

User's Guide for the Mountain Pine Beetle in Lodgepole Pine Risk Rating Event Monitor Addfile (I)¹

Based on Amman et al. 1977

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Introduction

The Mountain Pine Beetle in Lodgepole Pine Risk Rating Event Monitor (EM) Addfile (I) (*mpb_lpp_amman.kcp*) is an FVS **keyword component** file (a *.kcp* file) that calculates a stand's hazard rating based on a system developed by Amman et al. 1977. The system was designed for mountain pine beetle (MPB; *Dendroctonus ponderosae* Hopkins) in lodgepole pine (LPP; *Pinus contorta* var. *latifolia* Engelm) in the Rocky Mountains. It provides a "risk susceptibility score" that ranks the risk of stand to attack by the MPB. This EM addfile does not schedule or perform any activities that affect the simulated stand. It only schedules COMPUTE statements that calculate stand hazard ratings over the duration of the simulation.

Overview

The overall risk rating score is determined by three risk factors:

- elevation/latitude
- average age
- average DBH (of trees greater than 5 inches DBH).

Stands are assigned a risk factor values of 1, 2, or 3, depending upon the stand conditions for each risk factor (Table 1). The three risk factor scores are then multiplied together to arrive at a final "risk susceptibility" score (ranging from 1-27). The EM addfile reports a final numerical rating. It is up to the user to interpret the numerical rating. Amman et al. (1977) interpret the scores as follows:

¹This document is part of a package containing a number of files: (1) this document (*mpb_lpp_amman.pdf*), (2) the MPB in LPP Risk Rating EM Addfile *mpb_lpp_amman.kcp*, (which this document describes), and (3) one or more ArcView® legend file(s) that can be used by the custom ArcView® project FVS-EMAP. The package, a self-extracting WinZip® file (*mpb_lpp_amman.exe*), as well as the FVS-EMAP project software, is available online at:

<http://www.fs.fed.us/foresthealth/technology/products.htm>

For more information, contact: Eric Smith: email: elsmith@fs.fed.us phone: 970 295-5841

If the product of the three scores (risk factor 1 • risk factor 2 • risk factor 3) equals:

- 1-9 the overall risk is considered LOW
- 12-18 the overall risk is considered MODERATE
- 27 the overall risk is considered HIGH

Table 1: Risk factors, and associate risk factor values, of the Amman et al. (1977) risk rating system. The product of the stand’s three risk factor values determines the overall risk rating for a stand.

| RISK FACTOR 1 | RISK VALUE | RISK FACTOR 2 | RISK VALUE | RISK FACTOR 3 | RISK VALUE |
|---------------------|------------|---------------|------------|--------------------------------|------------|
| Elevation /latitude | | Age (yrs) | | Average DBH [†] (in.) | |
| High elev. | 1 | < 60 | 1 | < 7 | 1 |
| Moderate elev. | 2 | 60 - 80 | 2 | 7 – 8 | 2 |
| Low elev. | 3 | > 80 | 3 | > 8 | 3 |

[†]The average DBH is for host trees greater than 5 inches DBH.

The elevational/latitudinal ranking is determined from a hypothesized linear relationship between elevation, latitude, and risk. The following equations were estimated from the graph accompanying the Amman et al. 1977 publication.

If elevation (in feet) is greater than:

$$-444.4 * (\text{latitude [in degrees]}) + 27733.3$$

then the elevational/latitudinal risk factor value equals 1.

If the elevation (in feet) is less than the threshold above but greater than:

$$-444.4 * (\text{latitude}) + 26733.3$$

then the elevational/latitudinal risk factor equals 2.

Otherwise, if the elevation (in feet) is less than the “moderate” threshold, the risk factor value equals 3.

Threshold values for various latitudes (determined from the above formulae, and rounded to the nearest 10 feet) are provided in the Table 2, below. These elevation thresholds (“E_THRESHOLD”s) should be considered as a “first approximation”. Local conditions and local expert opinion may suggest that actual thresholds—separating low risk areas from moderate risk, and moderate risk from high risk—be different than those indicated in the table.

Users must set the elevational thresholds in the addfile (default settings are provided). This procedure is described in the following section (as well as in the EM addfile itself).

Table 2. Elevational thresholds for the Amman et al. (1977) MPB risk rating system derived from the mathematical relationships described above, and rounded to the nearest 10 feet. Users should consider these thresholds as first approximations only. (Users should adjust them to meet local conditions.) “E_THOLD1” and “E_THOLD2” refer to variable names in the EM addfile (*mpb_lpp_amman.kcp*).

| Latitude (degrees N) | Upper Elevation Threshold (in feet) (E_THOLD1) | Lower Elevation Threshold (in feet) (E_THOLD2) |
|-------------------------|------------------------------------------------------|------------------------------------------------------|
| 33 | 13070 | 12070 |
| 35 | 12180 | 11180 |
| 37 | 11290 | 10290 |
| 39 | 10400 | 9400 |
| 41 | 9510 | 8510 |
| 43 | 8620 | 7620 |
| 45 | 7740 | 6740 |
| 47 | 6850 | 5850 |
| 49 | 5960 | 4960 |

Using the Event Monitor Addfile

Note: the instructions below assume that the user wants to download the entire “package” (addfile, documentation, & ArcView legend(s)). Users not desiring the entire package may, instead, download the EM addfile *mpb_lpp_amman.kcp* by itself, in which case the reader should begin at step 3 (after downloading).

- 1) Download the file *mpb_lpp_amman.exe* by following the link from FHTET’s **Products** website at:

<http://www.fs.fed.us/foresthealth/technology/products.htm>

This file may be placed anywhere on your computer.

This WinZip® self-extracting file contains a number of files:

- (i) the MPB in LPP Risk Rating EM Addfile (I) (*mpb_lpp_amman.kcp*),
 - (ii) this User’s Guide (*MPB_LPP_EMI_User_Guide.pdf*), and
 - (iii) at least one optional ArcView® legend file (*amm_haz1.avl*) to be used with FVS-EMAP. (More *.avl* files may be added in the future). See next section for more information about FVS-EMAP.
- 2) After downloading, begin the extraction process by double-clicking the self-extracting WinZip® file (*mpb_lpp_amman.exe*). Although the files may be extracted to anywhere on your computer; we recommend that you allow the extraction procedure to place the files into the default extraction destinations. By default, the EM addfile and the User’s Guide will be extracted to **C:/fvsdata**; and the ArcView legend file(s) will be extracted to **C:/fvs_emap/legends**.²

² Thus, the default extraction procedure for this package assumes you are using the default directory structure provided with FVS-EMAP. If your installation of FVS-EMAP is different, then you will want to extract the *.avl* file(s) to your FVS-EMAP project directory’s ‘Legends’ subdirectory. Both extraction and use of the *.avl* file(s) are optional.

- 3) Before adding the *mpb_lpp_amman.kcp* EM addfile to a simulation, open it in a text editor and **verify that the elevation thresholds are correctly defined** for your location. (See the following section regarding Elevation Thresholds.)
Be sure to save the edited *mpb_lpp_amman.kcp* file before continuing.
- 4) Launch Suppose and build your FVS simulation (keyword) file.
- 5) Select the *Group* or individual *Stand* to which you want include the addfile by (1) toggling the applicable radio button ('Current Group' or 'Current Stand') in the main FVS 'Selections' window, and (2) selecting the applicable group or stand from the window above the 'Change Group Membership' button.
- 6) Select 'Edit Simulation File' from the main Suppose 'Selections' window.
- 7) Select 'Insert from file'.
- 8) Navigate to the directory where the *.kcp* file is located.
- 9) Select the file from the window browser; click 'Open'. The file is now included to all stands in the Current Group (or to the Current Stand—see step 5).
- 10) 'Close' the 'Edit Simulation File' window.
- 11) Continue building simulation file, and when done, click 'Run Simulation'.

Special Considerations: Elevation Thresholds

This EM addfile—as downloaded—is configured for the Central Rockies variant of FVS. The elevational thresholds are set to E_THOLD1 = 10400 ft and E_THOLD2 = 9400 ft.

As mentioned in step (3), above, if you want to change the elevation thresholds (E_THOLD1 and/or E_THOLD2), open the *.kcp* file in a text editor and make the appropriate changes. The file is set up so that a number of predefined E_THOLDS are already typed into the file, but all are commented-out except for one pair. You may “comment out” lines in the file by making the first character of a line an asterisk (*) or an exclamation point (!)³. Conversely, you may “activate” lines by removing leading asterisks or exclamation points. Comments within the file should help guide you through this procedure.

Output

If you want the values of the Event Monitor COMPUTE variables written to a file other than the standard FVS output file, you may request one or more of the post-processors that will create separate COMPUTE variable output files. These are accessible via the 'Select Post Processors' button from the main Suppose 'Selections' window. Three different types of output files are available for COMPUTE variables (via three different post-processors). In the 'Select Post Processors' window, the choices are:

³ “Commenting-out” lines in the addfile results in the keyword or expression being ignored by the program. You may comment out lines with asterisks or exclamation points. Comments beginning with a “*” will be printed in the output file. Comments beginning with a single “!” will *not* appear in FVS output, *unless* the commented-out line is an expression between a COMPUTE and END keywords, in which case the expression *will be* written to the output file. However if you precede an expression (that is between a COMPUTE and END keywords) with two exclamation points (“!!”), it will *not* print in the output file.

- Compute1-Table of COMPUTE Variables (with headers)
This post processor produces a file of all COMPUTE variables displayed by stand and by year in a table with headers. The file has a filename extension “.cmp”
- Compute2-Table of Concatenated COMPUTE Variables (comma delimited)
This post processor produces a file of all COMPUTE variables by stand, and by year, in a comma-delimited (machine readable) format. The file has a filename extension “.cp2”
- Compute3-Table of COMPUTE Variable Averages
This post processor creates a file containing averages (across stands, by year) for all COMPUTE variables. The file has a filename extension “.avc”.

Displaying COMPUTE Variable Output in ArcView®

Output from this EM addfile, written to a .cp2 file (via the Compute2 post processor), may be conveniently brought into ArcView® via **FVS-EMAP**. FVS-EMAP is a custom ArcView® project developed by FHTET, and available for download from FHTET at:

<http://www.fs.fed.us/foresthealth/technology/products.htm>

Users having an ArcView® shapefile (or an ARC/INFO® coverage) of the stands simulated in FVS, can use FVS-EMAP to **join** the FVS output data with their shapefile, resulting in **map displays** of user-defined COMPUTE variables over simulated time.

The ArcView® legend file that accompanies this package, while not necessary for the ArcView® project to work, facilitates the map creation process when making risk rating maps based on this application’s output. If the legend file resides in the ‘Legends’ subdirectory—immediately subordinate to FVS-EMAP’s project directory—then it will be available to the FVS-EMAP ArcView® project to be automatically loaded whenever a MPB hazard rating score is to be mapped. See footnote 2.

References:

- Amman, Gene D, Mark D McGregor, Donn B Cahill, and William H Klein. 1977. Guidelines for reducing losses of lodgepole pine to the mountain pine beetle in the Rocky Mountains. USDA Forest Service Gen. Tech. Rep. INT-36. Intermountain Forest and Range Exp. Sta., Ogden, UT. 22pp.
- Crookston, Nicholas L. 1990. User’s guide to the Event Monitor: Part of Prognosis Model Version 6. USDA Forest Service Gen. Tech. Rep. INT-275. Intermountain Res. Sta, Ogden, UT 29pp. [Electronic Version (modified Sept. 2001) available online: http://www.fs.fed.us/fmssc/fvs/documents/gtrs_event_monitor.php (last accessed 11/01)]

FVS software and documentation is available from the Forest Management Service Center, online at:

<http://www.fs.fed.us/fmssc/fvs/>

For further information, contact Eric Smith at: elsmith@fs.fed.us . 970 295-5841

Appendix: The *mpb_lpp_amman.kcp* Event Monitor Addfile

Note: users may “clip” the information below into a separate file and use it as an FVS addfile. Copying this information to its own file should be done in such a way as to preserve column spacing. The mono-spaced Courier font used below preserves column spacing.

```
*****
! THIS EVENT MONITOR CALCULATES A RISK RATING for MPB in LPP BASED ON THE
! SYSTEM OF AMMAN, et al. (1977)
! [Amman, McGregor, Cahill & Klein. 1977. Guidelines for reducing losses
! of LPP to the MPB in unmanaged stands in the Rocky Mountains.
! USDA FS GTR INT-36, Intermountain F&R Exp Sta., Ogden, UT 22pp.]
!
! RISK IS BASED ON THREE FACTORS:
!
!     STAND ELEVATION,
!     STAND AGE,
!     AND HOST QMD (OF HOST TREES >5 INCHES DBH)
!
! EACH FACTOR IS ASSIGNED A VALUE (1,2, OR 3) BASED ON STAND CONDITIONS.
! RISK RATING IS BASED UPON THE PRODUCT OF THE THREE FACTORS:
!
!     ELEVATION      AGE      DBH      FACTOR VALUE
!     >10400         <60     <7       1
!     9400-10400     60-80   7-8      2
!     <9400          >80     >8       3
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
! (Note: elevation breakpoints (E_THOLDS) vary with latitude.
! Those noted in table above are for ~ 39 deg. N latitude.
! See the "INITIALIZE" section below to set your E_THOLDS.)
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
! RISK RATING: FACTOR1 * FACTOR2 * FACTOR3
!
! (Possible values: 1, 2, 3, 4, 6, 8, 9, 12, 18, 27)
!
! 1-9 = LOW; 12-18 = MODERATE; 27 = HIGH
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!
!! Prepared 07/01 AJ McMahan, INTECS International, Inc., for:      !!
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!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!! INITIALIZE !!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!

COMPUTE          0
AMMAN1 = -1
AMMAN2 = -1
AMMAN3 = -1
QMD_GT_5 = SPMCDDBH(5,LP,0,5,999)
END
```

```

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!                               DEFINE E_THOLDS
!!
!! ADD asterisk(s) (*) or exclamation points (!) in column 1 to
!! "comment out" the line. (If "*" or "!", the line will be printed
!! [as a comment] in output; if "!!", line will not be printed in output.)
!!
!! REMOVE asterisks/exclamation points to "activate" the line.

!! The following blocks define E_THOLDS for various latitudes.
!! "Activate" the applicable pair for your latitude,
!! or enter your own E_THOLDS.

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

COMPUTE                0

!! For ~33 degrees N Latitude

!!E_THOLD1 = 13070
!!E_THOLD2 = 12070

!! For ~35 degrees N Latitude

!!E_THOLD1 = 12180
!!E_THOLD2 = 11180

!! For ~37 degrees N Latitude

!!E_THOLD1 = 11290
!!E_THOLD2 = 10290

!! For ~39 degrees N Latitude

E_THOLD1 = 10400
E_THOLD2 = 9400

!! For ~41 degrees N Latitude

!!E_THOLD1 = 9510
!!E_THOLD2 = 8510

!! For ~43 degrees N Latitude

!!E_THOLD1 = 8620
!!E_THOLD2 = 7620

!! For ~45 degrees N Latitude

!!E_THOLD1 = 7740
!!E_THOLD2 = 6740

!! For ~47 degrees N Latitude

!!E_THOLD1 = 6850
!!E_THOLD2 = 5850

```

!! For ~49 degrees N Latitude

!!E_THOLD1 = 5960
!!E_THOLD2 = 4960

!! OTHER--User Defined

!!E_THOLD1 =
!!E_THOLD2 =

END

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!! END OF DEFINING E_THOLDS
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!! FACTOR 1 (ELEVATION) !!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
ELEV GT E_THOLD1
THEN
COMPUTE 0
AMMAN1 = 1
END
ENDIF

IF
ELEV GE E_THOLD2 AND ELEV LE E_THOLD1
THEN
COMPUTE 0
AMMAN1 = 2
END
ENDIF

IF
ELEV LT E_THOLD2
THEN
COMPUTE 0
AMMAN1 = 3
END
ENDIF

!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!! FACTOR 2 (AGE) !!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!

IF
AGE LT 60
THEN
COMPUTE 0
AMMAN2 = 1
END
ENDIF

IF
AGE GE 60 AND AGE LE 80
THEN
COMPUTE 0
AMMAN2 = 2
END
ENDIF


```
IF
AGE GT 80
THEN
COMPUTE          0
AMMAN2 = 3
END
ENDIF
```

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!! FACTOR THREE (QMD OF HOST > 5") !!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

```
IF
QMD_GT_5 LT 7.0
THEN
COMPUTE          0
AMMAN3 = 1
END
ENDIF
```

```
IF
QMD_GT_5 GE 7.0 AND QMD_GT_5 LE 8.0
THEN
COMPUTE          0
AMMAN3 = 2
END
ENDIF
```

```
IF
QMD_GT_5 GT 8.0
THEN
COMPUTE          0
AMMAN3 = 3
END
ENDIF
```

```
!!!!!!!!!!!!!!!!!!!!
!! RISK RATING !!
!!!!!!!!!!!!!!!!!!!!
```

```
IF
AMMAN1 GT 0 AND AMMAN2 GT 0 AND AMMAN3 GT 0
THEN
COMPUTE          0
AMM_HAZ = AMMAN1 * AMMAN2 * AMMAN3
END
ENDIF
```