Landscape Analysis Software Tools

Don Vandendriesche[1]

Abstract—Recently, several new computer programs have been developed to assist in landscape analysis. The "Sequential Processing Routine for Arraying Yields" (SPRAY) program was designed to run a group of stands with particular treatment activities to produce vegetation yield profiles for forest planning. SPRAY uses existing Forest Vegetation Simulator (FVS) software coupled with a user interface that allows easy input of stand types, their associated silvicultural prescriptions, and possible timing options. Additionally, two support programs that facilitate data processing and interpretation are available. The "Combine" program was developed to summarize data at the strata level. This entails compiling output from individual samples (i.e. inventory plots or stands) and reporting composite values that can be used by SPRAY during batch processing. The "Yield Examination Program" (YEP) provides a graphical display of the vegetation yield profiles. YEP imports data from SPRAY output files to populate the data sources used for rendering scatter plots. A brief synopsis of each program is presented.

SPRAY Program

Planning at the landscape scale requires grouping many stands of like attributes, analyzing numerous vegetation treatment options, and assessing their related outputs. The "Sequential Processing Routine for Arraying Yields" (SPRAY) program was designed to address this purpose. SPRAY assembles multiple groups of stands with their associated keyword sets and creates many yield streams within a given processing run. Several Forest Vegetation Simulator (FVS) (Dixon 2002) post processors are linked into the data processing stream. The FVSStand Alone (Vandendriesche 1997) program generates either time or age based yield output. The Compute (Van Dyck 2003) program extracts Event Monitor (Crookston 1990) user defined variables from the FVS main output report. The Combine program (presented later in the text) determines mode, median, and mean values from nominal, ordinal, and interval/ratio data reported by the FVSStand Alone and Compute (Van Dyck 2003) post processors. The resultant vegetation yield profile can be arrayed based on projection year or stand age. The strength of the SPRAY program is its ability to be rapidly modified to run numerous vegetation yield profiles sequentially. SPRAY is independent of geographic location.

Suppose Connection

The founding principle in the development of the SPRAY program was to utilize existing FVS software as much as possible. Then, design a user interface that would allow easy input of stand types, their associated silvicultural prescriptions, and possible timing options. SPRAY uses Suppose (Crookston 1997) to construct FVS keywords that describe basic inventory parameters. Suppose builds the StdIdent, InvYear, ModType, StdInfo, Locate, Design, Growth, BAMax, SDIMax, SiteCode, NumCycle, TimeInt, Open, TreeData, SPLabel, and Process keywords per plot. SPRAY uses Suppose to create and manage these keywords. A base keyword set for the entire inventory data set is generated through Suppose (fig. 1).

For SPRAY, there should be only one stand type label per inventory plot. This is done simply by creating a Stand List File {*.slf} containing one primary vegetation group code on Record Type C lines. Stand type labels usually characterize the dominant forest cover, its relative size class, and associated crown density. The SPRAY program needs this label to organize its processing tree. Adding a pointer within the Suppose.loc file to the newly created stand list file completes the task.

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[1] Forester, USDA Forest Service, Forest Management Service Center, Fort Collins, CO; e-mail: dvandendriesche@fs.fed.us.

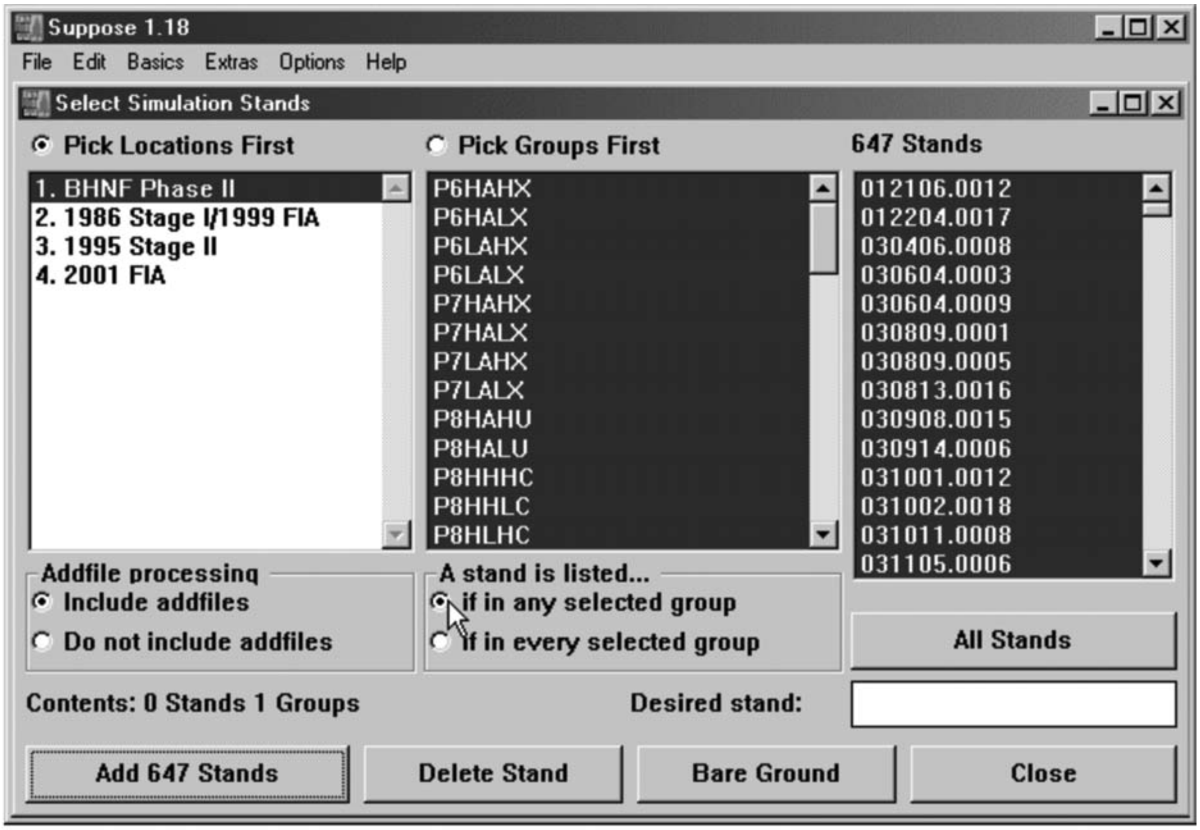

Figure 1—Suppose builds the base project keyword file.

SPRAY Setup

There are a few initial setup steps prior to running the sequential processing tree. The “Setup” menu option on the main SPRAY form provides access to the Common Year, Index Strata, and Select Variant configuration forms.

- Common Year—Establishes the inventory year, the number of cycles, and the time interval for each plot in the base keyword file. The inventory year can be derived from the most recent year recorded for all plots or it can be supplied by the user.
- Index Strata—Creates a “Spray.key” file containing FVS keywords. Suppose interface lines are removed from the base keyword set. The “Spray.key” file is formatted for ‘direct access’ to allow rapid retrieval of specific records. This step also creates a complementary “Spray.idx” index file that links stand type labels with line numbers in the “Spray.key” file. Thus, a connection is established between the “Spray.key” and “Spray.idx” files.
- Select Variant—Designates the FVS geographic variant to use in the simulation runs. Model extension can be chosen as well.

SPRAY Nodes

The Sequential Processing Routine uses a treeview similar to the Windows Explorer program. SPRAY is designed to process a four-level hierarchical tree. The “tree” is comprised of cascading branch “nodes” and each node consists of a label and a set of assigned FVS “addfiles” (i.e. auxiliary keyword files) (refer to fig. 2).

The base hierarchy for SPRAY begins with an assignment of a root node. Subordinate nodes are then declared for vegetative types, silvicultural treatments, and timing options. Using the “Add Node” menu option will display a new subordinate node. Using the “Remove Node” will delete an existing node. Using the “Label Node” will allow renaming the current node assignment. Using the “Associate Add-files” will prompt a window to appear that allows designating specific keyword component files (a.k.a. FVS addfiles) to a path node.

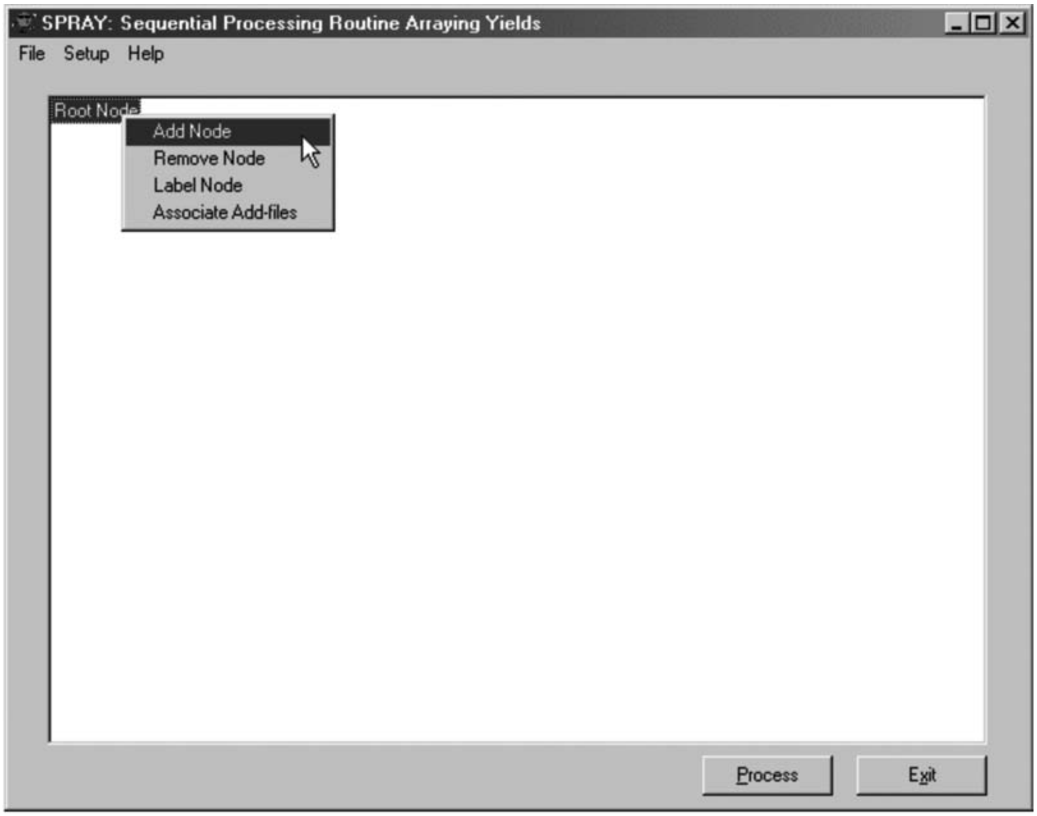

Figure 2—SPRAY treeview window.

SPRAY Associates

Various pre-built keyword component files (*.kcp) can be assigned to a tree node. Files are appended sequentially to the FVS keyword run. As displayed in figure 3, once the frame on the right is properly populated with associated addfiles, the list can be saved for retrieval at a later time. This aids in quickly assigning FVS *.kcp files to processing nodes.

After the pathway nodes have been defined (fig. 4) and FVS addfiles assigned, the runstream can be processed. The SPRAY program captures user input in two files. The "Spray.prj" file contains the FVS variant designated for the projection run and the layout of the pathway nodes. This allows easy retrieval of existing project files (*.prj). The "Spray.add" file contains a listing of the associated addfiles per node assignment.

The SPRAY program builds a composite keyword file set ("Spray.sim" file) per stand type per silvicultural prescription per timing option. Once created, the runstream is processed through the specified FVS variant. The FVSStand, Compute, and FireTbl post processors can then be called upon to generate report variables. Finally, the Combine program synthesizes the output files from the post processing programs into one composite yield profile. The processing continues with the next combination of vegetation stand type, silvicultural prescription, and timing option until all combinations have been completed. The resultant yield files supply input values to forest planning models.

SPRAY Applications

SPRAY provides a shell that brings together the specified FVS variant and several post processing programs. SPRAY is independent of geographic location and can be setup to run for any area. To date, SPRAY has been used for forest planning efforts on 18 National Forests located in most regions of the country.

SPRAY relies on two support programs that add functionality for processing and interpretation of vegetation yield profiles. The "Combine" program was written to take output from various FVS post processing programs and merge the resultant values. The

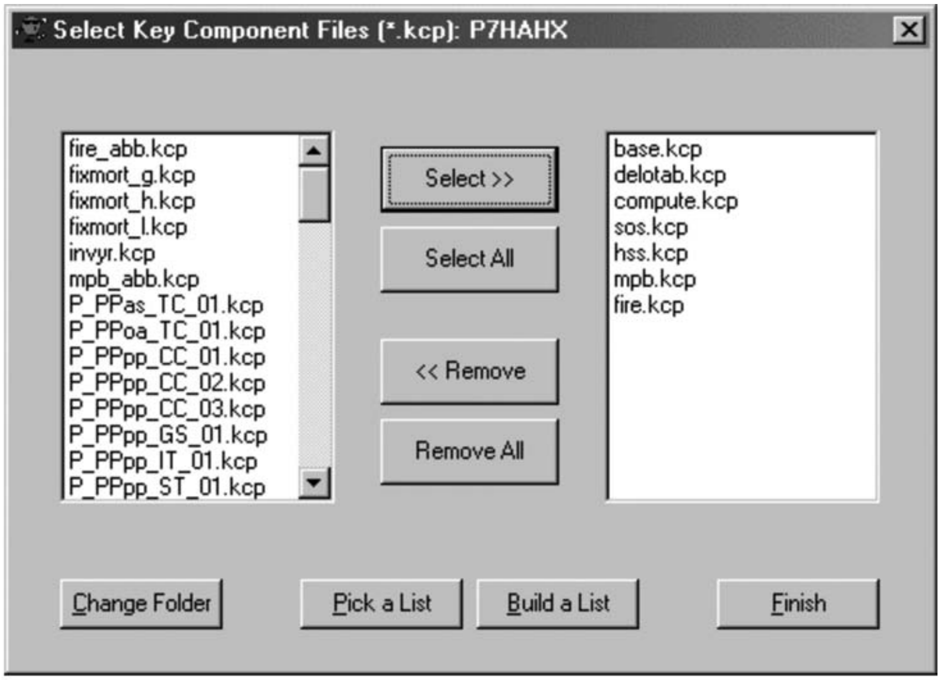

Figure 3—Assigning FVS addfiles to SPRAY treeview nodes.

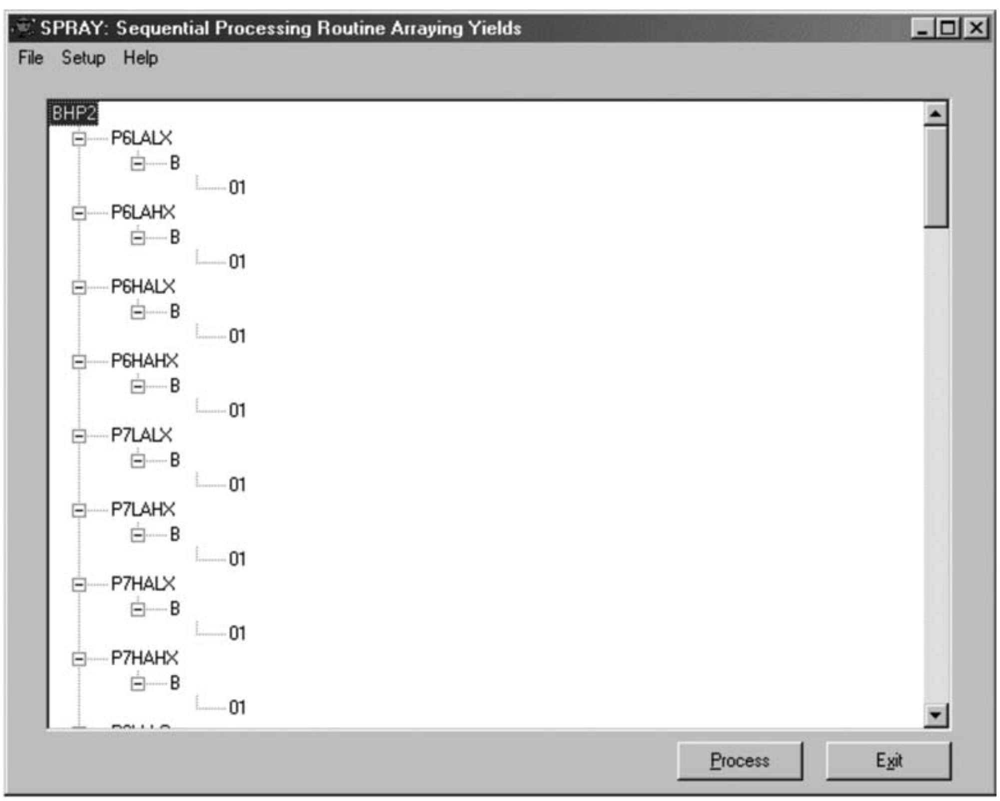

Figure 4—SPRAY hierarchical processing tree. *Root Node*: Project Area = Black Hill Forest Plan Amendment, Phase II (BHP2); *Vegetation Node*: Stand Type = Ponderosa Pine Cover Type (P)/Seedling Size Class (6L)/All Density Class (A)/Low Site (L)/No Understory (X); *Activity Node*: Silvicultural Prescription = Shelterwood (B); *Timing Node*: Entry Interval = 30, 60, 90, 120 years (01). Processing note: FVS addfiles are appended sequentially per subordinate node to the base keyword set for the associated inventory plots that represent the stand type. Post processing programs such as FVSStand, Compute, and Combine aggregate simulation results for each SPRAY branch.

"Yield Examination Processor" (YEP) provides a visual assessment tool to assist forest planning staffs in evaluating vegetation yield profiles.

Combine Program

The "Combine" program was written to facilitate the derivation of pre-eminent values. Combine aggregates means, modes, medians, and much more. Forest planning projects often require summarizing data at the strata level. This usually involves compiling output from individual inventory plots or stands and reporting composite values. Vegetation yields can be expressed in quantitative and qualitative terms. Quantitative data, such as average trees per acre, basal area, or volume units, are described by continuous variables that render 'mean' or average value estimates. Qualitative data, such as structural stage, insect hazard, and fire severity, are described by classification variables that render 'mode' or count value estimates. The class with the maximum count represents the strata condition.

Combine is straightforward to use: (1) click the checkbox for the FVS post processing output tables you would like to merge, (2) declare the variables to include, (3) define the aggregation method per variable, and (4) proceed to combine the results.

The window displayed in figure 5 is used to indicate the processing type and the current status of a specific variable. Prior to designating variable assignments, it is important to signify the type of processing to occur with the FVS projection. Two forms of data aggregation are available: either a 'Time Basis' or 'Age Basis' can be chosen. Time basis indicates to array the data by projection cycle. Age basis signifies that the resultant data should be arranged using stand age.

A variable's assignment can be changed by selecting the variable in the left list box and choosing the appropriate method and type in the middle and left list boxes, respectively. Reselecting the variable in the left list box will reveal its updated assignment. Once satisfied with the inclusion/exclusion of variables, choosing the "Save" button stores the assignments to a parameter list file. Upon return to this form, the "Load" option can be use to retrieve the preset configurations.

An input window allows specifying the minimum sample size to include in the output file. When combining plots using an age basis, it is quite possible to have limited number

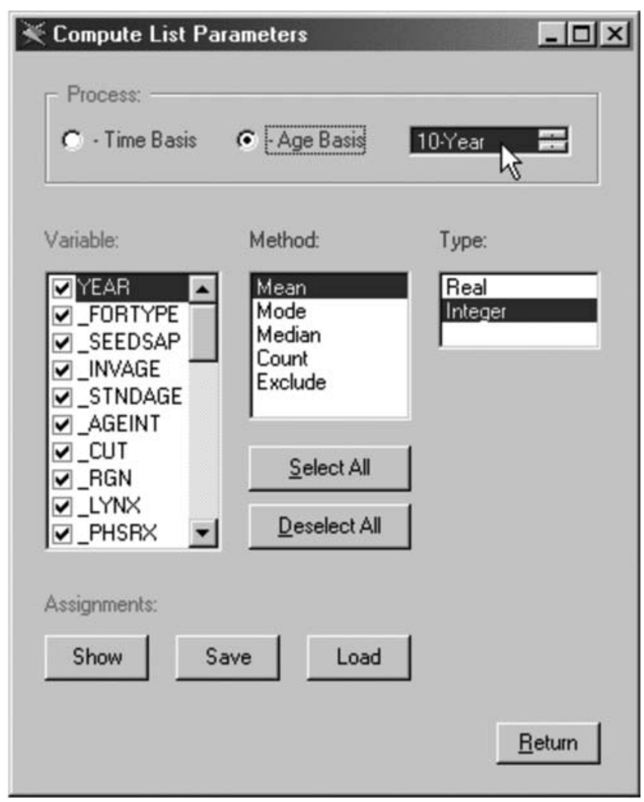

Figure 5—Combine variable designation window.

of samples at younger and older ages. The computed means and modes may be obscured by the minimal plot set. It is best to indicate the lowest acceptable sample size to ensure adequate interpretation of results.

The Combine program supports batch processing. Input parameters can be entered from the command line. This capability allows integration of the Combine program with the SPRAY program.

YEP Program

The Yield Examination Program (YEP) provides a graphical user interface to allow perusing the vegetation yield files built from the SPRAY program. YEP imports tabular data from text files and displays the results in scatter plots. The 'Select X/Y' form allows selecting any available data columns within the yield files (fig. 6).

YEP automatically displays a scatter plot of basal area per acre versus stand age. A natural log trendline is fit to the data (fig. 7). There are 15 different trendlines available for viewing. Related coefficients are presented per trendline at the bottom-left of the display screen. A hard copy of the scatter plot can be obtained by clicking the 'Print' button on the main form. The scatter plot is captured and sent directly to the default printer specified for the computer. The 'Combine' button can be used to merge several yield files into one composite for graphing. This can be useful where yield tables are delineated by size or density class.

Available Documentation

User guides to SPRAY, Combine, and YEP programs (Vandendriesche 2005) can be obtained from the USFS Forest Management Service Center Web Page at the following address:

http://www.fs.fed.us/fmsc/fvs/documents/gtrs_advance-topics.php

The software is also available at this site.

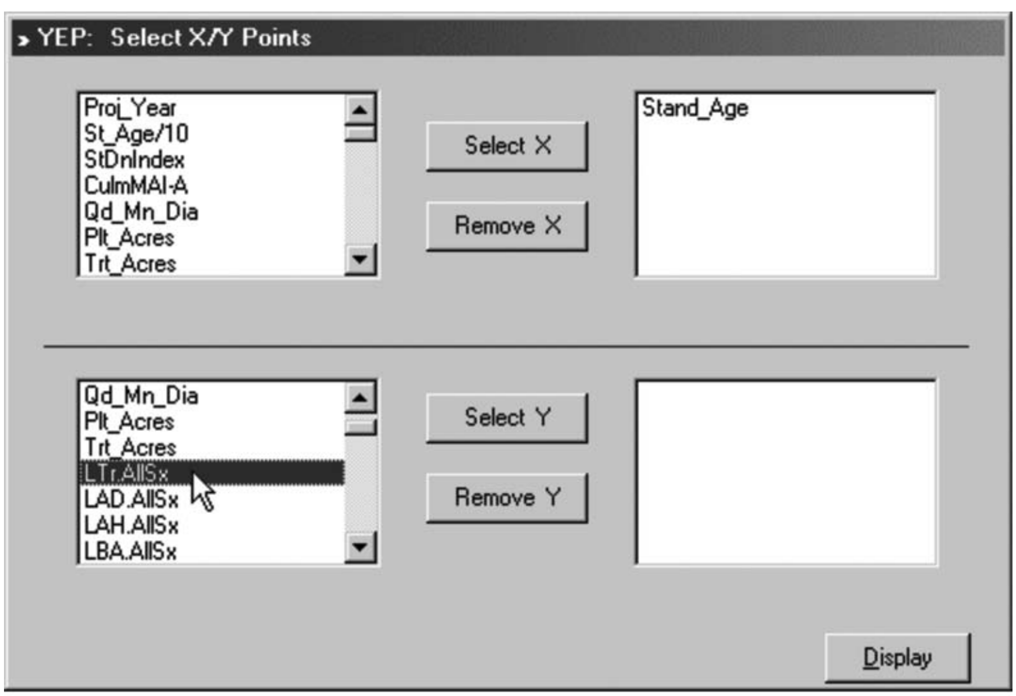

Figure 6—YEP variable selection window.

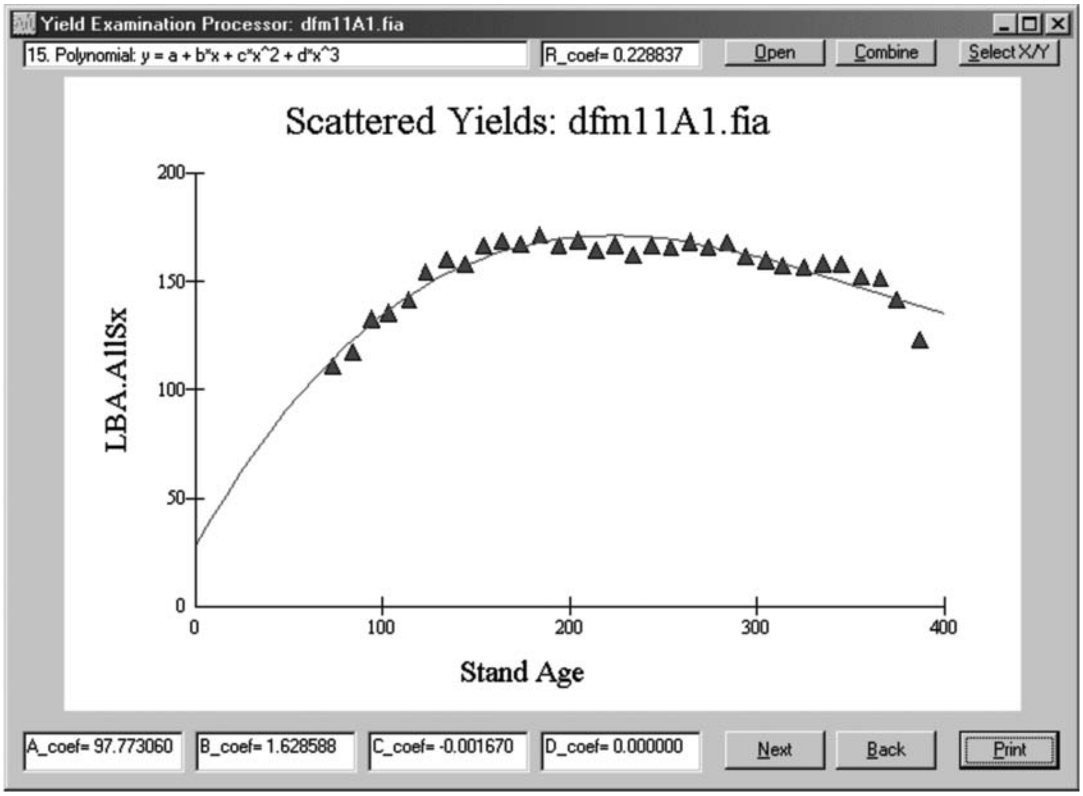

Figure 7—YEP scatter plot for Douglas-fir Moist large size class natural growth run (dfm11A1), (LBA.AllSx = Live Stand Basal Area, All Species, All Size Classes).

References

Crookston, Nicholas L. 1990. User's guide to the Event Monitor: Part of Prognosis Model version 6. Gen. Tech. Rep. INT-275. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 21 p.

Crookston, Nicholas L. 1997. Suppose: An interface to the Forest Vegetation Simulator. In: Proceeding: [1st] Forest Vegetation Simulator Conference. Fort Collins, CO. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 7-14.

Dixon, Gary E. 2002. Essential FVS: A user's guide to the Forest Vegetation Simulator. Interoffice publication. Fort Collins, CO. U.S. Department of Agriculture, Forest Service, Forest Management Service Center. 204 p.

Vandendriesche, Donald A. 1997. FVSSTAND Alone: Generate dynamic yield reports from the Forest Vegetation Simulator. In: Proceeding: [1st] Forest Vegetation Simulator Conference. Fort Collins, CO. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 168-177.

Vandendriesche, Donald A. 2005. Advanced FVS Topics for forest planning. Interoffice publication. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Forest Management Service Center. 119 p.

Van Dyck, Michael G. 2003. User's guide to the Post Processors for the Forest Vegetation Simulator. Interoffice publication. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Forest Management Service Center. 59 p.

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