

Supplementary material

Cost-effective fuel treatment planning: a theoretical justification and case study

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Appendix 1: supplementary methods

Section 1: Averted biomass loss

The averted biomass loss criteria takes Landfire existing vegetation type (EVT) spatial data and determines the FCCS-derived biomass (Ottmar *et al.* 2007) in six pools and the CONSUME-derived percent consumption (Ottmar 2014) of each pool given modeled flame heights (conditional flame length – CFL). This process can model the expected loss without treatment, or the expected loss given a treatment scenario. In this paper we model ‘no treatment’ and ‘all stands treated’ scenarios to determine the expected marginal loss of biomass at the stand level as a benefit criterion for use in the fuel treatment prioritization scenarios. The objective of each scenario is to maximize the averted loss of biomass (the different between ‘no treat’ and ‘all treated’). The same mode is then used for each fuel treatment scenario to determine the amount of biomass loss averted.

As an example using the first row of table S1, a Landfire EVT type #2035 (North Pacific Dry Douglass fir Forest and Woodland) is equivalent to FCCS ID #2 (Western hemlock – Western redcedar – Douglas fir forest), which contains the biomass values in columns F-K, and each pool is consumed by the fractions in columns O-T according to the relationship in table A1, below. Therefore, if a fire with a CFL of 2m occurred in EVT type 2035 (row 3 table S1), the fire would consume the Ground, Non-woody (NW), Lichen-litter-moss (LLM), Woody, and Shrubs pools of biomass according to the consumption fraction for each pool in table S1.

Table A1: For biomass consumption based on conditional flame lengths, we consumed pools for each type of fire according to this table and the biomass amounts and consumption percentages in table S1. This table is from Agee (1996) and partly based on Rothermel (1983).

Fireline intensity (kWm ⁻¹)	Flame length (m)	Interpretation of fire	Pools consumed according to CONSUME
0-258	0-1	Surface	Ground, Non-woody, Litter-Lichen-Moss, Woody, shrubs
258-2800	1-3	Understory	Ground, Non-woody, Litter-Lichen-Moss, Woody, Shrubs
>2800	>3	Crown	Ground, Non-woody, Litter-Lichen-Moss, Woody, Shrubs, Canopy

Section 2: Fuel treatment costs

These steps apply to running fuels treatments through FVS and MyFTP programs, to generate a surface of expected fuel treatment costs that are reflective of on the ground stand conditions. Input data are a FVS-ready tree list, a FVS treatment type, values for cost of treating fuels, mill prices and various distances used for determining costs.

Forest Vegetation Simulator (FVS)

(the Essential FVS user's guide can be viewed and downloaded [here](#), file names and paths will be different in each case)

- After installing FVS/Suppose (with the Southern Oregon (SO) variant) place the tree list database (Deschutes.mdb) file in C:\FVSDData
- Edit the Suppose Shortcut properties to Start in: C:\FVSDData (this will tell Suppose where your *.key and Suppose.loc files are located)
- Open Suppose
 - Select Stands, Groups, and pick which stands you are modeling in the right-most window
- Highlight the Group 'All_Stands'
- Select Time Scale
 - Common starting year = 2008 (this is the most recent year we have stand exam inventory)
 - Common cycle length = 10 years (this will model growth every ten years)
 - Common ending year = 2018 (models stands for just one cycle, allows you to inspect the output one year after cutting trees to check if they were cut)
- Select Outputs
 - Base FVS Treelists
 - Build Standard Treelist and Cutlist
 - uncheck Build Treelist
 - Click OK
- Add Keywords (this is also where you will add the management action; it can also be achieved under Select Management as well)
 - Type thinbta next to Select Keyword and click Accept
 - Schedule by year = 2008
 - Residual trees per acre = 100
 - Smallest DBH to be considered for removal = 1
 - Largest DBH to be considered for removal = 18
 - Click OK
- Run Simulation
 - Save the *.key file for this run, when you want to remodel this stand Suppose will look for this *.key file (you will be prompted to resave this file when any subsequent changes are made)
- After FVS is done, there will be a cutlist (*.trl) in the same directory as the *.key file

R script: run this script (Supplementary 2) to preprocess the cutlist data so it can be used in MyFTP. The output of FVS contains too many rows (likely) for input into MyFTP.

- Open the file in S2 “Forest2.R” to turn the cutlist into a condensed MS Excel file readable by MyFTP
- Follow prompt and comments within the “Forest2.R” file

MyFTP (the MyFTP User’s Guide can be viewed and downloaded [here](#))

- Open MyFTP and enable Macros, if prompted)
- Navigation within MyFTP is achieved via Add-Ins, MyFTP Navigation
- MyFTP was designed to populate the various workbooks in order they appear in the Navigation bar
- Rules workbook
 - Scenario data
 - Enter variables specific for the planning unit
 - State, county, size, slope, elevation, etc.
 - Name the scenario whatever the planning unit is called
 - Rules (this needs to occur prior to importing the batch file (cutlist))
 - Log rules - Enter cutoff sizes for each spp. of log to be utilized (XC can be used for all conifers if the rules are the same for each)
 - Chips rules - enter cutoff sizes for each spp. (XC and XH can be used for all conifers and all hardwoods if the rules are the same for each)
- Enter Cut Tree Data
 - Under Batch File Tree Entry click on Step 2b: Select Batch File for Processing and choose the appropriate inventory file for the planning unit.
 - After the import check the Error_file.xls workbook for problems
- Harvesting Costs
 - Enter the Yarding distance (~.25 miles and it is the max length for cable systems, some will be shorter and other likely will be longer)
 - MoveInDist – generate in ArcMap or estimate for planning unit
 - Used Mechanical whole tree as the Harvest Process
- Hauling Costs
 - Calculated using the hauling distances from planning unit center to the local mill and generated in ArcMap and the default rates.
- Mastication (this will include unutilized activity fuels from the thinning, via the FVS cutlist, and any pretreatment surface fuels entered on the Rules workbook)
- Mechanical Treatments
 - The Fire Regime and Region defaults are correct
- Prescribed Fire
 - Defaults are correct for Fuel Model (11 = logging slash) and USFS region
 - Check the WUI box for the units close to towns (not used in this example).
- Log / Chip Prices

- Determine log/chip prices from a local mill. Values used - Log/chip prices page: Log prices per MBF table (all tree types set to 4 SED and \$310 price/MBF), chip prices (\$12 per dry ton for dirty chips, \$62 per dry ton for clean chips)

Literature cited:

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- Rothermel, R (1983) How to predict the spread and intensity of wildfires. USDA Forest Service Gen. Tech. Rep. No. INT-143.