

5. Processor

Overview

BioSum's Processor module handles two major tasks: 1) preparing data summaries for input to OpCost (a forest operations cost simulator) and 2) summing the volume, biomass, and value of merchantable and energy wood collected from each stand at each simulation cycle where harvest occurs.

Based on harvest outcomes (represented as records in the FVS CutList table) for a stand undergoing a prescription, within a package, this module calculates cost-relevant statistics: trees per acre, average volume in cubic feet, average weight in green tons, hardwood proportion and chip fraction values for each of three harvest size classes (referred to as chip, small log and large log trees). For each stand, package and prescription, these statistics are passed as input to OpCost along with the assumed harvest system and other parameters. OpCost estimates harvest costs from this information, storing the results in a harvest_costs table in the processor scenario database (in the project/processor/scenario_name directory). At the same time, the volume, biomass and value per acre of merchantable and energy wood removed as a result of implementing a prescription are summed and stored in user-defined "bins" by diameter class and species group. These sums are also stored in the processor scenario database's tree_vol_val_by_species_diam_groups table.

These two tasks are initiated by the Start BioSum Processor button, the bottom button appearing in this module. The first 4 buttons access tasks that must be completed before starting the BioSum Processor for the first time for a project.

Module Components

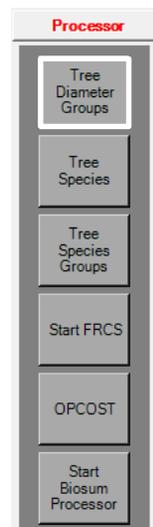
The button that activates the Processor module can be found in the left-menu pane of the FIA BioSum Manager (it's labeled "Processor"). Selecting it opens a 6-button panel that accesses five tasks: (1) **Tree Diameter Groups**—assign diameter groupings, (2) **Tree Species**—audit the tree species table, (3) **Tree Species Groups**—assign species groups, (4) **Start FRCS**—open the Fuel Reduction Cost Simulator application to display and/or edit parameters (users are encouraged to use the OPCOST application rather than FRCS), (5) **OPCOST**—specify directories for the OPCOST harvest cost estimator, and (6) **Start BioSum Processor's** interactive parameter specification.

Tree Diameter Groups

The form accessed from this button is used to specify diameter groups by which harvested tree volume and value will be summarized. In a later step, merchantable values per unit volume and energy wood values per unit weight will be assigned to tree species groups based on diameter group classes defined here.

Note: the diameter groups specified here will apply to EVERY processor scenario developed, and that they will determine the volume, biomass and value summaries in the tree_vol_val_by_species_diam_groups table when Processor executes. If the user elects to alter these diameter group specifications later in the analysis (and this is NOT advised), then every existing processor scenario and core analysis will need to be re-run; otherwise, the database will be corrupted in that entries in the tree_vol_val_by_species_diam_groups table of un-regenerated processor scenarios, and in the core analysis results that are linked to them, will be inconsistent with the most recently entered diameter limits.

1. Click on the <Tree Diameter Groups> button. The **Tree Diameter Groups List** will open.



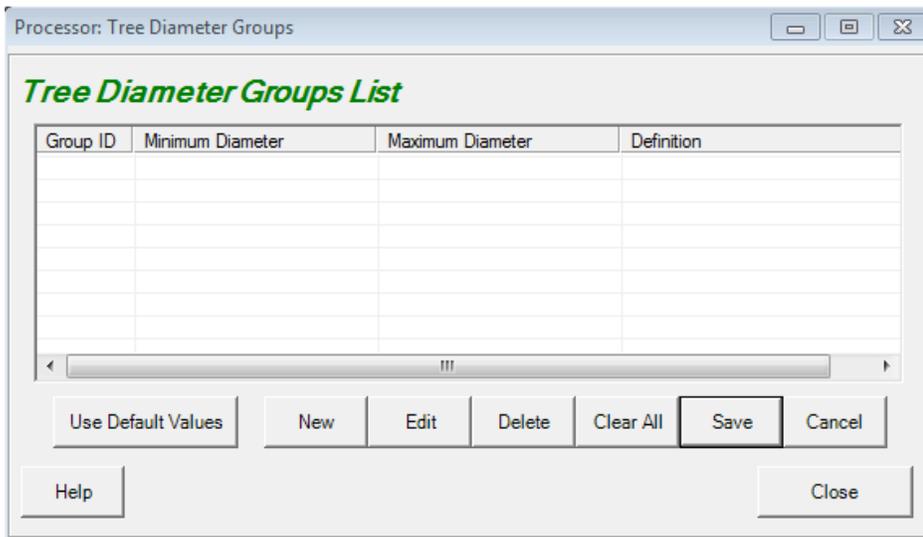


Figure 5.1 - Tree Diameter Groups entry form.

2. To add a new diameter group, click **<New>**. Enter minimum and maximum diameter values in the **Tree Diameter Groups** edit window. Values are entered and displayed in inches. An unlimited number of non-overlapping diameter groups can be specified; they must be specified in ascending order, and it may be necessary to use the right arrow key to enter values to the right of the decimal place. The maximum diameter for the last diameter group entered should be at least as large as the largest tree that might be cut by any prescription in any stand; 999 is a good choice to ensure that all trees will be accounted for in volume, biomass and value summaries. **Additionally, diameter groups should correspond with chip, brushcut, and large tree diameter limits specified later in the module.** For example, if trees less than 5" diameter are to be directed to the energy wood bin, there should be a break in the diameter group list at 5". Or, if in some packages trees less than 6" are to be directed to energy wood bin, but in other packages the threshold is 5", be sure to set a diameter limit at both of these thresholds.
3. To make changes to an existing diameter group definition, select the group from the list and click **<Edit>**.
4. To load, or revert to, the default diameter group specification click **<Use Default Values>**; these are listed in Table 5.1.

Table 5.1 – Default diameter group values.

Group ID	Minimum Diameter	Maximum Diameter
1	1	7
2	7.1	10
3	10.1	16
4	16.1	21
5	21.1	999

5. When you have finished editing or adding tree diameter groups, click **<Save>**, and then **<Close>**.

Tree Species

This button initiates a dialog in which all species of trees, along with key species attributes and FVS variant specific cross-references, found in the cut list output of FVS can be inspected and audited. Audits should be run on the *tree_species* table the first time FVS cut list output is used, to assess data readiness for subsequent processes. There are two audits to be completed: (1) check if each FIA tree species, FVS variant, and FVS tree species combination is in the *tree_species* table, and (2) check if oven dry weight and green weight conversion ratios exist in the *tree_species* table. To complete the rest of the tasks in the Processor module, the cut list must pass both audits.

1. Click the **<Tree Species>** button in the Processor panel to open the **Tree Species** window. The data displayed in the *tree_species* table in the bottom half of this window derives from a work table, generated by filtering the */db/ref_master_tree_species* table based on the FIA species codes present in the */fvs/data/TreeLists/variant_TREE_CUTLIST.MDB* database files. Note that ALL records for species with matches in the cut list will enter this work table, regardless of the variant associated with the record in the cut list.

This table shows every combination of variant and FIA species code and the FVS species to which it is “mapped”, the species group assigned to that species in the current project, the scientific nomenclature, and the oven dry weight (wood density) and dry to green ratio—both of which are required to estimate green weight of merchantable and energy wood (for calculating transportation costs).

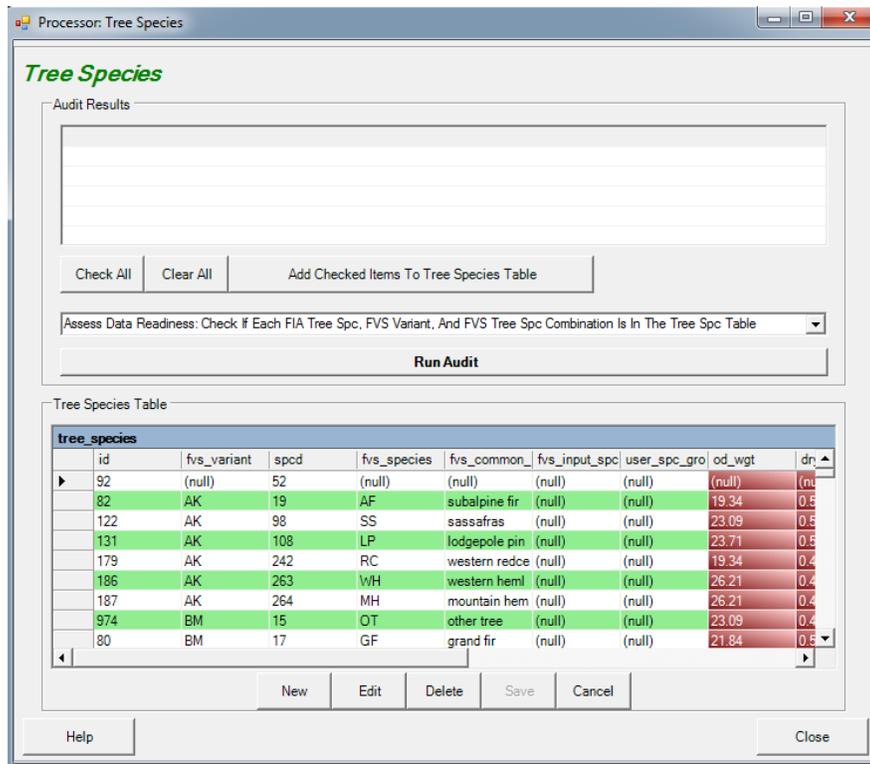


Figure 5.2 –Tree Species window, the *tree_species* table is visible in the lower half.

2. In the drop down list box above the *tree_species* table, select the first audit by clicking the downward pointing triangle on the right side of the list box and selecting “**Check If Each FIA Tree Spc, FVS Variant, And FVS Tree Spc Combination Is In The Tree Spc Table**”), then click **<Run Audit>**. Within the FVS module completed earlier in the BioSum workflow, an audit was performed to check if each FIA tree species and FVS variant combination in *project_name/db/master_tree* existed in the *tree_species* table. Within Processor, the audit checks, using CUTLIST tables as the source, rather than the TREE table, to be sure not only that every combination of FIA tree species and FVS variant exists, but also that FVS tree species is populated. The audit will display an error message if this requirement is violated for any CUTLIST tree.

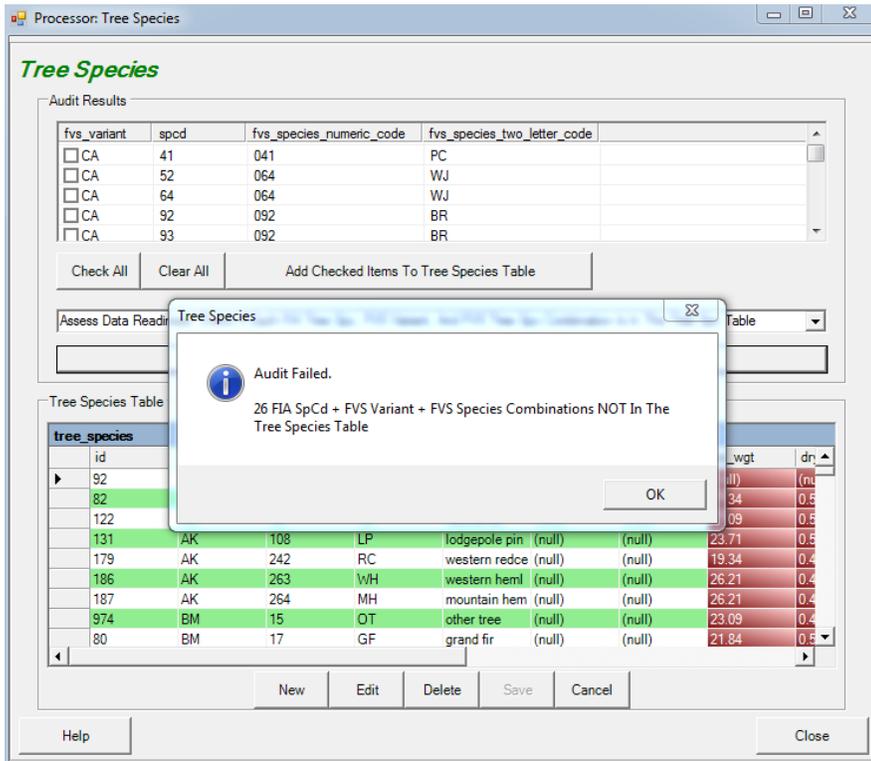


Figure 5.3 – Audit Failed message. Records in the Audit Results window need to be added to the tree_species table.

3. If this audit fails, results will be displayed for cases where combinations are missing from the *tree_species* table. These records can be selected (via checkboxes) for addition to the *tree_species* table individually, or en masse (by clicking Check All), followed by **<Add Checked Items To Tree Species Table>** button. Be sure to **<Save>** changes after adding records. These additions to the work table will automatically propagate through to also update *ref_master.tree_species*.
4. To run the second audit, select **“Check If Oven Dry Weight And Green Weight Conversion Ratios Exist In The Tree Spc Table”** from the drop-down menu; then click **<Run Audit>**. This audit will find instances of *tree_species* records where the *od_weight* or *dry_to_green* fields are null and display them at the top of the Tree Species window. These can typically be corrected by sorting the table on *spcd* (by left clicking on its column heading), and finding these values for another variant for the same species. Click on a record in the audit results window to select that record in the *tree_species* table. Values in the red-brown highlighted boxes can be edited directly, without opening the dialog, or select edit to open the editing window. Do this for each specified record in the audit results window. **<Save>** changes when done, and these updates will also propagate through to *ref_master.tree_species*.

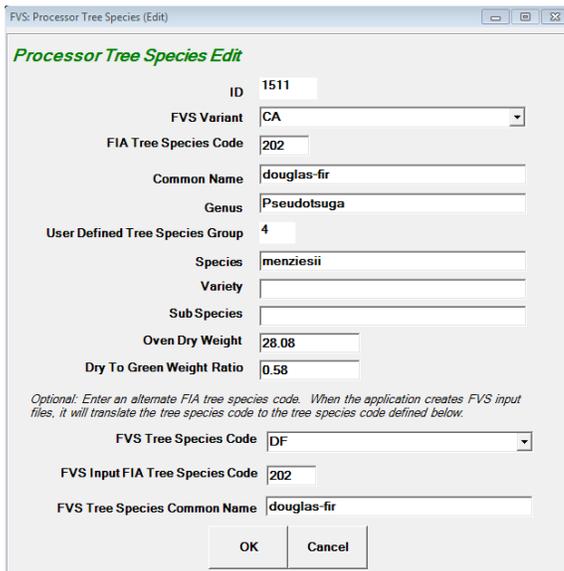


Figure 5.4 – Tree species edit window, update oven dry weight and dry to green weight ratios here or in Tree Species dialogue directly.

- Repeat Step 4 to ensure that every record that matches a cutlist tree has a valid wood density (oven dry weight) and dry to green ratio.

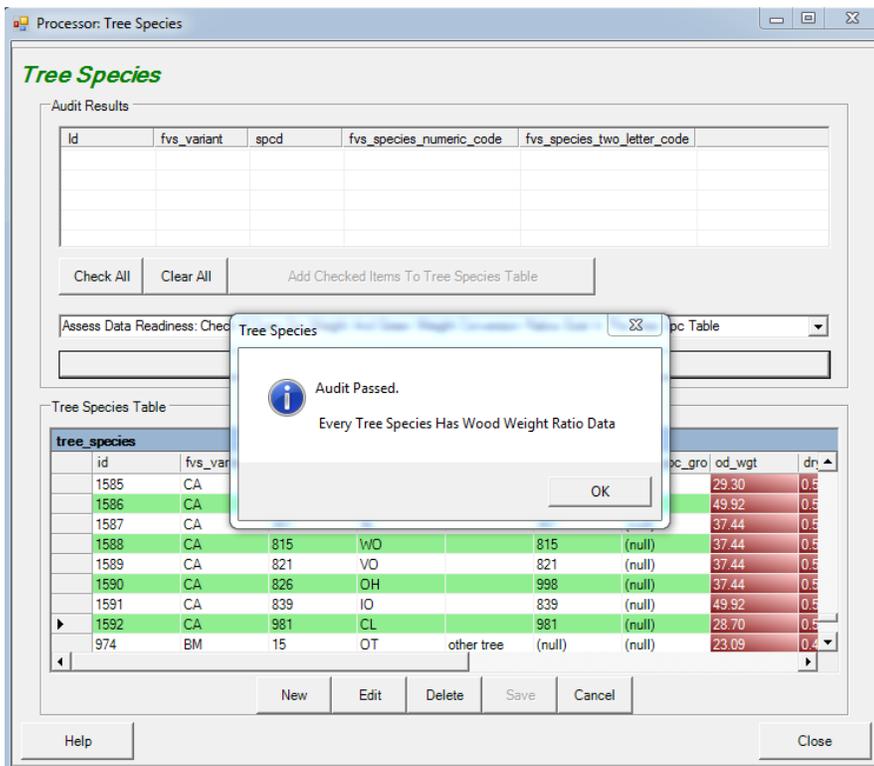


Figure 5.5 – Successful tree species audit.

- After both audits have passed without error, <Save> changes and <Close> the Tree Species window.

Tree Species Groups

BioSum summarizes volume, biomass and value by size class (diameter group) and species group. When parameterizing Processor towards the end of this module, merchantable values for harvested trees will need to be assigned for each combination of diameter and species group. Before that can happen, species groups must be assigned.

1. Click the **<Tree Species Groups>** button to display the **Species Groups** window.

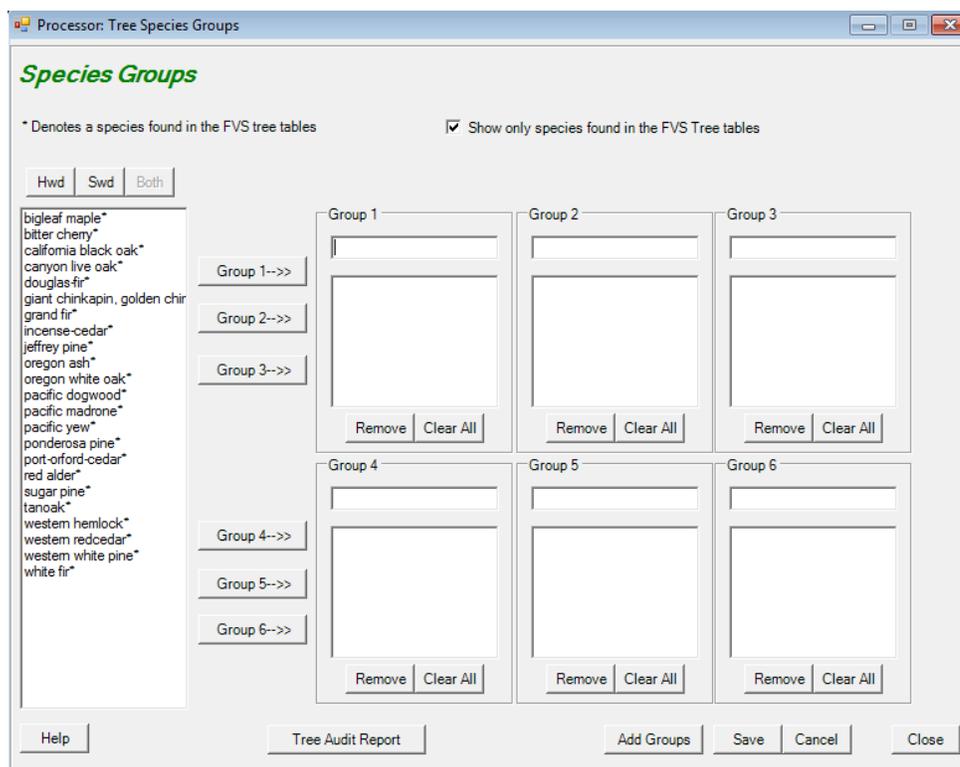
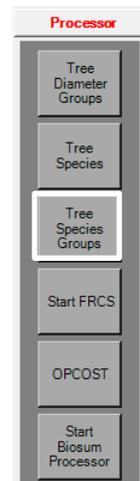


Figure 5.6 – Tree species groups window.

2. Click the check box at the top of the window, next to **“Show only species found in the FVS Tree Tables”** to limit the display of tree species common names to only those present in the project dataset.
3. Select a species from the list on the left and click any of the **<Group>** buttons to insert the species into that group. Note that species are removed from the list on the left as they are entered into groups. Enter a group name in the text box above each group species listing; blank names are not allowed. The **<Remove>** and **<Clear All>** buttons will remove one or all species respectively from the group and return it to the full list on the left. Additional groups can be added by clicking the **<Add Groups>** button at the bottom of the form.
4. When finished grouping all species, the list of ungrouped species will be empty. Click **<Save>** and then **<Close>** to complete this task.

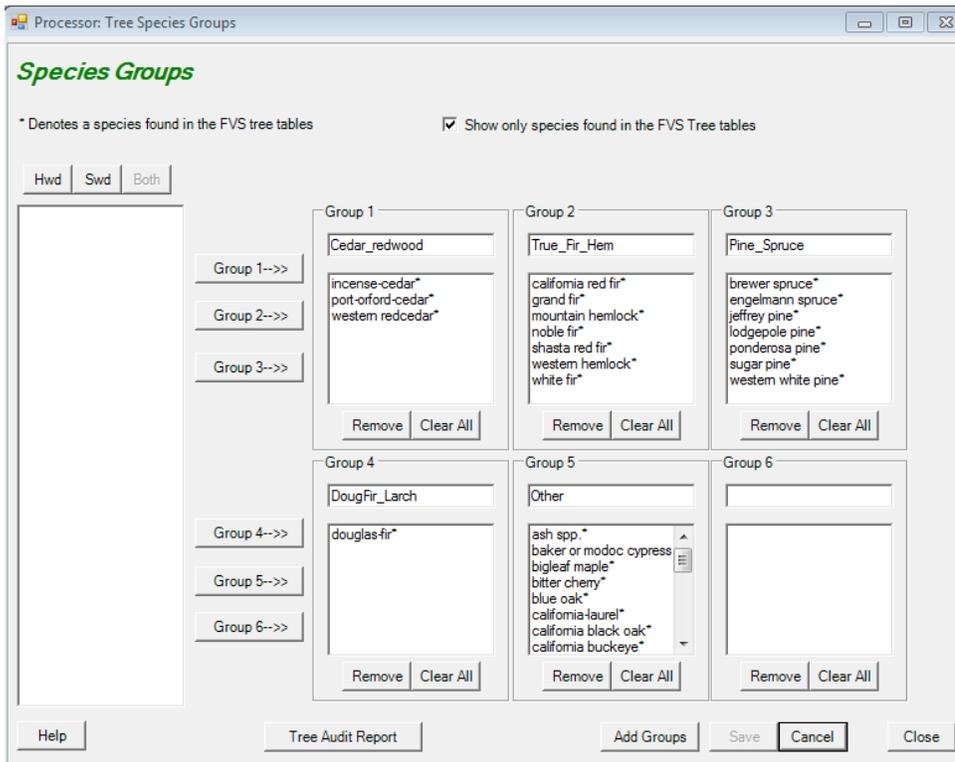


Figure 5.7 - All species have been grouped and group names have been added.

Fuel Reduction Cost Simulator (FRCS)

FRCS is a harvest cost estimator used in previous versions of BioSum, prior to the creation of the OpCost application. Users are encouraged to use OpCost to estimate harvest costs, as it uses more current machine costs and the application is actively maintained. However, in the case that users prefer FRCS as a harvest cost estimation tool, the application remains compatible with the BioSum framework. See **Appendix E** for information and instruction regarding the Fuel Reduction Cost Simulator.

OpCost

OpCost is an R script that estimates treatment costs per acre for each stand as a function of the following attributes, calculated in BioSum from project data:

- Percent slope
- One-way yarding distance
- FVS simulation year for cost calculation
- Stand elevation
- Harvesting system
- Chip trees per acre
- Residue fraction for chip trees
- Chip trees average volume per tree (ft³)
- Chip trees average wood density (lbs./ft³)
- Chip trees hardwood proportion
- Small log trees per acre
- Small log trees residue fraction
- Small log trees average volume per tree (ft³)
- Small log trees average wood density (lbs./ft³)
- Small log trees hardwood proportion
- Large log trees per acre
- Large log trees residue fraction
- Large log trees average volume per tree (ft³)
- Large log trees average wood density (lbs./ft³)



- Large log trees hardwood proportion
- BrushCut (cut but not taken to landing) TPA
- BrushCut average volume per tree (ft3)

OpCost relies on a large number of treatment and harvest cost models developed from empirical data over the last couple decades for many harvest systems applied in different geographic regions to different topographies and silvicultural systems. The data in these studies includes much detail on kinds and number of machines typically used for a given system and unit costs for machine hours and labor, for example. For a given harvest system, say, “Ground based mechanical whole tree”, there might be a dozen studies with potential applicability to a given stand; however, some might be more applicable than others based, for example, on the yarding distance, slope and mix and quantity of trees sizes to be harvested in a given stand.

OpCost estimates treatment costs using all potentially applicable models derived from the literature, then weights those model results based on a “proximity” metric in stand attribute space such that some model results will contribute more than others to the overall estimated costs per acre of treating a given stand. For users interested in which models are used and how they are weighted, please consult the OpCost documentation found in Appendix Z, published at http://biosum.info/biosum/user%20guide/OpCost_Brief_Bell_Keefe.pdf, which also includes instructions on how to update machine and labor costs per hour, if warranted. Users interested in adding a new harvest system to the R script should consult with OpCost developers Conor Bell and Rob Keefe at the University of Idaho.

The OpCost button in the Processor module is used to verify that BioSum is pointed to the directory containing the OpCost R script.

1. Open the OPCOST settings window by clicking <OPCOST> from the Processor menu.

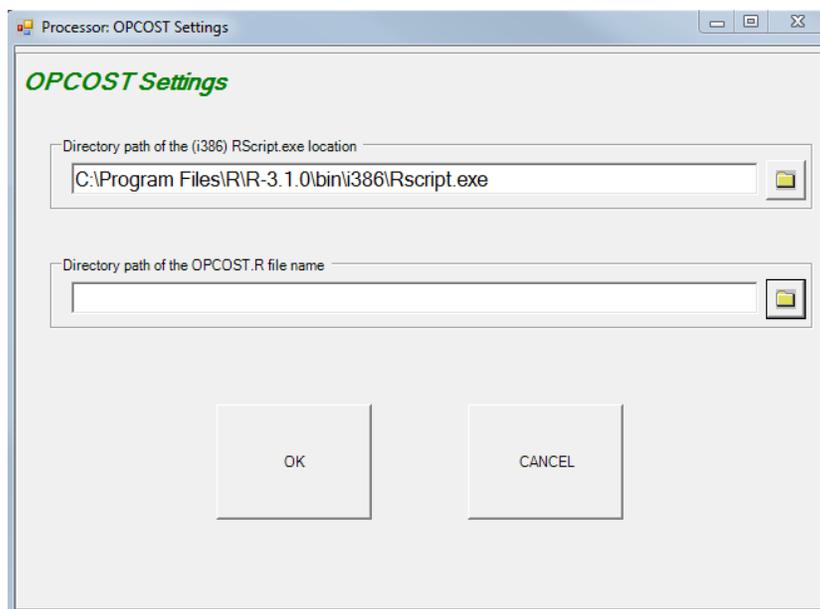


Figure 5.8 – OPCOST Settings window.

2. The top directory should be automatically populated to the default directory, the Rscript executable file in the R folder on the C:\ drive. This link will point to the version of R that was installed during the “full installation” of BioSum. OpCost was written and tested in version 3.1.0 of R, and is not guaranteed to work in newer versions.
3. The second directory path needs to point to the OpCost R script. Select the folder icon next to **Directory path of the OPCOST.R file name** and navigate to the R script found here: C:\Program Files (x86)\FIA PNW Portland Forestry Sciences Lab\FIA Biosum *version*\OpCost. Select the OpCost_*version*.R file and click <Open>.
4. Click <OK> to close the OPCOST Settings dialogue.

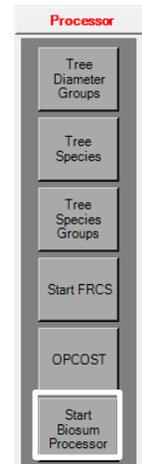
Start BioSum Processor

This task consists of several steps through which Processor scenarios are defined and executed to produce intermediate outputs that serve as inputs to the **Core Analysis** module. Calculations depend on links among tables in `project_name/db/master.mdb`, `project_name/db/ref_master.mdb`, `project_name/fvs/data/TreeLists/variant_code_TREE_CUTLIST.mdb`, and `project_name/processor/db/scenario_processor_rule_definitions.mdb`. Tables that are used as inputs include:

- The *plot* and *cond* tables in master contain information on the stands and conditions loaded in the current project.
- The *variant_tree_cutlist* tables contain biomass and volume estimates for harvested trees calculated using the FIADB Oracle Schema.
- The *tree_species* table is a reference table used to calculate the weight of harvested trees and convert FIA species codes to those used in FVS.
- The *tree_species_groups* and *diameter_groups* tables contain user-specified species and diameter group parameters. The *diam_dollar_value* table contains user entered product values by species and diameter groups.

Output from processor, which serves as essential input to Core Analysis, includes:

- The *harvest_costs* table, which stores cost per acre information generated by FRCS, and
- The *tree_vol_val_by_species_diam_groups* table, which stores key volume and value information by species and diameter groups.



1. To start the BioSum Processor, click the **<Start BioSum Processor>** button.
2. The **Processor Scenario** window will open. The first time BioSum Processor is started, a default scenario will be created titled **scenario1**. If scenario1 has already been defined and you wish to create a new scenario, click **<New>**. Enter a scenario name and description, then **<OK>**.

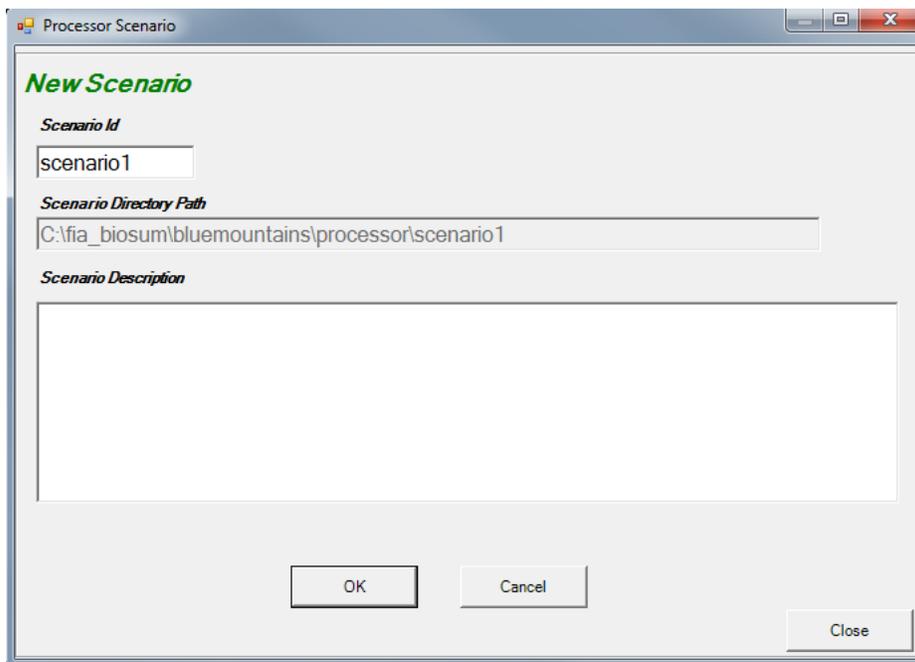


Figure 5.9 – New processor scenario window.

3. Select the scenario that you wish to define or refine in the **Scenario List** and then click **<OK>**.
4. The Processor **Scenario** window has four tabs: **Description**, **Notes**, **Data Sources**, and **Rule Definition**.
 - a. The **Description** tab provides a **Scenario Description** text box to enter or revise brief descriptive information about the processor scenario.
 - b. The **Notes** tab accesses a text box into which extensive notes may be recorded about the processor scenario for future reference.

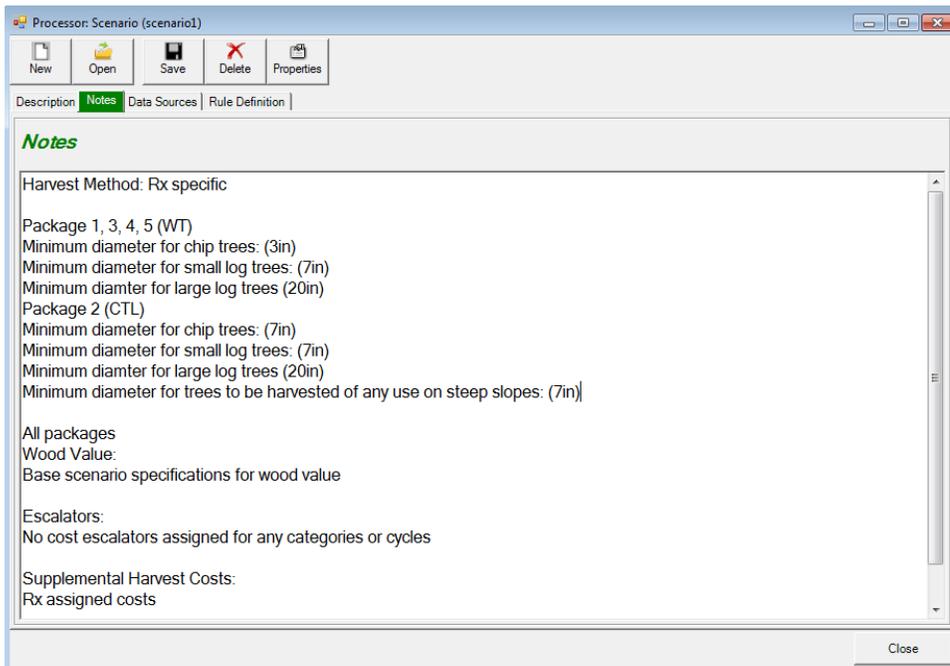


Figure 5.10 – Notes tab of Scenario window.

- c. The **Data Sources** tab displays pointers (file paths, file names, table names, status, records counts, etc.) to all types of source data used in the Processor scenario. Any of these data sources can be copied to another table or database and the pointer updated to point to the copy instead of the original data source. These copies can then be updated or customized to allow consideration of different situations. For example, if it was desired to customize the diameter groups for a particular processor scenario (and the core analysis scenarios that link to that processor scenario), it is easy to copy tree_diam_groups to another location (in the same MDB file or a different one) and edit the entries in the copy. To edit the pointer to the data source, and to make copies of data sources, select a table type and click **<Edit>**. The **Edit Data Source** window will appear. Here you can move, copy, or rename existing Access DB files and tables, and reset links for any table type.

Warning: Instigating changes to data sources is an advanced capability, not to be undertaken lightly or by BioSum beginners, and has the potential to be confusing.

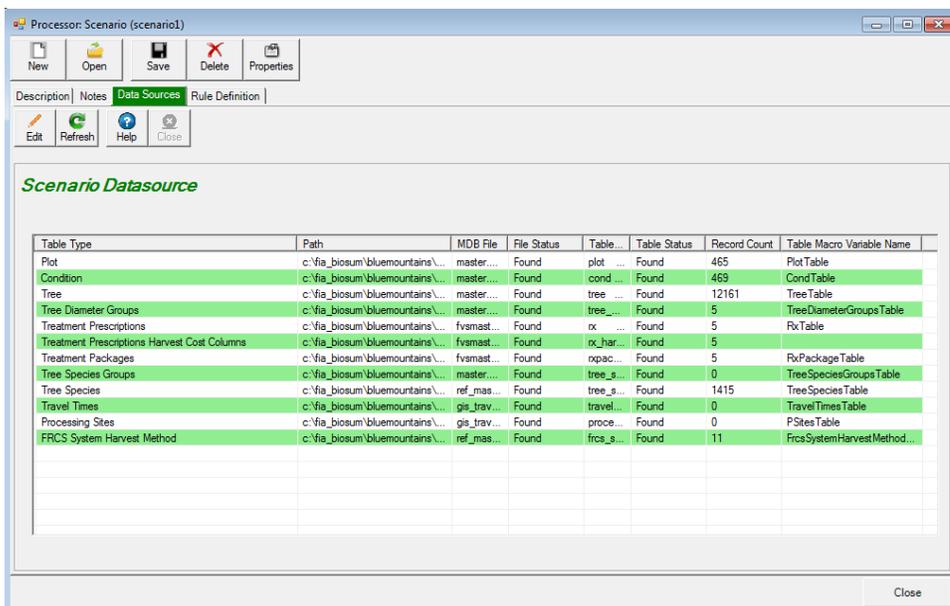


Figure 5.11 – Data Sources tab of the Processor Scenario window.

- d. The **Rule Definitions** tab is a trigger that opens five additional tabs for entering processor scenario parameters and selecting which packages and stands to process: **Harvest Method, Wood Value, Escalators, Supplemental Harvest Costs, and Run.**



Figure 5.12 – Harvest Method tab nested in the Rule Definitions tab of the Scenario window.

- i. **Harvest Method:** Every stand sent to OpCost for simulation via BioSum Processor must be assigned a harvest method. Harvest methods can be assigned within the FVS module during Rx creation or here, using the Harvest Method window.

1. By default, BioSum Processor will use the harvest methods that were defined for each treatment during treatment creation (FVS module.)
2. If you wish to instead define two standard harvest methods (one for steep, one for gentle slopes) that will be used for all treatments, uncheck the box next to **Use Treatment Default Harvest Method**. Select a **Low Slope Harvest Method** and a **Steep Slope Harvest Method** for your scenario using the drop-down menus. A description of each method is provided in the **Description** text box. Additionally, a list and description of the available harvest methods can also be found in **Appendix A** of this User Guide.
3. If different than the displayed default values, three tree size parameters can be defined by revising the entries in their respective entry fields: 1) **Minimum diameter for chip trees**—trees smaller than this may be harvested as part of the prescription but will not be collected to the landing and utilized; 2) **Minimum diameter for small log trees**—these are trees that can be harvested and processed by machine (if harvested under a mechanized harvest system) and utilized as logs (not chips); 3) **Minimum diameter for large log trees**—trees larger than this cannot be harvested and processed by mechanized equipment; rather they must be manually felled, bucked and yarded or skidded to the landing.

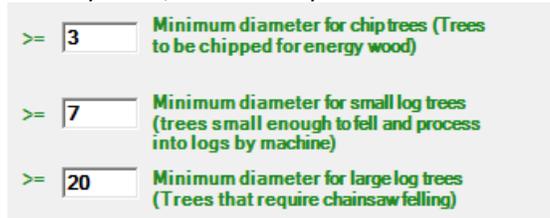


Figure 5.13 – Default diameter thresholds, revise as needed.

4. Define the **Percent slope threshold at which slope is categorized as steep** and the **Minimum Diameter of Trees to be harvested for All Uses ON STEEP SLOPES.**



Figure 5.14 – Default percent slope threshold for steep slopes and minimum tree diameter to be harvested for all uses on steep slopes, revise as needed.

In the **Cable One-Way Yarding Limits** section, define the maximum distance in feet for cable and helicopter yarding of harvested material.

Cable One-Way Yarding Limits (Feet)		Default
> 1300	Manual Whole Tree/Log, Manual Whole Tree, Manual Log, Manual Cut-to-Length	
> 10000	Helicopter Manual Whole Tree, Helicopter Cut-to-Length	

Figure 5.15 – Define cable one-way yarding limits.

- ii. **Wood Value:** This form provides for entering/revising the merchantable value in dollars per cubic foot, at the mill gate, for each species and diameter group combination in the project, and a value in dollars per green ton, at the delivery point (e.g., a biomass-based energy generating facility), for chipped residues (the material chipped at a treatment site and loaded onto a chip truck). To allocate a species/diameter group combination to energy wood, use the **Allocate to Energy Wood** checkbox. Note: if packages have different thresholds, or wood allocation, you can select parameters, and run for only appropriate packages. You can then return, change parameters, and run other packages.

Values Assumed for Delivered Wood at the Mill or Processing Site gate

Enter Average value in \$/cubic foot for each species group and diameter class for merchantable wood

Chip (Energy) Wood Values

Enter value for energy wood (chips) in \$/green ton: \$22.00

Species Group	Tree DBH Class	Allocate to Energy Wood	Merchantable Value in \$/ft3
dougfir_larch	3 - 5	<input checked="" type="checkbox"/>	\$0.00
dougfir_larch	5.1 - 7	<input type="checkbox"/>	\$2.01
dougfir_larch	7.1 - 10	<input type="checkbox"/>	\$2.26
dougfir_larch	10.1 - 20	<input type="checkbox"/>	\$2.50
dougfir_larch	20.1 - 999.0	<input type="checkbox"/>	2.5
other	3 - 5	<input checked="" type="checkbox"/>	\$0.00
other	5.1 - 7	<input checked="" type="checkbox"/>	\$0.00
other	7.1 - 10	<input checked="" type="checkbox"/>	\$0.00
other	10.1 - 20	<input checked="" type="checkbox"/>	\$0.00
other	20.1 - 999.0	<input checked="" type="checkbox"/>	\$0.00

Figure 5.16 – Wood Value tab, specify values assumed for delivered wood by diameter class and species group.

- iii. **Escalators:** The escalators tab offers the user an opportunity to apply a multiplier to costs or revenue, to be applied at the end of each cycle. Escalator values should be left at 1.00 unless it is expected that a revenue or cost will change at a rate that is different than general inflation. If, and only if, inflation for a cost or product price is expected to occur at a rate that is different from the general rate of inflation, enter an escalator value in the appropriate cost/cycle text box. For example, if it is anticipated that the carbon benefits of using wood as a construction material in lieu of concrete and steel drive its price up at 2% per year more than inflation index (such as the consumer price index, CPI, or producer price index, PPI) during the first 10 year cycle, then enter 1.22 (1.02^{10}) in the first cell on the second line. If this impact is assumed to end after the first decade (price does not rise faster than inflation for decades 2 and 3) then the other cells on this line would be left as 1.00.

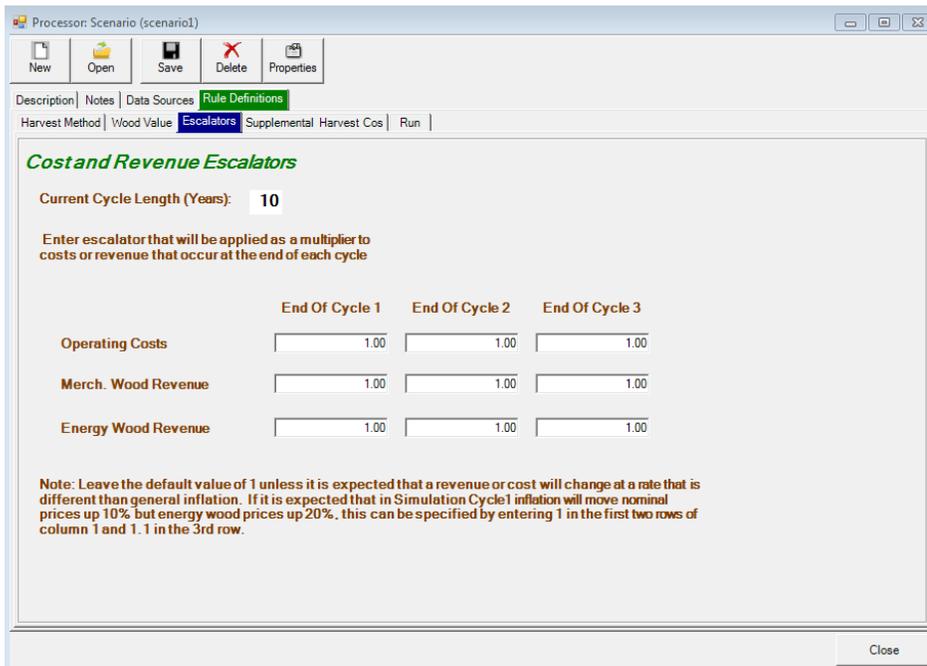


Figure 5.17 – Cost and revenue escalators tab.

- iv. **Supplemental Harvest Costs:** Within the FVS module, there was the option to specify additional harvest costs categories when prescriptions and packages were defined. This tab provides an interface for actually population these cost categories with suitable values.



Figure 5.18 –Supplemental Harvest Costs tab, specify new costs or edit costs previously added during Rx creation.

1. To assign a value to an Rx Harvest Cost Component that was created during Rx creation, enter a value (in \$/acre) in the text box under **Component Values**. There are several options in the values menu list for assigning a value for that cost component. Click the **<Go>** button to execute the user selected option.

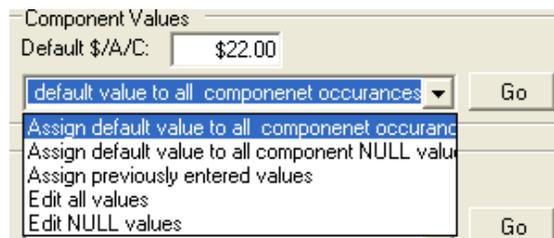


Figure 5.19 – Options for assigning values to a cost component.

Examples-(assume treatment id '050', harvest cost component brush_cutting_cpa, and a default value of \$22.00):

- **<Assign default value to all component occurrences>**: Each table row with a treatment id of '050' would get a value for a brush_cutting_cpa of \$22.00 per acre.
- **<Assign default value to all component NULL values>**: Each table row with a treatment id of '050; would get a value for the brush_cutting_cpa column if the value in that column is NULL.

- **<Assign previous entered values>**: Join the *additional_harvest_costs* table from a different scenario to the *additional_harvest_costs* table of the current scenario by stand/rx and update the brush_cutting_cpa values from the previous table to the current table for treatment id '050'.
 - **<Edit all values>**: Manually edit the brush_cutting_cpa column in the *additional_harvest_costs* table.
 - **<Edit NULL values>**: Manually edit all null values in the *additional_harvest_costs* table for the column brush_cutting_cpa.
2. To add a new cost component to be applied to all treatments in this processor scenario, click **<Add Scenario Component>**. When the Harvest Cost window appears, select a cost component from the drop-down list, or enter a new cost component, then click **<OK>**. Scenario components can be edited or removed by clicking the **<Edit>** or **<Remove>** buttons found under the Component Name section.
 3. Processor allows the user to copy supplemental harvest cost value per acre from one scenario to another. The process of manually adding these harvest cost columns to each stand/rx combination can be tedious; this copy function will speed up the process.
 - a. To copy supplemental harvest cost columns values from one scenario to another, click **<Update All Values Using Previously Entered Data>**.
 - b. Select the scenario from which to copy from, and click **<Select>**.
 - c. To confirm, select **<Yes>** when prompted.
 - d. Once the update has finished, click the **<OK>** button.
- v. **Run**: Once all the scenario rule definitions are complete, a processor simulation can begin. Note: Individual RxPackages within a single project may contain different Processor parameters by running a subset of rxpackages. For example, it may be the case that there are different minimum diameter thresholds in the rxpackages that use a Whole Tree harvest system, versus those using a Cut to Length method. In this case, users can input the Whole Tree parameters, run those packages through Processor, change the inputs to reflect a Cut to Length system, and then run the remaining packages.

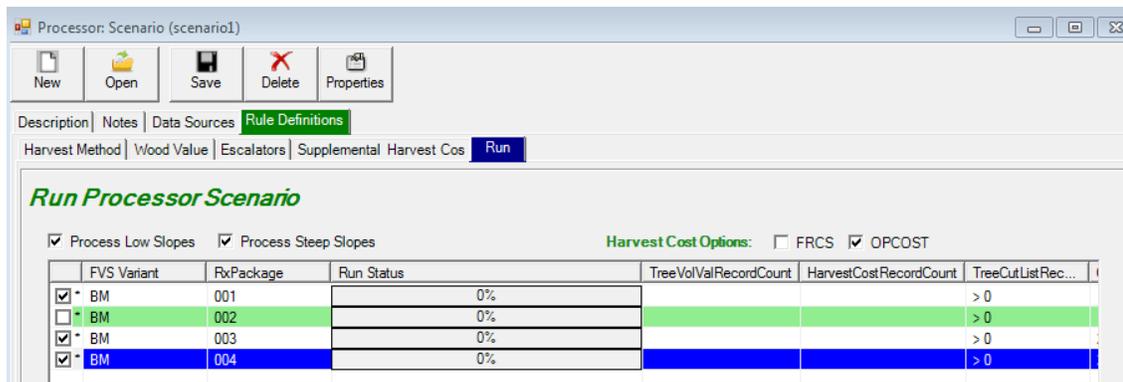


Figure 5.20 – Select variant/rxpackage combinations and run Processor Scenario within the Run tab.

1. Check the box next to any variant/rxpackage combinations to be included in the processor simulation. RxPackages that do not involve mechanical thinning will not appear on the list, and cannot be run through processor. Stands can be simulated separately by package, variant, or all together.
2. By default, Processor will include stands on both low and steep slopes. If you wish to filter by slope, uncheck the boxes next to either **<Process Low Slopes>** or **<Process Steep Slopes>** as desired.
3. To specify OPCOST as the harvest cost estimator, check the box next to OPCOST in the **Harvest Cost Options** section. Check next to FRCS if using the FRCS application.
4. Click **<Run>** to start Processor. Depending on computer speed and data size, this can take from several minutes to over an hour.

- When complete (all checked stands have a 100% bar in run status), click <Close> to return to BioSum Manager.

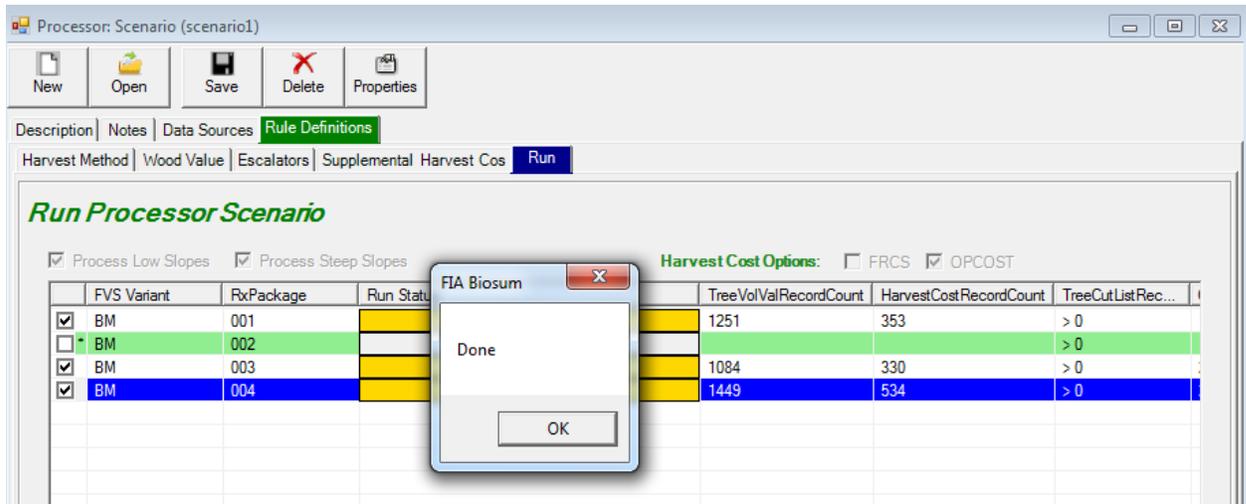


Figure 5.21 – Processor scenario successfully run with three variant/rxPackage combination.

- When you close the BioSum Processor form, you will return to the BioSum Manager and the data generated in the BioSum Processor will be stored in `processor/scenario name/scenario_results.mdb` in the tables:
tree_vol_val_by_species_diam_groups
harvest_costs

A short description of the Processor process

Access is used to create a table of diameters and categories of harvested material (utilized logs, utilized chips, and residue) from the *fvs_tree* table created in the FVS module. This table is populated with all diameters in 1/10 inch increments, from 1 inch to the largest diameter in the *FVS_TREE* table. The categories in the diameter tables entered as Y/N (yes or no) based on the diameters set in the minimum diameter text boxes on the BioSum Processor form.

Bins are created to store: tree count, trees per acre, merchantable volume, merchantable weight, biomass volume, and biomass weight for each tree harvested for chips, small logs, or large logs. The bins are filled based on the dbh of the tree and Y/N categories in the diameters table above.

The bins are then summed by plot, treatment, species group, and diameter group for merchantable weight in green tons, merchantable volume in cubic feet, biomass weight in green tons, and biomass volume in cubic feet. To this is added merchantable value in dollars per acre from the Value Entry form. This is saved in the *tree_vol_val_by_species_diam_groups* table.

Bins are totaled by plot and treatment type and a table is created with trees per acre, average volume in cubic feet, average weight in green tons, hardwood proportion, and chip fraction totaled by trees harvested for chips, small logs, and large logs. This table is then used as input to the OpCost process, which produces an estimate of harvest cost in dollars per acre for each stand and treatment. This data is stored in the harvest costs table.

Modification for Cut-to-length harvest systems (non whole tree harvest)

Due to a glitch, BioSum as of version 5.6.1, continues to “bin up” harvest residues as chip biomass and economic value (referenced collectively as chip values) as if these were delivered to the landing in all cases. Because log length harvest systems (i.e., all that are not described as “whole tree”) actually leave residues in the woods (as lopped and left, masticated, piled and burned or broadcast burned with prescribed fire), treatments implemented with these cut-to-length systems must, for now, have their chip values modified by the analyst in the

tree_vol_val_by_species_diam_groups table (hereinafter referred to as tree_vol) in Processor's scenario_results.mdb database before running core analysis.

There are various combinations of species class and diameter class that will need to be dealt with in different ways.

- Case 1:** Merchantable size trees of commercial species (e.g. Douglas-fir trees greater than 7" diameter). In these cases, chip values in the tree_vol table (chip_vol_cf, chip_wt_gt, and chip_val_dpa) consist of only tops and limbs, and can therefore be replaced with a zero value using an Access update query, given that tops and limbs are not delivered to the landing under log-length systems such as cut-to-length.
- Case 2:** Merchantable size trees of noncommercial species (e.g. bitter cherry trees greater than 7" diameter). Noncommercial tree species classified as chips within the Processor interface have chip values calculated by BioSum that include boles, tops, and limbs. Of course, in log length harvesting, only the boles are utilized as chips. To facilitate making corrections for these anomalies in handling biomass delivery under log length systems, an analysis of merchantable and chip biomass for the state of California was conducted. A bole fraction was calculated as the bole biomass divided by the sum of bole biomass and chip biomass for size classes greater than 7". Averages of the resulting bole fractions (which ranged from 0.61 to 0.66, depending on size class) could then be applied to the noncommercial species to get an admittedly rough estimate of delivered bole biomass under log length harvest systems. A similar analysis can be conducted to determine approximate bole fractions for any given project study area, or for a very rough estimate, a bole fraction of .64 can be applied to the chip values for noncommercial tree species of merchantable size, based on our California analysis.
- Case 3:** All trees of smaller size classes (i.e. size classes greater than the minimum threshold set for chip trees, but less than the minimum diameter set for small trees). Depending on specifications of harvest, these trees can be left in the stand, or the boles can be harvested and utilized as chips. In the former case, records can be dealt with in the same manner as Case 1, by zeroing out the chip columns. In the latter case, a bole fraction can be applied to these records, as specified in Case 2. In the California analysis, bole fractions were interpolated to estimate a value of 0.60 and this fraction was applied to the chip values in the smaller size classes to get better estimates of the actual delivered chip values for those trees.

We look forward to a future enhanced version of BioSum that avoids this "band-aid" step.