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Carlin Starrs <carlinstarrs@berkeley.edu>

Fire resistance score calculation (and fire hazard score calculation)

12 messages

Fried, Jeremy - FS <jsfried@fs.fed.us> Thu, Jan 4, 2018 at 6:14 PM
To: "carlinstarrs@berkeley.edu" <carlinstarrs@berkeley.edu>

Carlin and Sara,

There are 4 metrics calculated in various ways, then classed into subscores as follows:

SubScore	Canopy Bulk Density (kg/m3)	Target Canopy Base Height (feet)	Percent Basal area (ft^2/acre) of Resistant Species	Percent Volume (ft^2/acre) Left Alive
0	> 0.15	≤ 7	≤ 25	≤ 2
1	0.11 to 0.15	7 to 20	25 to 50	2 to 30
2	0.051 to 0.10	20 to 30	50 to 75	30 to 75
3	≤ 0.05	> 30	75 to 100	> 75

For each metric, you will want to convert the PRE and POST values to PRE and POST subscores for each cycle. In your project, I believe that the PRE years associated with each cycle are: 1, 11, 21 and 31 and those associated with the POST are 2, 12, 22 and 32. The values for the 4 subscores at each year (pre and post) will be summed to generate a fire resistance score (FRS) that ranges from 0-12. You will ultimately calculate a weighted combination of these values for the package and for the grow-only silvicultural sequence (which we are generically referring to as we move forward with the revisions to core analysis as the “reference sequence”). Let’s assume a 35 year analysis period that ranges from year 2 to year 36 (inclusive). The weights to apply then, for both a given silvicultural sequence and the reference sequence are:

Cycle	PRE	POST
1	0	5/35
2	5/35	5/35
3	5/35	5/35
4	5/35	5/35

I’ve deliberately omitted PRE for cycle 1 because in a weighted mean comparison to a reference sequence, we really don’t care about it—since it is the same value for all sequences including the reference sequence.

Or, if you can calculate a regular unweighted average of all 8 PRE and POST values but exclude the PRE for Cycle 1, that would give you the same result as the weighted calculation, e.g., 1/7*POST1 + 1/7*PRE2 +1/7*POST2 + 1/7*PRE3

etc.

Canopy bulk density can be found in PRE_FVS_POTFIRE and POST_FVS_POTFIRE tables in the PREPOST_FVS_POTFIRE database as Canopy_Density. Recode, using the above table, to a subscore, and you are good to go on this, the easiest of the metrics.

Target canopy base height is a bit trickier, as you perhaps read in Terrie's documentation. Sara generated some fancy code in the FTCE East PREPOST_FVS_STRCLASS database at this location: https://usfs.box.com/s/b0b5yr67d42p1ipmu80brc61f1bkhkrx which I believe calculates CBH. See the modules POSTCBH and PRECBH, which depend on the PRE and POST_FVS_STRCLASS tables. I am copying Sara on this to confirm that these scripts should be usable for the CEC data also, and to give her a heads up that you might be firing off a question or two on this. You likely need the POSTCBH1 and PRECBH1 queries in this database also. Once you have CEC for each PRE and POST CYCLE, you'll recode to subscore as above.

Percent Basal Area Resistant Species is already populated (I think) as fraction (rather than a percent) in the PRE and POST_FVS_COMPUTE tables in your PREPOST_COMPUTE database thanks to Sara's code in the KCP used to model these pacakges. It is in PERRESBA and, as I said, is a fraction not a percent, so when applying the recode table above, the tests would be <0.25 or between .25 and .50, etc.

The Percent Volume Left Alive (as described in the above table), **or SurvVolRatio**, if you prefer, was the metric that you calculated exogenously to FVS using queries or scripts or something. I believe that it is in your CEC project's PREPOST_SUMMARY database in the PRE and POST_FVS_SUMMARY tables in the 4th from the last column as SurvVolRatio. HOWEVER, I note that the value is missing in an awful lot of rows which leads me to think that there are cases where your scripts still need to be run or there is some other issue that needs to be addressed before you convert these to SurvVol subscores. You will want to be certain that you have values for each of the 4 subscores for PRE and POST at each cycle for each stand-treatment combination before moving forward with summing, averaging etc. so as not to end up with corrupted effectiveness data.

Ideally, in order to evaluate sensitivity to metrics, we'll also calculate the FFE based metrics as we have done before for Hazard Score, which is composed of Torch_Index, Ptorch_Sev, Surf_Flame_sev and MortVolPct (which gets calculated as Mortality_Vol_Sev divided by the SUMMARY.TCuFt for the same stand and year), all of which can be found in your PREPOST_FVS_POTFIRE database tables (except the denominator of MortVolPCt which comes from the Summary table). For those, we simply compare them to a threshold and assign a 1 if: <20 mph, >0.20 probability, > 4 feet and >0.30, respectively. If all conditions met, the hazard is level 4, if none, then level 0. A couple of caveats: Sometimes a stand has zero volume (TCuFt) so we would be dividing by zero (a no-no) so we define those has having 0 MortVolPct. Also, sometimes TorchIndex can't be calculated due to a very sparse canopy in which case it is calculated by FFE as -1 or -99 or something unhelpful—you'll need to trap for those cases and define torching index as some large number in that event. Actually, I recommend recoding all torching indices >100 to 101, and then assigning these negative value cases to 102, since anything over 100 is way far from being hazardous on that dimension and the numbers themselves don't mean a lot in that part of the range. In any case, they will code as TI_scores of 0 (not hazardous). Like with FRS, hazard score (HS) is calculated as the sum of 0s and 1s to get something between 0 and 4, and a weighted average can be calculated the same as above for FRS.

At the end of all this you will have:

For FRS

- Raw metrics (e.g., Resistant BA fraction) for each FRS component for PRE and POST for each cycle
- Subscores (0-3) for each component for PRE and POST for each cycle
- FRS PRE and POST for each cycle
- Mean FRS for each package stand combo

Ideally, Mean FRS subscores for each package stand combo

For HS

Raw metrics (e.g., MortVolPct) for each HS component for PRE and POST for each cycle

Subscores (0 or 1) for each component for PRE and POST for each cycle

HS for PRE and POST for each cycle

Mean HS for each package stand combo

Ideally, Mean HS subscores for each package stand combo

This will give us maximum flexibility if we later decide to drop components, weight differently, mix and match elements of HS and FRS, etc.

Please let me know what is unclear or confusing about any of this. I am happy to walk through it with you.

Thanks very much,

Jeremy

Jeremy Fried

Research Forester

Forest Service

Pacific Northwest Research Station, Forest Inventory and Analysis

p: 503-808-2058

jsfried@fs.fed.us

Carlin Starrs <carlinstarrs@berkeley.edu> Wed, Jan 17, 2018 at 1:57 PM
To: "Fried, Jeremy - FS" <jsfried@fs.fed.us>

Here's what the updated FVS_SUMMARY table looks like with what should be all the variables. Does this check out to you? After I re-ran, the only rows missing a survvolratio are Forest Type 999 which I believe is correct?

https://usfs.box.com/s/z9t6e2s9t9psjgqm2wz15mzbu6qr33mq
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Fried, Jeremy - FS <jsfried@fs.fed.us> Wed, Jan 17, 2018 at 3:24 PM
To: Carlin Starrs <carlinstarrs@berkeley.edu>

Having internet problem and have not been able to download. Will try tonight

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<image003.png>

Jeremy Fried

Research Forester

Forest Service

Pacific Northwest Research Station, Forest Inventory and Analysis

p: 503-808-2058

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image003.png
13K

Fried, Jeremy - FS <jsfried@fs.fed.us> Wed, Jan 17, 2018 at 9:34 PM

To: Carlin Starrs <carlinstarrs@berkeley.edu>

Carlin,

Many thanks for putting this together. I do have a number of questions though. We are seeking to end up with the following:

For FRS

Raw metrics (e.g., Resistant BA fraction) for each FRS component for PRE and POST for each cycle.

I see the following in PRE and POST SUMMARY:

PRE_FVS_SUMMARY
PERRESBA
0.077659085392952
PRE_FVS_SUMMARY
Canopy_Density
1.74514781683683E-02
PRE_FVS_SUMMARY
SurvVolRatio
0.834367485490296

However, I am a little confused about CBH. For stand 120050605050150084643000 1 at cycle 1, PRE, I am seeing 29. However, when I look at the structure class table, this stand has three strata, with CBH of 70, 29 and 7 for strata 1, 2 and 3, respectively. Did the script modules in the structure table that I pointed you to produce the choice of 29 as the canopy base height? It surprises me because stratum 3 certainly reaches up into stratum 2 and it has significant canopy cover at 32%. Can you double check this script to be sure it is working correctly? It is possible that it is—I am seeing in Terrie's draft write-up of this metric (Attached) that strata dominated by hardwoods are disregarded in her canopy base height calculation.

What I do not see are the subscores (0-3) for each component. While some of these can be calculated from the raw score, I am not certain that this is the case for canopy base height. Please see the attached to check on that.

I guess the weighted mean FRS and subscores (over the cycles) for each package stand combo remains to be calculated, right?

For Hazard Score

I am seeing the POTIFRE raw attributes (TI, Ptorch_sev, and Surf_Flam_len_sev) over in the POTFIRE tables in this project, so that's good. But I do not see MortVolPct, which needs to be calculated from POTFIRE.MortVol_sev and Summary.TCuFt. While you are at it, I think it would be good to calculate MortVolPct_mod for the _mod version of MortVol as we are learning from the post-fire plots that moderate severity predictions from FFE are a better match to observed fire effects on FIA plots.

Then you will need to calculate subscores for HS (based on thresholds of 20, 20, 4 and 30 for TI, Ptorch, SurfFlame and MortVolPct.

Then weighted mean HS and subscores as above.

You might as well put all of these in the SUMMARY table.

So in short, good progress, you are on the right track, but I'd appreciate a double check on the FRS version of CBH and its subscore, and there is more to be done before we are ready to run core.

I can imagine that a 999 (nonstocked) forest might often have no volume so a denominator of zero, but it would not surprise me if this occasionally happened with other stands also, though perhaps not since we eliminated conditions with CONDPROP<0.25 (the only cases where we rely on field call for forest type vs. the computed forest type which relies on there being some tally trees, so no possibility of zero volume).

We can talk tomorrow if any of this is confusing.

Jeremy

From: Carlin Starrs [mailto:carlinstarrs@berkeley.edu]
Sent: Wednesday, January 17, 2018 1:57 PM
To: Fried, Jeremy - FS <jsfried@fs.fed.us>
Subject: Re: Fire resistance score calculation (and fire hazard score calculation)

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Metrics.docx
15K

Carlin Starrs <carlinstarrs@berkeley.edu> Thu, Jan 18, 2018 at 10:11 AM
To: "Fried, Jeremy - FS" <jsfried@fs.fed.us>

Yes, I just wanted to make sure I had the right data pulled in in the right spots before doing the score calculations. I will dive into Sara's script more; I'm not super familiar with VBA or SQL but I can probably figure it out well enough.

We already calculated MortVol in FVS_Summary. Is that not what you wanted? Or are you referring to a different MortVol? This is how all those were calculated:

Vol = TCuFt * TPA

SuvVol = (1 - MORTRATE) * TCuFt * TPA
(mortrate was the value from the ALL_VARIANT_MORTALITY spreadsheet from Terrie's FOFEM stuff if I recall)

SurvVolRatio = SurvVol/Vol (unless Vol was 0 in which case SurvVolRatio was set to 1; my understanding is this would be the Percent Volume Left Alive in your above table)

MortVol = Vol - SurVol

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ALL VARIANT_MORTALITY 2 TO 8FTFL.csv
47K

Carlin Starrs <carlinstarrs@berkeley.edu> Thu, Jan 18, 2018 at 12:15 PM
To: "Fried, Jeremy - FS" <jsfried@fs.fed.us>

For STRCLASS:

The KCP files have the following parameters:

StrClass 1 30. 5. 25. 5. 200. 30.

1 = Print the table
30 = % of tree's height that is used to define the minimum gap size
5 = DBH boundary separating seedling/sapling size trees from pole sized trees
25 = DBH boundary separating poles from large trees
5 = Minimum % cover that must be exceeded for a potential stratum to qualify as an actual stratum
200 = Minimum TPA that must be exceeded for a stand that has less than 5% cover to be classified as stand initiation rather than bare ground
30 = % of maximum stand density index that must be exceeded for a stand to be classified stem exclusion rather than stand initiation

From Essential FVS:

The Structural Statistics Table (figure 4-5) (Crookston and Stage 1999) displays a description of the number of valid strata, percent canopy cover, and structural class for the stand. Included for each stratum are: the nominal diameter and height, the heights of the tallest and shortest trees, the crown base height, percent canopy cover, major species, and a code indicating if the stratum is invalid, valid, or the uppermost valid stratum.

If a stratum is not considered valid (based on the status code value; it looks like anything > 0 qualifies), it is not included in the Number_of_Strata total.

So Sara's script takes the Number of Strata value and sets CBH equal to the Crown Base value for that stratum, i.e. if there are 2 strata, CBH is set to the Stratum_2_Crown_Base value.

Then it calculates cbhdist. In this case, it takes the Number of Strata value, and subtracts the Stratum below's Crown Base value and subtracts the Stratum Above's Nom Ht value, i.e. if Number of Strata = 2, cbhdist = Stratum_1_Crown_Base - Stratum_2_Nom_Ht

Then it does the scoring, which follows a series of rules based Number of Strata, cbhdist, and CBH. For example:

Score = 0 if cbhdist <= 7 or CBH <= 7

Score = 1 if 20 <= cbhdist > 7 or 20<= CBH > 7
etc. If there is only 1 valid strata cbhdist will be NULL so it uses CBH only.

For stand 120050605050150084643000l rxpackage 001 rxcycle 1 in NC:

Stratum_1_Status_Code = 2 (stem exclusion)
Stratum _2_Status_Code = 0 (bare ground; this is likely because Stratum_2_Crown_Cover < 5, and based on the StrClass parameters that is below the minimum % cover that must be exceeded for a potential stratum to qualify as an actual stratum)
Stratum_3_Status_Code = 1 (stand initiation)

That makes Number_of_Strata = 2

As per Sara's script, 2 Strata means CBH will be set to the Stratum_2_Crown_Base value, which is 29.

cbhdist will be Stratum_1_Crown_base - Stratum_2_Nom_Ht, which is 70-114 = -44.

The score for 2 Strata will then be calculated based on either CBH or cbhdist. CBH is < 30, so it gets a score of 2.

Does that help?
[Quoted text hidden]

Fried, Jeremy - FS <jsfried@fs.fed.us> Thu, Jan 18, 2018 at 12:33 PM
To: Carlin Starrs <carlinstarrs@berkeley.edu>, "Jain, Terrie -FS" <tjain@fs.fed.us>, Sara Loreno <sloreno@ecotrust.org>

See GREEN CAPS below. Terrie, please weigh in on this.

From: Carlin Starrs [mailto:carlinstarrs@berkeley.edu]
Sent: Thursday, January 18, 2018 12:16 PM
To: Fried, Jeremy - FS <jsfried@fs.fed.us>
Subject: Re: Fire resistance score calculation (and fire hazard score calculation)

For STRCLASS:

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I AM CONCERNED AS TO WHETHER THIS SCRIPT OPERATES AS INTENDED. IF STRATUM 2 IS NOT A VALID STRATUM (BASED ON STATUS_CODE=0) IT DEFIES LOGIC THAT WE WOULD CALCLATE OUR METRICS FROM IT (WHETHER DISTANCE OR CBH). TERRIE—IS THIS WHAT YOU INTENDED?

cbhdist will be Stratum_1_Crown_base - Stratum_2_Nom_Ht, which is 70-114 = -44.

The score for 2 Strata will then be calculated based on either CBH or cbhdist. CBH is < 30, so it gets a score of 2.

Does that help?

Helps immensely. But raises questions. Thanks for such a clear response!

[Quoted text hidden]

Jain, Terrie -FS <tjain@fs.fed.us> Thu, Jan 18, 2018 at 12:50 PM
To: "Fried, Jeremy - FS" <jsfried@fs.fed.us>, Carlin Starrs <carlinstarrs@berkeley.edu>, Sara Loreno <sloreno@ecotrust.org>

If I recall and based on my notes: strata code = 0 then the total number of strata does not count that in the total number of strata; we used total number of strata to determine which specific stories we would include when developing the target canopy base height.

Make sense?

tj

From: Fried, Jeremy - FS
Sent: Thursday, January 18, 2018 12:34 PM
To: Carlin Starrs <carlinstarrs@berkeley.edu>; Jain, Terrie -FS <tjain@fs.fed.us>; Sara Loreno <sloreno@ecotrust.org>
Subject: RE: Fire resistance score calculation (and fire hazard score calculation)

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Fried, Jeremy - FS <jsfried@fs.fed.us> Thu, Jan 18, 2018 at 12:52 PM
To: "Jain, Terrie -FS" <tjain@fs.fed.us>, Carlin Starrs <carlinstarrs@berkeley.edu>, Sara Loreno <sloreno@ecotrust.org>

Not quite. If a stratum drops out due to status code =0, shouldn't the CBH metrics be calculated as if that stratum does not exist (i.e., based on strata 1 and 3 in the case Carlin documented)?

From: Jain, Terrie -FS
Sent: Thursday, January 18, 2018 12:50 PM
To: Fried, Jeremy - FS <jsfried@fs.fed.us>; Carlin Starrs <carlinstarrs@berkeley.edu>; Sara Loreno <sloreno@ecotrust.org>

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Fried, Jeremy - FS <jsfried@fs.fed.us> Thu, Jan 18, 2018 at 3:46 PM
To: Carlin Starrs <carlinstarrs@berkeley.edu>

Carlin,

Terrie and I have concluded that it appears Sara's scripts don't quite work on the CBH calculation. We don't see anything in that case that would indicate that cover is being considered in the assignment of status code 0 to that stratum—or is that happening internally in FVS? Even then, if a stratum zeros out as this one did, it should not be considered in the CBH calculation. In her SAS code, Terrie had put in a test and of stratum status was 0 (actually she

tested for cover, not status code), then she set stratum 2=3 and did the calcs on stratum 1 and the new 2 (recast from 3). Do you have a sense of how to mod Sara's code to do that? I have a call into Sara to discuss this but don't know when she will become available and don't want to hold you up. Is the Access code VBScript? Perhaps one of us can figure out how to modify it, or program Terrie's logic in a different language.

From: Carlin Starrs [mailto:carlinstarrs@berkeley.edu]
Sent: Thursday, January 18, 2018 12:16 PM

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Carlin Starrs <carlinstarrs@berkeley.edu> Thu, Jan 18, 2018 at 4:04 PM
To: "Fried, Jeremy - FS" <jsfried@fs.fed.us>

I can re-do it in R pretty easily, it's not actually a particularly complicated script. The status code is assigned via the FVS StrClass function I noted in my email. I'll re-paste below:

The KCP files have the following parameters:

StrClass 1 30. 5. 25. 5. 200. 30.

1 = Print the table
30 = % of tree's height that is used to define the minimum gap size
5 = DBH boundary separating seedling/sapling size trees from pole sized trees
25 = DBH boundary separating poles from large trees
5 = Minimum % cover that must be exceeded for a potential stratum to qualify as an actual stratum
200 = Minimum TPA that must be exceeded for a stand that has less than 5% cover to be classified as stand initiation rather than bare ground
30 = % of maximum stand density index that must be exceeded for a stand to be classified stem exclusion rather than stand initiation

If it doesn't pass the minimums it gets status code 0. Or at least that's what I can piece together from the 3 different spots this is incomplete and out of date in the FVS documentation.

Would it make more sense to have it use CBH values only from valid strata? So in the case of the stand we used, it would see number of strata, then look for which strata have status code > 0, and then use those strata to calculate CBH. I suppose that would effectively do the same thing as Terrie's script but without changing names around.
[Quoted text hidden]

Fried, Jeremy - FS <jsfried@fs.fed.us> Thu, Jan 18, 2018 at 5:10 PM
To: Carlin Starrs <carlinstarrs@berkeley.edu>

Sure, that would work. As long as the CBH is calculated as the min of CBH of the lowest height valid stratum and the distance from the top of the lowest height stratum to the base of the next highest valid stratum, if I am understanding Terrie's logic correctly. Sara said she could fix her VB scripts tomorrow and was going to focus on cases of 3 strata with a middle stratum that is invalid, but I found cases in NC of an invalid stratum 1 (due to low cover) with valid stratum 2 and sometimes a valid 3 also, so these may also need special handling.

From: Carlin Starrs [mailto:carlinstarrs@berkeley.edu]
Sent: Thursday, January 18, 2018 4:05 PM

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