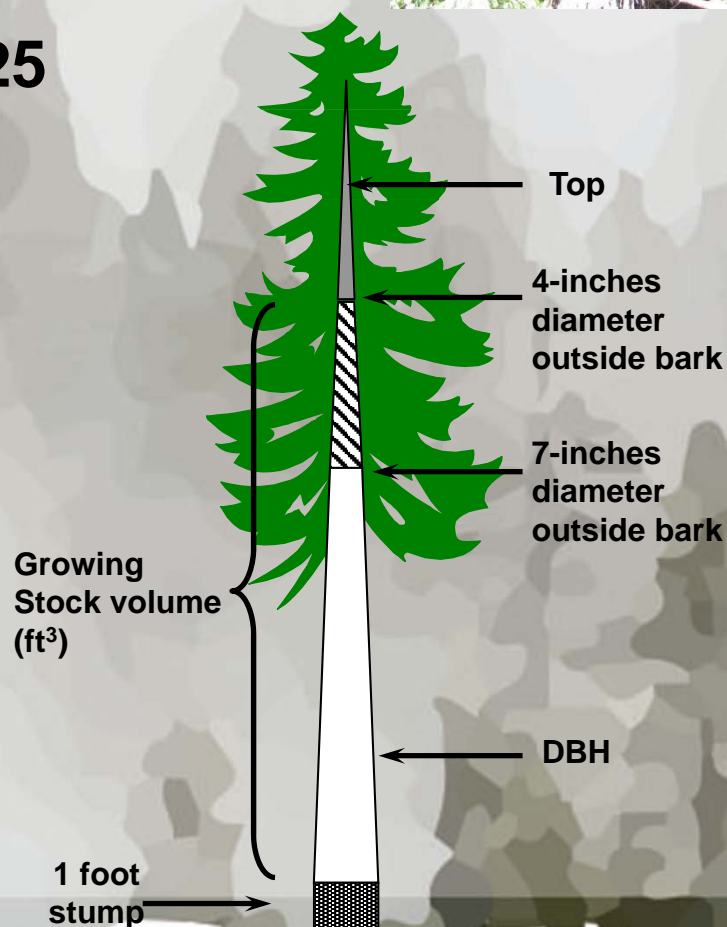
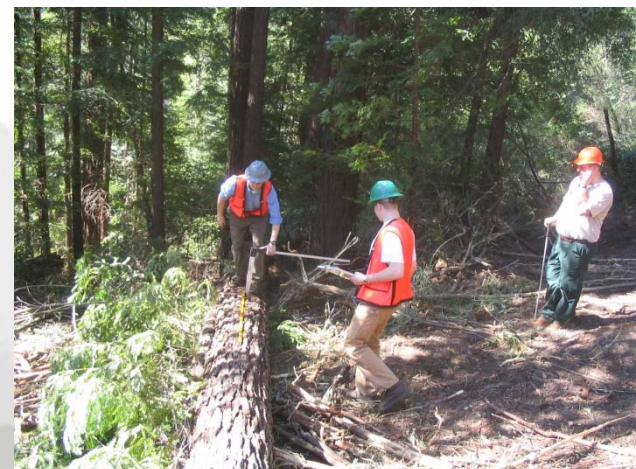
Models developed with logging utilization sample data that predict residues as a function of simple, easily obtained variables

- FVS leverages logging utilization research results by providing top and limb data, and a variety of biomass and volume equations



Methods

- Focus initial modeling efforts on Idaho: data from 815 felled green trees across 33 logging sites during 2008 and 2011 (25 trees per site)
- Tree measurements: outside bark diameter and section lengths \leq 16 feet
- Identify growing stock residue vs. mill delivered volume (cubic feet)



Methods

- The response variable is the ratio “F3”
- F3 is a function of only *bole wood*.
- F3 is *scalable*; beneficial for land managers.



***F3, the “growing stock
residue factor”***



**Growing stock logging residue
cubic foot volume (bole wood only)**



Delivered cubic foot volume

Methods

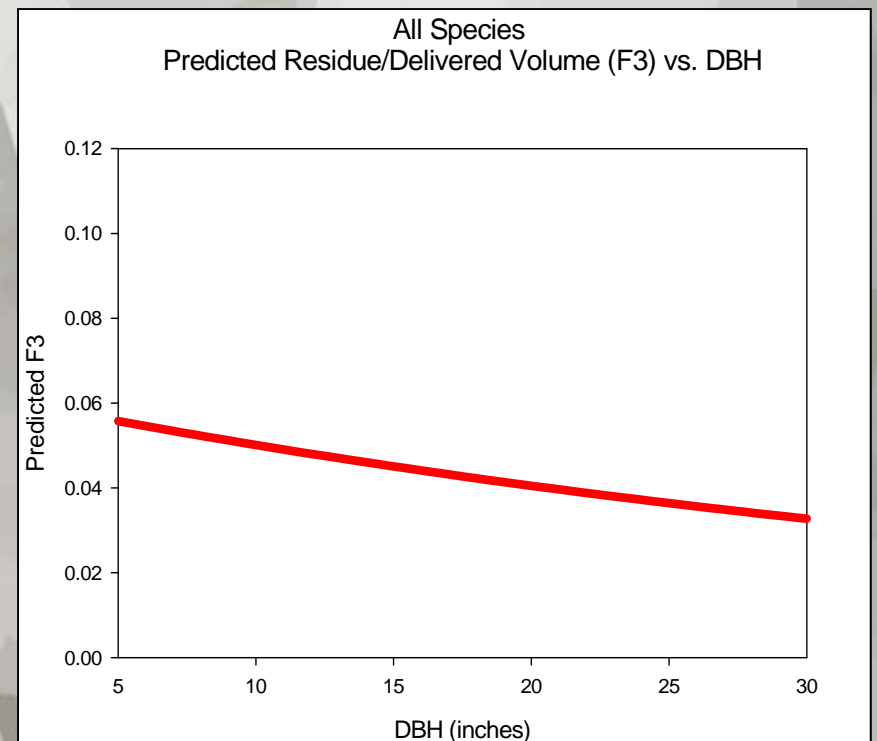
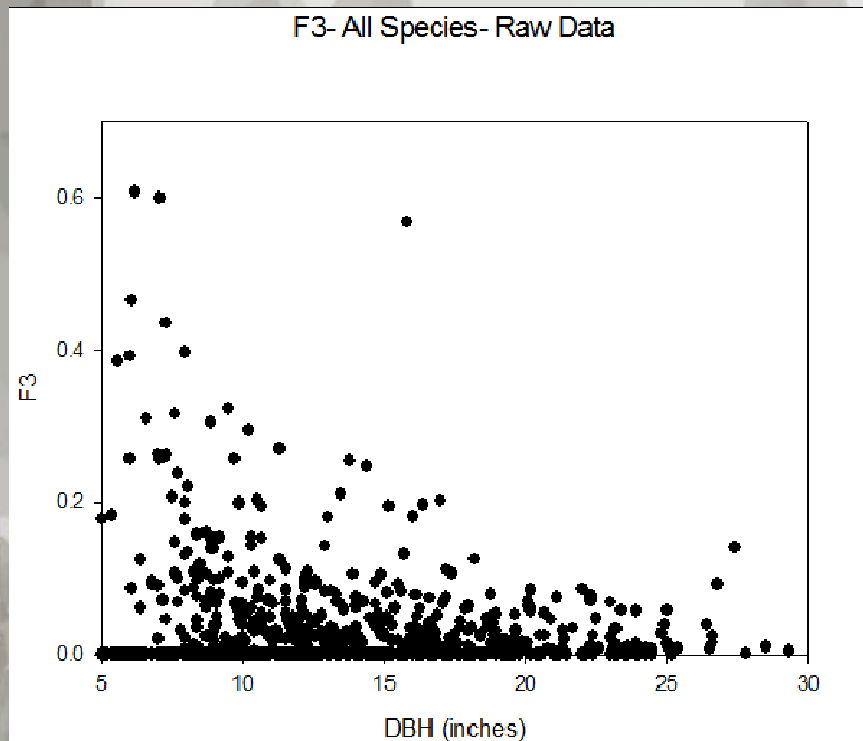
- **F3 modeled with hierarchical (trees nested within sites) mixed models.**

(based on 815 trees sampled within 33 Idaho sites)



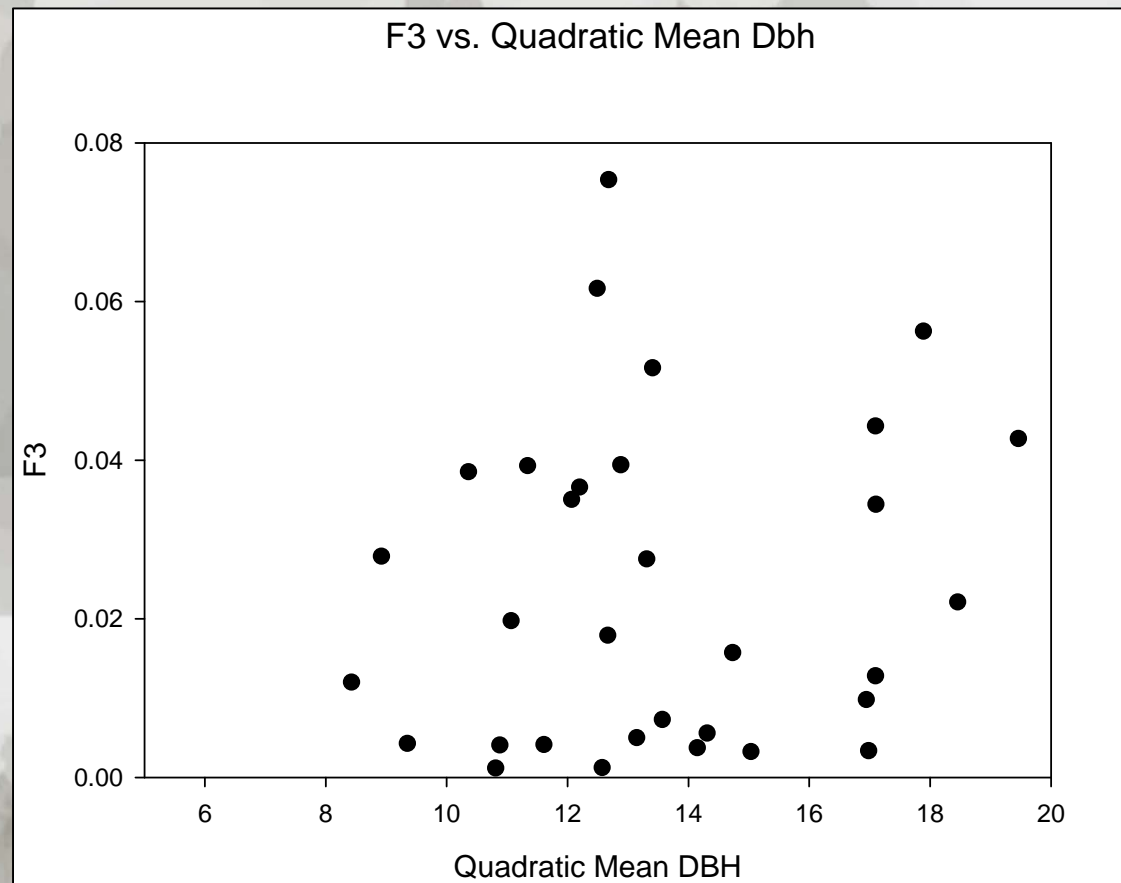
Analysis

DBH is an important variable, but problematic:



Analysis

- Quadratic mean dbh- *WEAKLY* related to F3!



Analysis

Important variable:

- Falling method- Mechanized vs. by hand (chainsaw).

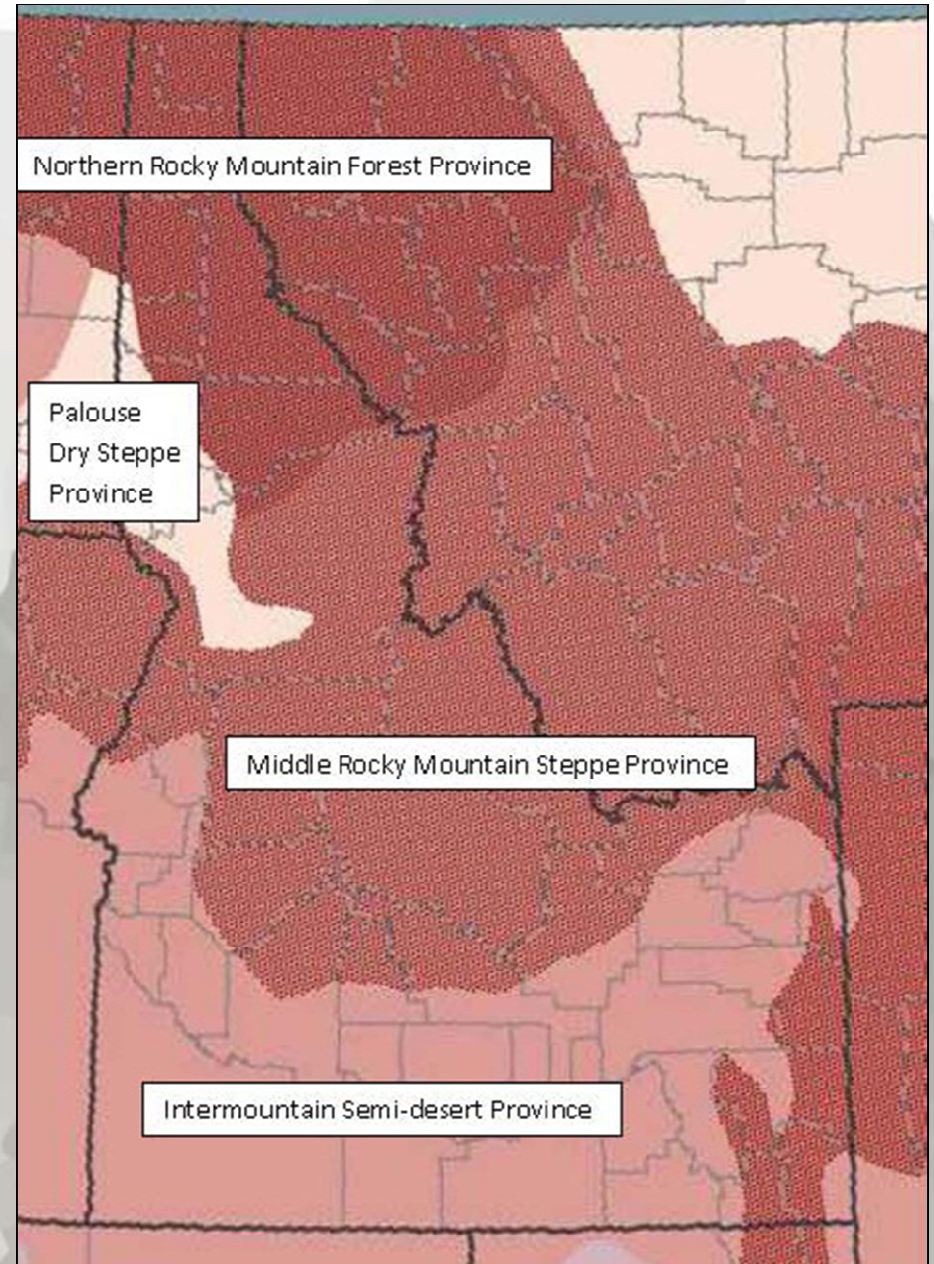


Analysis

Important variable:

Site quality

- Bailey's Ecoregion Province-moderately related to F3.

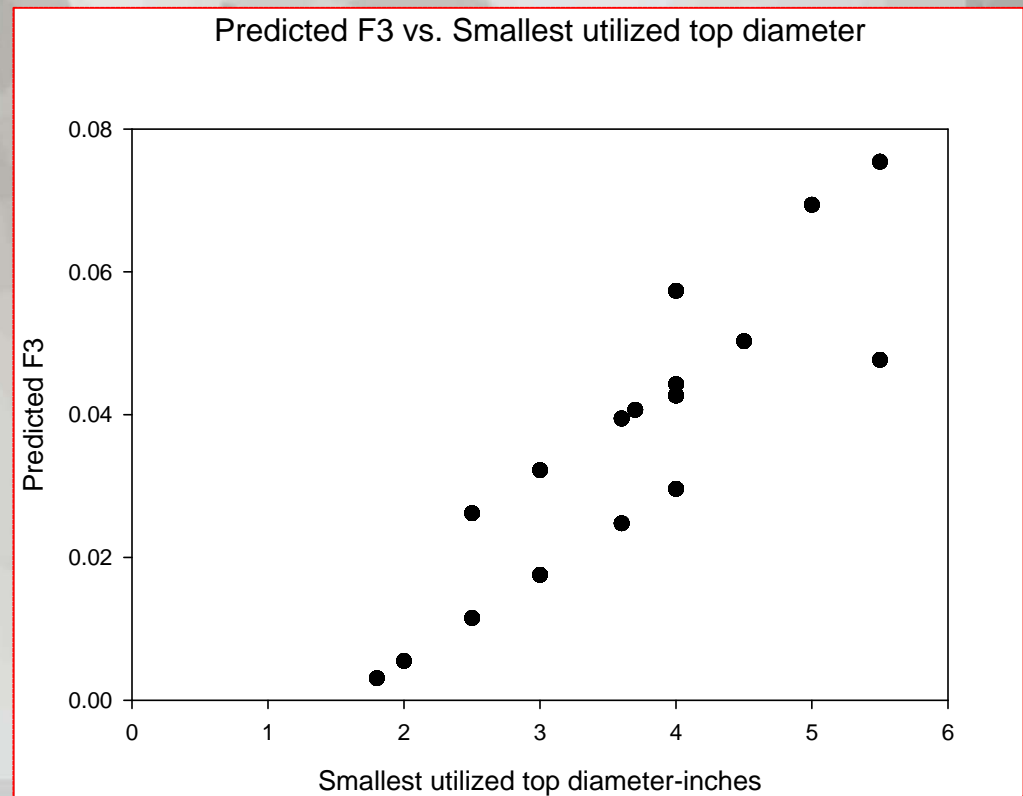
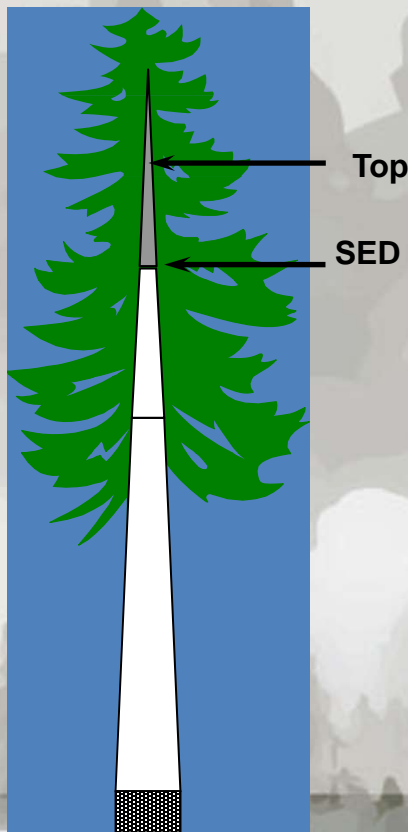


Analysis

Important variable:

Smallest utilized top diameter (SED)

- Has an *enormous* impact on F3!
- Substitute variable: taking pulp- yes or no.



Results- model variables

| Variable | Change in F3 (residue/delivered volume) |
|-----------------------------------------------------------------------------|------------------------------------------------------------------------|
| Mechanical harvesting - yes or no | F3 decreases when timber is mechanically felled (e.g. feller buncher). |
| Smallest utilized top diameter (SED) (can substitute taking pulp) | F3 <i>substantially</i> decreases when SED is small |
| Ecoregion - north or southern Idaho | F3 decreases in north Idaho. |

Incorporating logging utilization results in FVS

- Use research results in YARDLOSS:
 - Proportion of cut stems left in the stand: use predicted F3; e.g. .01
 - Proportion of left stems that are down: 1.0 for logging util.; but remember snag management!

The screenshot shows the 'Base FVS system: YardLoss' window. The title bar reads 'Base FVS system: YardLoss'. Below the title bar, there is a 'Name:' field containing 'Base FVS system: YardLoss'. The main interface has two radio buttons: 'Schedule by Year/Cycle' (selected) and 'Schedule by Condition'. Below these, there is a '2014' field with a 'Select Year' button, a '0' field with 'years after', a 'Condition' button, and 'is met'. There are three horizontal sliders with numerical input boxes on the right. The first slider is labeled 'Proportion of cut stems left in the stand.' and has a value of '0.'. The second slider is labeled 'Proportion of left stems that are down.' and has a value of '0.'. The third slider is labeled 'Proportion of branchwood left from removed stems.' and has a value of '1.'.

Incorporating logging utilization results in FVS

- **FVS/YARDLOSS users will need to know small end utilized diameter; if timber will be mechanically felled, e.g. feller buncher vs. by hand; and the geographic region where the stand is located to implement this protocol.**
- **Don't know variable values? SUPPOSE will include defaults.**



.01 residue; clearcut

***** FIRE MODEL VERSION 1.0 *****
ALL FUELS REPORT

STAND ID: 01160805050006

MGMT ID: NONE

| YEAR | SURFACE FUEL (TONS/ACRE) | | | | | | | ESTIMATED FUEL LOADINGS | | | | | STANDING WOOD (TONS/ACRE) | | | TOTAL BIOMASS | TOTAL BIOMASS CONS | BIOMASS REMOVED | |
|------|--------------------------|------|------|-----|------|-------|------|-------------------------|-------|------------|------|-----|---------------------------|------|-------|---------------|--------------------|-----------------|-----|
| | DEAD FUEL | | | | | | | LIVE | | SURF TOTAL | DEAD | | LIVE | | TOTAL | | | | |
| | LITT. | DUFF | 0-3" | >3" | 3-6" | 6-12" | >12" | HERB | SHRUB | | 0-3" | >3" | FOL | 0-3" | | | | | >3" |
| 2014 | 1.22 | 1.5 | 6.5 | 7.9 | 0.6 | 0.7 | 6.5 | 0.40 | 2.00 | 19.5 | 0.32 | 4.1 | 0.0 | 0.0 | 0 | 4 | 24 | 0 | 60 |

.07 residue; clearcut

***** FIRE MODEL VERSION 1.0 *****
ALL FUELS REPORT

STAND ID: 01160805050006

MGMT ID: NONE

| YEAR | SURFACE FUEL (TONS/ACRE) | | | | | | | ESTIMATED FUEL LOADINGS | | | | | STANDING WOOD (TONS/ACRE) | | | TOTAL BIOMASS | TOTAL BIOMASS CONS | BIOMASS REMOVED | |
|------|--------------------------|------|------|------|------|-------|------|-------------------------|-------|------------|------|-----|---------------------------|------|-------|---------------|--------------------|-----------------|-----|
| | DEAD FUEL | | | | | | | LIVE | | SURF TOTAL | DEAD | | LIVE | | TOTAL | | | | |
| | LITT. | DUFF | 0-3" | >3" | 3-6" | 6-12" | >12" | HERB | SHRUB | | 0-3" | >3" | FOL | 0-3" | | | | | >3" |
| 2014 | 1.25 | 1.5 | 6.8 | 11.1 | 0.9 | 1.9 | 8.3 | 0.40 | 2.00 | 23.0 | 0.32 | 4.1 | 0.0 | 0.0 | 0 | 4 | 27 | 0 | 57 |

A few caveats...

- Remember total stand dynamics, including snag management!
- Logging utilization research characterizes only green tree harvest; does not include salvage sales with dead timber, pre-commercial thinnings or other non-commercial cuttings.
- Logging utilization results will be incorporated in SUPPOSE, not in the “guts” of the FVS source code.
- This procedure is currently not available for use in FVS, but coming soon!



In summary

- **Changes in residue loadings create significant and cascading changes in fire behavior, carbon dynamics, etc. Don't ignore residues!**
- **Logging utilization research offers FVS users a defensible means to estimate post-logging residues.**
- **FVS leverages logging utilization research results by providing top and limb data and a variety of biomass and volume equations, extensions, and post-processors**

