White Pine Blister Rust Impact Model Keywords:

Program Execution and Control:

BRCLST
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BRTLST
BRUST
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Inventory Data Entry:

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Management Options:

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EXSPECS
PRNSPECS
PRUNE
STOCK

Modification of Model Assumptions:

INACT
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RUSTINDX

BRCLST   This keyword is used to produce detailed canker output from the Blister Rust Model. The following information will be provided for each catalogued canker on each tree: tree number, tree index, canker index, canker distance up (feet), canker distance out (inches), percent girdle, and canker status. Additional information provided for the tree on which the canker occurs is: tree height (feet), DBH (inches), crown ratio (%), and height to base of crown (feet). The BRCLST keyword may be entered more than once in a Blister Rust Model keyword set.

Canker status codes that appear in the output listing are:

IN = inactive canker
NL = non-lethal canker
PR = prunable canker
EX = excisable canker
NS = non-salvable canker
TK = top killed tree (due to this canker)
DD = dead tree (due to this canker)

Field 1   Date (calendar year or cycle number) in which a regional outbreak will occur. Entered as a 4-digit calendar year or 0 to 40 for cycle number.

Field 2   File unit number.
[Range: 20 to 35]

Field 3   Supplemental file name record flag; any numeric entry indicates a supplemental record will follow containing a file name left justified for detailed canker output. If this field is left blank, no supplemental record is required and the output file name defaults to BRTOUT.

Fields 4-7   Not used.

Supplemental Record   Name of the file to be opened, including a pathname if desired, up to 40 characters in length and beginning in column 1.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	0	27					

BRSEED   This keyword is used to change the random number generator seed value contained in the model.

Field 1   New random number generator seed value.
[Range: Any large, non-negative, odd integer]

Fields 2-7   Not used.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	55329						

BRTLST   This keyword is used to produce detailed tree output from the Blister Rust Model. The following information will be provided for each tree: tree number, stock type, age, DBH (inches), trees/acre, diameter growth (inches), height (feet), height to base of crown (feet), sum of target area, rust index, growth index, expected number of cankers, total number of cankers, and tree status based on the worst canker. The BRTLST keyword may be entered more then once in a Blister Rust Model keyword set.

Tree status codes that appear in the output listing include:

NO = no cankers
NL = worst canker is non-lethal
PR = worst canker is prunable
EX = worst canker is excisable
NS = worst canker is non-salvable
TK = worst canker has caused topkill
DD = worst canker has killed the tree

Field 1   Date (calendar year or cycle number) in which a regional outbreak will occur. Entered as a 4-digit calendar year or 0 to 40 for cycle number.

Field 2   File unit number.
                      [Range: 20 to 35]

Field 3   Supplemental file name record flag; any numeric entry indicates a supplemental record will follow containing a file name left justified for detailed canker output. If this field is left blank, no supplemental record is required and the output file name defaults to BRTOUT.

Fields 4-7   Not used.

Supplemental   Name of the file to be opened, including a pathname if desired, up to 40 characters
Record   in length and beginning in column 1.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	0	26					

BRUST   The BRUST keyword is actually an FVS Model keyword signifying that the Blister Rust Model is to be called. This keyword is required to invoke the Blister Rust Model, it must be the first keyword in the set, and all following keywords, up to the associated END keyword, must be Blister Rust Model keywords.

There are no fields associated with this keyword.

CANFMT   This keyword is used to provide a FORTRAN format statement that describes the layout of the canker data record. If present, the CANFMT keyword must precede the CANKDATA keyword in a Blister Rust Model keyword set, and it may appear only once in the set.

Note: Canker data should be formatted as follows: each canker data record should contain the first 5 measurements listed above (Tree ID though % Girdle), then immediately following all the individual canker records for a tree, a Total Cankers record is required which includes the Tree ID, Tree Age, and the Total Canker count with zeroes for Distance Up, Distance Out, and % Girdle. The number of total cankers for a tree can be much larger than the actual number of canker records listed, up to 999.

Example Canker Measurement Data

Tree IDDist UpDist Out% GirdleTree Age# Cankers

112.50.04334
15.04.00 34
17.011.00 34
10 0 0 343
28.00.02329
24.50.01129
215.02.00 29
210.55.50 29
20 0 0 2927

Fields 1-7   Not used.

CANKDATA　　This keyword is used to specify the source from which to read the canker data and the units of measure in which the canker data was collected. Canker data, which is used to initialize the model, may be supplied from an external file, or it may be included with this keyword in supplemental records. The CANKDATA keyword may appear only once in a Blister Rust Model keyword set.

Field 1　　　Unit number of external file from which canker data will be read. If the canker data directly follows the CANKDATA keyword, logical unit number 15 must be specified here.
[Range: 20 to 35]

Field 2　　　Units of measure in which canker data is provided. A "0" or blank indicates that distance up measurements are in feet and distance out measurements are in inches. An entry of "1" specifies that distance up and out measurements are in centimeters.

Field 3　　　Generate initial canker measurements where:

0 = use only canker measurement data and canker data counts listed
1 = in addition to canker measurement data, if any, use the total canker count to randomly generate cankers on the tree, up to 10 total.

Fields 4-7　　Not used.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	25	0	0				

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COMMENT   This keyword is used to enter a comment that will be reproduced in the keyword summary table. This keyword does not have any associated fields, but does require at least one supplemental record. Comments can be entered in columns 1 to 80 on as many supplemental records as desired. The comment is terminated with an END keyword; anything entered between the COMMENT and END keywords will not affect the operation of the model.

END   This keyword is used to signify the end of a keyword set or the end of a COMMENT block within a keyword set as shown in the example below.

      Example:
      BRUST
      White Pine Blister Rust Model keywords here
      .
      .
      .
      COMMENT
      any number of comment lines here
      .
      .
      .
      END
      .
      .
      .
      END

Fields 1-7   Not used.

EXCISE   This keyword is used to schedule excising activities in the stand. Excising will no take place in the model unless this keyword is present. Excisable cankers are bole cankers which are within a certain distance above ground level and which have girdled the tree less than a maximum percentage of the bole circumference. The EXCISE keyword may be entered more than once in a Blister Rust Model keyword set.

Note: A canker that passes all the exciting tests listed on this keyword and the EXSPECS keyword will still not be excised if any of the following is true: the status of the tree is dead, topkilled, or non-salvable based on the worst canker for the tree, or the tree has more than one excisable canker. If excising is successful, the canker is marked as inactive and then removed in the next cycle.

Field 1   Date (calendar year or cycle number) in which excising activity will occur. Entered as a 4-digit calendar year or 0 to 40 for cycle number.

Field 2   Probability of success of the excising activity; the canker will be removed if all conditions for removal are met (see EXSPECS keyword) and if a drawn random number for the canker is less than the specified success rate.
[Range: 0.0 to 1.0]

Fields 3-7   Not used.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	0	0.5					

EXSPECS   This keyword is used to change the parameters which define an excisable canker. Excisable cankers are defined as cankers within a certain distance of ground level, on a tree larger than a specified DBH, which have girdled the tree less than a maximum percentage of the bole circumference. The distance above ground level which defines an excisable canker is a range between a minimum height in inches and a maximum absolute height in feet. In addition, for a canker to be a candidate for removal by excising, the tree DBH must be greater than a specified minimum DBH and the canker must have girdled the bole less than a specified maximum percentage. The EXSPECS keyword may be entered more than once in a Blister Rust Model keyword set.

Note: A canker that passes all the excising tests listed on this keyword and the EXCISE keyword will still not be excised if any of the following is true: the status of the tree is dead, top-killed, or non-salvable based on the worst canker for the tree, or the tree has more than one excisable canker. If excising is successful, the canker is marked as inactive and then removed in the next cycle.

Field 1   Date (calendar year or cycle number) in which excising specifications will be changed. Entered as a 4-digit calendar year, 1 to 40 for cycle number, or "0" to indicate specifications will be changed during initialization of the simulation but not reported in the activity schedule.

Field 2   Minimum DBH (in inches) for the tree above which cankers will be considered for removal by excising; cankers on a tree with a DBH smaller than this value are considered non-salvable.
[Range: none]

Field 3   Maximum height (in feet) above ground level below which cankers will be considered for removal by excising; cankers above this height are considered non-salvable.
[Range: none]

Field 4   Maximum percentage of the tree bole circumference that can be invaded by rust (live cambium) after which the canker is no longer excisable and is assigned the status non-salvable.
[Range: 0 to 100]

Field 5   Percent of canker girdling needed to cause death; this value is used when determining the canker status – either the bole canker's girdling causes topkill or the canker kills the tree depending on its height relative to the height to base of crown.
[Range: 0 to 100]

Field 6   Minimum height (in inches) above ground level canker must be to qualify for excising; bole cankers below this height are assigned the status non-salvable.
[Range: none]

Field 7   Not used.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	0	3	6	50	90	3	

INACT   This keyword is used to specify the yearly canker inactivation rate for branch and bole cankers. The INACT keyword may be entered more than once in a Blister Rust Model keyword set. Inactivated cankers are removed in the following cycle.

Field 1   Date (calendar year or cycle number) in which canker inactivation rates will be changed. Entered as a 4-digit calendar year, 1 to 40 for cycle number, or "0" to indicate specifications will be changed during initialization of the simulation but not reported in the activity schedule.

Field 2   Canker inactivation rate for branch cankers.
                  [Range: 0.0 to 1.0]

Field 3   Canker inactivation rate for bole cankers.
                  [Range: 0.0 to 1.0]

Fields 4-7   Not used.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	0	0.05	0.01				

PRNSPECS   This keyword is used to change the parameters which define a prunable canker. Prunable cankers are defined as cankers within a certain distance of ground level and within a certain distance out on the tree branch. The distance above ground level which defines a prunable canker may be specified in one of two ways: either height above ground level is expressed as a percentage of total tree height or it is expressed as an absolute height. The model will always use the smaller of these two values to determine whether a canker will be a candidate for removal by pruning. The PRNSPECS keyword may be entered more than once in a Blister Rust Model keyword set.

Note: A canker that passes all the pruning tests listed on this keyword and the PRUNE keyword will still not be pruned if any of the following is true: the status of the tree is dead, topkilled, or non-salvable based on the worst canker for the tree. If pruning is successful, the canker is marked as inactive and then removed in the next cycle.

Field 1   Date (calendar year or cycle number) in which pruning specifications will be changed. Entered as a 4-digit calendar year, 1 to 40 for cycle number, or "0" to indicate specifications will be changed during initialization of the simulation but not reported in the activity schedule.

Field 2   Proportion of total tree height above ground level below which cankers will be considered for removal by pruning (if this value is smaller than the value in field 3); cankers above this height are considered non-salvable.
[Range: 0.0 to 1.0]

Field 3   Maximum height (in feet) above ground level below which cankers will be considered for removal by pruning (if this value is smaller than the value in field 2); cankers above this height are considered non-salvable.
[Range: none]

Field 4   Minimum distance out (in inches) on a branch a canker must be to be prunable. A canker closer to the tree than this distance will be treated like a bole canker.
[Range: none]

Field 5   Maximum distance out (in inches) on a branch after which a canker is considered non-lethal and therefore will not be pruned.
[Range: none]

Fields 6-7   Not used.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	0	0.5	8	6	24		

PRUNE   This keyword is used to schedule pruning activities in the stand. Pruning will not take place in the model unless this keyword is present and pruning may be specified for prunable trees and/or clean trees. Prunable trees contain no cankers but can be pruned to prevent the spread of blister rust in the stand. The PRUNE keyword may be entered more than once in a Blister Rust Model keyword set.

Note: A canker that passes all the pruning tests listed on this keyword and the PRNSPECS keyword will still not be pruned if any of the following is true: the status of the tree is dead, topkilled, or non-salvable based on the worst canker for the tree. If pruning is successful, the canker is marked as inactive and then removed in the next cycle.

Field 1   Date (calendar year or cycle number) in which pruning activity will occur.
[Range: 4-digit calendar year or 0 to 40 for cycle number]

Field 2   Probability of success of the pruning activity; the canker will be removed if all conditions for removal are met (see PRNSPECS keyword) and if a drawn random number for the canker is less than the specified success rate.
[Range: 0.0 to 1.0]

Field 3   A "1" indicates prunable trees will be pruned. A "0" or blank indicates prunable trees will not be pruned.

Field 4   Ribes Lacustre old number of bushes per acre.

Fields 5-7   Not used.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	0	0.9	0	0			

RIBES	This keyword is used to calculate either a stand rust index or a rust index reduction factor from user-specified Ribes spp (hudsonianum, lacustre, viscosissimum) populations. This keyword schedules an activity and may be used multiple times in a single run.

If zeroes are entered for old number of bushes per acre (fields 2, 4, and 6) or a zero is entered for date/cycle (field 1), the new number of bushes per acre values (fields 3, 5, and 7) will be used to calculate a new rust index value. Otherwise, the old and new bushes per acre values will be used to calculate a rust index reduction factor.

When either rust index or a reduction factor is calculated using this keyword, it is applied to all trees and it remains in effect until the values are replaced using a subsequent RIBES keyword.

Note: Using the RIBES and RUSTINDX keywords together in the same run may cause misleading results in the model. For calculating stand rust index, use either the RIBES keyword or the RUSTINDX keyword, but not both in the same keyword set. However, using the RIBES keyword to calculate a rust index reduction factor and the RUSTINDX keyword to calculate stand rust index IS allowable in the same run.

Field 1   Date (calendar year or cycle number) in which ribes population values are to be changed. Entered as a 4-digit calendar year or 1 to 40 for cycle number. If "0" is entered, no activity will be scheduled and fields 3, 5, and 7 will be used to calculate a stand rust index at initialization.

Field 2   Ribes Hudsonianum old of bushes per acre.

Field 3   Ribes Hudsonianum new number of bushes per acre.

Field 4   Ribes Lacustre old number of bushes per acre.

Field 5   Ribes Lacustre new number of bushes per acre.

Field 6   Ribes Viscosissimum old number of bushes per acre.

Field 7   Ribes Viscosissimum new number of bushes per acre.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	1	0.0	0.0	200.0	75.0	200.0	75.0

RUSTINDX This keyword is used to control the calculation of stand rust index based on stand basal area. It is also used to provide a stand deviation factor for the model. Stand deviation factor is calculated in the model using the percent of the stand population infected with blister rust and the average number of cankers per tree. It represents how much the actual infection level of the stand differs from the model-predicted infection level. The RUSTINDX keyword may appear only once in a Blister Rust Model keyword set.

Note: Using the RIBES and RUSTINDX keywords together in the same run may cause misleading results in the model. For calculating stand rust index, use either the RIBES keyword or the RUSTINDX keyword, but not both in the same keyword set. However, using the RIBES keyword to calculate a rust index reduction factor and the RUSTINDX keyword to calculate stand rust index IS allowable in the same run.

Field 1 Rust Index value. Format: F7.5 or #.#####.
[Range: none]

Field 2 Stand deviation factor; specifying a value in this field will override the calculation of a stand deviation factor. When a stand deviation factor cannot be calculated because canker data was not supplied, or the stand age is less than 10 years, or the denominator for the stand deviation factor equation happens to be zero, the model default value will be used. Format: F5.2 or ##.##.

Field 3 Rust Index Assignment Method. Default = 0.

0 – use stand rust index specified in field 1 throughout the run
1 – calculate stand rust index from basal area at initialization and use it throughout
2 – calculate stand rust index from basal area every cycle and apply it to all trees

Note: Fields 4, 5, and 6 are used only if the value in field 3 is not 0. The sum of fields 4, 5, and 6 must be 1.0 (+/- 0.01). If not, equal amounts will be added to or subtracted from all three fields as required. Values must be greater than or equal to 0.

Field 4 Proportion of ribes population that is Ribes hudsonianum.
Format: F4.2 or #.##.

Field 5 Proportion of ribes population that is Ribes lacustre.
Format: F4.2 or #.##.

Field 6 Proportion of ribes population that is Ribes viscosissimum.
Format: F4.2 or #.##.

Field 7 Not used.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	0.015	0.33	0	0.0	0.5	0.5	

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STOCK   This keyword is used to specify the resistance factor for White Pine stock of four different families, and the proportions of the White Pine population represented by the four individual stock types (families). The STOCK keyword may be entered more than once in a Blister Rust Model keyword set.

Field 1   Date (calendar year or cycle number) in which existing specifications will be changed.
[Range: 4-digit calendar year, 1 to 40 for cycle number, or "0" to indicate specifications will be changed during initialization of the simulation but not reported in the activity schedule]

Field 2   Stock type/family:

1 = wild stock
2 = F1 stock
3 = F2 stock, or
4 = GCOP stock (general combiner, open pollinated).

There is no default value for this field; a value must be entered.

Field 3   Blister rust resistance factor; this value is used as a multiplier with calculated Stand Rust Index to determine the appropriate Rust Index for different stock types:

Stock type 1 = 1.00
Stock type 2 = 0.20
Stock type 3 = 0.05, or
Stock type 4 = 0.60.

The defaults for these fields are listed above and depend on the value entered in field 2.

Field 4   Proportion of stock type in White Pine population:

Stock type 1 = 1.00
Stock type 2 = 0.00
Stock type 3 = 0.00, or
Stock type 4 = 0.00.

The defaults to these fields are listed above and depend on the value entered in field 2.

Fields 5-7   Not used.

Field Default Values

Field	1	2	3	4	5	6	7
All variants	0						