

Forest Planning Using Forest Inventory and Analysis Data and the Forest Vegetation Simulator

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Abstract—Data from the Forest Inventory and Analysis (FIA) program of the USDA Forest Service is available for all ownerships across the 48 contiguous states and southeast Alaska. FIA plots are situated on a systematic grid that renders a minimum sampling intensity of 1 plot per 6000 acres. It is well suited for strategic forest planning. This data can be downloaded from the World Wide Web into Forest Vegetation Simulator (FVS) ready files using the Forest Inventory Mapmaker program. Text files of the FIA data tables can also be retrieved from the Web. The comma separated values contained within these files can be reloaded into a MS-Access database file using the Prep program. The Pre-Suppose program dynamically queries the forest inventory data stored in the MS-Access database to provide preliminary statistics on a proposed data group. Features of the programming links between the FIA data sets available on the Web to their use in the Pre-Suppose program for forest planning will be presented in this paper.

Keywords: FIA, FVS, Mapmaker, Prep, Pre-Suppose.

Introduction

Forest Inventory and Analysis (FIA) data and growth and yield models such as the Forest Vegetation Simulator (FVS) have been used for National Forest planning since the inception of need as legislated by the Forest and Rangeland Renewable Resources Planning Act of 1974 and the affiliated amendments as specified in the Forest Management Act of 1976. Over the years, valiant efforts have been put forth to provide transparent links between data acquisition and analysis. Recent advances show promise in achieving this endeavor.

The FIA program has made significant strides with data availability by initially introducing separate Eastwide (Hanson 1992) and Westwide (Woudenberg 1995) forest inventory data bases followed by the consolidated Forest Inventory Analysis Database (FIADB) (Miles 2001). Diminishing local budgets for independent inventories as previously conducted by the individual National Forests, and the need to quantify cumulative effects across both public and private lands, has lead to a greater reliance on the nationally funded inventory program conducted by the various FIA research units.

A founding tenet of the newly created Forest Management Service Center, Growth and Yield Unit, in the early 1980's was to consolidate the numerous vegetation projection models into one entity for ease of use and understanding. To date, twenty-two geographic variants have been constructed. These FVS variants cover the vast majority of recognized forest ecozones throughout the country.

To a large degree, advances in computer automation have allowed for the progression made in providing inventory data and associated analysis in a timely manner for forest planning projects. The purpose of this paper is to describe methods used to download FIA data in FVS format from the World Wide Web and to create a local database file for querying and constructing forest strata for vegetation yield table construction.

Supporting Software

A brief discussion of the primary computer programs used for data gathering and analysis for forest planning is in order. The "Forest Inventory Mapmaker" program provides Web based access to the Forest Inventory and Analysis Database. The "Forest Vegetation Simulator" refers to a suite of computer programs used for data input, processing, and reporting of yield projections. The "Pre-Suppose" program can be employed to read inventory data, provide summary statistics, and produce support files for the Suppose interface. "Suppose" is the front-end program designed to construct runstreams for FVS. The "FVS Variant" refers to the growth model that is specifically fit for a given geographic area. FVS post processing programs, such as "Fvsstand", "Repute", "Compute", "Combine", and "Spray", have been developed to take the output from the FVS Variant and produce custom files and reports for forest planning projects (Vandendriesche 2005). A few specifics regarding these programs follow.



The Forest Inventory Mapmaker (Miles 2002) Web application generates both tables and maps of forest statistics for the 48 contiguous states – in many cases for multiple inventory dates. This Web tool uses data collected by the Forest Inventory and Analysis (FIA) Program of the USDA Forest Service. The data, stored in the FIA database, contains information from more than two hundred thousand forested plots and five million trees. These plots are located across all ownerships nationwide. The Forest Inventory Mapmaker program can also be used to generate FVS ready data files. Further reference can be found at the National FIA Web site under the link for “FIA Tools and Data”:

<http://www.fia.fs.fed.us/tools-data/tools/>.



The Pre-Suppose program (Vandendriesche 2002) was designed to assist in producing stand types for forest planning. Pre-Suppose rapidly generates preliminary statistics on a proposed data group. This allows quick evaluation of the homogeneity of selected forest strata. Plot attributes can be chosen based on a variety of code and range keys to designate a data group. Rapid processing of plot summary values renders important statistical information relevant to the keyed items. Support files can be created that link directly to the Suppose program, the graphical user interface to the Forest Vegetation Simulator. Pre-Suppose has been programmed to work dynamically with Forest Inventory Analysis data stored in a Microsoft Access database. Further details can be sought at:

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



Suppose (Crookston 1997) is the graphical user interface for the Forest Vegetation Simulator. Suppose permits silvicultural actions to be entered into FVS by using standard MS-Windows objects to accept input rather than using the FVS *keyword* system. Keywords are mnemonic acronym commands that direct the simulation. The Suppose program provides input windows allowing use of FVS without knowing the extensive FVS keyword language or having to remember the details of keyword usage. Suppose can simulate changes in forest vegetation over a long time period (100-400 years). Suppose creates input files used by the geographic variant. It is the FVS Variant that performs the projection. Further information of the Suppose interface can be obtained at:

<http://www.fs.fed.us/fmsc/fvs/software/suppose.php>.



The FVS Variant (Dixon 2004) is an individual-tree, distance independent, growth and yield model. It is based primarily on the original Stand Prognosis model (Stage 1973) framework. The U.S. Forest Service Forest Management Service Center has calibrated twenty-two variants to specific geographic areas throughout most regions of the United States. The variant requires plot and tree level data. Important variables include stand location and site productivity for the plot, and tree species and diameter measurement for the individual trees. The FVS model contains modules for growing trees; predicting mortality; establishing regeneration; simulating damage reductions due to insects and disease; performing management activities; calculating tree volumes; and producing reports. One of the strengths of the FVS system is its ability to incorporate local growth data directly into the simulations. Growth rates for common tree species as measured on the FIA plots are automatically compared to embedded growth rates used by variant. Calibration factors are developed accordingly. Additional information relative to FVS and its component parts can be obtained at:

<http://www.fs.fed.us/fmsc/fvs/>.

In Translation

Prior to the release of the Forest Inventory and Analysis Database (FIADB), conversion of FIA data to FVS format was rather cumbersome. Requests were submitted to the administrating U.S. Forest Service Research Station. Text files that contained the inventory data of interest were then returned. To complete the process, computer programs were written that properly translated FIA codes to FVS codes.

Subsequent to the release of the FIADB, a concerted effort was undertaken to provide easy access to readily available FIA data translated to FVS format. The Forest Inventory Mapmaker program was augmented to perform this task. Additionally, the Prep program was developed to assemble the FIADB downloadable data files into a MS-Access database that the Pre-Suppose program could read. Links from the Pre-Suppose program to the Suppose interface to the FVS Variant to the Post Processing programs already existed. Thus, Mapmaker and Prep provided the missing links to complete the automation chain of providing data for analysis for forest planning.

Tutorial

Much can be demonstrated and learned through a concise tutorial. The goal will be to provide an adequate description of retrieving FIA data, building a local database file from this information, and querying capabilities thereafter. A systematic process will be laid out as a *Users Guide* to the necessary steps. As an example, FIA data from the Kootenai National Forest in Idaho will be retrieved from the Web using the Mapmaker program and set up by the Prep program for use by the Pre-Suppose program.

Initial Steps:

- 1) Create a subfolder under the \Fvsdata folder called \Press.
- This folder will be used to store the Pre-Suppose software.
- 2) Create a subfolder under the \Press folder called \Id.
- This folder will be used to save the FIADB downloaded data files for Idaho (i.e. C:\Fvsdata\Press\Id).

Mapmaker Steps:

- 3) Key the following internet address into a Web browser.

<http://ncrs2.fs.fed.us/4801/fiadb/index.htm>

- 4) Scroll below to the 'Downloads' section on the Web Page.
- 5) Select the "NIMS_FIADB downloadable data files ..." option.
- The State Downloads Web Page will appear.
- 6) Scroll down to the State of Idaho.
- Note that there are two measurements available, Cycle 1 (1991) and Cycle 2 (2004).
- 7) Create additional data folders to store the downloaded files:
 - a. C:\Fvsdata\Press\Id\Cycle1\Fvs
 - b. C:\Fvsdata\Press\Id\Cycle1\Zip
 - c. C:\Fvsdata\Press\Id\Cycle2\Fvs
 - d. C:\Fvsdata\Press\Id\Cycle2\Zip

- 8) Save the "ID_01.zip" file to the C:\Fvsdata\Press\Id\Cycle1\Zip folder.
- 9) Save the "ID_02.zip" file to the C:\Fvsdata\Press\Id\Cycle2\Zip folder.
- 10) Return to the main Mapmaker Web Page (select the "Back" arrow).
- 11) Under the "Applications" section, click on the "Run Forest Inventory Mapmaker program ..." option.
- The Reporting Option Web Page will appear.
- 12) Under the "Report Type" section, click on the "Forest Vegetation Simulator (FVS) ready dump files" option.
- 13) At the bottom of the page, click the "Continue" button.
- The Retrieval Option Web Page will appear.
- 14) Scroll down the Web Page until the selection table for the State of Idaho is displayed. Read the note in RED.

Idaho

reportyr 2004 notes: Annual 01 of 10 subcycles
 reportyr 1991 notes: Periodic inventory

No Selection
 All Counties
 Specific Counties (You must choose one or more of the following counties)

16001 Ada
16003 Adams
16005 Blaine
16007 Bear Lake
16009 Benewah

- 15) Select the "1991" report year.
- 16) Click the "All Counties" option button.
- 17) Scroll to the bottom of the page and click the "Continue" command button.
- The Filtering Option Web Page will appear.

Note: Data querying filters can be specified on this page. Seven pre-defined categories are available. User defined attributes can also be designated. This is a powerful page that allows isolating particular FIA plots of specified characteristics. If a limited number of iterations are needed to retrieve the data of interest, use this feature, bypass the Prep and Pre-Suppose narrative. Be aware that each combination of attributes will require repeating the Mapmaker steps listed. Using the Pre-Suppose program will alleviate the multiple retrieval process. The primary focus of this tutorial is to provide the set up files needed for Pre-Suppose.

- 18) Click the "Continue" button at the bottom of the page.
- The FVS Configuration Page will appear.

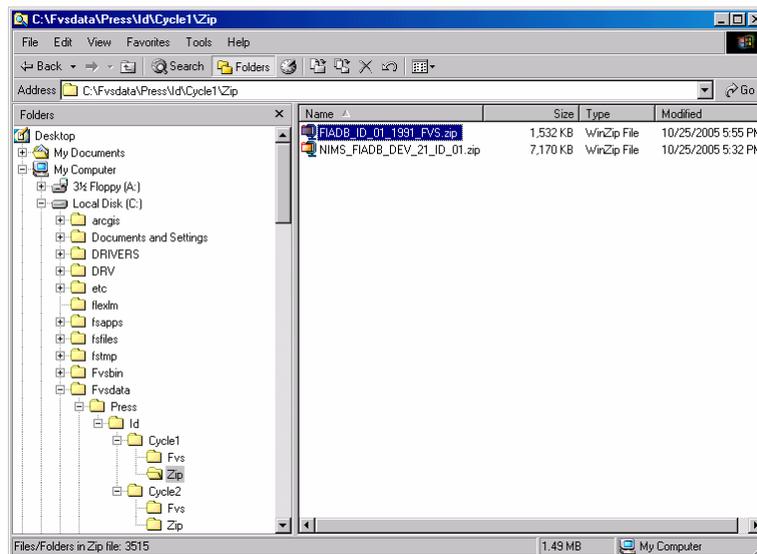
- 19) Select the FVS Variant to associate with the FIA data. Highlight “IE = Inland Empire”
- 20) Enter the PROJECT name to coincide with the downloaded data set, “FIADB_ID_01_1991_FVS”.

Note: Currently, forest cover type is listed as a ‘Grouping Code’ for FVS. If desired, additional data labels can be specified to identify the size class, stocking class, ecoregion subsection, and habitat type of the individual FIA plots. The Pre-Suppose program allows post stratification of the FIA data set with unlimited ability to identify and label groups of similar plots. Thus, using Pre-Suppose precludes the need to pre-define data groups.

- 21) Click the “Continue” button at the bottom of the page.

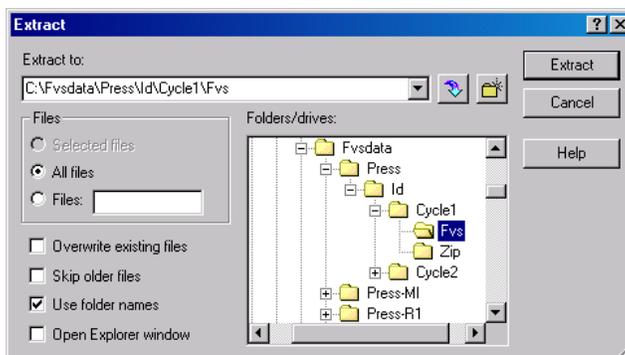
Mapmaker queries the FIADB based on the specified criteria. A progress bar at the bottom right reports the retrieval activity. When complete, the FVS Ready Files Web Page will appear. The process is finished when the spiraling globe presented by the Internet Explorer browser stops. A listing of the individual download files are presented under the “FVS Results” section. Clicking on any file will display its content in a text viewer. A zip file of the entire data set is listed under the “Zip file of FVS Results” section. This file contains all of the FVS ready files.

- 22) Click on the “FIADB_ID_01_1991_FVS.zip” filename.
 - A File Download dialog window will appear.
- 23) Click the “Save” button.
- 24) Save the zip file to the folder “C:\Fvsdata\Press\Id\Cycle1\Zip” that was created prior.
 - Notice that the FIADB downloadable data file already resides in this folder.

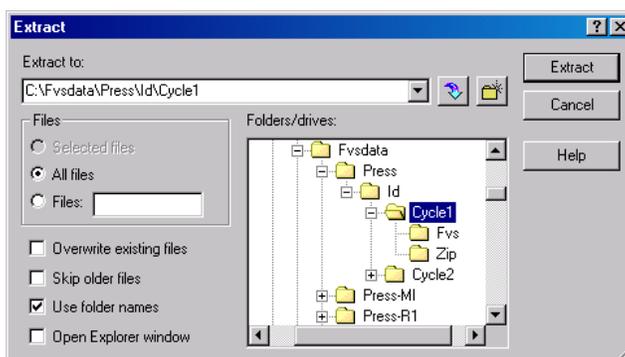


The process described in Steps 11-24 for retrieving FVS ready files though the Mapmaker program would need to be repeated for the Cycle 2 (2004) measurement.

- 25) Exit Internet Explorer to close the Mapmaker program.
- 26) Navigate to the C:\Fvsdata\Press\Id\Cycle1\Zip folder and double click on the “FIADB_ID_01_1991_FVS.zip” file.
- 27) Extract to the C:\Fvsdata\Press\Id\Cycle1\FVS folder. Close WinZip.



- 28) Return to the C:\Fvsdata\Press\ld\Cycle1\Zip folder and double click on the “NIMS_FIADB_DEV_21_ID_01.zip” file (a.k.a. “ID_01.zip” in Mapmaker).



- 29) Extract to the C:\Fvsdata\Press\ld\Cycle1\ folder. Close WinZip.

Repeat Steps 25-29 to extract the zip files for the Cycle 2 (2004) measurement.

Prep Program Steps:



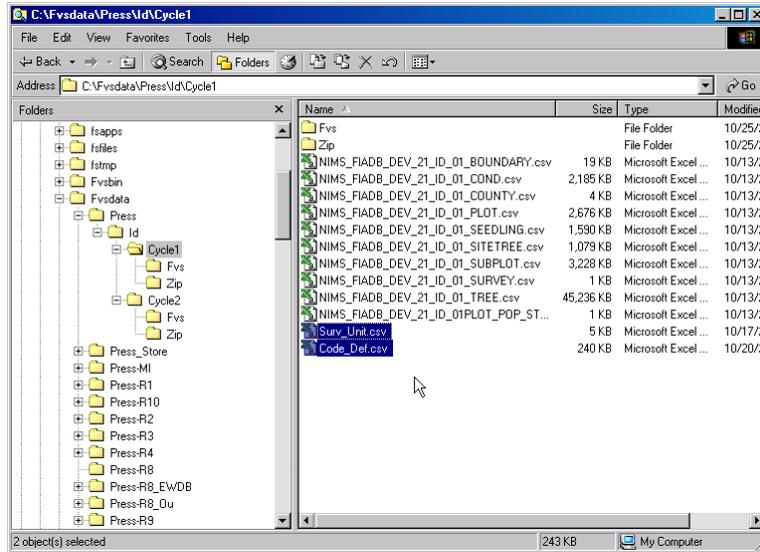
Prep

The “Prep” program was written to reload the comma separated values contained within the FIADB downloadable text files into a MS-Access database. The Pre-Suppose program dynamically works with forest inventory data that is stored within the database to provide querying capability and analysis reporting. Prep condenses the various FIADB files into four data tables: Plot Classification, Plot Summary, Tree Measurement, and Tree Calculated. The plot summary table is created by summing the individual tree calculated values per plot to a per acre basis. Pre-Suppose uses the plot summary table to generated preliminary statistics on a proposed data group. If the specified plot set is sufficient, associated links are available to produced the prerequisite files for input into the Suppose interface and FVS variant.

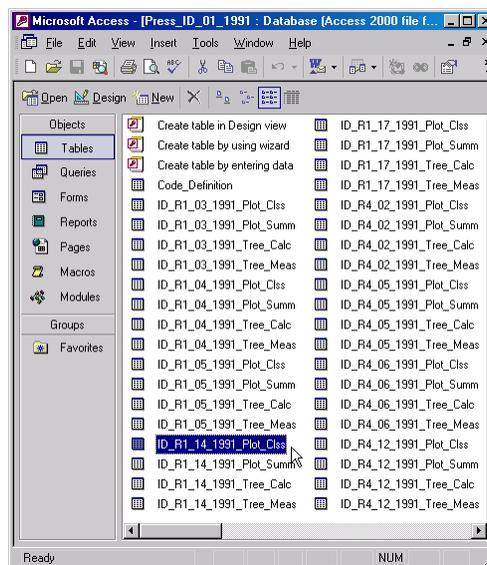
- 30) Retrieve the Prep program set up package by keying the following internet address into a Web browser {Forest Management Service Center (FMSC) FVS Web site}.

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

- 31) Drop down the Web page to find Prep (Prep_z.exe).
 32) Download this file to the C:\Fvsdata\Press folder and execute. Follow setup program prompts.
 - ‘Ignore’ superfluous warnings and direct file extracts to the C:\Fvsdata\Press folder.
 33) Copy the “Code_Def.csv” and “Surv_Unit.csv” files from “C:\Fvsdata\Press” into each of the Cycle folders.



- 34) Click the “Prep.exe” application file from the “C:\Fvsdata\Press” folder to execute the program.
- 35) When prompted, open the “NIMS_FIADB_DEV_21_ID_01_COND.csv” file from the “C:\Fvsdata\Press\Id\Cycle1” folder.
- 36) Click the “Go Prep” button to initiate processing.
 - The Prep program will build a new database file that contains a Plot Classification, Plot Summary, Tree Measurement, and Tree Calculated table for each subdivision of National Forest. FIA plots not residing within National Forests are assigned to their respective FIA Survey Unit.



- 37) Repeat the steps relative to the Prep program for the Cycle 2 data set.
- 38) Move the resultant “Press_ID_01_1991.mdb” and “Press_ID_02_2004.mdb” database files from their respective \Cycle1 and Cycle2 folders to the “C:\Fvsdata\Press” folder.
- 39) Copy the “FIADB_ID_01_1991_FVS.slf” and “FIADB_ID_01_1991_FVS.idx” files from the “C:\Fvsdata\Press\Id\Cycle1\Fvs” folder into the “C:\Fvsdata\Press” folder.
- 40) Copy the “FIADB_ID_02_2004_FVS.slf” and “FIADB_ID_02_2004_FVS.idx” files from the “C:\Fvsdata\Press\Id\Cycle2\Fvs” folder into the “C:\Fvsdata\Press” folder.

Pre-Suppose Setup Steps:

- 41) Retrieve the Pre-Suppose program setup package by keying the following internet address into a Web browser {FMSC FVS Web site, same site as the Prep program}.

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

- 42) Drop down the Web page to find Pre-Suppose (Press_z.exe).
 43) Download this file to the C:\Fvsdata\Press folder and execute. Follow set up program prompts.
 - 'Ignore' superfluous warnings and direct file extracts to the C:\Fvsdata\Press folder.
 44) Click the "Presuppose.exe" application file from the "C:\Fvsdata\Press" folder to execute the program.

Final Touches:

FIA data for the State of Idaho is now ready for the Pre-Suppose program. Pre-Suppose can be used to further query the data into user defined groups. An in-depth discussion of Pre-Suppose can be found at the FMSC FVS Web site, Documents/GTRs & Guides/Advance Topics, same site as the program setup file. Navigate to "Topic_I_Pre-Suppose.pdf" file, save and review. Follow the steps outlined in this paper to complete the process for the extracting FIA plots residing on the Kootenai National Forest.

For a description of the use of FIA data for National Forest Planning, from the FMSC FVS site, Documents/GTRs & Guides/Advance Topics, select the Kipz_Ylds.pdf file. Save, print, and review this document.

Application Products

The aforementioned software system has proven to be a valuable tool for National Forest Plan Revision projects. Additionally, these data links and analysis tools have been used for several regional assessments. Disturbance agents such as insects, disease, and wildfires impact the landscape. Assessing the potential risks relative to particular parcels aids decision makers at the strategic and mid-level planning scales. To date, project application includes:

1. USFS R-1: Forest Plan Revision, Western Planning Zones
2. USFS R-1: Hazard-Risk Assessment, Montana
3. USFS R-2: Forest Plan Amendment, Black Hills National Forest
4. USFS R-3: Hazard-Risk Assessment, Arizona and New Mexico
5. USFS R-4: Hazard-Risk Assessment, Idaho and Utah
6. USFS R-6: Hazard-Risk Assessment, Oregon and Washington
7. USFS R-8: Forest Plan Revision, Southern Appalachian and Ozark Mountains
8. USFS R-9: Forest Plan Revision, Lake, Central, and Northeast States
9. USFS WO: FY-2000 Senate Appropriations Act Request
10. Bureau of Indian Affairs, Forest Plan Revision, Nationally
11. Bureau of Land Management: Assessment Projects, Montana
12. Private: West Virginia Forest Products Company

The need for data and analysis will always be a fundamental part of forest planning. Providing service in a timely manner is paramount. The collaborative effort between the Forest Inventory and Analysis Program and the Forest Management Service Center has and will continue to be beneficial to the forestry community.

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