**OPCOST Settings**

This form is used to tell BioSum where to find the executable (or program) for R and the OPCOST.R script.

The top directory path 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 3.4.0 of R, and is not guaranteed to work in newer versions.

If you need to update the location of your R installation, be sure to choose the Rscript.exe version in the i386 directory. This is the 32-bit version that has been verified to work with OpCost/BioSum.

The second directory path needs to point to an OpCost R script. Select the folder icon next to Directory path of the OPCOST.R file name and navigate to the R script you wish to use. The OpCost R script packaged with your BioSum installation can always be found here: C:\Program Files (x86)\FIA PNW Portland Forestry Sciences Lab\FIA Biosum <current version>\opcost. Select the .R file and click <Open>.

Note that any errors generated when OpCost runs during processing can be found in a file named “opcost\_error\_log.txt” in your AppData\Local\Temp folder.

**Tree Diameter Groups List**

The Tree Diameter Groups List is used to specify diameter groups by which harvested tree volume and value will be summarized**.** In a later step, merchantable value per unit volume and energy wood value per unit weight will be assigned based, in part, on the diameter groups defined here.

Note: The diameter groups specified here determine how volume, biomass and value are summarized 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, then the processor and any related core analysis scenarios will need to be re-run to reflect the changes to diameter group definitions.

1. 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. 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. **Important! It is incumbent on the analyst to define diameter groups that comport with brush-cut, chip, small and large tree diameter thresholds limits specified during the work flow defined by the Start BioSum Processor task**.
2. To make changes to an existing diameter group definition, select the group from the list and click <Edit>.
3. To load, or revert to, the default diameter group specification click <**Use Default Values**>.
4. To delete a diameter group, select that group to highlight it and click **<Delete>**. To delete all diameter classes click **<Clear All>**.
5. When finished editing or adding tree diameter groups, click <Save>, and then <Close>.

**Tree Species help screen**

The Tree Species window initiates a dialog for conducting audits of cut list species attributes and for managing the tree\_species table stored in project\db\ref\_master. The purpose of this table is two-fold: 1) it provides a systematic method for assigning FVS species codes, that can vary by FVS variant, for every FIA species code in the FIA data, and 2) it stores the species specific parameters for wood density and green weight conversions that are used by BioSum to convert between volume and biomass, and from dry biomass to the green biomass values used in estimating haul costs. 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 three audits to be completed: (1) check if an FVS tree species value is assigned to each tree species record, (2) identify any combinations of FIA tree species, FVS variant, and FVS tree species that are absent from the *tree\_species* table, and (3) confirm that non-null oven dry weight and green weight conversion parameters ratios exist in the *tree\_species* table for every FIA tree species present in the cut list. To assure successful completion of the rest the Processor module, it is wise to first make sure that all three audits are successful.

1. 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/ *variant/*BioSumCalc*/variant\_*Pxxx\_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).
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 a 2-Character FVS Tree Species Value is Assigned to Each Tree Species Table Record”**, then click **<Run Audit>**. If the audit passes, the analyst will see a window displaying that the audit has passed. The audit will display an error message if any tree species in the table record does not have an FVS value assigned to it.
3. If this audit fails, results will be displayed for cases where tree species in the table record do not have an FVS species assigned. 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* in the Project/db directory
4. In the drop down list box above the tree\_species table, select the second 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 Processor, this second audit checks, using CUTLIST tables as the source, rather than the TREE table, to be sure that every combination of FIA tree species (as determined by the tree record in MASTER.TREE) and FVS tree species (as specified in the CUTLIST output) for a tree has a tree\_species record for the FVS variant where that tree exists. The audit will display an error message if this requirement is violated for any CUTLIST tree.
5. 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*.
6. To run the third 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 willfind instances of *tree\_species* records wherethe *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*.
7. Repeat Step 6 to ensure that every record that matches a cutlist tree has a valid wood density (oven dry weight) and dry to green ratio.
8. After all 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 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.
2. 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> button will remove the selected species from the group and the <Clear All> button will remove all species from the group, returning them to the full list of unallocated species at the left edge of the species groups form. Additional groups can be added by clicking the <Add Groups> button at the bottom of the form.
3. The **<Tree Audit Report>** button pulls up the Tree Species audit window, should the analyst need to edit tree species records or rerun an audit while using this form.
4. When finished assigning species to groups, the list of unallocated species will be empty. Click <Save>andthen <Close> to complete this task.

**Data Sources Tab**

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. 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.   
  
Caution: Making changes to data sources is an advanced capability, not to be undertaken lightly or by BioSum beginners, and has the potential to be confusing or produce unintended consequences.

**Processor Scenario (Description and Notes Tabs)**

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>, to begin work with a new scenario, or <Cancel> to return to the processor scenario selection dialog**
3. If not initiating a new processor scenario, 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 top-level tabs: **Description**, **Notes**, **Data Sources**, and **Rule Definition** and 5 action buttons (**new, open, save, delete, properties** and **copy**).
   1. The function of most of the action buttons is straightforward, but the copy function is less intuitive. To copy and existing scenario, first create a New scenario. With the new scenario open, select copy and then choose a scenario to copy into the currently open scenario. A dialog will appear asking for confirmation of the desire to copy FROM scenario A to scenario B—if the dialog statement is correct, choose Yes. A Done/OK dialog will display when copying is complete.
   2. The **Description** tab provides a **Scenario Description** text box to enter or revise brief descriptive information about the processor scenario.
   3. The **Notes** tab accesses a text box into which extensive notes may be recorded about the processor scenario for future reference.
   4. Click the **<Help>** button on the **Data Sources** screen for help on **Data Sources** functionality

**Rule Definitions (Harvest Method)Tab**

The **Rule Definitions** tab is a trigger that, after a moderate delay, the length of which depends on the size of the project and can be as long as a few minutes, displays six, second-tier tabs for entering processor scenario parameters and selecting which packages and stands to process: **Harvest Method**, **Move-In Cost**, **Wood Value**, **Escalators**, **Supplemental Harvest Costs**, and **Run**. Each of these second tier tabs access parameter settings that control some aspect of the Processor Scenario. If a scenario, say TimberPrice1 is copied into a new scenario name, say TimberPrice2, all of these parameter settings will be copied along with it. Then, if interested, for example, in the effect on treatment feasibility of higher or lower prices for merchantable and/or energy wood, one could modify wood values stored in the TimberPrice2 scenario, re-run BioSum, and see how the effect plays out.

Every stand-treatment combination must have an associated harvest method for OpCost to simulate costs when the information is passed to OpCost by BioSum Processor. Harvest methods can be assigned within the BioSum FVS module when prescriptions (Rx) are specified, or here, via the Harvest Method fields that, when populated, apply to all treatments in the scenario (Figure 5.15).

1. By default, BioSum Processor will use the harvest methods that were defined for each treatment during treatment creation (FVS module). The <**Defined by treatment**> radio button will be toggled as selected.
2. To instead define two standard harvest methods (one for steep, one for gentle slopes) that will be applied for all treatments in the processor session, select the radio button <**Specified below**>. Select **a Low Slope Harvest Method** and a **Steep Slope Harvest Method** for the scenario using the drop-down menus. A description of each method is provided in the **Description** text box. A current list and description of the harvest methods supported by BioSum and OpCost can also be found in **Appendix A** of this User Guide.
3. To allow OpCost to choose, for each stand, the harvest method that incurs the lowest cost, select the <**Lowest per acre cost**> radio button. Note that this option may or may not achieve purposes such as minimizing dead wood left in the stand following treatment, or maximizing wood extracted from the site.
4. 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 for utilization;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 which have boles potentially suitable for utilization as merchantable 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.Note that “chip trees”, as used here, refers to size class of trees from a harvest cost calculation point of view—these trees may be chipped and utilized as energy wood or not chipped and utilized as merchantable wood, or not utilized at all, depending on other settings selected by the user in the Processor module. Also, note that chipped wood (to be used for bioenergy, for example) may include either the boles or entirety of trees in the chip size class (depending on harvest system) and also the tops and limbs of merchantable sized trees (that may be costed as small or large log trees) and perhaps the entirety of small and large log trees belonging to noncommercial species.
5. Define the **Percent slope threshold at which slope is categorized as steep.** Stands on slopes greater than or equal to this threshold will be modeled as harvested using a harvest method appropriate for steep slopes, whether that method is determined at prescription level, for the processor scenario or by OpCost’s lowest cost logic.
6. The **Percent of woodland species biomass assumed of merchantable size** parameter determines how BioSum and OpCost account for harvesting costs for these species under different harvest methods. This assumption is needed because FIA does not have separate estimates of volume or biomass for merchantable and non-merchantable parts of these trees. Available equations estimate total volume and biomass.
7. The parameter **Percent of sapling biomass assumed of merchantable size** is needed because trees smaller than 5 inches dbh have no calculated bole volume, only total volume, in FIA databases. Whether all or parts of these small trees are utilized as merchantable logs, energy wood or not at all, the percent of their volume in boles is needed to accurately estimate treatment costs, and this parameter provides the basis for this.
8. The **Minimum Diameter of Trees to be harvested for All Uses ON STEEP SLOPES,** tells OpCostwhich trees need to be accounted as being transported to the landing, versus cut and left.
9. The **Cull threshold, above which trees are assumed nonmerchantable and processed instead as chips**, enables customization of how much of a tree must be rated as cull before BioSum assumes that it has no merchantable value and reverts to utilization as energy wood.

**Rule Definitions (Move-in Costs)Tab**

This form contains three parameters that can be used to account for the costs of moving logging equipment to a forest operation and one, **yarding distance threshold,** that does not relate to move-in costs, but does not readily fit within any other dialog. To estimate move-in costs, OpCost must know a rough average time required to move forest operations equipment (e.g., feller-bunchers, forwarders, chippers) from a previous location (either a home-base or another forest operation) to the location of the FIA plot where the stand exists. It must also know the number of pieces of equipment that will need to be moved in—a statistic that OpCost derives from the harvest system to be implemented—and, to obtain per acre move-in costs, the area of a forest operation over which the move-in costs can be distributed.

1. The yarding distance threshold overrides the yarding distance calculated between the FIA plot and the nearest point on the road network to address issues that arise when short yarding distances are passed to the operations cost equations within OpCost. For example, if the calculated distance for a particular stand, based on FIA plot location and road position, is 3 feet, a threshold value of 100 feet will modify that 3 to 100 when that stand’s data is passed to OpCost. For some of the equations used in OpCost to estimate yarding or forwarding costs for some harvest systems, providing small values for average yarding distance produces anomalous results because the values are outside the range of data that were used to fit the equations. Setting the threshold to 150 feet or greater will likely avoid these anomalies, though for some harvest systems (e.g., helicopter based ones), Processor and/or OpCost may internally override even this threshold with a higher threshold value.
2. Assumed Harvest Area, in acres, is used to convert move-in costs for the stand to a per acre cost that can be summed with the operations and supplemental harvest costs per acre to obtain total per acre costs. The parameter value should reflect the typical size of forest operations that implement the kinds of treatments being modeled.
3. Given the uncertainty concerning exactly where equipment might be based, one option for obtaining a rough approximation of move-in time (which OpCost uses to obtain move-in cost) is the simplistic assumption that equipment “lives” where merchantable wood processing facilities exist (i.e., in at least a semi-developed area), and specifically, at the nearest facility for processing merchantable wood. To model that assumption, the analyst would enter a “1” for the **Move-in Time Multiplier**. Alternatively, any non-negative value other than 1 can be selected to represent at time that is a fraction or multiple of the time to the closest wood processing facility. If desiring a move-in cost estimate that depends only on travel time to the nearest wood processing facility, ensure that the **Move-In Adjustment** is set to zero.
4. Another option is to assume a fixed move-in time for all stands that is independent of where stands are relative to wood processing facilities. To do so, set **Move-in Time Multiplier** to zero (effectively cancelling out the use of travel time in the calculation) and set the fixed **Move-in Adjustment** time (in decimal hours) to a non-negative value.
5. The third option is to combine approaches—e.g., a value of 0.5 for **Move-in Multiplier** and 0.75 for **Move-in Adjustment** would calculate move-in time as the sum of half the travel time to the nearest merchantable wood processing facility and 45 minutes.

**Rule Definitions (Wood Value)Tab**

This form provides for entering/revising the merchantable value in dollars per cubic foot, at the mill gate, for each combination of species and diameter group represented in the Processor scenario, 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). The latter should be entered in the field labeled “Energy value for energy wood (chips) in $/green ton”. To allocate a species/diameter group combination to energy wood, use the **Allocate to Energy Wood** checkbox. Note: if silvicultural sequences are designed to have different thresholds, or wood allocation choices, it is possible to select parameters, and run processor for one set of sequences with one set of wood value parameters, then run another set of sequences with a modified set of parameters.

**Rule Definitions (Escalators)Tab**

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 (i.e., 1.0210) 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. Note that if modeling 5 year cycles instead of 10 year ones, the formula above would need modification.

**Rule Definitions (Supplemental Harvest Costs)Tab**

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

* + - 1. To assign a value to an Rx Harvest Cost Component that was created a the time the Rx was defined, locate the Rx Harvest Cost you wish to add a value to under the **Component Name** heading. The analyst can enter a description for that Cost Component in the **Description** text box. Enter a cost per acre in the **Assign Values: Default cost/ac** section. There are several options in the Assign Values drop-down box for assigning a value for that cost component. Click the **<Go>** button to execute the user selected option (see below).

For example, suppose you want to modify the additional harvest cost values, for treatment id ‘050’, for the harvest cost component brush\_cutting\_cpa, to assign a value of $22.00). You would first find the row for component name brush\_cutting\_cpa. Then you could:

* **<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 Processor 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 (via entry/edit form) the brush\_cutting\_cpa column in the *additional\_harvest\_costs* table.
* **<Edit NULL values>:** Manually edit (via entry/edit form) all null values in the *additional\_harvest\_costs* table for the column brush\_cutting\_cpa.
  + - 1. 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.
      2. 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.
         1. To copy supplemental harvest cost columns values from one scenario to another, click **<Update All Values Using Previously Entered Data>.**
         2. Select the scenario from which to copy from, and click **<Select>**.
         3. To confirm, select **<Yes>** when prompted.
         4. Once the update has finished, click the **<OK>** button.

**Rule Definitions (Run Processor)Tab**

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.

1. Check the box next to any variant/rxpackage combinations to be included in the processor simulation. Silvicultural sequences (RxPackages) that do not involve mechanical thinning, for example a grow-only sequence, will not appear on the list, and cannot be run through Processor. Stands can be processed one at a time, by package, by variant, or all stands in one run.
2. Click **<Run>** to start Processor. Depending on computer speed and data size, this can take from several minutes to over an hour.
3. When complete, a “Done” OK dialog will display (it may display underneath other windows on the desktop). Click OK to confirm this. All checked stand package combinations should have a 100% bar displayed for run status. Click **<Close>** to return to BioSum Manager**.**
4. Closing the BioSum Processor form, returns the display to the BioSum Manager; the data generated by Processor will be stored in processor/[scenario name]/scenario\_results.mdb in two tables:
   * tree\_vol\_val\_by\_species\_diam\_groups
   * harvest\_costs