**Plot FVS Variants help screen**

FVS simulations rely on equations (such as those that predict diameter and height growth) and computation code that differ among geographic areas, known as “variants” in FVS parlance. Surface fuel model assignment, site class calculation, mortality estimation, crown ratio and crown width parameters, and fuel moisture content assumptions are a few of the many other items that differ among variants. Thus it is very important that each plot, and the stands (conditions) that it contains be assigned to the variant in which it geographically resides. The *fiadb\_fvs\_variant* table in the *ref\_master* database contains the correct variant assignments for all plots in the FIA database in the states of CA, OR, WA, ID, MT and UT.

1. To assign the appropriate variant to plot records or to review the current assignments, select **<Plot FVS Variants>.**
2. The **Plot FVS** **Variants** window will appear, with a list of plots and their existing FVS variant assignment in a sienna-brown colored, editable column. This table can be browsed, sorted (indexed) or filtered, via functions available from the right click menu when right clicking while the cursor is placed in the desired column. However, it is easier to find cases of plots that lack a variant assignment by running an “audit” on the plot. Ignoring audits could result in unidentified issues that corrupt or invalidate the BioSum analysis.
3. To run an audit select the button labeled **<Check For Plots Without Variant Codes>,** which initiates a script that identifies plots without a variant assignment. A message box will indicate whether the audit passed or failed, and if it failed, those plots without variant assignments will appear in the table in the upper half of this task window, provided they exist in the fiafb\_fvs\_variant table in the database.
4. Select the records to be updated using the **<Check All>** button, or manually select individual plot records. After records are selected, update plot table using the **<Update Plot Records With FIADB FVS Variant Table>** button to automatically make variant assignments based on the values in the fiadb\_fvs\_variant table in the *ref\_master* database. To confirm that all plots have been assigned a variant, the audit can be re-run by selecting **<Check For Plots Without Variant Codes>**.
5. If plots exist outside the states for which the fiadb\_fvs\_variant table contains variant assignments, it will be necessary to correct NULL values manually.
6. Click **<Save>,** then **<Close>** to save the FVS variant assignments and exit the task window.

**Rx- Treatment List window help screen**

We refer to treatments as “Rx” throughout this guide. Treatments ultimately consist of a file of keywords and parameters provided to FVS to guide what happens at a particular time. For example, one might define treatment 200 as “thin across diameter classes (a constant harvest proportion applied to all diameter classes) to a residual density of 85 sq. ft basal area per acre, while cutting no trees larger than 36” in diameter, using mechanized whole tree harvest on gentle slopes and cable manual logging on steep slopes”.

The harvest systems are not specified in the KCP file, but the implications of their use are, for example, via “yardloss” keyword statements indicating the quantity of wood residues left behind. To model a different residual density or upper diameter limit, you would create additional prescriptions (e.g., 201 with residual basal area=100, upper dimeter limit 36”, etc.). Sometimes two treatments will be identical except that one uses whole tree harvest systems and captures all or most forest residues for utilization while the other relies on a log length system that brings only merchantable logs to the landing, leaving residues in the forest, possibly to be treated later at additional expense.

Treatments may also include activities that take place in the stand that are not harvest per se, for example, piling and burning or masticating harvest residues; however, these are usually specified as supplemental (to tree harvest) activities that incur additional harvest costs specified by the user. Once treatments are defined, they can be assigned to one or more prescription packages, which are simply sequences of either the same or different silvicultural prescriptions, implemented over 4 cycles. Note that some cycles in a package may have Rxs that are essentially “grow-only” and harvest no trees. By convention, it can be useful to define Rx 999 as grow-only, for repeated use in a grow-only silvicultural sequence.

Prescription definition workflow is as follows:

1. Define silvicultural treatments to be applied in FVS by clicking **<Rx>** to load the Rx task window.
2. For each treatment to be added to the project:
   1. Select **<New>** to open the **Treatments** window, which will display three tabs: Treatment, Harvest Method and Additional CPA.
   2. **Treatment:** After selecting the treatment tab, choose Prescription ID number. After choosing one for the new Rx, enter a brief description of that treatment. Apply your edits by clicking **<Select>.**
   3. **Harvest Method**: Choose the Harvest Method tab. Select a harvest method for low slopes and a harvest method for steep slopes. Percent slope threshold at which a slope is categorized as steep will be specified later in the Processor module of BioSum. Once a harvest method is selected, a brief description of the method will appear in the Description text box.
   4. **Additional CPA:** Add any additional harvest cost components – i.e., those that are not accounted for by the OpCost model, such as the cost for conducting prescribed fire or pile and burn operations. The actual costs (in dollars per acre) of these components will need to be assigned during the Processor phase of BioSum. To define a cost component, select **<New>** and enter the name for the cost component and a brief description in the window that pops-up.
   5. When all desired information has been entered (treatment and harvest method are required; others are optional), select **<OK>** in the upper left hand corner to return to the Treatment List. Click <**Save**> to save the treatment.
3. To make changes to a treatment displayed in the treatment list, select it and click **<Edit>**.
4. When finished creating or editing treatments, click **<Save>,** then **<Close>,** to exit **Treatments** window.

**Rx Package- Treatment Package List window help screen**

In BioSum a series of treatments applied to a stand over a 15 or 30 year time period (three 5-year cycles or three 10-year cycles) is referred to as an Rx package. An Rx package consists of a sequence of one or more of the Rxs already defined with the possibility that some cycles will have no Rx assigned or a prescription of grow only.

1. Assemble a sequence of silvicultural prescriptions to be applied in FVS by clicking **<Rx Package>** to load the Treatment Packages task window.
2. To create a new package:
   1. Select **<New>** to open the Treatment Package Item window, which has two tabs: Package and Additional CPA.
   2. **Package:** To create a new package**:**
      1. Select an available package ID number from the **<Package ID>** drop-down list.
      2. Write a brief description of the package in the **<Description>** text box.
      3. Next, specify whether your projection will utilize 5- or 10-year cycles by selecting the radio button next to the cycle length of choice in the **<FVS Cycle Length>** box. (Note: all packages within a BioSum project must have the same cycle length.)
      4. To add a treatment to a cycle year, select the year: 00, 10, 20, or 30, and click **<Edit>.**
      5. Uncheck the box next to **<Skip Treatment>** (by default, each cycle will be populated with a “skip treatment” via the check box)**.**
      6. Assign a prescription from the dropdown list next to **<Rx ID>.** You will see a list of prescription ids that have been defined in this project within in the dropdown window. Select the prescription to assign.
      7. Select **<OK>** to add the treatment to the package. The treatment selected should appear next to the desired year along with its description.
      8. To add another treatment to the package, return to step IV. If no treatment is to be administered in a cycle year, no action is necessary; BioSum will assume no treatment when the “skip treatment” box is checked.
   3. **Additional CPA:** This window contains a list of harvest costs, assigned during **Rx** creation, for each prescription in the package. These items are read-only since they are bound to the treatment.
   4. Click **<OK>** to close the Treatment Package Item window.
3. Repeat step 2 for each package you wish to create. When finished, click **<Save>** then **<Close>** to exit.
4. To make changes to a treatment package you have already created, simply select the package from the Treatment Package List table and click **<Edit>.** Select **<Delete>** to delete a package from your project. Remember that no changes, including deletions, are saved as final until clicking <**Save**> at the bottom of the Treatment Package List.
5. To display full documentation of prescriptions and packages in the project click **<Properties>** from the Treatment Packages window to open an text file in a separate BioSum window.
6. Click **<Close>** to exit the Treatment Packages window.

**Tree Species help screen**

FVS predictions are customized to both geography and tree species, via allometric, regional and tree species specific equations for tree growth, mortality, and volume. Therefore, each tree in a BioSum analysis must be assigned an FVS tree species code. The FIA database, however, has a greater number of tree species than are specifically simulated in FVS. The *tree\_species* table in the project’s *ref\_master* database contains FVS species code assignments for many FVS variant and FIA species combinations. If you have a tree species in your data that is not recognized by the FVS variant used for prediction, the *tree\_species* reference table may be customized to “map” that species to one that FVS does recognize for that variant. Trees that have not been assigned a FVS species code valid for the variant in which they are modeled can lead to unpredictable results, including invalid predictions of growth and biomass and volume that “disappear” from the analysis.

1. The **Tree Species** window displays the *tree\_species* reference table. This table can be browsed, sorted, or filtered to find specific tree and variant combinations, or reference oven dry weight and dry to green values for specific tree species. To sort or filter, right click in a cell under the desired column type and select the desired type of filtering.
2. To ensure every FIA tree species and FVS variant combination in your project has an assigned FVS species code, select **<Run Audit>** from the Tree Species window.
3. A list of species\variant combinations without an assigned FVS species code will appear in the **Audit Results** table in the upper half of the window, and a pop-up window will appear with audit details. If there are no missing values in your project database, a pop-up window will appear stating that the audit has passed. If your project contains tree species that do not have a corresponding FVS species code in the *tree\_species* table, an error message will appear to alert you that the audit failed.
4. To add the records with null values (missing or invalid FIA/FVS species code combinations) to the *tree\_species* table, select the check boxes next to each record, or use the **<Check All>** button to add all records with null values, and then click **<Add Checked Items To Tree Species Table>.** To clear any selected records in the Audit Results table click <**Clear All**>.
5. Once records are in the *tree\_species* table, a record can be edited by clicking the **<Edit>** button to open the Procesor Tree Species Edit window to edit the FVS variant, FIA tree species code, common name, oven dry weight, and other descriptors associated with the selected entry.
6. Save edits to the *tree\_species* table by clicking on the **<Save>** button. Changes to the table will not be updated until saved.
7. If duplicate tree species\variant combinations are found within the table, a warning will appear when changes are saved. Close the warning window using the **<OK>** button, select one of the duplicate records in the table, and click **<Delete>**. Be sure to **<Save>** your update.

**FVS Input Data help screen**

This window allows the analyst to create the files necessary for FVS growth projection: a database with condition and tree tables, and a KCP file. It is recommended that when using BioSum, these files are created using the FVS Input Data tool to ensure consistancy throughout the workflow.

All data fields required for FVS projections, including fields that are to be used to calibrate growth projections (e.g. increment data, seedling records, tree defect values) should be added when importing plot data into BioSum. Otherwise, these fields will not be included in FVS input files created by BioSum.

BioSum creates an SQLite FVSIn.db to be used as input to FVS starting with the STANDINIT\_COND and TREEINIT\_COND tables from an FIA Data Mart as input. BioSum filters the contents of those tables to only include stands and trees that are part of a BioSum project.

To create FVS input files:

1. The **<Create FVS Input Database File>** button executes the process to create FVS input database and populate it for the variant(s) selected in the grid. Click the <**Check All>** checkbox to select all variants or select the desired variant(s) by clicking on the check box next to each.
2. When creating FVS input files, BioSum starts with the STANDINIT\_COND and TREEINIT\_COND tables in an FIA Data Mart SQLite database. The **path to the FIA Datamart input SQLite database** to be used by BioSum must be specified before creating an FVS input database. Each state has its own FIA Datamart database. If generating input files for an FVS variant that spans multiple states, this process needs to be run once for each state.
3. The **Selected Group** should be specified. The options for this list come from the FVS\_GroupAddFilesAndKeywords table in the template FVSIn.db. The template FVSIn.db can be found in the application installation db folder.
4. It is recommended to review the options on the screen before creating the input file. See the FVSIn Options information below for details regarding the usage of DWM and Tree Growth Calibration data in the FVSIn process.
5. BioSum may recalculate some fields in the STANDINIT\_COND and TREEINIT\_COND tables as recommended by FVS. An input database is created and populated with data for each selected variant and can be found in the \fvs\data folder.

BioSum copies the keywords.kcp.template file into the fvs\data folder when the FVSIn.db is generated. These template kcp files should be further customized and used to format FVS output.

1. BioSum generates a log file named biosum\_fvs\_input\_debug.txt also in the fvs\data folder that can be used for reconciliation or troubleshooting. BioSum makes a record of the settings used to create the FVSIn.db file in a table called biosum\_fvsin\_configuration in the FVSIn.db.
2. Once the FVS input database files have been createdthe FVS Input Data window can be closed.

**FVSIn Options**

The other controls on this window affect what data is brought into the FVSIn.db database. It is up to the analyst to understand how to tell FVS whether and how to use the information that ends up in this database. For example, you can choose to rely on the surface fuel model recorded by FIA field crews (for the years it is available—2013 and later) or the calculated down wood biomass—both can be propagated to the FVSIn file, but the analyst will need to tell FVS which to use as the basis for representing surface fuels (relied on heavily to calculate the estimates in the POTFIRE and CARBON tables, for example) in the KCP file.

Down woody material can be filtered by Transect Length—for example, if a forested condition occurs on only one subplot, and on only a part of that subplot, the **Minimum CWD Transect Length (ft)** could be as short as 5 feet or less—a VERY small sample on which to base surface fuel biomass estimates, so the analyst might choose to set a higher threshold and pass CWD to FVS only for conditions (stands) where the transect length on which down wood was sampled, exceeds that threshold. It’s advisable to consult the field guides for each year of data you are interested in using, and/or the down wood tables, and/or an FIA analyst, for assistance in making these choices. The number, orientation and length of down wood transects has changed repeatedly over the past two decades.

Early in the annual inventory, confusion about duff and litter protocols (some due to the use of tenths of inches as a unit) leaves many analysts with little confidence that they are consistently and correctly recorded. The **Duff/Litter Years to Exclude** filtering checkboxes provide the option to load duff and litter data (for example to represent fuels or forest floor carbon) except for certain years (in which case FVS will assign what it “thinks” is a viable default for stand data collected in those years).

Checking the **Tree Growth Calibration** data boxes (checked by default) for previous height and/or diameter will result in those values being loaded for every tree which has those values populated in the FIADB database. These can be found in the FVSIn database’s FVS\_TREEINIT\_COND table’s tree-level height and diameter growth fields (FVS\_TREEINIT\_DG; FVS\_TREEINIT\_HTG). When these values are populated, FVS will use them to calibrate its species-level growth models towards values empirically observed within each stand.

If seedlings are present in the master.tree table, unchecking the <Include seedlings from FIADB> checkbox provides the option to exclude them from FVS input. A seedling is defined as a tree with a 0.1 diameter.

**FVS Output PRE-POST Sequence Number Definition**

For each table to be loaded from FVS output and used in the Treatment Optimizer workflow or for other analytic purposes, up to 8 table records per stand can be loaded into the BioSum PREPOST databases (each of which contains a PRE and a POST table) for each package, corresponding to whichever FVS cycles are most useful for analysis—a decision that needed to have been at least partly made before the FVS simulations were conducted. If the data will be used for a pre-post optimizer analysis at BioSum cycle 1 (the only BioSum cycle for which an optimizer pre-post analysis is possible), it is typically important that the BioSum Cycle 1 PRE and POST values entered be the FVS cycle at which treatment first occurs and the first FVS cycle after treatment occurs (usually 1 year later), respectively. The “sequence numbers” (abbreviated SEQNUM) are really the same as the FVS cycle numbers and are not named “cycles” mainly in order to avoid confusion with the 4 “BioSum cycles” in BioSum’s conceptual framework.

**Editing sequence number assignments**

Multiple tables can be selected for editing of SEQNUM assignments by use of **<control><left-click>** after clicking the first table to toggle the selection highlight, but some combinations are not possible to edit in a single edit session. POTFIRE and STRCLASS must each have their sequence numbers defined separately from the other tables owing to idiosyncrasies of those table designs. The CUTLIST table is not listed in the set of choices for editing SEQNUM assignments. It will automatically be loaded as long as the SUMMARY table is assigned a SEQNUM pattern for loading (at a minimum, SUMMARY must be specified for loading in every BioSum project) – the CUTLIST table will always load consistent with the SEQNUM assignments made for SUMMARY.

After one or more table types are selected for editing SEQNUM assignments, the next step is to click the **<Edit>** button. If the patterns suggested in the User Guide’s FVS chapter are implemented during FVS simulation, then assignment is easy. Just select the pattern label from the **<Choose SEQNUM Assignment Template>** dropdown corresponding to the Timeint code block that was the basis of the FVS simulation. The options are:

1. **Mgt1X**, if treatments occurred only in the first BioSum cycle (regardless of whether the interest is in a PREPOST or WTD\_MEAN analysis in Optimizer)
2. **Mgt4X\_PrePost** if treatment could happen in more than BioSum Cycle 1 and if it is necessary to have FVS outputs from Pre and Post-treatment years
3. **Mgt4X\_WtdMean** if treatment could happen in more than BioSum Cycle 1 and if only weighted mean comparisons (between a treatment sequence and a baseline sequence) are contemplated and it is not important to have FVS output for pre- and post-treatment every cycle.

If none of these templates is applicable, careful attention needs to be devoted to understanding the Timeint block so that it, and needs with respect to number of cycles with treatment and whether pre-post or weighted mean analyses are desired, can be considered in choosing the right FVS cycle to load into each of the 8 registers (Pre and Post for BioSum cycles 1-4). Inspecting the SUMMARY table and noticing when RTpa > 0 can be helpful in understanding when treatments result in harvested trees—typically, those records would be the Pre-treatment instance for a BioSum cycle and the record with the next larger year value (i.e., the next SEQNUM) would be post, if working with the SUMMARY and STRCLASS tables.

**FFE based table considerations**

For FFE based tables (POTFIRE, CARBON and most of the others), each table record shows values AFTER any scheduled tree harvest has occurred (but before growth or any fires, including pile and burns, have been simulated). For those tables, it is essential to check the **<FFE>** box next to the **<Choose SEQNUM Assignment Template>** drop down so that the correct values are loaded. For example, with **Mgt4X\_PrePost**, checking the FFE box ensures that the BioSum Cycle 1 Pre values are truly pre-treatment (FVS cycle and SEQNUM 1, the “grow-only year”, rather than SEQNUM 2, which holds values that reflect trees being cut in FVS Cycle 2). Not checking FFE would bring SEQNUM 2 values in as Pre, when they are not, in fact Pre.

Click **<Done>** when SEQNUM values are as desired or **<Cancel>** to abandon the edits. Click **<Close>** when finished specifying SEQNUM patterns for all tables to be loaded into PREPOST databases. Finally, click **<Save>** to save revisions to the SEQNUM assignments. The **Assigned Count** in the table grid indicates how many registers are scheduled to be populated with data from the FVS output tables. **Tables with a count of 0 will not be imported into PREPOST databases.**

Typically, all of the tables should be loaded into PREPOST databases with the same underlying SEQNUM preset (e.g., Mgt4X\_PrePost OR Mgt1X, not some tables with one of these and others with another preset). The SEQNUMs themselves will differ depending on whether a table is FFE patterned or SUMMARY patterned, as explained above. It is **VERY** important to inspect all SEQNUM assignments for **ALL** tables for consistency before proceeding to step 2 and beyond. See the BioSum Users Guide for more information.

**Join and Append FVS OUT Data**

There are 4 required and 2 optional tasks managed here, with the required tasks to be executed in sequence. Only Steps 2-4 and the pre- and post-append and audit tables and logs buttons respect the status of the checkboxes adjoining FVS variant and package identifiers—the other selections in the drop down “step list” apply to all variants and packages.

Defining the sequence number assignments (**Step 1**) builds the data structures that control FVS output loading. See the BioSum Users’ Guide for details on how to assign sequence numbers; the help screen accessed from the sequence number assignment dialog (reached via **Step 1**) summarizes the mechanics of that specification. Variant-package combinations showing an “a” next to the checkbox have not yet been appended (or the source data in what was exported for that combination from FVSOut contains a more recent time stamp than what is currently loaded in the BioSum data structures.

**Steps 2** and **4** are audit steps that assess data readiness and perform QA chores on the package-variants with checked boxes.

**Step 2-Pre-Processing Audit Check**

When running the **Step 2-Pre-Processing Audit Check**, packages that cut no trees (for example, grow-only packages) will throw a warning dialog that can be cleared with a **<Yes>** click.

The audit operation builds and analyzes temporary databases that live within your windows\user\[username]\appdata\temp folder. The sizes of these databases as the audit proceeds are monitored with progress bars as a diagnostic in case a glitch occurs owing to exceed the MS Access maximum database size allowed (2 GB).

When the audit concludes, a dialog appears returning an audit status. Click **<OK>** to dismiss this dialog after reviewing it. Detailed information about any issues that arose can be viewed clicking the **<Open Pre Audit Log>** or **<PRE-APPEND Audit Tables>** buttons.

**Step 3-Append FVS Output Data**

Step 3 loads the FVS output data into BioSum PrePost databases (in the project’s fvs\db folder) and the cut tree list in the FVSOUT\_TREE\_LIST.DB (in the project’s fvs\data folder). A warning dialog for packages with no harvested trees can be cleared—this is typically displayed when a package is grow-only (so no cut trees will be written to FVSOUT\_TREE\_LIST.DB), but such packages nonetheless must be loaded into BioSum (to populate the PrePost databases). When the loader calculates volume and biomass of the projected trees, you will see a black window appear for a short time.

**Step 4-Post-Processing Audit Check**

It is essential to complete the post-load audit to ensure data integrity, **step 4**. Audit results will post to the Audit Results dialog and be written to the log file that can be accessed via the **<Open Post Audit Log>** button. It is common for there to be warnings about species changes, almost always due to the mapping of species that must be specified in the Tree Species table to address the fact that some trees in an FVS variant will not be directly supported as the species that they are.

After successful loading and a clean bill of health from pre- and post-append audits for every variant package combination, one can proceed to the Processor module. There are two optional tasks that can be completed here at any time—they source data from the FVSOut.DB and do not depend on a successful append operation. They also act on all package combinations represented in the FVSOut database (ignoring the checkboxes).

**Create FVSOut\_BioSum.DB**

The **Create FVSOut\_BioSum.DB** task writes an SQLite database, sourced from FVSOut.DB, that formats all data as data types that are fully compatible with MS Access. This can be very helpful if needing to work with FVSOut data from MS Access, as the native data types in that database (such as LONG TEXT, which translates to Memo in Access) are nearly impossible to work with (e.g., sort, filter, etc.). As this is not a small file, it only makes sense to create it if you believe you will use it. Moreover, it can be created at any time, as it is not used in any BioSum module.

**Write FVS\_InForest to FVSOUT\_TREE\_LIST.DB**

The **Write FVS\_InForest to FVSOUT\_TREE\_LIST.DB** task copies all data from the TREELIST in FVSOut.DB into the FVSOUT\_TREE\_LIST.DB (in the project’s fvs\data folder). This can be useful if needing tree level biomass or carbon data, for example, at all time points in the simulation for analysis beyond what the BioSum framework manages directly. As this is not a small file, it only makes sense to create it if you believe you will use it. Moreover, it can be created at any time, as it is not used in any BioSum module.

Additional columns in the data grid (which can be scrolled to see) provide status information that is sometimes useful for diagnosing issues.