



SIMPPLLE, Version 2.5 USER'S GUIDE



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ABSTRACT

SIMPPLLE is a spatially-interactive, dynamic landscape modeling system for projecting temporal changes in the spatial distribution of vegetation in response to insects, disease, wildland fire, and other natural and management-caused disturbances. SIMPPLLE is designed to provide a balance between incorporating enough complexity and interactions in modeling ecosystem processes to provide an acceptable level of realism while making simplifications in the choices on required data input requirements, required computer platforms, and computing time to be a management tool useful in collaborative planning processes. SIMPPLLE is designed to serve as a decision support system in collaborative efforts to help managers and resource specialists quantify and incorporate concepts that are often difficult to interpret for specific landscapes. Managers can use SIMPPLLE to help define and evaluate desired future conditions at landscape scales, to identify what parts of a landscape are more prone to disturbance processes over a given time frame, and to help design and evaluate different strategies for achieving desired future conditions. We explain data input requirements, the GIS tools to create the necessary input files, input values specific to geographic areas, directions for executing the system and generating model output, and GIS displays.

Keywords: dynamic landscape simulation, forest management, simulation models, resource management, landscape ecology, decision support, collaborative modeling

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1. INTRODUCTION—OVERVIEW OF SIMPPLLE

SIMulating Patterns and Processes at Landscape scaleEs (SIMPPLLE) was initially developed for U.S. Department of Agriculture (USDA) Forest Service, Region One as a management tool to integrate disturbance processes and vegetation conditions at a range of spatial scales. A basic overview publication is in the Western Journal of Applied Forestry (Chew et al. 2004). Earlier publications discussing the design and development of the system can be found in Chew (1993), Chew (1995), and Chew (1997).

The objective of SIMPPLLE is to help provide an understanding of the dynamics of landscapes. Multiple simulations can provide a range of possible outcomes—a prediction of general trends for when and where disturbance processes may occur on specific landscapes. Any single simulation can present a possible scenario of what could happen, but it cannot be taken as a precise prediction. SIMPPLLE is spatially interactive because of the importance of the spatial interaction between landscape features and disturbance processes. Individual simulations can be selected from a set of multiple simulations to represent worst-case scenarios for specific disturbance processes, a most likely scenario, or a most optimistic scenario.

SIMPPLLE's purpose is to provide the user with the ability to:

- Simulate future vegetation changes caused by disturbance processes at multiple landscape scales.
- Simulate ranges of conditions of plant communities and processes that can be expected for specific landscapes.
- Simulate how changes in vegetation patterns influence the activity of fire, insect, and disease processes.
- Help identify areas that have a high priority for treatments that can help achieve and sustain desired conditions at landscape scales.
- Simulate management treatment alternatives for their impact on disturbance processes and the attainment of desired conditions defined at landscape scales.
- Compare effectiveness of varying treatment alternatives at altering fire, insect, or disease probabilities.
- Simulate impacts over time on a variety of resource objectives that can be defined by a combination of vegetation conditions and spatial attributes.
- Provide a basis for identifying the probability of disturbance processes and vegetation conditions.

There are many features of SIMPPLLE that are designed to provide these capabilities.

The development of SIMPPLLE places emphasis on creating data structures within an object-oriented design to capture knowledge represented by both research results and expert opinion. Knowledge for the system is represented in data structures that provide maximum flexibility in adapting the system to new areas and making updates as new research knowledge or experience becomes available.

The user can make many choices in the knowledge and simulation parameters to tailor the application to specific issues. The total design for SIMPPLLE is to provide a system that has four components of an interacting landscape: vegetation, land units, aquatic units, and manmade features. SIMPPLLE is spatially explicit. The location of each existing landscape unit is unique. Each existing unit has an attribute that identifies its adjacent units. SIMPPLLE is also spatially interactive in that it provides for interaction between disturbance processes and the vegetative pattern of a unique landscape. The probability of a disturbance process originating or spreading from a vegetation unit is determined not just by a plant community's attributes (e.g., species, size, structure, and density), but also by what exists around it, what processes are occurring around it, and what processes have occurred in the past. Rather than a transition matrix approach, process probabilities are used in a stochastic fashion for each individual vegetation unit. Disturbance processes with a low probability of occurrence are often the ones that determine the pattern of a landscape and future events.

To be spatially interactive requires that the input for SIMPPLLE has to be processed through a geographic information system (GIS). SIMPPLLE does not execute within a GIS framework; however, the files that are used to create SIMPPLLE input files must be developed from a GIS. The means for developing the SIMPPLLE input files and for displaying the output have been developed for ESRI's ArcGIS. However, it could be possible for other geographic information systems to be utilized. All of the required ArcGIS products are included in the downloaded executable for SIMPPLLE. Within some of the SIMPPLLE user interface screens, there are choices that are shaded out, indicating features that are either not fully developed yet, or not available for the stage the user is at within the system. In using SIMPPLLE, there are choices that have to be made that are related to the analysis objectives, the issues, and the inventories available. These are discussed under the section "Decisions to Make Prior to Simulations." The choices one makes have a significant impact on the amount of computer resources needed and the time taken to make the simulations.

SIMPPLLE consists of the necessary GIS tools, the SIMPPLLE modeling environment, and Microsoft Excel spreadsheets with macros for processing simulation output. Since the initial release of SIMPPLLE 1.0 in 1997 for the Westside Region One and Eastside Region One, Forest Service, the system has been expanded to cover additional geographic zones. Each of these areas has unique conditions that require changes and new features in SIMPPLLE. The appendices contain the valid values for the nonspatial attributes for all the geographic zones and a discussion of the system knowledge. Not all zones are described in the same level of detail.

2. APPLICATION OF SIMPPLLE

SIMPPLLE has been applied by both individuals and teams. It has been applied for a range of research projects (Chew 2003; Chew and others 2000; Jones and Chew 1999, 2000; Jones and others 1999) planning projects within the Forest Service (Slaughter and others 2003), Bureau of

Land Management (USDI 2005), U.S. Geological Survey and the National Park Service (Turner and others 2008), States (State of South Dakota 2006) and private organizations (Ecosystem Research Group 2006; Haufler and others 2008; Mehl and others 2009). The modeling system features that enable this range of applications are the same features that facilitate the use of SIMPPLLE in collaborative efforts.

The use of SIMPPLLE is very appropriate for two trends in natural resource management that have emerged: a trend toward engaging stakeholders in participatory, collaborative processes, and a trend toward wider use of modeling to help manage the inherent complexity of natural systems. Collaborative engagement of stakeholders results in more inclusive and transparent decision making, which can engender greater acceptance of decisions and a wider sense of stewardship (Wondolleck and Yaffee 2000). The trend toward the use of modeling in resource management addresses the need to accommodate the numerous and complex interactions of natural systems (Jakeman et al. 2006). To adequately represent the inherent complexities of natural systems one has to address the interactions and feedback among individual components of the system. Although a large number of models are available to address individual components of natural systems and their integration, their data requirements and their computing needs often exceed what is appropriate for a usable management tool. SIMPPLLE is a modeling system that utilizes a range of model types, from empirical to phenomenological, to mechanistic and rule based, to provide the integration at a level that can serve as a management tool.

The following is an overview of the steps to run SIMPPLLE and the manual sections that contain the detailed information:

1. Install SIMPPLLE (Section 4)
2. Make memory management decisions (Section 5)
3. Create SIMPPLLE input files (Section 6)
4. Make decisions on simulation parameters (Section 7)
5. Execute a simulation (Section 8)
6. Make choices for output (Section 9)

3. GEOGRAPHIC ZONES AVAILABLE

Geographic Area	Sample Landscape
Forest Service – Westside Region One	Bitterroot National Forest, Montana
Forest Service – Eastside Region One	Helena National Forest, Montana
Sierra Nevada	Yosemite National Park, California
Southern California	Angeles National Forest, California
South Central Alaska	Kenai Peninsula, Alaska
Gila	Gila National Forest, New Mexico
South West Utah	Beaver Creek Drainage, Utah
Michigan	No sample landscape
Colorado Front Range	Portions of two National Forests, Colorado
Colorado Plateau	Mesa Verde National Park, Colorado
Western Great Plains Steppe	Thunder Basin National Grassland, Wyoming
Mixed Grass Prairie	Landscape from South Dakota
Great Plains Steppe	Landscape from South Dakota
Teton	No sample landscape
Northern Central Rockies	No sample landscape
Zone builder	No sample landscape

Table 1 Geographic areas available for SIMPPLLE version 2.5.

The two zones for the Forest Service, Region One, were developed with funding from the Region and represent the initial development of SIMPPLLE. A Joint Fire Sciences funded project, Project, 98-1-8-06 (a risk-based comparison of potential fuel treatment tradeoff models (Weise et al. 2000, 2003), provided the funding for a model comparison study developing two California zones, south central Alaska, the Gila Forest, southwest Utah, and Michigan. A second Joint Fire Sciences funded project (Kaufmann et al. 2001) funded the development of the Colorado Front Range Zone. Funding and expertise from the Ecosystem Management Research Institute (EMRI) of Seeley Lake, Montana, provided the basis for the development of the three grassland zones (Ganguli et al. 2007). The U.S. Geological Survey's (USGS) project of Framing Research for Adaptive Management of Ecosystems (Turner et al. 2008) provided the funding to participate in their effort on Mesa Verde National Park to develop the Colorado Plateau zone. A grant with Montana State University covered the incorporation of the invasive species logic for the Eastside of Region One. The Teton and Northern Rocky Mountain zones were funded by the Teton County Conservation District. The **Zone Builder** represents the long-term goal to allow users to completely build a new geographic zone through the user interface without the involvement of the system developers. This effort is still incomplete in version 2.5.

Most zones come with a sample landscape that can be loaded and simulated. Many of the sample landscapes have GIS files available that can be downloaded separately from the SIMPPLLE website download page:

1. Go to <http://www.fs.fed.us/rm/missoula/4151/SIMPPLLE/downloads.html>.
2. Select **GIS Extras Installer (GIS datasets for sample areas)**.

4. INSTALLING SIMPPLLE

Two executables for installing SIMPPLLE version 2.5 can be obtained from the SIMPPLLE website: <http://www.fs.fed.us/rm/missoula/4151/SIMPPLLE/>. One executable is for Microsoft's 64-bit operating system, both Vista and XP (simpplle-2.5.19-install-x64.exe). The second is for Microsoft's XP 32-bit operating system (simpplle-2.5.19-install-x32.exe).

To install SIMPPLLE from the executable after downloading it to your computer, execute the appropriate executable (*.exe) file and follow the instructions, accepting the defaults recommended. The installation places a SIMPPLLE icon on the computers desktop.

5. MEMORY MANAGEMENT

SIMPPLLE makes an initial assignment of your computer system's memory to the **Java Max Heap Size** when the installation is made. On 64-bit operating systems the default is set to 90 percent of the available memory. On 32-bit operating systems, the default is set to 1100 MB.

To adjust memory, select **Utilities > Change Java Heap Size** (Figure 1).

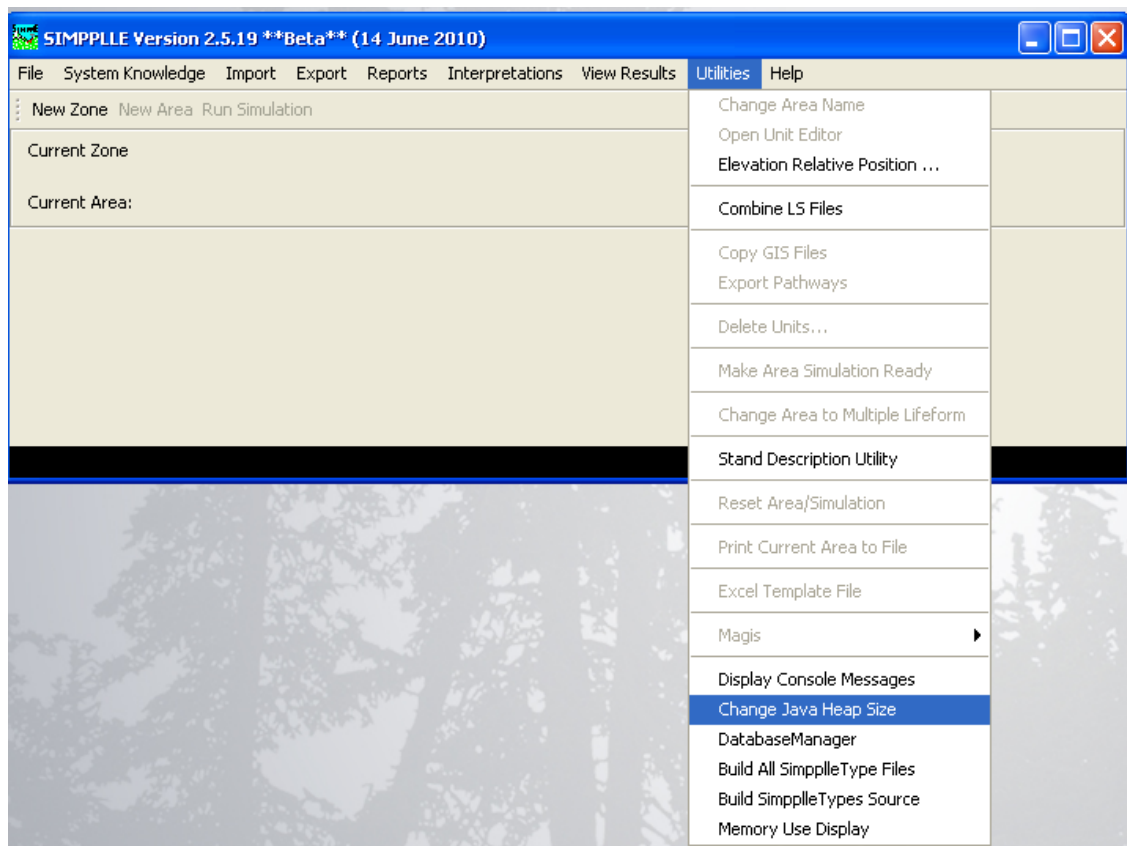


Figure 1 Location of Change Java Heap Size choice in user interface.

The **Java Max Heap Size (MB)** window will appear (Figure 2).

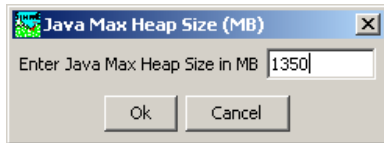
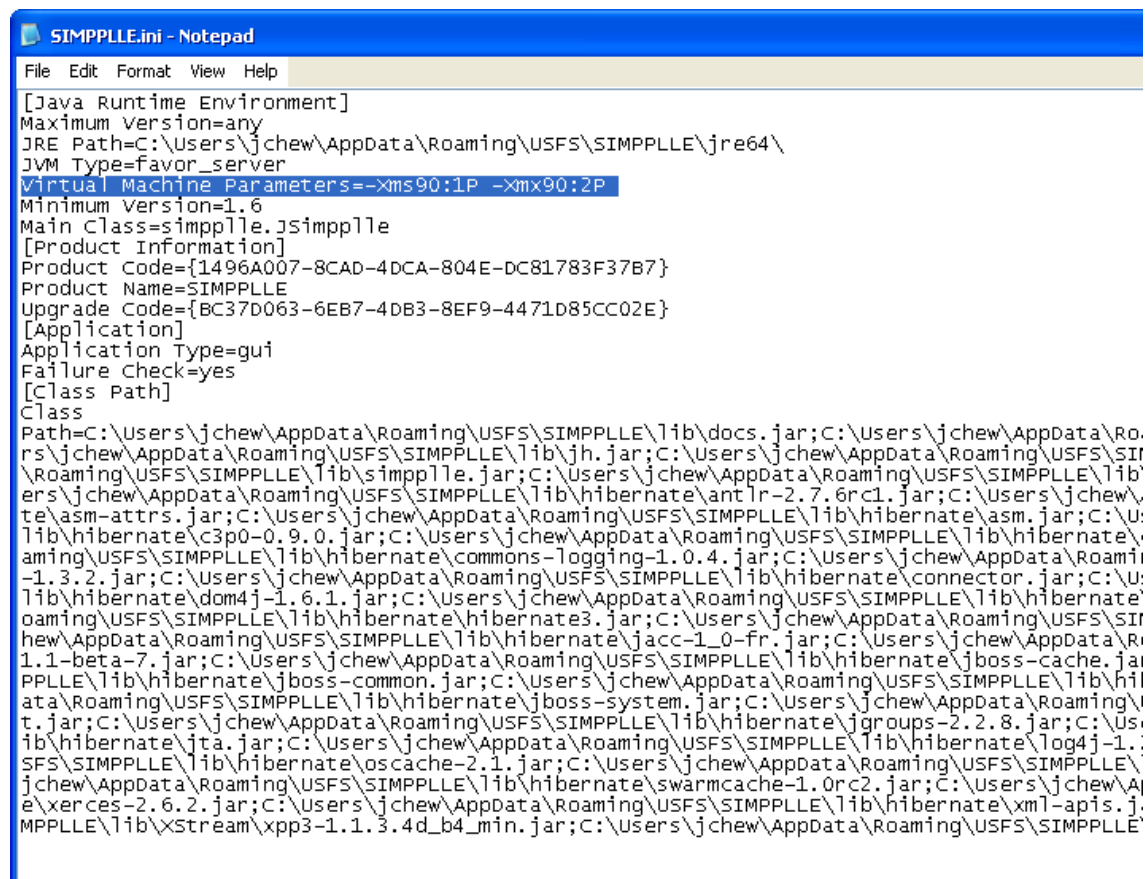


Figure 2 Dialog box for changing Java Heap Size.

The value may need to be lowered to 512 MB if you have only 1 GB of memory. Sometimes, trying to assign too much memory may make it impossible to start SIMPPLLE, and you will get a Java error. If this is the case, you will have to edit a file in the SIMPPLLE installation directory. This file is “SIMPPLLE.ini” in the SIMPPLLE 64 bit installation directory (Figure 3) or “SIMPPLLE.bat” in the 32 bit installation directory (Figure 4). The location of these files can be easily found by going to **Start >Programs > SIMPPLLE > Application Folder**.

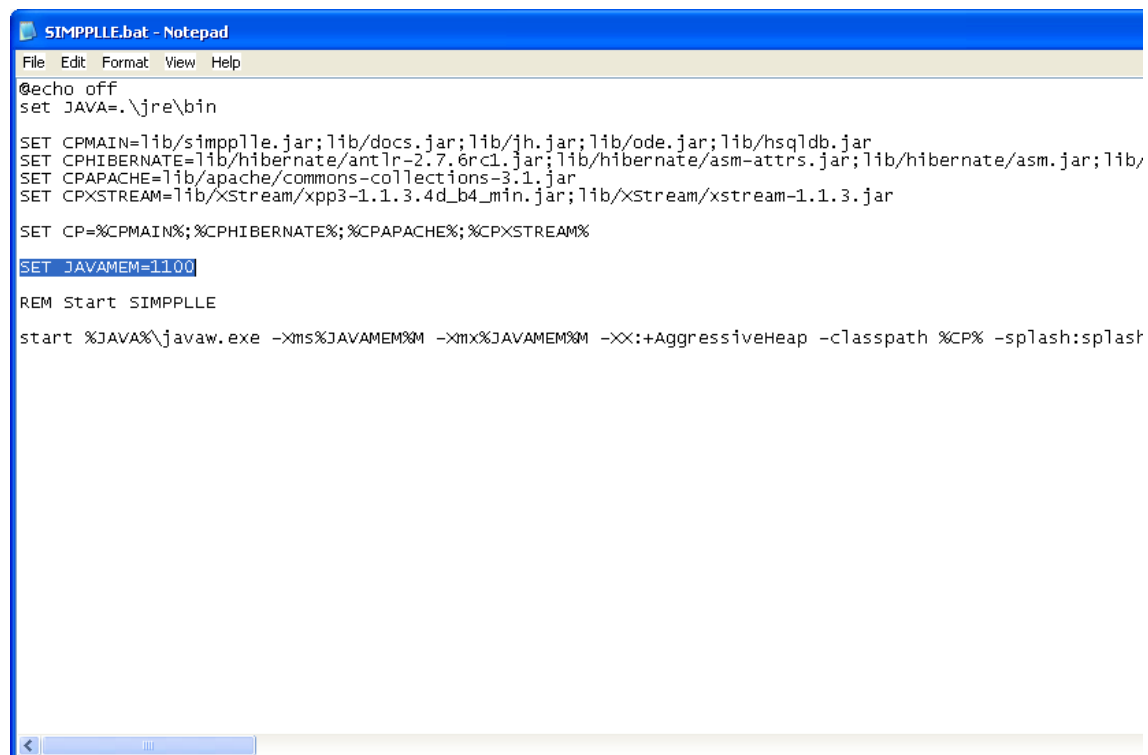


```

SIMPPLLE.ini - Notepad
File Edit Format View Help
[Java Runtime Environment]
Maximum Version=any
JRE Path=C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\jre64\
JVM Type=favor_server
Virtual Machine Parameters=-xms90:1P -xmx90:2P
Minimum Version=1.6
Main Class=simpplle.jsimpplle
[Product Information]
Product Code={1496A007-8CAD-4DCA-804E-DC81783F37B7}
Product Name=SIMPPLLE
Upgrade Code={BC37D063-6EB7-4DB3-8EF9-4471D85CC02E}
[Application]
Application Type=gui
Failure Check=yes
[Class Path]
Class
Path=C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\docs.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\jh.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\simpplle.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\antlr-2.7.6rc1.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\antlr-2.7.6rc1.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\asm-attrs.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\asm.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\c3p0-0.9.0.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\commons-logging-1.0.4.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\dom4j-1.6.1.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\hibernate3.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\jacc-1.0-fr.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\jboss-cache.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\jboss-common.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\jboss-system.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\jgroups-2.2.8.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\log4j-1.2.12.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\oscache-2.1.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\swarmcache-1.0rc2.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\xml-apls.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE\lib\hibernate\xpp3-1.1.3.4d_b4_min.jar;C:\Users\jchew\AppData\Roaming\USFS\SIMPPLLE

```

Figure 3 Line in the SIMPPLLE.ini file to be edited for changing the Java Heap Size. The two 90s (highlighted) can be set to a lower value.



```
SIMPPLLE.bat - Notepad
File Edit Format View Help
@echo off
set JAVA=.\jre\bin

SET CPMAIN=lib/simpplle.jar;lib/docs.jar;lib/jh.jar;lib/ode.jar;lib/hsqldb.jar
SET CPHIBERNATE=lib/hibernate/antlr-2.7.6rc1.jar;lib/hibernate/asm-attrs.jar;lib/hibernate/asm.jar;lib/
SET CPAPACHE=lib/apache/commons-collections-3.1.jar
SET CPXSTREAM=lib/XStream/xpp3-1.1.3.4d_b4_min.jar;lib/XStream/xstream-1.1.3.jar

SET CP=%CPMAIN%;%CPHIBERNATE%;%CPAPACHE%;%CPXSTREAM%

SET JAVAMEM=1100

REM Start SIMPPLLE

start %JAVA%\javaw.exe -xms%JAVAMEM%M -xmx%JAVAMEM%M -XX:+AggressiveHeap -classpath %CP% -splash:splash
```

Figure 4 Line in the SIMPPLLE.bat file to be edited for changing the Java Heap Size. The 1100 can be set to a lower value.

As simulations are run, the amount of memory used is displayed at the bottom of the main screen. The information for each landscape unit, time step, and fire event is kept in memory. This provides for maximum flexibility in producing reports after the simulations are made; however, it requires considerable memory. There are options on the simulation parameter screen to reduce the memory required. One option is to discard unnecessary simulation data. If this option is selected, there are limitations on the reports that can be made. Writing to a database can help to reduce these limitations; however, it does increase the simulation time. The database is discussed further under “System Output.”

6. SIMPPLLE INPUT FILES

Two files created in ArcGIS are imported into SIMPPLLE to create the input file that represents a landscape: spatial attributes (named “user-provided-name.spatialrelate”) and nonspatial attributes (named “user-provided-name.attributesall”).

The spatial attributes are the relationships between the components carried in SIMPPLLE, which can be existing vegetation units, land units, aquatic units, and manmade units. The range of spatial relationships depends on the landscape components being modeled. If landscape components are utilized in addition to existing vegetation, their associated spatial relationships and attributes are included in the two files.

SIMPPLLE GIS tools create both files from the ArcGIS environment.

The geographic extent represented by these input files is dependent on the issues to be addressed. Based on prior analyses, 6th field hydrologic code units (HUCs) appear to be too small to simulate by themselves when considering spreading disturbance processes. Many disturbance processes originate outside and spread into most drainages of this size. The exception is when watershed boundaries function as barriers and prevent disturbance processes from spreading. A combination of several 6th field HUCs or a single 5th field HUC is an appropriate minimum size to simulate. The plant communities in these areas can be as small as one acre or less. The maximum size of a plant community is determined by the size of an area in which spatial relationships are important and what can be handled by the memory limitations of SIMPPLLE on the computer being used. Currently, 4th level subbasins represented by 10 acre uniform sized polygons are a reasonable upper limit. We have simulated entire ecological sections of millions of acres, but the vegetation unit size has been increased to 20 acres or larger and the number of long term simulations is very limited even with discarding unnecessary simulation data.

6.1 NONSPATIAL ATTRIBUTES

Each landscape component (vegetation, land, aquatics, and manmade) must be represented in a separate feature class or coverage in ArcGIS. Attributes for each class are needed. The valid values for the nonspatial attributes for each geographic area are covered in an appendix for each area. These fields must be manually added to the feature classes. For version 2.5, the field names and formats must be identical to what is shown. There is no required order within the GIS files.

It is recommended that all these fields be created and edited within ArcMap or Catalog 9.3 or 9.3.1 on feature classes within a file geodatabase. If previous work was done in shape files, we do not recommend continuing to work with these, but import these into a file geodatabase first. There are field size limitations in shape files that are not compatible with the field names we use. Although ArcMap and Catalog are not case sensitive, some python scripts are, so make sure all field names are upper case. **Null** cannot be a value in any field. The length of the text fields depend on the descriptors used for the specific geographic area.

6.1.1 Vegetation

The level of vegetation attributes required is dependent on the way that SIMPPLLE uses them in combination with other variables to generate a probability for disturbance processes (Chew et al. 2004).

SIMPPLLE can represent a single dominant vegetation life form for each plant community or any combination of three life forms: trees, shrubs, and herbaceous. All the species belonging to each life form will have separate pathways in the system.

Although the pathways are separate, an additional component allows for interaction between the life forms that are present, allowing for the density of one life form to be impacted by the density of the others (see “System Knowledge” section).

There are multiple ways to create files of the existing vegetation attributes and other optional fields for the units in the GIS coverages. The most common has been to use data from a vegetation management record system, satellite imagery, or a combination of the two. SIMPPLLE can represent vegetation as irregular size units derived from vector GIS files or uniform sized units from raster GIS files.

The question of the accuracy of inventory data and the assignment of attributes to individual plant communities is left to the user to resolve. The user makes choices on how to represent a landscape for modeling purposes when the attributes are assigned in the data. It is the user’s responsibility to express the limitations of making choices about the representation of spatially explicit plant communities.

The fields in an ArcGIS cover or feature class required depend on whether you are using single life forms or multiple life forms and if you are using **Tracking Species**. The order in a cover or feature class attributes table is not important, however, the spelling is. The format for the field required by ArcGIS is specified in parenthesis.

Fields for the entire vegetation unit regardless of single or multiple life form:

SLINK (created by script)

This field provides the link between the unit in SIMPPLLE and the GIS environment.

It is added by one of the SIMPPLLE ArcGIS toolbox options. If the field already exists, it will be recalculated by the script. Once SIMPPLLE Spatial Relations has run, it is important to use the geodatabase created so the SLINK field will properly match what SIMPPLLE is using as identifiers for units.

HT_GRP (required – text)

This field for ecological stratification started as habitat type group values in the first geographic zones developed. HT-GRP has been broadened in concept and varies for each geographic zone (see appendices A through I). HT_GRP ranges from no stratification, to broad classes of elevation and aspect, to specific soil types. Within the user interface screens, the name has been changed to **Ecological Grouping**. All of the system knowledge can be varied by this stratification/grouping by the user choosing to add a column for this field to the probability and logic screens.

ACRES (required – long)

Acres of the individual unit.

STAND_ID (required — text)

A number (although represented as text) that can be tied to other record keeping systems. For vegetation, this is often a vegetation management record keeping number. It must be set to zero if it is not used.

OWNERSHIP (optional — text)

To utilize the fire suppression logic, ownership needs to be: National Forest Wilderness (**NF-WILDERNESS**), National Forest Other (**NF-OTHER**), or **OTHER**. **OTHER** can be State, private or other federal ownership or more specific, but in its use with fire suppression logic it all is treated as other. The user does not have to make differences in fire suppression by ownership and wilderness versus non-wilderness, but the system does provide the capability.

ROADS (optional — text)

The road status can be identified in two ways. If road units are not created for the landscape file, the user can (in the GIS environment) decide what status to assign to each plant community. The road status can then be used in the fire suppression logic (if the logic includes road status). It needs to be one of the three: Open Roaded (**O**), Closed Roaded (**C**), or None (**N**).

If roads units are part of the landscape file, which they need to be for the Eastside Region One zone for invasive species, this status value is determined dynamically. Treatments can be utilized to close and open roads.

ELEV (optional — long)

If this field is not used, a digital elevation model must be identified when running the SIMPPLLE spatial relations tool from the SIMPPLLE toolbox. The system uses a difference of 10 percent in the mean elevation of a unit to determine if a neighbor is above or below a vegetation unit. At the time of area-file creation a window will appear, allowing the user to change the percent, or the Elevation Relative Position choice under the utilities menu can be used. Both the elevation and distance in the feature classes has to be in meters.

FMZ (required — text)

This field is for designating the fire management zone (FMZ). These are delineations that have had some meaning for fire management planning (fire suppression and fire occurrence). There is usually variation in terms of numbers of past fires, suppression costs, and suppression policy. A delineation may be utilized to represent a wildland urban interface. If no zone value is used, **All** is interpreted for the field.

SP_AREA (optional — text)

This field can be used to facilitate a spatial breakdown of the outcome from SIMPPLLE in the reports. In past analyses we have seen drainage designations, wildlife management units, Forest Plan Management Areas, and a broad designation of Forest versus non forest ecological types used. If the field is used, it cannot be blank, have a space, or have a dash in the value. All of these cause problems in Excel macros or ArcGIS. An underscore can be used.

LANDTYPE (optional — text)

This field can be used to assign to a vegetation unit some feature of the land that it occupies. This can be utilized if a user does not want to create a GIS layer of land units to incorporate into SIMPPLLE.

Vegetation fields for single life form:

SPECIES (required — text)

The dominant species may be assigned from any source of input that is available. Its assignment should match guidelines from the inventories in the geographic area.

SIZE_CLASS (required — text)

There is variability in how this attribute is represented across zones. One has to use values that are tied to inventories and needed for a combination of interpretation and influence on disturbance processes. The user must be aware that if structure is built into pathways it may not always be shown in initial vegetation conditions because of limitations from an inventory. However, simulation will “add” structure according to the vegetative pathways over time steps (see appendix for specific zone) showing a significant increase in structure.

DENSITY (required — text)

There is variability by zones, but all utilize absolute canopy cover because it is most easily obtained from remote sensing and most commonly found in inventories.

PROCESS (optional — text)

This can be used to provide SIMPPLLE with a disturbance process history that can be utilized in the initial simulation time steps. If used, the Process_T field must also be utilized.

The values must be one of the acceptable disturbance processes used in the system. This is not the same as identifying a current, ongoing process. See the “lock-in” process feature for current processes. Without specifying a disturbance process, each plant community starts out as if succession was occurring.

TREATMENT (optional — text)

This field can be used to provide a treatment history for the initial simulation time steps.

PROCESS_T (optional — long)

The number of time steps past that the process occurred. Although you can put values of more than 1, SIMPPLLE currently always uses a value of 1.

TREAT_T (optional — long)

The number of time steps past that the treatment occurred. Although you can put values of more than 1, SIMPPLLE currently always uses a value of 1. This field is used inside SIMPPLLE to keep track of time steps since simulated treatments as well.

6.1.2 Multiple Life Form Input Fields

To use multiple life forms requires additional fields in the GIS files. If the inventories do not contain this information it can often be added by extrapolating from sources such as Forest Inventory and Analysis (FIA) plots. If it has not been added, but the SIMPPLLE area file must be multiple life forms to be able to run a specific feature (such as using invasive species in the Eastside Region One), there is a choice under **Utilities** that will convert the file to be recognized as having multiple life forms even though no additional values exist. This will have an impact on the summary report and the user must keep this in mind. See “Notes” under “Reports.”

The species, size-class, density, process, and treatment have to be expanded to account for each life form. The following abbreviations used are shown in Table 2.

Abbreviation	Definition
TR	Trees
S	Shrubs
H	Herbaceous
A	Agriculture
N	Non-Forest
PROC	Disturbance Process
TREAT	Treatment

Table 2 Abbreviations used with multiple life forms.

The required fields in a text format are:

SPECIES_TR

SPECIES_S

SPECIES_H

SPECIES_A

SPECIES_N

SIZE_TR

SIZE_S

SIZE_H

SIZE_A

SIZE_N

DENSITY_TR

DENSITY_S

DENSITY_H

DENSITY_A

DENSITY_N

PROC_TR

PROC_S

PROC_H

PROC_A

PROC_N

TREAT_TR

TREAT_S

TREAT_H

TREAT_A

TREAT_N

PROC_TR_T

PROC_S_T

PROC_H_T

PROC_A_T

PROC_N_T

TREAT_TR_T

TREAT_S_T

TREAT_H_T

TREAT_A_T

TREAT_N_T

6.1.3 Tracking Species Input Fields

Tracking species can be used with single and multiple life forms and any life form (trees shrubs, and herbaceous). This is used for two cases. One case is with grass communities where users do not want to use a size and density, but an aggregate of species (see Appendix H for the grassland zones). The second is to account for invasive species in the two zones that have logic for invasive species, Eastside Region One and Colorado Plateau.

To use tracking species as a means to represent plant communities, the pathways have to be built to identify the species that comprise the aggregate and will be tracked. Within the pathways, the inclusion rule has to be identified for what species have to be within certain percents to identify the state. The rate of change (as a percent of what exists) for all species and all possible disturbance processes has to be identified. If a species listed to track has a zero value in the attributes file that comes from the GIS cover, and it is not a species listed in the ecological stratification as a species to track, it is not brought into SIMPPLLE. If the species value in the attributes file that came from the cover is greater than zero but there still is no species change information for it within the pathway files, it will be brought in, but the species value will not change. In this case, the user can edit the pathway file, adding in change values for this new species. Additional information on inclusion rules and rates of changes is covered under the discussions on Pathways.

For tracking invasive species, the species has to be checked as invasive in the species attributes editor and the rate of change and a threshold value has to be provided in the invasive species system knowledge.

There is no limit for the number of species that can be tracked.

Each species being tracked must include a field for the species name (text format) and a field for the percent of cover (long format):

SPTK_TRx	SPTK_TRxP
SPTK_Sx	SPTK_SxP
SPTK_Hx	SPTK_HxP

SPTK_Ax SPTK_AxP

SPTK_Nx SPTK_NxP

The tracking species number from 1 to the number of tracking species, with the number within each life form is represented by **x**. These values have to be attributed for all records in the vegetation feature class, even if the value is zero.

The following components in SIMPPLLE are necessary only if you are working in a zone that requires them or for the features desired.

6.1.4 Land Units

Land units have been used in two geographic areas. They have been used in the Colorado Plateau area to provide soils information that is required in the logic for predicting the probability of invasive species. They have been used in the Eastside Region One to provide topographic information used in the prediction of the probability of invasive species.

Required fields and format:

SLINK (added by ArcGIS python script)

ACRES — long

SOIL_TYPE — text

LANDFORM — text

SLOPE — float

ASPECT — text

PARENT_MAT — text

DEPTH — text

In the case of the Eastside Region One, only slope and aspect are used for predicting the probability of invasive species. Since the other fields are still required, but not used, one can just enter any valid value in the field and make it the same for all units.

6.1.5 Aquatic Units

Fields for the aquatic class were initially created for a prototype that displayed the capabilities to include the dynamics of stream reaches. They have been used in the grasslands zones to identify water sources for bison grazing. In this case, we simply make the LTA_GRP, AQ_CLASS,

AQ_ATTRIB, and INT_PROCESS, have the same value for all units. The status field is used to identify if the stream reach, aquatic unit, is perennial or intermittent.

Required fields and format

- SLINK (added by ArcGIS python script)
- LENGTH — double
- LTA_GRP — text
- AQ_CLASS — text
- AQ_ATTRIB — text
- SEG_NUM — short
- INIT_PROC — text
- STATUS — text

Until further development of the aquatic component of the landscape is done in a geographic zone, the only valid values available for these fields are those from the initial prototype study that was done in the Westside Region One zone (see Appendix A).

The LTA_GRP has values that represent Landtype Association, valley bottom groupings.

Any of the following values (defined in Appendix A) can be used:

12-FMA

12-FWC

12-FWB

45-41-FMA

45-41-FNA

51-FMA

51-UWB

51-FWB

62-72-FNA

The AQ_CLASS has values that represent the Rosgen type assigned the stream unit. Any of the following values can be used:

A1, A2, A3, A4

B2, B3, B4

C4

D4

E4

G3, G4

The AQ_ATTRIB is intended to represent the status of temperature, stream bank stability, large woody debris, and stream bed conditions. Different combinations of these variables being in or out of reference conditions were developed. For the purpose of using an acceptable value for the system, use: REF.

The INIT_PROC has values that are intended to be representative of the dynamics of an individual stream reach. For the purpose of using an acceptable value for the system, use: STREAM-DEVELOPMENT.

STATUS has been added to meet the needs for the grassland zones modeling bison grazing. This has two possible values: PERENNIAL or INTERMITTENT.

Small polygons of water can be converted to arcs if desired. Through the use of **Change Rules and Tracking Species**, and the Regional Climate variable, ecological types can vary between water and vegetation.

6.1.6 Roads

The only use of the road class has been in the Eastside Region One area in connection with predicting the probability of invasive species. Even when they are in the system (the area file) we have not added the means to look at these features.

Required fields and valid values:

Required fields:

STATUS — text

Values

OPEN

CLOSED

PROPOSED

ELIMINATED

UNKNOWN

KIND — text

Values

SINGLE_LANE

DOUBLE_LANE

UNIMPROVED

SYSTEM

NONSYSTEM

UNKNOWN

6.1.7 Trails

The only use of the trail class has been in the Eastside Region One area in connection with predicting the probability of invasive species. Even when they are in the system, the area file, we have not added the means to look at these features.

Required fields:

STATUS — text

Values

OPEN

CLOSED

PROPOSED

ELIMINATED

UNKNOWN

KIND — text

Values

HIKE

6.2 SPATIAL ATTRIBUTES

Version 2.5 includes a SIMPPLLE ArcGIS toolbox. It needs to be added to the toolboxes in ArcMap (and ArcCatalog) after installing SIMPPLLE by right clicking in the toolbox space to open up a dialog box with the option **Add Toolbox** (Figure 5). In the resulting dialog window, enter the pathway and file name to where the SIMPPLLE toolbox is located under the installed directory (Figure 6). This information is included in a file that can be displayed during the SIMPPLLE installation process.

Adding the SIMPPLLE Arc Toolbox.

1. Select the "Application Folder" Shortcut in the Programs Menu for SIMPPLLE, to open up a window to the Installation Folder.
2. Navigate to gis\python (which is where the file SIMPPLLE.tbx is located).
3. Copy the pathname from this window to the clipboard.
4. Open ArcCatalog
5. Right-Click in the ArcToolBox Window
(click the toolbox icon to show window)
6. Select "Add Toolbox..."
7. Paste the pathname into the Add Toolbox Dialog (Ctrl-V)
8. Press Enter or Press Open.
9. Select SIMPPLLE.tbx
- 10 Click Open.

Please Review the Release Notes for important information on changes in this release. (Available via the SIMPPLLE menu under Start-->Programs.

Figure 5 Instructions for adding the SIMPPLLE ArcGIS Toolbox.

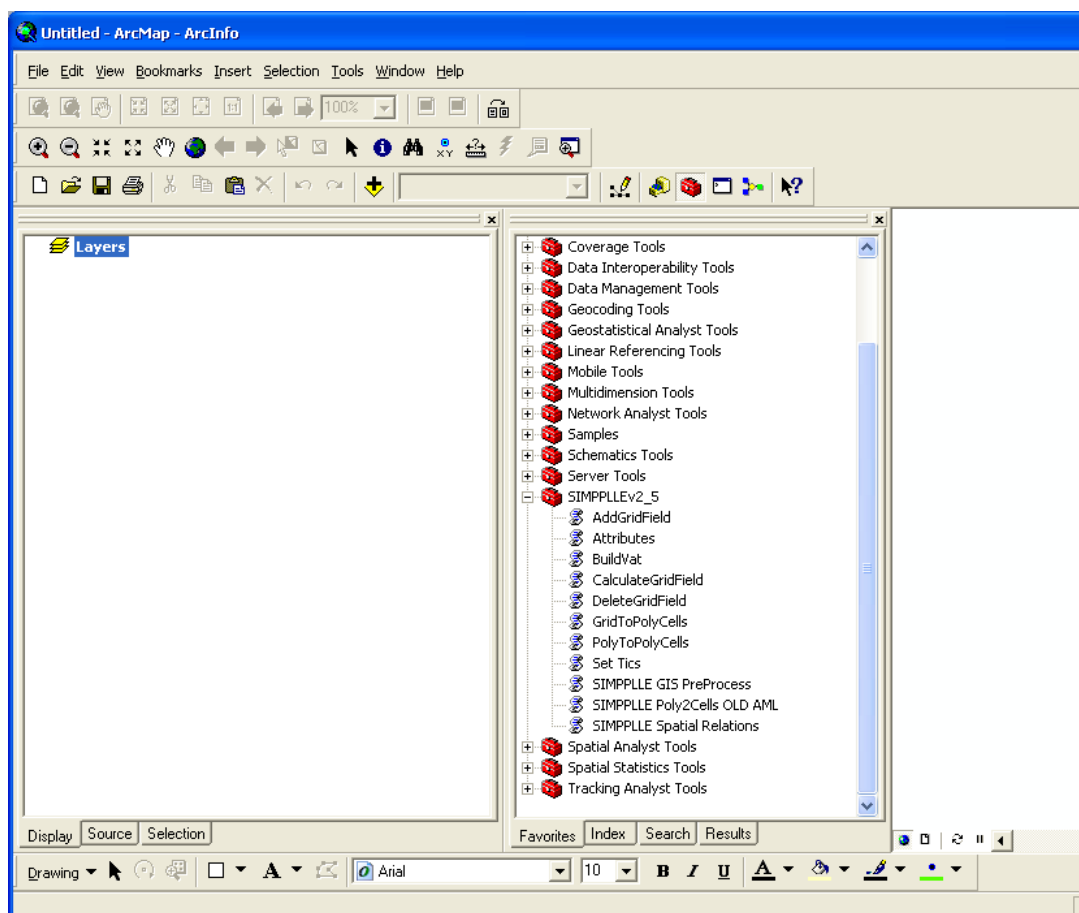


Figure 6 The choices available in the SIMPPLLE toolbox under ArcMap.

The following spatial relationships are used in SIMPPLLE.

For vegetation, we identify the set of adjacent neighbors for each vegetation unit. If using irregular polygons it is any unit that shares a boundary. If polygons are uniform, the system can identify a maximum of eight neighbors. Each neighbor is identified as being **Above**, **Below**, or **Next To** by comparing the elevation of the center of the plant community. The elevation has to come from either an elevation field in the cover for the vegetation or a digital elevation model. The neighbors that are **Downwind** are identified by providing a dominant wind direction for the landscape. The distance to the nearest aquatic unit and distance to nearest road unit is calculated in SIMPPLLE.

For aquatics, the upstream predecessor and the successor aquatic unit in the network is identified. We identify what vegetation units are adjacent to each aquatic unit.

For constructed features of roads and trails, the predecessor and successor in the network is identified.

For land units, we identify the adjacent neighboring land units (similar to vegetation) and the vegetation units that coincide with it.

6.3 GIS PROCESSING OF INPUT DATA

After all of the initial landscape components have been attributed in the GIS environment, a choice on the shape and size of the vegetation units has to be made. If the units are irregular polygons, are they to be left that way or converted into uniform polygons and of what size? If the units were initially grid data are they to be left at the original size or combined into larger units? Through the use of the SIMPPLLE GIS toolbox, the user has a choice to model irregular polygons, or convert them to uniform, rectangular size polygons, essentially a grid, or to aggregate small grids into larger uniform size polygons.

Within SIMPPLLE, a disturbance process or management treatment is modeled to apply to all of a plant community. SIMPPLLE does not split existing vegetation units. If an initial coverage consists of irregular size polygons with a wide range of sizes, the user may not like how SIMPPLLE spreads the processes in irregular size units. Uniform sized units are recommended. Because of the GIS tools used to determine the spatial relationships between SIMPPLLE units, we need to convert any grid input into polygons within the GIS environment. The resulting coverages have the appearance of being a grid. A polygon coverage is used for the advantages it provides in spatial display of output and the ability to join modeled results back to the coverage polygons.

In the SIMPPLLE toolbox, **PolyToPolyCells** (Figure 7) creates a feature class of uniform rectangular size polygons of the acreage the user identifies from irregular sized polygons. **GridToPolyCells** (Figure 8) will take small grids (e.g., 15–30 meters) and create uniform polygons of a larger, user specified size.

Following the conversion of units using either of these two tools, **SIMPPLLE Spatial Relations** (Figure 9) must be run in order to create the two files to be imported into SIMPPLLE.

A feature class of the plant communities (and any other landscape component) must exist in an ArcGIS file geodatabase, regardless of the original source of the polygons. A digital elevation model (DEM) for the landscape also must exist (or an elevation field must be in the vegetation and land covers). As a road or trail feature class is converted into a cover, one must do a BUILD on NODE followed by a BUILD on LINE prior to using them as input to SIMPPLLE Spatial Relations. All feature classes and the DEM must be in the same projection. The elevation from a field or from a DEM is used to determine if each plant community's neighbors are **Above**, **Below**, or **Next To** it. This is computed dynamically as SIMPPLLE is executing using a percent difference in elevation between the unit's center points. The distance in the feature class, the elevation field, and elevation in a DEM must all be in meters. To change the percent difference, select **Utilities > Elevation Relative Position**. Older landscape files that had the relative position determined prior to file import can still be utilized. With new files that contain the elevation for each vegetation unit, the percent value can be changed with the utility and new simulations made to test the difference in how relative position is calculated.

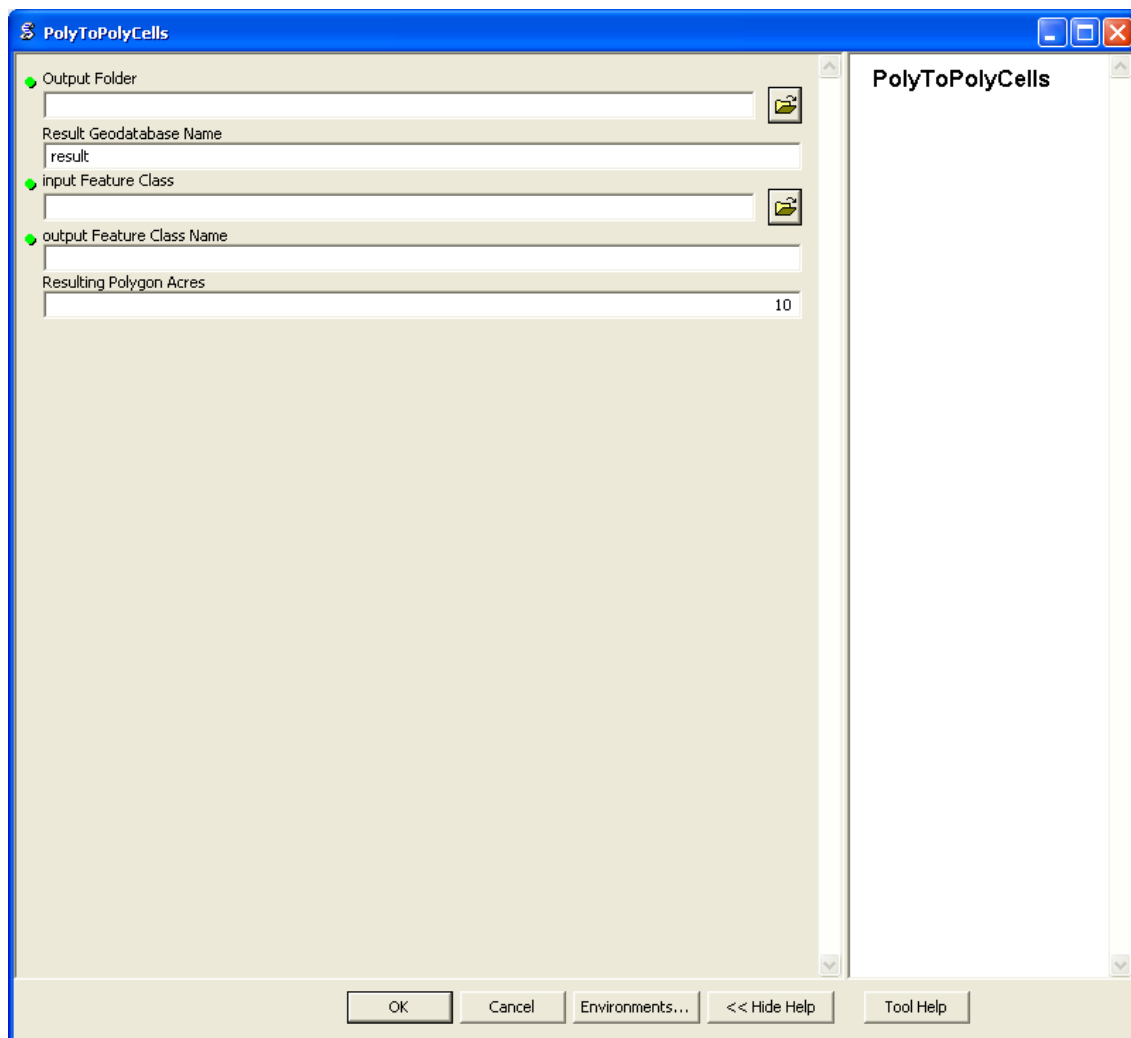


Figure 7 Screen to provide input for running SIMPPLLE poly2polycells.

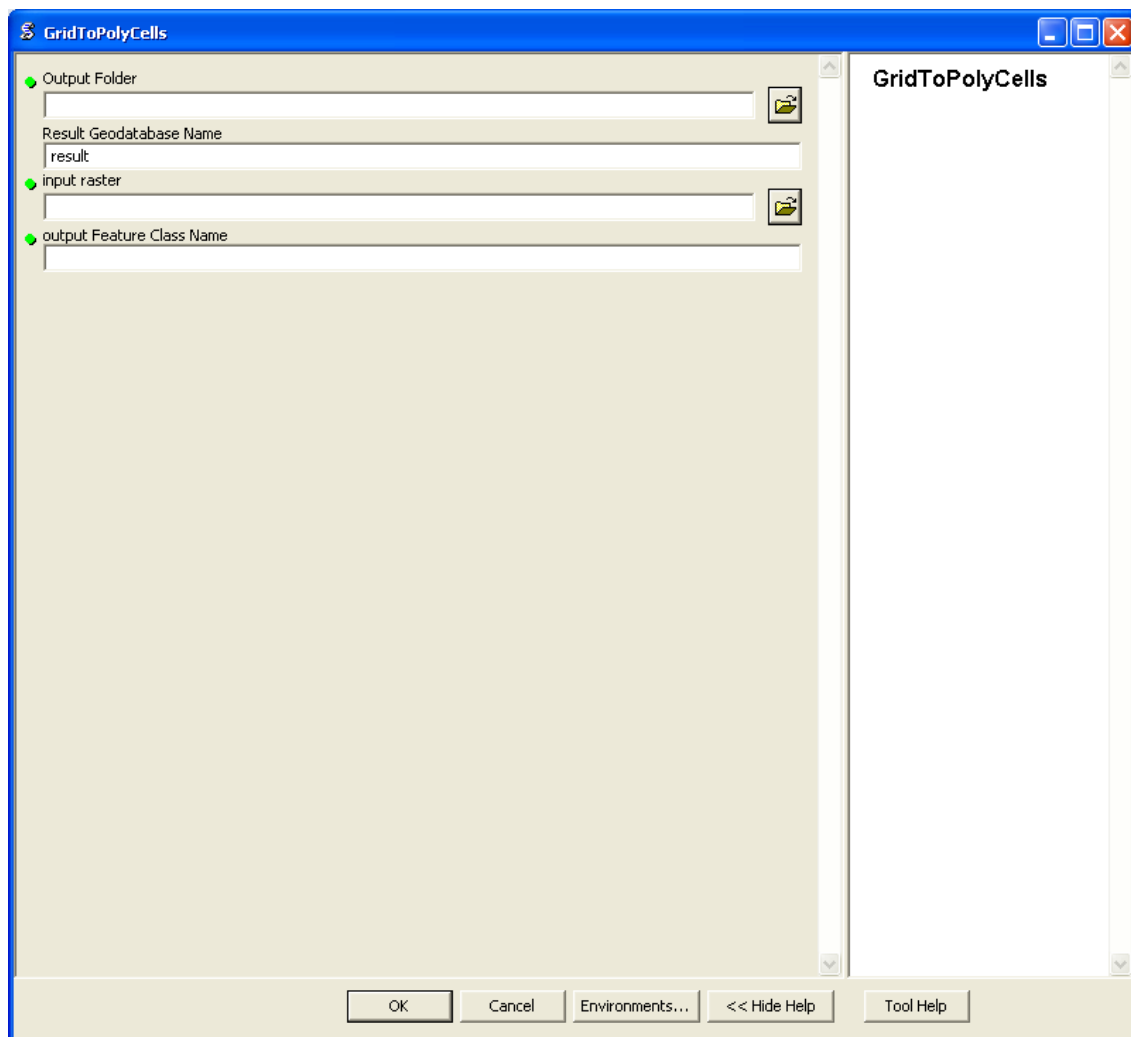


Figure 8 Dialog box to provide input for running the SIMPPLLE gridtopolycells from the toolbox.

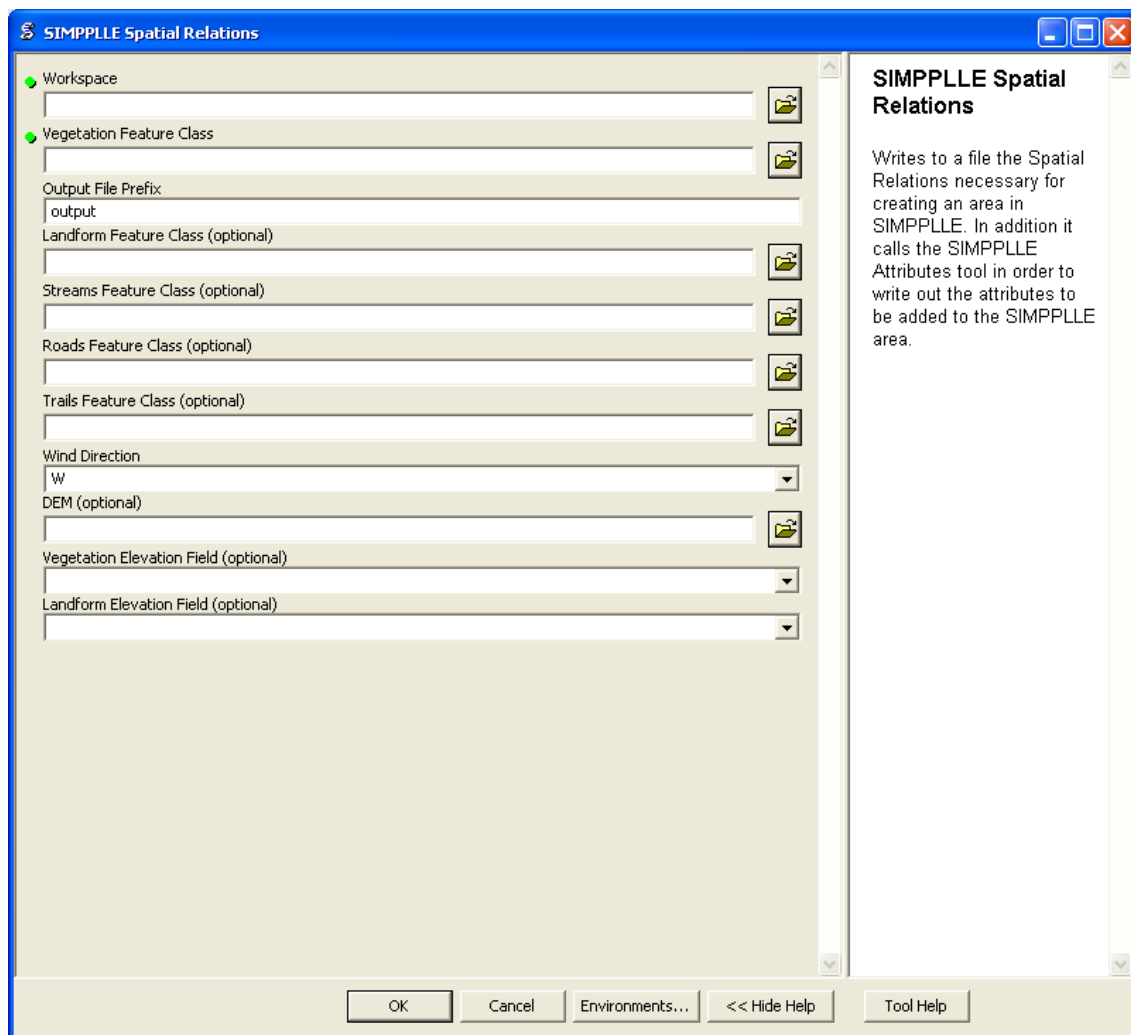


Figure 9 interface screen for SIMPPLLE spatial relations started from the toolbox in ArcMap.

6.4 IMPORTING FILES WITHIN SIMPPLLE:

Importing can only be done after the SIMPPLLE Spatial Relations tool is run in the GIS environment. Select **Import > Create New Area** (Figure 10).

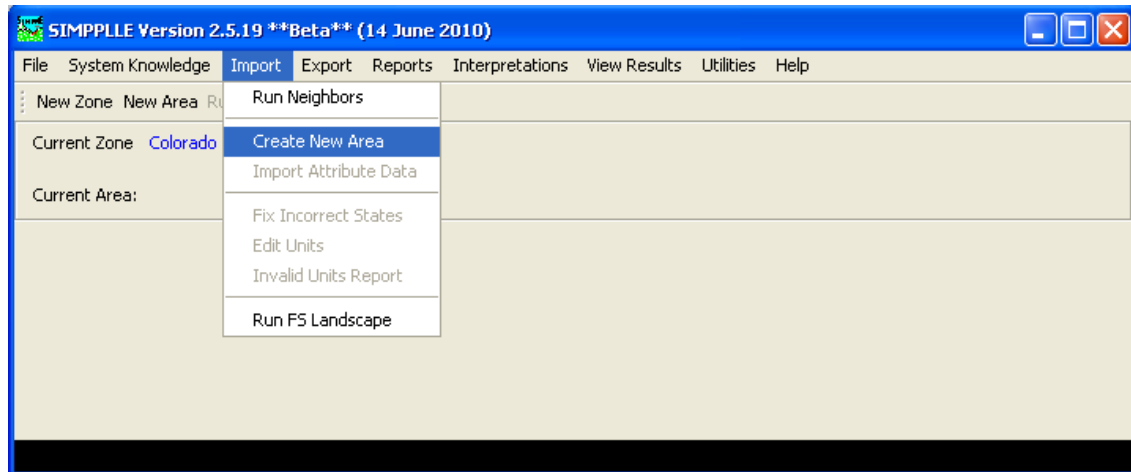


Figure 10 Selecting Create New Area from the SIMPPLLE interface.

The user will be prompted for the name of the file that resulted from executing the SIMPPLLE spatial relations tool (Figure 11). If a working directory is designated under **File** and the results are placed from running the tool in the working directory, then the system will open up the dialog box listing all the files ending with the “*.spatialrelate” extension.

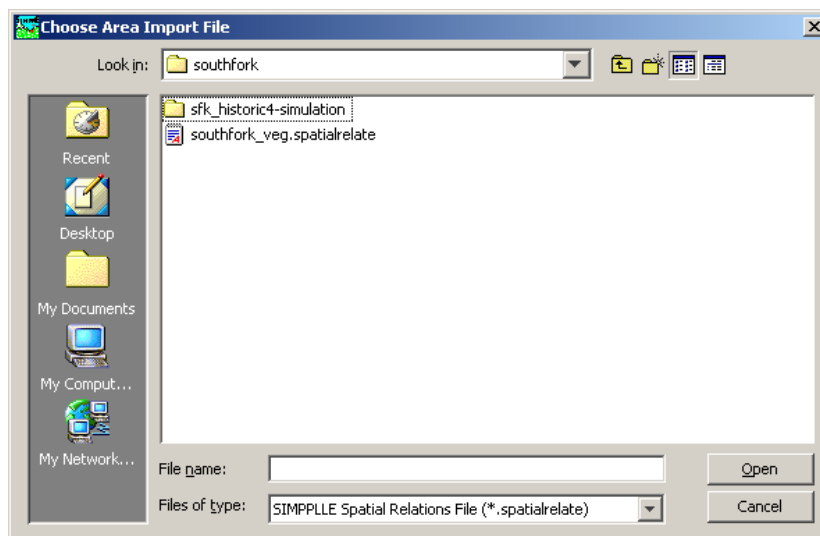


Figure 11 SIMPPLLE dialog box to provide the name of the file containing the spatial attributes.

After selecting and choosing **Open**, the system will find the corresponding “*.attributesall” file with the same prefix name that has been created and placed in the same directory.

As the files are processed, the existing vegetation attributes that are created are compared to the system knowledge for the geographic area.

Incompatibilities will result in invalid units. The following problems will result in the display of Figure 12:

- FMZ values in the fields but not having an FMZ (fire occurrence) file loaded that recognizes the zone values
- Combined existing vegetation states do not match potential states in the pathway files

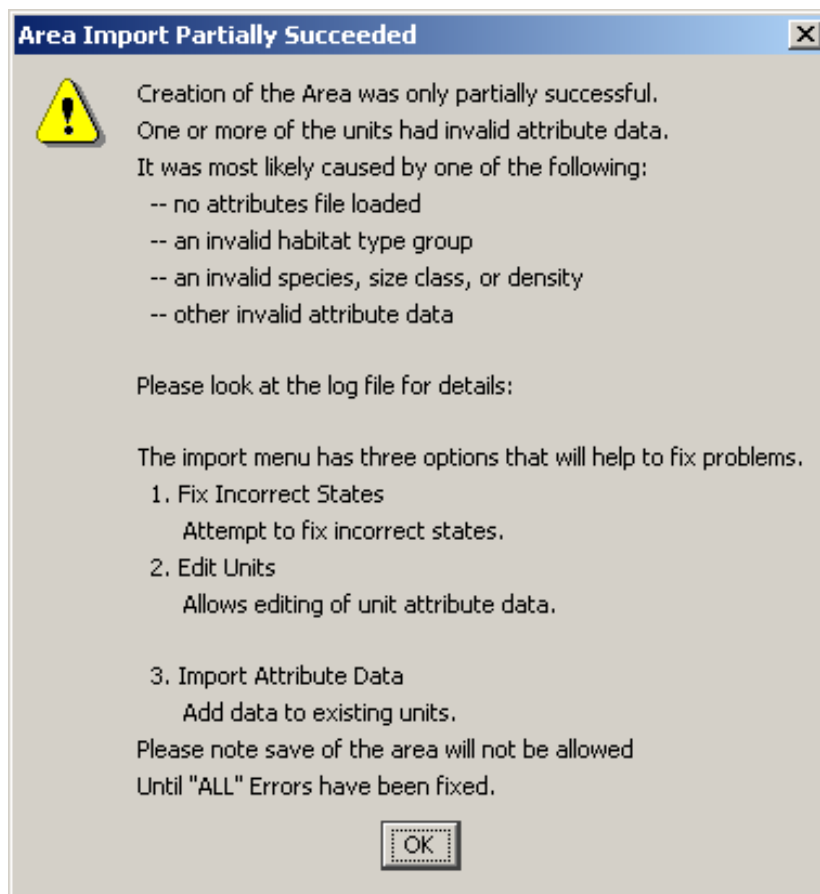


Figure 12 SIMPPLLE screen that identifies the creation of area was only partially successful. Options are provided to fix the problems.

An example of the log file mentioned above is displayed in Figure 13.

```

swan_vegattrib.log - Notepad
File Edit Format Help
40,504,46,0,9.98329569098,D3,#,1,ES,LTS,3,?,?,?,?,#,?,?,?,170102080108,?
In Evu-40Could not build a valid state.
One or more of the following must be invalid:
Species, Size Class, Density, or Ecological Grouping
88,501,54,0,9.98329569098,G1,#,1,AF,MTS,3,?,?,?,?,#,?,?,?,170102090606,?
In Evu-88Could not build a valid state.
One or more of the following must be invalid:
Species, Size Class, Density, or Ecological Grouping
99,500,50,0,9.98329569098,D3,#,1,AF,MTS,3,?,?,?,?,#,?,?,?,170102080108,?
In Evu-99Could not build a valid state.
One or more of the following must be invalid:
Species, Size Class, Density, or Ecological Grouping
112,499,48,0,9.98329569098,D3,#,1,AF,LTS,4,?,?,?,?,#,?,?,?,170102080108,?
In Evu-112Could not build a valid state.
One or more of the following must be invalid:
Species, Size Class, Density, or Ecological Grouping
125,498,47,0,9.98329569098,D3,#,1,ES,LTS,3,?,?,?,?,#,?,?,?,170102080108,?
In Evu-125Could not build a valid state.
One or more of the following must be invalid:
Species, Size Class, Density, or Ecological Grouping
126,498,48,0,9.98329569098,D3,#,1,ES,LTS,2,?,?,?,?,#,?,?,?,170102080108,?
In Evu-126Could not build a valid state.
One or more of the following must be invalid:
Species, Size Class, Density, or Ecological Grouping
131,498,53,0,9.98329569098,G1,#,1,WB-ES-AF,MEDIUM,3,?,?,?,?,#,?,?,?,170102080108,?
In Evu-131Could not build a valid state.
One or more of the following must be invalid:
Species, Size Class, Density, or Ecological Grouping
155,496,51,0,9.98329569098,D3,#,1,ES,LTS,3,?,?,?,?,#,?,?,?,170102080108,?
In Evu-155Could not build a valid state.
One or more of the following must be invalid:
Species, Size Class, Density, or Ecological Grouping
175,494,43,0,9.98329569098,D3,#,1,AF,MTS,4,?,?,?,?,#,?,?,?,170102080108,?
In Evu-175Could not build a valid state.
One or more of the following must be invalid:
Species, Size Class, Density, or Ecological Grouping
188,493,43,0,9.98329569098,D3,#,1,AF,MTS,3,?,?,?,?,#,?,?,?,170102080108,?

```

Figure 13 Log file identifying invalid units.

The editing options within the **Import** drop-down menu are shown in Figure 14.



Figure 14 SIMPPLLE Import choices with edit options after an attempt to create a new area file was only partially successful.

Import > Fix Incorrect States is not available in all geographic areas. It was developed in one geographic area, Eastside Region One, to test logic that was an attempt to automatically correct invalid states.

Import > Invalid Units Report can be used to create a text file of unit ids that are invalid, but is not as useful as the "log file" above.

If **Import > Edit Units** is selected, Figure 15 is displayed. To open the same editor, select **Utilities > Open Unit Editor**.

The screenshot shows the 'Existing Vegetative Unit Editor' window. At the top, there are navigation buttons 'Prev' and 'Next' with arrows, and a text field containing 'EVU-119' and '119'. Below this, there are two radio button groups: 'Show All Units' (selected) and 'Show Only Invalid Units', and a 'Lifeform' section with radio buttons for 'Trees', 'Shrubs', 'Herbaceous', 'Agriculture', and 'Other' (selected). A message states 'Attributes of the lifeform are Valid.' The main section contains several input fields: 'Ecological Grouping' (D3), 'Vegetative Type' (AF/LTS/3) with a red '(invalid)' label, 'Species' (AF), 'Size Class' (LTS), 'Density' (3), 'Age' (1), 'Fire Management Zone' (all), 'Acres' (9.98), and 'Initial Process' (SUCCESSION). The bottom section has fields for 'Unit Number' (0), 'Ownership', 'Road Status' (UNKNOWN), and 'Special Area' (170102090703). At the very bottom are 'Close' and 'Check Unit Validity' buttons.

Figure 15 SIMPPLLE screen identifying an invalid vegetative unit.

In this case, the **Vegetative Type** is invalid because we have large, two-storied (LTS) for a sizeclass/structure combination. In the pathways for this zone, two-storied stands are not identified for subalpine fire (AF) but multistoried (MU) is. One can either go back and modify the pathway (or if the wrong pathway files have been loaded, load new ones) or edit this invalid state through the user interface. To edit the invalid state, click **Utility > Global Changes** for all units that have the same invalid attributes (Figure 16). This process can be repeated for all invalid units and then the corrected landscape file can be changed.

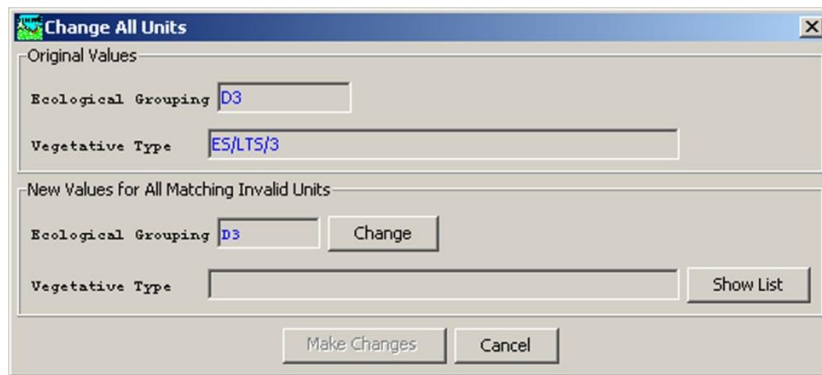


Figure 16 The global change screen to correct invalid attributes.

However, any changes made through the user interface are not made in the “*.attributesall” file, the geodatabase that was created, or the original feature class. In most cases, one will want to go back to the original feature class, make the changes and rerun SIMPPLLE Spatial Relations.

If we have no invalid states, an **Area Import Succeeded** screen will appear. This screen reminds you to give the area a name using **Utility > Change Area Name** and then save the area (*.area) file using **File > Save**.

Utilities > Change Area Name provides a dialog box to insert a name for the landscape. This is not a file name, but the name within the file that still has to be saved. It is just the name that will be used on SIMPPLLE screens and in many reports. After providing the desired name we can now save our new landscape file so we will have it for future simulations. The name provided here for the file name does not have to match the name just given to the area.

File > Save Area will open a dialog box at the working directory level for the user to provide a name. The area (*.area) extension will be automatically added to the saved landscape file name.

7. DECISIONS TO MAKE PRIOR TO SIMULATIONS

7.1 VEGETATION—SINGLE OR MULTIPLE LIFE FORMS

The use of multiple life forms is necessary if the system is to be used to address invasive species. If this decision was not made when the vegetation was attributed in the GIS files a utility can change the file without the initial input, select **Utility > Change Area to Multiple Lifeform**.

7.2 SINGLE OR MULTIPLE SIMULATIONS

Single simulations are often used to check system behavior and to gain an understanding of how changes have an interacting effect on many processes. The short time it takes to make a SIMPPLLE simulation makes it easy to use in a team environment to test system knowledge and to design and evaluate management options.

Multiple simulations are most often used to help quantify a range of outcomes on management options once they have been designed. A statistical test (see Appendix M) is provided with the Microsoft Excel spreadsheet template that comes with SIMPPLLE to compare the distribution of outcomes to see if there are any significant differences. Multiple simulations can be used to provide quantification for the concept of a range of variability in both vegetation attributes and disturbance processes. They can be used with long-term simulations to help provide a quantification of historic landscape conditions. When making multiple simulations, you have the option of tracking by ownership and Special Area within the data set. This enables the file using the Excel macro to be stratified by these levels. When making multiple simulations a location and a prefix to go with the files that are created must be identified.

7.3 NUMBER OF TIME STEPS

Short-term time step simulations (1–5 decades) are often used to provide a means to compare alternative management scenarios or current trends.

Long-term (greater than 5 decades) time step simulations are most often used to help quantify the interaction and cycling of disturbance processes and vegetation conditions. Long-term simulations (5–10 decades) without fire suppression are one way to help provide a quantification of historic conditions for a specific landscape.

7.4 HOW MANY SIMULATIONS TO MAKE

The number of simulations to run depends on both the size and the variability of vegetation within the area. Based on previous work, 30 simulations appear to be adequate to capture the variability created within SIMPPLLE. An Excel spreadsheet with a statistical test is provided to make it possible to test sets of simulations to see if additional simulations increase the variability of specific attributes (see Appendix M).

7.5 FIRE SUPPRESSION

Simulations to compare management options are usually made with fire suppression. Making simulations without fire suppression is most commonly used with long term simulations to create an interaction between fire, insect and disease disturbances and the vegetation pattern to quantify a historic range of variability. If fire suppression costs are incorporated, however, they are very simplistic. The user can access the dialogue **System Knowledge > Vegetative Process > Fire Suppression Costs**. Costs are assigned on a per acre basis, by fire size class, and by fire management zone.

7.6 SIMULATION METHOD

There are three choices for simulation method. **Stochastic** is the most common simulation method used. A Monte Carlo approach is used with the probability values for each disturbance

process calculated for each individual plant community to reinforce the concept that our landscapes are not always shaped by processes that have a high probability of happening on any given acre. The probability of many events is relatively low, but when these disturbance events happen, they make significant changes that shape the development of the landscapes. Stochastic, multiple simulations can be used to create the probability of vegetation attributes existing or disturbances occurring within a landscape. They are also useful to help add quantification to the concept that there is variability in the outcome in our landscapes. For some analyses on a very specific location of treatment choice (e.g., for example fuel management treatments) it may be more useful to lock-in specific disturbance processes to see how the landscape will vary with or without the treatments. **Highest Probability** will utilize the disturbance process that has the highest probability for each plant community. Choosing **Stand Development** as a simulation method can be used to eliminate all disturbance processes. This will create a landscape in which all plant communities will simply grow older.

7.7 DECADE, YEARLY, OR SEASONAL TIME STEPS

The default time step is decades. However, some of the interactions between processes, such as fire, insects, or the response of grasses to yearly moisture changes, make more sense if the system is run with yearly time steps. For some geographic areas, such as the grasslands, the interaction between processes is important on a seasonal basis. For these geographic areas, the default time step is yearly. For those geographic areas where the user can choose between yearly or decade time steps, most system knowledge is automatically adjusted. Two system knowledge components that the user must adjust are:

- Regeneration delay—this has to match the user's choice of time steps
- Rate of change for tracking species when used for invasives—user has to make this match the time step

Both of these changes can be made through the user interface.

7.8 PREDICTING INVASIVE SPECIES

This can be used only if the logic is included for the geographic zone / area in use.

In this release of version 2.5, only two geographic areas have logic for invasive species; the Colorado Plateau and the Eastside of Region One

7.9 LOCKING IN DISTURBANCE PROCESSES

Any disturbance process can be scheduled in a plant community by locking it in for a specified time step. Without specifying locking-in processes, a simulation begins with the assumption that no disturbances processes are ongoing. The simulations can be more realistic by accounting for processes that the user knows are currently active, such as mountain pine beetle or root disease. These processes can be scheduled for the first time step by building a file through the

user interface. Processes can also be scheduled to evaluate the impact of possible extreme events—large-scale occurrences of processes such as mountain pine beetles or stand replacing fires. There are a variety of ways that the user can explore “what if” scenarios. Some disturbance processes can be locked in while the system models others stochastic; or, by choosing **Stand Development** for the simulation type, the only disturbance processes will be those locked-in. The probability screens for each process can be utilized to selectively zero out the occurrence of a process.

7.10 SCHEDULING TREATMENTS

To represent management scenarios, treatments have to be scheduled. There are a number of ways that this can be accomplished. See more information on treatments under “System Knowledge.”

7.11 TRACKING BY OWNERSHIP OR SPECIAL AREA

The **Special Area** field has been used to summarize conditions and processes and to schedule treatments by watershed, management areas, or simply a break between non forest ecological stratification and forested ecological stratification. These assignments must be made during the GIS setup and can be used to stratify results post-simulation (e.g., ownership, forest versus non forest, management areas, and HUCs).

8. MAKING SIMULATIONS

Making a simulation involves the following steps:

1. Identify a working directory
2. Select a zone—geographic area
3. Load any user modified system knowledge files
4. Load a landscape
5. Set simulation parameters
6. Run simulation

8.1 IDENTIFY A WORKING DIRECTORY

The first step is to identify the working directory. This is the area where you want output files sent to and may also be where you have the input file for the landscape you wish to simulate.

File > Set Working Directory opens a dialog box to allow the user to browse to the desired location (Figure 17).

Note: Do not put working files in the installation directory that the installation of SIMPPLLE created.

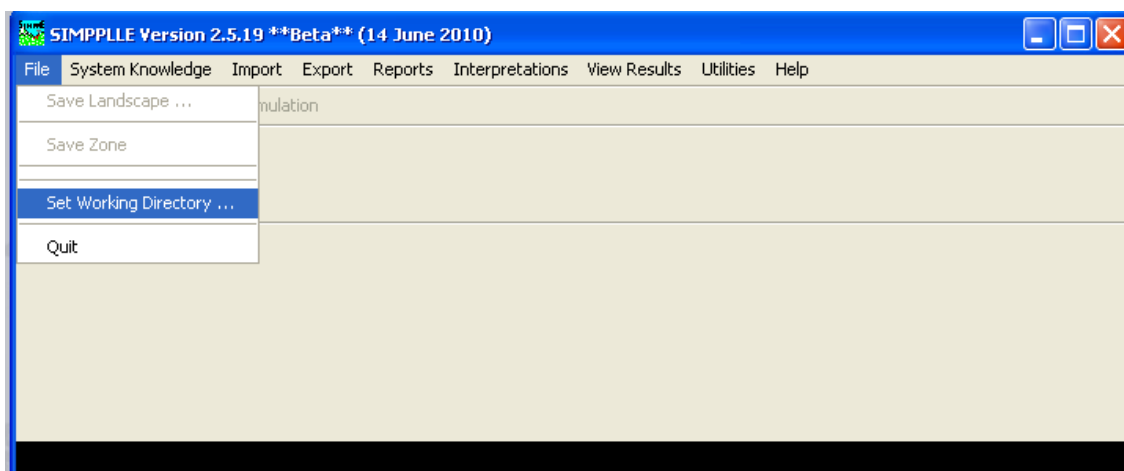


Figure 17 SIMPPLLE main menu with choice under the File selection to set the working directory.

The working directory is saved when SIMPPLLE is closed. The next time SIMPPLLE is started, the saved directory is recalled.

8.2 SELECT A ZONE—GEOGRAPHIC ZONE

After you have identified the working directory, the main screen displays limited options until a zone is selected (Figure 18).

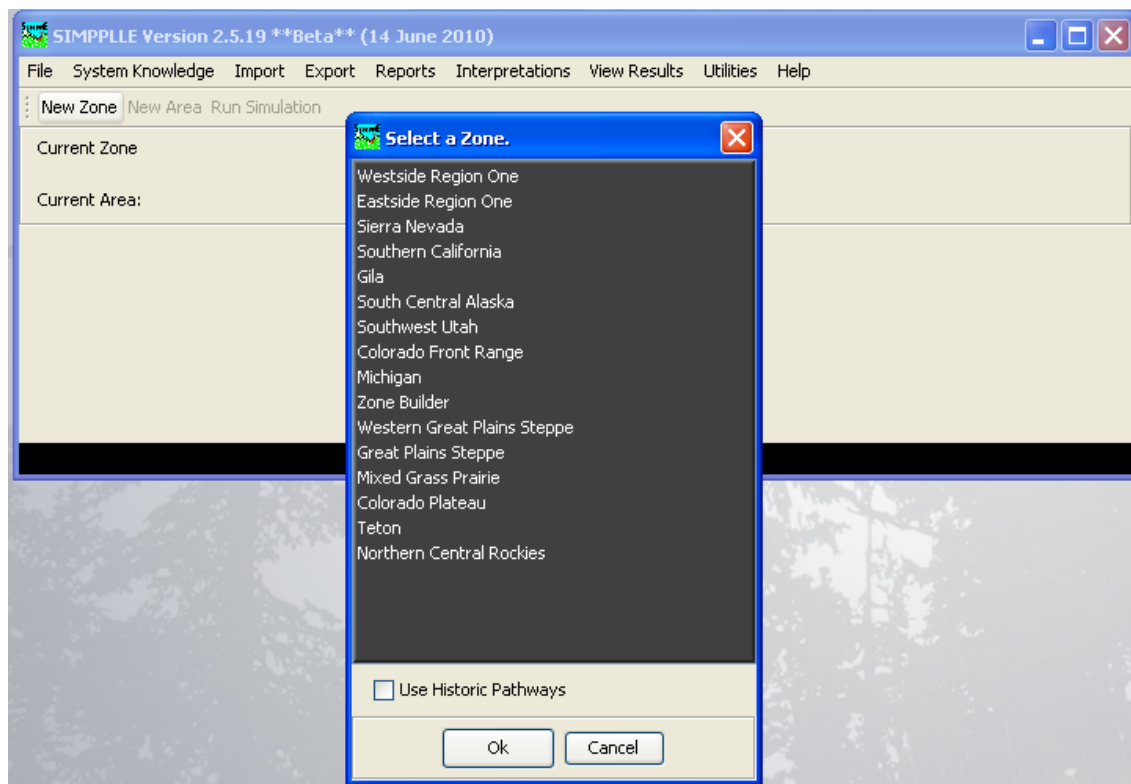


Figure 18 SIMPPLLE screens for selecting a zone (geographic area).

After the zone is loaded, its name is displayed on the screen as the **Current Zone**, and the **New Area** button is enabled.

8.3 LOAD A LANDSCAPE

After the zone has been loaded, the option to load a new area is now available. There are four choices the user can make (as shown in Figure 19):

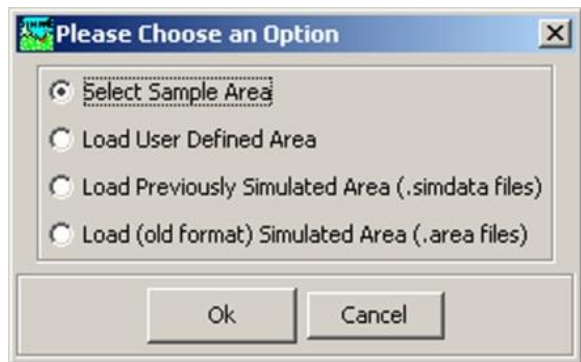


Figure 19 Different types of SIMPPLLE area files that can be loaded.

Loading the saved file from a previous simulation can be used to create additional reports, GIS files that were not created at the time of the initial simulation, or reports for a saved file from a set of multiple simulations (see “System Output” section). All the landscape files are identified by an area (*.area) extension. Landscape files containing the results of a simulation can be loaded as a previously simulated area and have a “*.simdata” extension.

8.4 SET SIMULATION PARAMETERS

To run a simulation, select **Run Simulation** (Figure 20).

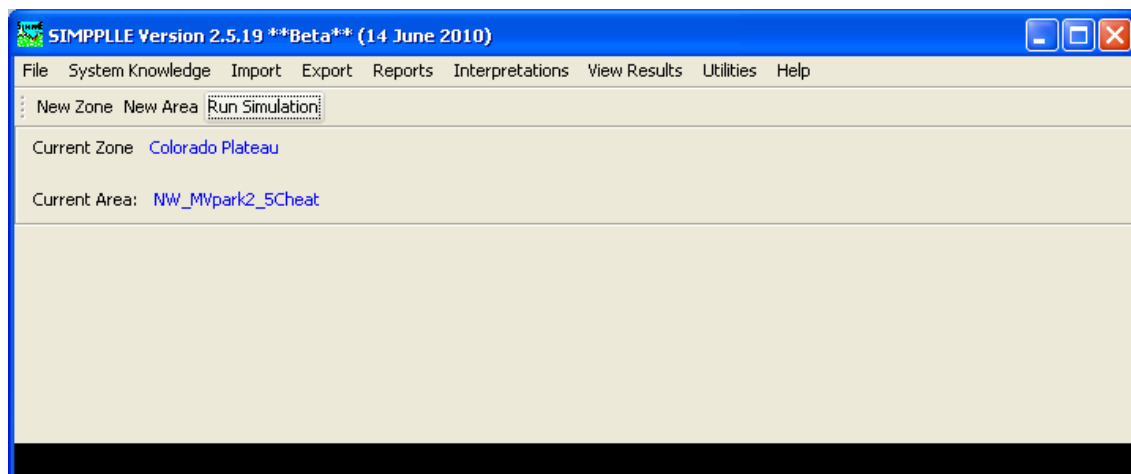


Figure 20 SIMPPLLE main screen with both a Zone and Area loaded. The choice to Run Simulation is now available.

This will bring up the **Set Simulation Parameters** screen, which contains a number of choices for the user to select (Figure 21).

Set Simulation Parameters

File

Number of Simulations: 1

Number of Time Steps: 5

Simulation Method: STOCHASTIC

Invasive Species Logic: NONE

Options

☐ Yearly Time Steps ☐ Track Ownership

☐ Fire Suppression ☐ Track Special Area

☐ Discounted Cost: 1.04

Results Output Options

☐ GIS Update/Spread Files

Memory Saving Options

☐ Use Database (saves memory, slows run)

☐ Discard Unnecessary Simulation Data, needed for extremely long term simulations.

10 Time Steps kept in memory (minimum 10)

All States Report

☐ Enable All States Report (needed if above discard option is checked or doing multiple runs)

Rules File (optional)

☐ Generate Tracking Species Report (needed if discarding data or multiple runs)

Adjust Categories

Run Simulation Cancel

Figure 21 SIMPPLLE screen for the simulation parameters that can be changed by the user.

Number of Simulations can be set from one to one hundred. Multiple sets of 100 simulations can be made if desired. An option in Excel spreadsheets provides for combining the output files from multiple sets of simulations. The limit on the **Number of Time Steps** is 10,000. The **Simulation Method** can be set to **Stochastic**, **Highest**, or **Stand Development**.

Invasive Species Logic must match the geographic area being used. At this time, only Colorado

Plateau and Eastside Region One have logic for predicting invasive species.

The time steps can be set as yearly or decade. The default is decade. To change the time steps to yearly, check the **Yearly Time Steps** box. The three grassland geographic areas must use a yearly time step. There is no user choice.

Fire Suppression must be checked, or no fire suppression logic is used. If the **Fire Suppression** box is checked, **Discounted Cost** is enabled, and the user can choose to have the system calculate and discount suppression costs at the rate specified.

If Ownership and Special Area are attributed in the landscape file, the option to have the output file of “*-ls.txt” stratified by these levels can be chosen by selecting **Track Ownership** or **Track Special Area**. These can only be selected for multiple simulations.

For a single simulation, no output files are automatically created and saved so no file names have to be entered in the **Results Output Options**. If multiple simulations are made, some output files are automatically created using a prefix file name provided by the user.

If multiple simulations are being made, a directory has to be identified for the output files. The prefix for this directory name is also used as a prefix for all files names. Unless the **GIS Update/Spread Files** box is checked, the only GIS files generated for the multiple simulations will be those that provide the basis of making probability maps. The update files showing the changes in all attributes and disturbance processes by time step by simulation will not be generated unless this box is checked. The spread files that show the origin and spread of the spreading disturbances such as wildfire will not be generated unless this box is checked. Checking this box can result in a very large number of files being created. Often, the approach is not to check it, generating only the probability files. After an analysis of the multiple simulations, the user can select an individual simulation, reload it and generate the update and spread GIS files. However, this is possible only if the simulations were made without discarding unnecessary simulation data.

Simulation choices involve **Memory Saving Options** that are based on trying to keep SIMPPLE’s system requirements appropriate for the type of PCs in common use at the field level in many organizations. The simulation results can be written to a database or past time step data can be discarded. There is a minimum of how many time steps to keep in memory. Some of the logic associated with disturbance probabilities looks back to use disturbance and treatment history. The default and minimum is set at 10 time steps. For the Eastside Region One zone, the minimum must be set to 20 time steps for logic that is associated with the conifer encroachment process.

The **All States Report** requires the detailed data for each plant community for all time steps and if the simulations are made discarding data, the reports must be run during the simulation. If simulation data is not discarded, these reports can be run after the simulations.

The **Tracking Species Report** is designed to be used in two cases: where some plant communities have pathways that are defined by percentages of individual species, and where invasive species are being simulated.

8.5 RUN SIMULATION

After all parameters have been set, click **Run Simulation** within the **Set Simulation Parameters** screen.

A message for the projection of each time step as it is simulated displays at the bottom of the main screen. This also displays the amount of memory being used from what is available (Figure 22).

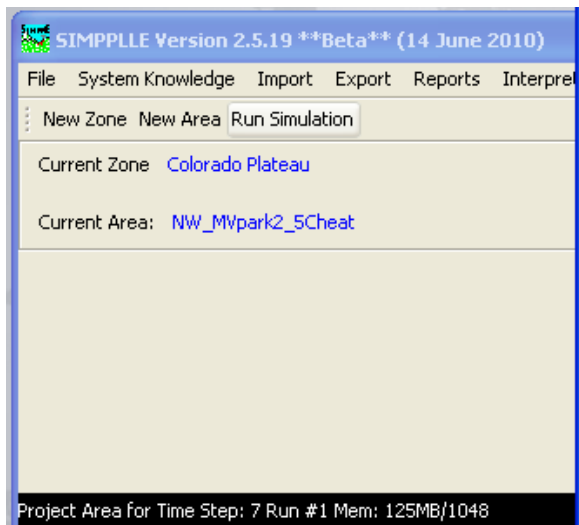


Figure 22 SIMPPLLE screen displaying the time step and simulation number being projected and the amount of memory used.

Once the simulation is completed, the **Simulation Finished** screen is displayed. Click on **OK** in the dialog box.

Following a simulation, the results can be viewed in the user interface. If examination of the results is satisfactory, a variety of output files can be created using **Export**, **Reports**, or **Interpretation** from the main menu (see output section). If no reports are desired, another simulation can be started by going back to **Run Simulation** on the main menu. The system resets to original conditions. Running another simulation will result in different output as long as the simulation method is stochastic.

If one wants to continue the simulation from the end point select **Utilities > Make Area Simulation Ready**.

This will set the landscape to the end point to enable starting a simulation from those conditions. The last time step disturbance process is also saved for each vegetation unit so the landscape is starting with a one-time step history.

9. SYSTEM OUTPUT

Output from the system is in a variety of forms. Output can be viewed within the user interface, reports, interpretations, and export files that can be joined back to the vegetation units within the GIS environment. Additionally, there are two Excel macros that help summarize modeled results. These outputs vary depending on whether a single simulation or multiple simulations are made. The distinction between reports versus interpretations is in the amount of processing of plant community attributes needed. For individual simulations, no output files are automatically generated. This enables the user to make many simulations to become familiar with the system, test ideas, or test changes in values without creating a file management job. A set of multiple simulations will automatically generate a number of files. The user has to specify the directory location and a file prefix name. Table 3 summarizes what is currently available for outputs by the type of simulation.

	Single Simulation	Multiple Simulations no memory saving options	Multiple With database ¹	Multiple Discarding data
User interface				
Vegetative unit analysis	X	X		-
Vegetative condition summary				X
Process	X	X		
Species	X	X		
Size class / structure	X	X		
Density	X	X		
Treatments	X	X		
Reports				
Summary	X	X		
Individual unit	X	X		
All States	X	X		
Tracking Species	X	-		
Multiple simulation	-	-		
Detailed fire	X	-		
Fire suppression cost	X	X		Specify at beginning
Emission	X			
Interpretations		X		
Ecosystem restoration	-	-		
Wildlife habitat	X	-		
Export				
GIS simulation	X	X ²		
Area Creation files	X			
User-supplied-name-ls.txt		X ²		

Table 3 Types of output available for a single or multiple simulations.

The “**User-supplied-name-ls.txt**” file is a space-delimited file that contains all the output from all the multiple simulations in a set. This form can be imported into Microsoft Excel for additional analysis. Two Excel spreadsheet templates are in the application folder (**Start > All Programs > SIMPPLLE > Excel Macros**).

A third Excel spreadsheet contains a statistical test that can be used to determine if there is a difference in attributes in different sets of simulations.

Many of the reports, interpretations, and GIS files for single simulations can be created at a future time. Click **File > Save Landscape...** at the end of a single simulation (Figure 23).

¹ Testing has to be done before we can identify what can be accomplished from the database.

² These files are created automatically with multiple simulations. It is impossible to re-create these files later.

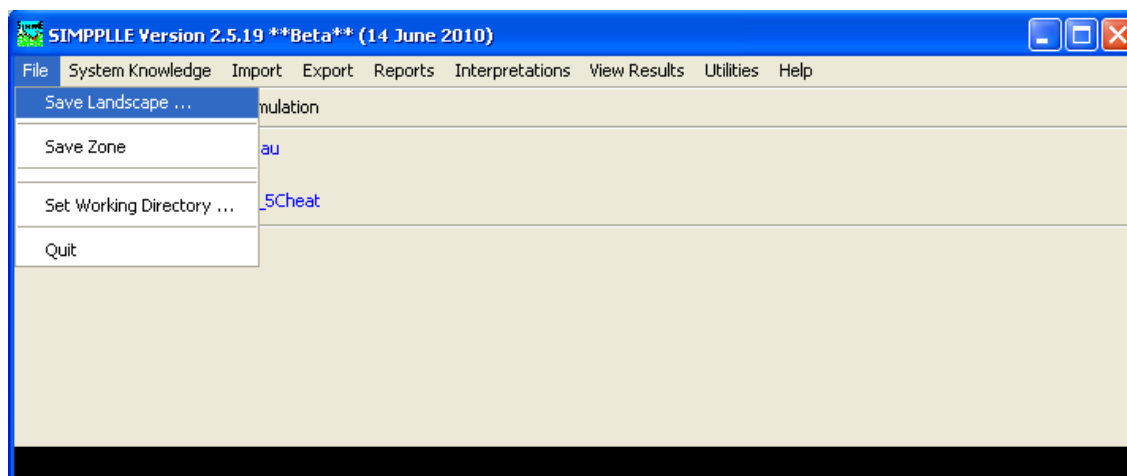


Figure 23 Main SIMPPLLE screen highlighting the Save Landscape choice.

Save Landscape... saves the landscape file with all the changes by each plant community over the duration of the simulation. This saved file loads when the user chooses **Load a Previously Simulated Area**. Each of the simulations from a set of multiple simulations is automatically saved in a similar fashion and can be reloaded. However, if the simulations were made with the **Discard Simulation Data** option, there are limitations to what can be generated after reloading (Table 4).

	Reloading Saved Simulation (previously simulated landscape)
View Results	
Vegetative unit analysis	X
Vegetative condition summary	
Process	X
Species	X
Size class / structure	X
Density	X
Treatments	X
Reports	
Summary	X
Individual unit	X
Multiple simulation	X
Detailed fire	X
Fire suppression cost	X
Emission	X
Interpretations	
Ecosystem restoration	-
Structural development stage	X
Wildlife habitat	X
Export	
GIS simulation	X
Attributes file	X
User-supplied-name-ls.txt	

Table 4 Output that can be created by reloading a saved simulation, whether it is an individual one or from a multiple set.

9.1 GRAPHICAL USER INTERFACE—OUTPUT

There are two options within the user interface for viewing the results of the simulations (Figure 24). **Vegetative Unit Analysis** looks at individual units. **Vegetative Condition Summary** looks at summaries of the attributes, disturbance processes, and any applied treatments for the entire landscape. Whether the landscape components other than vegetation are available depends on the geographic area being used and if they have been included when the SIMPPLLE area file was created from the GIS files.

The intent of the two levels of the reports is that most analyses will utilize the summary information. However, to provide confidence in the system's behavior the individual plant communities can be examined. If the system's behavior at the individual plant community level is not acceptable, one cannot defend the landscape summaries.

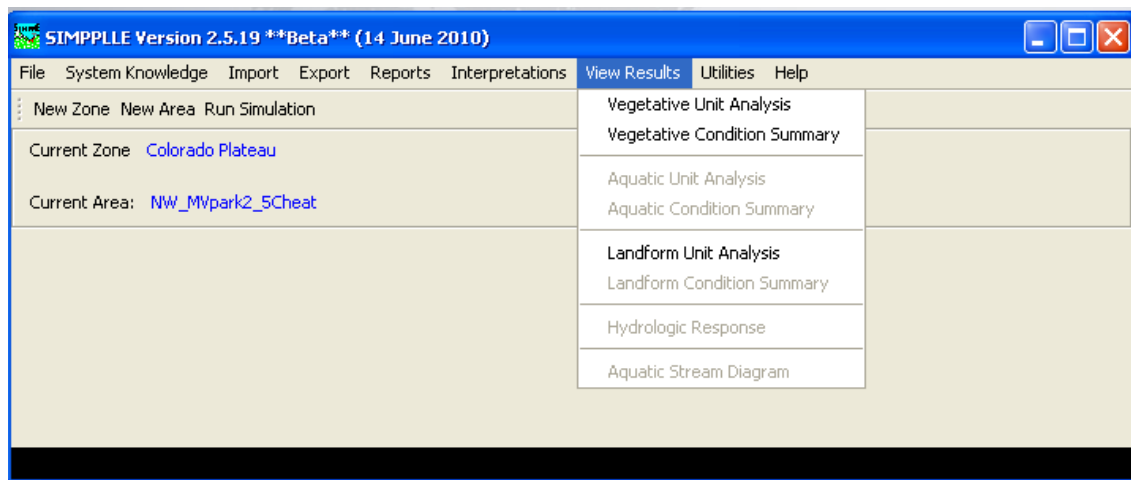


Figure 24 Main SIMPPLLE screen with the choices under View Results for looking at simulation output.

The results for both the individual units and summary vary by individual and multiple simulations.

9.1.1 Single Simulation—Vegetative Unit Analysis

For a single simulation, the screen opens at the lowest numbered plant community in the landscape. It displays the current state, which is the condition at the end of the simulation, the ecological grouping and the acres of the plant community. The adjacent plant communities are shown as the identifying number, its position relative to the unit, and if it is downwind, or not,

according to the dominant wind direction associated with a weather front passage for this landscape.

History

The history for the simulation is displayed by individual vegetative units showing the sequence of vegetation conditions and the disturbance processes.

Prev and **Next** are used to move to other plant communities, or the desired number of a plant community can be typed in the box between the two buttons. The vegetation units in the adjacent units can be double clicked, and the interface will move to that unit.

Figure 25 shows the history for a five-decade simulation. Since the time step is set to **Decade**, seasons do not occur and are represented by **Year**. Time Step 0 represents the starting conditions. The data set is for a single life-form representation of plant community 32, so **no classification** is used with life form. The process of succession was the dominant process in all but Time Step 3. In this time step, mixed severity fire originated in the unit. The value of 8 is the probability used by the system which resulted in a fire event occurring in the unit. If the fire event would have occurred in another unit and spread into this one, an **S** would have been in place of the number 8. The following Time Step 4 shows that the process of change was succession. In the probability column, there is **SUPP**. This represents the situation where a fire event did occur as the result of using the probabilities. However, in this case, the fire suppression logic resulted in the fire event being suppressed at the Class A level (less than one-quarter acre). A fire event suppressed at this level does not change the character of the vegetation attributes of the plant community, but fire suppression costs are accrued. The process of succession is assigned instead of redoing the evaluation of all process probabilities again.

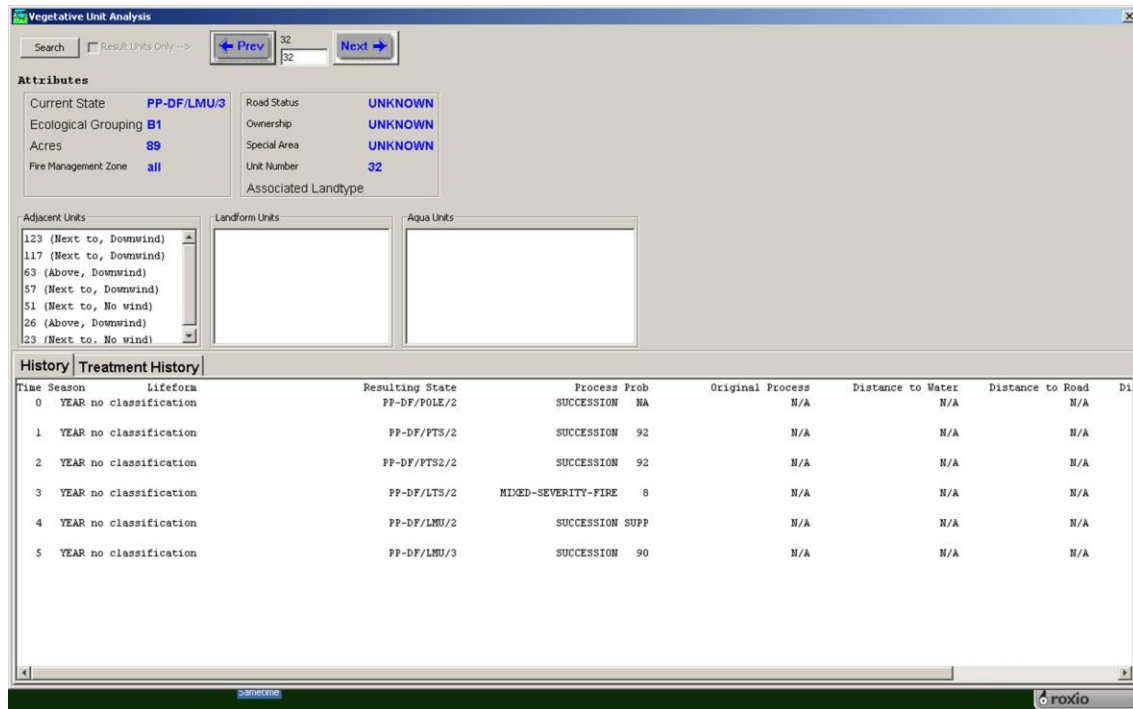


Figure 25 View Results screen for individual vegetative unit number 32 displaying the history of state changes for a simulation.

Figure 26 is another individual vegetative unit. This unit is multiple life forms, but the only form present is trees. In Time Step 1, succession is shown as the process. However, a **D** is shown for its probability and the original process is spruce-beetle. This means the system tried to assign spruce beetle to this existing vegetation unit (EVU), but it could not find what the resulting state would be in the pathway file. An error was made in creating the pathway file. Thus, the system defaulted to succession for a process. Severe lp-mpb occurred in Time Step 2 as a result of the 7 percent probability. In Time Step 3, a mixed severity fire spread into the unit from one of its neighbors.

Vegetative Unit Analysis

Search ☐ Result Units Only --> Prev 1374 Next

Attributes

Current State	LP/MEDIUM/3	Road Status	UNKNOWN
Ecological Grouping	F1	Ownership	FS
Acres	28	Special Area	UNKNOWN
Fire Management Zone	all	Unit Number	0
Trail Status	UNKNOWN	Associated Landtype	
Elevation	-999999		

Adjacent Units

- 1424 (Next to, No wind)
- 1422 (Next to, No wind)
- 1397 (Next to, Downwind)
- 1387 (Next to, No wind)
- 1339 (Next to, Downwind)
- 1333 (Next to, No wind)
- 1226 (Next to, Downwind)

Landform Units

Aqua Units

History **Treatment History**

Time	Season	Lifeform	Resulting State	Process	Prob	Original Process
0	YEAR	trees	LP/MEDIUM/4	SUCCESSION	NA	N/A
1	YEAR	trees	LP-AF/MMU/4	SUCCESSION	D	SPRUCE-BEETLE
2	YEAR	trees	LP-AF/MMU/3	SEVERE-LP-MPB	7	N/A
3	YEAR	trees	LP/MEDIUM/2	MIXED-SEVERITY-FIRE	S	N/A
4	YEAR	trees	LP/MEDIUM/2	SUCCESSION	93	N/A
5	YEAR	trees	LP/MEDIUM/2	SUCCESSION	97	N/A
6	YEAR	trees	LP/MEDIUM/2	SUCCESSION	95	N/A
7	YEAR	trees	LP/MEDIUM/2	SUCCESSION	97	N/A

Figure 26 Individual unit display.

Figure 27 is the result of moving the scroll bar at the bottom of the individual unit display to the far right. This shows additional attributes that would have values if roads, trails, or aquatic units were in the system or if individual species were being tracked.

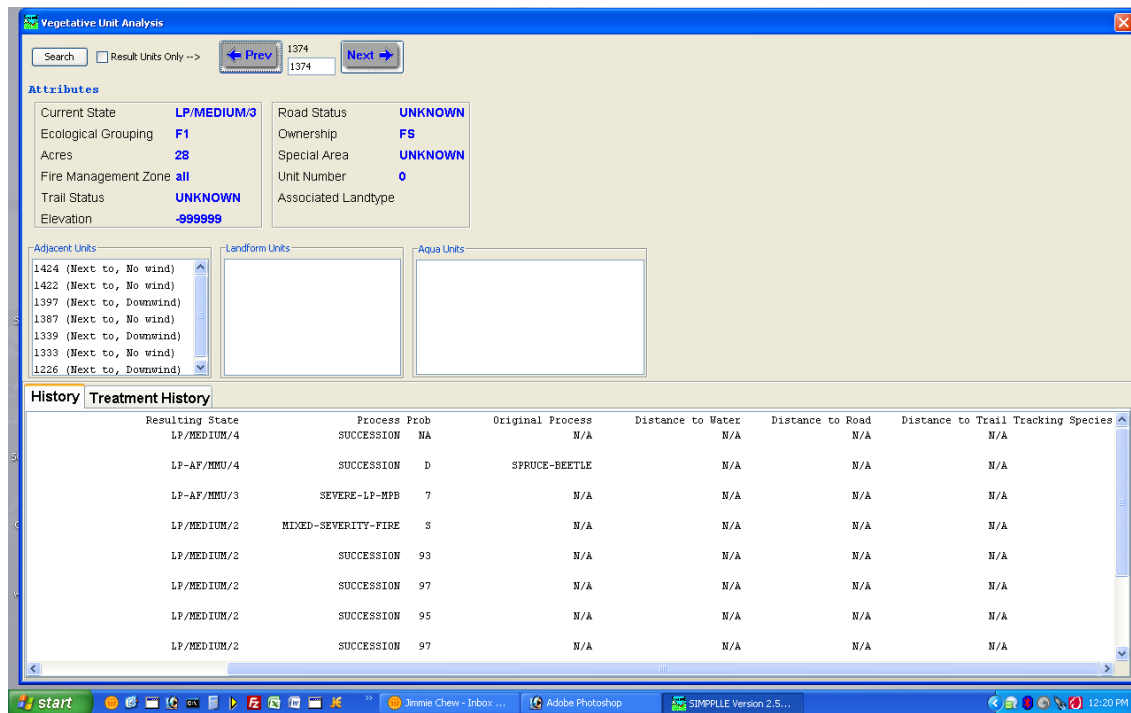


Figure 27 Individual unit display (far right portion of screen).

The values that may occur in the **Prob** column are displayed in Table 5.

Value	Description
# (a number)	The probability generated by the system
S	Fire event spread into the unit under average conditions
SE	Fire event spread into the unit under extreme wind driven conditions
SFS	Fire event was spread via fire spotting
SUPP	Fire event was suppressed at less than .25 acres
COMP	Life form competition occurred
GAP	Process was a GAP process
D	A process was predicted but no next state could be found in the pathways. The system defaulted to succession
L	The disturbance process has been "locked-in" by the user.

Table 5 Values that may occur in the Prob column in the vegetation unit display.

The original process is used when **D** or **GAP** occurs in the **Prob** column. This is the process that the system predicted would occur. In the case of **D**, the system could not find a next state in the pathways. This helps the user identify the corrections that need to be made in the pathways. **GAP** identifies the process that occurred on only a small portion of the plant community.

Figure 28 is from a landscape in one of the grassland zones. The plant community is still represented by single life form, but yearly time steps are made in which the season of the disturbance process is modeled. Tracking species is used.

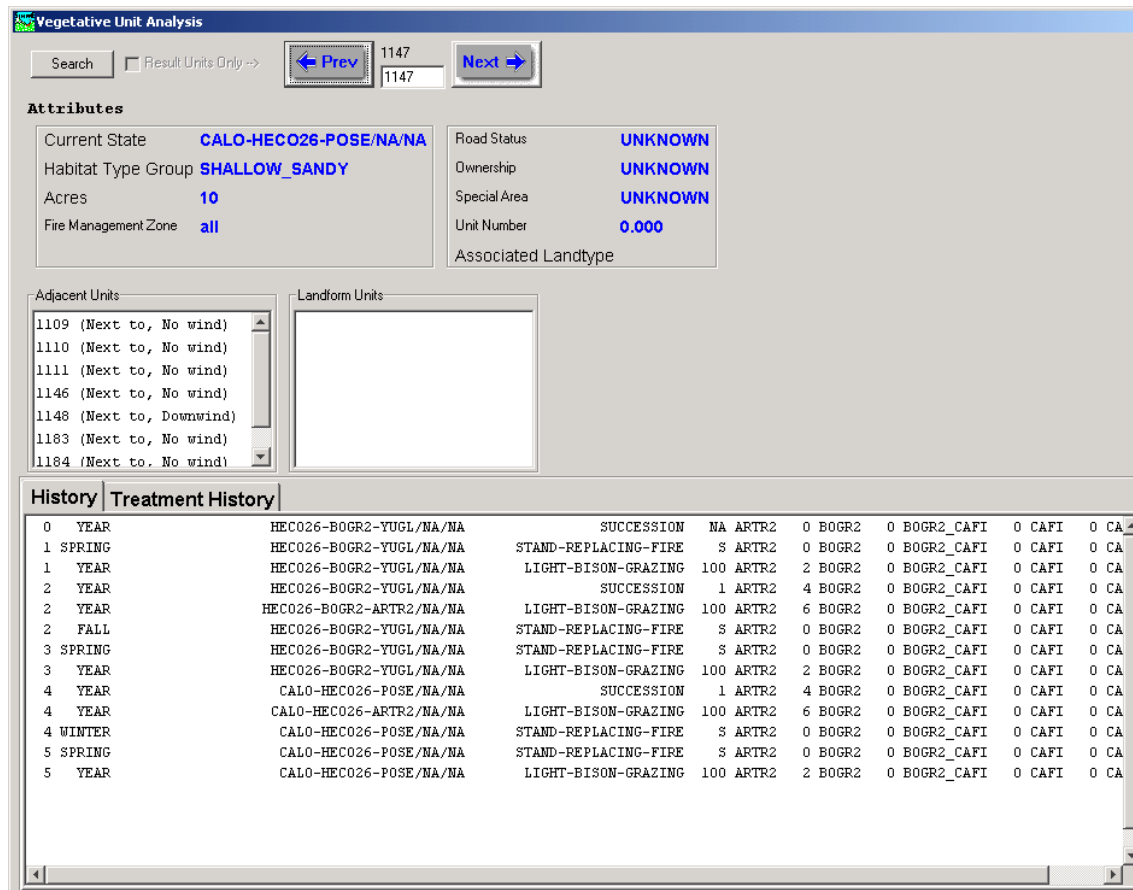


Figure 28 Individual vegetation unit display with processes occurring by seasons and tracking species utilized.

Figure 29 is also a single life form, but notice that the **Distance to Water** is displayed with a **(P)**—indicating it is a perennial water source.

Navigation: ← Prev 27527 Next →

Unit ID: NAVI4-PASM-HECO26-SYOC/NA/NA

Special Area: CLAYEY

Unit Number: 10

all

Properties:

- Road Status: UNKNOWN
- Ownership: UNKNOWN
- Special Area: CLAYEY
- Unit Number: 54889.000
- Associated Landtype:

Landform Units: [Empty Box]

Aqua Units: [Empty Box]

History:

Lifeform	Resulting State	Process	Prob	Original Process	Distance to Water	Distance to Road
herbaceous	PASM-NAVI4-BOCU-BOGR2/NA/NA	SUCCESSION	NA	N/A	N/A	N/A
shrubs	PASM-NAVI4-BOGR2-SYOC/NA/NA	SUCCESSION	100	N/A	6461ft EAU-7702 (P)	N/A
shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	SUCCESSION	100	N/A	6461ft EAU-7702 (P)	N/A
shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	SUCCESSION	100	N/A	6461ft EAU-7702 (P)	N/A
shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	SUCCESSION	100	N/A	6461ft EAU-7702 (P)	N/A
shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	SUCCESSION	100	N/A	6461ft EAU-7702 (P)	N/A
shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	SUCCESSION	100	N/A	6461ft EAU-7702 (P)	N/A
shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	SUCCESSION	100	N/A	6461ft EAU-7702 (P)	N/A

Figure 29 Individual vegetation unit display showing a distance and number to the aquatic unit that is the nearest perennial water source for each time step.

A display for an aquatic unit is shown in Figure 30.

The screenshot shows the 'Aquatic Unit Analysis' window. At the top, there is a search bar and a checkbox for 'Result Units Only -->'. Navigation buttons 'Prev' and 'Next' are present, with the current unit number '7702' displayed. The 'Attributes' section shows 'Current State' as 'A2-REF', 'LTA Valley Segment Group' as '62-72-FNA', 'Length' as '1,157', 'Segment Number' as '7702', and 'Status' as 'PERENNIAL'. Below this, there are two main sections: 'Aquatic Units' and 'Vegetative Units'. The 'Aquatic Units' section has two columns: 'Predecessors' (containing '6441') and 'Successors' (containing '6496'). The 'Vegetative Units' section has two columns: 'Upland' (empty) and 'Adjacent' (containing a list of numbers: '26067', '26068', '26069', '26200', '26202', '26332', '26333'). At the bottom, there are tabs for 'History' and 'Treatment History', with the 'History' tab currently selected and showing an empty list.

Aquatic Units		Vegetative Units	
Predecessors	Successors	Upland	Adjacent
6441	6496		26067 26068 26069 26200 26202 26332 26333

Figure 30 Display for an individual aquatic unit showing its status as Perennial.

Multiple Life Forms

Notice Figure 31, showing the initial time step before any simulation, that three life forms are used to represent the vegetation unit. The current state in the attributes section is the dominant life form only. Both land and aquatic units are represented in this landscape. The ones that have a spatial relationship to this vegetative unit are identified.

Vegetative Unit Analysis

Search ☐ Result Units Only --> ← Prev 504 Next →

Attributes

Current State	PIED-JUOS/LMU/2	Road Status	UNKNOWN
Ecological Group	DGX	Ownership	UNKNOWN
Acres	2	Special Area	UNKNOWN
Fire Management Zone	all	Unit Number	UNKNOWN
		Associated Landtype	126

Adjacent Units

- 482 (Next to, No wind)
- 503 (Next to, No wind)
- 505 (Next to, Downwind)
- 526 (Next to, Downwind)

Landform Units

- 504

Aqua Units

- 48-A2-REF

History | **Treatment History**

Time	Season	Lifeform	Resulting State	Process	Prob	Distance to Water	Tracking Spe
0	YEAR	trees	PIED-JUOS/LMU/2	SUCCESSION	NA		N/A
0	YEAR	herbaceous	POFE/CLUMPED/2	SUCCESSION	NA		N/A
0	YEAR	shrubs	QUGA/MEDIUM-SH/2	SUCCESSION	NA		N/A

Figure 31 Individual vegetation unit display when vegetation is represented by multiple life forms and land units and aquatic units are part of the SIMPPLLE data set for the landscape.

By selecting the value in either **Landform Units** or **Aqua Units**, the interface switches to the display for the selected unit (Figure 32). Neither of these units have any dynamic processes associated with them in this version of SIMPPLE.

The screenshot shows the 'Unit Analysis' window with a 'Land Units' tab selected. At the top, there is a search bar and a 'Result Units Only ->' checkbox. Navigation buttons 'Prev' and 'Next' are present, with the unit number '504' displayed in the center. The main area is divided into several sections:

- Attributes:**
 - Soil Type: SIDESHOW-ZIGZAG
 - Landform: SIDESHOW-ZIGZAG
 - Acres: 2
 - Elevation: 2185
 - Slope: 14.0
 - Aspect: xeric
 - Parent Material: unknown
- Adjacent Units:** A list box containing the values 482, 503, 505, and 526.
- Vegetative Units:** A list box containing the value 504-PIED-JUOS/LMU/2.
- History:** A tabbed interface with 'History' and 'Treatment History' tabs. The 'History' tab is currently selected, showing an empty list box.

Figure 32 Display for an individual land unit showing its attributes and spatial relationship to other land and vegetation units.

Figure 33 illustrates a change in the tree life form in Time Step 1, changing from large, multi-storied at density 3 to a single story at density 1. The disturbance process was **SUCCESSION**.

Vegetative Unit Analysis

Search ☐ Result Units Only --> ← Prev 2 Next → 2

Attributes

Current State	PIED-JUOS/LARGE/1	Road Status	UNKNOWN
Ecological Grouping	SSX	Ownership	TRIBAL LANDS
Acres	2	Special Area	UNKNOWN
Fire Management Zone	2	Unit Number	201870
		Associated Landtype	

Adjacent Units

3 (Next to, Downwind)
18 (Next to, Downwind)
17 (Below, No wind)
19 (Next to, Downwind)

Landform Units

2

Aqua Units

Double click to go to a unit.

History | **Treatment History**

Time	Season	Lifeform	Resulting State	Process	Prob	Original Process
0	YEAR	trees	PIED-JUOS/LMU/3	PIED-BE	NA	N/A
0	YEAR	shrubs	PUTR2/MEDIUM-SH/2	SUCCESSION	NA	N/A
0	YEAR	herbacious	POFE-ACHY/CLUMPED/1	SUCCESSION	NA	N/A
1	YEAR	trees	PIED-JUOS/LARGE/1	SUCCESSION	97	N/A
1	YEAR	shrubs	PUTR2/MEDIUM-SH/2	SUCCESSION	100	N/A
1	YEAR	herbacious	POFE-ACHY/CLUMPED/3	SUCCESSION	100	N/A
2	YEAR	trees	PIED-JUOS/LARGE/1	SUCCESSION	98	N/A
2	YEAR	shrubs	PUTR2/MEDIUM-SH/2	SUCCESSION	100	N/A
2	YEAR	herbacious	POFE-ACHY/CLUMPED/3	SUCCESSION	100	N/A
3	YEAR	trees	PIED-JUOS/LARGE/1	SUCCESSION	98	N/A
3	YEAR	shrubs	PUTR2/MEDIUM-SH/2	SUCCESSION	100	N/A
3	YEAR	herbacious	POFE-ACHY/CLUMPED/3	SUCCESSION	100	N/A
4	YEAR	trees	PIED-JUOS/LARGE/1	SUCCESSION	98	N/A

Figure 33 Display for an individual vegetation unit that shows only the tree life form has a disturbance in time step one.

Treatment History

If the **Treatment History** tab is selected, the follow screen is displayed (Figure 34). This shows a mechanical thinning was applied in Time Step 1 and the change the application made.

The screenshot displays the 'Vegetative Unit Analysis' window. At the top, there is a search bar and navigation buttons labeled 'Prev' and 'Next' with a page number '2'. Below this is the 'Attributes' section, which is divided into two columns. The left column lists 'Current State' (PIED-JUOS/LARGE/1), 'Ecological Grouping' (SSX), 'Acres' (2), and 'Fire Management Zone' (2). The right column lists 'Road Status' (UNKNOWN), 'Ownership' (TRIBAL LANDS), 'Special Area' (UNKNOWN), 'Unit Number' (201870), and 'Associated Landtype'. Below the attributes are three empty boxes labeled 'Adjacent Units', 'Landform Units', and 'Aqua Units'. The 'Adjacent Units' box contains a list of units: 3 (Next to, Downwind), 18 (Next to, Downwind), 17 (Below, No wind), and 19 (Next to, Downwind). At the bottom, the 'History' tab is selected, showing a 'Time Treatment (Status)' log. The log indicates that at time step 1, 'MECHANICAL-THIN (Applied)' was performed, changing the state from 'PIED-JUOS/LMU/3' to 'PIED-JUOS/LARGE/1'. Subsequent time steps (2, 3, 4, 5) show 'No Scheduled Treatment'.

Attributes	
Current State	PIED-JUOS/LARGE/1
Ecological Grouping	SSX
Acres	2
Fire Management Zone	2
Road Status	UNKNOWN
Ownership	TRIBAL LANDS
Special Area	UNKNOWN
Unit Number	201870
Associated Landtype	

Adjacent Units	Landform Units	Aqua Units
3 (Next to, Downwind) 18 (Next to, Downwind) 17 (Below, No wind) 19 (Next to, Downwind)	2	

History	Treatment History
<pre>Time Treatment (Status) State Change 0 ** No Scheduled Treatment ** 1 MECHANICAL-THIN (Applied) PIED-JUOS/LMU/3 --> PIED-JUOS/LARGE/1 2 ** No Scheduled Treatment ** 3 ** No Scheduled Treatment ** 4 ** No Scheduled Treatment ** 5 ** No Scheduled Treatment **</pre>	

Figure 34 The individual vegetation unit display showing treatment history for an individual unit. Mechanical thinning was applied in time step one and it changed the size class and density.

Unit Attribute Search

A useful feature of the individual vegetation unit analysis is the search capability. By selecting **Search** in the upper left corner of the **Vegetative Unit Analysis** screen, the **Unit Attribute Search** screen is available (Figure 35).

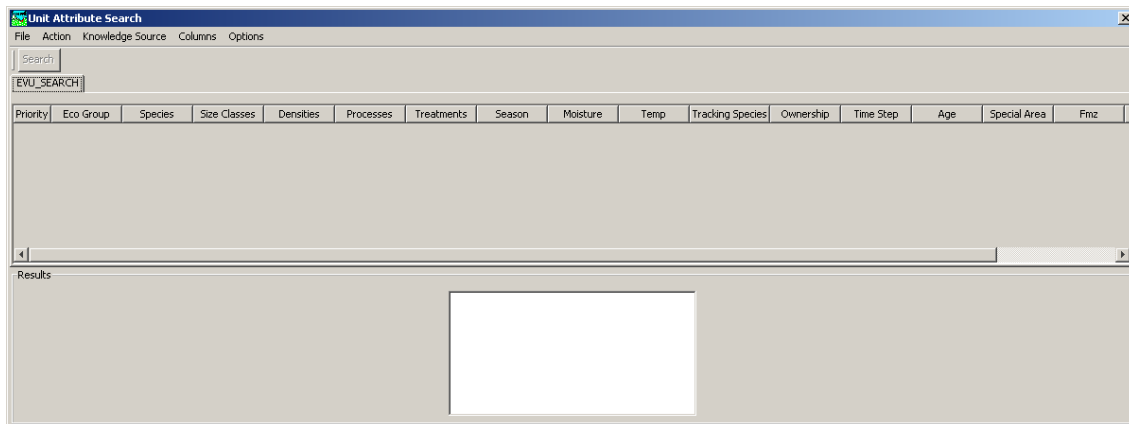


Figure 35 The blank search screen that can be used to find vegetation units that meet the conditions specified in logic combinations.

The **Unit Attribute Search** screen allows the user to create logic that can be used to search for vegetation units that meet the requirements. Select **Columns** for the basic set of logic choices available to use throughout the system for all other logic screens. Figure 36 shows a search for the occurrence of stand-replacing fire in Time Step 2. The result is 321 acres. The window lists all units that meet the criteria. Clicking on any of the units will move the screen to the units display.

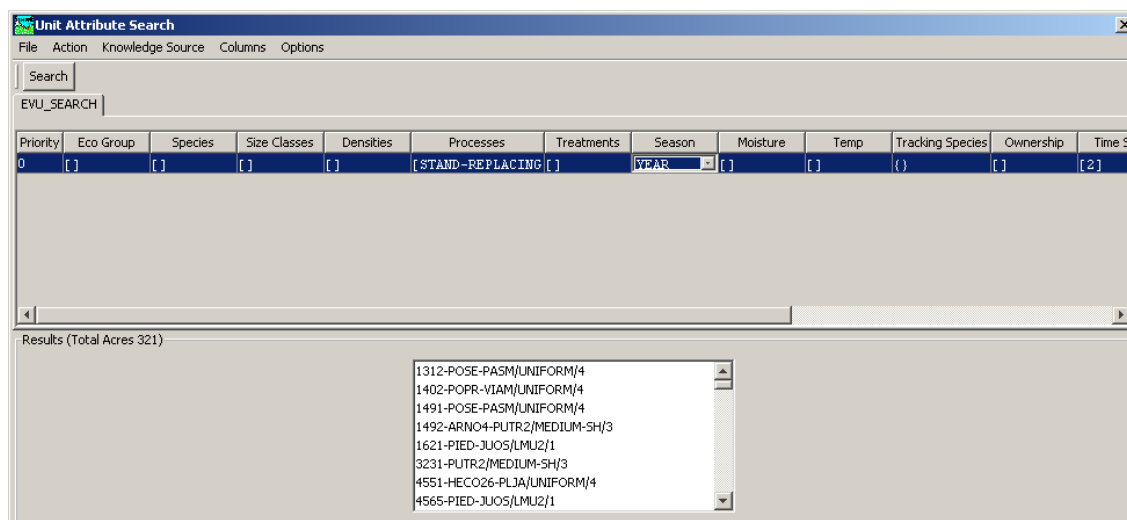


Figure 36 Results from searching the simulation for the conditions in the selected combination.

Options > Make Treatment Schedule allows the user to build a treatment schedule. **Options > Make Lock-in Process Schedule** allows the user to lock in process schedule from the units that were selected.

Double clicking on a unit within the results window will lead to the individual unit screen opening to that unit. There is an option on the individual unit screen that can be checked so the **Prev** and **Next** buttons can be used to move through all of the units that meet the search criteria.

9.1.2 Single Simulation—Vegetation Condition Summary

The conditions for the entire landscape are displayed in **View Results > Vegetation Condition Summary**. Radio buttons allow the user to view the summary report by acres of disturbance processes (**Processes**), each of the vegetation attributes of species (**Species**), **Size Class**, **Density**, **Treatments**, and a breakdown of the acres of fire is given by their distribution (**Fire Events**).

Time Step 0 represents the initial conditions. Unless the user initializes the system by identifying what disturbance processes may have recently occurred (see input files), all communities have a history—a Time Step 0—of succession. In the summary below (Figures 37 and 38), 163,344 acres of stand replacing fire occurred in the past decade and was entered into the GIS layer for this landscape. **Acres of Processes** are only for the dominant life form if the landscape file is described using multiple life forms.

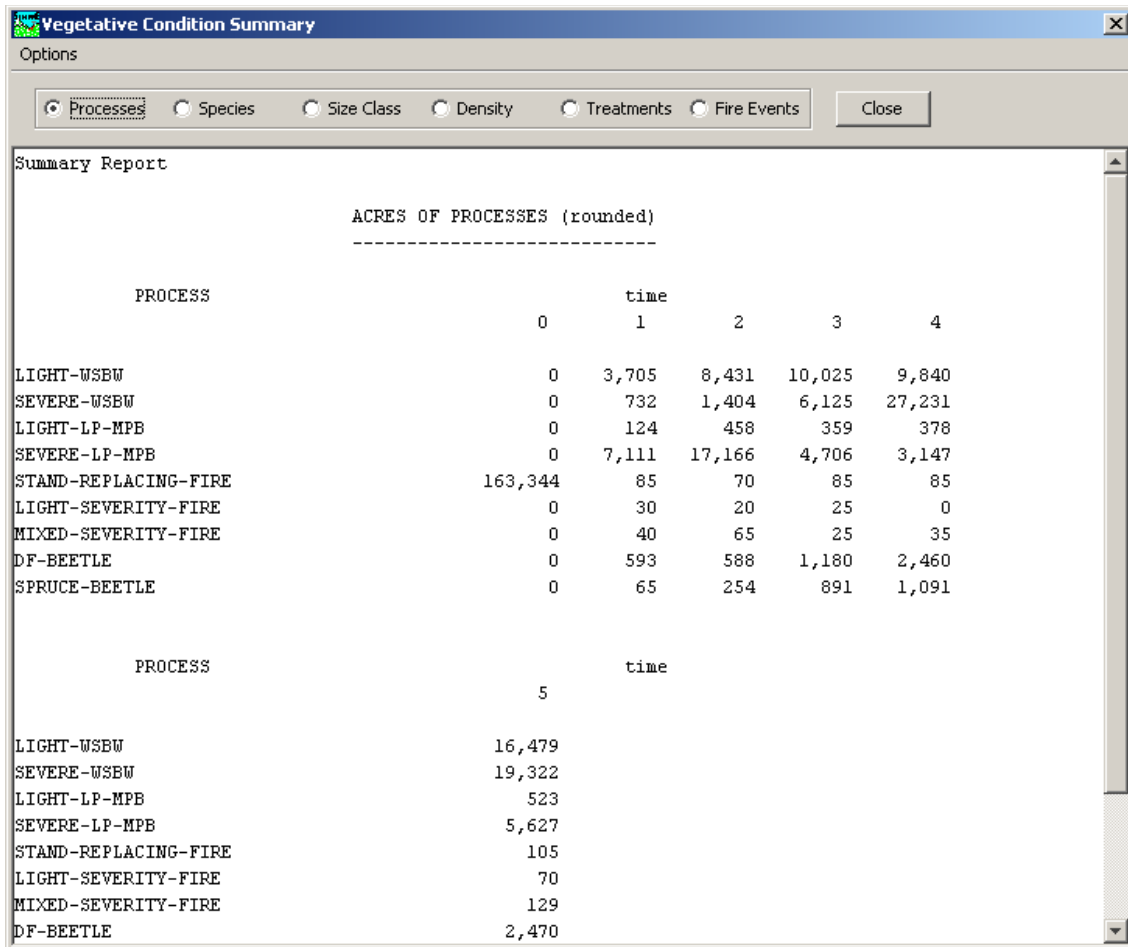


Figure 37 Vegetation Condition Summary for a single simulation displaying the acres of each process by time step.

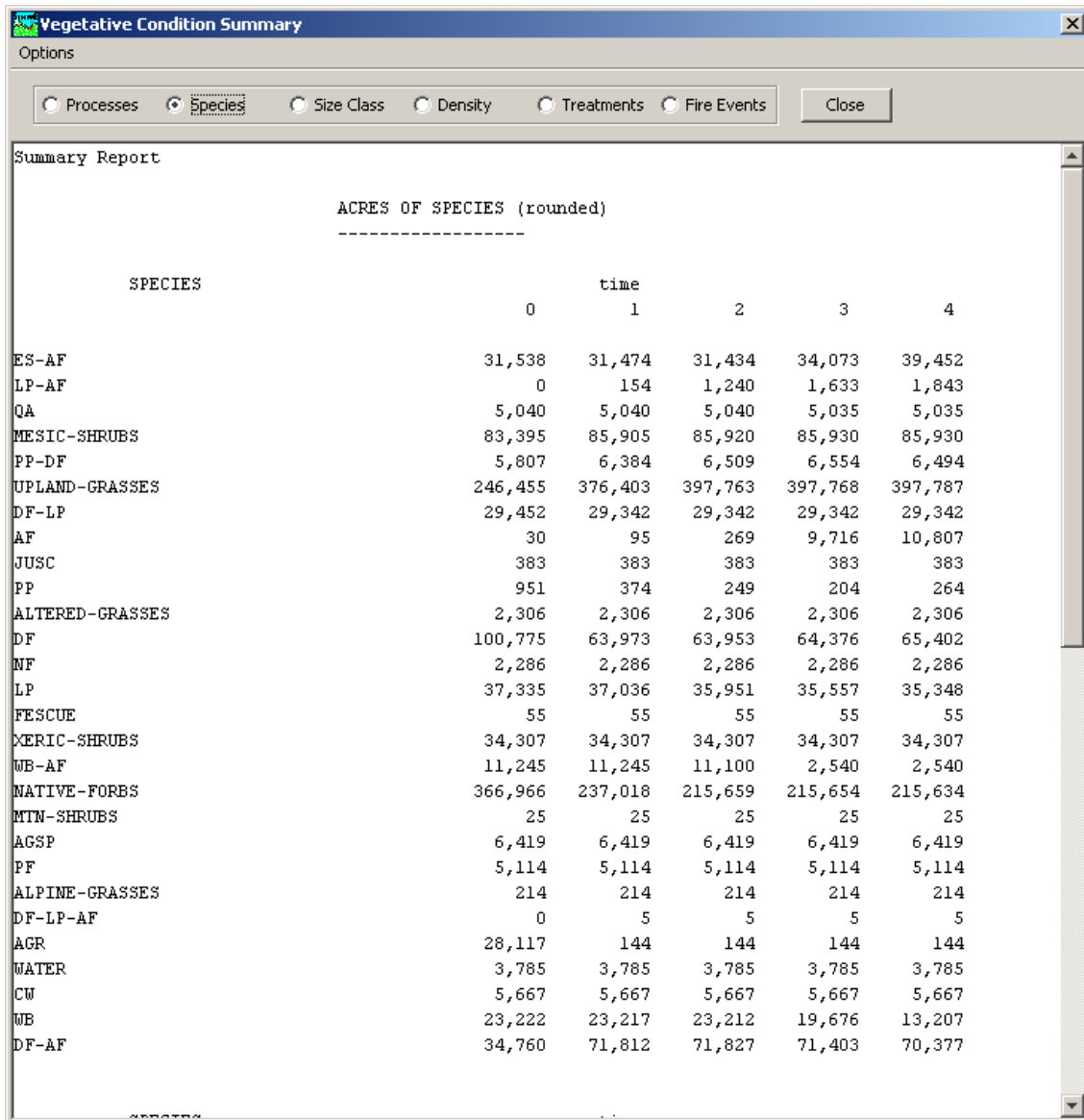


Figure 38 Vegetation Condition Summary for a single simulation displaying the acres of each species by time step.

If single life forms are used, then each plant community has only one species. Thus, the acres of species will equal the acres of the landscape. However, if multiple life forms are used, the acres of species will be greater than the landscape acres. The same is true for both the size class and density attributes (Figures 39 and 40).

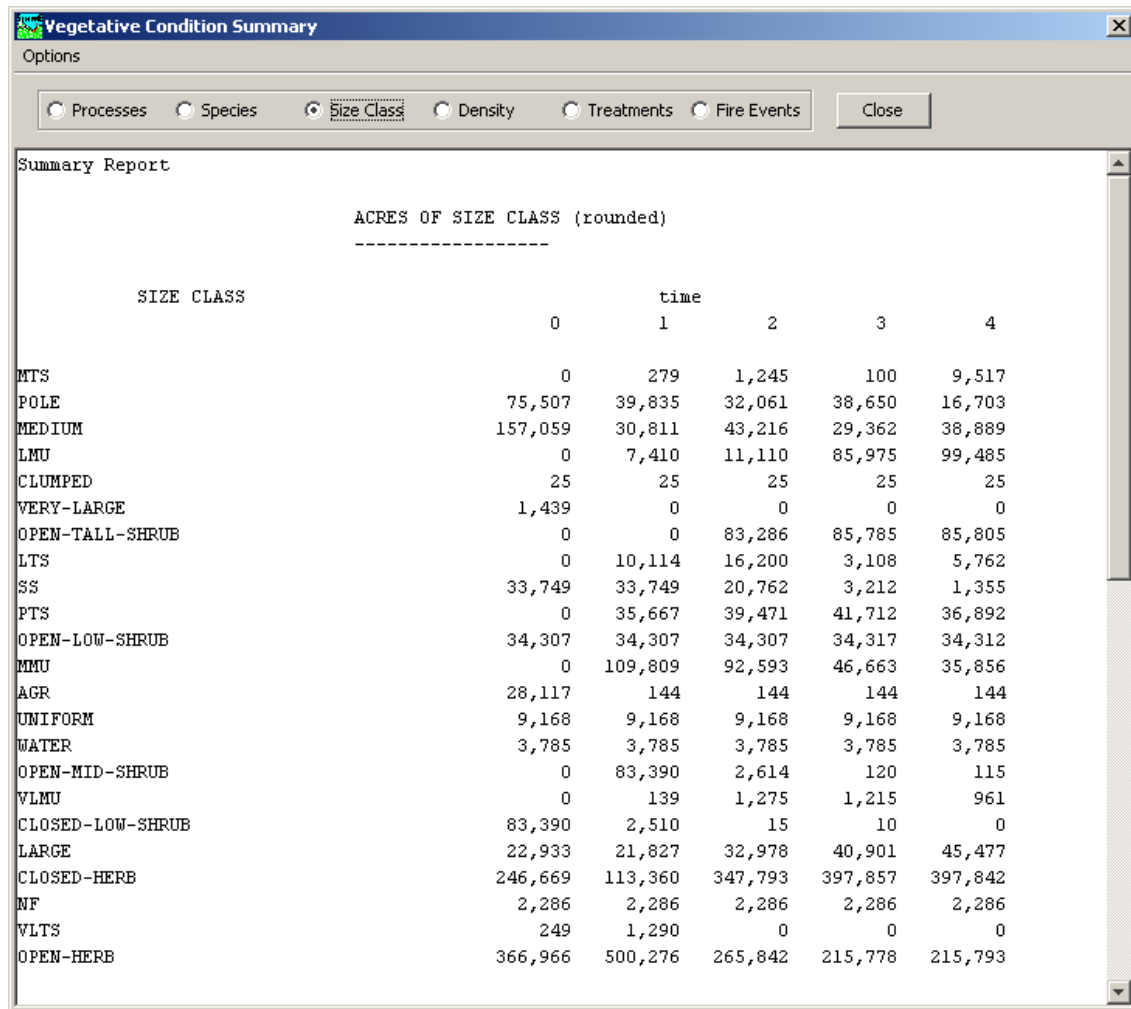


Figure 39 Vegetation Condition Summary for a single simulation displaying the acres of each size class by time step.

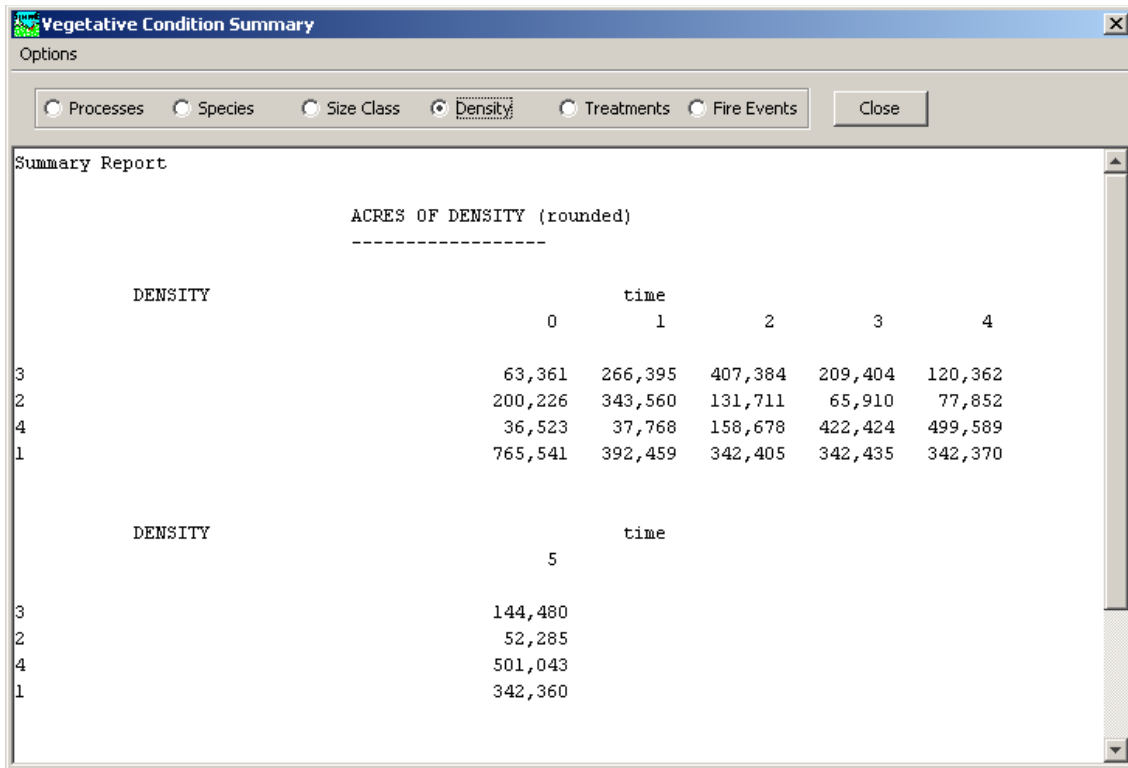


Figure 40 Vegetation Condition Summary for a single simulation displaying the acres of each density class by time step.

Acres of treatments scheduled by time-step can be displayed (Figure 41). If any scheduled treatments are infeasible due to changing landscape conditions, they are shown as infeasible in the report. By infeasible, we mean that the vegetation conditions change before the system gets to the time step in which the treatment is scheduled for. Later sections on treatments will address the logic for treatment feasibility.

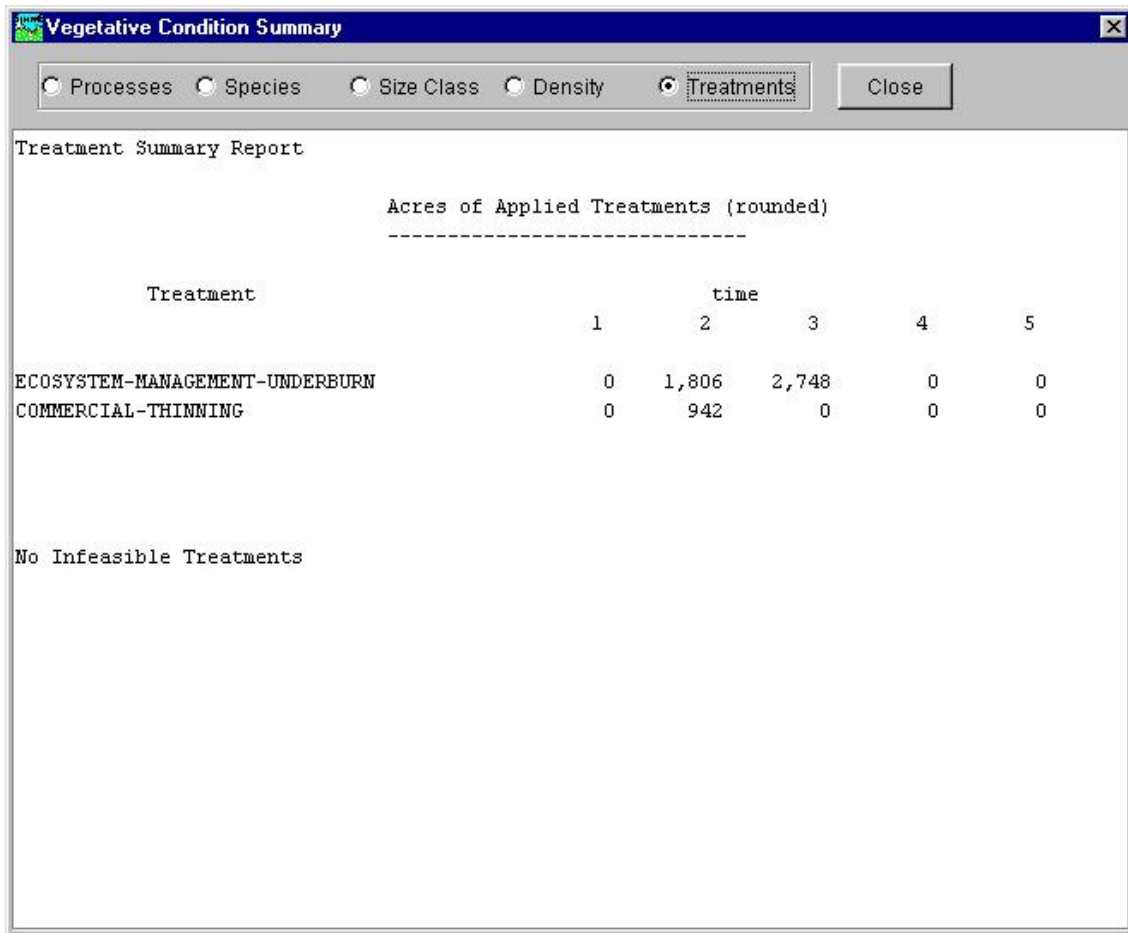


Figure 41 Vegetation Condition Summary for a single simulation displaying the acres of each treatment applied by time step.

The single simulation was made with fire suppression, so there are a significant number of fire events that are kept at the Class A size (Figure 42).

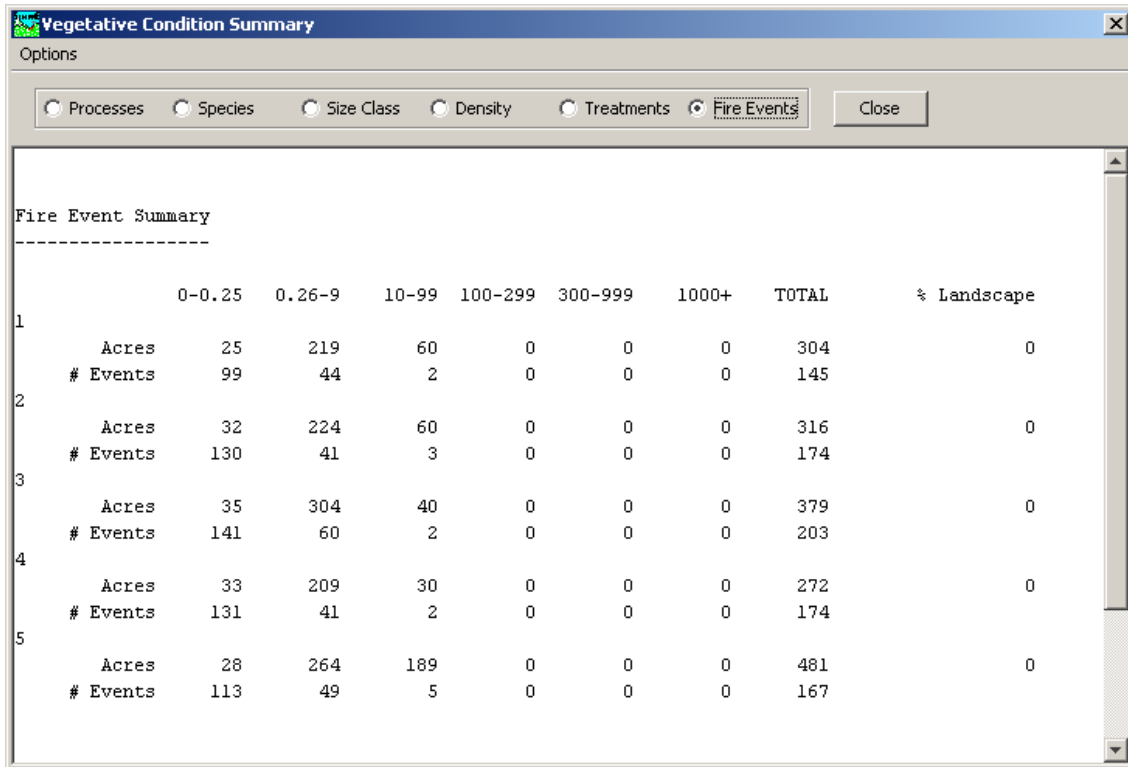


Figure 42 The display for Fire Events that shows the number and acres of fire by fire size class. Total acres are given for each time step as well as the percent of the landscape burned.

9.1.3 Multiple Simulations—Vegetative Unit Analysis

The display for an individual unit after multiple simulations provides the frequency of the values for each attribute and disturbance process (Figure 43).

Vegetative Unit Analysis

Search ☐ Result Units Only --> ← Prev 3318 Next →

Attributes

Current State	MESIC-SHRUBS/CLOSED-LOW-SHRUB/1	Road Status	UNKNOWN
Ecological Grouping	G2	Ownership	UNKNOWN
Acres	10	Special Area	170102110401
Fire Management Zone	all	Unit Number	0
		Associated Landtype	

Adjacent Units

- 3367 (Next to, No wind)
- 3317 (Below, No wind)
- 3269 (Next to, No wind)
- 3366 (Below, No wind)
- 3368 (Next to, Downwind)
- 3268 (Next to, No wind)

Landform Units

Aqua Units

History | **Treatment History**

Species	Size Class	Density	Process
Frequencies	Frequencies	Frequencies	Frequencies
LP	84% POLE	9% 3	9% SEVERE-LP-MPB 2%
MESIC-SHRUBS	16% LMU	38% 2	11% STAND-REPLACING-FIRE 16%
	OPEN-MID-SHRUB	13% 4	64% MIXED-SEVERITY-FIRE 9%
	SS	33% 1	16% LIGHT-SEVERITY-FIRE 2%
	LARGE	4%	LIGHT-LP-MPB 11%
	CLOSED-LOW-SHRUB	4%	

Figure 43 Individual vegetative unit display for a multiple simulation. Display shows the frequency of each attribute.

9.1.4 Multiple Simulations—Vegetative Condition Summary

For each attribute, the mean value for each time step from the multiple simulations is calculated. The minimum and maximum values are also provided (Figure 44).

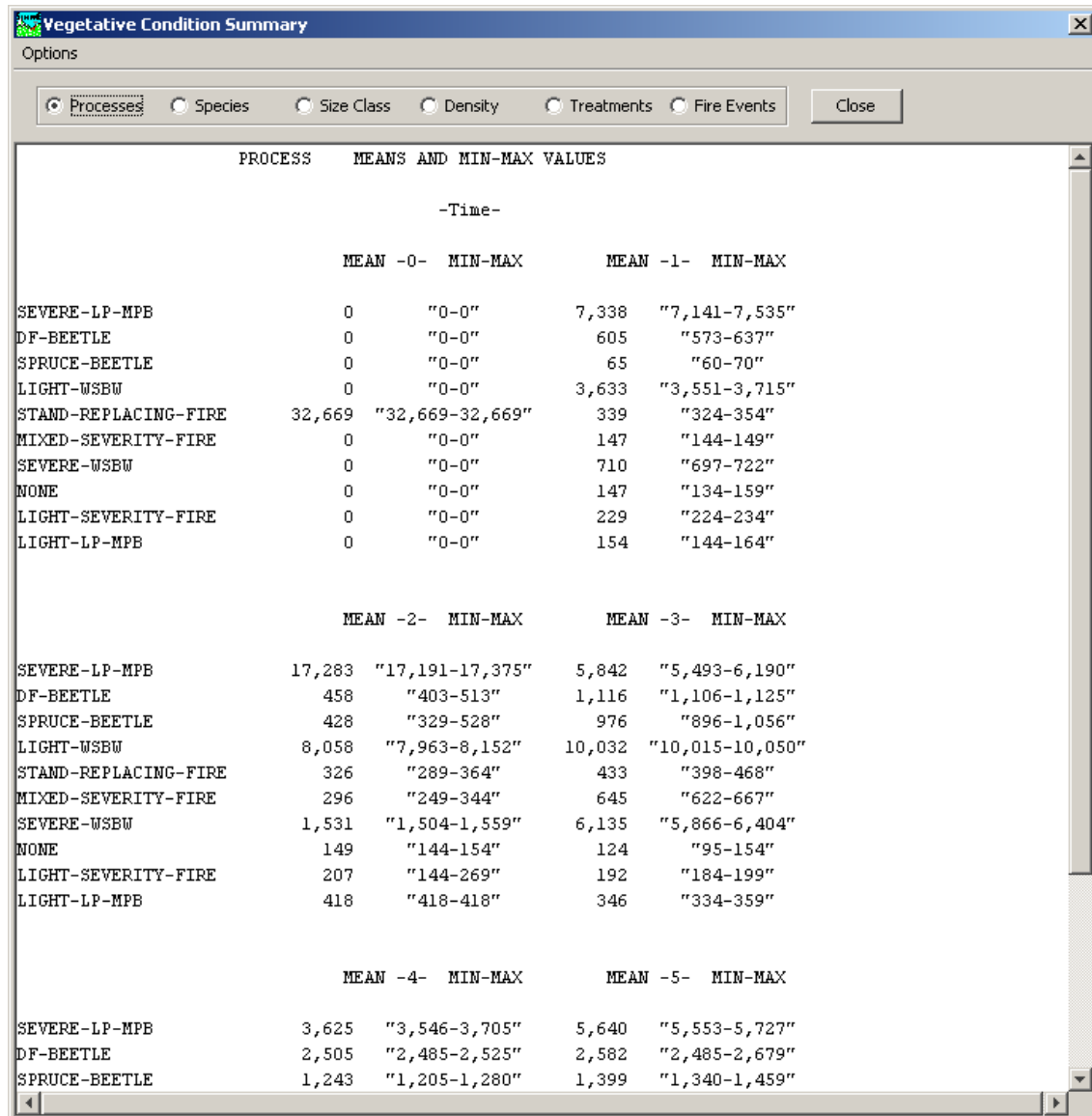


Figure 44 Multiple simulation condition summary display. The average acres and the minimum and maximum levels from the multiple simulations are shown for each process by time step.

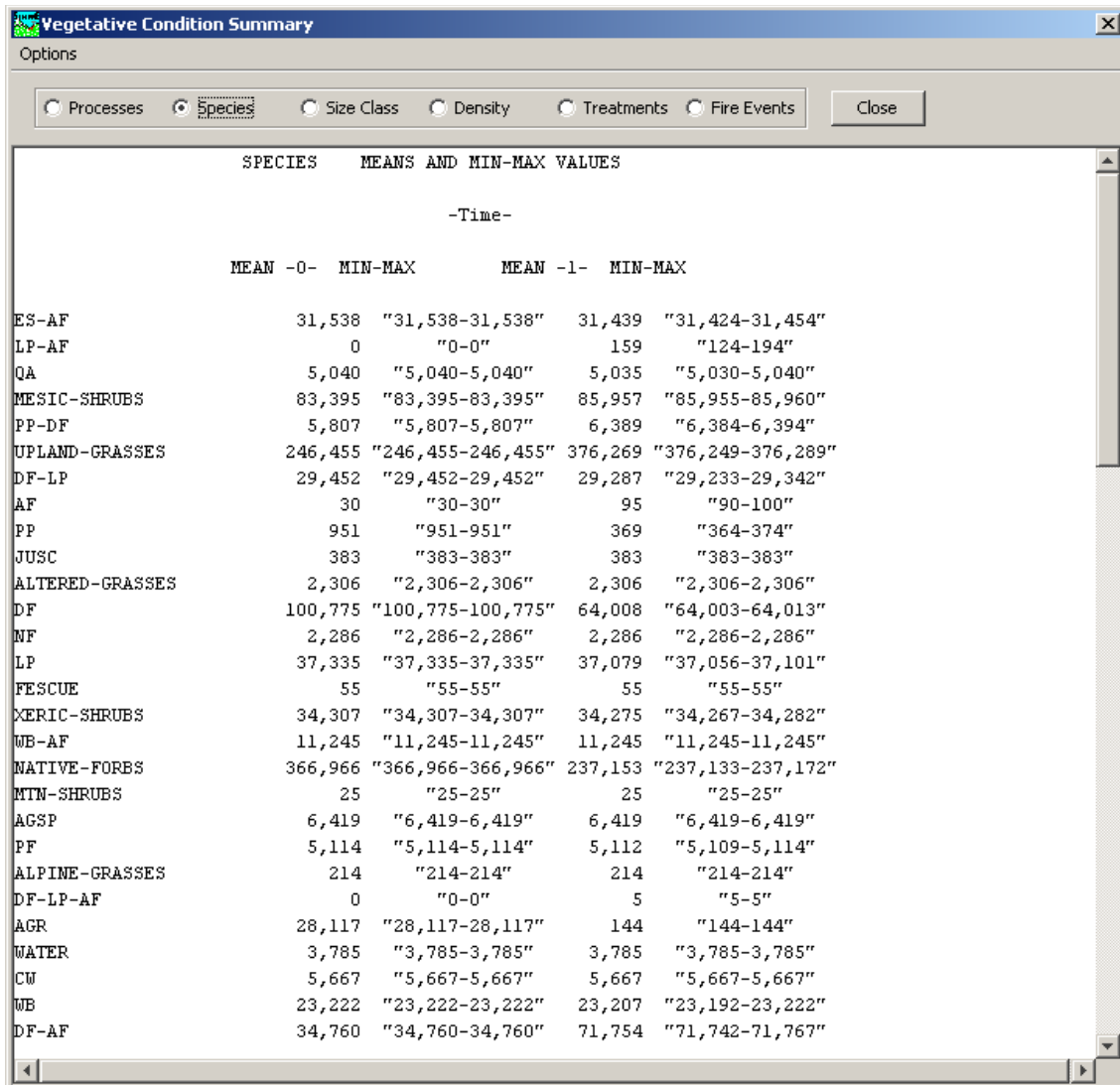


Figure 45 Multiple simulation condition summary display. The average acres and the minimum and maximum levels from the multiple simulations are shown for each species by time step.

The displays for species, size class, density, and treatments are similar. There is no summary display for fire events from multiple simulations. The fire event display is for the last simulation in the set.

9.2 REPORTS

9.2.1 Single Simulation

Under **Reports**, both the **Summary** and the **Individual Unit** reports (Figure 46) provide the same information, which can be seen through **View Results**.

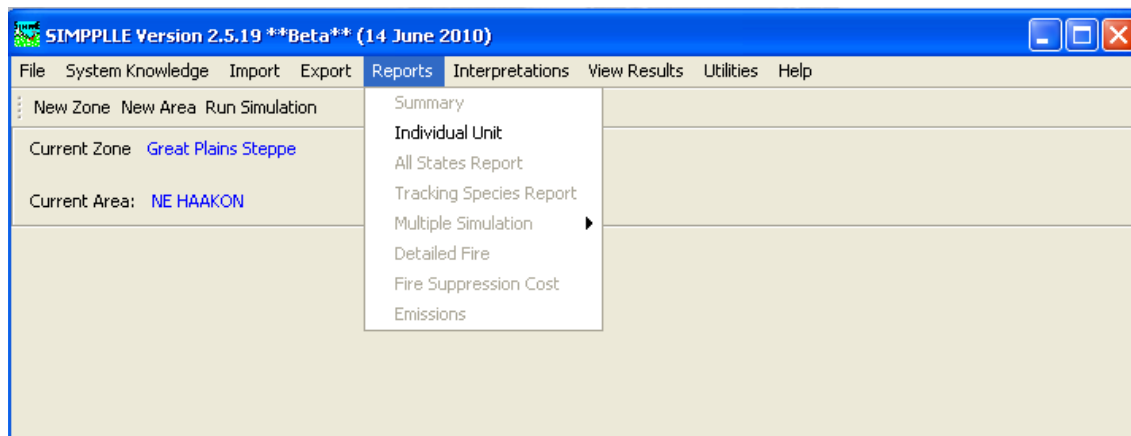


Figure 46 SIMPPLLE main screen showing the choice available for “Reports” for single simulations

An **Individual Unit** report can be created, but it is a very large file displaying the history for each plant community in the landscape for the simulation. When **Summary** is selected, the following screen (Figure 47) is displayed with options for the report.

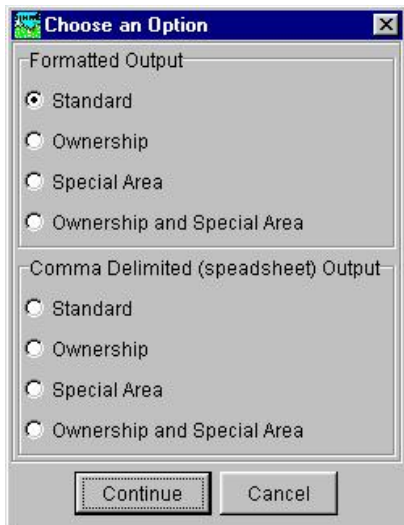


Figure 47 Additional options to choose from when making a “summary” report for a single simulation.

There are two basic options for report output:

- **Formatted Output:** an easy-to-read format that looks similar to what is seen in the view-results.
- **Comma Delimited (spreadsheet) Output:** easy to import into a spreadsheet program such as Microsoft Excel.

Within both options, other choices are available if these attributes have been assigned to the plant community polygons (see input file). **Standard** provides for no additional breakdown of the information. Other choices will result in the information being stratified by ownership, special area, or both. See “Input Requirements” for explanation of **Special Area**. Reports cannot be made by ownership or special area unless the simulation has been made specifying in the simulation parameters that these be tracked. When **Continue** is selected, a dialog window opens to the working directory, and a file name for the report can be selected (Figure 48).

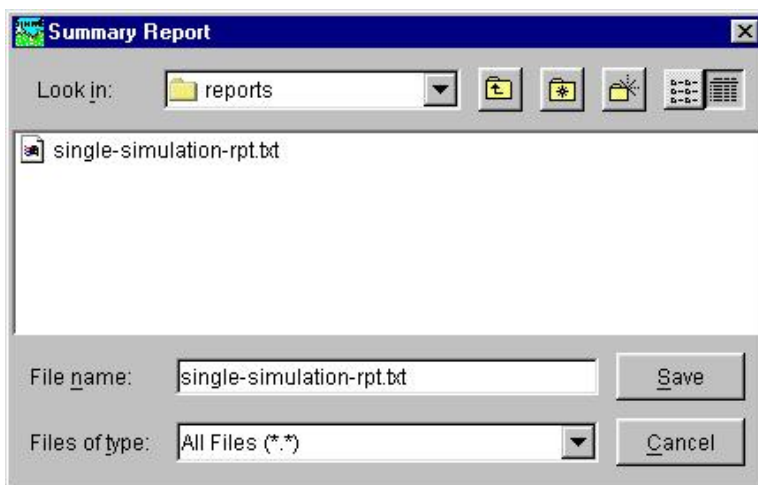


Figure 48 SIMPPLE dialog window providing for the user to enter the name to be used for a summary report.

When providing a name for the reports, use a text (*.txt) extension to make it possible to read the report with a variety of applications (i.e., Notepad or WordPad).

A summary of the fire events is provided in this report (Table 6).

		0-0.25	0.26-9	10-99	100-299	300-999	1000+	TOTAL
1								
	Acres	7	0	228	873	1,051	0	2,159
	#Events	28	0	6	5	2	0	41
2								
	Acres	6	8	149	154	1,457	0	1,774
	#Events	23	1	3	1	3	0	31
3								
	Acres	6	0	134	1,219	785	0	2,144
	#Events	22	0	5	6	2	0	35
4								
	Acres	6	0	362	0	2,921	1,096	4,384
	#Events	22	0	5	0	6	1	34
5								
	Acres	4	0	127	852	3,780	1,420	6,183
	#Events	16	0	3	5	7	1	32

Table 6 Summary of Fire Events provided in the summary report for a single simulation.

The **Fire Event Summary** breaks down the number of fire events by acres and fire size class by time step. The choice of polygon size used in the landscape file can have an impact on what is seen in this report. If the user has created coverage of uniform, ten acre polygons, it would be impossible for any fire events to show up in the 0.26–9 acre class. There would still be fire events in the 0.0–0.25 acre class due to fire suppression or weather events occurring at the time of the ignition event.

All States Report

Reports > All States Report provides the acres for any specified combination of vegetation attributes. If desired for a single simulation, this report is available after the simulation. One does not have to check in the **Simulations Parameters** screen that they are wanted. For a single simulation the results after processing through the appropriate Excel spreadsheet will give only total acres. There is no range of occurrences from a single simulation.

See Appendix K for a detailed description of this report.

Tracking Species Report

Reports > Tracking Species Report is designed to give the acres for the species being tracked.

If desired for a single simulation, this report is available after the simulation. One does not have to check in the Simulations Parameters screen that they are wanted. For a single simulation the results after processing through the appropriate Excel spreadsheet will give only total acres. There is no range of occurrences from a single simulation.

See Appendix L for a detailed description of this report.

Detailed Fire

Reports > Detailed Fire Report provides more information on the fire events. It identifies the plant community each event originates in, the communities it spreads to, and what type of fire it is. An asterisk beside a unit number means the fire spread under extreme, wind driven events by spotting to this unit. Table 7 displays part of a detailed fire report.

Time	Originated in	Total Acres	Spread To
1	105-CLASS-A	0	
1	112-CLASS-A	0	
1	158-CLASS-A	0	
1	1410-CLASS-A	0	
1	399-SRF	452	468-LSF 485-LSF 512-LSF 377-SRF 386-SRF 426 -MSF 454-SRF
1	467-SRF	156	363-MSF 376-MSF 481-MSF
1	528-SRF	286	511-LSF 568-LSF
1	528-SRF		
1	606-SRF	31	No Spread
1	845-SRF	194	769-LSF 777-MSF
1	869-SRF	599	945-SRF 965-SRF 1028-MSF 852-LSF 955-MSF 974-SRF 977-SRF 1003-MSF
1	935-SRF	78	885-SRF 947-SRF
1	73-MSF	22	No Spread
1	279-MSF	114	No Spread
1	814-MSF	123	No Spread
1	1016-MSF	18	No Spread
1	1527-MSF	19	No Spread
1	327-LSF	60	No Spread
2	16-CLASS-A	0	
2	22-CLASS-A	0	
2	103-CLASS-A	0	
2	1519-CLASS-A	0	
2	859-SRF	331	842-LSF 848-SRF 865-SRF 1041-MSF

Table 7 Portion of a Detailed Fire Report showing by time step each fire event, the plant community it originated in, the total acres of the event, and the communities it spread to and as what type of fire.

The **Menu** option in the **Detailed Fire Report** will be unavailable if the **Discard Data** option is selected.

The **Fire Suppression Cost Report** is only available if the simulation is made with fire suppression and if costs are included in the fire occurrence and cost input table. This simplified version of fire suppression costs utilizes a per-acre cost based on the size class of the fire event.

Table 8 illustrates a **Fire Suppression Cost Report**. In this example, the costs are not discounted and not identified by fire management zones (FMZs). If FMZs are used, the cost is displayed by each FMZ in addition to the total.

FMZ	Time				
	1	2	3	4	5
All	2,068,792	2,170,796	1,713,806	4,656,188	5,803,487
Total	2,068,792	2,170,796	1,713,806	4,656,188	5,803,487

Table 8 Fire suppression report showing undiscounted costs for the entire landscape that was simulated.

At the time the report is selected, the user can change the default discount rate from 1.04 percent. The suppression costs utilize the per-acre cost that can vary by fire size class and fire management zone if that level of detail has been provided by the user. The costs are calculated by using the combination of process origin and the units to which the process spreads to get the size-class of each fire event. The costs are discounted to the middle of each decade time step.

The emissions report was developed for use in a Joint Fire Sciences Study (Weise et al. 2000, 2003). Data is taken from Hardy et al. (2000). The emissions values were developed for Westside Region One, Southern California, Sierra Nevada, South Central Alaska, Gila, and South West Utah zones. These values have not been kept current. Use of the report in any other zone will default to values for the Westside Region One. No user interface access to this system knowledge is available. Emissions are provided for both fire events and treatments of ecosystem management underburn and broadcast burn. This makes it possible to compare tradeoffs in emissions between simulations with and without treatments. No emissions are calculated for the fuel treatment associated with other activities such as broadcast burning of harvest units, or burning hand or machine piles (what is often referred to as activity fuels). Table 9 is an example of an **Emissions Report**.

		Time				
		1	2	3	4	5
Fire Emissions (Tons)						
	PM 10	377	349	436	988	1,419
	PM 2.5	302	279	349	790	1,135
Treatment Emissions (Tons)						
	PM 10	0	10	20	0	0
	PM 2.5	0	8	16	0	0

Table 9 Emissions Report showing tons of particulate by time step.

9.2.2 Multiple Simulations Report

When making multiple simulations, one report file is created automatically. This is a text (*.txt) file with a user-provided name. This report file provides the results from each time step for each simulation for processes, vegetation attributes, fire information, suppression costs, and emissions in a form that can be readily imported into a spreadsheet for further analysis. The use of the Excel spreadsheet with the ls.txt file is the basic processing tool for SIMPPLLE simulations.

With multiple simulations, the same reports can be made at the end of a simulation as with a single simulation. However, if they are made, they are for the last simulation of the multiple set. For example, if you made 10 five-decade simulations, the reports made from the user interface will be for the 10th simulation. The additional report that shows up after a set of multiple simulations is **Reports > Multiple Simulation**. If ownership and special area are identified within the plant communities, then the report can be stratified **By Special Area** or **By Ownership**. Without them, only **Normal** is available.

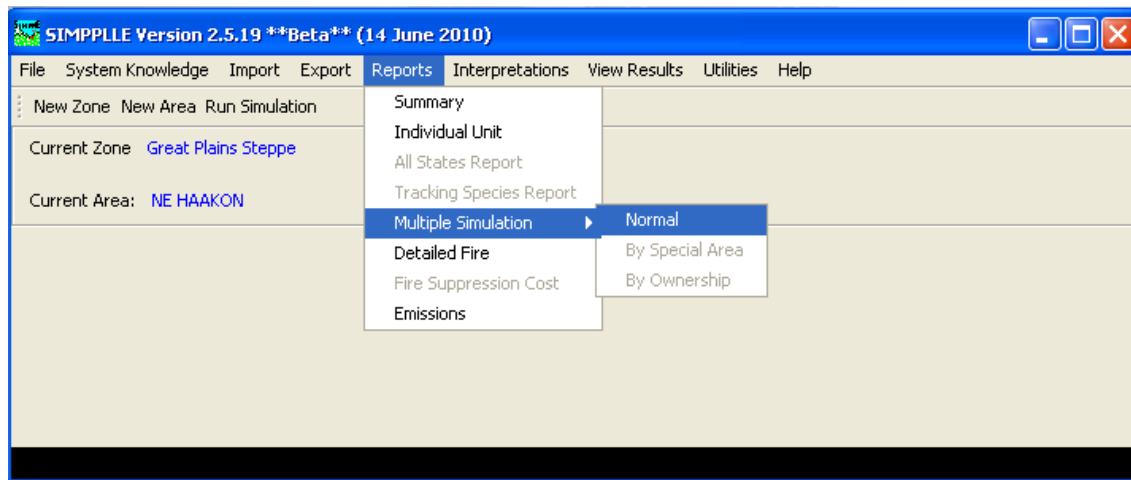


Figure 49 Report option for Multiple Simulation.

The **Multiple Simulation Report** provides the mean and range of values identical to what is seen throughout the user interface. This report looks similar to what is seen in view results with multiple simulations.

9.3 DATABASE

In running a simulation in SIMPPLLE, the user has an option to output data to a database (*.mdb). The data output to the database is all of the simulation results that are accumulated in the course of a run. This is the same data that is utilized in generating reports from within

SIMPPLLE. This gives the user great flexibility to utilize the database to analyze the data in ways that we have not provided for in the built in reports.

The database currently used is Hypersonic SQL. Hypersonic SQL is an open-source, free-use database. Currently, this database has a size limitation of approximately 8GB. All of the primary tables in the database use only numbers (e.g., all processes are assigned an ID). The reason for this is to save space in the database because the amount of data that SIMPPLLE generates is very large.

The database is written using Hibernate, allowing the use of databases other than Hypersonic SQL in the future.

Currently, when a database is written, a Windows Batch file is written to the output directory that will run a database viewing utility provided with Hypersonic SQL. This is a very basic program that requires the user to know SQL in order to manipulate the database.

It is important to note that these databases can get quite large, so large, in fact, the viewer cannot display the entire table of simulation data. If you find that the program runs out of memory, merely rephrase the SQL statement to limit the query.

In the future, we are planning to add built-in report queries to make it easier for the user to get the information desired. In the meantime, a good SQL tutorial may be in order. In addition, the viewing utility has an option to output the results of a query into a format that can be imported into Access.

9.3.1 Database Tables

AREA_SUMMARY_DATA

ID	Database Row ID
ORIGINUNITID	Unit Id where the process originated
UNITID	Unit ID in which the process occurred
TOUNITID	ID of the unit that the process spread to (if applicable)
PROCESS_ID	Process ID as specified in the PROCESS_ID table
RATIONALPROB	Probability of Process Event times 100 (see Prob Ref table for negative values)
RATIONALACRES	Acres of Process in the unit times 100

SEASON_ID	Season ID (see SEASON ID Ref Table)
TIMESTEP	Time step in which the process occurred
RUN	Run in which the process occurred
GROUP_ID	Group ID as specified in the ECOLOGICAL_GROUP table
OWNERSHIP_ID	Ownership ID as specified in the OWNERSHIP_ID table
SPECIAL_AREA_ID	Special Area ID as specified in the SPECIAL_AREA_ID table
FMZ_ID	FMZ ID as specified in the FMZ_ID table

Table 10 Information on process events.

PROBABILITY REFERENCE TABLE

Report Value	Description	Database Value
D	Process no next state	-2
L	Locked in process	-3
S	Spreading process	-4
SUPP	Suppressed process	-5
SE	Extreme fire spread	-6
SFS	Fire spotting spread	-7
COMP	Competition	-8
GAP	Gap process	-9

Table 11 Description of probability values found in the database.

SEASON ID REFERENCE TABLE

ID	Database Value
SPRING	0
SUMMER	1
FALL	2
WINTER	3
YEAR	4

Table 12 The season the numbers found in the database refer to.

DENSITY

ID	ID used in primary tables
DENSITY	Actual density value

Table 13 A database table used to assign numeric ID's to Density values.

ECOLOGICAL_GROUPING

ID	ID used in primary tables
NAME	Group name

Table 14 A database table used to assign numeric ID's to Ecological Grouping values.

EVU_SIM_DATA

ID	Table row ID
SLINK	Unit Identifier
TIMESTEP	Simulation time step
RUN	Simulation run number (starts at 0)
LIFEFORM_ID	Life form ID
SPECIES_ID	Species ID
SIZECLASS_ID	Size Class ID
AGE	Age
DENSITY_ID	Density ID
PROCESS_ID	Process ID
PROB	Probability of process event times 100 (see Prob ref table for negative values)
SEASON_ID	Season ID (see SEASON ID Ref Table)

Table 15 A database table that contains all of the simulation data for Vegetative Units.

FMZ

ID	ID used in primary tables
NAME	Fire Management Zone

Table 16 A database table used to assign numeric ID's to FMZ values.

INCLUSION_RULE_SPECIES

ID	ID used in primary tables
NAME	Inclusion Rule Species Name

Table 17 A database table used to assign numeric ID's to Inclusion Rule Species values.

LIFEFORM

ID	ID used in primary tables
NAME	Life form name

Table 18 A database table used to assign numeric ID's to Life form values.

OWNERSHIP

ID	ID used in primary tables
NAME	Ownership name

Table 19 A database table used to assign numeric ID's to Ownership values.

PROCESS

ID	ID used in primary tables
PROCESSNAME	Process name

Table 20 A database table used to assign numeric ID's to Process values.

SIZECLASS

ID	ID used in primary tables
SIZECLASS	Size class name

Table 21 A database table used to assign numeric ID's to Size Class values.

SPECIAL_AREA

ID	ID used in primary tables
NAME	Special Area name

Table 22 A database table used to assign numeric ID's to Special Area values.

SPECIES

ID	ID used in primary tables
SPECIES	Species Name

Table 23 A database table used to assign numeric ID's to Species values.

TRACKING_SPECIES

ID	ID of the database row in the EVU_SIM_DATA table
PCT	Tracking/Invasive Species Percent
SPECIES_ID	Inclusion Rule Species ID

Table 24 A database table that hold tracking species information for data in the EVU_SIM_DATA table.

See Figure 50 for example results from a database query.

```
SELECT * FROM EVU_SIM_DATA INNER JOIN PROCESS ON EVU_SIM_DATA.PROCESS_ID = PROCESS.ID WHERE PROCESSNAME='STAND-REPLACING-FIRE'
```

ID	SLINK	TIMESTEP	RUN	LIFEFORM_ID	SPECIES_ID	SIZECLASS_ID	AGE	DENSITY_ID	PROCESS_ID	PROB	SEASON_ID	ID	PROCESSNAME
7086	2447	1	0	1	12	8	1	1	3	14	4	3	STAND-REPLACING-FIRE
7087	2447	1	0	2	13	7	1	3	3	14	4	3	STAND-REPLACING-FIRE
8783	3090	1	0	1	1	8	1	1	3	-4	4	3	STAND-REPLACING-FIRE
8784	3090	1	0	2	13	7	1	3	3	-4	4	3	STAND-REPLACING-FIRE
9016	3178	1	0	1	1	8	1	0	3	-8	4	3	STAND-REPLACING-FIRE
9017	3178	1	0	2	2	2	1	0	3	-8	4	3	STAND-REPLACING-FIRE
9018	3179	1	0	1	1	8	1	1	3	-4	4	3	STAND-REPLACING-FIRE
9019	3179	1	0	2	13	7	1	3	3	-4	4	3	STAND-REPLACING-FIRE
9254	3268	1	0	1	1	8	1	1	3	-4	4	3	STAND-REPLACING-FIRE
9255	3268	1	0	2	13	7	1	3	3	-4	4	3	STAND-REPLACING-FIRE
11543	4135	1	0	1	12	8	1	1	3	14	4	3	STAND-REPLACING-FIRE
11544	4135	1	0	2	13	7	1	3	3	14	4	3	STAND-REPLACING-FIRE

Figure 50 Results from database query.

9.4 INTERPRETATIONS

The current choices under **Interpretations** are limited and vary for single or multiple simulations. Choices have been developed as users have requested them. The choices shaded out in the **Interpretations** pull-down menu are those that have either been used at some time in the past and not maintained, or have been proposed but not yet developed. These choices are:

- **Pattern Analysis (Fragstats):** The logic has not been incorporated into the system to perform an analysis. If analysis for spatial statistics is desired, make sure the SIMPLLE area file is created with uniform sized units. Following simulations, the feature class can be updated for any number of time steps and converted to a grid in the GIS environment. The resulting grid can be utilized in Fragstats.
- **Timber Volumes:** This capability to track standing inventory and identify what disturbance processes or management treatments are playing a role in its change has not been maintained since version 1.0. Users will have to create their own links between updated vegetation conditions by joining output files and average standing volumes by cover type, size class, and density.
- **Structure Development Stages (Oliver and Larson 1990):** Provides an interpretation of the combination of current conditions and processes that created them to provide acres by time step. Not maintained since version 1.0.
- **Risk Calculator:** This interpretation is to provide the optimization modeling system MAGIS (Zuuring et al. 1995), an input file to use based on an interpretation of disturbance process probabilities from multiple simulations. This option has not been fully developed.

- **Weed Potential:** This choice was added in early versions to incorporate work being done by Region One. It has been replaced by invasive species logic and will be removed in the next build of version 2.5

9.4.1 Single Simulations

Two choices are currently active for single simulations: **Wildlife Habitat and Ecosystem Restoration**. **Ecosystem Restoration** is available because it uses probability files from previous multiple simulations (Figure 51).



Figure 51 Interpretation Choices available for current version.

Wildlife Habitat Report

Interpretations > Wildlife Habitat Report is only available for the two Region One zones. The relationships that have been developed by states as GAP models are made accessible to SIMPPLLE through their inclusion in a database. The flexibility has been created to be able to include any Region specific models. Within SIMPPLLE, only the habitat relationships are included. Any spatial relationships are not included until the ArcView project (or extension) is accessed. The database could be utilized for relationships in other geographic areas.

Interpretations > Wildlife Habitat results in the **Wildlife Habitat Interpretations** screen (Figure 52), giving the user the choice of a report for the entire group or individuals within it.

The screenshot shows a software window titled "Wildlife Habitat Interpretations" with a standard Windows-style title bar (minimize, maximize, close buttons). Below the title bar is a "Knowledge Source" section. The main area is titled "Species Groups" and contains four vertically stacked panels for "Mammals", "Birds", "Amphibians", and "Reptiles". Each panel has a checked checkbox for the group name. To the right of each checkbox are two radio buttons: "Entire Group" (selected) and "Select Individuals" (unselected), followed by a "Pick ..." button. Further right is a "Models" box containing three checked checkboxes: "Montana GAP", "Idaho GAP", and "Region 1". At the bottom center of the window is a "Generate Report" button.

Figure 52 Main screen for Wildlife Habitat Interpretations.

Additional choices must be made on which model to use (Figure 53).

Mammals / Models			
	☐ Gray Wolf	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Black-footed Ferret	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Woodland caribou	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Black-tailed Prairie Dog	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Idaho ground squirrel	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Townsend's Big-eared Bat	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Fisher	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Lynx	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Spotted Bat	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ White-tailed Prairie Dog	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Swift Fox	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Northern Bog Lemming	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Bighorn Sheep	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Pygmy Rabbit	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Pallid Bat	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Wolverine	☐ Montana Gap	☐ Idaho Gap ☐ Region 1
	☐ Grizzly Bear	☐ Montana Gap	☐ Idaho Gap ☐ Region 1

Figure 53 Display of choices for individual species within a group.

The report format is displayed in Figure 54.

test1.txt - Notepad

File Edit Format Help

Montana GAP (acres for species whose models include spatial requirements are incomplete see the arcview extension to get complete analysis)

Mammals		0	1	2	3	4	5
	Gray wolf	38311.0	45558.0	47037.0	46829.0	46398.0	47074.0
	Black-footed Ferret	9710.0	9855.0	10379.0	10159.0	10434.0	10613.0
	Black-tailed Prairie Dog	9710.0	9855.0	10379.0	10159.0	10434.0	10613.0
	Townsend's big-eared bat	12353.0	15743.0	16069.0	16994.0	15641.0	16229.0
	Fisher	14313.0	23018.0	28376.0	27228.0	26026.0	31885.0
	Lynx	31095.0	30172.0	33361.0	32872.0	30650.0	32299.0
	Spotted bat	960.0	5046.0	3597.0	3542.0	3752.0	2602.0
	White-tailed Prairie Dog	0.0	227.0	751.0	770.0	824.0	1295.0
	Swift Fox	0.0	227.0	751.0	388.0	764.0	943.0
	Northern bog lemming	7688.0	7123.0	7640.0	7550.0	5783.0	5762.0
	Bighorn sheep	679.0	9206.0	7618.0	8066.0	10590.0	9632.0
	Pygmy rabbit	0.0	0.0	0.0	0.0	0.0	0.0
	Pallid bat	0.0	267.0	751.0	388.0	1028.0	943.0
	Wolverine	37351.0	36153.0	39220.0	38421.0	35567.0	37201.0
	Grizzly bear	38311.0	45331.0	46286.0	46441.0	45634.0	46131.0
Birds		0	1	2	3	4	5
	Harlequin duck	37351.0	40512.0	43440.0	43287.0	42646.0	44472.0
	Flammulated Owl	23764.0	24856.0	21043.0	20676.0	24538.0	18962.0
	Bald eagle	38091.0	30263.0	28721.0	27180.0	24351.0	22569.0
	Whooping Crane	0.0	0.0	0.0	0.0	0.0	0.0
	Burrowing owl	9429.0	9656.0	10180.0	10199.0	10253.0	10724.0
	Ferruginous hawk	8090.0	7217.0	6490.0	6519.0	10220.0	8423.0
	Columbian Sharp-tailed Grouse	281.0	4825.0	5170.0	5978.0	8408.0	8807.0
	Peregrine falcon	967.0	8645.0	6658.0	6709.0	9836.0	8399.0
	Mountain Plover	9429.0	9429.0	9429.0	9429.0	9429.0	9429.0
	Trumpeter swan	0.0	0.0	0.0	0.0	0.0	0.0
	Sage Grouse	0.0	0.0	0.0	382.0	60.0	352.0
	Boreal owl	34127.0	35065.0	38178.0	37680.0	35234.0	36898.0
	Sprague's Pipit	0.0	227.0	751.0	388.0	764.0	943.0
	Loggerhead shrike	281.0	4825.0	5170.0	5978.0	8408.0	8807.0
	Golden eagle	10296.0	11170.0	9091.0	8674.0	7914.0	6511.0

Figure 54 Report for Wildlife Habitat Interpretations.

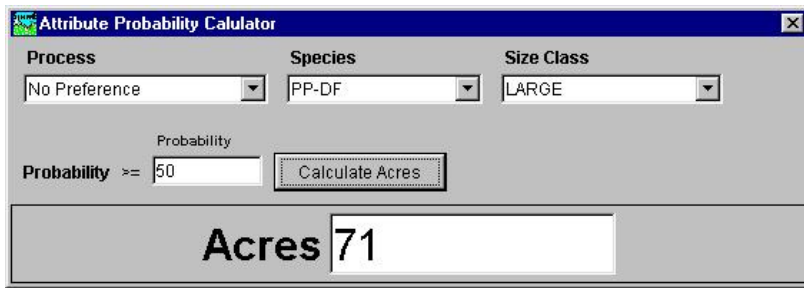
This is only available for single simulations. If it is executed at the end of a set of multiple simulations, the numbers will be computed on the last simulation in the set. At this time, the use of multiple simulations and the resulting probabilities for providing vegetation conditions for wildlife habitat must be addressed through using numerous output files in a GIS environment.

9.4.2 Multiple Simulations

Both **Attribute Probability Calculator** and **Ecosystem Restoration** (under **Interpretations**) require multiple simulations as probabilities are generated from multiple simulations.

Interpretations > Attribute Probability Calculator provides the means to determine how many acres of a given combination of attributes or processes exist at a specified probability level. This provides a way to obtain these acres without creating GIS files to do it in the GIS environment. If multiple simulations are made, the **Attribute Probability Calculator** can be used to identify how many acres of certain conditions exist at or above a specified probability level. Alternatively, this can also be determined within the GIS extension by multiple queries.

The screen in Figure 55 shows the selection of **PP-DF** for **Species** and a **Size Class** of **Large** occurring at least 50 percent of the time. There are only 71 acres that meet these criteria. If the combination is important for some resource value, this feature is useful to give an idea of how limited the combination may be in the landscape over the time of the simulation.

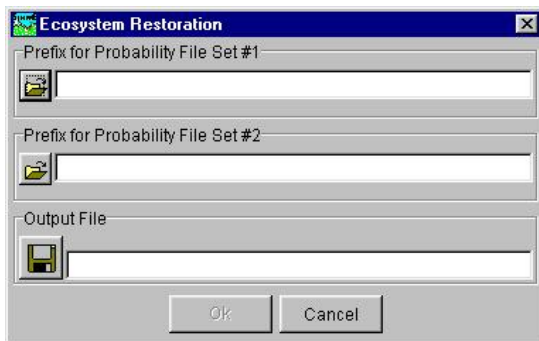


The 'Attribute Probability Calculator' dialog box has three dropdown menus at the top: 'Process' set to 'No Preference', 'Species' set to 'PP-DF', and 'Size Class' set to 'LARGE'. Below these is a 'Probability' section with a label 'Probability' and a value '50' in a text box, followed by a 'Calculate Acres' button. At the bottom, a large text box displays 'Acres 71'.

Figure 55 Acres that meet the criteria of being PP-DF and Large greater than or equal to 50 percent of the time for a set of multiple simulations.

Ecosystem Restoration

Interpretations > Ecosystem Restoration uses probability files from two different sets of multiple simulations that have to have been made previously (Figure 56).



The 'Ecosystem Restoration' dialog box contains three file selection fields. The first is labeled 'Prefix for Probability File Set #1', the second 'Prefix for Probability File Set #2', and the third 'Output File'. Each field has a folder icon to its left. At the bottom are 'Ok' and 'Cancel' buttons.

Figure 56 The SIMPPLLE dialog screen used to identify two sets of probability files used to identify Ecosystem Restoration needs.

This interpretation choice is designed to help identify the need for ecosystem maintenance, conversion, or restoration. Using SIMPPLLE for this analysis incorporates the dynamics of specific landscapes that are dependent upon unique spatial patterns. SIMPPLLE uses probabilities from two sets of simulations. One set is considered a representation of the historic conditions of the specific landscape. The other set is a projection of the current landscape. SIMPPLLE provides a comparison between the files of the two vegetation types which occurred at the highest frequency level. It does not make a difference in the order in which the probability files are entered in the dialog screen.

A comparison is made for each existing vegetation unit:

Use the two species that have the two highest probabilities for each file. If there is a difference, assign a value of "1," if there is no difference, assign a "0."

Use the two densities that have the highest probability for each file. If there is a difference, assign a value of "1," if there is no difference, assign a "0."

Use the two size-class/structures that have the two highest probabilities for each file. If there is a difference, assign a value of "1," if there is no difference, assign a "0."

Using the "difference" values:

If species is = 1 assign "C"

Regardless of other two values

If species = 0

And density = 0

And size = 1 assign "R"

If species = 0

And density = 1

And size = 0 assign "R"

If species = 0

And density = 0

And Size = 0 assign "M"

A file of the EVU number and assigned value of **C**, **R**, or **M** is created and can be joined to the landscape coverage in the ArcView project. Although the logic was initially developed for use in Region One, it can be applied in any other geographic area.

This report and its use on sample landscapes are documented in Chew (2003).

9.5 EXPORT FILES

9.5.1 Area Creation Files

The user can correct for mismatches that occur when files are imported through the user interface (see previous section). To reflect these changes in the GIS coverage you can export the attributes file and join it back to the coverage within ArcMap or ArcCatalog. Click **Export > Area Creation Files** (Figure 57).

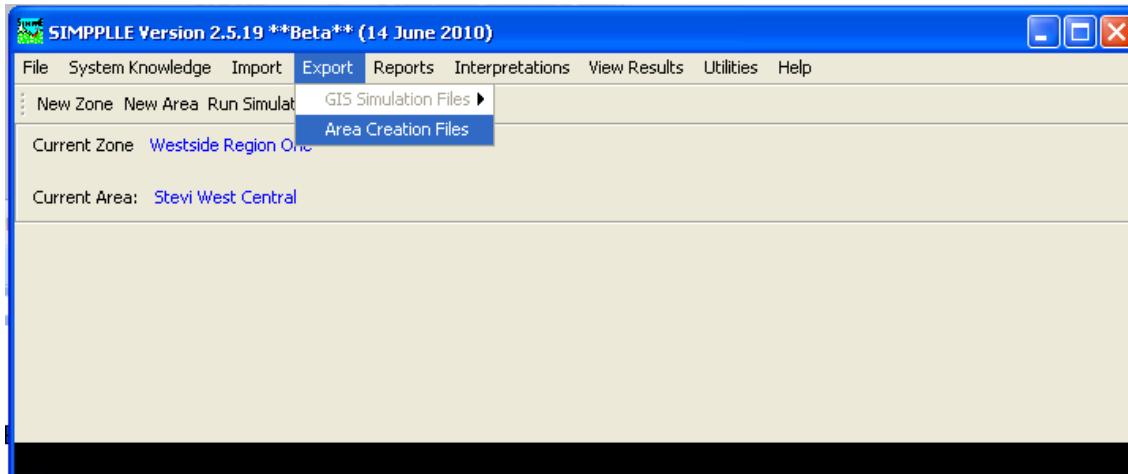


Figure 57 Choice to create an attributes file that can be joined to the GIS coverage to account for changes made through the user interface.

This choice brings up the **Information** dialog box shown in Figure 58.



Figure 58 Identification of the files that SIMPPLLE is going to use.

9.5.2 GIS Simulation Files

The creation of files to use in a GIS environment can result in a significant number of files. To minimize this impact, single simulations do not automatically create files. This allows the user make many single simulations without having to worry about file cleanup. For multiple simulations, there are some files that are created without the user's choice as it would be impossible to create after the simulations. Types of files vary with either single simulations or multiple simulations and are discussed in the following sections.

These files are designed to be used with both the ArcView customized SIMPPLLE project and the ArcMap SIMPPLLE extension. However, a proficient GIS user can utilize them with basic ArcGIS tools.

GIS Simulation Files—Single Simulation

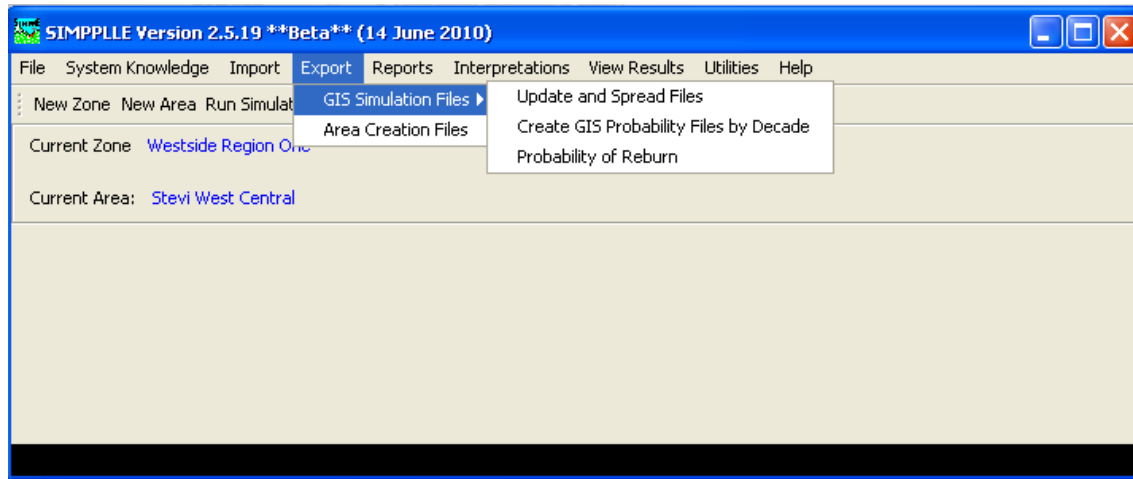


Figure 59 Choices available for GIS output files under the Export main menu choice.

With the expansion to include multiple life forms, there are more choices that have to be made with these files. Select **Export > GIS Simulation Files > Update and Spread Files** to bring up the **Chooser Lifeform** dialog screen (only if the area file is multiple life form)(Figure 60).

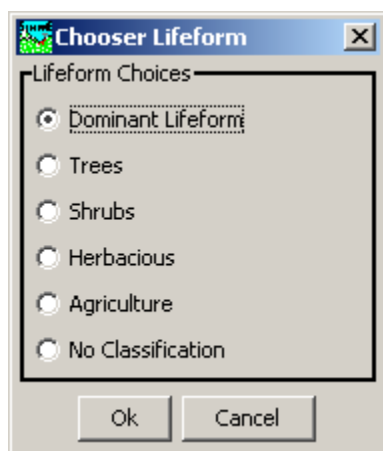


Figure 60 Choice available when exporting GIS files for a simulation if multiple life forms are used to describe the vegetation in the landscape.

Update Files—Single Simulation

Export > GIS Simulation Files > Update and Spread Files is used to map the individual time steps which include the processes that occurred, vegetation attributes, and treatments after a single simulation is made, or a single simulation file has been reloaded. The files are named with the user-provided prefix and a file for each time step of the simulation: “user-prefix-#.txt.”

Spread Files—Single Simulation

Spread Files are for those disturbances that spread. These files provide the means to map where a specific process originates versus where it spreads. The files are named using the user-provided prefix with a file for each time step of the simulation: “user-prefix-#-spread.txt.”

Probability of Reburn—Single Simulation

Export > GIS Simulation Files > Probability of Reburn will identify what plant communities get a stand replacing fire more than once within the length of the simulation made. There is no access to this code to make any changes, such as using any fire event, not just stand replacing fire events. This report is not functional for version 2.5.

GIS Simulation Files—Multiple Simulations

Three types of GIS files are created automatically from multiple simulations: probability files, time step attribute update files and spread files, and an area file for each simulation. Probability files are for the processes and each attribute of species, sizeclass, and density. There are two sets of probability files: one set of files based on the entire simulation and one set of files for each time step. Probability files for the total duration of the simulation use the user supplied name plus “username-n-process.txt” “username-n-species.txt,” “username-n-size.txt,” “username-n-canopy.txt.” These files are used in the ArcView project file or the GIS extension to

display the probability of a process or attribute occurring over the length of the number of time steps in the simulations. The files for the probability by each individual time step are named using the user provided prefix, the time step, and the attribute: "userprefix-#-attribute.txt."

Update and Spread Files cannot be used if the choice was made to discard simulation information. If you want to discard information, then GIS files must be made at the time of the simulation by making a choice from the simulation parameters screen. These update and spread files are made for an individual simulation, even if they are made as a set of simulations. If the user wants to create files from many of the simulations in the set, the saved area file that contains the simulation results (*.simdata) from the run must be loaded as a **Previously Simulated Landscape**. The choice of discarding information will limit what can be done with the simdata file.

Create GIS Probability Files by Decade

For some analyses, the probability of a process or vegetation attribute over the entire simulation period may not be the best expression. Files can be generated to display the probability by time steps. These files are automatically created for each time step for each attribute, species, size, and density when a set of multiple simulations are made. These files are put in a separate directory for each of the multiple simulations with additional subdirectories for each life form.

9.6 EXCEL SPREADSHEETS

9.6.1 Basic Processing

When working with multiple simulations, one of the easiest ways to process the output is in a spreadsheet. This makes it easy to cut and paste data to create any variety of graphic comparisons. To facilitate this effort, an output file is automatically created when multiple simulations are made. This file contains the output by time step, by simulation in the following sequence: acres of processes, acres of species, acres of size-class/structure, acres of density class, fire suppression costs, emissions for fire events pm-10, emissions for fire events pm 2.5, emissions for treatments pm-10, emission for treatments pm 2.5.

With sets of multiple simulations for a number of management alternatives, each alternative can have its own spreadsheet plus one spreadsheet that provides a comparison of values between management alternatives.

The basic spreadsheet macro is provided with SIMPPLLE. The instructions are in Appendix J.

9.6.2 All States Report

Reports > All States Report is most commonly used with multiple simulations. The **All States Report** was designed to provide the capability to track specific combination of species/size class – structure/density. The report is designed to identify the mean, maximum, minimum, and

standard deviation for each state—the results from multiple simulations. This report requires an output file generated by SIMPPLLE and the use of an Excel template. The input file can be structured to track each individual combination. **Note:** You must have Excel 2002 or newer to run the macros in the Report Template.

If the report is run on all individual states, it may take a considerable time to complete. Most likely the report will be done on groupings of the states, such as grouping used for a Diversity Matrix.

The user interface to query the user for the desired grouping has not yet been created. Instead, the system asks for the name of a text file (*.txt) that contains the information to create groups. Many text files for different groupings may be made.

It is possible to exceed line limitations with this report in older versions of Excel.

Instructions are included in Appendix K.

9.6.3 Tracking Species Macro

Reports > Tracking Species Report was created to provide support for using the tracking species feature for invasive species. Instructions are included in Appendix L.

9.6.4 Statistical Analysis—Multiresponse Permutation Procedure (MRPP)

An Excel spreadsheet template with macros for statistically testing differences in values between alternatives is included. Instructions are in an Appendix M. A separate General Technical Report is being prepared for the use of the statistical test.

10. SYSTEM KNOWLEDGE

Within SIMPPLLE, change is not driven by transition matrices. The system has to contain adequate knowledge to predict the probability of the occurrence of disturbance processes for each plant community. The collection of knowledge about vegetation change by processes, the probability of processes and their spread, and the impact from treatments is all collectively referred to as system knowledge. This knowledge is a combination of specific research results modified to fit the level of inventory information commonly available at landscape scales and the incorporation of the expert opinion of field silviculturists, ecologists, and resource specialists from each geographic area. It is represented in many different forms ranging from equations to logic screens. Each time SIMPPLLE is started, the default system knowledge for a geographic zone is loaded.

The goal is to make all of this knowledge easily accessible, but only certain components of it are changeable by the user. Changes made through the user interface can be saved and easily reloaded. Changes in the system knowledge beyond what is accessible by the user require changes by the system developers. **System Knowledge** (Figure 61) provides access to the knowledge components. There are many reasons why the user should be able to change the default system knowledge. Many of the geographic areas are rather large, and one can expect the behavior of many of the disturbance processes to vary across this area. Both the research results and the expert opinion that provides the basis of the system knowledge is far from complete. Changes can be made to test different relationships or to account for the differences that vary within what may be large geographic zones. A **Knowledge Source** menu choice exists on each screen under system knowledge. This can be used to identify the source of the knowledge. It is the user's responsibility to document changes made in the default system knowledge.



Figure 61 System knowledge choice from the main SIMPPLLE menu.

Version 2.5 offers more consistency in the knowledge screens for each component than in previous versions. To access the **Process Probability Logic** screen, select **System Knowledge >**

Vegetative Process > Process Probability Logic. The user has a choice of **Columns** that can be added to the screens to have as much or as little system knowledge utilized. Figure 62 displays the list of the system components that can be used in a logic screen.

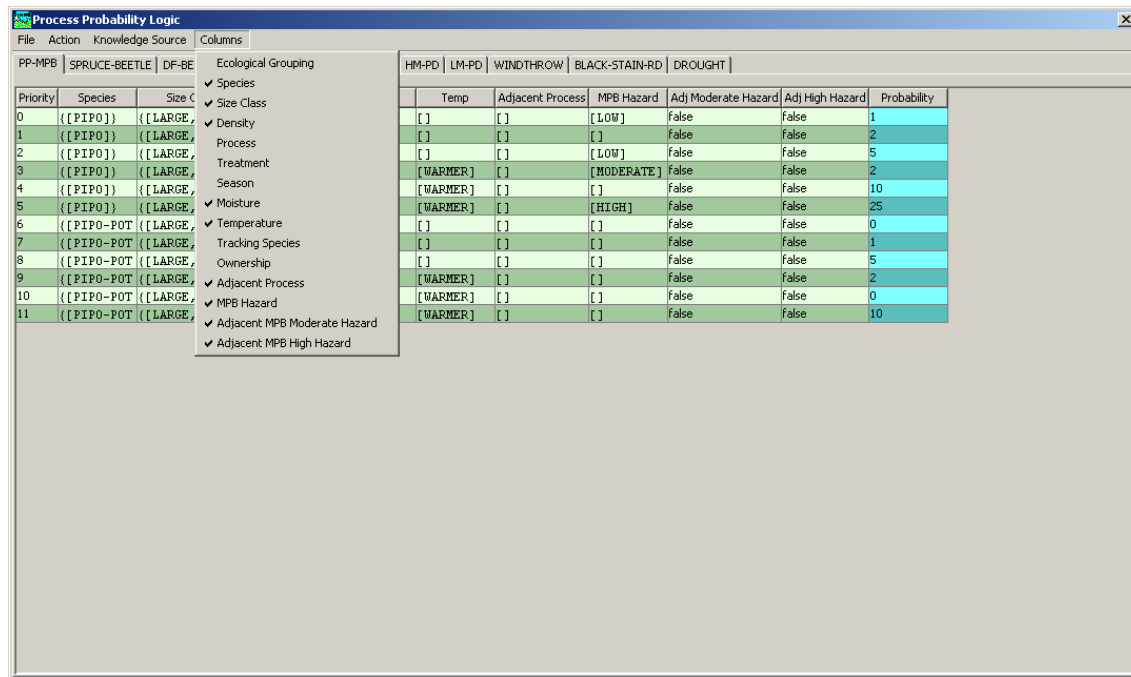
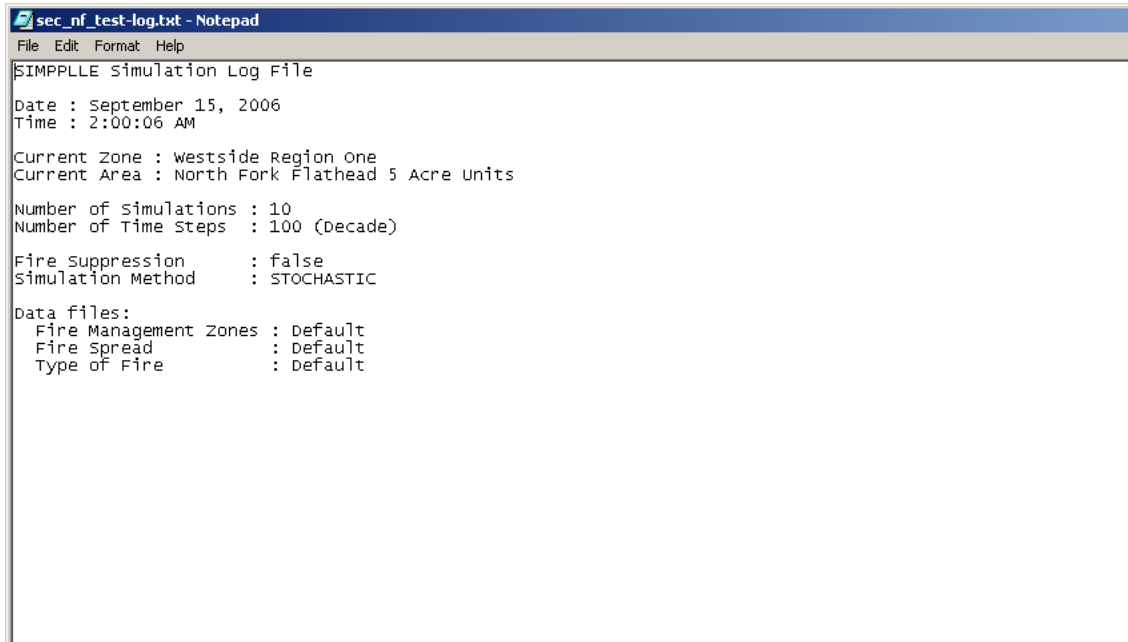


Figure 62 The basic disturbance process probability logic screen showing the pull-down menu for columns. This displays the system knowledge that the user can choose to utilize.

There are always going to be some components in geographic areas that are so unique that they require a separate form of screen. For example, the **Bison Grazing** screen in the grassland areas and the **Invasive Species** screen in the Colorado Plateau area each are unique screens. When building logic combinations for any screen, the more detailed the combinations, the more specific knowledge requirements must be listed first. For any given screen, the system goes through the combinations in order. The first one that matches, the system will utilize. If a generalized combination is the first one, the more detailed conditions will never be utilized.

Managing the changes from the default system knowledge for a zone can be a significant task. A log file is created for a simulation if a prefix name is provided for the output. However, this file does not capture all of the changes that may be made in the various system knowledge components, especially if they were made for the duration of a single set of simulations. The log file currently identifies only a portion of the saved knowledge files that may be loaded. Thus, a major part of managing the system knowledge requires the user to keep records on what comprises each simulation. Figure 63 is an example of a log file for a set of simulations.



```
sec_nf_test-log.txt - Notepad
File Edit Format Help
SIMPPLLE Simulation Log File
Date : September 15, 2006
Time : 2:00:06 AM
Current Zone : westside Region One
Current Area : North Fork Flathead 5 Acre Units
Number of Simulations : 10
Number of Time Steps : 100 (Decade)
Fire suppression      : false
Simulation Method     : STOCHASTIC
Data files:
  Fire Management Zones : Default
  Fire Spread           : Default
  Type of Fire          : Default
```

Figure 63 SIMPPLLE log file from a set of 10 simulations display a subset of the simulation parameter values.

Knowledge Components Shaded Out

SIMPPLLE's design of classes that can be used to represent a range of landscape components has not been fully implemented. The initial emphasis has been on the vegetation part of the landscape. Thus, there are numerous parallel choices associated with other landscape components, land and aquatic units, that are shaded out until they are developed in future versions.

System Knowledge Not Accessible

Our goal is to have all system knowledge accessible, but there are currently some components that are not in version 2.5. The following identifies system knowledge that the user cannot access at this time:

- emissions code

- reburn probability
- fire spotting under extreme fire spread
- hazard rating systems for mountain pine beetle in lodgepole and ponderosa pine
- the spruce beetle expert system incorporated into the south central Alaska zone
- pulse regeneration logic
- code that identifies acres of adjacent units for use in determining adjacent seed sources
- code controlling Insect/Disease Process spread

System Knowledge Source

All logic screens have a **Knowledge Source** choice on the main menu bar. This provides the means to document the source of the logic used in the screens. Any changes by the user should be documented in this screen. If the logic is saved as a file to be loaded again, this documentation is a part of the file.

System Knowledge Files

Changes in components of the system knowledge can be applied during a simulation session or saved to files that are in a specific format for SIMPPLLE by selecting **File > Save As**. These new files can be reloaded for future simulations by loading each separately from the **File** choice at the main menu for each of the knowledge components, or they can be loaded collectively. To load all of them collectively, the user must first load the files individually and then select **System Knowledge > Save User Knowledge File**.

The next time SIMPPLLE is started after the zone and area are loaded, select **System Knowledge > Open User Knowledge File** to load the changed knowledge files. Table 25 identifies the file extensions for each type of system knowledge.

Type of Knowledge	File Extension
Vegetation pathways	sk_pathway
Lock-in processes	sk_processsched
Treatment logic	sk_treatlogic
Treatment schedules	sk_treatsched
Fire Spread Rate	sk_firesupspreadratellogic
Fire suppression production rate	sk_firesupproductionratellogic
Fire Spread logic	sk_firespread
Type of fire logic	sk_firetype
Fire suppression costs	sk_fmz
Fire occurrence numbers	sk_fmz
Fire suppression beyond class A	sk_firesuppbeyondclassallogic
Fire suppression class A	Sk_firesuppclassallogic
Class A fire suppression due to weather	sk_firesupweathera
Fire suppression beyond Class A due to weather	sk_firesupweather
Regional climate	sk_climate
Insect and Disease probabilities	sk_processproblogic
Species attributes	sk_species
Regeneration logic –fire	sk_regenlogicfire
Regeneration logic –succession	sk_regenlogicsucc
Regeneration delay	sk_regendelaylogic
Producing seed logic	sk_producingseedlogic
Conifer Encroachment logic	sk_conifer
Gap Process logic	sk_gapprocesslogic
Vegetation Unit fire type logic	sk_vegunitfiretypellogic
Invasive species logic	sk_invasivespecieslogic
Life form competition logic	sk_competitionlogic
User system knowledge file	sysknowledge

Table 25 Types of system knowledge files and their file name extensions assigned by the system.

If the user makes many changes to system knowledge components from the zone defaults, it can become time consuming to load all the files each time SIMPPLLE is restarted. For this reason, once all the changed files have been loaded, select **System Knowledge > Save User Knowledge File** (Figure 64).

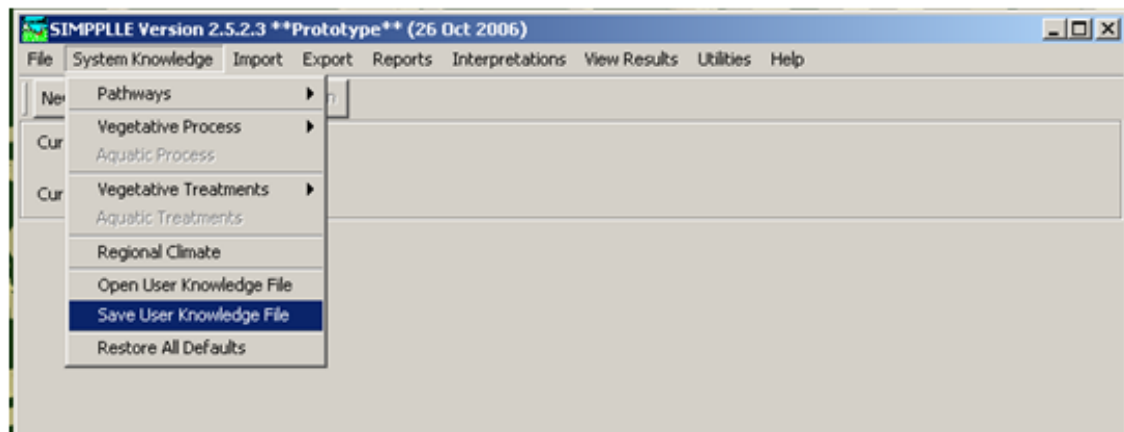


Figure 64 The choice of "Save User Knowledge File" on the pulldown menu from System Knowledge.

The **Save System Knowledge** screen (Figure 65) allows the user to save as much as desired and provide a name for the system knowledge file. This file actually contains all the modified system knowledge. It does not just “point” to the location of individual files. Thus, the individual files may be located in separate directories.

Save System Knowledge

Check what data you wish to save

Select All Select None

Fire Knowledge

- ☐ Fire Occurrence -- Fire Suppression Costs -- Fire Management Zones
- ☐ Type of Fire Logic
- ☐ Fire Suppression Beyond Class A
- ☐ Fire Suppression Beyond Class A due to Weather
- ☐ Fire Spread Rate
- ☐ Fire Season
- ☐ Fire Spread
- ☐ Class A Fire Suppression
- ☐ Class A Fire Suppression due to Weather
- ☐ Extreme Fire Settings
- ☐ Fire Suppression Production Rate
- ☐ Species Settings (e.g. Fire Resistance)

Pathways

- ☐ Vegetative Pathways
- ☐ Aquatic Pathways

Schedules

- ☐ Process Schedules
- ☐ Treatment Schedules

Miscellaneous

- ☐ Fire Regeneration Logic
- ☒ Treatment Logic
- ☒ Invasive Species Logic
- ☒ Lifeform Competition Logic
- ☐ Climate
- ☐ Succession Regeneration Logic
- ☐ Insect/Disease Probabilities
- ☒ Regeneration Delay Logic
- ☐ Producing Seed Logic
- ☐ Conifer Encroachment Logic
- ☒ Process Probability Logic
- ☒ Gap Process Logic
- ☐ Veg Unit Fire Type Logic

File Name

Pick

Save Cancel

Figure 65 The save system knowledge screen that lets the user specify what modified system knowledge should be included.

10.2 PATHWAYS—VEGETATION

Existing vegetation can be represented in two formats called pathways. One format is discrete states that are combinations of species, sizeclass and structure, and canopy density. The other format is an aggregate of numerous species with the percent of canopy cover for each species that has to fall within a specified range of cover for the aggregate. The choice of attributes used to describe the states is dependent on what is commonly available from current inventories, what is needed to provide the means to predict disturbance process probability on an individual plant community basis, and what is needed to interpret conditions for impacts on natural resources. Ecological groupings or stratifications are used to stratify the pathway states.

Pathways are constructed as:

- Trees changes based on a decade time between states
- Shrubs and herbaceous as yearly changes

Within SIMPPLLE, only a limited part of the system knowledge is in the pathways. The knowledge stored within these files of pathway states includes the processes that are applicable for each state and the resulting state if the process occurs.

Within this collection of states we identify:

- The time spent within a size-class
- Density changes over time
- When a tolerant species is added to the species mixture
- How long seral species stay in a mixture
- Influence of density on time within states
- Influence of the ecological stratification

For the initial geographic areas of the Westside and Eastside Region One, this information was provided by relationships in the “Regional Stocking Charts” (USDA Forest Service 1987) which were derived from hundreds of Forest Vegetation Simulator (FVS) runs on a very large number of sample stands. The initial relationships have been modified by expert opinion through numerous workshops. Users or user groups should consider using sample stands or FIA plots with FVS (or an appropriate growth model for their area) to improve the relationships within specific pathways.

This knowledge can be built and refined through the use of fine scale models such as FVS on sample plant communities, research results on vegetative growth and disturbance processes, and expert opinion. Some detail on pathway development for each geographic area is given in the Appendix for each zone/area and is planned for future publications.

The knowledge for determining the probability of a given process and how it may spread is stored in other parts of the system. It is not a part of the pathways. The simulated spatial patterns of plant communities that can be unique to each area impact the probability and spread of the processes. The pathways capture information that does not require site specific, spatially explicit knowledge. Any information about vegetation change that depends upon knowledge about neighboring plant communities cannot be captured within the pathways and requires other components of system knowledge.

10.2.1 Viewing Pathway State Diagrams

To view pathway files, select **System Knowledge > Pathway > Vegetative Pathways** (Figure 66).



Figure 66 Sequences of choices from the main menu to access the knowledge stored in the Vegetation Pathways.

A display (Figure 67) opens up to one of the ecological stratifications. For the Westside Region One zone, this is **Ecological Grouping D3**, and the first vegetative type of alpine fir (**AF**) with the **Process of Succession**.

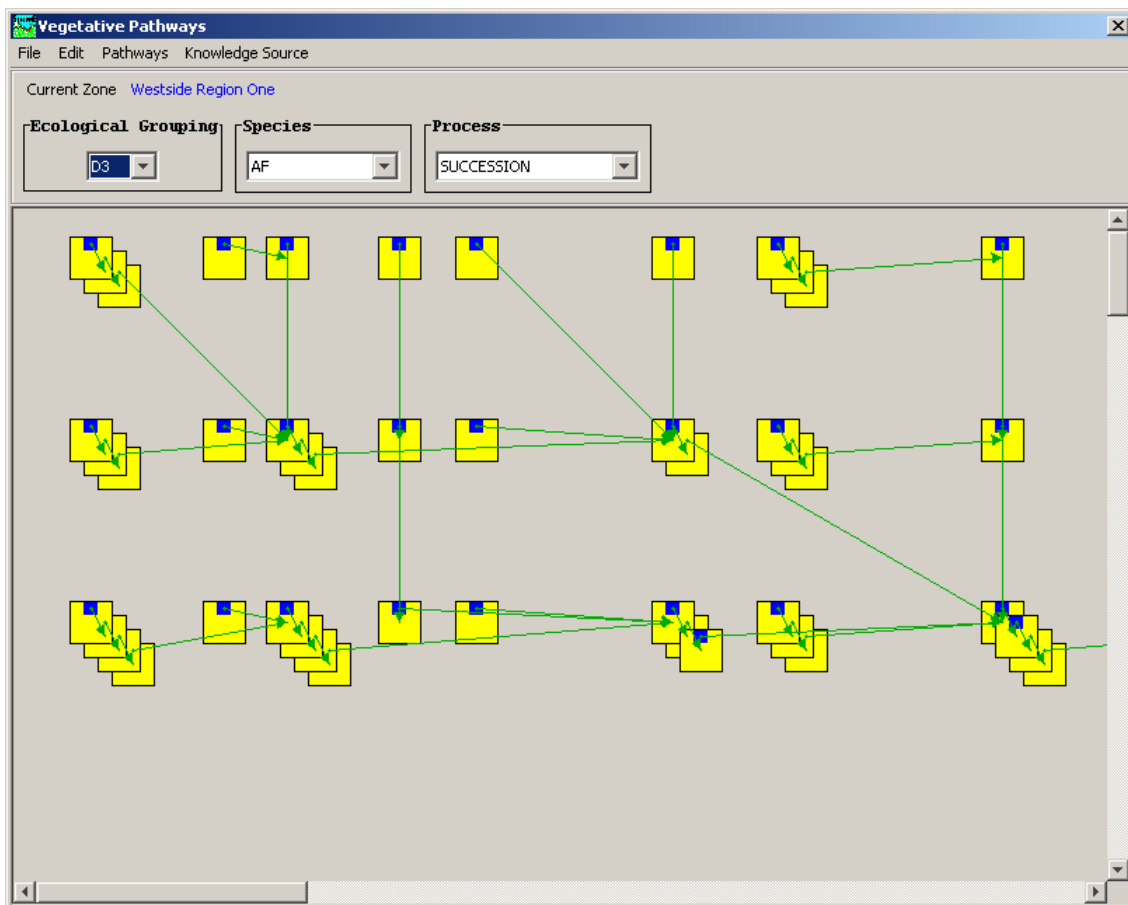


Figure 67 Diagrams of vegetation states for habitat group D3, alpine fir for the dominant species and succession as the process of change.

A choice of the **Ecological Grouping** to display is selected from the drop down menu as shown in Figure 68.

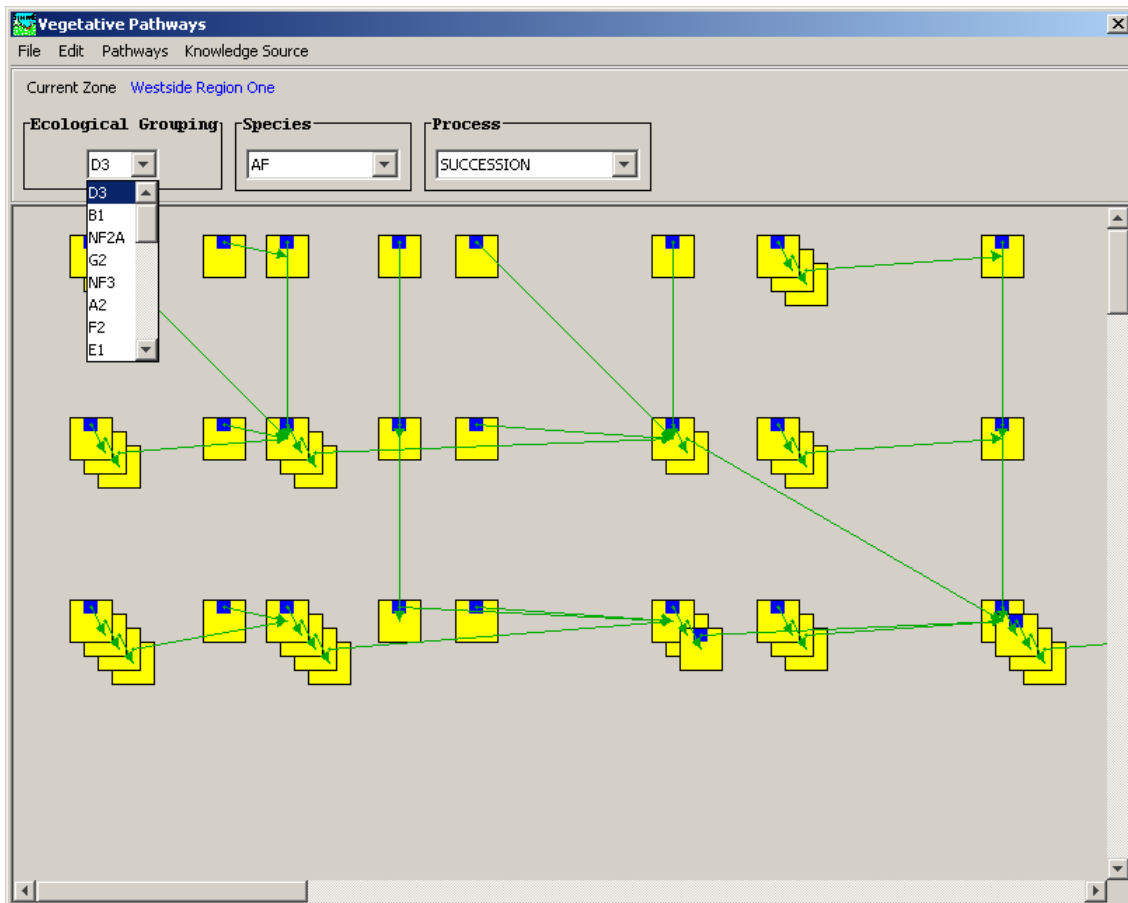


Figure 68 The pulldown menu that provides access to other habitat type groups.

The ecological grouping (habitat type group for this zone) display is further divided by species to avoid having diagrams that are too difficult to read. The **Species** pulldown menu enables one to select the dominate species diagram to view (Figure 69).

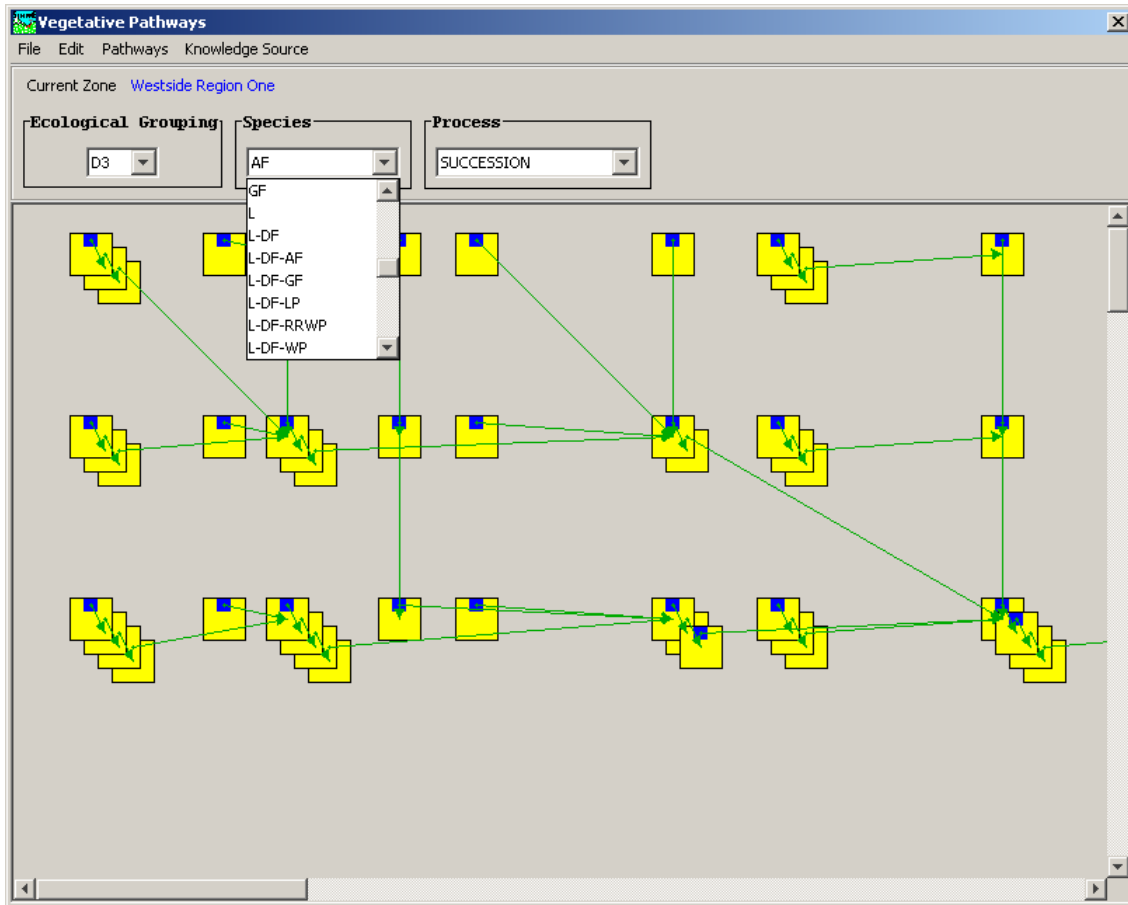


Figure 69 The pulldown menu to provide access to the dominant species within the group.

As displayed in Figure 70, the states are arranged with the youngest and smallest seedling/saplings on the left and the oldest and largest on the right. The lowest density class is in the top and the highest class in the bottom of the diagram. Each decade within a size-class is represented by a separate state. This allows variation within the processes to occur over time within a given size-class/structure combination. The boxes (states) that are shaded represent different species combinations that processes change a plant community to. The user must switch to the different species display within the same habitat type group in order to see the complete set of states for the new species. This is done by using the drop down menu, or simply double clicking on one of the shaded states.

To keep the diagram readable, the title for each state is not automatically displayed on the diagram. Instead, the identifier for a given state is displayed when the cursor is placed on the state, or select **Pathways > Show All Labels**.

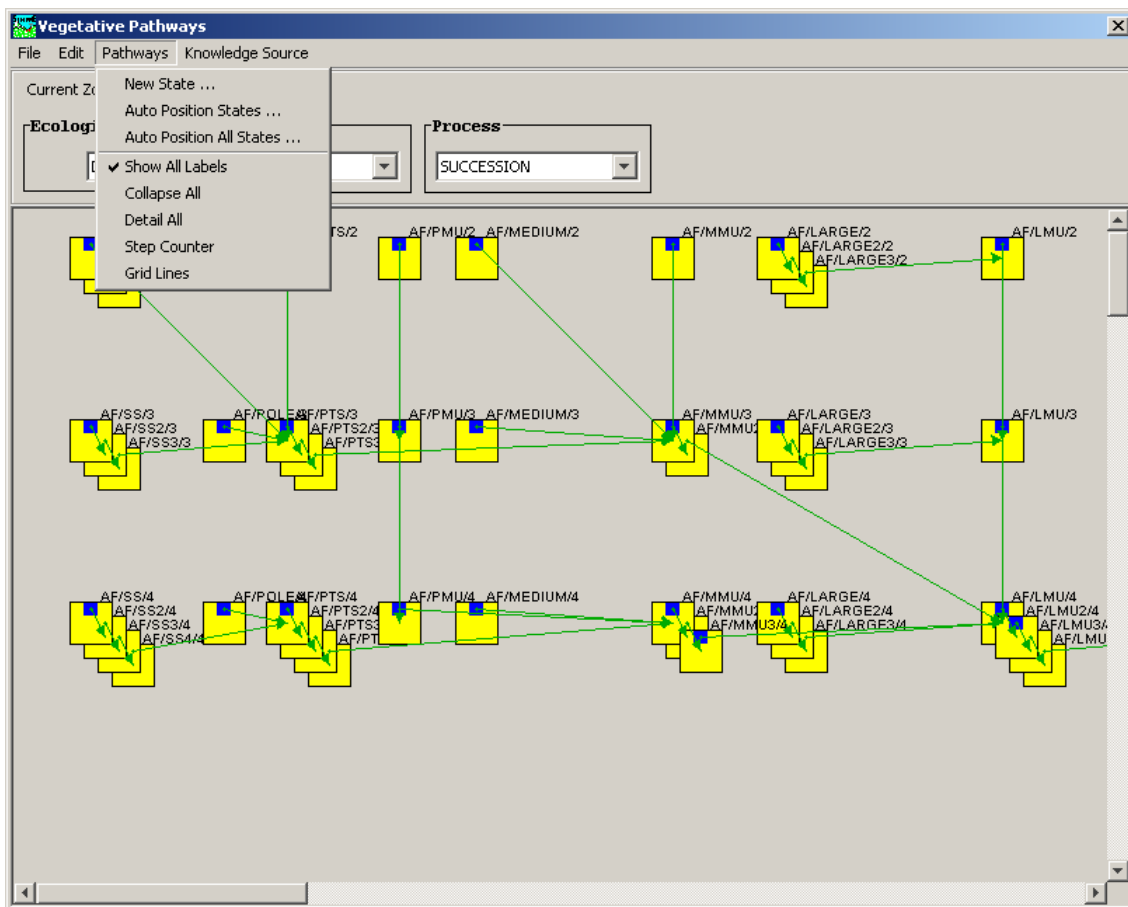


Figure 70 Diagram of all possible states of the dominant species af on habitat type group D3. The descriptive labels for each state are displayed. The process linking all the displayed states is succession.

Other choices available under **Pathways** are:

- **New State:** Adds a new state to a pathway such as adding an additional decade for the time spent in a given size class.
- **Auto Position States:** Adding new states or editing existing can result in a confusing spatial arrangement of the states. This places the states in a predetermined arrangement for the displayed pathway.
- **Auto Position All States:** This is similar to the above choice, only it is done for all pathways in the system.
- **Collapse All:** Reduces the pathway to a single state for each size class. The separate states for age within a size class will be collapsed.
- **Detail All:** Expands each size class to display all the states for each decade within it.
- **Step Counter:** Determines the number of years between two selected states in the pathway. This is very useful in the editing process.
- **Grid Lines:** Adds a grid separating size class and densities.

Succession, stand-development, is the default process link that is displayed. Different processes can be displayed from the pulldown menu for **Process** (Figure 71). The processes of **Regeneration** and **Invasive Species Occurrence** are not shown in these diagrams as they require spatial information to be implemented. They require knowledge of the conditions of a plant community's neighbors and place in the landscape.

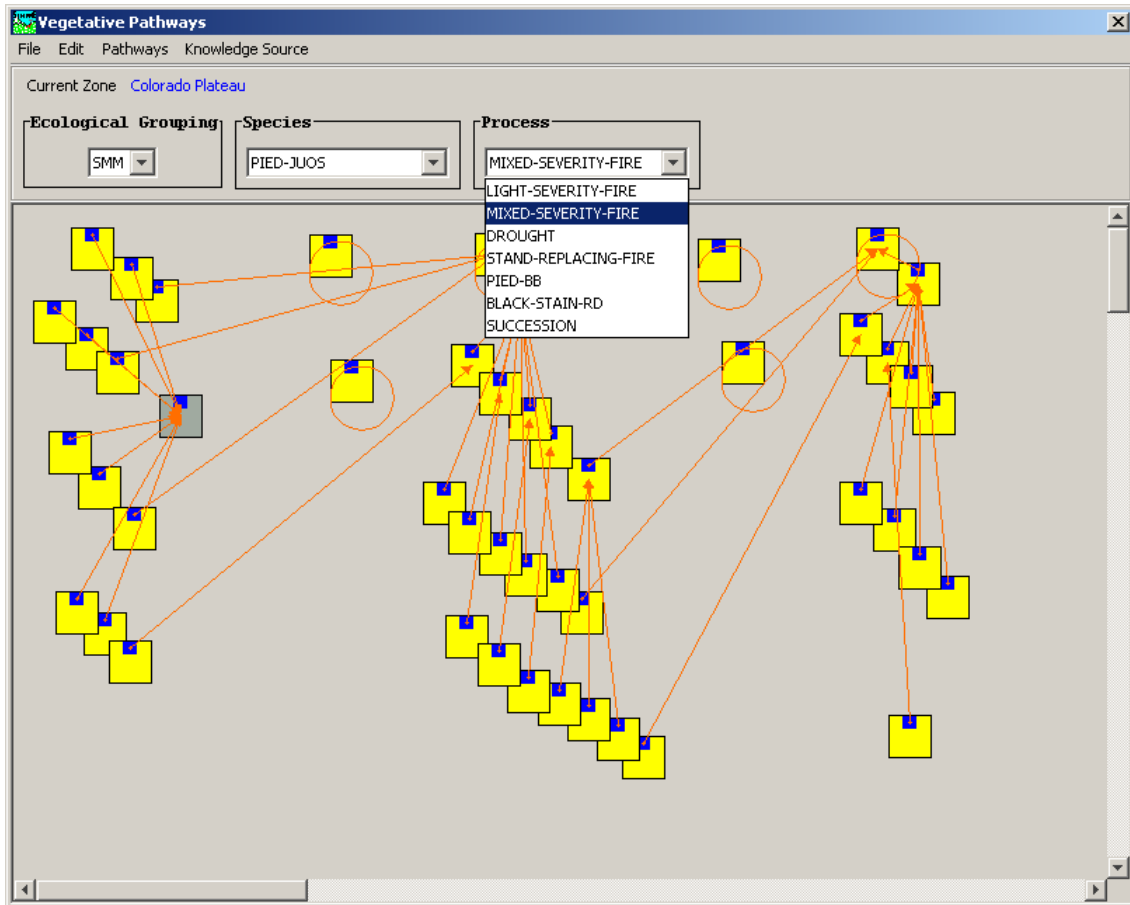


Figure 71 Display of the process drop down menu for changing the disturbance process linking all of the states in the diagram.

10.2.2 Creating Pathway Diagrams

In version 2.5, new pathways diagrams and diagrams of new species combinations cannot be created directly through the user interface. To add a new species or species combination that is not currently in the system, create a text file of the pathways and import it through the menu choice, as shown in Figure 72. Existing pathway files can be exported as text files to use as a format.

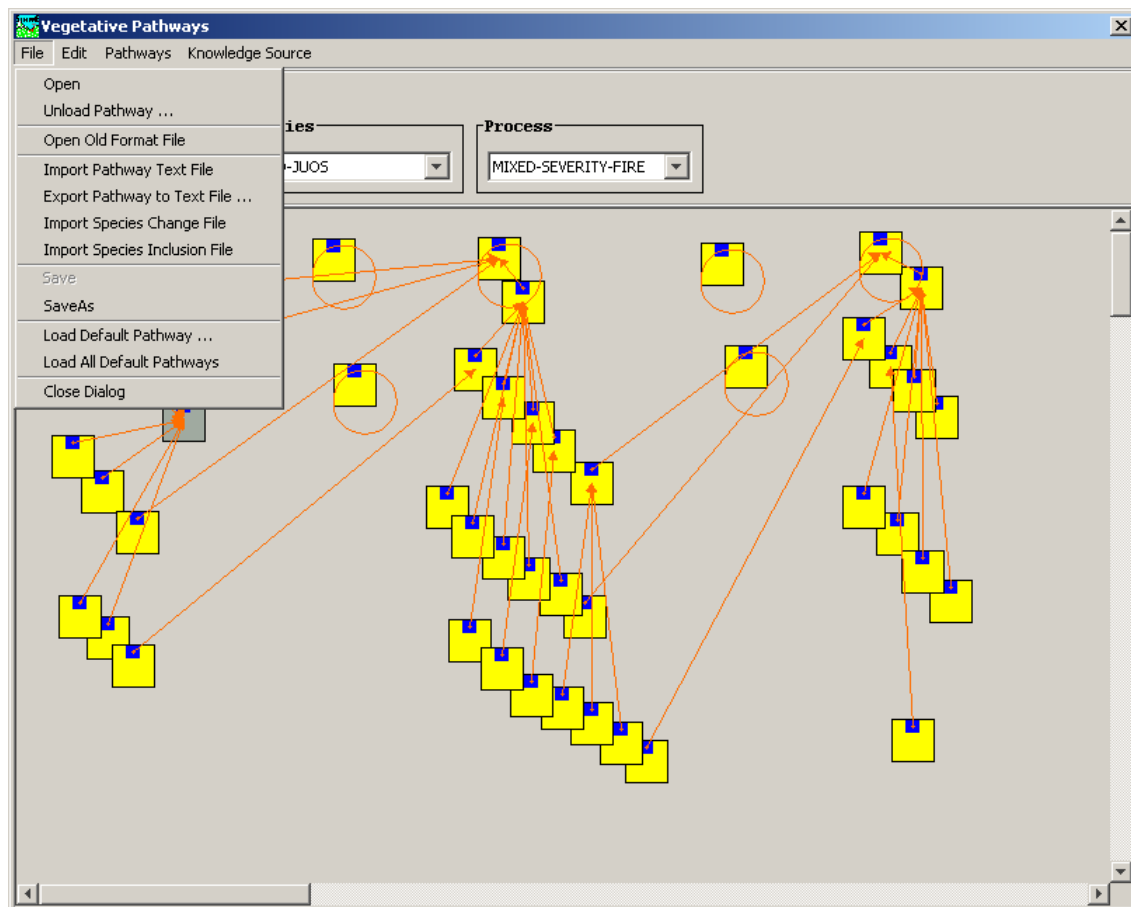


Figure 72 Pulldown menu from “file” that gives the option of importing and exporting pathways as text files.

Adding a new species pathway also requires that the new species be added to the system through **System Knowledge > Vegetative Process > Species Attribute Editor** (Figure 73).

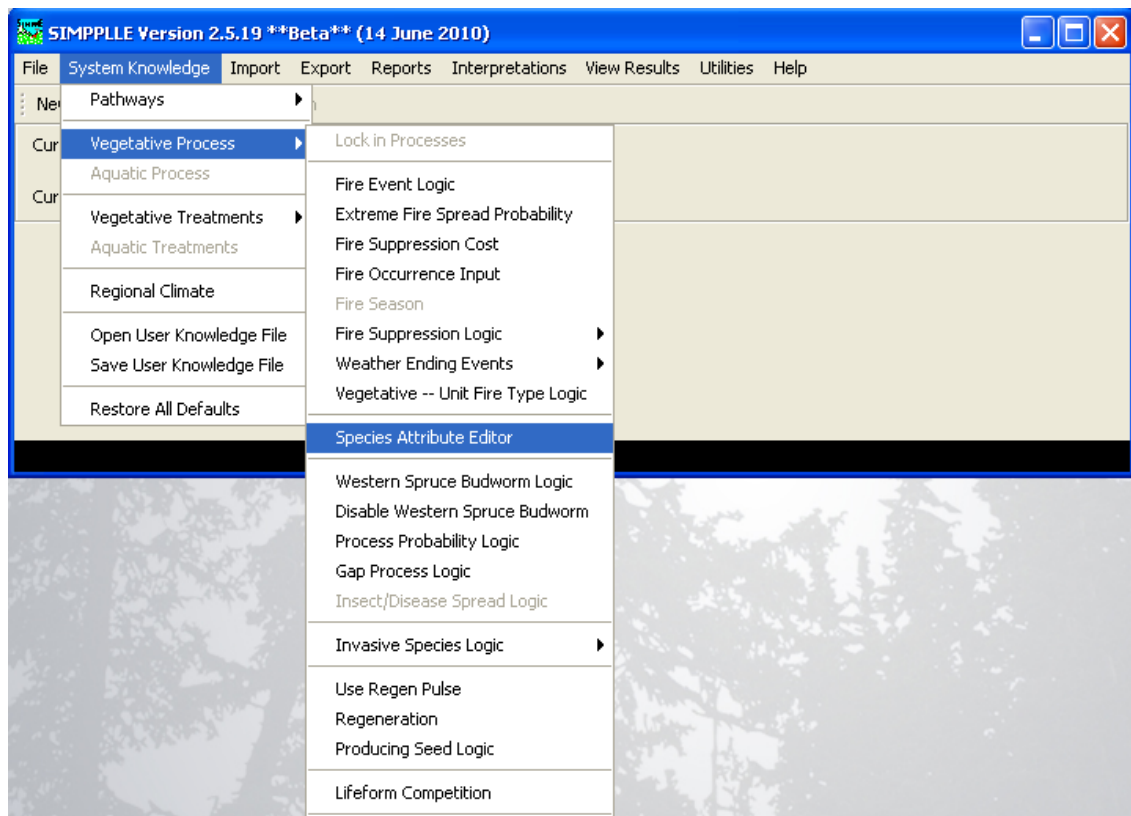


Figure 73 Menu choices to access the Species Attribute Editor.

10.2.3 Editing Pathway Diagrams

The default pathway relationships are developed for each zone. It is expected that the relationships within the pathways will not be appropriate for some parts of the zone. For example, the tolerant tree species that come in with natural regeneration for a specific habitat type group will probably not be the same on the Flathead Forest as the Nez Perce Forest, both in the Westside Zone for Region One. The impact that a process such as root disease has on the next state for plant communities can be expected to be different on the Lolo Forest than on the Idaho Panhandle Forests. Editing features are available to capture additional work to improve the knowledge in the states such as fine scale modeling with FVS on sample plant communities, the incorporation of new research studies, and expert opinion gained from workshops of

silviculturists and ecologists. The editing features allow for changing the time spent in decades in a size-class/structure by adding or deleting states. The next state as a result of a process can be changed to a different species, size-class/structure, or density class. An additional process can be added to a state as long as it is one that currently exists within the system. Changes can be saved to new files that the user can reload for future simulations.

There are two ways to edit pathway files: within the SIMPPLLE environment and outside of it. To edit within the SIMPPLLE environment:

Place the cursor on a state and click the right mouse button (Figure 74). Select **Edit**.

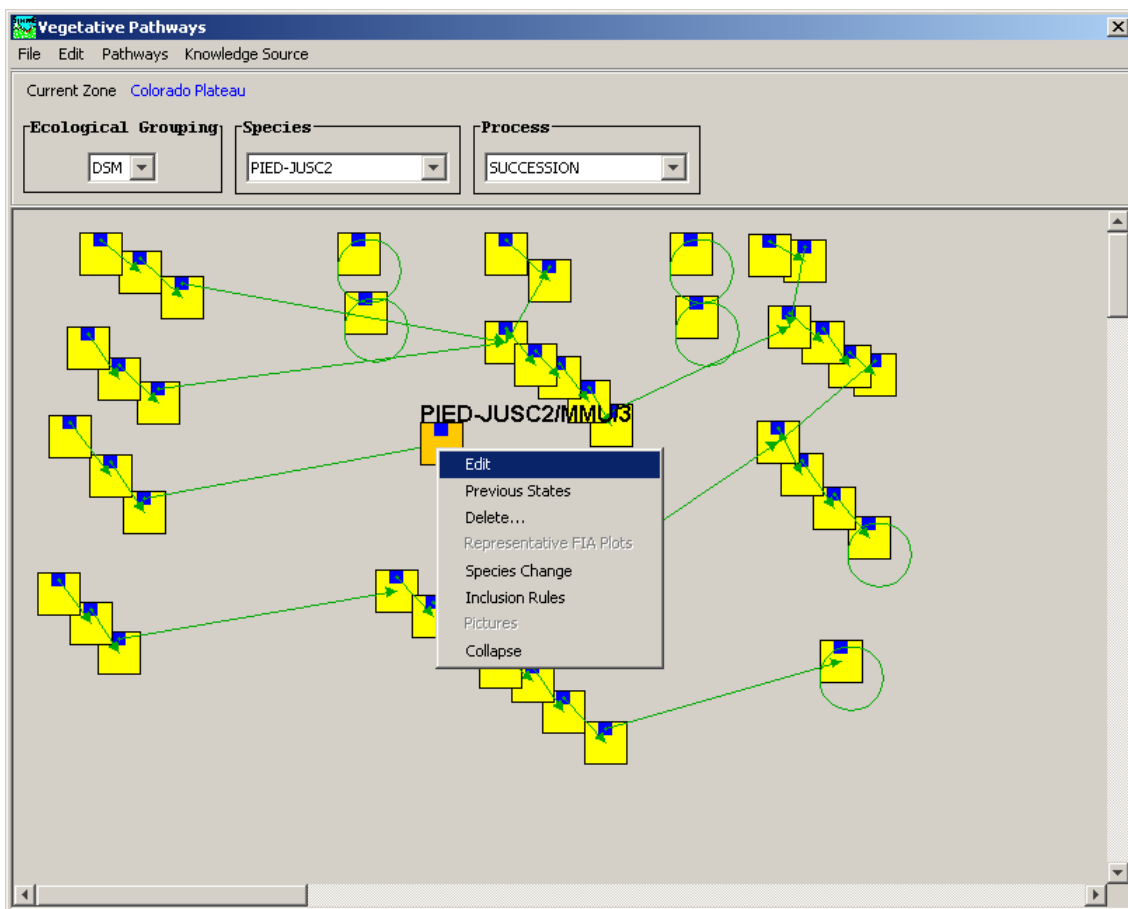


Figure 74 The choices for editing a state that are accessed by clicking with the right mouse button with the cursor on the state.

This will open the **Pathway Editor** screen, shown in Figure 75.

The screenshot shows a window titled "Pathway Editor". It contains several sections:

- Ecological Grouping**: DSM
- Vegetative Type**: PIED-JUSC2/MMU/3
- Species**: PIED-JUSC2
- Size Class**: MMU
- Density**: 3
- Age**: 1

Below these fields is a section titled "Next Vegetative State" which includes:

- Process**: (empty field)
- Vegetative Type**: (empty field)
- Show List**: button
- Save Edits**: button

At the bottom, there is a list of processes:

- DROUGHT ---> PIED-JUSC2/MMU/2
- SUCCESION ---> PIED-JUSC2/MMU2/3
- MIXED-SEVERITY-FIRE ---> PIED-JUSC2/MMU2/1
- PIED-BB ---> PIED-JUSC2/MMU/2
- STAND-REPLACING-FIRE ---> POSE-PASM/UNIFORM/1
- LIGHT-SEVERITY-FIRE ---> PIED-JUSC2/MMU2/2

On the right side, there is a section titled "Processes" with two buttons: "Add" and "Delete Selected".

Figure 75 The editor screen that is accessed by choosing the edit option when the right mouse button is clicked on the state in a diagram.

Within the **Pathway Editor**, select the process/next state combination that requires editing. In Figure 76, the **Mixed-Severity-Fire** process is selected for editing.

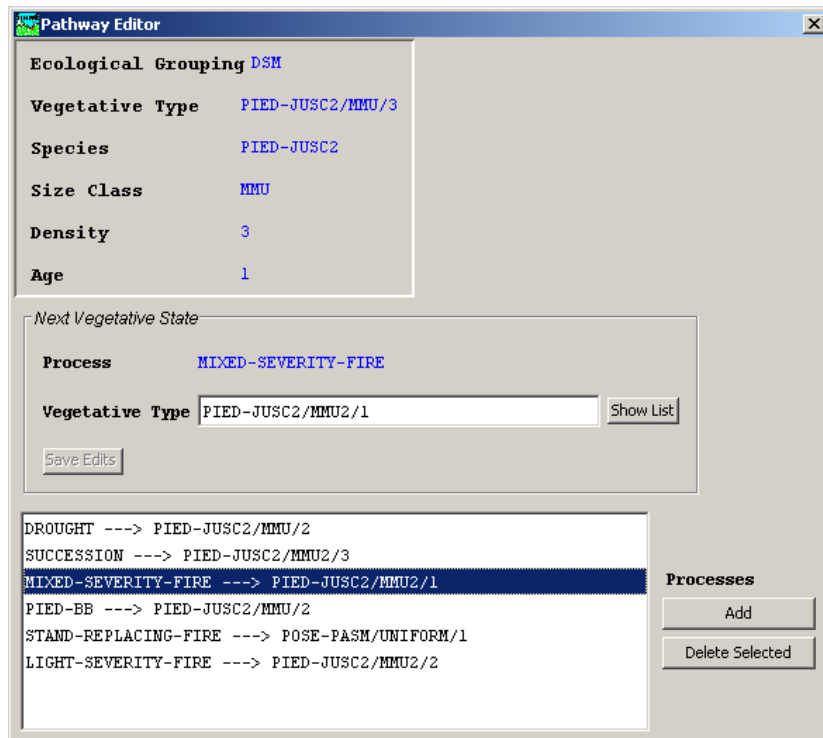


Figure 76 Editor screen for a specific Vegetative Type state. The Process of Mixed-Severity-Fire is selected and the next vegetative type is ready to be edited.

The next vegetative state can be typed in the box, or click **Show List** to see what other valid states can be selected.

The **Add** option below Processes opens additional process choices to add to this state. **Delete Selected** removes the change to a next-state.

Save Edits must be selected after making changes.

If the desired next-state already exists in the pathway, the change can be made within the diagram by placing the cursor on the line where it comes from a state (the blue area) and holding down with left mouse button, dragging it to the new one we want to go to. Moving the line will make the corresponding changes in the file.

The initial right mouse click on the state provides other choices besides **Edit**. We could delete the entire state at this time. However, deleting a state cannot be done if there are other states with processes that lead to this state. An error message will indicate there are **Previous States**. The choice of **Previous States** can be used to identify states that have to be edited prior to deleting the selected state.

After editing all previous states, the desired state can be deleted.

Species Change and **Inclusion Rule** are both available for grassland geographic areas. These are discussed under “Viewing and Editing Pathways that are Single States.”

Collapse will collapse the individual decade states into just one state for each combination of species, size-class/structure, and density.

If one needs to add a new state, but not an entirely new species, click **Pathways** at the top of the **Vegetative Pathways** screen, then select **New State**. This opens up a dialog box to allow the user to add a new state.

10.2.4 Examples of Editing—Things to Look For

Editing can be started by viewing the diagrams. Errors in logic are often spotted by turning on arrows for different processes. Figure 77 contains a number of errors. The third decade of the pole, density 3 does not seem to go anywhere. If you edit this state (this is in the default pathway file for the Westside) you will see that the next state after succession returns to the previous state. There are also two circular paths where the next state is the same, but it is easy to see the next state should continue within an age series. Another important point to notice with this species is that there are no multi-story states, only single and two-story. In workshops held to develop these pathways, the consensus was that if the states are called larch only, multi-story stands will never appear. If multi-story stands develop, another species will need to be added to the larch.

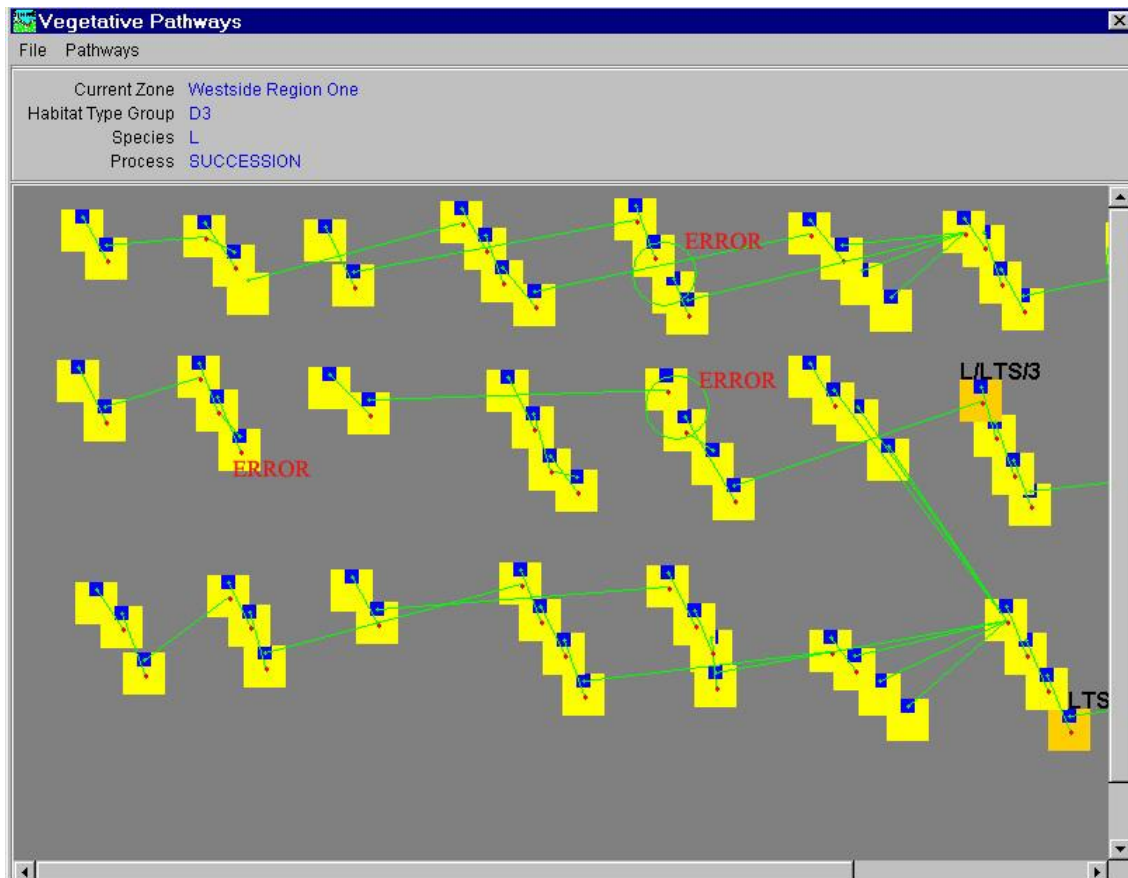


Figure 77 Pathway display showing errors in three different locations. One state does not have a next-state. Two states cycle when they should be going to another state.

The red ERROR in Figure 77 has been added by editing the image. The system does not automatically recognize these types of errors.

Figure 78 displays severe mountain pine beetle in lodgepole pine. The arrows display that the occurrence in most states completely kills the lodgepole pine with the resulting state being mesic shrubs. However, some of the older multi-story states do have their arrows going to a low density seedling/sapling state. One of the states in density 4 class is considered to have had a significant amount of Douglas-fir regenerating and with the mortality of lodgepole pine, it goes to a different species. The smaller size-classes do not have any arrows because they are too small to have a risk for the disturbance process.

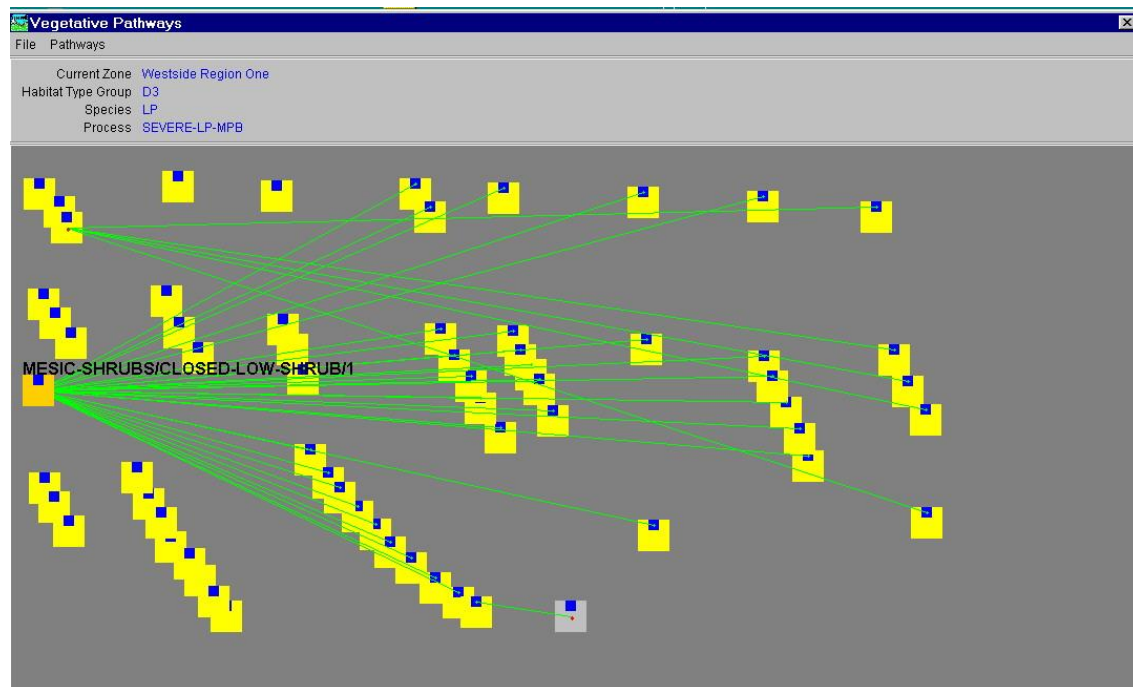


Figure 78 Pathway display shows variability in the next-states resulting from severe lodgepole pine mountain pine beetle.

Examining the summary report and the changes in acres of species or size-class/structure over time can provide some clues that some relationships may not be appropriate. If these do not appear logical (or even if they do) look at individual units to see how they are responding to disturbance processes.

The **Vegetative Condition Summary**, shown in Figure 79 (selected from **View Results**), shows a rapid loss in larch in the first few decades of the simulation (red lines added for emphasis will not show up in simulation).

Summary Report

ACRES OF SPECIES (rounded)

SPECIES	time			
	0	1	2	3
DF-GF	0	5	5	5
ES-AF	359	378	374	453
L-PP	0	0	0	5
AF	383	403	408	428
L-DF	1,728	1,579	1,718	1,683
EARLY-SERAL	129	0	5	0
DF	5,000	3,770	3,685	3,730
L-GF	0	0	15	25
GF	0	10	10	10
L-DF-WP	0	120	0	0
DF-LP-ES	139	10	10	10
L	4,133	3,297	428	483
DF-LP	224	55	30	40
C	40	40	40	40
L-LP	443	244	105	0
LP	2,450	2,385	2,251	2,201

Figure 79 Summary display of species showing a rapid loss of acres in larch (L).

Figure 80 represents a state that changed from a larch type to a larch mixture in two decades as a result of succession.

Vegetative Unit Analysis

← Prev 23 Next →

Current State **L-DF-GF/MMU2/3**

Habitat Type Group **D3**

Associated Landtype

Acres **5**

Adjacent Units

- 10 (Next to, No wind)
- 37 (Next to, No wind)
- 36 (Next to, No wind)
- 35 (Next to, No wind)
- 24 (Next to, Downwind)
- 12 (Next to, No wind)
- 22 (Above, No wind)

History Treatment History

Time	Resulting State	Process	Probability
0	L/SS/2	SUCCESSION	N/A
1	L/SS2/2	SUCCESSION	99
2	L-DF-GF/PTS/2	SUCCESSION	99
3	L-DF-GF/PTS2/2	SUCCESSION	99
4	L-DF-GF/MMU/3	SUCCESSION	99
5	L-DF-GF/MMU2/3	SUCCESSION	99

Close Help

Figure 80 History display showing a change in species in the second time step from L to L-DF-GF.

Elements that need to be changed on one ecological group will probably need to be changed on a number of habitat types. The above problem with larch has to be corrected across all the pathways where larch exists. There is no easy way to make such a change without going into each pathway file (one for each ecological/habitat type group) and making the change in the **Next State** after **Succession**.

The **Vegetative Unit Analysis** screen in Figure 81 shows the impact of severe-lp-mpb that spread into a plant community. It completely killed all lodgepole above sapling size in the large, multi-story, density 3 community. Only the seeding/sapling size lodgepole at a lower density class was left. Whether this is an appropriate impact of severe mountain pine beetle and whether it should kill all of the larger trees needs to be decided by the user. This impact or change of states, due to **SEVERE-LP-MPB** is separate from the probability that the disturbance would

occur.

The screenshot shows a software window titled "Vegetative Unit Analysis". At the top, there are navigation buttons "Prev" and "Next" flanking a text input field containing the number "680". Below this, the current state is displayed as "LP/MTS/3", the habitat type group as "D3", and the associated landtype as "5". A list of adjacent units is shown in a scrollable box, including units 681, 636, 679, 635, 634, 728, and 727 with their respective wind directions. At the bottom, there is a "History" tab which is active, displaying a table of state transitions over time. The table has columns for "Time", "Resulting State", "Process", and "Probability". The history shows a sequence of states from LP/LMU/3 to LP/MTS/3, with a "SEVERE-LP-MPB" process at time 1. "Close" and "Help" buttons are at the bottom right.

Current State **LP/MTS/3**

Habitat Type Group **D3**

Associated Landtype

Acres **5**

Adjacent Units

- 681 (Below, Downwind)
- 636 (Below, No wind)
- 679 (Above, No wind)
- 635 (Below, No wind)
- 634 (Next to, No wind)
- 728 (Next to, No wind)
- 727 (Above, No wind)

Time	Resulting State	Process	Probability
0	LP/LMU/3	SUCCESSION	N/A
1	LP/SS3/2	SEVERE-LP-MPB	S
2	LP/PTS/3	SUCCESSION	100
3	LP/PTS2/3	SUCCESSION	100
4	LP/PTS3/3	SUCCESSION	100
5	LP/MTS/3	SUCCESSION	100

Figure 81 Individual unit history display showing the impact of severe-lp-mpb that spread into this existing-vegetation-unit.

The following example (Figure 82) is a lodgepole pine pole-size plant community that had a stand replacing fire in time step one. The regeneration logic identifies pole-size lodgepole as having serotinous seed. Thus, the stand regenerates to lodgepole. Note that for this habitat type at this density it takes three decades to move through the seedling/sapling size class. It is up to the user to determine if this an appropriate time or if the pathway should be edited.

The screenshot shows the 'Vegetative Unit Analysis' window. At the top, there are navigation buttons 'Prev' and 'Next' with a central input field containing '696'. Below this, the 'Current State' is 'LP/POLE2/3', 'Habitat Type Group' is 'D3', 'Associated Landtype' is blank, and 'Acres' is '5'. A list of 'Adjacent Units' is shown in a scrollable box, including units 744, 743, 742, 697, 652, 695, and 651 with their respective descriptions. At the bottom, a 'History' tab is active, displaying a table of unit transitions over time.

Time	Resulting State	Process	Probability
0	LP/POLE/3	SUCCESSION	N/A
1	LP/SS/3	STAND-REPLACING-FIRE	SE
2	LP/SS2/3	SUCCESSION	99
3	LP/SS3/3	SUCCESSION	99
4	LP/POLE/3	SUCCESSION	99
5	LP/POLE2/3	SUCCESSION	99

Figure 82 An individual unit history display showing the time to move through the seedling and sapling size following a stand replacing fire.

Editing pathways is not an easy task. It can be very difficult to maintain consistency in relationships. We have to remember that states are abstractions. We often show abrupt changes from single story, to two-story or multi-story, or from single species, to two species. In most cases your experience tells you that most single-story states will have some understory in it. Within the pathways, it is often a judgment call as to the number of decades necessary for a state to develop enough understory that we change our abstraction label to two-story. The same is true for species changes.

10.2.5 Editing Pathway Text Files

Pathway files can be edited in a text file format. Within the Vegetative Pathways screen (**System Knowledge > Pathways > Vegetative Pathways**) select **File > Export Pathway to Text File...** to create text files. A basic text editor such as Word or Notepad can be used to make changes, and import the new file back into SIMPPLLE using **File > Import Pathway Text File**. The exported text files are created for an ecological stratification. All species within a stratification are included in one text file.

Once the file is loaded back into SIMPPLLE it must be saved as a **Pathway** file using the **Save As** so it can be loaded in the future by using **Open**.

An example of an exported pathway file is in Figure 83.

```
HABITAT-TYPE-GROUP C2

HABITAT-TYPES 516 517 518 519 520 521 522 524 525 526 529

CLIMAX-SPECIES GF
SERAL-SPECIES DF PP LP L CW MC WP

VEGETATIVE-TYPE L-PP-LP/LMU6/4
MIXED-SEVERITY-FIRE L-DF-PP/VERY-LARGE/2 0
LIGHT-SEVERITY-FIRE L-DF-PP/VERY-LARGE/3 0
STAND-REPLACING-FIRE MESIC-SHRUBS/CLOSED-LOW-SHRUB/1 0
LIGHT-LP-MPB L-DF-PP/VERY-LARGE/3 0
SUCCESSION L-DF-PP/VLMU/4 0
SEVERE-LP-MPB L-DF-PP/VERY-LARGE/2 0
DF-BEETLE L-PP/LMU/2 0
PP-MPB L-DF-PP/VERY-LARGE/2 0
XY-COORDINATE L-PP-LP 716,351

VEGETATIVE-TYPE DF-PP-GF/PTS2/3
MIXED-SEVERITY-FIRE DF-PP-GF/POLE/2 0
LIGHT-SEVERITY-FIRE DF-PP-GF/POLE/2 0
STAND-REPLACING-FIRE MESIC-SHRUBS/CLOSED-LOW-SHRUB/1 0
ROOT-DISEASE DF/PMU/2 0
SUCCESSION DF-PP-GF/PTS3/3 0
XY-COORDINATE DF-PP-GF 193,165

VEGETATIVE-TYPE DF-PP-GF/PTS2/2
MIXED-SEVERITY-FIRE PP-DF/POLE/2 0
LIGHT-SEVERITY-FIRE DF-PP-GF/POLE/2 0
STAND-REPLACING-FIRE MESIC-SHRUBS/CLOSED-LOW-SHRUB/1 0
ROOT-DISEASE DF/PMU/2 0
SUCCESSION DF-PP-GF/PTS3/2 0
XY-COORDINATE DF-PP-GF 189,23

VEGETATIVE-TYPE L-GF/LMU4/4
MIXED-SEVERITY-FIRE L-GF/LARGE/2 0
SEVERE-WSBW L-GF/LARGE/2 0
LIGHT-SEVERITY-FIRE L-GF/LMU/3 0
STAND-REPLACING-FIRE MESIC-SHRUBS/CLOSED-LOW-SHRUB/1 0
ROOT-DISEASE L-GF/MMU/2 0
LIGHT-WSBW L-GF/LMU6/4 0
SUCCESSION L-GF/LMU6/4 0
XY-COORDINATE EARLY-SERAL 926,416
XY-COORDINATE LATE-SERAL 909,431
XY-COORDINATE L-GF 651,391
```

Figure 83 Text format of an exported pathway file.

10.2.6 Viewing and Editing Pathways That are Single States

Pathways represented by single states were developed for use in the grassland geographic areas. In version 2.5 they are available for use in any geographic area in combination with the multiple state pathways representation.

Single-state pathways represent a species aggregate in which certain species are within defined percentages. The size class and density attributes are not used and are coded **NA**. Figure 84 represents a single-state pathway. The screen provides access to the detailed information on the species aggregate.

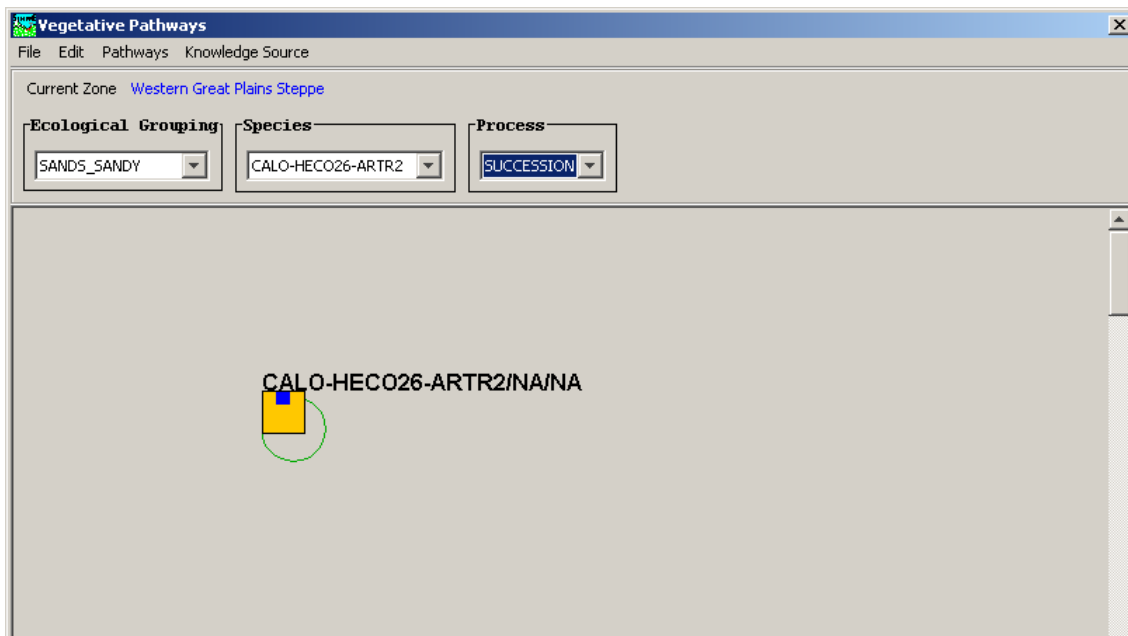
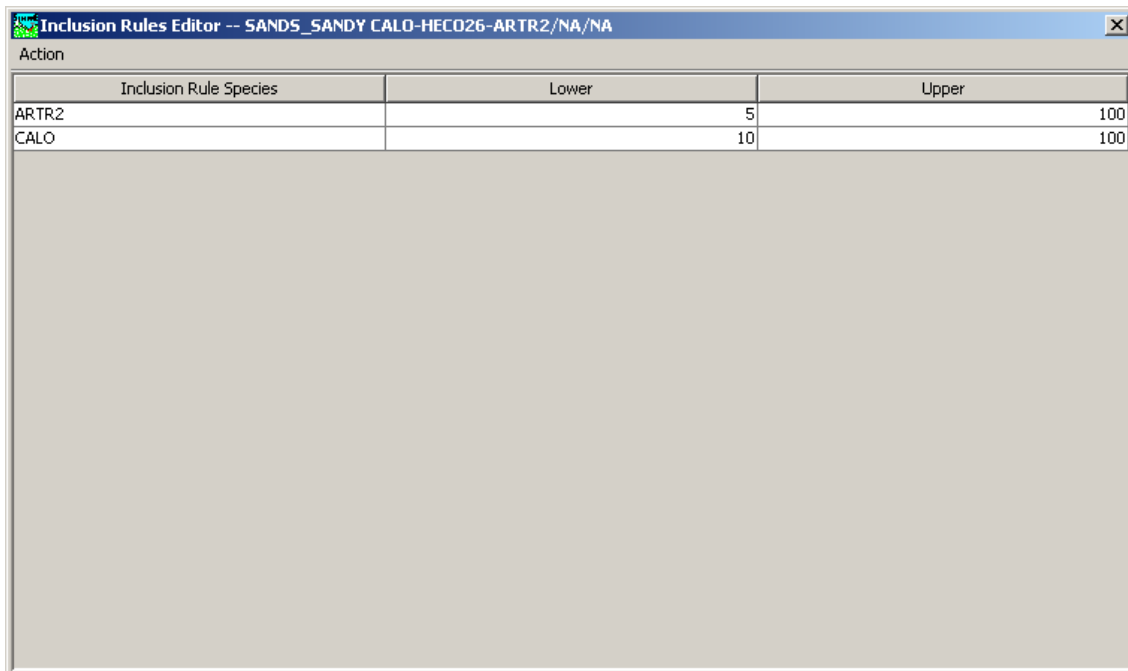


Figure 84 The pathway for the species aggregate of CALO-HECO26-ARTR2.

The only option within the **Process** drop-down menu is **SUCCESSION**. By placing the cursor on the state and clicking with the right button, access is provided to the information in the pathway that includes **Species Change** and **Inclusion Rules**.

Inclusion Rules identify the species and the percents they have to be within for a plant community to be identified as this state. Figure 85 shows the inclusion rule format. The percentages can be edited within the screen. To add an entry for a new species that already exists in the system, click on **Action** within the **Inclusion Rules Editor**. The new entry allows a

new species to be added. This species must also be entered through the **Species Attributes Editor** first, as in the other pathway format.

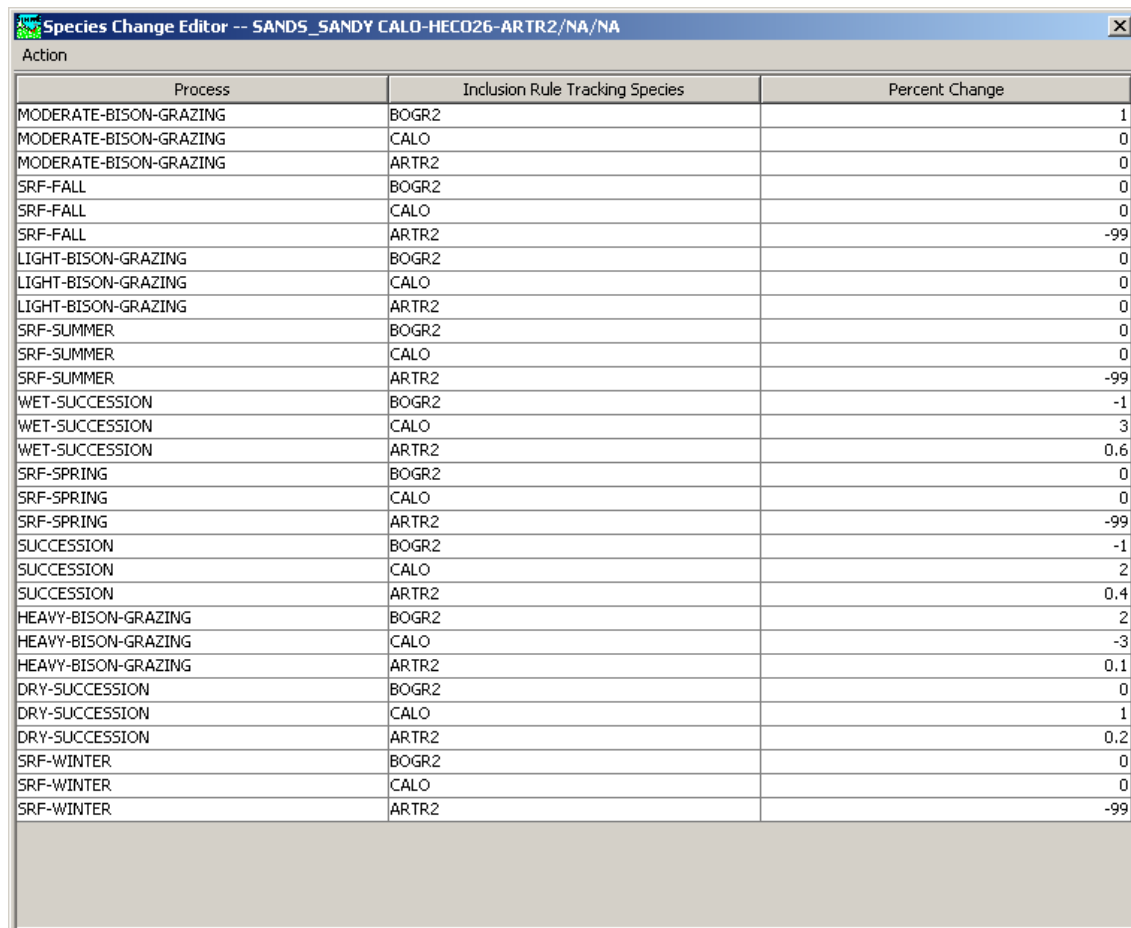


The screenshot shows a software window titled "Inclusion Rules Editor -- SANDS_SANDY CALO-HEC026-ARTR2/NA/NA". Below the title bar is a tab labeled "Action". The main content area contains a table with three columns: "Inclusion Rule Species", "Lower", and "Upper". There are two data rows: one for "ARTR2" with values 5 and 100, and one for "CALO" with values 10 and 100. The bottom half of the window is a large, empty gray area.

Inclusion Rule Species	Lower	Upper
ARTR2	5	100
CALO	10	100

Figure 85 Inclusion rule for a specific state identifying what species at what percents are required for a plant community to be identified as this state.

With this pathway format, the information is not a change to another state, but the rate of change for each individual species. There can be more species identified than comprise the aggregate name. Figure 86 displays the rate of change for each species for each process that is applicable. As a simulation is made and the species percents change for each plant community with each time step, the system checks the percents against the inclusion rules. When a plant community's species percent change puts it outside the initial inclusion rule, a new rule is found for the current percents, and a new state name is assigned. The rate of change in this format is constant across all the years in a simulation. The values can be less than whole percents. Future versions may provide more complexity to the change by making it possible to assign functions.



Species Change Editor -- SANDS_SANDY CALO-HEC026-ARTR2/NA/NA

Action

Process	Inclusion Rule Tracking Species	Percent Change
MODERATE-BISON-GRAZING	BOGR2	1
MODERATE-BISON-GRAZING	CALO	0
MODERATE-BISON-GRAZING	ARTR2	0
SRF-FALL	BOGR2	0
SRF-FALL	CALO	0
SRF-FALL	ARTR2	-99
LIGHT-BISON-GRAZING	BOGR2	0
LIGHT-BISON-GRAZING	CALO	0
LIGHT-BISON-GRAZING	ARTR2	0
SRF-SUMMER	BOGR2	0
SRF-SUMMER	CALO	0
SRF-SUMMER	ARTR2	-99
WET-SUCCESSION	BOGR2	-1
WET-SUCCESSION	CALO	3
WET-SUCCESSION	ARTR2	0.6
SRF-SPRING	BOGR2	0
SRF-SPRING	CALO	0
SRF-SPRING	ARTR2	-99
SUCCESSION	BOGR2	-1
SUCCESSION	CALO	2
SUCCESSION	ARTR2	0.4
HEAVY-BISON-GRAZING	BOGR2	2
HEAVY-BISON-GRAZING	CALO	-3
HEAVY-BISON-GRAZING	ARTR2	0.1
DRY-SUCCESSION	BOGR2	0
DRY-SUCCESSION	CALO	1
DRY-SUCCESSION	ARTR2	0.2
SRF-WINTER	BOGR2	0
SRF-WINTER	CALO	0
SRF-WINTER	ARTR2	-99

Figure 86 The rate of change for each species by each process.

To edit within the **Species Change Editor**, click **Action**. **Percent Change** can be edited directly on the screen.

The files for both the species change and inclusion rule can be built in an Excel spread sheet, saved as a text (*.txt) file, and imported into SIMPPLLE using options under **File** on the **Pathway** main menu screen. The text file for the species changes must be tab delimited (.txt), and the file for the inclusion rule has to be comma delimited (.csv).

Once the files have been loaded into SIMPPLLE, the **Save** by the system adds an extension of “*.sk_pathway.”

Using this pathway format requires that the plant communities in the GIS files have the tracking species fields populated (see previous section on “Vegetation Attributes”). If the species value in the attributes file that came from the GIS files is greater than zero, but there still is no species change information for it within the pathway files, it will be brought into the SIMPPLLE area file, but the species value will not change in simulations. This can easily be seen by looking at the individual unit displays. In this case, the user can edit the pathway file, adding in change values for this new species.

10.3 PATHWAYS—AQUATICS

Pathways for aquatic units were used in an early version for a prototype—Westside Region One geographic zone. A limited discussion is in Appendix A. Aquatic units are used in the grassland geographic areas to represent a water source for grazing animals. At least one pathway file has to exist for this purpose, but no changes from the pathway file are utilized (see Appendix H for grassland zones).

10.4 VEGETATIVE PROCESS

10.4.1 Lock in Process

There are a variety of ways that the user can explore what-if scenarios. Disturbance processes can be locked in, while the system models others as stochastic. By choosing **Stand Development** for type of simulation, the only disturbance processes will be those locked in. The probability screens for each process can be utilized to selectively zero out the occurrence of a process.

Locking in a process is not the same as identifying a process within the input files. Identifying processes in the input files gives a simulation a disturbance history. The simulations can be more realistic by accounting for processes that the user knows are currently active or have recently occurred such as mountain pine beetle or root disease. Processes can also be scheduled to evaluate the impact of possible extreme events or large-scale occurrences of processes such as mountain pine beetles or stand replacing fires.

To lock in a specific disturbance process to a plant community and time step select **System Knowledge > Vegetative Process > Lock in Processes** (Figure 87).

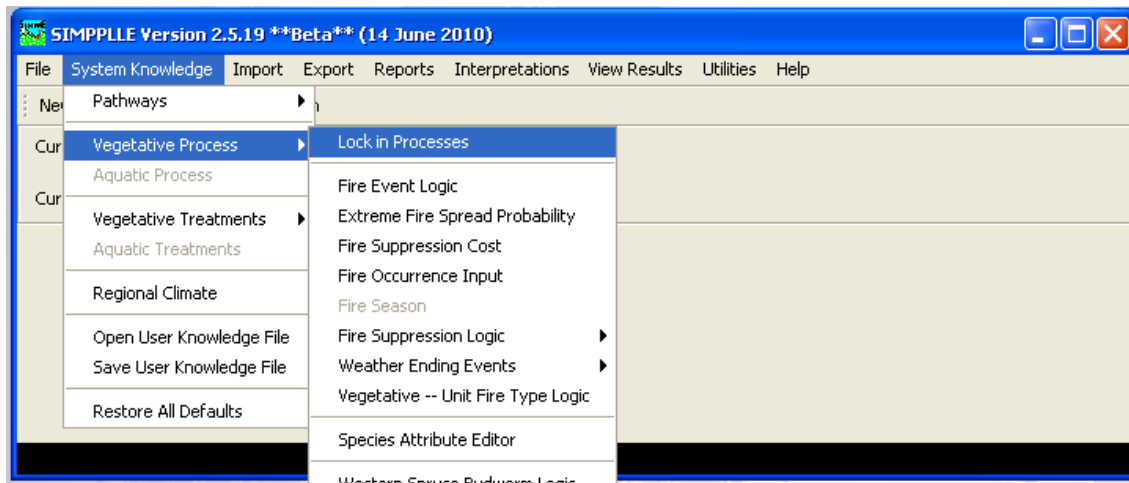


Figure 87 Choices made in SIMPPLE menus to get to the screen needed to lock-in specific disturbance processes.

This will open the **Process Schedule** (Figure 88). The **Process Schedule** allows the user to create combinations of **Time Step**, **Process**, and **Unit Ids**. Each combination represents an entry that is created by choosing (from **File** in the **Process Schedule**) **New** or **Copy Current Process**. **Prev** and **Next** can be used to move through the combinations you have created.



Figure 88 SIMPPLLE screen for scheduling disturbance processes.

To create a new schedule, select **File > New** (Figure 89).

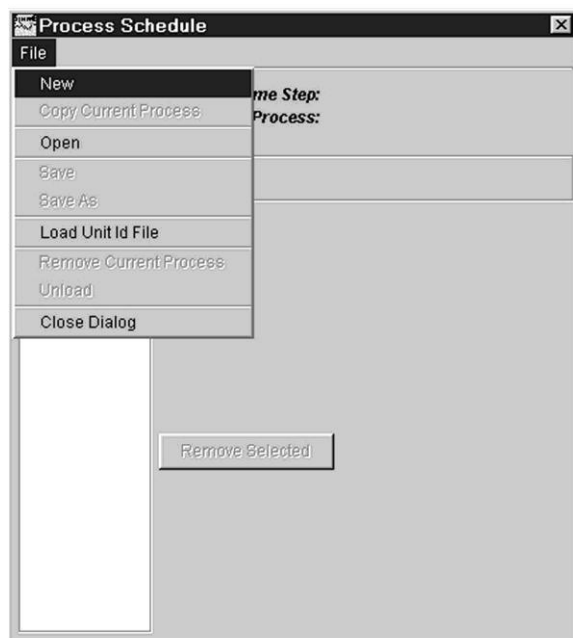


Figure 89 Choices under the "File" pulldown menu on the "Process Schedule" main screen.

This opens a dialog box from which the user can select a new process (Figure 90).



Figure 90 SIMPPLLE screen listing all disturbance process that can be locked-in for a specific zone.

The selected process is added to the **Process Schedule** screen. Notice with the fire processes **FIRE-EVENT** shows up as a process (Figure 91). If this is specified, the system knowledge for the type of fire event is used to determine what type of fire actually occurs (see fire process). A choice of time step must be entered, followed by the **Enter** key. The plant community id values (slink numbers) are then entered in by typing the number and selecting **Add**.



Figure 91 A completed SIMPPLLE screen that locks-in the “fire-event” process for Time Step 1 for four vegetation units.

If the user wants to schedule the same process for additional time steps, select **File > Copy Current Process** (Figure 92).

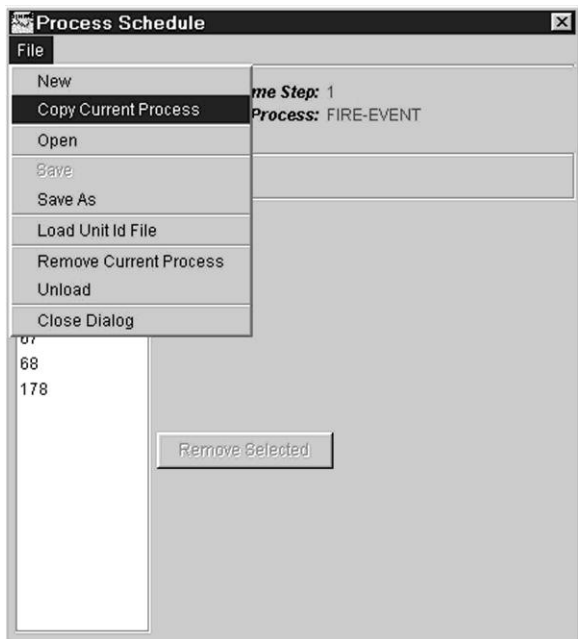


Figure 92 The choice needed to copy a locked-in process to apply to another time step.

File > Copy Current Process changes the screen to have the same process and the same units scheduled; however, the time step is blank and must be entered. If you do not want the same exact units scheduled, use the **Add** or **Remove Selected** buttons for modification. This process may be repeated to create as many combinations of **Time Step**, **Process**, and **Unit Id** lists as desired. **Prev** and **Next** can be used to move between the combinations if additional editing of the unit ids is needed. To add a different process, create a new combination of **Time Step**, **Process**, and **Unit Id** lists.

After you have created all the combinations of **Time Step**, **Process**, and **Unit Id** lists and you are ready to make a simulation with these processes locked in, select **File > Close Dialog**. If at any time in the process of creating a lock-in schedule you want to remove all the combinations you made, select **File > Unload**. To remove a combination currently displayed, select **File > Remove Current Process**.

To save this lock-in schedule so it can be loaded in the future for other SIMPPLLE sessions without having to reenter everything, go to **File > Save As**. This can be done as soon as you have all the combinations made, or you can come back to this later after you have made simulations and decided you like the results. Selecting **Save As** opens a screen to the working directory you have identified. The system will add the extension of “.process” to the name you have provided.

The file that is saved cannot be viewed or edited outside of SIMPPLLE. In future SIMPPLLE simulations, to use the file go to **File > Open**. This opens a screen at the working directory and identifies all “*.process” files that are available.

Another option is **File > Load Unit Id File**. This loads a file that can be created outside of SIMPPLLE and is in a text (*.txt) format (Figure 93).

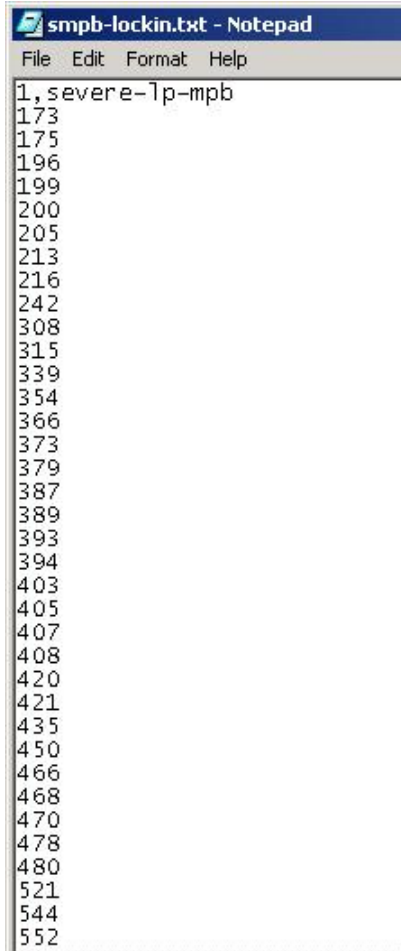


Figure 93 Example of a text formatted file for locking-in a process to specific plant communities.

10.4.2 Fire Process

Many aspects of the fire process have been simplified. However, what we have given up in the detail of modeling fire (using fuel models, FARSIGHT, etc.) we consider is more than offset by the inclusion of the interaction with other disturbance processes and the spatial pattern of the landscape. Figure 94 illustrates how SIMPPLLE models the fire process and identifies where information can be adjusted by the user.

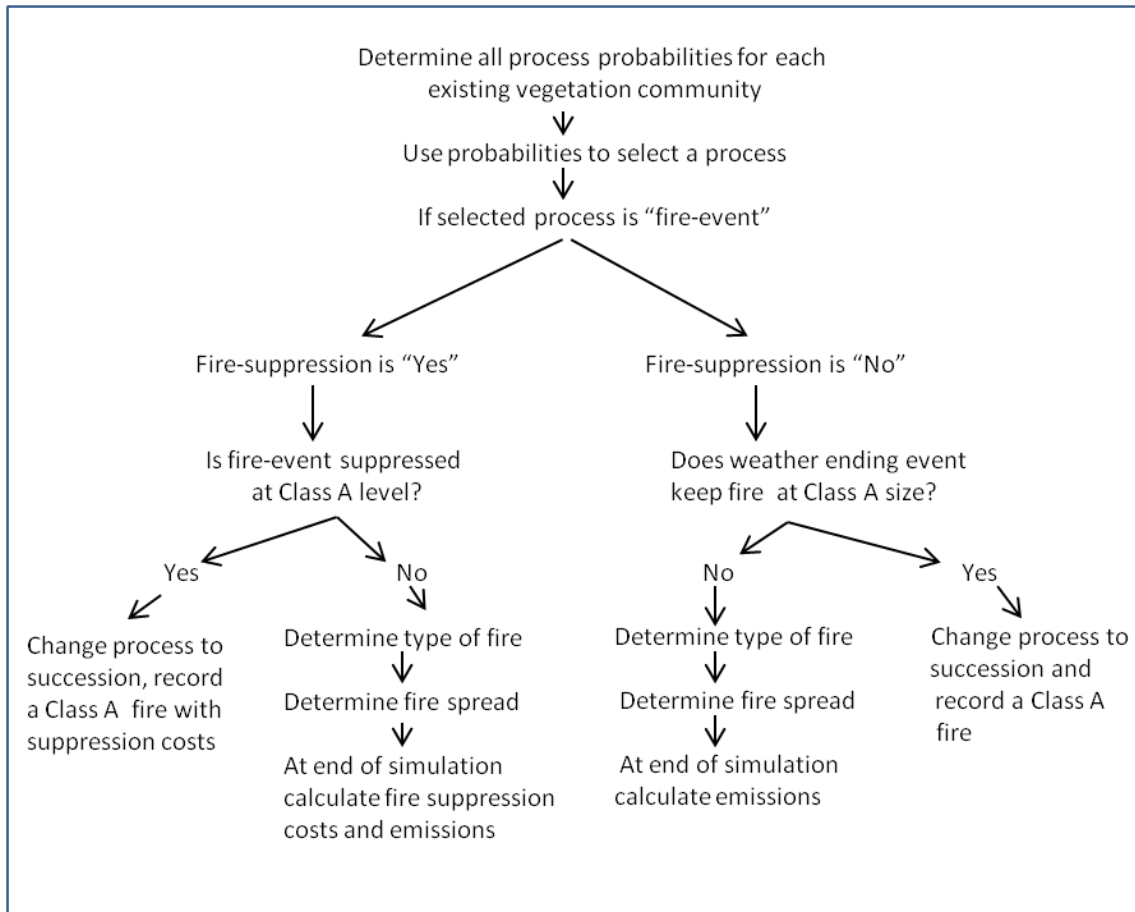


Figure 94 Diagram of the steps used by SIMPPLLE in modeling the fire process.

Fire logic is accessible through the user interface screens under **System Knowledge > Vegetative Process > Fire Event Logic** (Figure 95).

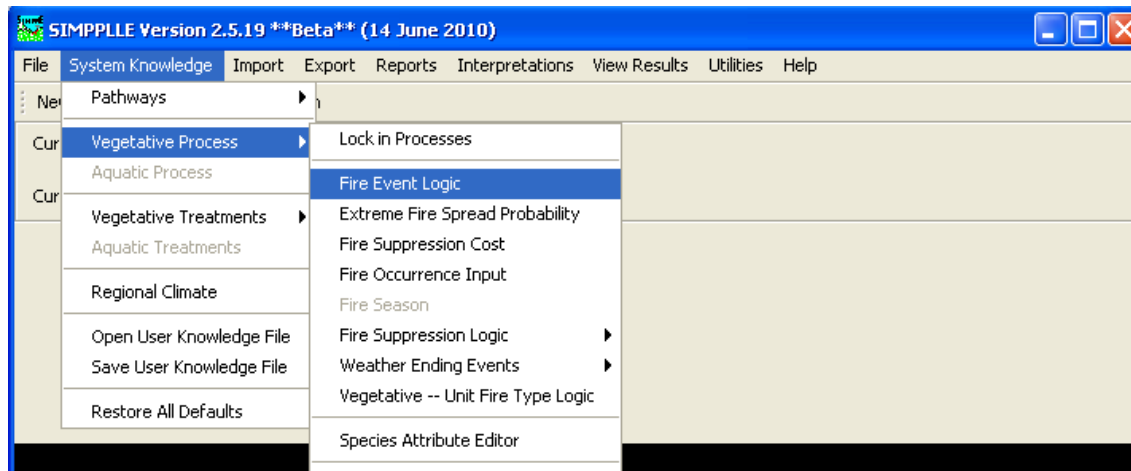


Figure 95 Access to the fire process logic.

10.4.3 Fire Event Logic

Fire event logic is separated into two components: type of fire and fire spread. To access the two components, use the **SPREAD** or **TYPE** tabs within the **Fire Event Logic** screen (Figure 96).

If a fire event is not kept at less than one-quarter acre by either suppression or weather-ending events, the logic utilizes the **TYPE** screen to identify the type of fire in the plant community that has the origin of the event.

The screenshot shows the 'Fire Event Logic' screen with the 'TYPE' tab selected. The table below represents the logic rules displayed in the interface.

Priority	Species	Size Classes	Densities	Processes	Treatments	Wetter	Normal	Drier
0	{(LOW)}	{(NON_FOREST)}	{1, 2, 3, 4}	{}	{}	LSP	SRF	LSP
1	{(MODERATE)}	{(NON_FOREST)}	{1, 2}	{}	{}	LSP	MSF	LSP
2	{(MODERATE)}	{(NON_FOREST)}	{3, 4}	{}	{}	LSP	SRF	LSP
3	{(HIGH)}	{(NON_FOREST)}	{1, 2}	{}	{}	LSP	LSP	LSP
4	{(HIGH)}	{(NON_FOREST)}	{3, 4}	{}	{}	LSP	SRF	LSP
5	{(LOW, MODERATE)}	{(SS)}	{1, 2}	{}	{ECOSYSTEM-MANAGEMENT-BROADCAST-BURN, ...}	LSP	MSF	LSP
6	{(LOW)}	{(SS)}	{1, 2, 3, 4}	{}	{}	LSP	SRF	LSP
7	{(LOW, MODERATE)}	{(POLE)}	{1, 2}	{}	{ECOSYSTEM-MANAGEMENT-BROADCAST-BURN, ...}	LSP	MSF	LSP
8	{(LOW, MODERATE)}	{(POLE)}	{1, 2, 3, 4}	{}	{}	LSP	SRF	LSP
9	{(LOW)}	{(LARGE, MEDIUM)}	{1, 2}	{LIGHT-SEVERITY-FIRE, ...}	{ECOSYSTEM-MANAGEMENT-BROADCAST-BURN, ...}	LSP	SRF	LSP
10	{(LOW)}	{(LARGE, MEDIUM)}	{1, 2, 3, 4}	{}	{}	LSP	MSF	LSP
11	{(MODERATE)}	{(SS)}	{1, 2, 3, 4}	{}	{}	LSP	LSP	LSP
12	{(MODERATE)}	{(LARGE, MEDIUM)}	{1, 2}	{LIGHT-SEVERITY-FIRE, ...}	{ECOSYSTEM-MANAGEMENT-THIN-AND-UNDERBURN, ...}	LSP	LSP	LSP
13	{(MODERATE)}	{(LARGE, MEDIUM)}	{1, 2, 3, 4}	{PP-MPD, ROOT-DISEASE, ...}	{AGRICULTURE, ASPEN-RESTORATION-BURN, ...}	LSP	SRF	LSP
14	{(MODERATE)}	{(LARGE, MEDIUM)}	{1, 2, 3, 4}	{}	{}	LSP	MSF	LSP
15	{(HIGH)}	{(SS)}	{3, 4}	{}	{}	LSP	MSF	LSP
16	{(HIGH)}	{(SS)}	{1, 2}	{}	{}	LSP	LSP	LSP
17	{(HIGH)}	{(POLE)}	{1, 2}	{}	{}	LSP	LSP	LSP
18	{(HIGH)}	{(POLE)}	{3, 4}	{}	{}	LSP	MSF	LSP
19	{(HIGH)}	{(LARGE, MEDIUM)}	{1, 2, 3, 4}	{LIGHT-SEVERITY-FIRE, ...}	{ECOSYSTEM-MANAGEMENT-THIN-AND-UNDERBURN, ...}	LSP	LSP	LSP

Figure 96 Logic for determining the type of fire that results from a fire event in a plant community.

The resistance of species to fire is taken from Fischer and Bradley (1987) for Western Montana, and Smith and Fischer (1997) for Northern Idaho.

As the fire event spreads to adjacent plant communities, the logic in the fire spread screen is used. The user can decide how many of the fields to display. Select **Columns** on the menu bar to include as much of the system knowledge as is appropriate. For example, Figure 97 is a **Fire Event Logic** screen for one of the grassland areas in which the only type of fire is stand replacing fire (SRF).

The screenshot shows the 'Fire Event Logic' window with a menu bar (File, Action, Knowledge Source, Columns) and a toolbar (SPREAD, TYPE). The main area displays a table with the following columns: Priority, Species, Processes, Season, Origin Processes, Position, Average, and Extreme. The table contains 34 rows of logic rules for various plant communities and fire events.

Priority	Species	Processes	Season	Origin Processes	Position	Average	Extreme
0	{(MODERATE)}	[SUCCESSION]	YEAR	[SRF]	[ABOVE]	SRF	SRF
1	{(MODERATE)}	[DRY-SUCCESSION]	YEAR	[SRF]	[ABOVE]	SRF	SRF
2	{(MODERATE)}	[WET-SUCCESSION]	YEAR	[SRF]	[ABOVE]	NONE	SRF
3	{(MODERATE)}	[STAND-REPLACING-FIRE]	SPRING	[SRF]	[ABOVE]	SRF	SRF
4	{(MODERATE)}	[STAND-REPLACING-FIRE]	SUMMER	[SRF]	[ABOVE]	SRF	SRF
5	{(MODERATE)}	[STAND-REPLACING-FIRE]	FALL	[SRF]	[ABOVE]	NONE	SRF
6	{(MODERATE)}	[STAND-REPLACING-FIRE]	WINTER	[SRF]	[ABOVE]	NONE	SRF
7	{(MODERATE)}	[LIGHT-BISON-GRAZING]	YEAR	[SRF]	[ABOVE]	SRF	SRF
8	{(MODERATE)}	[MODERATE-BISON-GRAZING]	YEAR	[SRF]	[ABOVE]	SRF	SRF
9	{(MODERATE)}	[HEAVY-BISON-GRAZING]	YEAR	[SRF]	[ABOVE]	SRF	NONE
10	{(MODERATE)}	[PRAIRIE-DOG-ACTIVE]	YEAR	[SRF]	[ABOVE]	NONE	NONE
11	{(HIGH)}	[SUCCESSION]	YEAR	[SRF]	[ABOVE]	SRF	SRF
12	{(HIGH)}	[DRY-SUCCESSION]	YEAR	[SRF]	[ABOVE]	SRF	SRF
13	{(HIGH)}	[WET-SUCCESSION]	YEAR	[SRF]	[ABOVE]	NONE	NONE
14	{(HIGH)}	[STAND-REPLACING-FIRE]	SPRING	[SRF]	[ABOVE]	SRF	SRF
15	{(HIGH)}	[STAND-REPLACING-FIRE]	SUMMER	[SRF]	[ABOVE]	SRF	SRF
16	{(HIGH)}	[STAND-REPLACING-FIRE]	FALL	[SRF]	[ABOVE]	NONE	SRF
17	{(HIGH)}	[STAND-REPLACING-FIRE]	WINTER	[SRF]	[ABOVE]	NONE	SRF
18	{(HIGH)}	[LIGHT-BISON-GRAZING]	YEAR	[SRF]	[ABOVE]	SRF	NONE
19	{(HIGH)}	[MODERATE-BISON-GRAZING]	YEAR	[SRF]	[ABOVE]	SRF	NONE
20	{(HIGH)}	[HEAVY-BISON-GRAZING]	YEAR	[SRF]	[ABOVE]	NONE	NONE
21	{(HIGH)}	[PRAIRIE-DOG-ACTIVE]	YEAR	[SRF]	[ABOVE]	NONE	NONE
22	{(MODERATE)}	[SUCCESSION]	YEAR	[SRF]	[BELOW,	SRF	SRF
23	{(MODERATE)}	[DRY-SUCCESSION]	YEAR	[SRF]	[BELOW,	SRF	SRF
24	{(MODERATE)}	[WET-SUCCESSION]	YEAR	[SRF]	[BELOW,	NONE	SRF
25	{(MODERATE)}	[STAND-REPLACING-FIRE]	SPRING	[SRF]	[BELOW,	SRF	SRF
26	{(MODERATE)}	[STAND-REPLACING-FIRE]	SUMMER	[SRF]	[BELOW,	SRF	SRF
27	{(MODERATE)}	[STAND-REPLACING-FIRE]	FALL	[SRF]	[BELOW,	NONE	SRF
28	{(MODERATE)}	[STAND-REPLACING-FIRE]	WINTER	[SRF]	[BELOW,	NONE	SRF
29	{(MODERATE)}	[LIGHT-BISON-GRAZING]	YEAR	[SRF]	[BELOW,	SRF	SRF
30	{(MODERATE)}	[MODERATE-BISON-GRAZING]	YEAR	[SRF]	[BELOW,	SRF	SRF
31	{(MODERATE)}	[HEAVY-BISON-GRAZING]	YEAR	[SRF]	[BELOW,	SRF	NONE
32	{(MODERATE)}	[PRAIRIE-DOG-ACTIVE]	YEAR	[SRF]	[BELOW,	NONE	NONE
33	{(HIGH)}	[SUCCESSION]	YEAR	[SRF]	[BELOW,	SRF	SRF

Figure 97 Logic screen for fire spread for geographic zone that has only grasslands with stand replacing fire events.

Figure 98 displays a greater number of logic combinations for a more complex situation.

Fire Event Logic										
File Action Knowledge Source Columns										
SPREAD type										
Priority	Species	Size Classes	Densities	Processes	Treatments	Origin Processes	Position	Average	Extreme	
67	{[HIGH]}	{[LARGE, MEDIUM,	{3, 4}	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
68	{[HIGH]}	{[LARGE, MEDIUM,	{3, 4}	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
69	{[HIGH]}	{[LARGE, MEDIUM,	{3, 4}	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	LSF	
70	{[LOW]}	{[LNU, LTS, NNU, MTS, PMU,	{1, 2}	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
71	{[LOW]}	{[LNU, LTS, NNU, MTS, PMU,	{1, 2}	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
72	{[LOW]}	{[LNU, LTS, NNU, MTS, PMU,	{1, 2}	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF	
73	{[LOW]}	{[LNU, LTS, NNU, MTS, PMU,	{3, 4}	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
74	{[LOW]}	{[LNU, LTS, NNU, MTS, PMU,	{3, 4}	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	MSF	SRF	
75	{[LOW]}	{[LNU, LTS, NNU, MTS, PMU,	{3, 4}	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF	
76	{[MODERATE]}	{[LNU, LTS, NNU, MTS, PMU,	{1, 2}	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
77	{[MODERATE]}	{[LNU, LTS, NNU, MTS, PMU,	{1, 2}	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
78	{[MODERATE]}	{[LNU, LTS, NNU, MTS, PMU,	{1, 2}	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF	
79	{[MODERATE]}	{[LNU, LTS, NNU, MTS, PMU,	{3, 4}	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
80	{[MODERATE]}	{[LNU, LTS, NNU, MTS, PMU,	{3, 4}	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
81	{[MODERATE]}	{[LNU, LTS, NNU, MTS, PMU,	{3, 4}	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF	
82	{[HIGH]}	{[LNU, LTS, NNU, MTS, PMU,	{1, 2}	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
83	{[HIGH]}	{[LNU, LTS, NNU, MTS, PMU,	{1, 2}	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
84	{[HIGH]}	{[LNU, LTS, NNU, MTS, PMU,	{1, 2}	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF	
85	{[HIGH]}	{[LNU, LTS, NNU, MTS, PMU,	{3, 4}	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
86	{[HIGH]}	{[LNU, LTS, NNU, MTS, PMU,	{3, 4}	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF	
87	{[HIGH]}	{[LNU, LTS, NNU, MTS, PMU,	{3, 4}	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF	
88	{[LOW, MODERATE, HIGH]}	{[CLOSED-HERB,	{1, 2}	[]	[]	[SRF]	[ABOVE]	NONE	SRF	
89	{[LOW, MODERATE, HIGH]}	{[CLOSED-HERB,	{3, 4}	[]	[]	[SRF]	[ABOVE]	SRF	SRF	
90	{[LOW, MODERATE, HIGH]}	{[SS]}	{1, 2}	[]	[]	[SRF]	[ABOVE]	MSF	SRF	
91	{[LOW, MODERATE, HIGH]}	{[POLE]}	{1, 2}	[]	[]	[SRF]	[ABOVE]	LSF	MSF	
92	{[LOW, MODERATE, HIGH]}	{[POLE]}	{1, 2}	[DF-BEETLE,	[]	[SRF]	[ABOVE]	MSF	SRF	
93	{[LOW]}	{[LARGE, MEDIUM,	{1, 2}	[LIGHT-LP-MPB,	[]	[SRF]	[ABOVE]	LSF	MSF	
94	{[LOW]}	{[LARGE, MEDIUM,	{1, 2}	[DF-BEETLE,	[]	[SRF]	[ABOVE]	MSF	SRF	
95	{[LOW]}	{[LARGE, MEDIUM,	{1, 2}	[LIGHT-SEVERITY-FIRE,	[]	[SRF]	[ABOVE]	LSF	MSF	
96	{[LOW, MODERATE, HIGH]}	{[SS]}	{3, 4}	[]	[]	[SRF]	[ABOVE]	MSF	SRF	
97	{[LOW]}	{[POLE]}	{3, 4}	[LIGHT-LP-MPB,	[]	[SRF]	[ABOVE]	MSF	SRF	
98	{[LOW]}	{[POLE]}	{3, 4}	[DF-BEETLE,	[]	[SRF]	[ABOVE]	SRF	SRF	
99	{[LOW]}	{[POLE]}	{3, 4}	[LIGHT-SEVERITY-FIRE,	[]	[SRF]	[ABOVE]	MSF	SRF	
100	{[LOW]}	{[LARGE, MEDIUM,	{3, 4}	[LIGHT-LP-MPB,	[]	[SRF]	[ABOVE]	MSF	SRF	
101	{[LOW]}	{[LARGE, MEDIUM,	{3, 4}	[DF-BEETLE,	[]	[SRF]	[ABOVE]	SRF	SRF	
102	{[LOW]}	{[LARGE, MEDIUM,	{3, 4}	[LIGHT-SEVERITY-FIRE,	[]	[SRF]	[ABOVE]	MSF	MSF	
103	{[MODERATE]}	{[LARGE, MEDIUM,	{1, 2}	[LIGHT-LP-MPB,	[]	[SRF]	[ABOVE]	LSF	MSF	
104	{[MODERATE]}	{[LARGE, MEDIUM,	{1, 2}	[DF-BEETLE,	[]	[SRF]	[ABOVE]	MSF	SRF	
105	{[MODERATE]}	{[LARGE, MEDIUM,	{1, 2}	[LIGHT-SEVERITY-FIRE,	[]	[SRF]	[ABOVE]	LSF	MSF	
106	{[MODERATE]}	{[POLE]}	{3, 4}	[LIGHT-LP-MPB,	[]	[SRF]	[ABOVE]	MSF	SRF	

Figure 98 Fire spread logic for a geographic zone that has all three intensities of fire: stand replacing (SRF), mixed severity fire (MSF), and light severity fire (LSF).

10.4.4 Extreme Fire Spread Probability

Burning conditions within SIMPPLLE have been simplified to represent two conditions; average conditions as well as extreme conditions that represent wind driven fire events. The occurrence of wind driven fire conditions, such as the passage of a weather front, or the behavior that results from the size of fire event creating its own weather once it exceeds a given size, can be set in the **Extreme Fire Spread Probability** screen (Figure 99) by selecting **System Knowledge > Vegetative Process > Extreme Fire Spread Probability**.

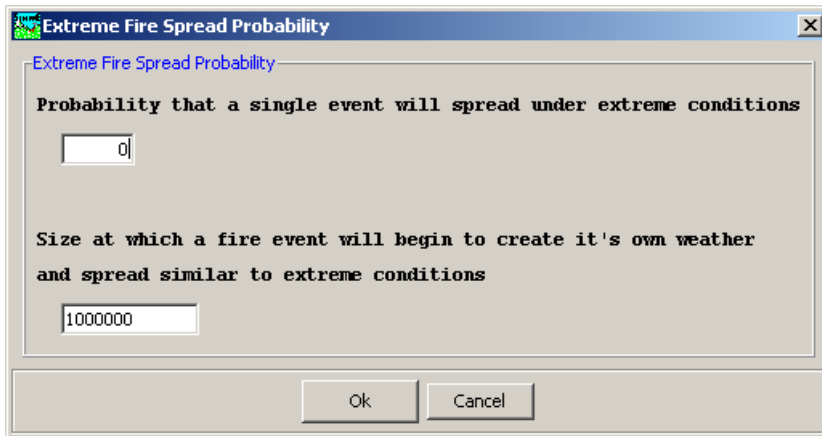


Figure 99 Screen that provides the means to change default values controlling the probability that a fire event will spread under extreme conditions.

Extreme fire spread logic also includes a component to allow for spotting downwind of a fire event. This logic is not accessible at this time.

10.4.5 Fire Suppression Costs

In version 2.5, the input screen is used for both fire occurrence and suppression costs. Select **System Knowledge > Vegetative Process > Fire Suppression Cost**. The distribution of fires size classes are used to provide the basis for suppression costs which usually varies by fire size class. If the demand for utilizing fire suppression costs within SIMPPLLE increases, a separate screen will be created for the interaction of costs with other variables.

10.4.6 Fire Occurrence Input

The probability of a fire event in SIMPPLLE is on an acre basis. This can vary by fire management zone (FMZ) if the landscape is stratified by them (if the vegetation polygons have FMZ as an attribute). To access the **FMZ Editor**, select **System Knowledge > Vegetative Process > Fire Occurrence Input**. If FMZs are not used, the zone must be identified as **All** and a zero placed in the FMZ data field for each polygon in the cover (Figure 100). SIMPPLLE uses the number of fires for a past ten-year period divided by the total acres on which that the number of fires occurred. (These probabilities are on a decade basis. If yearly time steps are used, the system divides the values by ten.) The fires are listed by size class, but past distribution by sizes does not influence the future fire size distribution. The size of any given fire event is influenced by the vegetation pattern and the probability of extreme fire spread behavior. In version 2.5, the input screen is used for both fire occurrence and suppression costs and should look similar to the Personal Computer Historic Analysis (PCHA) reports that are generated by most National Forests and BLM field offices.

Fire Management Zone

← Prev all Next →

Acres in Analysis Area: 11121974

Fire Suppression Response Time (Hours): 0.5

Fire Size	# Fires in 10 Year Period		Suppression \$/Acre
	Lightning	Man-Caused	
0.00 - 0.25	5340	1256	1149
0.26 - 9.99	1975	656	811
10.00 - 99.99	196	84	1653
100.00 - 299.99	62	21	403
300.00 - 999.99	55	12	1272
1000.00 +	55	17	310

Figure 100 The Fmz Editor screen showing both the number of fires for a past 10 year period and the suppression cost per acre. The values can vary by fire management zone.

A sensitivity analysis on the number of fires has been done as part of a Joint Fire Science funded project (Weise et al. 2000, 2003)

10.4.7 Fire Season

In version 2.5, the probability of the season of a fire occurring is only available in the grassland zones where the season of the fire is important in some of the logic. To access the **Fire Season Probabilities** screen (Figure 101), select **System Knowledge > Vegetative Treatments > Fire Season**.

Fire Season Probabilities

Spring: 30

Summer: 50

Fall: 15

Winter: 5

Total: 100

Ok Cancel

Figure 101 Screen that gives user access to changing the probability of the season of a fire event.

10.4.8 Fire Suppression Logic

To access fire suppression logic options, select **System Knowledge > Vegetative Process > Fire Suppression Logic** (Figure 102).

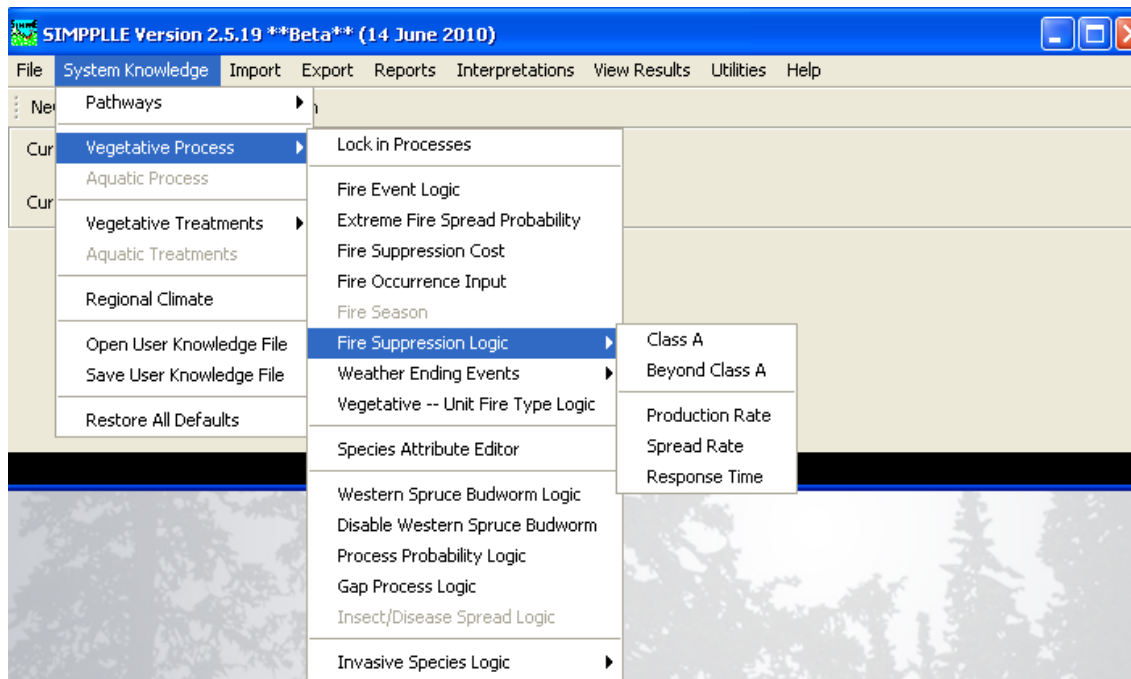


Figure 102 Access to the Fire Suppression Logic through the user interface.

Fire suppression logic varies by the logic used to keep fires at a Class A size and for fires that go beyond the Class A size. The fire suppression logic beyond the Class A size is different if the SIMPPLE area file uses irregular polygons or uniform sized units.

Class A Size Events

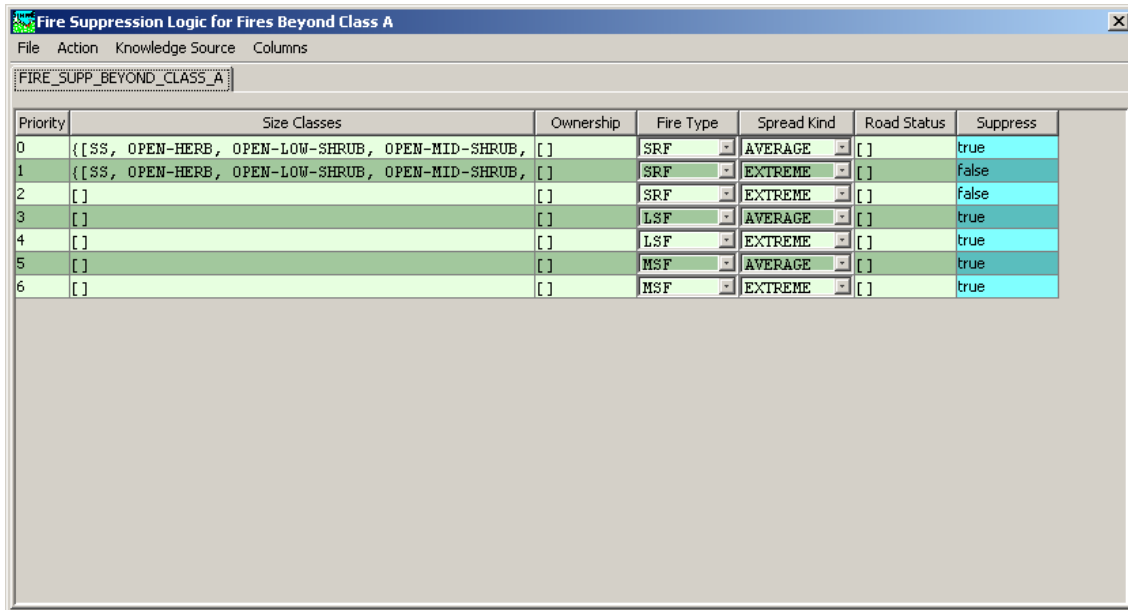
If fire suppression is being used in a simulation, the logic that is used to identify the probability of suppressing a fire at the Class A level is accessible for change. The probability can vary by what the Regional Climate is for a time step: wetter, normal or drier. Regional Climate is normal unless it is specified to be different for a simulation. Under the main menu, select **System Knowledge > Vegetative Process > Fire Suppression Logic > Class A**. This will pull up the **Fire Suppression for Class A Fires Logic** screen (Figure 103). **Columns** are available from the menu bar to utilize as many variables as desired. However, all variables used must be attributes of each plant community in the landscape (see input requirements).

Fire Suppression for Class A Fires Logic									
File Action Knowledge Source Columns									
FIRE_SUPP_CLASS_A									
Priority	Size Classes	Densities	Processes	Treatments	Moisture	Ownership	Road Status	Probability	
0	{(NON_FOREST)}	{1, 2, 3, }	{}	{}	{(WETTER)}	{(NF-WILDERNESS)}	{}	30	
1	{(NON_FOREST)}	{1, 2, 3, }	{}	{}	{(NORMAL)}	{(NF-WILDERNESS)}	{}	10	
2	{(NON_FOREST)}	{1, 2, 3, }	{}	{}	{(DRIER)}	{(NF-WILDERNESS)}	{}	0	
3	{(SINGLE_STORY, MULTIPLE_STORY)}	{1, 2, 3, }	{(MIXED-SEVERITY-FIRE,	{}	{(WETTER)}	{(NF-WILDERNESS)}	{}	80	
4	{(SINGLE_STORY, MULTIPLE_STORY)}	{1, 2, 3, }	{(MIXED-SEVERITY-FIRE,	{}	{(NORMAL)}	{(NF-WILDERNESS)}	{}	70	
5	{(SINGLE_STORY, MULTIPLE_STORY)}	{1, 2, 3, }	{(MIXED-SEVERITY-FIRE,	{}	{(DRIER)}	{(NF-WILDERNESS)}	{}	50	
6	{(SINGLE_STORY, MULTIPLE_STORY)}	{1, 2, 3, }	{}	{}	{(WETTER)}	{(NF-WILDERNESS)}	{}	70	
7	{(SINGLE_STORY, MULTIPLE_STORY)}	{1, 2, 3, }	{}	{}	{(NORMAL)}	{(NF-WILDERNESS)}	{}	60	
8	{(MULTIPLE_STORY, SINGLE_STORY)}	{1, 2, 3, }	{}	{}	{(DRIER)}	{(NF-WILDERNESS)}	{}	40	
9	{(NON_FOREST)}	{1, 2, 3, }	{}	{}	{(WETTER)}	{}	{(OPEN,	80	
10	{(NON_FOREST)}	{1, 2, 3, }	{}	{}	{(NORMAL)}	{}	{(OPEN,	68	
11	{(NON_FOREST)}	{1, 2, 3, }	{}	{}	{(DRIER)}	{}	{(OPEN,	30	
12	{(SINGLE_STORY, MULTIPLE_STORY)}	{2, 3, 4}	{(LIGHT-SEVERITY-FIRE,	{}	{(WETTER)}	{}	{(NONE,	80	
13	{(SINGLE_STORY, MULTIPLE_STORY)}	{2, 3, 4}	{(LIGHT-SEVERITY-FIRE,	{}	{(NORMAL)}	{}	{(NONE,	70	
14	{(SINGLE_STORY, MULTIPLE_STORY)}	{2, 3, 4}	{(LIGHT-SEVERITY-FIRE,	{}	{(DRIER)}	{}	{(NONE,	50	
15	{(SINGLE_STORY, MULTIPLE_STORY)}	{2, 3, 4}	{(ROOT-DISEASE, SEVERE-LP-MPB,	{}	{(WETTER)}	{}	{(OPEN,	70	
16	{(SINGLE_STORY, MULTIPLE_STORY)}	{2, 3, 4}	{(SEVERE-WGBW, PP-MPB, SEVERE-LP-MPB,	{}	{(NORMAL)}	{}	{(OPEN,	60	
17	{(SINGLE_STORY, MULTIPLE_STORY)}	{2, 3, 4}	{(SEVERE-WGBW, PP-MPB, SEVERE-LP-MPB,	{}	{(DRIER)}	{}	{(OPEN,	40	
18	{(SINGLE_STORY, MULTIPLE_STORY)}	{2, 3, 4}	{}	{(ECOSYSTEM-MANAGEMENT-BROADCAST-BURN,	{(WETTER)}	{}	{(NONE, OPEN,	80	
19	{(SINGLE_STORY, MULTIPLE_STORY)}	{2, 3, 4}	{}	{(ECOSYSTEM-MANAGEMENT-BROADCAST-BURN,	{(NORMAL)}	{}	{(NONE, OPEN,	70	
20	{(SINGLE_STORY, MULTIPLE_STORY)}	{2, 3, 4}	{}	{(ECOSYSTEM-MANAGEMENT-BROADCAST-BURN,	{(DRIER)}	{}	{(NONE, OPEN,	50	
21	{}	{}	{}	{}	{(WETTER)}	{}	{}	60	
22	{}	{}	{}	{}	{(NORMAL)}	{}	{}	40	
23	{}	{}	{}	{}	{(DRIER)}	{}	{}	30	
24	{}	{}	{}	{}	{}	{}	{}	80	

Figure 103 Fire Suppression logic for the probability of keeping a fire event at a Class A level, less than .25 acres.

Beyond Class A

If a fire event does not stay at a class A level as a result of either fire suppression or weather events, the logic for fire suppression beyond the Class A size is utilized. Under the main menu, select **System Knowledge > Vegetative Process > Fire Suppression Logic > Beyond Class A**. This will pull up the **Fire Suppression Logic for Fires Beyond Class A** screen (Figure 104). If irregular sized plant communities are used, this logic can be rather simple. A change in vegetation conditions that changes the type of fire to mixed severity or stand replacing fire must occur for it to be suppressed in a plant community that the fire has spread to.



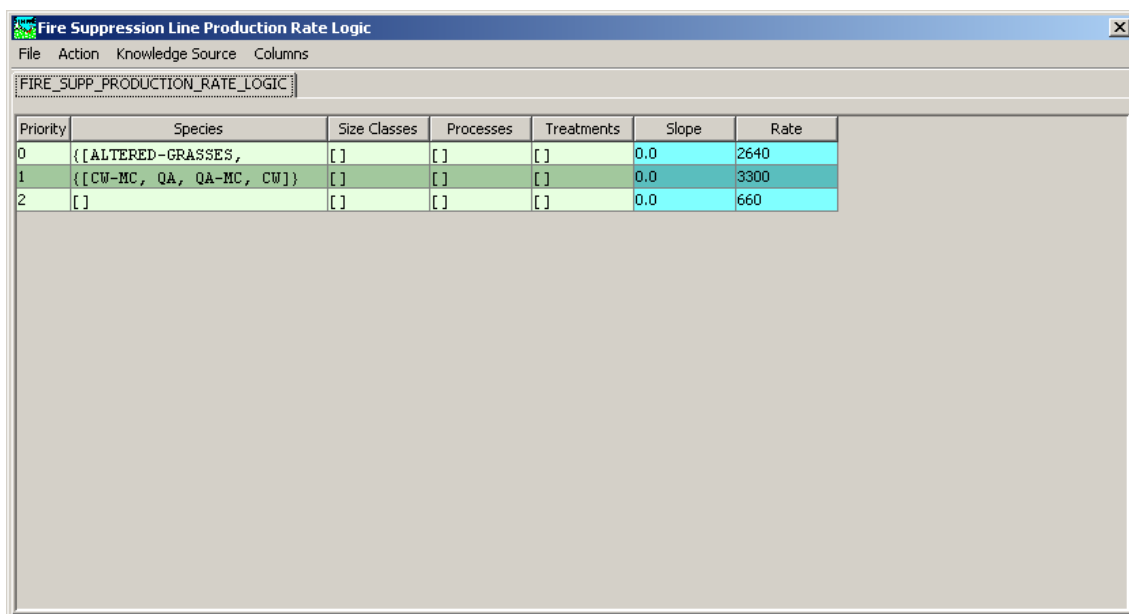
Priority	Size Classes	Ownership	Fire Type	Spread Kind	Road Status	Suppress
0	{[SS, OPEN-HERB, OPEN-LOW-SHRUB, OPEN-MID-SHRUB, []	[]	SRF	AVERAGE	[]	true
1	{[SS, OPEN-HERB, OPEN-LOW-SHRUB, OPEN-MID-SHRUB, []	[]	SRF	EXTREME	[]	false
2	[]	[]	SRF	EXTREME	[]	false
3	[]	[]	LSF	AVERAGE	[]	true
4	[]	[]	LSF	EXTREME	[]	true
5	[]	[]	MSF	AVERAGE	[]	true
6	[]	[]	MSF	EXTREME	[]	true

Figure 104 Logic used to determine how fire suppression is applied to fire events that exceed initial suppression at a Class A level.

Production Rate, Spread Rate, Response Time

There are three components to fire suppression if uniform size units are being used: a fire line production rate for the suppression forces, a spread rate, and a delay time for the suppression forces arriving at the fire event. Each of these can be accessed by selecting **System Knowledge > Vegetative Process > Fire Suppression Logic**. The spread and production values can be derived from other fire analyses performed by fire suppression organizations.

Figure 105 is a simplified set of production values for a geographic zone.



Priority	Species	Size Classes	Processes	Treatments	Slope	Rate
0	{[ALTERED-GRASSES,	[]	[]	[]	0.0	2640
1	{[CW-MC, QA, QA-MC, CW]}	[]	[]	[]	0.0	3300
2	[]	[]	[]	[]	0.0	660

Figure 105 Production rates used for uniform size plant communities.

To capture the same concept that was used with irregularly sized plant communities (no direct suppression against stand replacing fire), Figure 106 shows the addition of a line of logic showing no production if Time Step 0 has stand replacing fire.

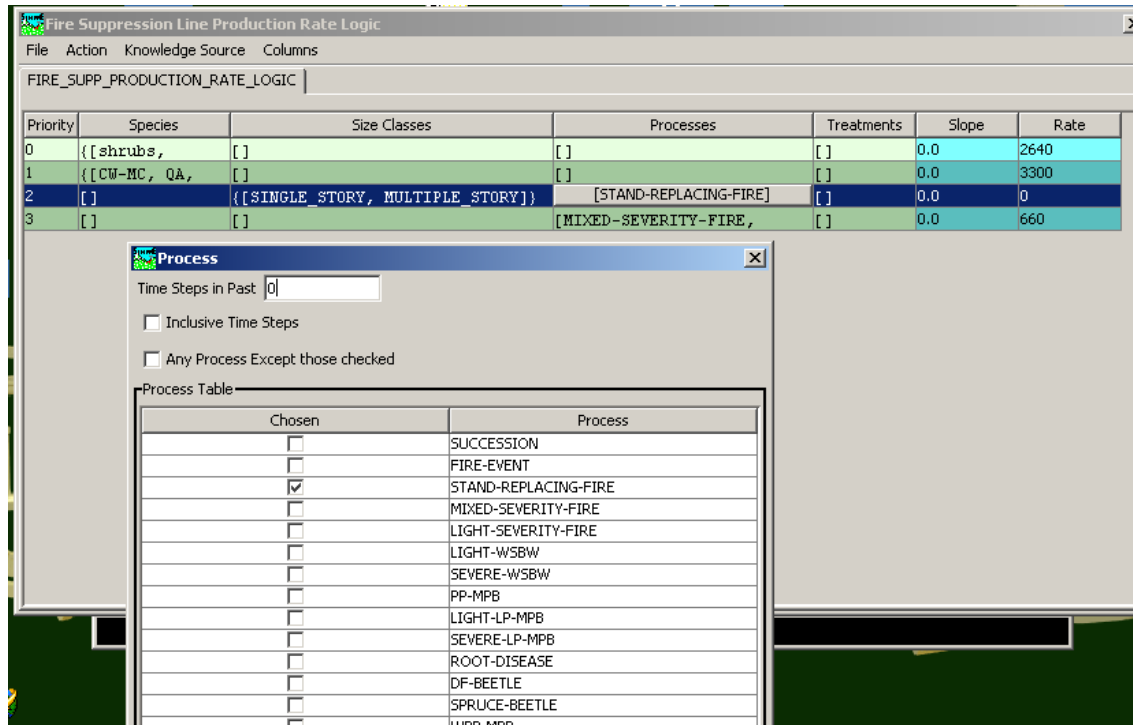
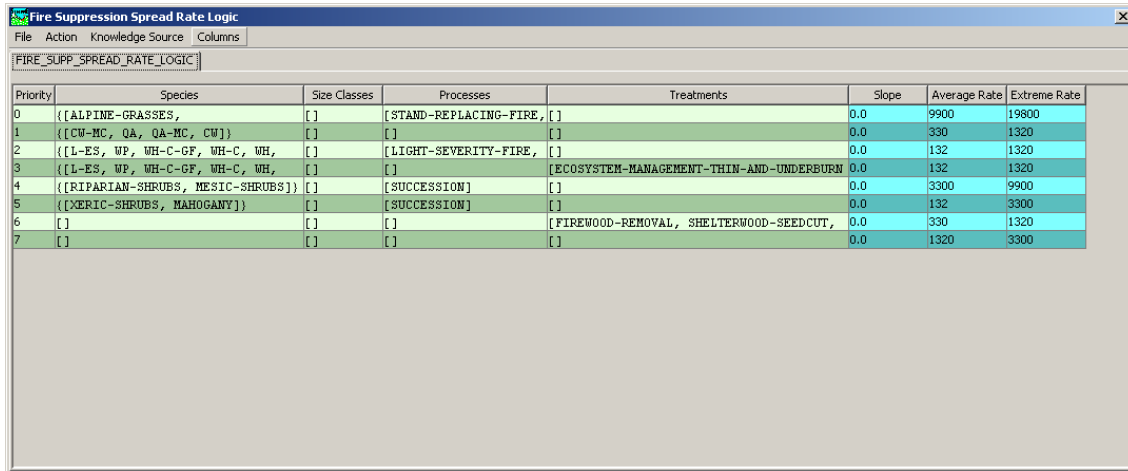


Figure 106 A set of production rates that includes a combination that states for a plant community that has stand replacing fire in the current time step, 0, there will be no production. Or, in other words, direct fire suppression activity is not taken against stand replacing fire.

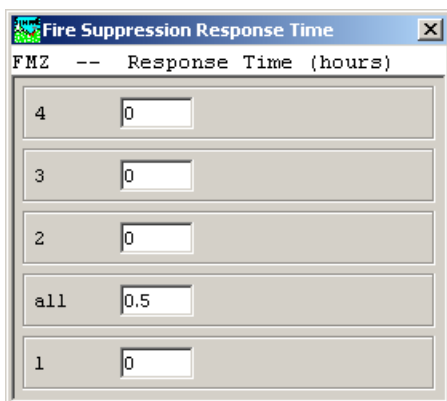
The spread rates for the same zone are shown in Figure 107.



Priority	Species	Size Classes	Processes	Treatments	Slope	Average Rate	Extreme Rate
0	{ALPINE-GRASSES,	{}	[STAND-REPLACING-FIRE,	{}	0.0	9900	19800
1	{CW-MC, QA, QA-MC, CW}	{}	{}	{}	0.0	330	1320
2	{L-ES, WP, WH-C-GF, WH-C, WH,	{}	[LIGHT-SEVERITY-FIRE,	{}	0.0	132	1320
3	{L-ES, WP, WH-C-GF, WH-C, WH,	{}	{}	[ECOSYSTEM-MANAGEMENT-THIN-AND-UNDERBURN	0.0	132	1320
4	{[RIPARIAN-SHRUBS, MESIC-SHRUBS]}	{}	[SUCCESSION]	{}	0.0	3300	9900
5	{[XERIC-SHRUBS, MAHOGANY]}	{}	[SUCCESSION]	{}	0.0	132	3300
6	{}	{}	{}	[FIREWOOD-REMOVAL, SHELTERWOOD-SEEDCUT,	0.0	330	1320
7	{}	{}	{}	{}	0.0	1320	3300

Figure 107 Fire spread rates for use with uniform sized plant communities.

System Knowledge > Vegetative Process > Fire Suppression Logic > Response Time allows the user to specify a delay time by FMZ if the landscape is stratified by them (Figure 108).



FMZ	Response Time (hours)
4	0
3	0
2	0
all	0.5
1	0

Figure 108 Delay time in response of suppression forces by FMZ. Time is utilized in the calculation of fire spread and suppression forces production to determine size of fire events that are suppressed.

10.4.9 Weather-Ending Events

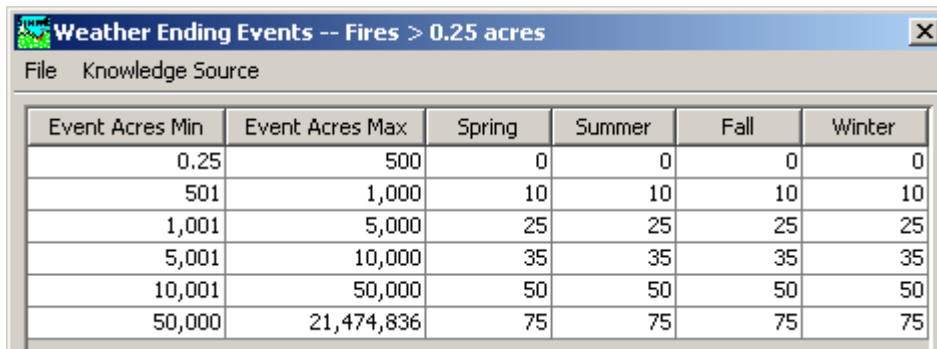
An additional stochastic component exists to represent the probability of a weather event ending a fire event's spread (such as a season ending rain). This logic is separated into fire size less than Class A and greater Class A. To access the Weather-Ending Events screen, select **System Knowledge > Vegetative Process > Weather Ending Events**, then choose **Fires Less than .25 acres (Class A)** or **Fires Greater than .25 acres** (Figure 109).

Many fires do not develop beyond the Class A (less than one-quarter acre) level due to weather events such as significant rain occurring with the lightning that starts the fire event. The default conditions identify the species that are associated with higher elevation areas. However, if one believes the original data for Class A events does not include those ignitions that did not make it to the reporting level because they already went out, then this should all be set to zero. Or, in other words, they are already taken out of the data by the reports used to generate the number of fire events.

Priority	Eco Group	Species	Moisture	Probability
0	[]	{[ES, AF, WB, AL, ES-AF, AL-AF, WB-ES-AF, AL-WB-AF]}	[WETTER]	50
1	[]	{[ES, AF, WB, AL, ES-AF, AL-AF, WB-ES-AF, AL-WB-AF]}	[NORMAL]	25
2	[]	{[ES, AF, WB, AL, ES-AF, AL-AF, WB-ES-AF, AL-WB-AF]}	[DRIER]	0
3	[]	[]	[WETTER]	25
4	[]	[]	[NORMAL]	0
5	[]	[]	[DRIER]	0

Figure 109 Logic screen for probability of weather events that keep fire events from developing past the Class A size, less than 0.25 acres.

If a fire event exceeds Class A size as SIMPPLE is spreading a fire event and each set of neighbors is evaluated for spread, the following probabilities (Figure 110) are used to see if the spread continues. This logic is very sensitive. Small values can lead to very significant reductions in level of fire.

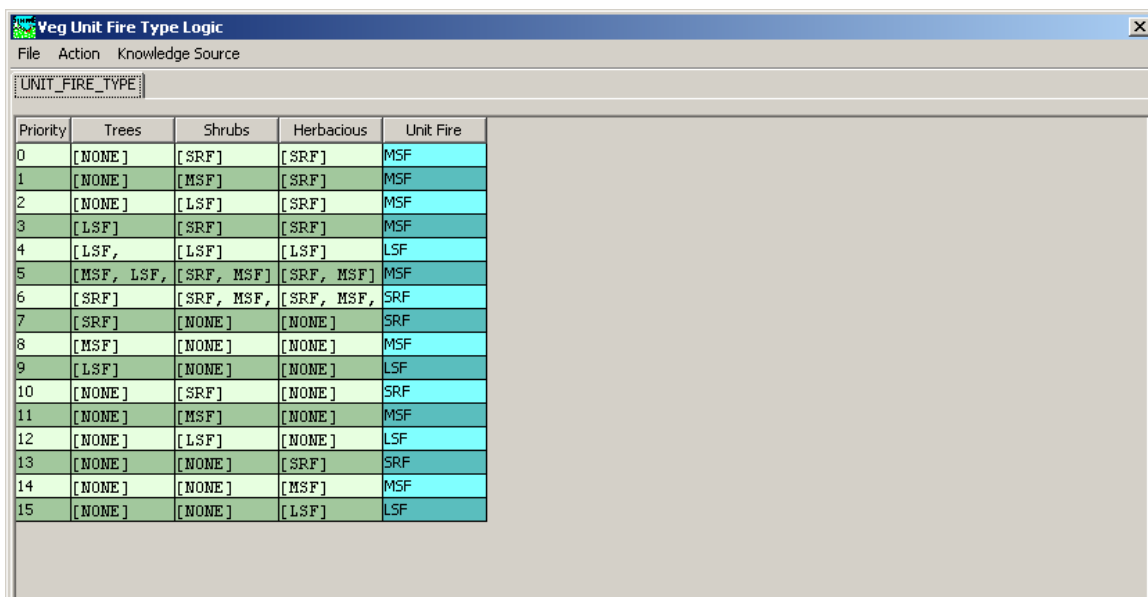


Event Acres Min	Event Acres Max	Spring	Summer	Fall	Winter
0.25	500	0	0	0	0
501	1,000	10	10	10	10
1,001	5,000	25	25	25	25
5,001	10,000	35	35	35	35
10,001	50,000	50	50	50	50
50,000	21,474,836	75	75	75	75

Figure 110 Screen for providing probabilities to link a weather-ending event to the size of a fire event.

10.4.10 Vegetative—Unit Fire Type Logic

If multiple life forms are being utilized in a landscape, the logic for deciding what type of fire to assign to an entire unit must be included. Select **System Knowledge > Vegetative Process > Vegetative – Unit Fire Type Logic**. This allows the user to access the **Veg Unit Fire Type Logic** screen (Figure 111).



Priority	Trees	Shrubs	Herbaceous	Unit Fire
0	[NONE]	[SRF]	[SRF]	MSF
1	[NONE]	[MSF]	[SRF]	MSF
2	[NONE]	[LSF]	[SRF]	MSF
3	[LSF]	[SRF]	[SRF]	MSF
4	[LSF,	[LSF]	[LSF]	LSF
5	[MSF, LSF,	[SRF, MSF]	[SRF, MSF]	MSF
6	[SRF]	[SRF, MSF,	[SRF, MSF,	SRF
7	[SRF]	[NONE]	[NONE]	SRF
8	[MSF]	[NONE]	[NONE]	MSF
9	[LSF]	[NONE]	[NONE]	LSF
10	[NONE]	[SRF]	[NONE]	SRF
11	[NONE]	[MSF]	[NONE]	MSF
12	[NONE]	[LSF]	[NONE]	LSF
13	[NONE]	[NONE]	[SRF]	SRF
14	[NONE]	[NONE]	[MSF]	MSF
15	[NONE]	[NONE]	[LSF]	LSF

Figure 111 Logic to be used with multiple life forms descriptions of vegetation to decide what type of fire to assign to the entire plant community.

10.4.11 Editing and Testing the Fire Process Logic

Fire cycles, return fire intervals, or fire regimes are not input into SIMPPLLE. The simulated fire behavior is the result of the interaction of the logic and the unique vegetation pattern of a landscape. All of the logic in SIMPPLLE represents default values for a zone. There is the potential for considerable variation within these zones. The extent to which the user refines the default values/logic depends on what is judged to be acceptable model behavior. This should be determined by making simulations on sample landscapes and on landscapes where there is a history of disturbance processes to check against. To assess whether the logic in any of the screens needs to be adjusted, the user should start by looking at the number of fire events in a simulation. This is displayed in the **Summary Report** (see “Reports” section).

If the number of fires appears reasonable, the acres associated with individual fire events can be evaluated by examining the **Detailed Fire Report** (see “Reports” section). The GIS files for spread can be created and examined to help decide if the spread of the fire process appears reasonable. Changes can be easily made and simulations made to see what impact they have. For example, with the extreme fire probability set to zero a fire event can be locked-in to a specific plant community to examine the fire spread with and without treatments or other disturbance processes.

A test of fire spread logic can be accomplished by utilizing a file that tracks what spread logic is used as a fire event spreads from one unit to another. To utilize this capability, a “flag” has to be set to “true” in the “simpplle.properties” file in the user's home directory.

For Windows XP, this is C:\Documents and Settings\username\.

For Vista, this is C:\Users\username.

The file looks similar to Figure 112.

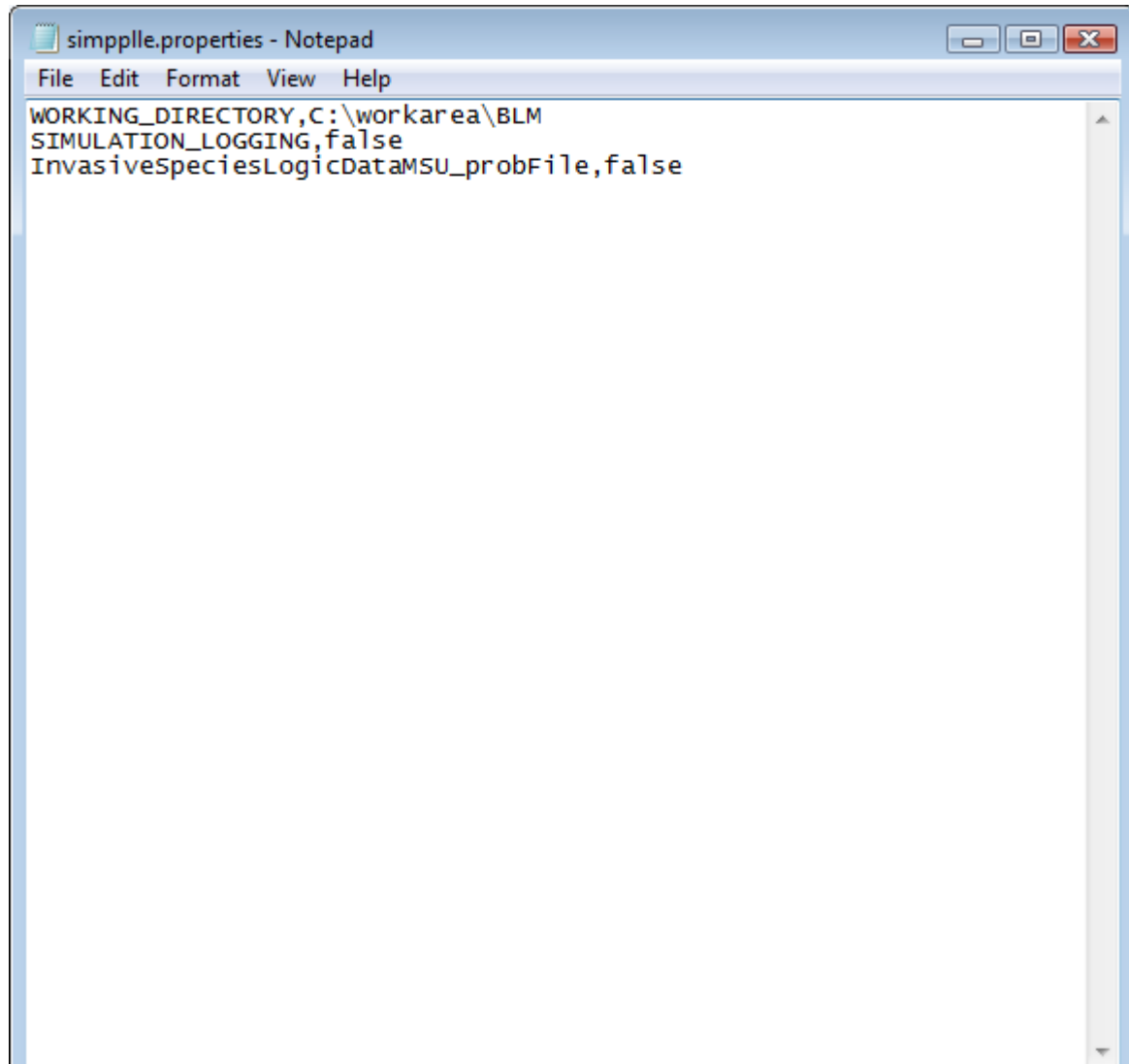


Figure 112 File to set the flag for analysis of the use of fire logic.

This file will produce a text file that is placed in the output directory identified for a single simulation.

The easiest way to utilize this capability is to set the FMZ file fire occurrences all to zero. Then lock-in a fire event to a specific plant community. This way there will be only one fire event that occurs.

Once the simpplle.properties file has the “false” changed to “true” for the “SIMULATION_LOGGING”, you have to close and open SIMPPLLE again. A single time step can be

made without fire suppression. Select an output directory and provide a prefix name. Be sure to “uncheck” the GIS files. You don't need them for this analysis.

In the output directory created there is the file that provides standard fire event information. In Figure 113, the one fire was locked into EVU 649. The spread resulted in a 2,638 acre fire.

test2-firespread-1.txt - Notepad

File Edit Format View Help

DETAILED FIRE EVENT REPORT

Fires were NOT Suppressed.

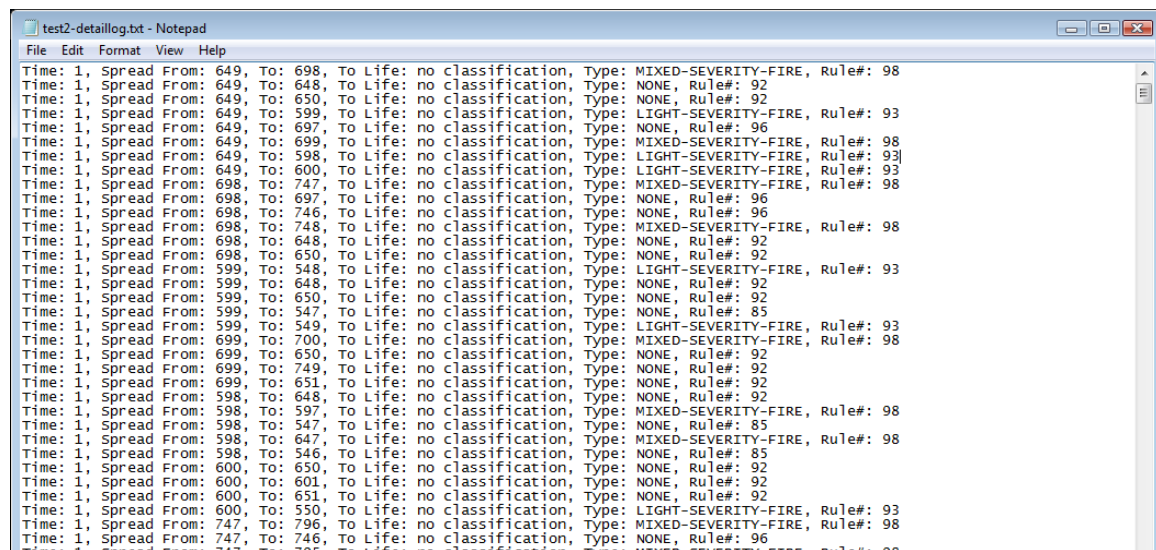
Time	originated in	Total Acres	Spread to
1	649-LSF	2,638	649-LSF 698-MSF 599-LSF 699-MSF 598-LSF 600-LSF 747-MSF 748-MSF 548-LSF 549-LSF 700-MSF 597-MSF 647-MSF 550-LSF 796-MSF 795-MSF 497-LSF 498-MSF 499-MSF 596-MSF 646-MSF 545-MSF 845-MSF 844-MSF 846-MSF 794-MSF 843-MSF 745-MSF 595-MSF 645-MSF 694-MSF 494-MSF 894-MSF 893-MSF 895-MSF 892-MSF 896-LSF 793-MSF 842-MSF 744-MSF 891-MSF 693-MSF 743-MSF 742-MSF 943-MSF 942-MSF 944-MSF 941-MSF 945-MSF 940-MSF 848-LSF 792-MSF 841-MSF 890-MSF 939-MSF 791-MSF 997-MSF 996-MSF 998-MSF 995-MSF 1000-MSF 849-LSF 799-LSF 898-LSF 800-LSF 992-MSF 1061-MSF 1060-MSF 1063-MSF 1058-MSF 1064-MSF 1065-LSF 850-LSF 899-LSF 801-LSF 751-LSF 948-LSF 752-LSF 1056-MSF 991-LSF 1055-LSF 1128-MSF 1125-MSF 1129-MSF 1130-MSF 1124-MSF 1123-MSF 1131-MSF 1066-LSF 1132-MSF 1002-LSF 851-LSF 900-LSF 949-LSF 702-LSF 703-LSF 1003-LSF 1121-LSF 990-MSF 936-MSF 1193-LSF 1195-MSF 1191-MSF 1196-MSF 1197-MSF 1188-MSF 1198-MSF 1067-LSF 1133-MSF 1199-MSF 901-LSF 950-LSF 1004-LSF 653-LSF 1068-LSF 989-MSF 935-MSF 887-MSF 886-MSF 1263-MSF 1264-MSF 1265-MSF 1266-LSF 1256-LSF 1255-MSF 1257-MSF 1267-LSF 1134-MSF 1268-LSF 902-LSF 951-LSF 1005-LSF 1069-MSF 603-LSF 838-MSF 837-MSF 836-LSF 1331-MSF 1330-MSF 1334-LSF 1324-MSF 1325-MSF 1322-MSF 1336-LSF 1201-MSF 903-LSF 952-LSF 1136-MSF 552-LSF 789-MSF 788-MSF 787-MSF 786-MSF 1399-MSF 1401-MSF 1329-LSF 1398-MSF 1393-MSF 1394-MSF 1395-MSF 1391-MSF 1390-MSF 1203-MSF 1071-MSF 740-MSF 739-MSF 738-MSF 737-MSF 736-MSF 1470-MSF 1471-MSF 1464-MSF 1465-MSF 1466-MSF 1467-MSF 1462-MSF 1461-MSF 1389-MSF 1460-MSF 1320-MSF 1204-MSF 1272-MSF 1138-MSF 1072-MSF 1008-MSF 691-MSF 690-MSF 689-LSF 688-MSF 687-MSF 735-LSF 784-LSF 1542-MSF 1533-MSF 1535-MSF 1537-MSF 1538-MSF 1532-MSF 1531-MSF 1530-MSF 1388-MSF 1459-MSF 1319-MSF 1529-MSF 1251-MSF 1205-MSF 1273-MSF 1139-MSF 1073-LSF 954-MSF 642-MSF 641-LSF 640-MSF 639-LSF 638-LSF 637-LSF 1612-MSF 1611-MSF 1613-MSF 1603-MSF 1602-MSF 1605-MSF 1607-MSF 1608-MSF 1609-LSF 1601-MSF 1600-MSF 1599-MSF 1387-LSF 1458-MSF 1318-MSF 1528-MSF 1250-MSF 1598-MSF 1183-MSF 1182-LSF 1274-MSF 1140-MSF 1342-MSF 1074-MSF 1010-MSF 636-LSF 1683-MSF 1682-MSF 1684-MSF 1610-MSF 1681-MSF 1614-LSF 1685-LSF 1674-MSF 1673-MSF 1675-MSF 1672-MSF 1676-MSF 1677-MSF 1678-MSF 1679-MSF 1671-MSF 1670-MSF 1669-MSF 1386-LSF 1457-MSF 1317-LSF 1527-MSF 1249-MSF 1597-MSF 1668-MSF

Fire Event Summary

	0-0.25	0.26-9	10-99	100-299	300-999	1000+	TOTAL	% Landscape
1	Acres	0	0	0	0	2,638	2,638	8
	# Events	0	0	0	0	1	1	
2	Acres	0	0	0	0	0	0	0

Figure 113 Standard fire event information for a fire locked in to plant community 649.

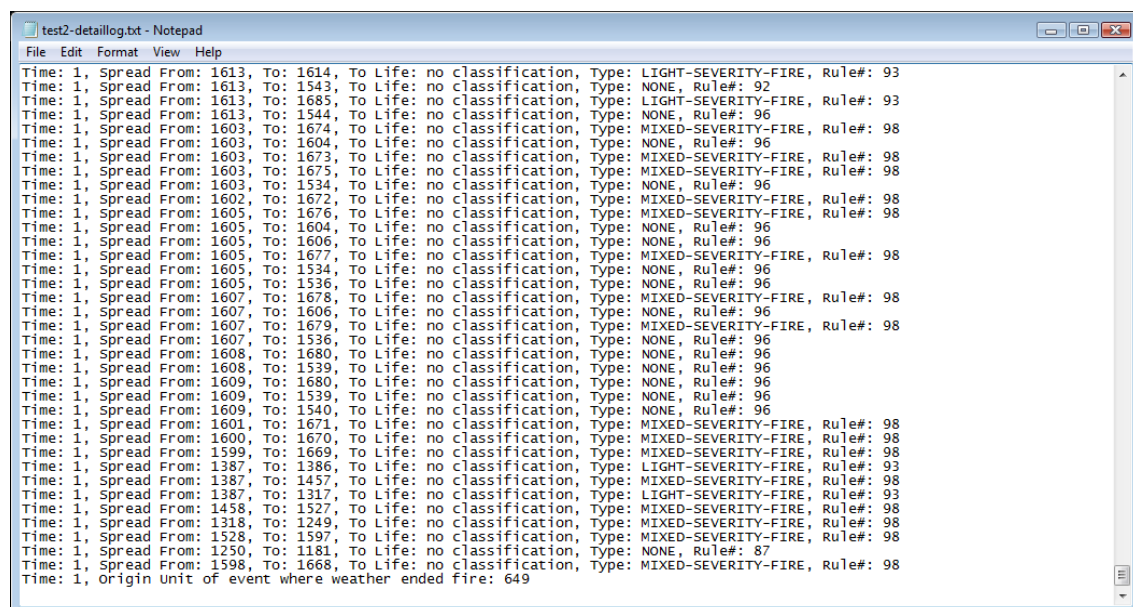
Figure 114 shows the logic rule used to make the spread to another unit, or stop the spread “NONE.”



```
test2-detailedlog.txt - Notepad
File Edit Format View Help
Time: 1, Spread From: 649, To: 698, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 649, To: 648, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 649, To: 650, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 649, To: 599, To Life: no classification, Type: LIGHT-SEVERITY-FIRE, Rule#: 93
Time: 1, Spread From: 649, To: 697, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 649, To: 699, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 649, To: 598, To Life: no classification, Type: LIGHT-SEVERITY-FIRE, Rule#: 93
Time: 1, Spread From: 649, To: 600, To Life: no classification, Type: LIGHT-SEVERITY-FIRE, Rule#: 93
Time: 1, Spread From: 698, To: 747, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 698, To: 697, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 698, To: 746, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 698, To: 748, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 698, To: 648, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 698, To: 650, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 599, To: 548, To Life: no classification, Type: LIGHT-SEVERITY-FIRE, Rule#: 93
Time: 1, Spread From: 599, To: 648, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 599, To: 650, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 599, To: 547, To Life: no classification, Type: NONE, Rule#: 85
Time: 1, Spread From: 599, To: 549, To Life: no classification, Type: LIGHT-SEVERITY-FIRE, Rule#: 93
Time: 1, Spread From: 699, To: 700, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 699, To: 650, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 699, To: 749, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 699, To: 651, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 598, To: 648, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 598, To: 597, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 598, To: 547, To Life: no classification, Type: NONE, Rule#: 85
Time: 1, Spread From: 598, To: 647, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 598, To: 546, To Life: no classification, Type: NONE, Rule#: 85
Time: 1, Spread From: 600, To: 650, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 600, To: 601, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 600, To: 651, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 600, To: 550, To Life: no classification, Type: LIGHT-SEVERITY-FIRE, Rule#: 93
Time: 1, Spread From: 747, To: 796, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 747, To: 746, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 747, To: 745, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
```

Figure 114 The detailedlog.txt file that shows what logic was used in spreading the fire events.

Figure 115 shows the information provided when a weather-ending event stopped the spread of the fire.

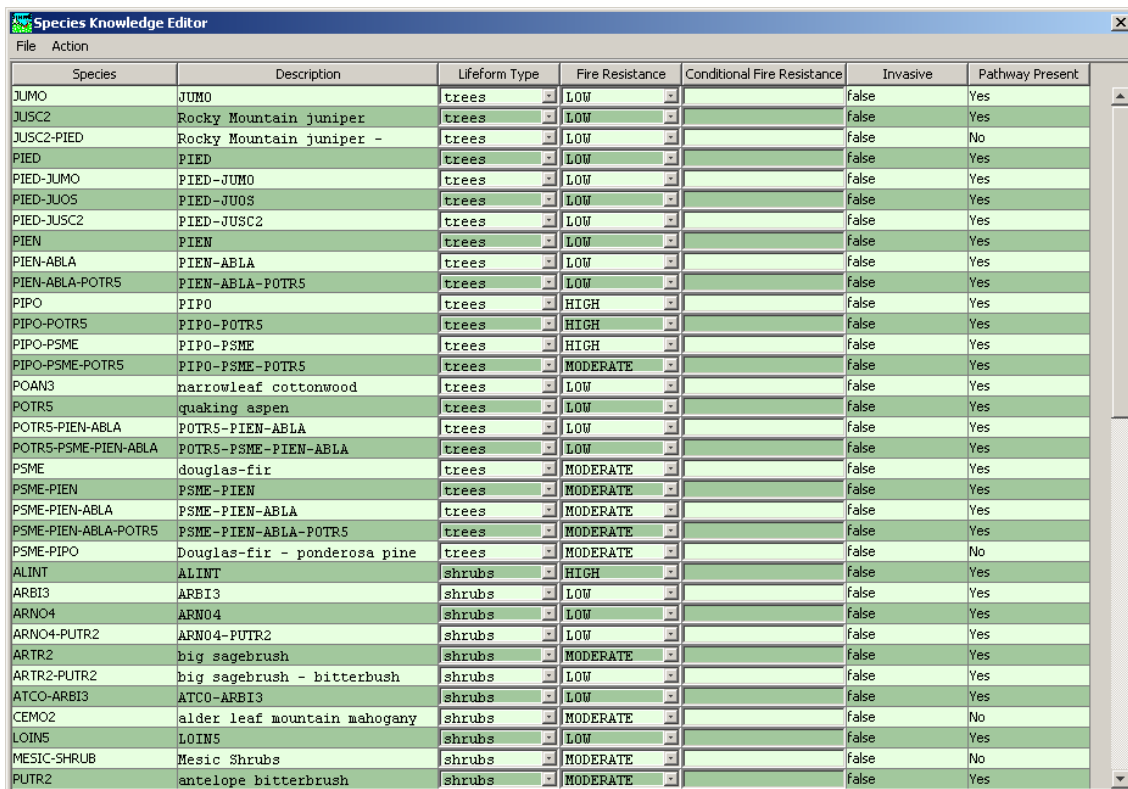


```
test2-detailedlog.txt - Notepad
File Edit Format View Help
Time: 1, Spread From: 1613, To: 1614, To Life: no classification, Type: LIGHT-SEVERITY-FIRE, Rule#: 93
Time: 1, Spread From: 1613, To: 1543, To Life: no classification, Type: NONE, Rule#: 92
Time: 1, Spread From: 1613, To: 1685, To Life: no classification, Type: LIGHT-SEVERITY-FIRE, Rule#: 93
Time: 1, Spread From: 1613, To: 1544, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1603, To: 1674, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1603, To: 1604, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1603, To: 1673, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1603, To: 1675, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1603, To: 1534, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1602, To: 1672, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1605, To: 1676, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1605, To: 1604, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1605, To: 1606, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1605, To: 1677, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1605, To: 1534, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1605, To: 1536, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1607, To: 1678, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1607, To: 1606, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1607, To: 1679, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1607, To: 1536, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1608, To: 1680, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1608, To: 1539, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1609, To: 1680, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1609, To: 1539, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1609, To: 1540, To Life: no classification, Type: NONE, Rule#: 96
Time: 1, Spread From: 1601, To: 1671, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1600, To: 1670, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1599, To: 1669, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1387, To: 1386, To Life: no classification, Type: LIGHT-SEVERITY-FIRE, Rule#: 93
Time: 1, Spread From: 1387, To: 1457, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1387, To: 1317, To Life: no classification, Type: LIGHT-SEVERITY-FIRE, Rule#: 93
Time: 1, Spread From: 1458, To: 1527, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1318, To: 1249, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1528, To: 1597, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, Spread From: 1250, To: 1181, To Life: no classification, Type: NONE, Rule#: 87
Time: 1, Spread From: 1598, To: 1668, To Life: no classification, Type: MIXED-SEVERITY-FIRE, Rule#: 98
Time: 1, origin Unit of event where weather ended fire: 649
```

Figure 115 Detailed fire spread log file with last line showing the fire event was stopped by a weather-ending event.

10.4.12 Species Attribute Editor

The **Species Attribute Editor** identifies **Species**, **Description**, **Lifeform Type**, **Fire Resistance** rating, **Conditional Fire Resistance**, whether they are considered **Invasive** (and thus, having probability logic associated with them) and a check by the system to see if a pathway is loaded for the species (**Pathway Present**). To access the editor select **System Knowledge > Vegetative Process > Species Attribute Editor**. Within the editor window, **File** and **Action** provide choices that include adding a new species and deleting existing ones.



Species	Description	Lifeform Type	Fire Resistance	Conditional Fire Resistance	Invasive	Pathway Present
JUM0	JUM0	trees	LOW		false	Yes
JUSC2	Rocky Mountain juniper	trees	LOW		false	Yes
JUSC2-PIED	Rocky Mountain juniper -	trees	LOW		false	No
PIED	PIED	trees	LOW		false	Yes
PIED-JUM0	PIED-JUM0	trees	LOW		false	Yes
PIED-JU05	PIED-JU05	trees	LOW		false	Yes
PIED-JUSC2	PIED-JUSC2	trees	LOW		false	Yes
PIEN	PIEN	trees	LOW		false	Yes
PIEN-ABLA	PIEN-ABLA	trees	LOW		false	Yes
PIEN-ABLA-POTR5	PIEN-ABLA-POTR5	trees	LOW		false	Yes
PIPO	PIPO	trees	HIGH		false	Yes
PIPO-POTR5	PIPO-POTR5	trees	HIGH		false	Yes
PIPO-PSME	PIPO-PSME	trees	HIGH		false	Yes
PIPO-PSME-POTR5	PIPO-PSME-POTR5	trees	MODERATE		false	Yes
POAN3	narrowleaf cottonwood	trees	LOW		false	Yes
POTR5	quaking aspen	trees	LOW		false	Yes
POTR5-PIEN-ABLA	POTR5-PIEN-ABLA	trees	LOW		false	Yes
POTR5-PSME-PIEN-ABLA	POTR5-PSME-PIEN-ABLA	trees	LOW		false	Yes
PSME	douglas-fir	trees	MODERATE		false	Yes
PSME-PIEN	PSME-PIEN	trees	MODERATE		false	Yes
PSME-PIEN-ABLA	PSME-PIEN-ABLA	trees	MODERATE		false	Yes
PSME-PIEN-ABLA-POTR5	PSME-PIEN-ABLA-POTR5	trees	MODERATE		false	Yes
PSME-PIPO	Douglas-fir - ponderosa pine	trees	MODERATE		false	No
ALINT	ALINT	shrubs	HIGH		false	Yes
ARBI3	ARBI3	shrubs	LOW		false	Yes
ARN04	ARN04	shrubs	LOW		false	Yes
ARN04-PUTR2	ARN04-PUTR2	shrubs	LOW		false	Yes
ARTR2	big sagebrush	shrubs	MODERATE		false	Yes
ARTR2-PUTR2	big sagebrush - bitterbrush	shrubs	LOW		false	Yes
ATCO-ARBI3	ATCO-ARBI3	shrubs	LOW		false	Yes
CEMO2	alder leaf mountain mahogany	shrubs	MODERATE		false	No
LOIN5	LOIN5	shrubs	LOW		false	Yes
MESIC-SHRUB	Mesic Shrubs	shrubs	MODERATE		false	No
PUTR2	antelope bitterbrush	shrubs	MODERATE		false	Yes

Figure 116 The Species Knowledge Editor.

10.4.13 Disturbance Process Probability (other than fire)

The choice of disturbance processes, such as insect and disease processes, to include in SIMPPLLE involves consideration of:

- the processes that have significant knowledge that may be used to predict a probability of occurrence;

- the processes that make significant changes in the attributes that are used to describe vegetation;
- their presence has a significant impact on the occurrence of other processes; and
- the processes that require data for predictions that could be derived from the inventory data we could expect to find in a geographic area.

To incorporate many of the processes into SIMPPLLE, significant modifications of the existing research are required, such as hazard rating systems, in order to be able to work with the level of inventory data available for landscape scales. The western spruce budworm logic derived from Carlson and Wulf (1989) for many of the zones and the spruce beetle for south central Alaska utilizing the Spruce Beetle Expert System (Reynolds and Holsten 1997) are two examples. However, as with other components of SIMPPLLE, what we have given up in detail in some areas we more than gain by being able to capture an interaction with spatial patterns of vegetation, past history of processes, and other disturbance processes.

Past research and monitoring has provided long-term measurement that provides rates of change due to insect and disease process. These values have been used in transition matrices in other models but we do not want to lock these values into SIMPPLLE. They should serve as comparisons to SIMPPLLE output on similar landscapes with multiple stochastic simulations. Future analysis should be done to compare the results from multiple simulations to see how these observed values lie in relation to the range created by the simulations.

10.4.14 Western Spruce Budworm Logic

Western Spruce Budworm Logic is not accessible to the user. Screens have not been created for it, but it is discussed in the appendices for the geographic areas. Instead of options to modify the logic, the user can disable the use of this process by selecting **System Knowledge > Vegetative Process > Disable Western Spruce Budworm**.

10.4.15 Process Probability Logic

To access the **Process Probability Logic** screen (Figure 118) select **System Knowledge > Vegetative Process > Process Probability Logic** (Figure 117). Using the **Columns** drop-down menu within the **Process Probability Logic** screen, the user can decide how much or how little of the system knowledge can be used. The probabilities in the logic screens are independent of the choice of time-step—yearly or decade. They should be considered as the likelihood of the given combination of conditions resulting in a plant community being impacted by that process.

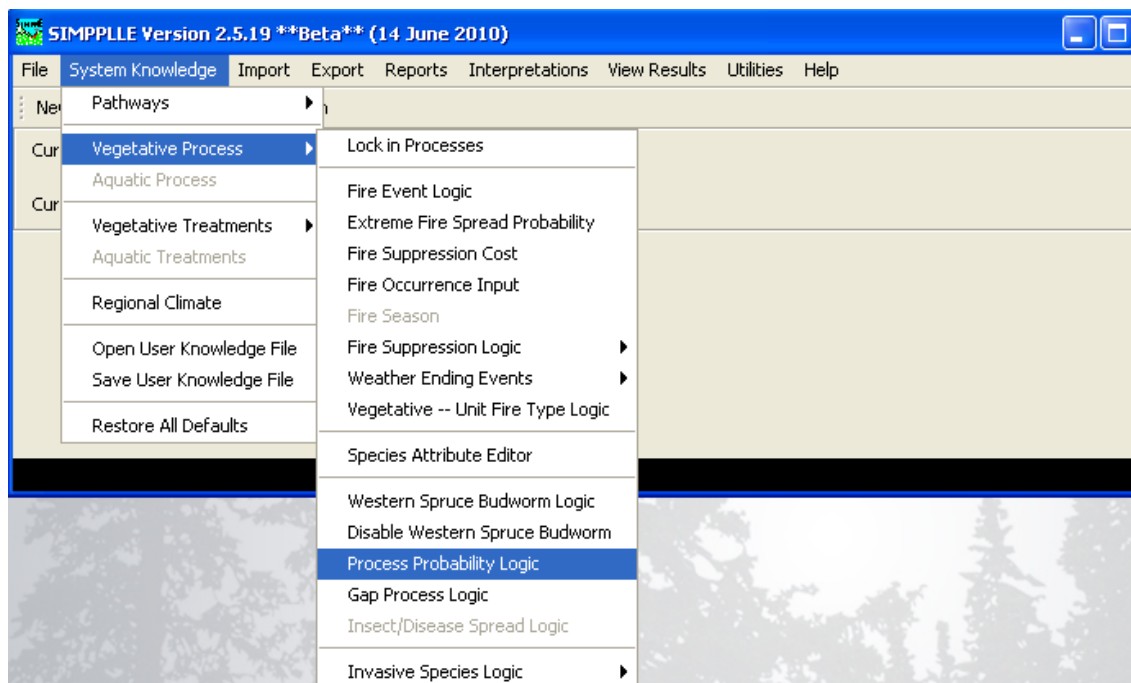


Figure 117 Access to the disturbance process probability logic that includes insects and disease processes.

Process Probability Logic							
File Action Knowledge Source Columns							
WILDLIFE-BROWSING		PIED-BB	PRAIRIE-DOG	WINDTHROW	SPRUCE-BEETLE	ROOT-DISEASE	TUSOCK-MOTH
PP-MPB		LIGHT-LP-MPB	SEVERE-LP-MPB	DF-BEETLE	LIGHT-WSBW		SEVERE-WSBW
Priority	Species	Processes	Adjacent Process	MPB Hazard	Adj Moderate Hazard	Adj High Hazard	Probability
0	{[PIPO,	[PP-MPB]	[STAND-REPLACING	[LOW]	true	true	20
1	{[PIPO,	[PP-MPB]	[]	[LOW]	false	false	10
2	{[PIPO,	[]	[STAND-REPLACING	[LOW]	true	true	10
3	{[PIPO,	[]	[STAND-REPLACING	[LOW]	false	false	5
4	{[PIPO,	[]	[]	[LOW]	true	true	1
5	{[PIPO,	[PP-MPB]	[STAND-REPLACING	[MODERATE]	false	true	60
6	{[PIPO,	[PP-MPB]	[]	[MODERATE]	false	true	20
7	{[PIPO,	[]	[STAND-REPLACING	[MODERATE]	false	true	50
8	{[PIPO,	[]	[STAND-REPLACING	[MODERATE]	false	false	10
9	{[PIPO,	[]	[]	[MODERATE]	false	true	15
10	{[PIPO,	[]	[]	[MODERATE]	false	false	5
11	{[PIPO,	[PP-MPB]	[STAND-REPLACING	[HIGH]	false	true	70
12	{[PIPO,	[PP-MPB]	[]	[HIGH]	false	true	65
13	{[PIPO,	[]	[STAND-REPLACING	[HIGH]	false	false	50
14	{[PIPO,	[]	[STAND-REPLACING	[HIGH]	false	true	60
15	{[PIPO,	[]	[]	[HIGH]	true	false	15
16	{[PIPO,	[]	[]	[HIGH]	false	true	15
17	{[PIPO,	[]	[]	[HIGH]	false	false	10

Figure 118 The process probability logic screen for a zone with tabs for each process.

Process Probability Logic							
File Action Knowledge Source Columns							
WILDLIFE-BROWSING		Ecological Grouping		WINDTHROW	SPRUCE-BEETLE	ROOT-DISEASE	TUSOCK-MOTH
PP-MPB		☒ Species ☐ Size Class ☐ Density ☒ Process ☐ Treatment ☐ Season ☐ Moisture ☐ Temperature ☐ Tracking Species ☐ Ownership ☒ Adjacent Process ☒ MPB Hazard ☒ Adjacent MPB Moderate Hazard ☒ Adjacent MPB High Hazard		DF-BEETLE	LIGHT-WSBW		SEVERE-WSBW
Priority	Species			MPB Hazard	Adj Moderate Hazard	Adj High Hazard	Probability
0	{[PIPO,	[P		[W]	true	true	20
1	{[PIPO,	[P		[W]	false	false	10
2	{[PIPO,	[]		[W]	true	true	10
3	{[PIPO,	[]		[W]	false	false	5
4	{[PIPO,	[]		[W]	true	true	1
5	{[PIPO,	[P		[MODERATE]	false	true	60
6	{[PIPO,	[P		[MODERATE]	false	true	20
7	{[PIPO,	[]		[MODERATE]	false	true	50
8	{[PIPO,	[]		[MODERATE]	false	false	10
9	{[PIPO,	[]		[MODERATE]	false	true	15
10	{[PIPO,	[]		[MODERATE]	false	false	5
11	{[PIPO,	[P		[HIGH]	false	true	70
12	{[PIPO,	[P		[HIGH]	false	true	65
13	{[PIPO,	[]	[STAND-REPLACING	[HIGH]	false	false	50
14	{[PIPO,	[]	[STAND-REPLACING	[HIGH]	false	true	60
15	{[PIPO,	[]	[]	[HIGH]	true	false	15
16	{[PIPO,	[]	[]	[HIGH]	false	true	15
17	{[PIPO,	[]	[]	[HIGH]	false	false	10

Figure 119 The choice of columns of system knowledge that can be used in a process logic screen.

The ordering of the logic lines is important. The system starts working with the first line in the screen and as soon as one matches all conditions for a plant community it is used. This means more detailed combinations have to be placed first. The last line can be a generalized, default combination that the system will use if no other conditions match (Figure 120).

Process Probability Logic							
File		Knowledge Source		Columns			
I	Move Rule Up	PIED-BB	PRAIRIE-DOG	WINDTHROW	SPRUCE-BEETLE	ROOT-DISEASE	TUSsock-MOTH
	Move Rule Down	MPB	SEVERE-LP-MPB	DF-BEETLE	LIGHT-WSBW	SEVERE-WSBW	
	Insert New Rule	Processes	Adjacent Process	MPB Hazard	Adj Moderate Hazard	Adj High Hazard	Probability
0	Delete Selected Rule	MPB	[STAND-REPLACING	[LOW]	true	true	20
1	Duplicate Selected Rule	MPB	[]	[LOW]	false	false	10
2		{ [PIPO,	[]	[STAND-REPLACING	[LOW]	true	10
3		{ [PIPO,	[]	[STAND-REPLACING	[LOW]	false	5
4		{ [PIPO,	[]	[]	[LOW]	true	1
5		{ [PIPO,	[PP-MPB]	[STAND-REPLACING	[MODERATE]	false	60
6		{ [PIPO,	[PP-MPB]	[]	[MODERATE]	false	20
7		{ [PIPO,	[]	[STAND-REPLACING	[MODERATE]	false	50
8		{ [PIPO,	[]	[STAND-REPLACING	[MODERATE]	false	10
9		{ [PIPO,	[]	[]	[MODERATE]	false	15
10		{ [PIPO,	[]	[]	[MODERATE]	false	5
11		{ [PIPO,	[PP-MPB]	[STAND-REPLACING	[HIGH]	false	70
12		{ [PIPO,	[PP-MPB]	[]	[HIGH]	false	65
13		{ [PIPO,	[]	[STAND-REPLACING	[HIGH]	false	50
14		{ [PIPO,	[]	[STAND-REPLACING	[HIGH]	false	60
15		{ [PIPO,	[]	[]	[HIGH]	true	15
16		{ [PIPO,	[]	[]	[HIGH]	false	15
17		{ [PIPO,	[]	[]	[HIGH]	false	10

Figure 120 Choices available for working with logic combinations.

There are a number of processes that have unique screens (e.g., Bison Grazing) and are accessed separately through system knowledge choices. There are some processes in which the screen has no probability logic (e.g., Windthrow). The only way the process can be used is by locking it in to specific plant communities.

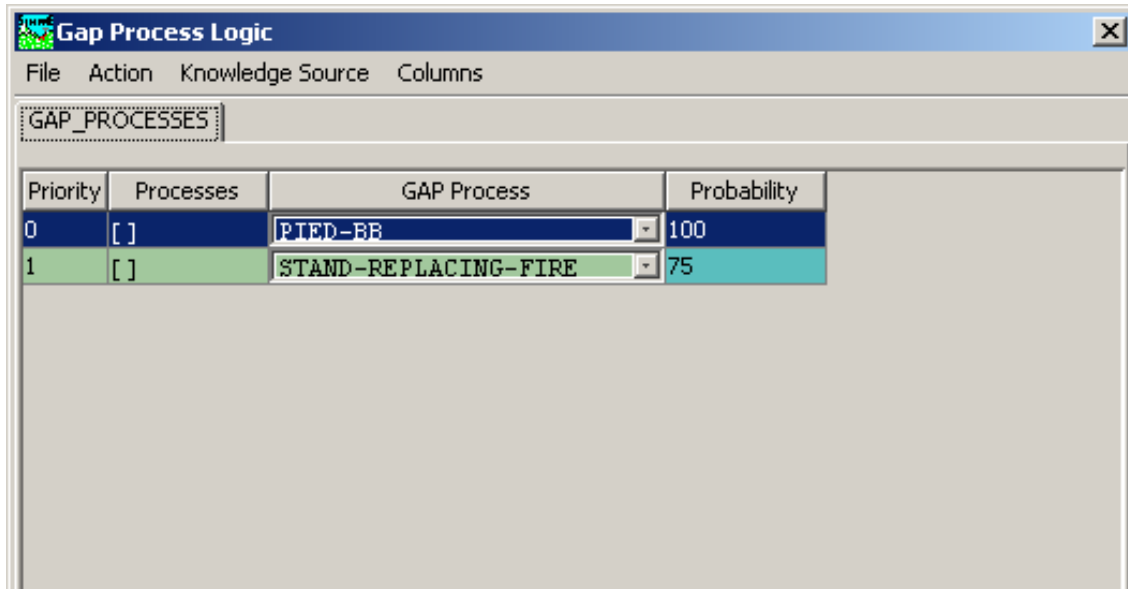
The specific process logic is discussed in the appendices for each geographic zone.

10.4.16 Gap Process Logic

This logic was initially developed for the Colorado Plateau zone where the scale at which processes occurred was significantly less than the size of the unit that the inventories supported simulating. The goal with version 2.5 is to make this feature available in other geographic areas. The user can create logic to account for some processes happening at scales less than the size of the plant community being simulated.

The **Gap Process Logic** screen (Figure 121) displays two logic combinations occurring at a gap scale: pinyon pine bark beetles (PIED-BB), *Ips hoppingi*, and stand replacing fire (STAND-REPLACING-FIRE). The scale is parallel to fire events that are kept at the Class A size of 0.25

acres. The logic is parallel. The system keeps track that the process occurred in the plant community, but it does not change any attributes of the community. To access this screen, select **System Knowledge > Vegetative Process > Gap Process Logic**.



The screenshot shows a window titled "Gap Process Logic" with a menu bar (File, Action, Knowledge Source, Columns) and a text field containing "GAP_PROCESSES". Below is a table with four columns: Priority, Processes, GAP Process, and Probability.

Priority	Processes	GAP Process	Probability
0	[]	PIED-BB	100
1	[]	STAND-REPLACING-FIRE	75

Figure 121 Two logic combinations for having disturbance process occur at a scale of 0.25 acres.

Figure 122 displays a plant community that has had a gap process. **GAP** occurs in the **Probability** column. To access the **Vegetative Unit Analysis** screen, select **View Results > Vegetative Unit Analysis**. The disturbance process for the entire plant community is **SUCCESSION**, but the original process column shows **STAND-REPLACING-FIRE**.

Figure 122 also shows another feature in Time Step 2. For probability, the herbaceous life form shows **COMP**. This indicates that the density of this life form was influenced by the presence and increase in density of the trees and shrubs. The pathways for this herbaceous species would have changed the herbaceous density to a Class 4; however, the logic in the **Life form** interaction system knowledge results in the density at a level 3 due to competition.

The screenshot shows the 'Vegetative Unit Analysis' window. At the top, there are search and navigation buttons. Below, the 'Attributes' section displays various unit details. To the left, a list of 'Adjacent Units' is shown. In the center, there are boxes for 'Landform Units' and 'Aqua Units'. At the bottom, a 'History' table tracks changes over time.

Attributes

Current State	PIED-JUOS/LMU4/3	Road Status	UNKNOWN
Ecological Grouping	DGM	Ownership	NPS
Acres	2	Special Area	MESA VERDE
Fire Management Zone	2	Unit Number	198333
		Associated Landtype	

Adjacent Units

- 241 (Next to, No wind)
- 309 (Next to, No wind)
- 311 (Next to, Downwind)
- 387 (Next to, Downwind)
- 240 (Next to, No wind)
- 242 (Next to, No wind)
- 386 (Next to, No wind)

Landform Units

20585

Aqua Units

History

Time	Season	Lifeform	Resulting State	Process	Prob	Original Process
0	YEAR	trees	PIED-JUOS/LMU/3	PIED-BB	NA	N/A
0	YEAR	shrubs	PUTR2/MEDIUM-SH/2	SUCCESSION	NA	N/A
0	YEAR	herbaceous	POFE-ACHY/CLUMPED/1	SUCCESSION	NA	N/A
1	YEAR	trees	PIED-JUOS/LMU2/3	SUCCESSION	92	N/A
1	YEAR	shrubs	PUTR2/MEDIUM-SH/2	SUCCESSION	100	N/A
1	YEAR	herbaceous	POFE-ACHY/CLUMPED/3	SUCCESSION	100	N/A
2	YEAR	trees	PIED-JUOS/LMU3/3	SUCCESSION	GAP	STAND-REPLACING-FIRE
2	YEAR	shrubs	PUTR2/MEDIUM-SH/3	SUCCESSION	GAP	STAND-REPLACING-FIRE
2	YEAR	herbaceous	POFE-ACHY/CLUMPED/3	SUCCESSION	COMP	STAND-REPLACING-FIRE
3	YEAR	trees	PIED-JUOS/LMU4/3	SUCCESSION	93	N/A
3	YEAR	shrubs	PUTR2/MEDIUM-SH/3	SUCCESSION	100	N/A
3	YEAR	herbaceous	POFE-ACHY/CLUMPED/4	SUCCESSION	100	N/A
4	YEAR	trees	PIED-JUOS/LMU4/3	SUCCESSION	93	N/A

Figure 122 Displays the occurrence of a fire event at a gap level in this 2 acre plant community in Time Step 2.

The gap processes contribute acres to the reports at the rate of one-quarter acre per occurrence.

In a future version of SIMPPLLE, the logic will be expanded in order to keep track of the occurrence and provide screens for the user to say what percent occurrence represents a

threshold over which an entire community's attributes are changed as a result, or how the community responds to other processes is different.

10.4.17 Insect/Disease Spread Logic

System Knowledge > Vegetative Process > Insect and Disease Spread Logic is shaded out.

Spread across the landscape is solely provided by the probability logic screens which determine how adjacent unit occurrence or occurrence within the landscape may increase the probability of the process spreading to other units.

10.4.18 Windthrow—Wildlife Browsing

If these choices are available on the **Vegetative Process** pull-down screen for a geographic zone they have to be locked-in to plant communities to be used. There has not been any probability logic developed. If the processes are locked in, the next-states for the processes have to have been incorporated into the vegetative pathways.

10.4.19 Invasive Species Logic

To access this screen (Figure 123), select **System Knowledge > Vegetative Pathways > Invasive Species Logic**. The system knowledge is based on research that is very specific to a geographic area. The Eastside of Region One and the Colorado Plateau are the only two areas with invasive species capabilities at this time. With the logic being based on very specific research there are significant differences in the probability screens for the species in each geographic area. The appendices for the zones identify the specific research used.

Regardless of the difference in the research, the screens have two parts in common. One part for the probability logic (**PROBABILITY** tab) and one part for the change rate logic (**CHANGE_RATE** tab). The probability screen contains the information from the research necessary to link to a probability of occurrence and a starting canopy density value for the species.

Invasive Species Logic (Mesa Verde NP)											
File Action Knowledge Source Columns											
PROBABILITY CHANGE_RATE											
Priority	Eco Group	Species	Processes	Treatments	Moisture	Invasive Species	Soil Type	Veg Functional Group	Dist to Seed Source	Start Value	Probability
0	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
1	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
2	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
3	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
4	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
5	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
6	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
7	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
8	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
9	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
10	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
11	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
12	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
13	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
14	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
15	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
16	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
17	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
18	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
19	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
20	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
21	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
22	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
23	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
24	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]
25	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]	[]

Figure 123 Screen for the Colorado Plateau Zone invasive species logic.

The change rate contains the logic on how a species' canopy density responds to other disturbance processes or succession (Figure 124). It also identifies a threshold value that is a canopy density level above which the invasive is no longer just a species within a plant community, but is the dominant species, in which case the name used to label the community, or that life form, is changed to be the invasive.

Invasive Species Logic (Mesa Verde NP)						
File Action Knowledge Source Columns						
PROBABILITY CHANGE_RATE						
Priority	Species	Processes	Treatments	Invasive Species	Rate of Change	State Change Threshold
0	[]	[]	[]	[]	[]	[]
1	[]	[]	[]	[]	[]	[]
2	[]	[]	[]	[]	[]	[]
3	[]	[]	[]	[]	[]	[]
4	[]	[]	[]	[]	[]	[]
5	[]	[]	[]	[]	[]	[]

Figure 124 Change Rate screen for the Colorado Plateau invasive species logic.

Within the individual plant communities, the invasive species are handled as tracking species. The percent of canopy density will be displayed as shown in Figure 125.

Vegetative Unit Analysis

Search ☐ Result Units Only --> Prev 12 Next 12

Attributes

Current State	UPLAND-GRASSES/CLOSED-HERB/4	Road Status	UNKNOWN
Ecological Grouping	B1	Ownership	UNKNOWN
Acres	10	Special Area	GALLATIN RIVER
Fire Management Zone	all	Unit Number	116795
		Associated Landtype	

Adjacent Units

- 26 (Next to, No wind)
- 11 (Next to, No wind)
- 13 (Next to, Downwind)
- 1 (Next to, No wind)
- 25 (Next to, No wind)
- 27 (Next to, Downwind)
- 2 (Next to, Downwind)

Landform Units

12

Aqua Units

History | **Treatment History**

Process	Prob	Original Process	Distance to Water	Distance to Road	Distance to Trail	Tracking Species
SUCCESSION	NA	N/A	N/A	N/A	N/A	N/A
SUCCESSION	100	N/A	N/A	1474ft ROAD-4864	10560ft MAX-DIST	BRTE 10.0
SUCCESSION	100	N/A	N/A	1474ft ROAD-4864	10560ft MAX-DIST	BRTE 15.0
SUCCESSION	100	N/A	N/A	1474ft ROAD-4864	10560ft MAX-DIST	BRTE 20.0
SUCCESSION	100	N/A	N/A	1474ft ROAD-4864	10560ft MAX-DIST	BRTE 25.0 CEMA 10.0
SUCCESSION	100	N/A	N/A	1474ft ROAD-4864	10560ft MAX-DIST	BRTE 30.0 CEMA 15.0 CIAR 10.0

Figure 125 Individual plant community display showing invasive species (BRTE—cheatgrass) as tracking species by time step for a simulation.

Acres of invasive species will show up in the Summary Report (**Reports > Summary**) when the percent of canopy density exceeds the threshold value. To get acres of invasive species at the full range of different densities **Reports > Tracking Species Report** has to be used.

The incorporation of invasive species into the system provides the means to capture possible interaction with other processes. For example, by using **Columns** in the logic screen for fire spread tracking species of cheatgrass, BRTE, greater than or equal to 45 percent canopy cover made a difference in how fire spread as shown in Figure 126.

severity fire that has prepared a seedbed. The change in structure and density as reflected in the pathways will then occur.

10.4.22 Regeneration

A significant part of the variability that exists over time in a landscape can come from the high variability in the regeneration process. The variability depends on not just the regeneration mechanisms of the species but also the spatial arrangement of adjacent plant communities that can be in different development stages.

Regeneration is handled as a process but it does not show up in the potential vegetative states (the pathway diagrams) because it depends on spatially explicit information. It does not happen automatically. It is possible to have forested communities in a landscape not return to a tree cover type for a number of decades following stand-replacing events. To access the Regeneration Logic screen (Figure 127), select **System Knowledge > Vegetative Process > Regeneration**. The regeneration knowledge is applied under two specific conditions. It is applied if a non forest state exists on a forested habitat type. This application is referred to as succession regeneration (**SUCCESSION tab**). It is also applied following a stand-replacing-fire in a plant community as fire regeneration (**FIRE tab**).

Priority	Size Classes	Densities	Species	Resprouting State	Adjacent Resprouting	In-place Seed	In Landscape	Adjacent
0	[]	[]	ABCO	[]	[]	[ABCO/SS/2	[]	[ABCO/SS/2
1	[]	[]	ABCO-PIEN	[]	[]	[ABCO-PIEN	[]	[ABCO-PIEN
2	[]	[]	ABCO-PIFL2	[]	[]	[ABCO-PIFL	[]	[ABCO-PIFL
3	[]	[]	ABCO-PIPO	[]	[]	[ABCO-PIPO	[]	[ABCO-PIPO
4	[]	[]	ABCO-POTR5	[POTR5/SS/3	[POTR5/SS/3	[ABCO/SS/2	[]	[ABCO/SS/2
5	[]	[]	ABCO-PSME	[]	[]	[ABCO-PSME	[]	[ABCO-PSME
6	[]	[]	ABLA	[]	[]	[ABLA/SS/2	[]	[ABLA/SS/2
7	[]	[]	ABLA-PIAR	[]	[]	[ABLA-PIAR	[]	[ABLA-PIAR
8	[]	[]	ABLA-PICO	[]	[]	[ABLA-PICO	[]	[ABLA-PICO
9	[]	[]	ABLA-PIEN	[]	[]	[ABLA-PIEN	[]	[ABLA-PIEN
10	[]	[]	ABLA-PIFL2	[]	[]	[ABLA-PIFL	[]	[ABLA-PIFL
11	[]	[]	ACNE2	[ACNE2/SS/2	[]	[ACNE2/SS/	[]	[ACNE2/SS/
12	[]	[]	ACNE2-PSME	[ACNE2/SS/2	[]	[PSME/E/2	[]	[ACNE2-PSM
13	[]	[]	JUMO	[]	[]	[]	[JUMO/SS/1	[JUMO/SS/1
14	[]	[]	JUMO-PIED	[]	[]	[]	[JUMO-PIED	[JUMO-PIED
15	[]	[]	JUSC2	[]	[]	[]	[JUSC2/SS/	[JUSC2/SS/
16	[]	[]	JUSC2-PIED	[]	[]	[]	[JUSC2-PIE	[JUSC2-PIE
17	[]	[]	JUSC2-PIPO	[]	[]	[PIPO/E/2	[JUSC2/SS/	[JUSC2/SS/

Figure 127 The Regeneration Logic screen for the fire regeneration.

New species can be added to both of these screens as long as it is first added to the system through the species attribute editor (**System Knowledge > Vegetative Process > Species Attribute Editor**). Both screens have the **Columns** option in the menu bar that enables additional columns to be added to use additional system knowledge to quantify the regeneration logic.

Fire Regeneration

When regeneration is applied through the fire logic (**FIRE** tab), the knowledge consists of five different components used to determine how a plant community can regenerate. They are: the species resprouts in place (**Resprouting State**), the species resprouts from adjacent communities (**Adjacent Resprouting**), seed is produced by the plants that burned (**In-Place Seed**), seed is provided from adjacent communities (**Adjacent**), or seed is transported from communities within the landscape (**In Landscape**). Through the interface screen, the user can specify by species the appropriate regeneration component. For example various shrubs and quaking aspen are identified as resprouting. Quaking aspen can be identified by resprouting from adjacent communities of aspen. Lodgepole pine can be identified as having serotinous characteristics providing in place seed. Ponderosa pine and Douglas-fir if the large or very large size-class can also have some seed survive a stand replacing fire event. Most species are capable of producing seed that can serve as a seed source for an adjacent plant community that burns. Some species such as white bark pine or junipers have seed that is commonly spread across a landscape by birds.

Notice that a preference sequence can be identified to be used with adjacent seed source such as placing those species that have light wind borne seed first. The entire table can be stratified by ecological grouping if so desired to account for variability in some species regeneration methods. Placing the cursor in a cell will open up a dialog box that enables the user to select what species and what state regenerates (Figure 128).

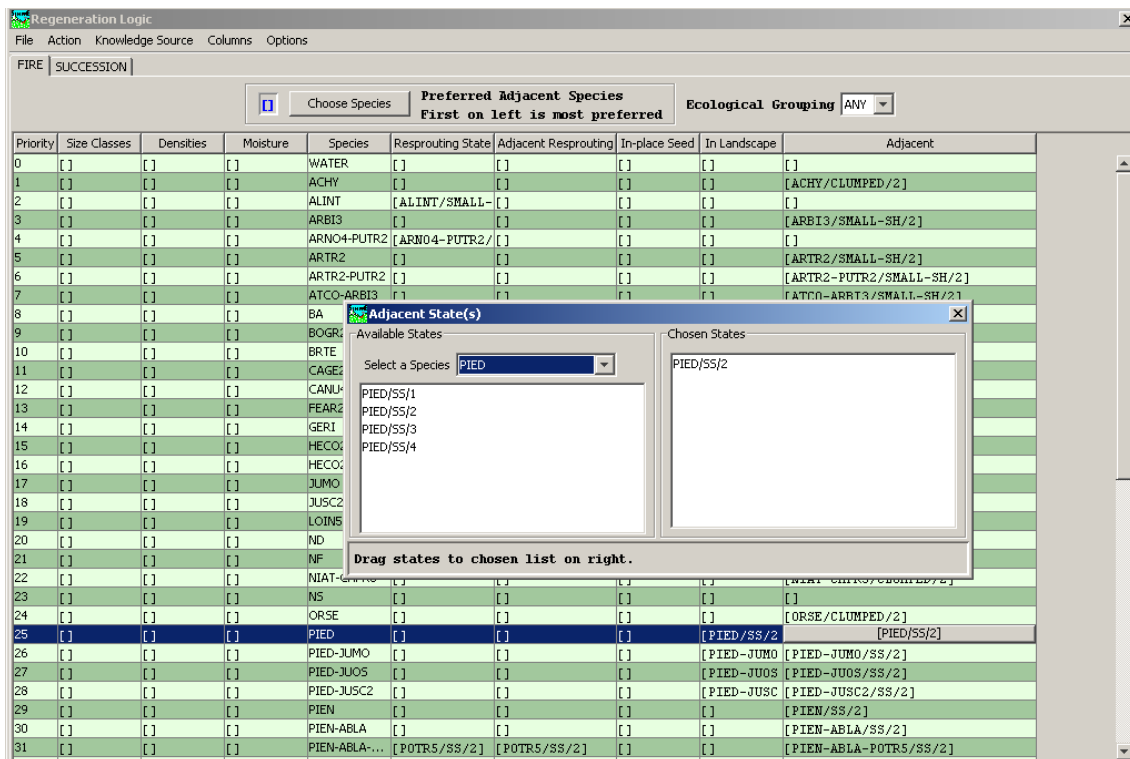


Figure 128 Selecting what species and what state to result from PIED providing adjacent seed as a seed source for a neighboring plant community impacted by a stand replacing fire event.

The “regeneration following fire” logic evaluates the possible components in the order they are listed on the screen from left to right. If none of the above criteria result in a community being regenerated to a tree life form, the non forest state, shrubs or grasses, that is in the pathway resulting from stand replacing fire is assigned. In following time-steps, the succession regeneration logic is evaluated.

The code that identifies the sequence of evaluation uses the adjacent plant community that has the greatest area, not the most shared boundary, to determine what adjacent seed source to use. This code cannot be accessed or modified in this version.

Succession Regeneration

The Succession Regeneration (**SUCCESSION** tab) uses logic that only looks for seed sources from adjacent communities. The logic in this screen (Figure 129) identifies what grass or shrub states can have trees regenerate into it (if the seed source is present). Using this screen one can identify those grass and shrub communities on certain ecological sites that are not suitable for other species regenerating through it. Plant communities that are capable of being regenerated will be evaluated each time step for an adjacent suitable seed source. Those plant communities not suitable will follow the pathway trajectory for that species until a disturbance event changes them to a state that is suitable for other species regenerating in it.

Regeneration Logic

File Action Knowledge Source Columns Options

FIRE SUCCESSION

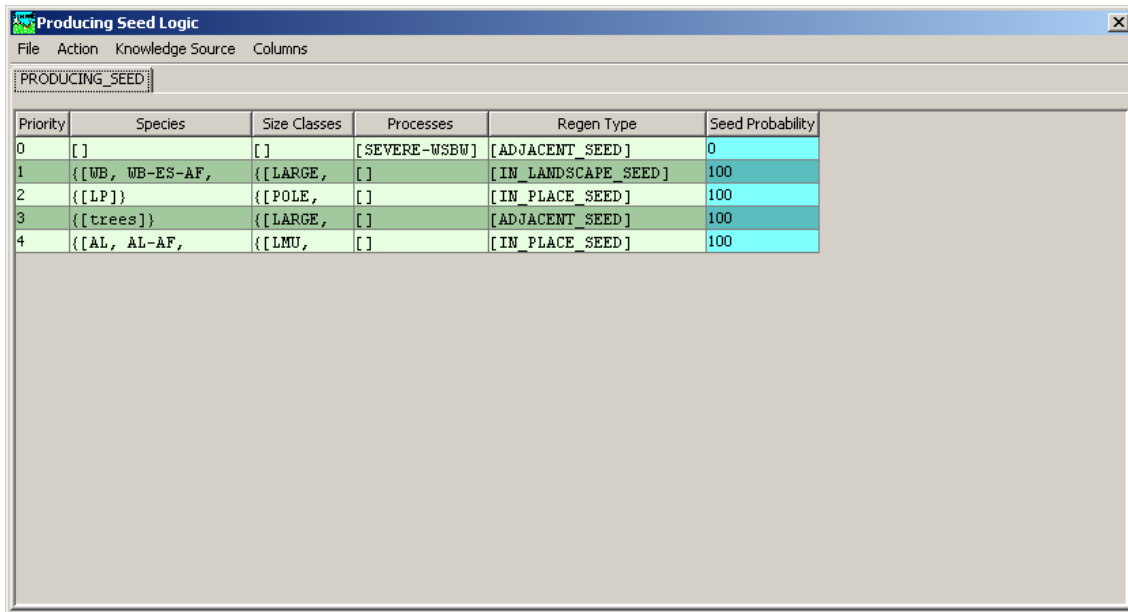
Ecological Grouping ANY

Priority	Size Classes	Densities	Moisture	Species	Succession Regen Possible	Succession Seed species/To State
0	[]	[]	[]	WATER	false	[]
1	[]	[1, 2]	[]	ACHY	true	[PIED-JUOS=>PIED-JUOS/SS/2,
2	[]	[]	[]	ALINT	false	[]
3	[]	[1, 2]	[]	ARBI3	true	[PIED-JUOS=>PIED-JUOS/SS/2]
4	[]	[1, 2]	[]	ARNO4-PUTR2	true	[PIED-JUOS=>PIED-JUOS/SS/2]
5	[]	[1, 2]	[]	ARTR2	true	[PIED-JUOS=>PIED-JUOS/SS/2]
6	[]	[]	[]	ARTR2-PUTR2	false	[]
7	[]	[1, 2]	[]	ATCO-ARBI3	true	[PIED-JUOS=>PIED-JUOS/SS/2]
8	[]	[]	[]	BA	false	[]
9	[]	[]	[]	BOGR2	false	[]
10	[]	[]	[]	BRTE	false	[]
11	[]	[1, 2]	[]	CAGE2	true	[QUGA-AMAL2=>QUGA-AMAL2/SMALL-SH/2]
12	[]	[]	[]	CANU4	false	[]
13	[]	[1, 2]	[]	FEAR2	true	[QUGA-AMUT=>QUGA-AMUT/SMALL-SH/1]
14	[]	[1, 2]	[]	GERI	true	[VAMY2-RIM02=>VAMY2-RIM02/SMALL-SH/2]
15	[]	[]	[]	HECO26	false	[]
16	[]	[1, 2]	[]	HECO26-PLJA	true	[ATCO-ARBI3=>ATCO-ARBI3/SMALL-SH/2]
17	[]	[]	[]	JUMO	false	[]
18	[]	[]	[]	JUSC2	false	[]
19	[]	[1, 2]	[]	LOIN5	true	[PSME-PIEN-ABLA-POTR5=>PSME-PIEN-ABLA-POTR5/SS/2,
20	[]	[]	[]	ND	false	[]
21	[]	[]	[]	NF	false	[]
22	[]	[]	[]	NIAT-CHFR3	false	[]
23	[]	[]	[]	N5	false	[]
24	[]	[1, 2]	[]	ORSE	true	[LOIN5=>LOIN5/SMALL-SH/2]
25	[]	[]	[]	PIED	false	[]
26	[]	[]	[]	PIED-JUMO	false	[]
27	[]	[]	[]	PIED-JUOS	false	[]
28	[]	[]	[]	PIED-JUSC2	false	[]
29	[]	[]	[]	PIEN	false	[]
30	[]	[]	[]	PIEN-ABLA	false	[]
31	[]	[]	[]	PIEN-ABLA...	false	[]
32	[]	[]	[]	PIEN...	false	[]

Figure 129 Succession logic screen showing what species can have other species regenerate within them and what the resulting state would be.

10.4.23 Producing Seed Logic

System Knowledge > Vegetative Process > Producing Seed Logic (Figure 130) enables the user to identify the criteria under which a species will be considered capable of producing seed. In Figure 130, the **Processes** column has been used to identify that past western spruce budworm activity eliminates the capability to produce seed. Research on the frequency of seed crops can be incorporated; however, at this time all default probabilities are either 0 or 100 percent.

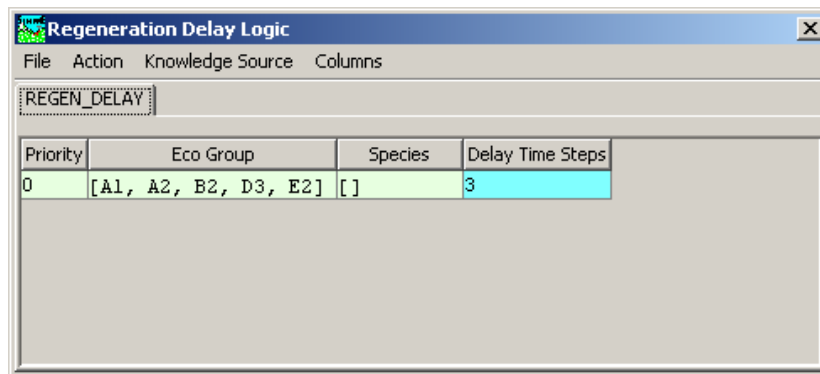


Priority	Species	Size Classes	Processes	Regen Type	Seed Probability
0	[]	[]	[SEVERE-WSBW]	[ADJACENT_SEED]	0
1	{ [WB, WB-ES-AF,]	{ [LARGE,]	[]	[IN_LANDSCAPE_SEED]	100
2	{ [LP] }	{ [POLE,]	[]	[IN_PLACE_SEED]	100
3	{ [trees] }	{ [LARGE,]	[]	[ADJACENT_SEED]	100
4	{ [AL, AL-AF,]	{ [LMU,]	[]	[IN_PLACE_SEED]	100

Figure 130 Screen for the logic for requirements for a species to be producing seed.

Regeneration Delay

To access regeneration delay, select **System Knowledge > Vegetative Process > Regeneration Logic**. Within the Regeneration Logic screen, select **Options > Delay Logic**. This provides access to knowledge to account for regeneration having a delay on many ecological sites. All the factors that are responsible for regeneration delays are not modeled. The process that is used instead is illustrated in Figure 131. For a set of ecological groups (**Eco Group**) in the Eastside Region One geographic area the system will wait three time-steps before evaluating the fire regeneration logic. The original logic with the Eastside zone was developed using decade time steps. In this case, the three time steps are decades. If the user changes to making simulations with yearly time steps the regeneration delay must be changed to 30 to be consistent with the original logic.



Priority	Eco Group	Species	Delay Time Steps
0	[A1, A2, B2, D3, E2]	[]	3

Figure 131 Regeneration Delay screen. The time steps have to match yearly or decade time steps used in a simulation.

10.4.24 Conifer Encroachment

This is a special case developed for the Eastside Region One zone (Figure 132).

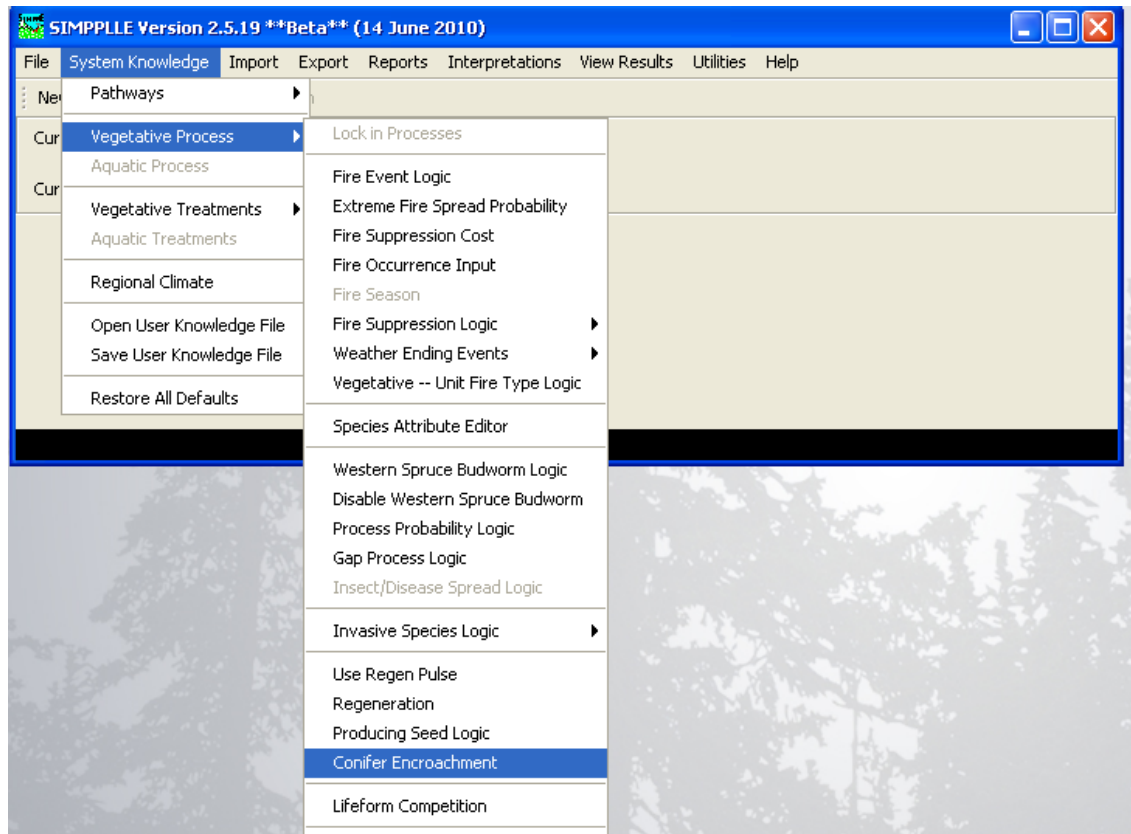


Figure 132 Choices to access conifer encroachment logic for the Eastside Region One geographic zone.

The ecological stratification utilized in the Eastside Region One zone uses habitat types that make a distinction between forested and non forested sites. The conifer encroachment logic (**System Knowledge > Vegetative Process > Conifer Encroachment**) allows for the regeneration of conifers on some of the non forested sites in the absence of fire events. The amount of time a plant community has to be free of fire is dependent on the size of the plant community. There has to be an adjacent seed source. The pathways for these non forest habitat type groups must contain the species that the users want to have the potential to encroach. Similar to the regeneration delay, the number of time steps in this logic was designed for decades. If yearly time steps are used they must be changed (see Figure 133).

Unit	Acres Range	# Time Steps	Adjacent in Succession
0 --	5	5	
6 --	10	10	
11 --	15	15	
16 --	20	15	
21 --	25	15	
26 --	30	15	
31 -	35	20	
36 --	40	20	
41 --	45	20	
46 --	50	20	
51+			

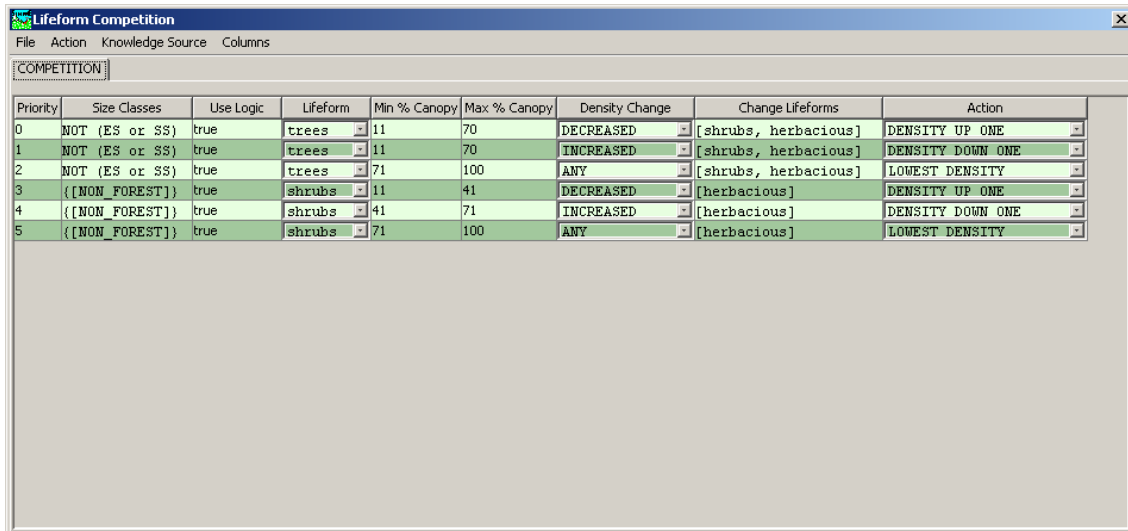
Acres Range is the acres of the unit being considered.
Blank value for time steps indicates no encroachment
The unit must have been in Succession for N steps to be considered.

Figure 133 Logic for conifer encroachment in the Eastside Region One zone.

10.4.25 Life Form Competition

To access the Life form Competition screen, select **System Knowledge > Vegetative Process > Lifeform Competition**. With the expansion to include multiple life forms, we had to make an initial simplistic way to account for interaction. At this time, we only account for changes in

density because of the presence of other life forms. The need to expand this logic will be evaluated over time.



Priority	Size Classes	Use Logic	Lifeform	Min % Canopy	Max % Canopy	Density Change	Change Lifeforms	Action
0	NOT (ES or SS)	true	trees	11	70	DECREASED	[shrubs, herbacious]	DENSITY UP ONE
1	NOT (ES or SS)	true	trees	11	70	INCREASED	[shrubs, herbacious]	DENSITY DOWN ONE
2	NOT (ES or SS)	true	trees	71	100	ANY	[shrubs, herbacious]	LOWEST DENSITY
3	([NON_FOREST])	true	shrubs	11	41	DECREASED	[herbacious]	DENSITY UP ONE
4	([NON_FOREST])	true	shrubs	41	71	INCREASED	[herbacious]	DENSITY DOWN ONE
5	([NON_FOREST])	true	shrubs	71	100	ANY	[herbacious]	LOWEST DENSITY

Figure 134 Logic screen to account for changes in density because of interaction between multiple life forms.

10.4.26 Show Zone Processes

This choice displays the processes that are available within a geographic zone and whether they are treated as spreading or not spreading.

10.4.27 Import Zone Processes

This choice shows up in certain geographic zones. It no longer serves any purpose for the user.

10.5 AQUATIC PROCESS

Aquatic Process is not functional for any of the geographic zones.

10.6 VEGETATIVE TREATMENTS

Treatments within SIMPPLLE are not part of the collection of all possible vegetative states, the pathways. This means there are no assumptions made in the system about levels of management within these states. Any concept of management emphasis must be created by the user by scheduling acres of treatments.

To represent specific management emphases or scenarios in SIMPPLLE, the user must create combinations of schedules of treatments and fire suppression choices. SIMPPLLE can utilize treatment schedules developed by other modeling systems such as MAGIS (Zuuring et al. 1995) and SPECTRUM (USDA Forest Service 1998) but specific files have to be created for SIMPPLLE to use. Treatments affect not only a specific plant community's attributes but also the pattern of vegetation on a landscape, both of which affect future disturbance processes and resource uses.

New treatments may be added. The conditions that must exist for a treatment to be seen as feasible by the system and the attributes that change as a result of a treatment are all part of the system logic accessible to the user.

Treatments are applied at the beginning of a time step, and then the changed plant community is evaluated for the probability of a disturbance process. Thus, in any given time step both treatments and processes can occur. Often times the coarse level of vegetation description may not enable one to capture the difference in changes as a result of the treatment. In this case the fact that a treatment was applied can be used by the system to make a difference in other events occurring. Each treatment has logic that identifies what conditions have to exist before it can be applied, the conditions that are necessary to be feasible, and the logic for the change that results. The feasibility logic can include the condition that adjacent plant communities must be in. It is possible to schedule treatments for future decades and have disturbance processes change vegetation conditions making some treatments infeasible when the system gets to that time step. These infeasible treatments are identified within the summary report. It is also possible for treatments that are feasible to be "not applied." These treatments not applied are the result of missing information in the "change" portion of the treatment logic. All three categories of treatment status are displayed in the report on treatments. Figure 135 is an example of treatments from a simulation summary report.

File Edit Format Help					
Treatment					
	1	time 2	3	4	5
ASPEN-RESTORATION-BURN	3,084	0	0	0	0
SANITATION-SALVAGE	0	1,067	971	622	420
ASPEN-RESTORATION-CUT-AND-BURN	1,352	0	0	0	0
COMMERCIAL-THINNING	8,891	1,346	1,815	6,885	853
Special Area BLM-NF					
Treatment					
	1	time 2	3	4	5
ENCROACHMENT-BURN	1,838	0	0	0	0
ENCROACHMENT-CUT-AND-BURN	4,621	0	0	0	0
No Not Applied Treatments					
Treatment Summary Report					
Acres of Infeasible Treatments (rounded)					

Special Area BLM-ROCK					
Treatment					
	1	time 2	3	4	5
ASPEN-RESTORATION-CUT-AND-BURN	6	0	0	0	0
Special Area BLM-NF					
Treatment					
	1	time 2	3	4	5
ASPEN-RESTORATION-BURN	3,074	0	0	0	0

Figure 135 Output display for treatments from a simulation.

System Knowledge > Vegetative Treatments displays two available choices: **Treatment Schedule** and **Treatment Logic**. **Desired Future Conditions** is an option under development that will allow the user to specify the desired future vegetation conditions and SIMPPLLE will select from a set of user-identified treatments that can compliment disturbance processes over the course of a simulation to attain the desired goals. **Treatment Schedule** is not available until a landscape file is loaded. Since the schedule is based on either specific plant communities or attributes of communities, a landscape must be loaded first.

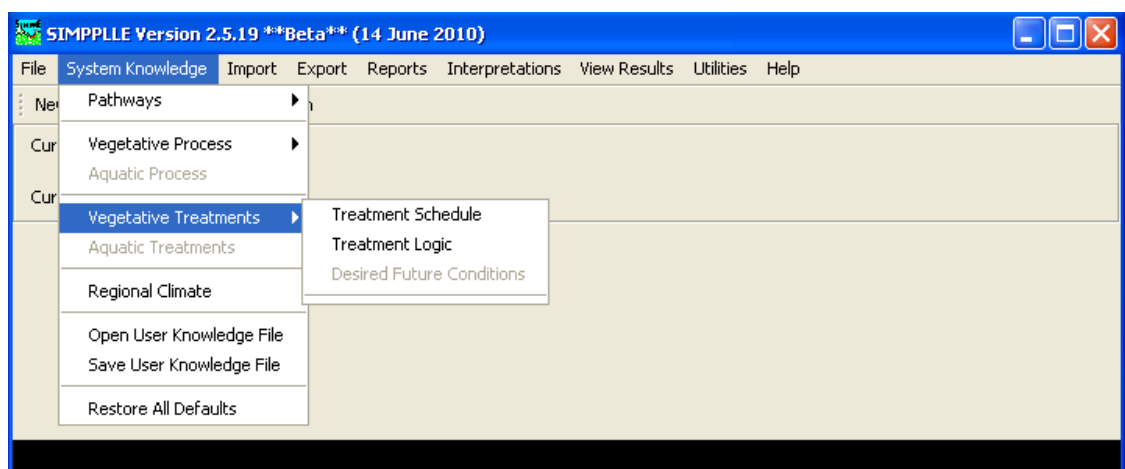


Figure 136 Access to the treatment schedule and treatment logic in SIMPPLLE.

10.6.1 Treatment Scheduling

Treatment Schedule cannot be accessed until a landscape with specific plant communities has been loaded into the system.

Treatments can be scheduled in three different ways. The user can:

- specify individual units by treatment type and time step;
- schedule by attributes specifying an acreage goal for a combination of vegetation attributes of ecological stratification, species, size-class/structure, density and let SIMPPLLE select the units at each time step; or
- schedule treatments by probability. The user can specify threshold levels of disturbance process probabilities and let SIMPPLLE select the units.

An advantage of letting SIMPPLLE select units for treatments is that the system does it at the beginning of each time step. SIMPPLLE builds the schedule as the simulation is made and takes into account the dynamic changes from disturbance processes that SIMPPLLE projects to occur. This will result in fewer infeasible treatments than when they are assigned on vegetation conditions that exist at the beginning of a simulation.

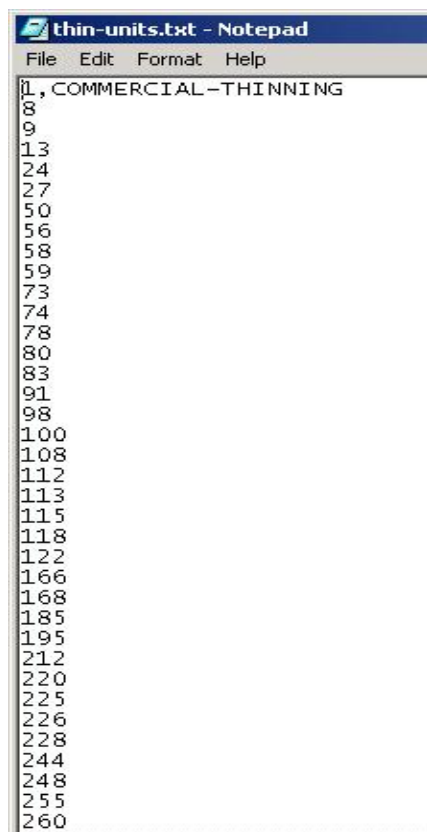
At this time, no costs have been associated with any treatment. If the user desires to include treatment costs and other resource objectives and constraints as part of the scheduling of treatments, SIMPPLLE can be used with scheduling and optimization modeling systems such as MAGIS (Zuuring et al. 1995) or costs can simply be applied to the acres shown in the summary report.

Specifying Individual Units

Scheduling treatments by specifying individual plant communities can be done both within the SIMPPLE user interface and outside of it.

Outside of SIMPPLE:

Working outside of SIMPPLE is accomplished by creating a separate text file with a text editor such as WordPad. If creating a separate text file, the general design of the file is fairly basic, but the creator must know which treatments will be applied to which units, and all these choices must be written out. Figure 137 is an example of a text file. Notice that it is named with a text (*.txt) extension.



```
1, COMMERCIAL-THINNING
8
9
13
24
27
50
56
58
59
73
74
78
80
83
91
98
100
108
112
113
115
118
122
166
168
185
195
212
220
225
226
228
244
248
255
260
```

Figure 137 Text file format of treatments scheduled.

Within the file, the time step is specified first. In this case it is Time Step 1, followed by the treatment type. The units to which the treatments are to be applied are listed beneath it. The same pattern would be used to add other time step treatment combinations. Once this file is completed, it is opened within the SIMPPLE model under **System Knowledge > Vegetative Treatments > Treatment Schedule**.

From the **Treatment Schedule** window, select **File > Load Unit ID File** as shown in Figure 138.

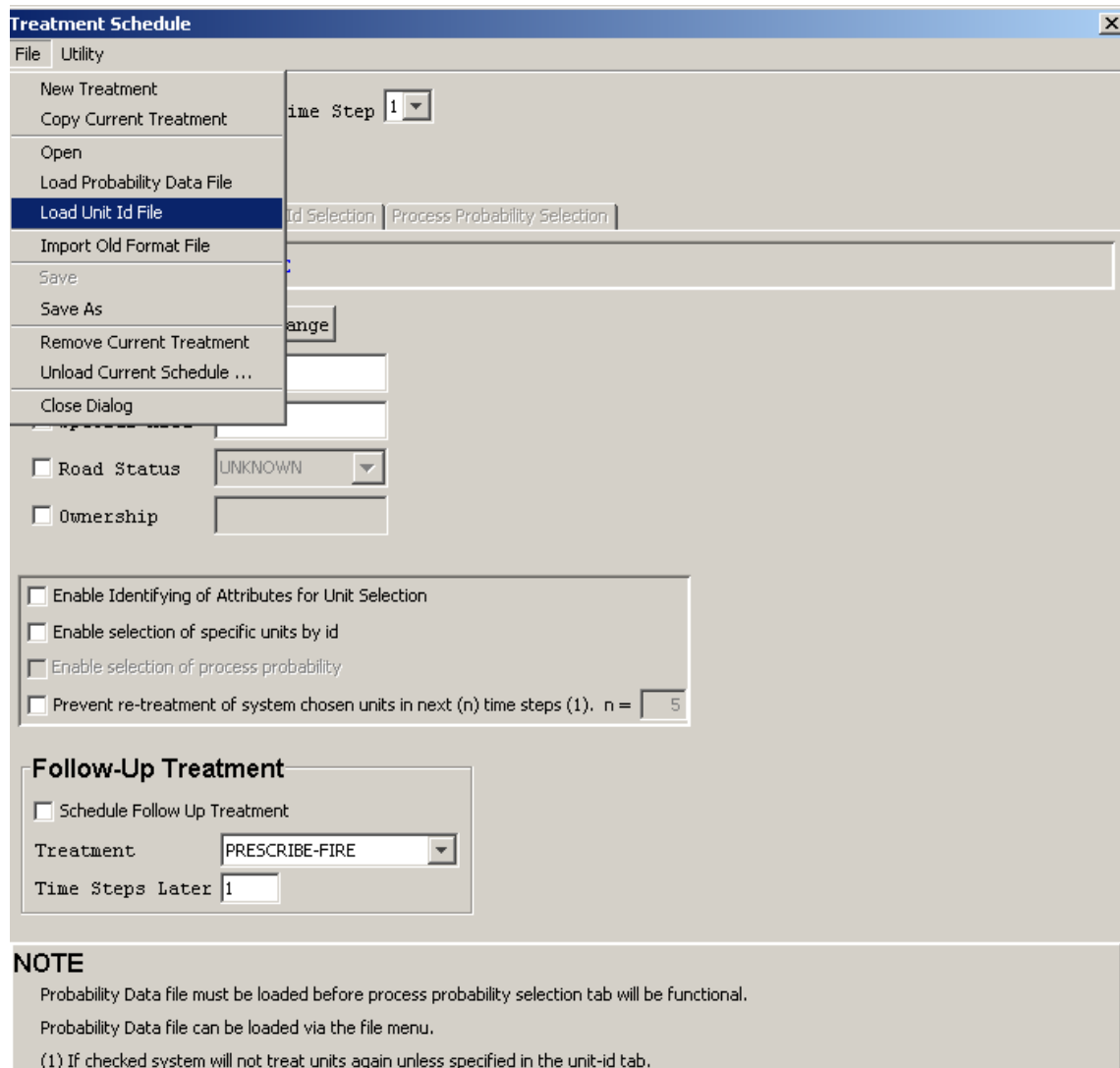


Figure 138 SIMPPLE screen displaying the choice to Load Unit Id File of treatments to be scheduled that has been created outside of the SIMPPLE user interface.

Within SIMPPLE:

In the **Treatment Schedule** window, select **File > New Treatment**.

A dialog box opens that provides the treatments that can be selected. Once a treatment is selected, another dialog box opens asking for the time step. Figure 139 displays the selection of mechanical-thinning for Time Step 1. By default, the number in the **Desired Acres** field is the entire landscape acres.

The screenshot shows a window titled "Treatment Schedule" with a menu bar containing "File" and "Utility". Below the menu bar are two buttons: "Prev" (with a left arrow) and "Next" (with a right arrow). To the right of these buttons is a "Time Step" dropdown menu currently set to "1".

Below the buttons is a tabbed interface with four tabs: "General" (selected), "Attribute Selection", "Unit Id Selection", and "Process Probability Selection".

In the "General" tab, the "Treatment" field displays "MECHANICAL-THIN". Below this, there is a "Time Step" field set to "1" with a "Change" button next to it. The "Desired Acres" field contains the value "54597". There are four checkboxes with associated fields:

- ☐ Special Area: followed by an empty text field.
- ☐ Road Status: followed by a dropdown menu currently showing "UNKNOWN".
- ☐ Ownership: followed by an empty text field.

Below these are four more checkboxes:

- ☐ Enable Identifying of Attributes for Unit Selection
- ☐ Enable selection of specific units by id
- ☐ Enable selection of process probability
- ☐ Prevent re-treatment of system chosen units in next (n) time steps (1). n = 5

At the bottom of the main area is a section titled "Follow-Up Treatment" containing:

- ☐ Schedule Follow Up Treatment
- Treatment: a dropdown menu currently showing "HERBICIDE-APPLICATION".
- Time Steps Later: a text field containing the value "1".

At the very bottom is a "NOTE" section with the following text:

Probability Data file must be loaded before process probability selection tab will be functional.
 Probability Data file can be loaded via the file menu.
 (1) If checked system will not treat units again unless specified in the unit-id tab.

Figure 139 Treatment schedule screen that displays the selected treatment choice of mechanical-thinning.

To identify the treatments by entering individual unit numbers, click on the box for **Enable selection of specific units by id**. This activates the **Unit Id Selection** tab, as shown in Figure 140.

The screenshot shows the 'Treatment Schedule' window with the 'Unit Id Selection' tab active. The interface includes a menu bar with 'File' and 'Utility'. Navigation buttons for 'Prev' and 'Next' are present, along with a 'Time Step' dropdown set to '1'. The 'Treatment' field displays 'MECHANICAL-THIN'. Below this, there are fields for 'Time Step' (1), 'Desired Acres' (54597), and checkboxes for 'Special Area', 'Road Status' (UNKNOWN), and 'Ownership'. A section for unit selection options includes checkboxes for 'Enable Identifying of Attributes for Unit Selection', 'Enable selection of specific units by id' (checked), 'Enable selection of process probability', and 'Prevent re-treatment of system chosen units in next (n) time steps (1). n = 5'. A 'Follow-Up Treatment' section has a checkbox for 'Schedule Follow Up Treatment', a 'Treatment' dropdown set to 'HERBICIDE-APPLICATION', and a 'Time Steps Later' field set to '1'. A 'NOTE' section at the bottom provides instructions on loading probability data files and a note about re-treatment.

Treatment Schedule

File Utility

← Prev Next → Time Step 1

General Attribute Selection **Unit Id Selection** Process Probability Selection

Treatment MECHANICAL-THIN

Time Step 1 Change

Desired Acres 54597

☐ Special Area

☐ Road Status UNKNOWN

☐ Ownership

☐ Enable Identifying of Attributes for Unit Selection

☒ Enable selection of specific units by id

☐ Enable selection of process probability

☐ Prevent re-treatment of system chosen units in next (n) time steps (1). n = 5

Follow-Up Treatment

☐ Schedule Follow Up Treatment

Treatment HERBICIDE-APPLICATION

Time Steps Later 1

NOTE

Probability Data file must be loaded before process probability selection tab will be functional.

Probability Data file can be loaded via the file menu.

(1) If checked system will not treat units again unless specified in the unit-id tab.

Figure 140 Main Treatment Schedule screen with the choices made for treatment, time step, and selection of specific units by id.

To activate the **Unit Id Selection** tab, check the **Enable selection of specific units by id** box. The **Unit Id Selection** screen enables the plant community id values (slink numbers) to be typed in the **Unit Id** box and entered by clicking **Add**.

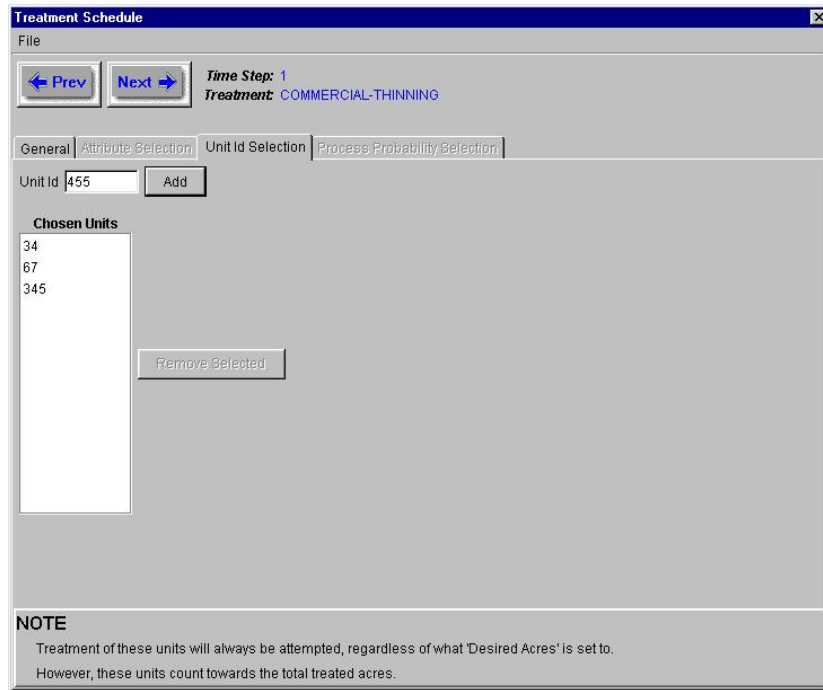


Figure 141 Completed “unit id selection” screen for scheduling treatments within the SIMPPLLE interface.

To schedule the same process for additional time steps, select **File > Copy Current Process**. This selection changes the screen to have the same process and the same units scheduled, however, the time step is blank and the desired time step must be entered.

Select the **Add** or **Remove Selected** button to modify the Unit Ids.

Repeat the steps to create as many treatments for a time step, or combinations of **Time Step**, **Process** and **Unit Id** lists as desired, **Prev** and **Next** can be used to move between the combinations for additional editing of the **Unit Ids**. To add a different process, create a new combination of the **Time Step**, **Process**, and **Unit Id** lists. To create a new combination, return to the **File** dropdown menu. After the new combinations are created, and a new simulation is ready to be made, select **File > Close Dialog**.

To remove the combinations made, or remove combinations to make simulations without them, select **File > Unload**. To remove a combination currently displayed, select **File > Remove Current**

Treatment. To save the treatment schedule for other SIMPPLLE sessions, select **File > Save As**. Saving can be done as soon as all of the combinations have been made, or you can come back to this later after you have made simulations and decided you like the results. Selecting **Save As** opens a screen to the working directory you have identified. The system will add the treatment (*.treatment) extension to the name you have provided.

The saved file cannot be viewed or edited outside of SIMPPLLE. To use it again, select **File > Open**. This will load the saved file.

When some treatments are scheduled they involve a follow-up treatment. The user can schedule these (check the box next to **Schedule Follow Up Treatment** as shown in Figure 142), or some are already built into the treatment. In our previous selection of mechanical thinning we had a herbicide application added as a follow-up. For those that are part of the original designed treatment for a zone, the follow-up will automatically show up. An example is a group -selection -cut that is followed by another harvest in the next time step. These follow-up treatments can be changed or disabled through the screen for scheduling the treatment (Figure 142).

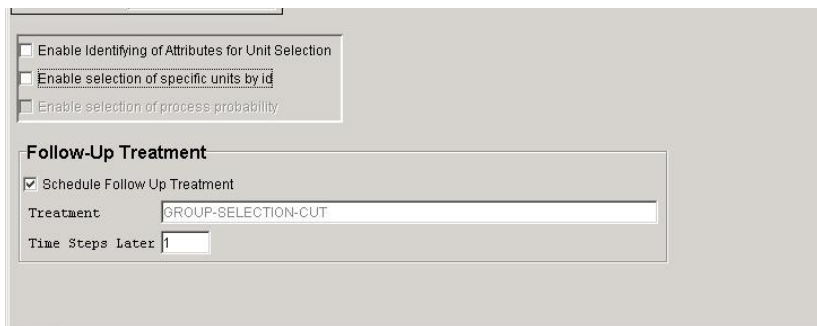


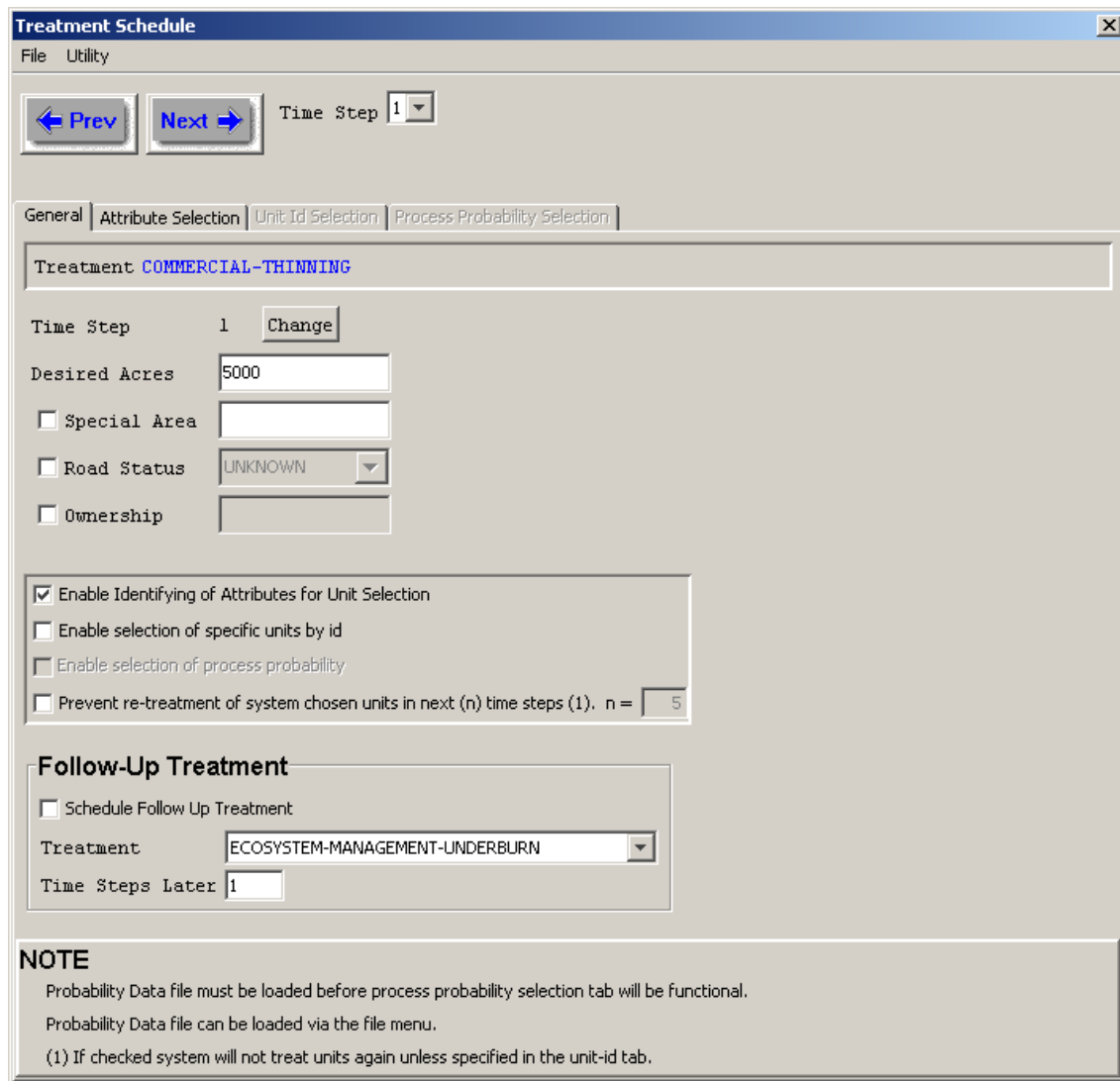
Figure 142 Treatment Schedule screen showing a group-selection-cut treatment that will be followed up in the next time step by another group-selection-cut treatment.

Schedule by Identifying Attributes

Instead of trying to identify all the individual units, you may want to apply treatments to a type of condition such as commercial thinning the lodgepole pine stands that are medium in size and at the highest density levels. The user has the option of specifying a desired level of acres for treatment. In this case SIMPPLLE will decide where to apply the treatment to try and achieve the acreage specified. The advantage of having SIMPPLLE look for the units that meet the attribute conditions is that it does it at each individual time step. The schedule is not built for all time steps based on starting conditions, but takes into account the conditions at the start of each time step. In other words, the disturbance processes that are changing the landscape have an

impact on what is scheduled. The units that meet the attributes specified at the start of each time step are put in a list and SIMPPLE sequentially selects from this list till it meets your acreage goal. Additional selection criteria can be added in a future version if they are requested by users.

Figure 143 is an example of the activated **Attribute Selection** tab.



Treatment Schedule

File Utility

← Prev Next → Time Step 1

General | **Attribute Selection** | Unit Id Selection | Process Probability Selection

Treatment **COMMERCIAL-THINNING**

Time Step 1 **Change**

Desired Acres 5000

☐ Special Area

☐ Road Status UNKNOWN

☐ Ownership

☒ Enable Identifying of Attributes for Unit Selection

☒ Enable selection of specific units by id

☐ Enable selection of process probability

☒ Prevent re-treatment of system chosen units in next (n) time steps (1). n = 5

Follow-Up Treatment

☐ Schedule Follow Up Treatment

Treatment ECOSYSTEM-MANAGEMENT-UNDERBURN

Time Steps Later 1

NOTE

Probability Data file must be loaded before process probability selection tab will be functional.
 Probability Data file can be loaded via the file menu.
 (1) If checked system will not treat units again unless specified in the unit-id tab.

Figure 143 Screen within the “Treatment Schedule” with the choices made to activate the “Attribute Selection” screen to provide the information to enable SIMPPLE to select units for treatment application.

In Figure 144, under **Chosen Items**, three habitat-type groups (**Ecological Grouping**), some combinations of lodgepole pine species (**Species**), size classes of medium and above (**Size Class**), the highest two density classes (**Density**), plus an additional requirement that the units have had a previous process of light mountain pine beetle in them (**Processes**) have been identified to be potentially selected for treatment.

The screenshot shows the 'Treatment Schedule' window with the 'Attribute Selection' tab active. The title bar includes 'File' and 'Utility' menus. Navigation buttons for 'Prev' and 'Next' are present, along with a 'Time Step' dropdown set to '1'. The main section is titled 'Identify Attributes for Evu Selection'. It features a table-like structure with five rows of attributes: Ecological Grouping, Species, Size Class, Density, and Processes. Each row has a 'Possible Choices' list on the left and a 'Chosen Items' list on the right. Between these lists are 'Append' and 'Insert' buttons. To the right of the 'Chosen Items' lists are 'Remove Item' buttons. The 'Possible Choices' lists are as follows:

- Ecological Grouping:** B2, A1, NF4, B3, xx4
- Species:** L-WP, L-WP-GF, LATE-SERAL, LP, LP-ΔF
- Size Class:** LMU, LTS, MEDIUM, MMU, MTS
- Density:** 1, 2, 3, 4
- Processes:** SUCCESSION, LIGHT-WSBW, SEVERE-WSBW, PP-MPB, LIGHT-LP-MPB

The 'Chosen Items' lists contain the following selections:

- Ecological Grouping:** B1, B2, B3
- Species:** L-DF-LP, L-LP, L-LP-GF, LP
- Size Class:** LMU, LTS, MEDIUM, MMU, MTS
- Density:** 3, 4
- Processes:** LIGHT-LP-MPB

Figure 144 Combinations of attributes that have been identified to provide SIMPLLE the basis for selecting units for treatment assignment.

An upper limit of 5000 acres has been set in Figure 143; however, no limits by ownership or special areas within the landscape are set.

Time Selection by Probability

The choice of this attribute (the grayed-out **Enable selection of process probability**) to schedule treatments involves making multiple simulations to create a probability file and using these probabilities to let the system guide the selection of units to treat. This choice is currently not functional.

Prevent Retreatment

To activate this choice, check the box next to **Prevent re-treatment of system chosen units in next (n) time steps (1)**. This enables the user to enter a value for **n**. Some treatments may make minor changes in attributes such as a precommercial thinning that only lowers the density or, for a low-density class to begin with, may not make any change in the attributes at all. In this case on the basis of the attributes, the plant community may be seen as feasible for the same treatment in the next decade (depends on what the treatment schedule calls for). By use of this feature, the user can prevent the plant community from being repeatedly treated on too short of a cycle.

View/Order Treatments

A treatment schedule can be created by any combination of these choices for scheduling.

Total treatments can be scheduled from the Treatment Schedule screen. Select **Utilities > View/Order Treatments**. All the treatments for a time step are shown. **Prev** and **Next** can be used to move through the schedule for all time steps. If multiple treatments may apply to plant communities with the same attributes, the treatments can be ordered by priority. Figure 145 is an example of a set of treatments for Time Step 1. The three columns to the right are the acre goal, the special area field, and the road status field. Reordering the treatments is done by selecting and dragging with the mouse.

	Treatment Name	Area	Status
1	AGRICULTURE	5806210	n/a
1	IMPROVEMENT-CUT	5806210	n/a
1	COMMERCIAL-THINNING	15000	blm-wd OPEN ROADED
1	GROUP-SELECTION-CUT	15000	blm-wd OPEN ROADED
1	SANITATION-SALVAGE	5806210	n/a OPEN ROADED
1	CLEARCUT-WITH-RESERVES	20000	n/a OPEN ROADED
1	ECOSYSTEM-MANAGEMENT-BROADCAST-BURN	1500	n/a OPEN ROADED
1	ECOSYSTEM-MANAGEMENT-BROADCAST-BURN	100000	n/a OPEN ROADED
1	ECOSYSTEM-MANAGEMENT-BROADCAST-BURN	15000	n/a OPEN ROADED
1	ECOSYSTEM-MANAGEMENT-BROADCAST-BURN	4000	n/a OPEN ROADED
1	INDIVIDUAL-SELECTION-CUT	20000	blm-cm OPEN ROADED
1	COMMERCIAL-THINNING	15000	blm-str-wd OPEN ROADED
1	COMMERCIAL-THINNING	15000	blm-srg-wd OPEN ROADED
1	INDIVIDUAL-SELECTION-CUT	20000	blm-str-cm OPEN ROADED
1	INDIVIDUAL-SELECTION-CUT	20000	blm-srg-cm OPEN ROADED
1	SEEDTREE-FINAL-CUT	100000	n/a OPEN ROADED

Figure 145 The treatments scheduled for Time Step 1. The order can be changed to represent a priority for SIMPLLE. The system starts at the top of the schedule.

10.6.2 Treatment Logic

To access the treatment logic screen, select **System Knowledge > Vegetative Treatments > Treatment Logic**.

The **Treatment Logic** screen is designed to provide the user with two capabilities: identify the conditions under which the treatment is feasible or infeasible, and identify changes in the plant community attributes that result from the treatment. Changes can be used for the duration of the simulation session, or they can be saved in a file that can be reloaded in future sessions. The user has the ability to create a treatment that does not currently exist.

Within the **Treatment Logic** screen, the **Current Treatment** pulldown menu allows the user to select a treatment. In Figure 146, **MECHANICAL-THIN** is selected. The **Feasibility** tab is active. Six items can be used to define the feasibility of this treatment. In this example (Figure 146), we have the two attributes of species and size class that have specific values that must be met to be feasible. In the middle of the screen the **AND** radio button is selected, meaning both conditions have to be met. The **Species** tab is selected showing that a vegetation community has to be **one** of the listed species.

Treatment Logic

File Feasibility Change Utility Knowledge Source

Current Treatment MECHANICAL-THIN

Feasibility | Change

Check Item to Activate

☐ Habitat Type ☒ Species ☒ Size Class

☐ Density ☐ Current State ☐ Call Function

Treatment is: ☒ Feasible ☐ NOT Feasible

Evaluation Left to Right according to below

Species ☒ AND ☐ OR Size Class

Ecological Grouping Species Size Class Density Current State Call Function

☒ one of: ☐ NOT one of: Choose Items from List

PIED, PIED-JUOS, PIED-JUSC2

Figure 146 Feasibility screen for the Mechanical-thin treatment showing the species that have to exist to be feasible.

The **Size Class** tab (selected in Figure 147) displays the values that the size class must be.

Treatment Logic

File Feasibility Change Utility Knowledge Source

Current Treatment MECHANICAL-THIN

Feasibility | Change

Check Item to Activate

☐ Habitat Type ☒ Species ☒ Size Class

☐ Density ☐ Current State ☐ Call Function

Treatment is: ☒ Feasible ☐ NOT Feasible

Evaluation Left to Right according to below

Species ☒ AND ☐ OR Size Class

Ecological Grouping Species Size Class Density Current State Call Function

☒ one of: ☐ NOT one of: Choose Items from List

LARGE, LMU, MMU

Figure 147 Feasibility screen for the treatment of mechanical-thin showing the size classes that have to exist to be feasible.

Figure 148 displays one of the change rules for the effects of mechanical thinning. This rule is for **Size Class** and shows that if the treatment is applied to a medium multi-story (MMU) community, the resulting change will be to a **MEDIUM Size Class**.

The screenshot shows the 'Treatment Logic' application window. The 'Current Treatment' dropdown is set to 'MECHANICAL-THIN'. The 'Feasibility' tab is active, and the 'Change' sub-tab is selected. Under 'Check Item to Activate', the 'Size Class' checkbox is checked. The 'Rule #0' section contains 'Prev' and 'Next' navigation buttons, along with a 'Pseudo Code Text' button. Below this, a text box indicates 'Evaluation Left to Right according to below' followed by 'Size Class'. A tabbed interface shows 'Ecological Grouping', 'Species', 'Size Class', 'Density', 'Current State', and 'Cell Function'. The 'Size Class' tab is active, showing radio buttons for 'one of' (selected) and 'NOT one of', with a 'Choose Items from List' button. A text box below contains 'MMU'. The 'Change' section at the bottom has tabs for 'To State Item', 'To State', and 'To Function Call'. The 'To State' tab is active, showing a 'To One of:' section with three columns: 'Species' (radio button, dropdown 'ACHY'), 'Size Class' (radio button, dropdown 'MEDIUM'), and 'Density' (radio button, dropdown '1').

Figure 148 The change rule for the change in size class that mechanical-thin makes to a MMU plant community.

Figure 149 displays the rule for the large multi-story (LMU) size class. The change is to a single story, **LARGE Size Class**.

The screenshot shows the 'Treatment Logic' application window. At the top, there's a menu bar with 'File', 'Feasibility', 'Change', 'Utility', and 'Knowledge Source'. Below the menu bar, a dropdown menu for 'Current Treatment' is set to 'MECHANICAL-THIN'. The main interface has two tabs: 'Feasibility' and 'Change', with 'Change' being the active tab. Under 'Check Item to Activate', there are checkboxes for 'Habitat Type', 'Species', 'Size Class' (which is checked), 'Density', 'Current State', and 'Call Function'. To the right of these checkboxes is 'Rule #1' with 'Prev' and 'Next' buttons, and a 'Pseudo Code Text' button. Below this, a text box says 'Evaluation Left to Right according to below:' followed by 'Size Class'. A horizontal tab bar shows 'Ecological Grouping', 'Species', 'Size Class' (selected), 'Density', 'Current State', and 'Call Function'. Below the tabs, there are radio buttons for 'one of' (selected) and 'NOT one of', and a 'Choose Items from List' button. A list box contains 'LMU'. At the bottom, the 'Change' section has sub-tabs 'To State Item', 'To State', and 'To Function Call'. Under 'To One of:', there are three columns: 'Species' with a dropdown set to 'ACHY', 'Size Class' with a dropdown set to 'LARGE' (and a radio button selected), and 'Density' with a dropdown set to '1'.

Figure 149 Change rule for mechanical-thin treatment for the LMU size class.

Notice there is no **MEDIUM OR LARGE** specified in these rules. They could have been in both rules, but if not specified, no change is made by the system. As one progresses through the rules for change, there is no rule for species. Without a rule, no change is made. For the **MECHANICAL-THIN** treatment, no change in species composition will be made.

Figure 150 shows the change to the **Density** attribute and the rule associated with it.

The screenshot displays the 'Treatment Logic' application window. At the top, the 'Current Treatment' is set to 'MECHANICAL-THIN'. Below this, the 'Feasibility' tab is active, showing a list of attributes: 'Habitat Type', 'Species', 'Size Class', 'Density' (checked), 'Current State', and 'Call Function'. To the right of these attributes are 'Rule #2' buttons: 'Prev', 'Next', and 'Pseudo Code Text'. Below the 'Feasibility' tab, the 'Evaluation Left to Right according to below' section is visible, with 'Density' selected. A text input field below this contains the values '2, 3, 4'. The 'Change' tab is also visible, showing 'To State Item' with 'To State' and 'To Function Call' sub-tabs. Under 'To One of:', there are three dropdown menus: 'Species' (set to 'ACHY'), 'Size Class' (set to 'AGR'), and 'Density' (set to '1').

Figure 150 Change rule for density for the mechanical-thin treatment showing densities 2, 3, and 4 all go to level 1.

Figure 151 shows a **Species** change rule for a treatment.

The screenshot shows the 'Treatment Logic' window with the 'Current Treatment' set to 'ECOSYSTEM-MANAGEMENT-THIN-AND-UNDERBURN'. The 'Feasibility' tab is active, and the 'Change' sub-tab is selected. Under 'Check Item to Activate', the 'Species' checkbox is checked. The 'Rule #0' section includes 'Prev' and 'Next' buttons and a 'Pseudo Code Text' button. The 'Evaluation Left to Right according to below' section shows 'Species' as the selected attribute. The 'Ecological Grouping' section has 'one of' selected, and the list contains 'DF-AF, DF-ES, DF-GF, DF-LP, DF-WP-GF'. The 'Change' section has 'To State Item' selected, and the 'To One of' sub-section shows 'DF' selected for Species, 'AGR' for Size Class, and '1' for Density.

Figure 151 Species change rule for the ecosystem management thin and underburn treatment showing the removal of the more tolerant understory species from Douglas-fir mixtures.

An entire state (“To State Item”) can be changed (“To State”) in addition to showing the treatment change individually by one of the vegetation state attributes of species, size class or density. The **To Function Call** tab is a third way to represented change. Figure 152 shows the use of the **TypeOfFireNextState** function call.

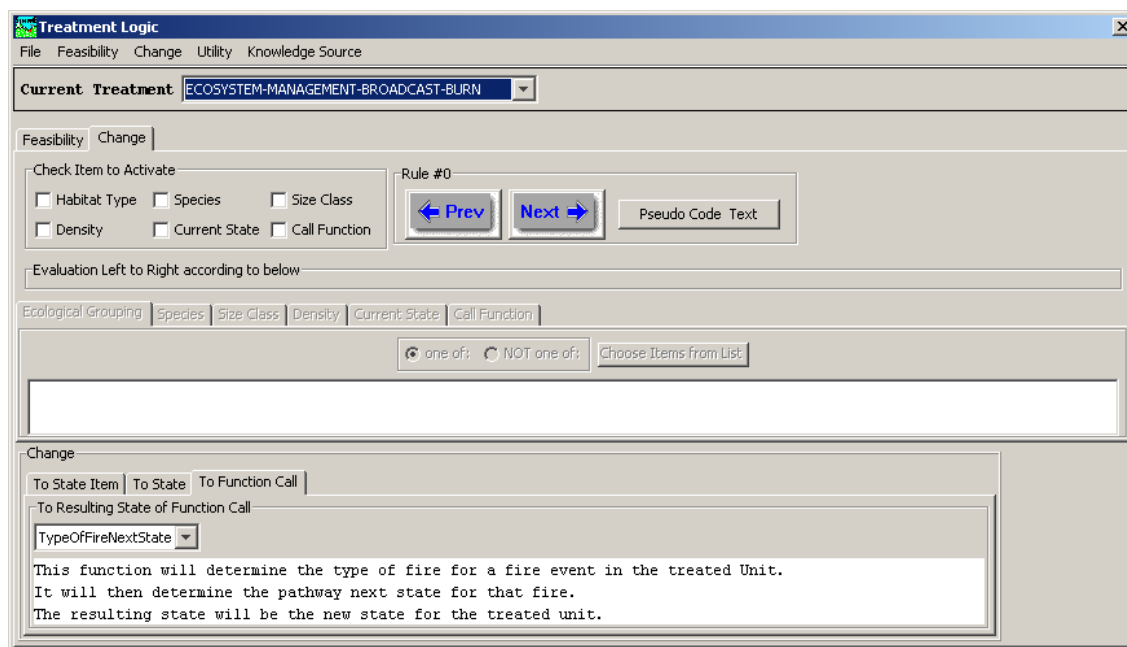


Figure 152 Change rule for a treatment showing the use of the Function Call to identify the state following the treatment.

A limited number of functions have been developed for specific cases and are available to use with both the feasibility and change logic. To see the available choices, use the pull-down arrow on the right of the function name slot. The description is given in the text box below as seen in Figure 152 for the “TypeofFireNextState” function. New function calls cannot be created by the user in version 2.5.

10.7 AQUATIC TREATMENTS

This choice is not functional for this version.

10.8 REGIONAL CLIMATE

System Knowledge > Regional Climate is a simplified way to account for the variability that can result from time steps that have different weather conditions. SIMPPLLE uses two variables, temperature and moisture. **Temperature** selections are **COOLER**, **NORMAL**, or **WARMER**. **Moisture** selections are **WETTER**, **NORMAL**, or **DRIER**. Figure 153 represents an approach used in simulating Mesa Verde National Park. From precipitation records for the park, the years 1950 to 1970 were selected and the standard deviation was calculated for this period. A sequence of normal, drier, or wetter was assigned based on a year beginning within, above, or below one standard deviation of the mean precipitation for this period. This sequence of the moisture component of the regional climate was utilized in simulations.

	A	B	C	D	E
1	Site	MVNP C			
2	Year	6			
3	1940	600.964			
4	1941	846.836			
5	1942	371.856			
6	1943	436.118			
7	1944	505.206			
8	1945	370.84			
9	1946	418.338			
10	1947	435.102			
11	1948	398.018			
12	1949	524.002			
13	1950	240.284	drier		
14	1951	430.53	normal		
15	1952	359.41	normal		
16	1953	453.136	normal		
17	1954	477.774	normal		
18	1955	475.234	normal		
19	1956	248.412	drier		
20	1957	782.574	wetter		
21	1958	354.076	normal		
22	1959	433.324	normal		
23	1960	413.258	normal		
24	1961	450.088	normal		
25	1962	364.49	normal		
26	1963	393.446	normal		
27	1964	447.294	normal		
28	1965	666.75	wetter		
29	1966	411.734	normal		
30	1967	313.436	drier		
31	1968	382.27	normal		
32	1969	660.654	wetter		
33	1970	510.286	normal		
34	1971	419.1	normal		

Figure 153 Calculation of a sequence of moisture for the regional climate variable using past precipitation records from Mesa Verde National Park.

Many processes can have their behavior modified by the Regional Climate. Version 2.5 includes these two variables in the columns that can be selected for all logic screens.

When loading a previously saved system knowledge file, a similar screen is available. The user can choose to load all or just parts of what was put in the saved system knowledge file.

10.9 OPEN USER KNOWLEDGE FILE—SAVE USER KNOWLEDGE FILE

See the general comments within the “System Knowledge” section.

10.10 RESTORE ALL DEFAULTS

System Knowledge > Restore All Defaults will restore all of the system knowledge to the default values for the geographic zone. This has the same effect as reloading the current zone.

11. UTILITIES

Utilities (Figure 154) contains a variety of features, some that have been briefly covered in other sections. This section provides a more complete discussion of each choice. These features have been developed as a need has been identified over a number of years. Some have been incorporated into other parts of the system with newer versions of SIMPPLLE.

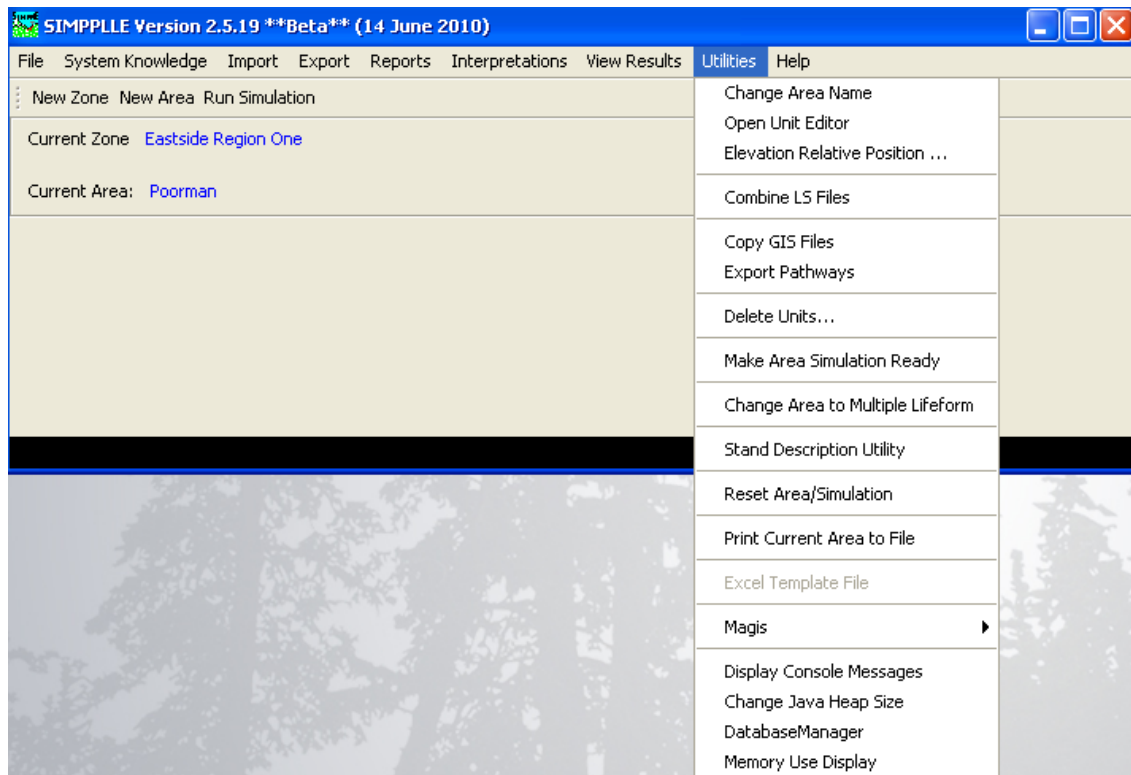


Figure 154 Choices under the Utility menu.

11.1 CHANGE AREA NAME

Utilities > Change Area Name provides a dialog box to provide a name for the landscape being simulated. This is not the name of the area (*.area) file, but the name will be associated with the area file and will be used in a number of screens and reports. This same feature is used to provide a name the first time an area file is created through the **Import** menu.

11.2 OPEN UNIT EDITOR

Utilities > Open Unit Editor is only available when an area file is first loaded, or changes are made that result in invalid units. The **Open Unit Editor** is identical to **Edit Units** (under the **Import** menu).

11.3 ELEVATION RELATIVE POSITION

Default 10 percent difference in elevation (in meters) between a vegetation unit and its adjacent vegetation units to determine relative position (**ABOVE**, **BELOW**, or **NEXT-TO**). The user can enter a different value if the default is not desired.

11.4 COMBINE LS FILES

When a set of multiple simulations is made, one of the basic output files created is the *-ls.txt file used with the Excel basic processing macro. **Utilities > Combine LS Files** has been created for a situation where memory constraints do not allow the user to make as many simulations in a set as desired. For example, for evaluating the historic range of variability for a landscape, the combination of total area and size of units allow only five 100-decade simulations to be made. If the desired number of simulations is thirty 100-decade simulations, then six sets of simulations can be made. This utility will let the user combine all six “*-ls.txt” files into one for processing.

11.5 COPY GIS FILES

Utilities > Copy GIS Files allows the user to move the files that come with SIMPPLLE to a desired location (Figure 155).

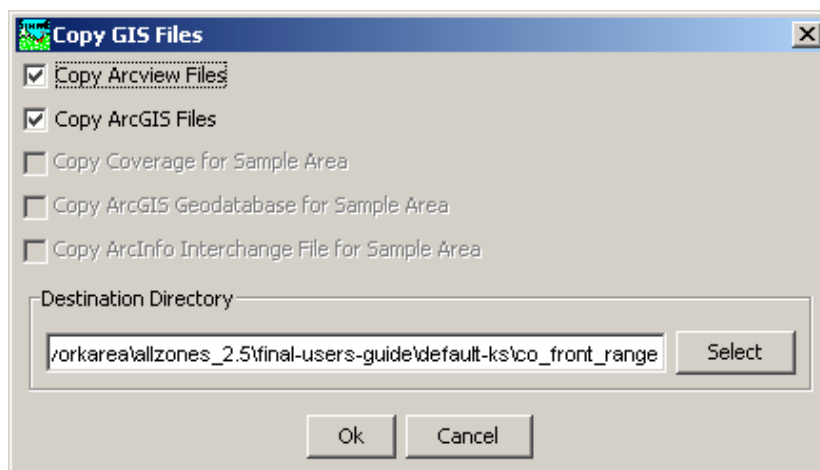


Figure 155 Dialog box for copying GIS files.

Copy Coverage for Sample Area, **Copy ArcGIS Geodatabase for Sample Area**, and **Copy ArcInfo Interchange File for Sample Area** are no longer functional. As the number of geographic zones increased, these became too large to automatically include in the installation. If one wants to work with the sample areas a separate download exists on the website for these GIS files (<http://www.fs.fed.us/rm/missoula/4151/SIMPPLLE/downloads.html>).

11.6 EXPORT PATHWAYS

Utilities > Export Pathways prompts the user to provide a file location and a name for SIMPPLLE to export a text file of all of the allowable species/size/density assignments by habitat group.

11.7 DELETE UNITS

Utilities > Delete Units provides a way to delete units without having to go back to the GIS environment. It also removes these units as neighbors in associated vegetation units. These changes are not permanent unless the user selects **File > Save Landscape**.

11.8 MAKE AREA SIMULATION READY

Utilities > Make Area Simulation Ready will take the vegetation conditions at the end of the simulation and make them the starting conditions so a simulation could begin with these new values. The disturbance processes in the last time step are also kept as Time Step 0 processes, giving the plant communities a one time-step history to start with.

This choice is often used in using SIMPPLLE to help quantify historic conditions. A very long simulation, 1000 years, can be made without fire suppression. The end results can then be made the starting point for a set of multiple simulations to help quantify a range of historic conditions.

11.9 CHANGE AREA TO MULTIPLE LIFE FORMS

In order to utilize the **Tracking Species** option for modeling invasive species, the area file must use the multiple life form method for describing plant communities. If an area file was not created with multiple life forms, this choice will make the system interpret the file as having multiple life forms. No additional life forms will actually be added except when the system predicts the occurrence of an invasive species that will show up as a tracking species.

11.10 STAND DESCRIPTION UTILITY

Utilities > Stand Description Utility has not been developed yet.

11.11 RESET AREA SIMULATION

Utilities > Reset Area/Simulation will delete all simulation results and leave the landscape file as it initially existed. This is automatically implemented if the user starts a new simulation.

11.12 PRINT CURRENT AREA TO FILE

Utilities > Print Current Area to File will create a text file listing each plant community and its attributes.

11.13 EXCEL TEMPLATE FILE

Utilities > EXCEL Template File is no longer functional. It has been replaced by the Excel spreadsheets with macros that are available with the installation.

11.14 MAGIS

The following choices create files that are utilized in running the MAGIS (Zuuring et al. 1995) modeling system:

Risk Rating

Utilities > Magis > Risk Rating is not fully developed. The purpose is to have a file that assigns a risk value to each vegetation community for each time step. The interpretation of risk would be made through an interface screen that utilizes vegetation attributes along with the probabilities of disturbances from a set of multiple simulations.

Process and Treatment Files

Utilities > Magis > Process & Treatment Files creates two text files (in the dialog box for naming the files, make sure you assign a text [*.txt] extension). One file lists all of the treatments in each time step by each vegetation unit. The second file lists all of the processes in each time step by each vegetation unit.

All Vegetative States

Utilities > Magis > All Vegetative States will create one text file that contains all of the vegetative states involved in the set of simulations made.

Examples of using SIMPPLLE and MAGIS together can be found in Jones and Chew (1999, 2000), Jones et al. (1999) and Chew et al. (2000).

11.15 DISPLAY CONSOLE MESSAGES

If the user is having problems executing SIMPPLLE, **Utilities > Display Console Messages** can provide information that can be sent to the developers to help identify the problem.

11.16 CHANGE JAVA HEAP SIZE

Utilities > Change Java Heap Size is discussed under Memory Management. It allows the user to match the maximum Java Heap size to the memory available on the computer in use.

11.17 DATABASE MANAGER

Utilities > DatabaseManager starts up a utility that comes with HSQLDB for working with the database. It allows running queries and writing the results out to a delimited text file. We have not developed any capabilities with the database yet.

11.18 MEMORY USE DISPLAY

Utilities > Memory Use Display opens a window that will show the memory use as a simulation is being made. This memory use has also been recently added to the message at the bottom of the SIMPPLLE screen that displays the status of the simulation.

12. MAPPING SIMULATION OUTPUT

SIMPPLLE version 2.5 is designed to work with ArcGIS 9. In addition to the SIMPPLLE toolbox for processing input, an Extension is provided to map the simulation results. The ArcView project file, which was customized for use with earlier versions, is still included with the installation. The instructions for both are included.

12.1 ARCVIEW PROJECT

Locating the ArcView Project file and legend files:

1. Startup up SIMPPLLE.
2. Choose a zone.
3. Go to the **Utilities > Copy GIS Files**.
4. Select **Copy Arcview files**.
5. Next you will be presented with another file dialog.
Simply change to the directory where you want the files to be saved and press **Ok**.
(legend files have a **.avl** filename extension).

Opening the SIMPPLLE Project File:

1. Start ArcView GIS 3.2.
2. Open the project file `simplle_arcview.apr`.
3. This will result in a small dialog being displayed which will ask for two directory pathnames.

Project Pathname: The directory containing output from SIMPPLLE (i.e., the .txt files).
Data Pathname: The directory containing the project file you just opened as well as all of the necessary legend files.

Note that all pathnames should have a forward slash (/) at the end. Remember, the pathways names are different for a PC and a UNIX platform.

The Three types of SIMPPLLE Displays:

1. Display Current Processes, Species, Size Class, Canopy Coverage, and Treatments.

- This display will show the processes (for example) on the theme map in different colors.
- The color scheme is defined in the legend files you moved using SIMPPLLE for use with the ArcView project.

The files <data prefix>-#.txt are used with this display

*Where <data prefix> is the name you provided when saved GIS files with SIMPPLLE (e.g. **stevi-**)*

- Where # represents a time step number (i.e. 0,,1,,2, ...)
- There will be one file for each time step in the simulation plus a zero time step file which has initial conditions.
- This display allows for easily changing to different time steps.
- There is also the option of producing a chart with this display type.

2. Display probability (frequency of occurrence) for Processes, Species, Size Class, and Canopy Coverage.

- This display shows probability information for a particular Process, Species, Size Class, or Canopy Coverage.
- The information is shown via colors that correspond to pre-defined ranges of probabilities.
- The color scheme and probability ranges are defined in the legend files you moved using SIMPPLLE for use with the ArcView project.

The files named <data prefix>-process.txt, <data prefix>-size.txt, <data prefix>-canopy.txt, <data prefix>-species.txt are used with this display.

*Where <data prefix> is the name you provided when saved GIS files with SIMPPLLE (e.g. **stevi-**)*

- This display type allows for easily changing the field for which probability information is currently displayed.

3. Display Process Spreading for each time step.

Recommendations Concerning Views and Themes

The Avenue scripts written for this project have been designed to allow multiple themes in a given view. However, it is recommended that only themes of the same type be displayed in a given view. For example try not to place a theme showing spread in the same view as a theme showing probability. This will work, however, the title of the view typically carries information on the current time step. This information could be erased should a theme be added to show probability after a theme showing spread in the same view.

Aside from the above, a view can have as many themes as desired. For example, one could add a theme for a few different spreading processes and make the color transparent.

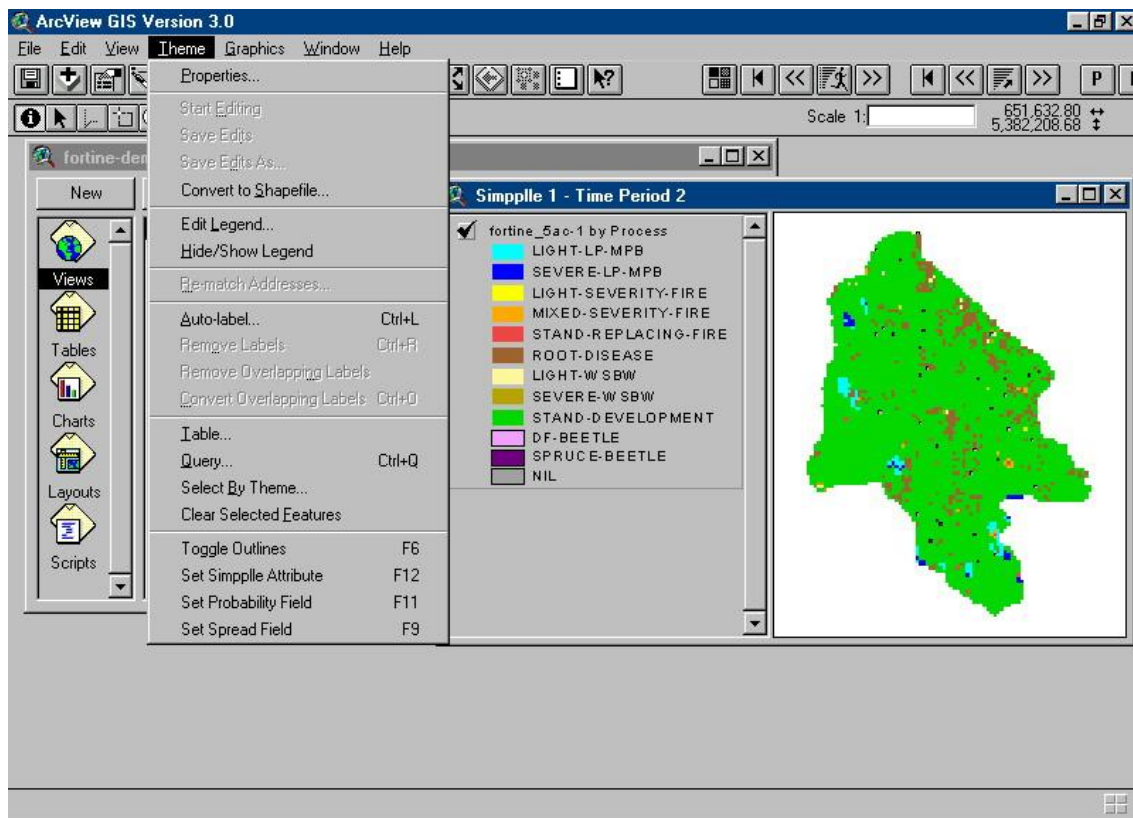


Figure 156 SIMPPLLE ArcView Project displaying processes for the second time step.

Toggle Outlines	F6
Set Simpplle Attribute	F12
Set Probability Field	F11
Set Spread Field	F9

Figure 157 Choices under the Theme Menu that serve specific functions in the SIMPPLLE project file.

Figure 157 displays options from the **Theme** drop down menu. The items function as follows: **Toggle Outlines (F6)** toggles the display of polygon outlines on and off. By default, all of the legends for use with SIMPPLLE have the polygon outlines turned off.

Set Simpplle Attribute (F12) is used with the SIMPPLLE Display and the Probability Display. This option displays a list of attributes to view for a particular theme: Process, Species, Size Class, Canopy Coverage, or Treatment. Treatment is not available for use with the Probability Display. **Set Simple Attribute** must be set in order to run the Simpplle Display or Probability Display setups.

Set Probability Field (F11) is used to choose which field to display probabilities for the currently selected theme. For example, if Process is chosen for the SIMPPLLE attribute,

then this would display a list of processes for the display of probabilities. *Note:* This is only used to change the field to a different one than chosen during probability setup. **Set Spread Field (F9)** is used to choose which Process to use in the spread display for the currently selected theme. This is only used to change the process field to a different one than chosen during spread setup.



Figure 158 Choice of customized buttons in the SIMPPLLE ArcView project file.

Figure 158 shows all of the view buttons within the **ArcView GIS Version 3.0** screen that are currently used for SIMPPLLE.

The  button will zoom all displays to the same extent as the currently selected view. For example, if you zoom in to a particular set of polygons in one view, pressing this button will zoom all of the other views to the same area.



Figure 159 The set of buttons used to display attributes by time-steps.

Figure 159 shows the set of buttons used in displaying current information on processes, species, size-class, canopy coverage, and treatments by time steps.

From left to right:

Button 1:

This moves the display of the all themes with this type of display back to the first loaded time step.

Button 2:

This moves the display of all themes with this type of display back one time step.

Button 3:

This is the setup button for this display type. Pressing it will display the **Display Setup** dialog box in Figure 160:

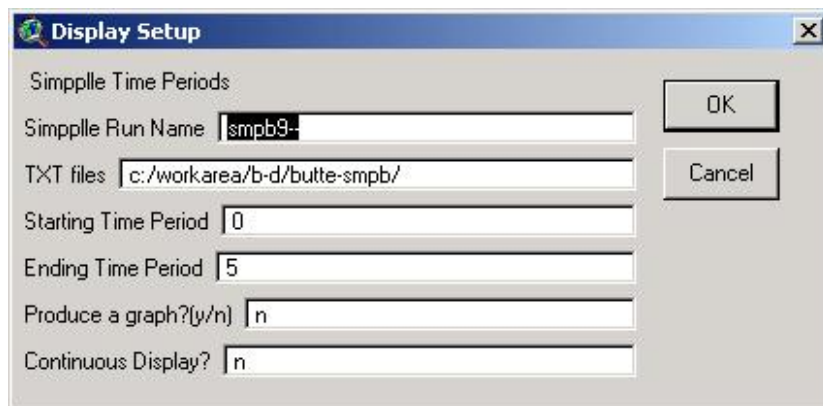


Figure 160 Dialog box for information required to display time steps.

The dialog shown in Figure 160 is used to get information needed to create the display for time-steps.

SIMPPLLE Run Name:

The prefix used in saving GIS Files in SIMPPLLE.

TXT files:

The directory where the SIMPPLLE output files are located.

Starting Time Period and Ending Time Period:

Enter the first and last time steps you wish to load.

Produce a graph:

Enter 'y' if you would like to produce a chart to summarize the displayed info.

Continuous Display:

Enter 'y' to load all of the time steps without being asked if you would like to load the next time step.

Button 4:

Same as button 2, except it moves forward one time step.



Figure 161 Buttons for the display of a process spread.

The set of buttons shown in Figure 161 controls the display of Process Spread.

From Left to Right:

Button 1:

This moves the display of the selected theme back to the first loaded time step.

Button 2:

This moves the display of the selected theme back one time step.

Button 3:

This is the setup button for this display type. Pressing it will display the dialog in Figure 65.

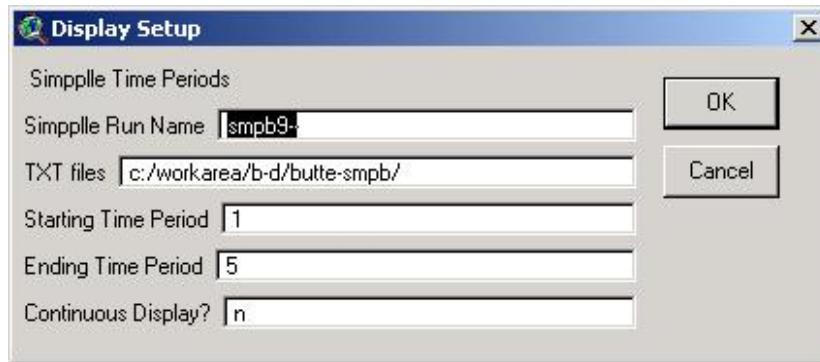


Figure 162 Dialog box for information needed for display of process spread and origin.

The dialog in figure 162 is very similar to that used for the time step information. The data requirements are identical.

Button 4:

This is the same as button 2, except it moves forward one time step.



Figure 163 This Button Display the setup dialog for Probability Displays.

Use the button in Figure 163 to bring up the Display Setup dialog box (Figure 164) to provide information required to display probability maps.

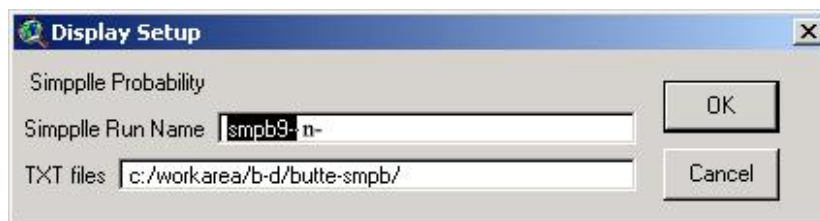


Figure 164 Dialog box for information required for probability map displays.

The following information is required for the probability displays.

SIMPPLLE Run Name:

This is the prefix used in saving GIS Files in SIMPPLLE.

TXT files:

This is the directory where the SIMPPLLE output files are located.



Figure 165 Button for exporting the current theme to a new cover.

The button in Figure 165 allows you to export the currently selected theme to a new coverage. Upon clicking this button, you will be presented with a file dialog asking for the output location and coverage name.



Figure 166 Button to return a selected theme(s) to the starting state.

The button in Figure 166 allows you to return a selected theme(s) to the state they were in when they were first added to a view. Specifically, it sets the themes **ProjectTag** to nil and executes an **UnJoinAll** on the theme table. This button will need to be used on a theme if the theme is currently showing one type of SIMPPLLE display and you wish to use this theme to display a different type of display. For example if a theme is currently showing spread and you wish to display probability information in this theme, it will be necessary to use this button first on the theme.

Step by Step Walk-through of Displaying SIMPPLLE data in ArcView

For this example, assume the following:

1. A simulation has been made for 5 time steps.
2. GIS output files with the prefix of **test-** have been created.

SIMPPLLE has been used to copy the Arcview project file and necessary legend files to the following location: C:/work1/gisdev

GIS output files are in the following location: C:/work1/gisdev. (Keep in mind this need not be the same directory as in #3).

We wish to look at the processes occurring in our area for each of the time steps.

Step 1: Starting ArcView

Once ArcView is started, a window similar to Figure 167 will appear.

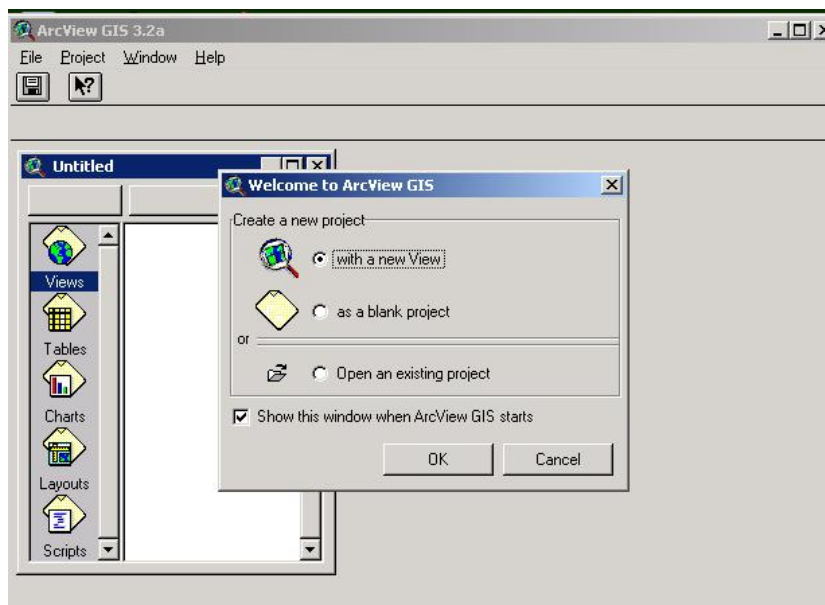


Figure 167 Dialog box for opening a new project file.

Step 2: Opening the SIMPPLLE Project file

Within the ArcView GIS menu, select **File > Open Project**. This will bring up the Open Project screen (Figure 168). Select the project file from the appropriate directory and click **OK**.

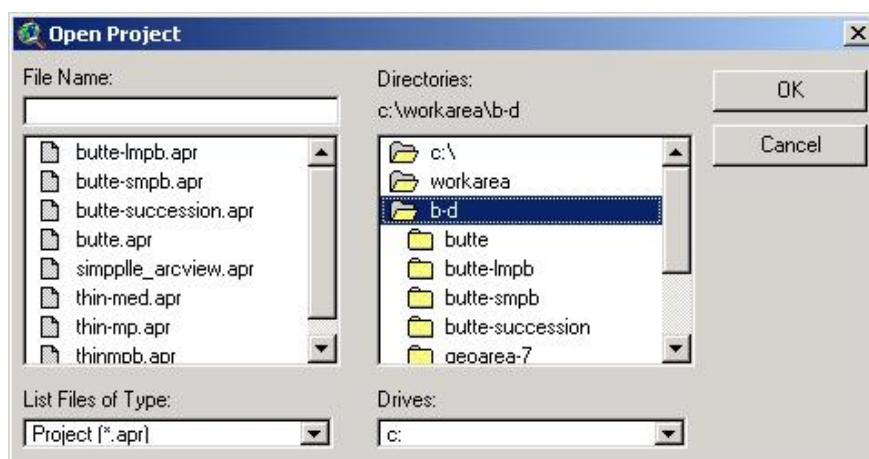


Figure 168 Dialog box for locating project files.

Step 3: Providing the Data and Project Pathnames

The selection of a project file will bring up the **Simpplle Pathnames** dialog box (Figure 169).

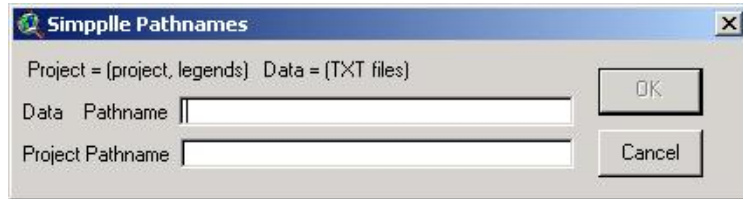


Figure 169 Dialog box for identifying pathnames for SIMPPLLE project.

The Data and Project pathnames can then be entered. **Project Pathname** is where the output from SIMPPLLE is stored (i.e., the text (*.txt) files). **Data Pathname** is where the legend files and the project file you just opened are stored.

Note: A forward slash (/) must be included at the end of a pathname.

Step 4: Creating a New View

After completing Step 3 you should see a window similar to Figure 170.

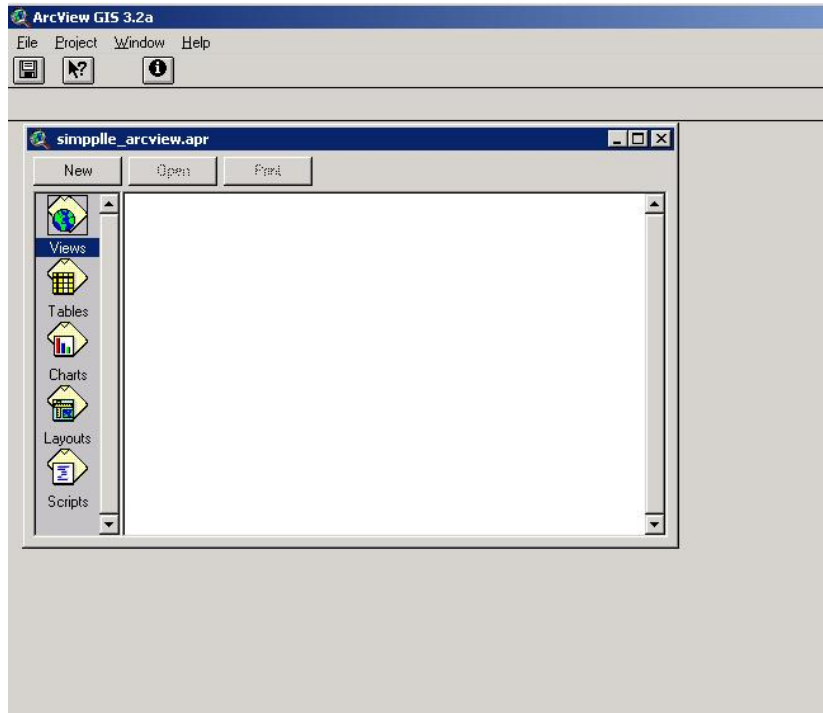


Figure 170 Basic opening screen for the SIMPPLLE project.

Click the icon with a picture of Earth labeled **Views**.

Next, click **New**. This will result in a window similar to Figure 171:

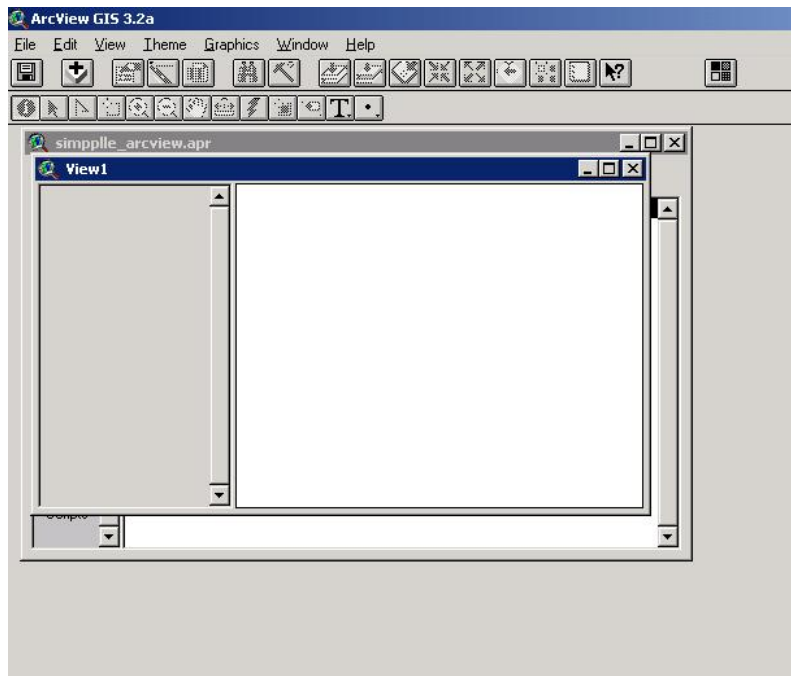


Figure 171 Display for adding a new view.

Step 5: Adding a Theme to the View

After successfully completing Step 4, make sure the new view is active by clicking on its window. The button with a plus sign (top row, second from left) is a shortcut to add a theme to a view (Figure 172). **View > Add Theme...** can also be used.

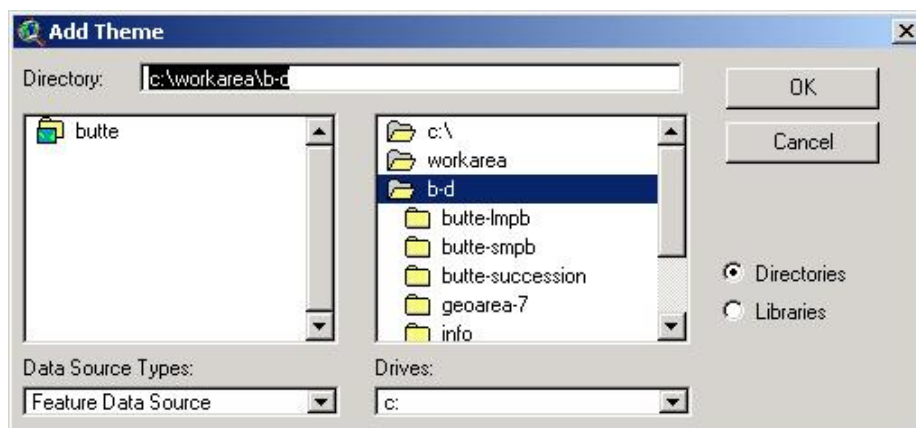


Figure 172 Display for adding a theme.

Navigate to the directory containing the coverage associated with the landscape run in SIMPPLE, select it, and press **OK**. You will now have a theme in the new view. Click on the small button next to the theme name. This will draw the theme in the window (Figure 173).

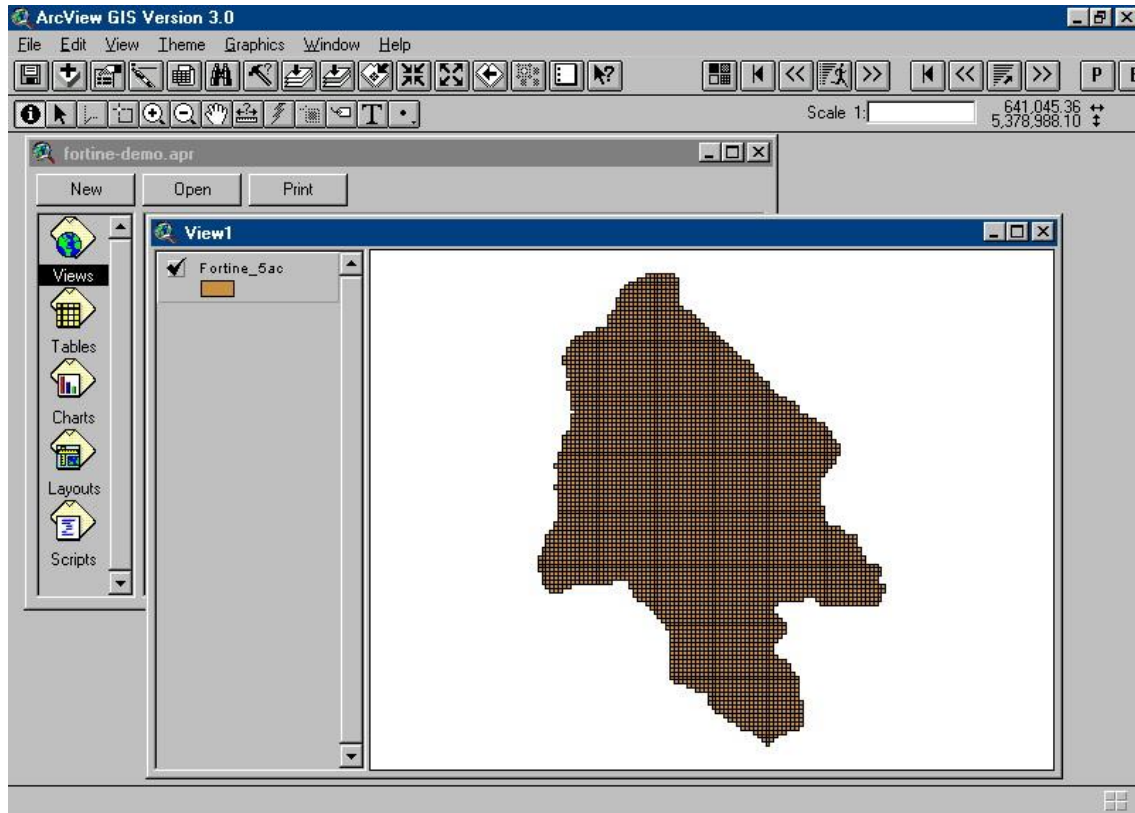


Figure 173 Display of plant community coverage added to the view.

Step 6: Setting the Simpplle Attribute

To set the Simpplle Attribute, make sure the new theme is selected in the view by clicking it. Press the **F12** key, or select **Theme > Set Simpplle Attribute** (Figure 174).

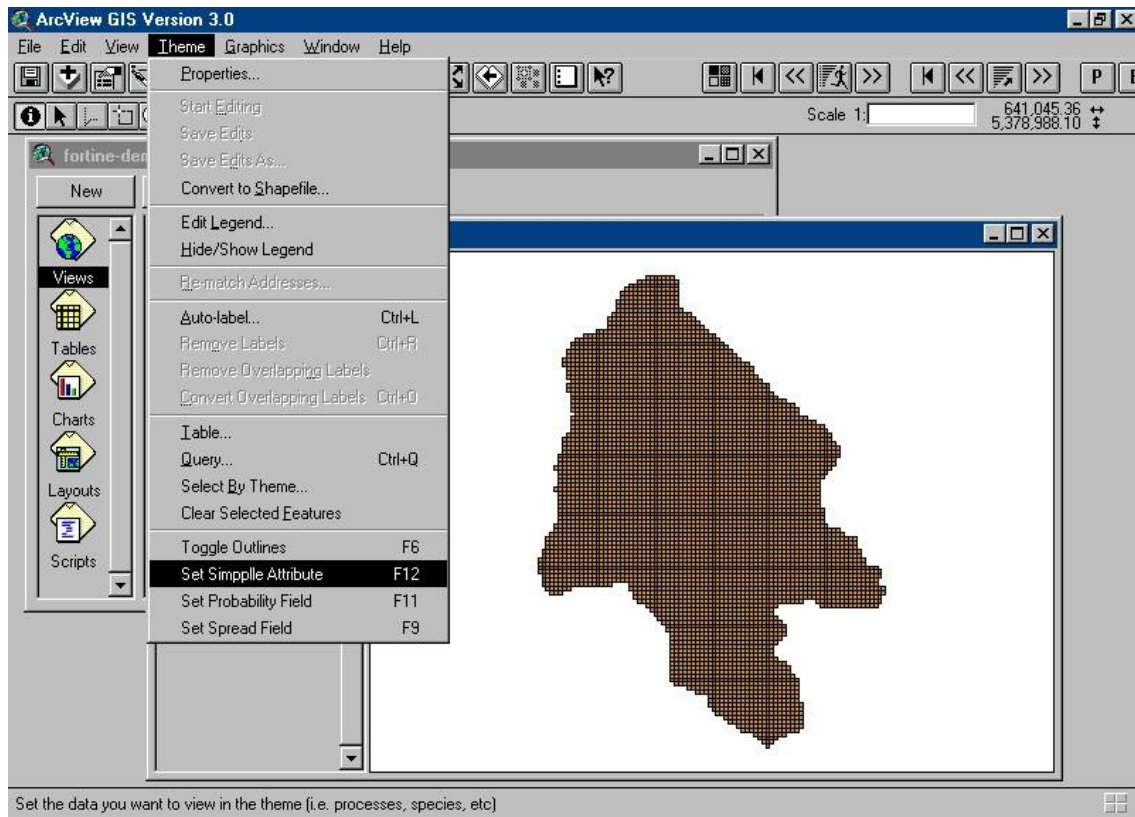


Figure 174 Display for selecting the attribute to show.

This will bring up **The List of Simpplle Attributes** screen (Figure 175).

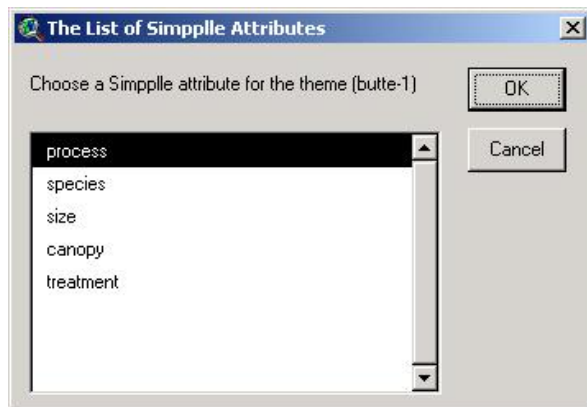


Figure 175 Choice of attributes to display.

Select **process** (as indicated in Figure 175) and click **OK**. Your view window will be similar to Figure 176.

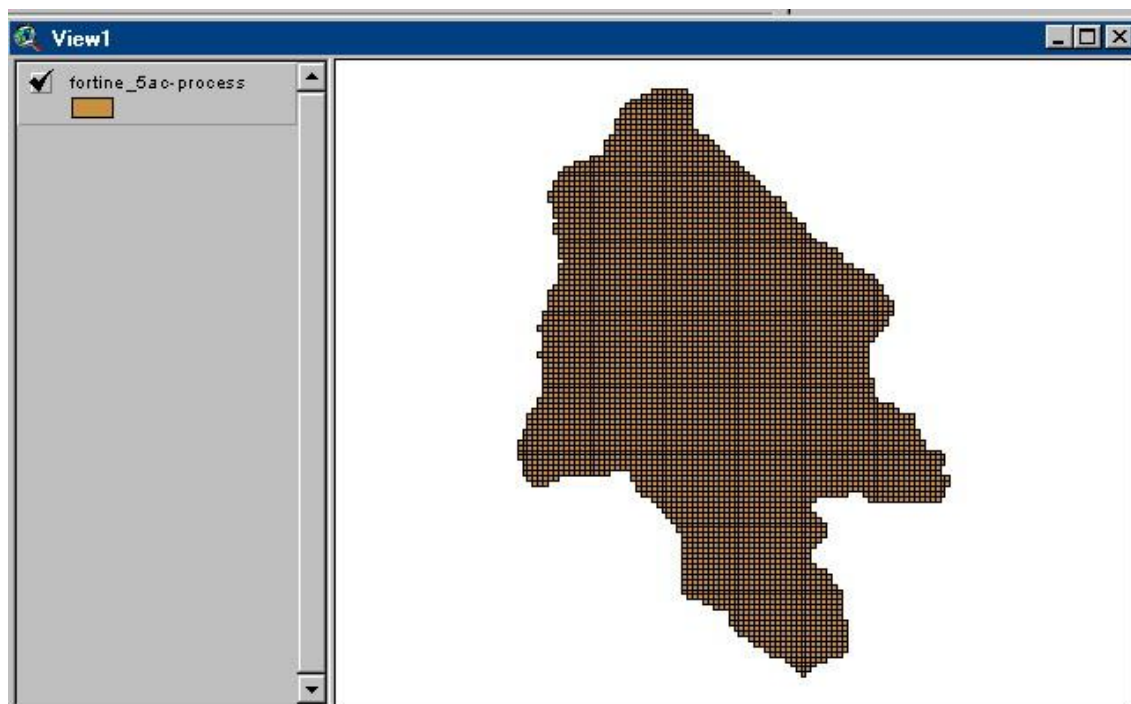


Figure 176 View with the process attribute selected.

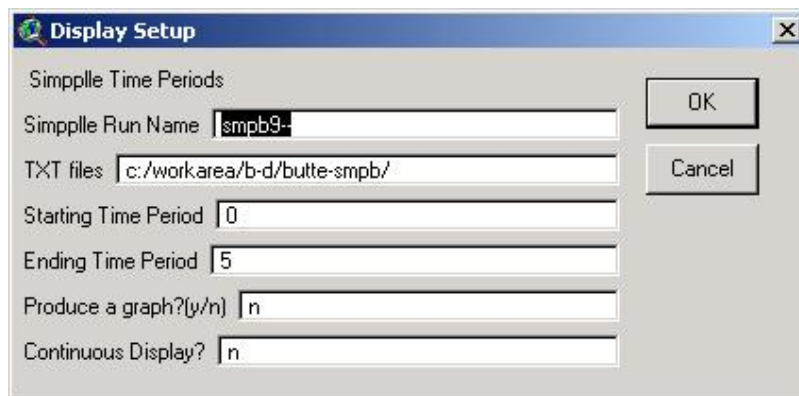
Step 7: Running the Simpplle Setup

To run the Simpplle setup, press the **Running Man** button shown in Figure 177.



Figure 177 Customized button for displaying attributes by time step.

Upon pressing the button you are presented with the following dialog:

A dialog box titled "Display Setup" with a close button (X) in the top right corner. It contains several input fields and two buttons (OK and Cancel) on the right side. The fields are: "Simpplle Time Periods" (empty), "Simpplle Run Name" (containing "smpb9-"), "TXT files" (containing "c:/workarea/b-d/butte-smpb/"), "Starting Time Period" (containing "0"), "Ending Time Period" (containing "5"), "Produce a graph?(y/n)" (containing "n"), and "Continuous Display?" (containing "n").

Field	Value
Simpplle Time Periods	
Simpplle Run Name	smpb9-
TXT files	c:/workarea/b-d/butte-smpb/
Starting Time Period	0
Ending Time Period	5
Produce a graph?(y/n)	n
Continuous Display?	n

Figure 178 Dialog box for providing information needed to display attribute by time step.

In Figure 179, the information shown in the dialog is correct; however, when you run the setup the information will undoubtedly be different. Assuming the information entered is correct, the Avenue Script will now start joining the "*.txt" files for each time step with the theme's table using the Slink field to join them. Upon completion, this will load the legend appropriate for the Simpplle Attribute chosen to display, in this case Processes (Figure 179).

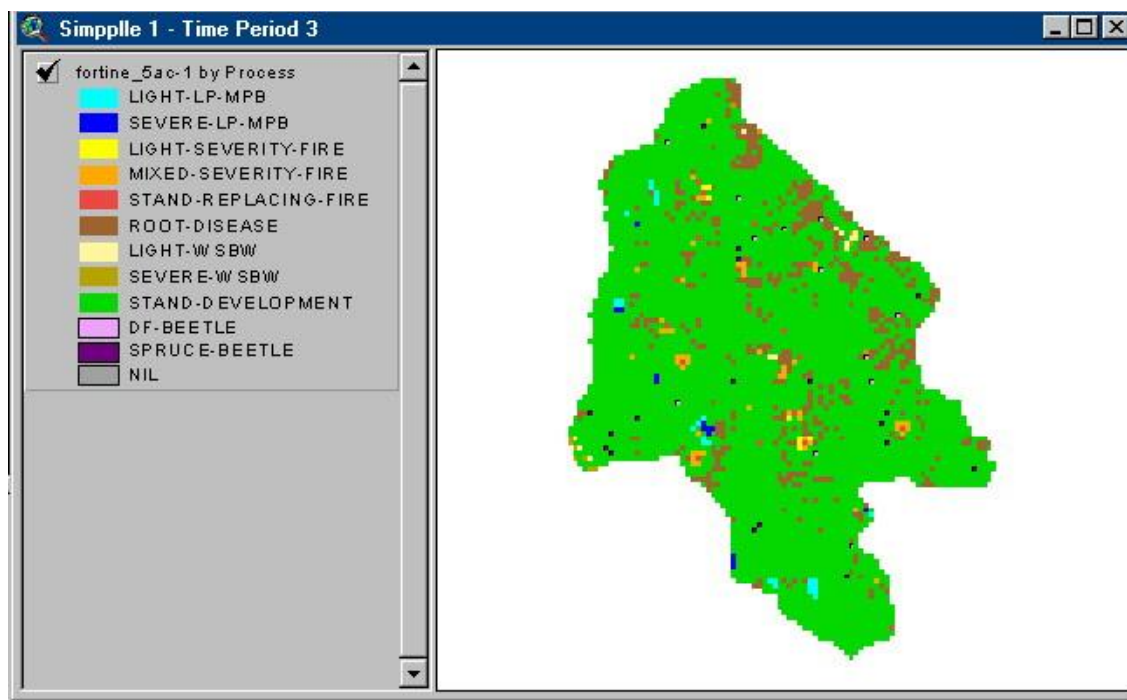


Figure 179 View with processes displayed for the third time step.

Step 8: Moving to a different time step

Moving to a different time step Can be achieved by pressing either the back (<<) or forward (>>) buttons shown in Figure 180.



Figure 180 Customized button to move from one time step to another.

The **Back (<<) Button** moves back a step.

The **Forward (>>) Button** moves forward a step.

Alternatively, the first button (left to right) in the above picture will take you to the first loaded time step, which in this example is Time Step 0.

Additional features of the customized ArcView project are given in Exercise 2 and 3.

12.2 ARCGIS EXTENSION

In addition to the SIMPPLLE toolbox that has to be added to the ArcGis environment (see section on Spatial Attributes) the user has to enable two other features in ArcMap. When SIMPPLLE is installed, the SIMPPLLE extension and SIMPPLLE toolbar are automatically added, but they must be enabled. To first enable the extension from the main menu in ArcMap select **Tools > Extensions**. This brings opens up the **Extensions** window (Figure 181) in which **ArcGIS SIMPPLLE Extension** must be checked.

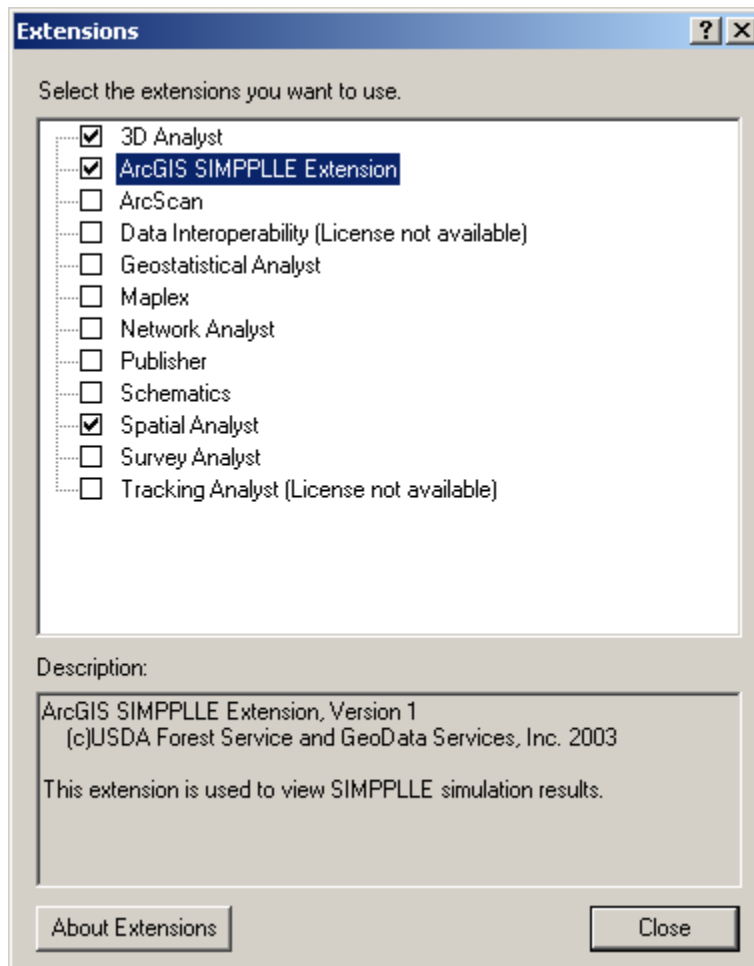


Figure 181 Selection that must be made to enable the SIMPPLLE extension.

To enable the SIMPPLLE toolbar for this extension, from the Untitled - ArcMap - ArcInfo screen, select **View > Toolbars** and click in the box **SIMPPLLE Toolbar** to enable it (Figure 182).

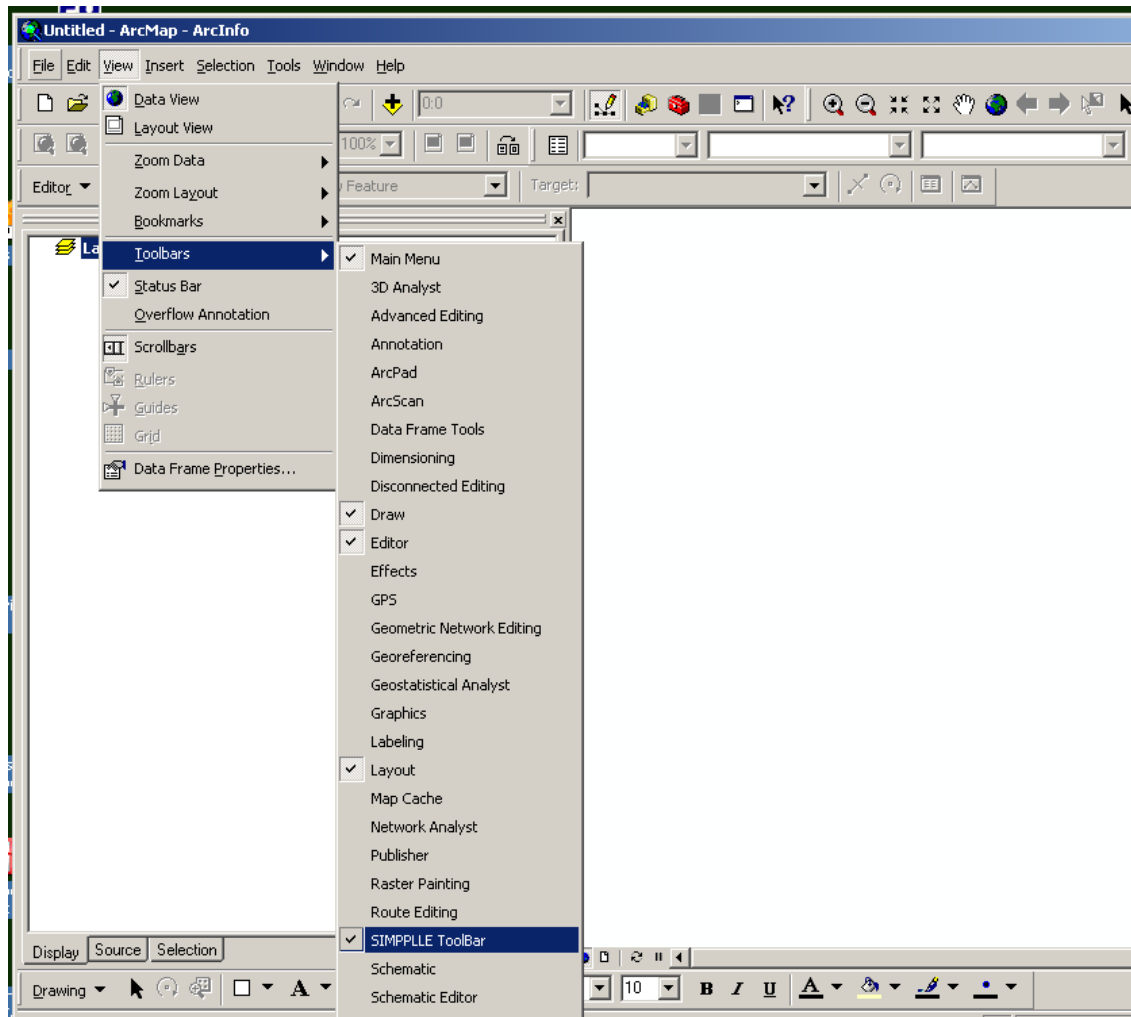


Figure 182 Choices that must be made to enable the SIMPPLLE toolbar.

When using the GIS extension you have to remember that different types of GIS files are created for single and multiple simulations. A single simulation will create (if you specify it in the simulations parameters) files that show an update of all the vegetation attributes and disturbance process occurrence for each time step and a spread file that shows the origin and spread of certain disturbance processes for each time step.

For multiple simulations, the only GIS files automatically created are probability files. There are probability files for each attribute and the processes for each time step and for the entire

simulation. If you specify in the simulation parameters that you want the update and spread files they will be generated and put in a separate directory for each simulation in the set. Usually, one does not specify the update and spread files at the time multiple simulations are made. The result would usually be far more files that one wants or needs. Instead, if after analysis using the probability files one wants to have a representation of an individual simulation, any number of the saved simulations (*.simdata) files can be reloaded and the GIS update and spread files created. All of this has a bearing on the extension in that you end up with two types of files in different directories. You can create an extension to display the probability files and/or an extension to display the update and spread files for an individual simulation. If you want an extension with both, it is best to make it by moving the update and spread files into the directory with the probability files and then using the SIMPPLLE GIS PreProcess tool.

Before running the GIS PreProcess tool, the default layer (*.lyr) files that the extension will use must be in a directory that you want. Initially, the default files can be downloaded from SIMPPLLE by going to **Utilities > Copy GIS Files**. Uncheck **Copy Arcview Files**, and leave the **Copy ArcGIS Files** checked (Figure 183). Next, provide a **Destination Directory**.

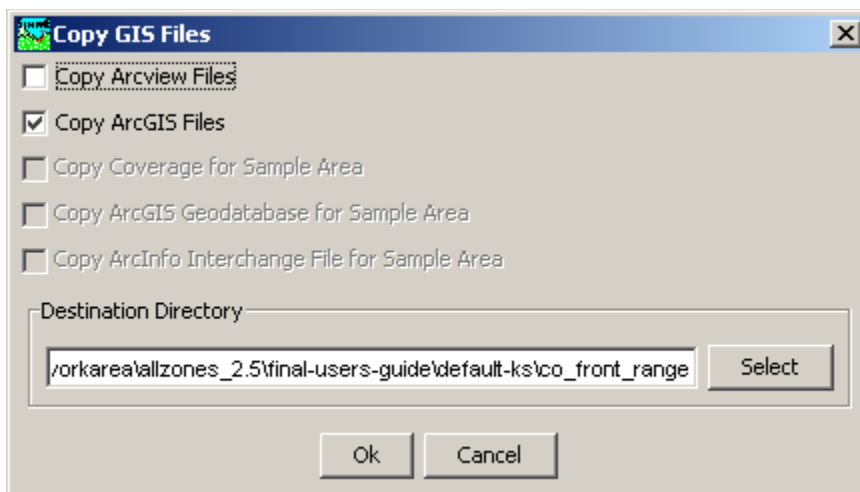


Figure 183 Choice to download the *.lyr files for the ArcGIS extension.

All of the layer files begin with the prefix "sim_." The system looks for the probability layer filed named "probability_legend.lyr." Until the next release of SIMPPLLE the probability file must be manually edited to drop the "sim_" prefix. If this is not completed, later in the process you will get an error message that the probability layer file cannot be found.

Once the layer files are in the desired location and the simulations have been made, the next step is to select the **SIMPPLLE GIS PreProcess** from the SIMPPLLE toolbox (Figure 184).

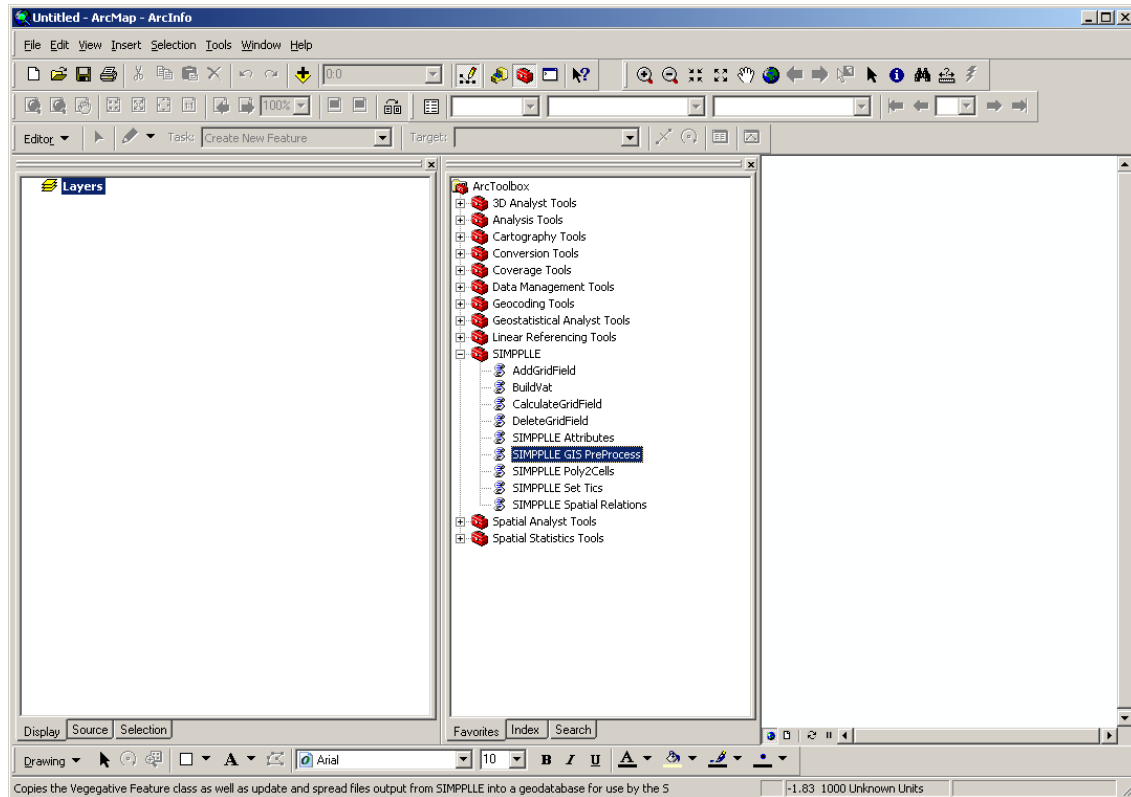


Figure 184 The SIMPPLLE GIS PreProcess tool.

This creates a geodatabase that combines the polygon layer feature class with the text files that are the SIMPPLLE output. The initial screen that comes up just mentions update and spread files, but it will load the probability files if that is what is in the “SIMPPLLE Files Directory” (Figure 185). It will load all the files with the prefix name used in the simulation.

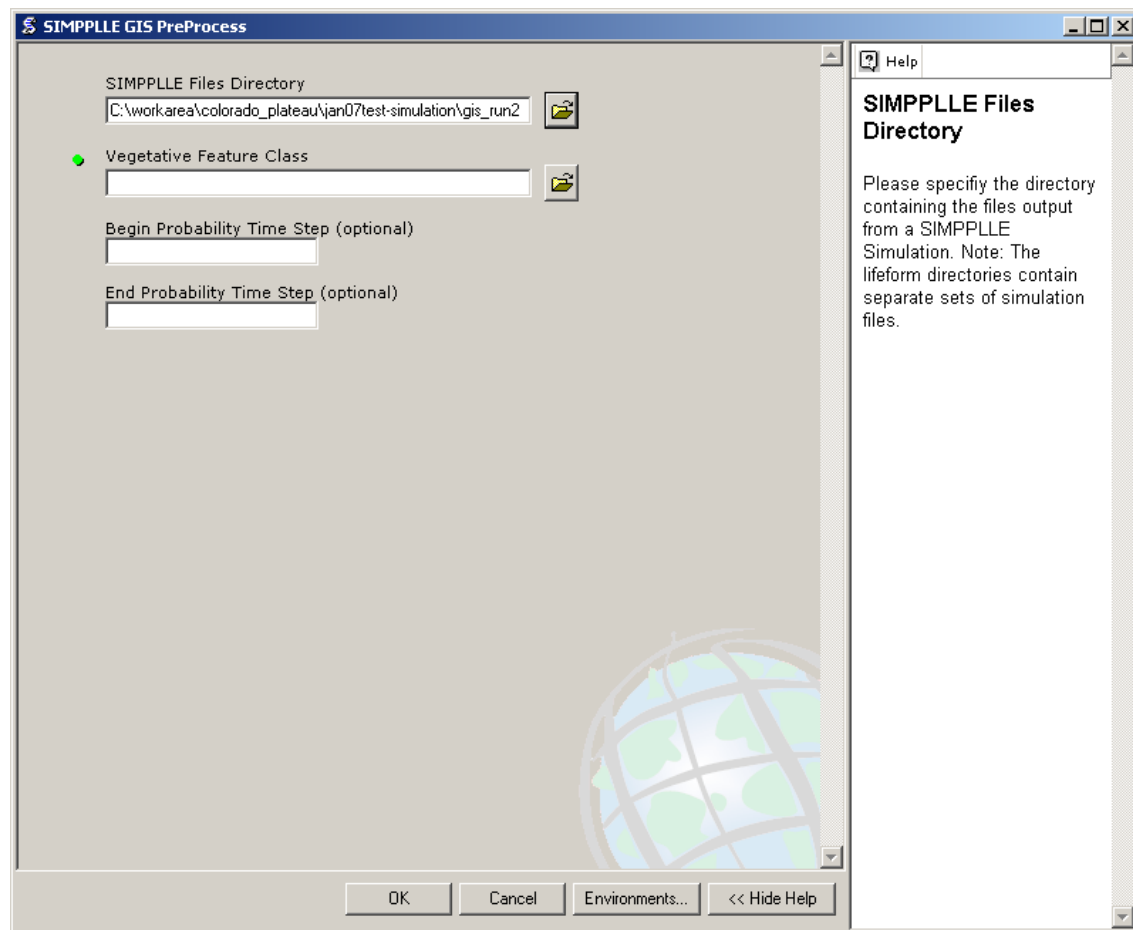


Figure 185 Specifying the location of the GIS *.txt files that were the output from a single or set of multiple simulations.

It is essential that you use the correct vegetative feature class as specified in the help screen (Figure 186). This must be the vegetation polygons in the feature class that was the result of running SIMPPLLE Spatial Relations.

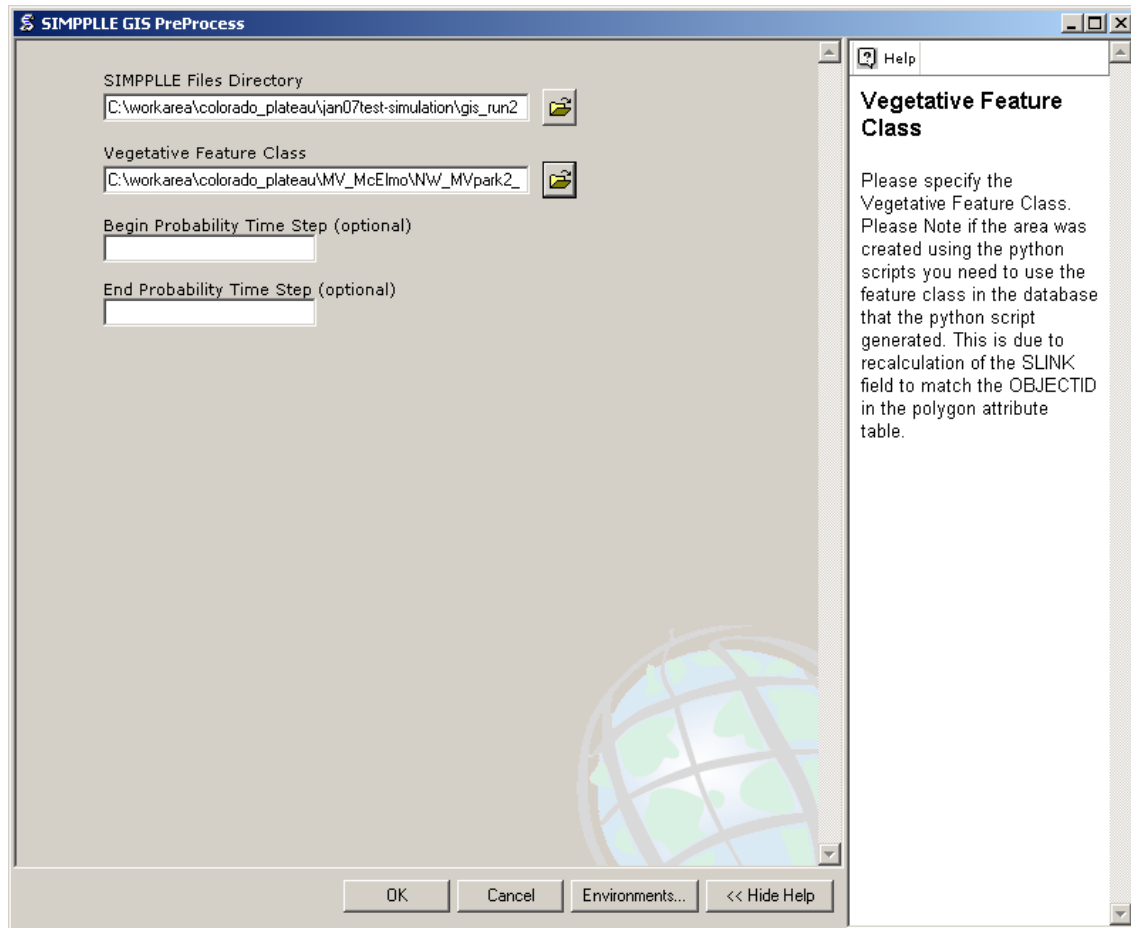


Figure 186 Specifying the vegetation feature class.

If you do not want to bring in all of the time steps, you can limit these by using the optional fields for beginning and ending time step. If left blank, all time steps will be used. Figure 187 will be displayed, showing the status of the process.

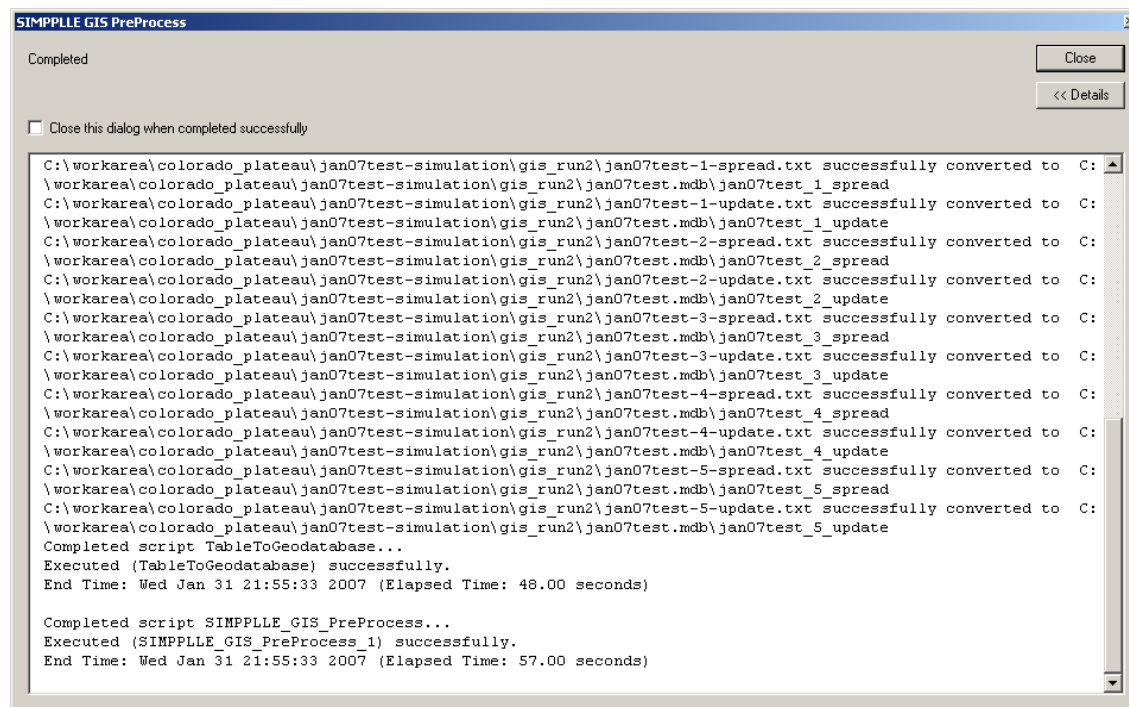


Figure 187 Status display for the PreProcess tool.

This tool creates a new geodatabase that has the original vegetative polygons plus all the imported tables. If the extension has been enabled and the SIMPPLLE toolbar added, the ArcMap screen will display it as shown in Figure 188.

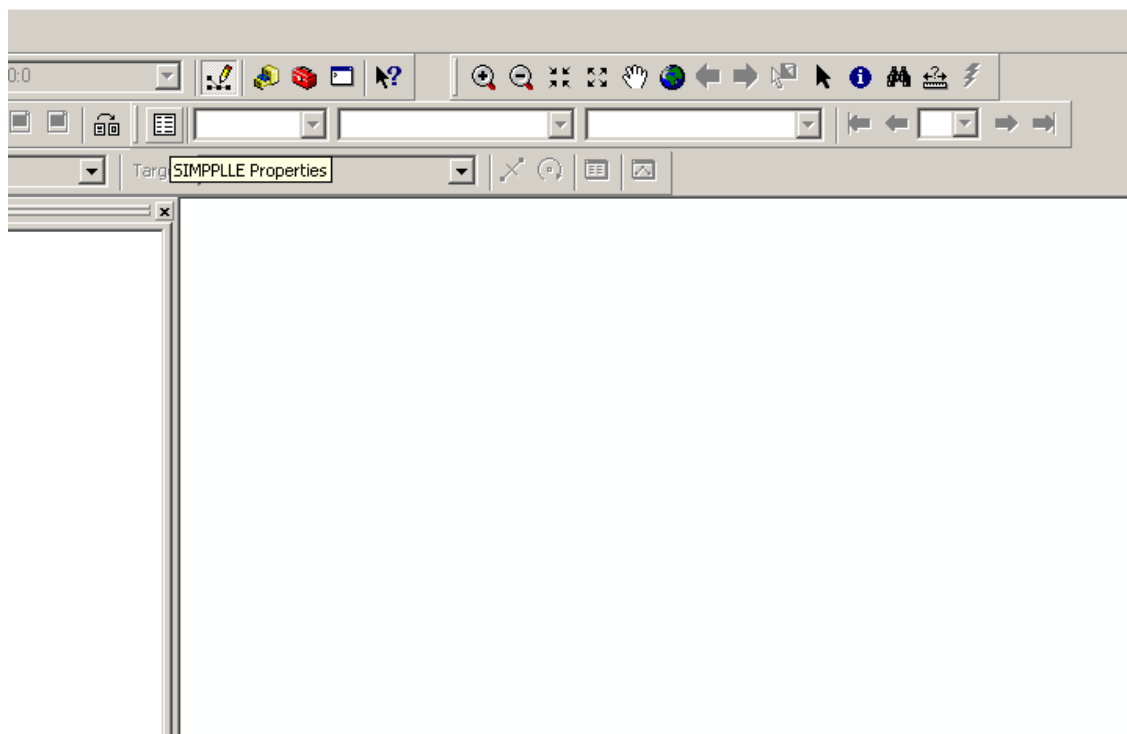


Figure 188 The SIMPPLLE toolbar. “SIMPPLLE Properties” only shows up when the cursor is placed on the “text” symbol.

Placing the cursor on the small symbol for SIMPPLLE Properties will open the initial window of the extension (Figure 189).

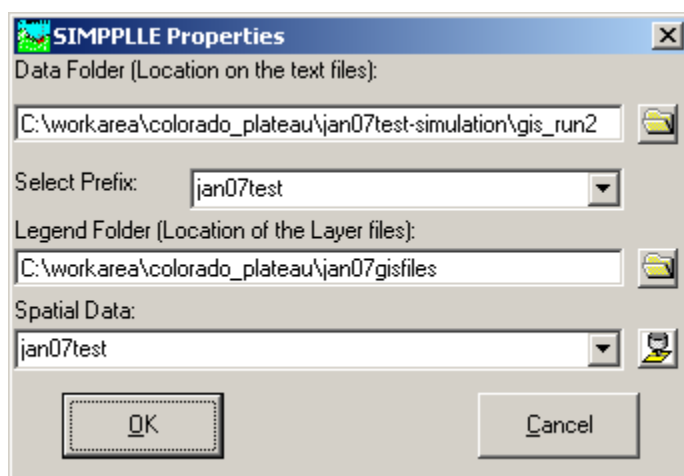


Figure 189 Information required in the SIMPPLLE properties dialog box.

The spatial data in this case is the new geodatabase that was created with the PreProcess tool. Upon completing all the fields it may take a few minutes to execute depending on the number of GIS files being loaded.

The ArcMap screen will then load the geodatabase and display the landscape. The display works best by change the feature class symbol so boundaries are not marked with a separate color for the polygons.

Make extension choices on the pulldown arrow within the boxes at the top of the screen (Figure 190). The first pulldown (highlighted in Figure 191) gives a choice of **Update**, **Spread**, or **Probability**. The choices available depend on what files were in the directory that was specified in the PreProcess tool. The second provides the choice of **sim_Species** (simulated species), **sizeclass**, **density**, **process**, **treatment**, or **probability**. The third pull-down choices are dependent upon the first two. With **Update** chosen, the attribute of **sim_Species** at Time Step 0 (the initial pre-simulation conditions) is displayed.

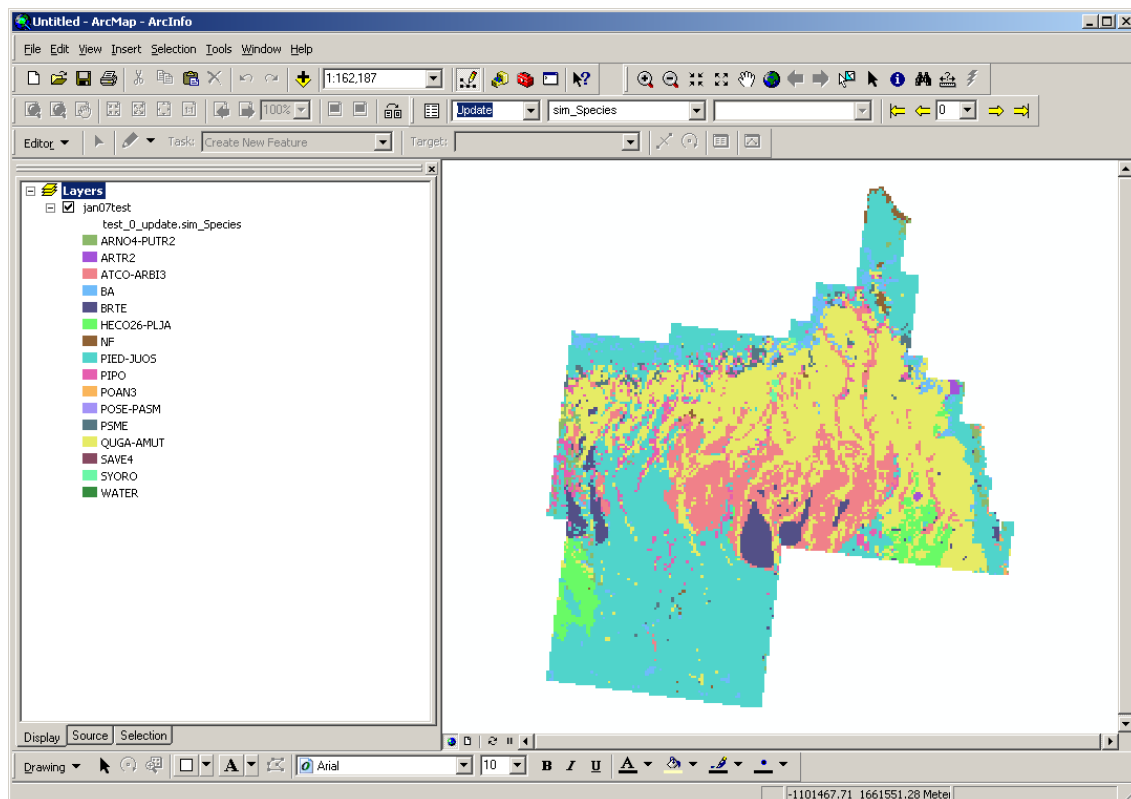


Figure 190 SIMPPLE extension display of species for Time Step 0.

The arrows on either side of time step display can be used to move through the simulation (Figure 191). If you have loaded in probability files from multiple simulations the choices for any

given attribute or disturbance process will be for an individual time step or across all time steps, the entire simulation, which is the “n” choice in the time step pulldown.

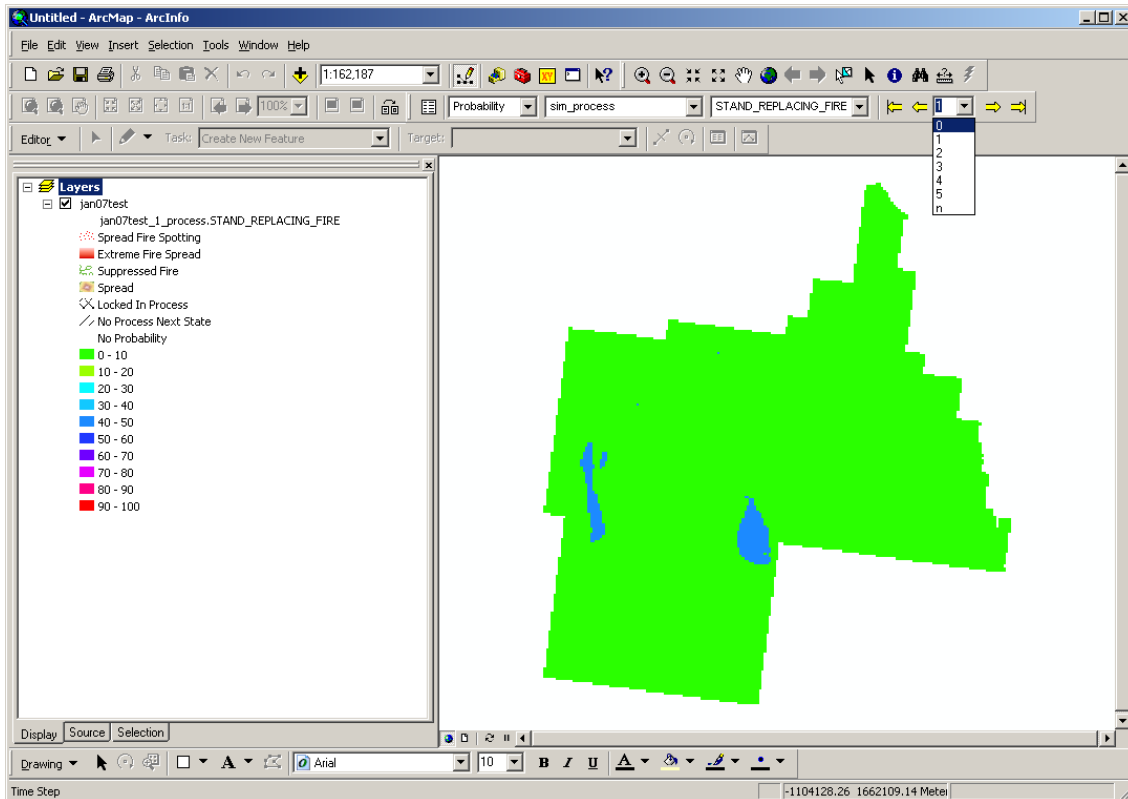


Figure 191 Pulldown showing choice of time steps for probability, or “n” for the entire simulation.

If only single simulations are made, then the only files to load are the update and spread files, and the extension does not have the probability choice. If a set of multiple simulations is made and either you did not check to create GIS update and spread files or you did but only loaded the probability files in using the PreProcess tool to make your extension, the only choice is for probability. If you now want to look at some update and spread files you have two choices. It is possible within an extension to open up the “SIMPPLLE properties” dialog box and identify a directory that contains the update and spread files. You can identify the spatial data as the new geodatabase created for this extension. However, the method that ArcGIS uses to load the new files into the geodatabase will take a very long time (hours). It will eventually work, but the recommended approach is to go back to the PreProcess tool. We recommend moving the update and spread files (along with the *.sinfo file) into the same directory that the probability

files are in. Then when the PreProcess is run again using the feature class in the geodatabase made with the previous extension, all of the choices: update, spread and probability will show up.

It is possible to leave the files in separate directories by the second execution of the PreProcess identifying the directory location of the update/spread files and the geodatabase with the probability file already loaded. This will get them all in the same geodatabase, but one would have to run the SIMPPLLE properties each time you wanted to switch between probabilities and updates/spread.

13. SYSTEM REQUIREMENTS

System Requirements:

- Java Runtime Environment version 1.5 (included in downloads)
- Windows (Uses Java 1.5 included in download)
- 2GB Memory (areas with large numbers of vegetation units, or includes land and aquatic units will require more memory)
- Will probably run on any processor but faster is always better.
- Known to work on: Win XP, Vista, and Mac OS X

ArcGIS 9 Software (recommend 9.3 or higher)

14. SYSTEM DOCUMENTATION

This user's manual can be accessed by selecting **Start > All Programs > SIMPPLLE > Application Folder > doc** or downloaded from the SIMPPLLE web site:

<http://www.fs.fed.us/rm/ecology/publications/simpplle/SIMPPLLE-MANUAL-2-5.pdf>.

There is additional documentation located at the directory structure identified:

"C:\fsapps\fsotter\SIMPPLLE\version2_5\doc".

This is a "Release Notes.pdf." This file contains developer's notes on the changes made in developing this version.

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16. APPENDICES

The following appendices provide a limited amount of information on each geographic zone. For all zones we provide a listing of the valid values for the attributes for SIMPPLLE. Some zones have a limited discussion on the system knowledge components.

16.1 APPENDIX A—FOREST SERVICE REGION ONE—WESTSIDE AND EASTSIDE

The initial development of SIMPPLLE was done for the two Region One geographic zones: west and east of the Continental Divide. Thus, there is more documentation of the system knowledge than with some of the other geographic areas. Both of these original geographic zones were developed for single life form description of the vegetation.

Ecological Stratification

The habitat type classification system in use by the Region provided the basis for an ecological stratification of system knowledge.

ht-grp	Description	Habitat type	ADP code	R1_PVT
A1	hot & very dry	pifl/agsp	91	pifl
		pifl/feid	92	pifl
		pifl/feid-feid	93	pifl
		pifl/feid-fesc	94	pifl
		pifl/juoc	95	pifl
		pipo/and	110	pipo
A1	hot & very dry	psme/syor	380	psme2
A2	warm & very dry	pipo/agsp	130	pipo
		pipo/feid	140	pipo
		pipo/feid-feid	141	pipo
		pipo/feid-fesc	142	pipo
		pipo/putr	160	pipo
		pipo/putr-agsp	161	pipo
		pipo/putr-feid	162	pipo
		psme/agsp	210	psme1
		psme/feid	220	psme1
		psme/fesc	230	psme1
		psme/syal-agsp	311	psme2

ht-grp	Description	Habitat type	ADP code	R1_PVT
		psme/caru-agsp	321	psme1
A2	Warm & very dry	psme/juoc	360	psme1
B1	warm & dry	pipo/syal	170	pipo
		pipo/syal-syal	171	pipo
		pipo/syal-bere	172	pipo
		psme/caru	320	psme1
		psme/caru-aruv	322	psme1
		psme/caru-caru	323	psme1
		psme/caru-pipo	324	psme1
		psme/cage	330	psme1
		psme/aruv	350	psme1
B1	warm & dry	psme/arco	370	psme1
B2	modwarm & dry	pipo/pruvi	180	pipo
		pipo/pruvi-prvi	181	pipo
		pipo/pruvi-shca	182	pipo
		pipo/phma	190	pipo
		psme/phma	260	psme2
		psme/phma-phma	261	psme2
		psme/phma-caru	262	psme2
		psme/phma-smat	263	psme2
		psme/vagl-aruv	282	psme2
		psme/syal	310	psme2
		psme/syal-caru	312	psme2
		psme/syal-syal	313	psme2
		psme/spbe	340	psme1
		picea/phma	430	picea

ht-grp	Description	Habitat type	ADP code	R1_PVT
		abgr/spbe	505	abgr1
		abgr/phma	506	abgr1
		abgr/phma-cooc	507	abgr1
B2	modwarm & dry	abgr/phma-phma	508	abgr1

Table A-1 Habitat type groups A1 thru B2.

ht-grp	Description	Habitat type	ADP code	R1_PVT
B3	warm & modmoist	psme/vaca	250	psme1
		psme/vagl	580	abgr2
		psme/vagl-vagl	281	psme2
		psme/vagl-xete	283	psme2
B3	warm & modmoist	psme/libo-caru	292	psme2
C1	modwarm & modmoist	psme/libo	290	psme2
		psme/libo-syal	291	psme2
		psme/libo-vagl	293	psme2
		abgr/xete	510	abgr2
		abgr/xete-cooc	511	abgr2
		abgr/xete-vagl	512	abgr2
		abgr/vagl	515	abgr2
		abgr/clun-xete	523	abgr2
		abgr/libo	590	abgr2
		abgr/libo-libo	591	abgr2
C1	modwarm & modmoist	abgr/libo-xete	592	abgr2
C2	modwarm & moist	abgr/asca	516	abgr2
		abgr/asca-asca	517	abgr2

ht-grp	Description	Habitat type	ADP code	R1_PVT
		abgr/asca-mefe	518	abgr2
		abgr/asca-tabr	519	abgr2
		abgr/clun	520	abgr2
		abgr/clun-clun	521	abgr2
		abgr/clun-arnu	522	abgr2
		abgr/clun-phma	524	abgr2
		abgr/clun-mefe	525	abgr2
		abgr/clun-tabr	526	abgr2
C2	modwarm & moist	abgr/setr	529	abgr2
D1	modcool & moist	thpl/clun	530	abgr2
		thpl/clun-clun	531	thpl
		thpl/clun-aarnu	532	thpl
		thpl/clun-mefe	533	thpl
		thpl/clun-xete	534	thpl
		thpl/clun-tabr	535	thpl
		thpl/asca	545	thpl
		thpl/asca-asca	546	thpl
		thpl/asca-mefe	547	thpl
		thpl/asca-tabr	548	thpl
		thpl/gydr	555	thpl
		tshe/gydr	565	tshe
		tshe/clun	570	tshe
		tshe/clun-clun	571	tshe
		tshe/clun-arnu	572	tshe
		tshe/clun-mefe	573	tshe
		tshe/clun-xete	574	tshe

ht-grp	Description	Habitat type	ADP code	R1_PVT
		tshe/asca	575	tshe
		tshe/asca-arnu	578	tshe
		tshe/asca-mefe	577	tshe
D1	modcool & moist	tshe/asca-asca	578	tshe

Table A-2 Habitat type groups B2 through D1.

ht-grp	Description	Habitat type	ADP code	R1_pvt
D2	modcool & modmoist	picea/sest	460	picea
		picea/sest-psme	461	picea
D2	modcool & modmoist	picea/sest-picea	462	picea
D3	cool & moist	picea/clun	420	picea
		picea/clun-vaca	421	picea
		picea/clun-clun	422	picea
		picea/libo	470	picea
		picea/smst	480	picea
		tshe/mefe	579	tsme
		abla/clun	620	abla1
		abla/clun-clun	621	abla1
		abla/clun-arnu	622	abla1
		abla/clun-vaca	623	abla1
		abla/clun-xete	624	abla1
		abla/clun-mefe	625	abla1
		abla/caca-vaca	654	abla1

		abla/libo	660	abla1
		abla/libo-libo	661	abla1
		abla/libo-xete	662	abla1
		abla/mefe	670	abla1
		abla/mefe-cooc	671	abla1
		abla/mefe-luhi	672	abla1
		abla/mefe-xete	673	abla1
		abla/mefe-vasc	674	abla1
		tsme/mefe	680	tsme
		tsme/mefe-luhi	681	tsme
		tsme-mefe-xete	682	tsme
		tsme/clun	685	tsme
		tsme/clun-mefe	686	tsme
		tsme/clun-xete	687	tsme
		abla/vasc-thoc	733	abla2
D3	cool & moist	abla/alsi	740	abla1
E1	modcool & wet	thpl/atfl	540	thpl
		thpl/atfl-adpe	541	thpl
		thpl/atfl-atfl	542	thpl
		thpl/opho	550	thpl
E1	modcool & wet	thpl/adpe	560	thpl

Table A-3 Habitat type groups D2 through E1.

ht-grp	Description	Habitat type	ADP code	R1_pvt
E2	cool & wet	picea/eqar	410	picea
		picea/gatr	440	picea
		abla/opho	610	abla1
		abla/gatr	630	abla1
		abla/stam	635	abla1
		abla/stam-mefe	636	abla1
		abla/stam-lica	637	abla1
		abla/caca	650	abla1
		abla/caca-caca	651	abla1
		abla/caca-lica	652	abla1
		abla/caca-gatr	653	abla1
		abla/caca-legl	655	abla1
		tsme/stam	675	tmse
		tsme/stam-luhi	676	tmse
E2	cool & wet	tsme/stam-mefe	677	tmse
F1	cool & mod dry	picea/vaca	450	picea
		abla/vaca	640	abla1
		abla/libo-vasc	663	abla1
		abla/xete	690	abla1
		abla/xete-vagl	691	abla1
		abla/xete-vasc	692	abla1
		abla/xete-cooc	693	abla1
		abla/xete-luhi	694	abla1
		tsme/xete	710	tmse
		tsme/xete-luhi	711	tmse
		tsme/xete-vagl	712	tmse

		tsme/xete-vasc	713	tmse
		abla/vagl	720	abla1
		abla/vasc	730	abla2
		abla/vasc-caru	731	abla2
		abla/vasc-vasc	732	abla2
		pico/putr	910	pico
		pico/vaca	920	pico
F1	cool & mod dry	pico/libo	930	pico
F2	modcool & mod dry	abla/caru	750	abla1
		abla/caru	770	abla1
		abla/clps	780	abla1
		abla/arco	790	abla1
		abla/cage	791	abla1
		abla/cage-cage	792	abla1
F2	modcool & mod dry	pico/caru	950	pico
G1	cold & moist	abla/rimo	810	abla2
		abla/pial-vasc	820	abla2
		abla/luhi	830	abla2
		abla/luhi-vasc	831	abla2
		abla/luhi-mefe	832	abla2
		tsme/luhi	840	tmse
		tsme/luhi-vasc	841	tmse
G1	cold & moist	tsme-luhi-mefe	842	tmse

Table A-4 Habitat type groups E2 through G1.

ht-grp	Description	Habitat type	ADP code	R1_pvt
G2	cold & dry	pial-abla	850	pial
		laly-abla	860	laly
		pial	870	pial
		pico/xete	925	pico
G2	cold & dry	pico/vasc	940	pico
NF1	grasslands	upland grassland	15	NA
		sticom	16	drygrass
		agrspi	17	drygrass
		fesida	18	fesida
		fessca	19	fessca
		androp	20	androx
NF1	grasslands	descae	21	ripgrass
NF2	shrublands	upland shrubland	30	NA
		artarb	31	bigsage
		arttri	32	bigsage
		arttrip	33	bigsage
		pottru	34	potfru
		purtri	35	dryshrub
		cerled	36	dryshrub
		rhulri	37	rhusx
		sarver	38	saltshrub
NF2	shrublands	eriogo	39	unknown
NF3	woodlands	upland woodland	50	NA
NF4	riparian	riparian	60	NA
		carex	61	ripgrass
		grass	65	ripgrass

		tall forb	70	ripforb
		cartaeg	71	crataeg
		celtis	72	celtis
		alnus	73	alnus
		salix	74	salix
		poptre	78	poptre
NF4	riparian	poptri	79	poptri
NF5	alpine	alpine	80	alpine
		alp sedge/grass	81	alpgrass
		alp forb	84	alpforb
NF5	alpine	alp shrub	87	alpshrub
XX1	agriculture	crop, hay, pasture	4	
XX2	exotics	exotics grass/fo	2	
XX3	urban/rural	towns, subdiv	3	
XX4	barren	rock, scree, ice	10	rock,scree
XX5	water	lakes, reservior	1	water

Table A-5 Habitat type groups G2 through non-forest.

Vegetation Attributes

The vegetation attributes were linked to Region One's vegetation mapping and inventory design.

Species Abbreviation	Species Names
AF	alpine fir
AF-ES-MH	alpine fir - Englemann spruce - mountain hemlock
AF-MH	alpine fir - mountain hemlock
AGR	agriculture

Species Abbreviation	Species Names
AL	alpine larch
AL-AF	alpine larch - alpine fir
AL-WB-AF	alpine larch - white bark pine - alpine fir
ALPINE-GRASSES	alpine grasses
ALTERED-GRASSES	altered grasses
C	cedar
CW	cottonwood
CW-MC	cottonwood - mixed conifers
DF	Douglas-fir
DF-AF	Douglas-fir - alpine fir
DF-ES	Douglas-fir - Englemann spruce
DF-GF	Douglas-fir - grand fir
DF-LP	Douglas-fir - lodgepole pine
DF-LP-AF	Douglas-fir - lodgepole pine - alpine fir
DF-LP-ES	Douglas-fir - lodgepole pine - Englemann spruce
DF-LP-GF	Douglas-fir - lodgepole pine - grand fir
DF-PP-GF	Douglas-fir - ponderosa pine - grand fir
DF-PP-LP	Douglas-fir - ponderosa pine - lodgepole pine
DF-RRWP	Douglas-fir - rust resistance white pine
DF-RRWP-GF	Douglas fir - rust resistance white pine - grand fir
DF-WP	Douglas-fir - white pine
DF-WP-GF	Douglas-fir - white pine -grand fir
EARLY-SERAL	early seral
ES	Englemann spruce
ES-AF	Englemann spruce - alpine fir
GF	grand fir

Species Abbreviation	Species Names
L	larch
L-DF	larch - Douglas-fir
L-DF-AF	larch - Douglas-fir - alpine fir
L-DF-ES	larch - Douglas-fir - Englemann spruce
L-DF-GF	larch - Douglas-fir - grand fir
L-DF-LP	larch - Douglas-fir - lodgepole pine
L-DF-PP	larch - Douglas-fir - ponderosa pine
L-DF-RRWP	larch - Douglas-fir - rust resistance white pine
L-DF-WP	larch - Douglas-fir - white pine
L-ES	larch - Englemann spruce
L-ES-AF	larch - Englemann spruce - alpine fir
L-GF	larch - grand fir
L-LP	larch - lodgepole pine
L-LP-GF	larch - lodgepole pine - grand fir
L-PP	larch - ponderosa pine
L-PP-LP	larch - ponderosa pine - lodgepole pine
L-RRWP	larch - rust resistance white pine
L-RRWP-GF	larch - rust resistance white pine - grand fir
L-WP	larch - white pine - grand fir
L-WP-GF	larch - white pine - grand fir
LATE-SERAL	late seral
LP	lodgepole pine
LP-AF	lodgepole pine alpine fir
LP-GF	lodgepole pine - grand fir
MESIC-SHRUBS	mesic shrubs
MH	mountain hemlock

Species Abbreviation	Species Names
NATIVE-FORBS	native forbs
ND	no data
NS	non stocked
PF	limber pine
PP	ponderosa pine
PP-DF	ponderosa pine - Douglas fir
QA	quaking aspen
QA-MC	quaking aspen - mixed conifers
RRWP	rust resistance white pine
UPLAND-GRASSES	upland grasses
WB	white bark pine - Englemann spruce - alpine fir
WB-ES-AF	white bark pine - Englemann spruce - alpine fir
WH	western hemlock
WH-C	western hemlock - cedar
WH-C-GF	western hemlock - cedar - grand fir
WP	white pine
XERIC-SHRUBS	xeric shrubs

Table A-6 Valid species values for forest habitat type groups for the Westside zone, Region One.

Species Abbreviation	Species Name
AF	alpine fir
AF-ES-LP	alpine fir - Englemann spruce - lodgepole pine
AGR	agriculture
ALPINE-GRASSES	alpine grasses
ALTERED-GRASSES	altered grasses
CW	cottonwood
CW-MC	cottonwood - mixed conifers
DF	Douglas-fir
DF-AF	Douglas-fir - alpine fir
DF-AF-ES	Douglas-fir - alpine fir - Englemann spruce
DF-ES	Douglas-fir - Englemann spruce
DF-LP	Douglas-fir - lodgepole pine
DF-LP-AF	Douglas-fir - lodgepole pine - alpine fir
DF-LP-ES	Douglas-fir - lodgepole pine - Englemann spruce
DF-PP-LP	Douglas-fir - ponderosa pine - lodgepole pine
DF-PP-PF	Douglas-fir - ponderosa pine - limber pine
ES	Englemann spruce
ES-AF	Englemann spruce - alpine fir
ES-LP	Englemann spruce - lodgepole pine
LP	lodgepole pine
LP-AF	lodgepole pine - alpine fir
MESIC-SHRUBS	mesic shrubs
NATIVE-FORBS	native forbs
ND	no data
NS	non stocked
PF	limber pine

Species Abbreviation	Species Name
PF-LP	limber pine - lodgepole pine
PP	ponderosa pine
PP-DF	ponderosa pine - Douglas-fir
QA	quaking aspen
QA-MC	quaking aspen - mixed conifers
UPLAND-GRASSES	upland grasses
WB	white bark pine
WB-AF	white bark pine - alpine fir
WB-ES	white bark pine - Englemann spruce
WB-ES-AF	white bark pine - Englemann spruce - alpine fir
WB-ES-LP	white bark pine - Englemann spruce - lodgepole pine
XERIC-SHRUBS	xeric shrubs

Table A-7 Valid species values for forest habitat type groups for the Eastside zone, Region One.

Species Abbreviation	Species Name
AGR	agriculture
AGSP	bluebunch wheatgrass
ALPINE-GRASSES	alpine grasses
ALPINE-HERBS	alpine herbs
ALPINE-SHRUBS	alpine shrubs
ALTERED-GRASSES	altered grasses

Species Abbreviation	Species Name
ALTERED-NOXIOUS	altered noxious
DF	Douglas-fir
FESCUE	fescue
FS-S-G	fire sprouting shrubs and grasses
EARLY-SERAL	early seral
GA	green ash
HERBS	herbs
JUSC	juniper
JUSC-AGSP	juniper - bluebunch wheatgrass
JUSC-ORMI	juniper - rice grass
LATE-SERAL	late seral
MAHOGANY	mahogany
MESIC-SHRUBS	mesic shrubs
MID-SERAL	mid seral
MTN-FS-SHRUBS	mountain fire sprouting shrubs
MTN-MAHOGANY	mountain mahogany
MTN-SHRUBS	mountain shrubs
NATIVE-FORBS	native forbs
NF	non forest
NOXIOUS	noxious
PF	limber pine
PP	ponderosa pine
QA	quaking aspen
QA-MC	quaking aspen - mixed conifers
RIP-DECID	riparian deciduous
RIP-DECID-MC	riparian deciduous - mixed conifers

Species Abbreviation	Species Name
RIP-GRAMS	riparian graminoids
RIPARIAN-GRASSES	riparian grasses
UPLAND-GRASSES	upland grasses
WATER	water
WOODLAND	woodland
XERIC-FS-SHRUBS	xeric fire sprouting shrubs
XERIC-SHRUBS	xeric shrubs

Table A-8 Valid species values for the non forest habitat type groups for the Westside and Eastside zones, Region One.

Size Class

Size Class - Structure	Name
NS	non-stocked
UNIFORM	uniform
SCATTERED	scattered
CLUMPED	clumped
OPEN-HERB	open herbaceous
CLOSED-HERB	closed herbaceous
OPEN-LOW-SHRUB	open low shrub
OPEN-MID-SHRUB	open mid shrub
OPEN-TALL-SHRUB	open tall shrub
CLOSED-LOW-SHRUB	closed low shrub
CLOSED-MID-SHRUB	closed mid shrub
CLOSED-TALL-SHRUB	closed tall shrub
WOODLAND	woodland
SS	seedling and saplings, less than 5 inches dbh

Size Class - Structure	Name
POLE	5 to 8.9 inches dbh
PTS	pole two stories
PMU	pole multiple stories
MEDIUM	9 to 14.9 inches dbh
MTS	medium two stories
MMU	medium multiple stories
LARGE	15 to 20.9 inches dbh
LTS	large two stories
LMU	large multiple stories
VERY-LARGE	
VLTS	very large two stories
VLMU	very large multiple stories
AGR	agriculture
NF	non forest
WATER	

Table A-9 Valid size-class / structure values by habitat type for the Westside zone and Eastside zone, Region One.

Density

Density class	Canopy coverage percent
1	0 – 14
2	15 – 39
3	40 – 69
4	70 – 100

Table A-10 Density classes for both Eastside and Westside.

Optional Attributes:

Owner: To utilize the Fire suppression logic, ownership needs to be one of the three: National

Forest Wilderness (**NF-WILDERNESS**), National Forest Other (**NF-OTHER**), or **OTHER**. **OTHER** can be State, private, or other federal ownership.

Roads: The road status is also used in the Fire suppression logic. It needs to be one of the three: Open Roaded (**O**), Closed Roaded (**C**), or None (**N**).

Fire-ignition-probability: This field is no longer being used. It can be left blank.

FMZ: This field is for designating the fire management zone. These are delineations that have some meaning for fire management planning on a National Forest. There can be considerable variation within the Region. There is usually variation in terms of numbers of past fires, suppression costs, and suppression policy. If no zone value is used, **All** is interpreted for the field.

Special Area: This field can be used to facilitate a spatial break down of the outcome from SIMPPLLE in the reports. In past analyses we have seen drainage designations, wildlife management units, Forest Plan Management Areas, and a broad designation of Forest versus non forest habitat type groups used.

Landtype: This value must be blank; it is not currently used in this version.

Initial Process: The values must be one of the acceptable disturbance processes used in the system. This allows the user to identify plant communities that have had a process in the previous time step such as root disease, light mpb in lodgepole, etc. To identify a current, ongoing process the “lock-in” process feature is used. Without specifying any disturbance process, each plant community starts out as if succession was occurring.

Disturbance processes:

Disturbance process	Description
LSF	Light severity fire
MSF	Mixed severity fire
SRF	Stand replacing fire
FIRE EVENT	Fire event
RD	Root disease
LIGHT-WSBW	Light western spruce budworm
SEVERE-WSBW	Severe western spruce budworm
PP-MPB	Ponderosa pine mountain pine beetle
LIGHT-LP-MPB	Light lodgepole pine mountain pine beetle
SEVERE-LP-MPB	Severe lodgepole pine mountain pine beetle

WP-MPB	White pine mountain pine beetle
WBP-MPB	White bark pine mountain pine beetle
DF-BEETLE	Douglas-fir beetle
SPRUCE BEETLE	Spruce beetle

Table A-11 Processes for the Westside and Eastside Region One.

AQUATIC UNITS

These fields for this class were initially created for a prototype that displayed the capabilities to include the dynamics of stream reaches and the interaction with changes in adjacent vegetation and vegetation in each reach's drainage area. The required fields that were developed were:

Required fields

SLINK

LENGTH

LTA_GRP

AQ_CLASS

AQ_ATTRIB

SEG_NUM

INT_PROCESS

STATUS

As a parallel to the ecological stratification with the vegetation units, the LTA_GRP has values that represent Landtype Association, valley bottom groupings.

The following values were used in the prototype drainage:

12-FMA

12-FWC

12-FWB

45-41-FMA

45-41-FNA

51-FMA

51-UWB

51-FWB

62-72-FNA

A combination of the AQ_Class and AQ_ATTRIB were used to represent current condition of an aquatic unit. The AQ_CLASS has values that represent the Rosgen type assigned the stream unit.

The following values were used for the prototype drainage:

A1, A2, A3, A4

B2, B3, B4

C4

D4

E4

G3, G4

The AQ_ATTRIB is intended to represent the status of temperature, stream bank stability, large woody debris, and stream bed conditions. Different combinations of these variables being in or out of reference conditions were developed. With the absence of an initial inventory, all of these attributes were considered within the **Reference** range of conditions, identified as:

REF

The INT_PROCESS has values that are intended to be representative of the dynamics of an individual stream reach.

In the Westside Region One zone, the sample landscape of Sweathouse Creek can be loaded. The individual aquatic units can be seen and the pathway files are available. However, no pathway diagram is displayed and no change occurs in the simulation.

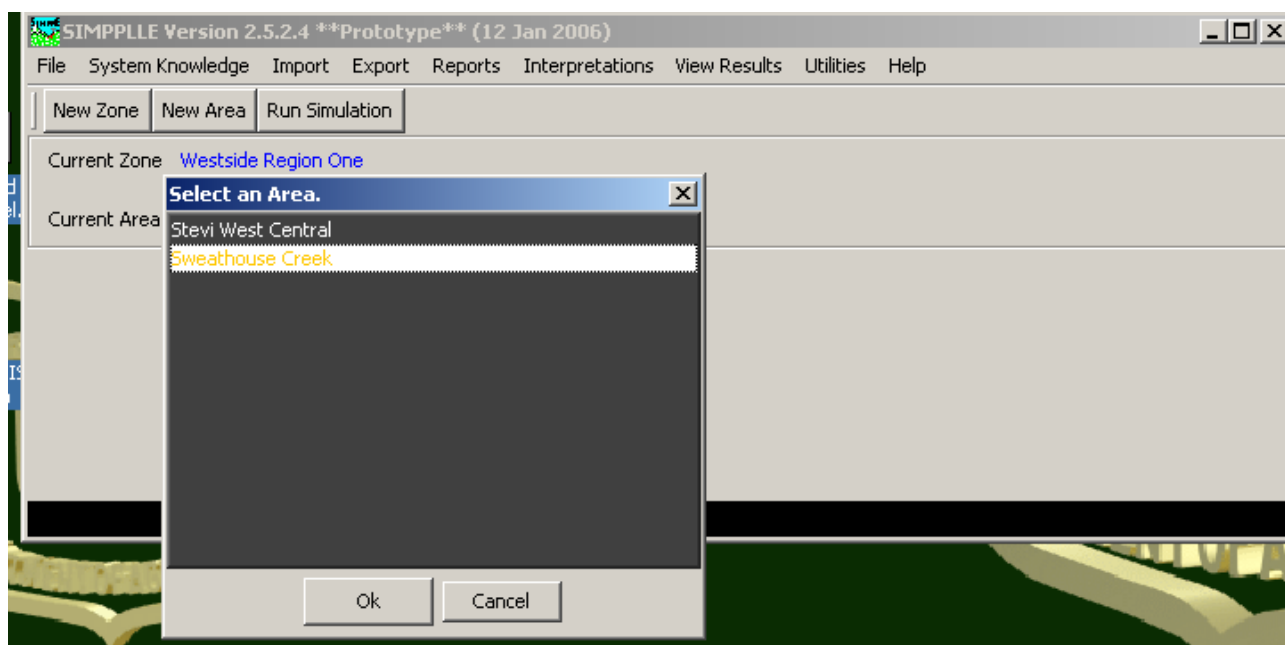


Figure A-1 Selection of the Sweathouse Creek area to load that contains aquatic units.

The functionality for the aquatics has not been maintained in newer versions of SIMPPLLE.

Discussion on System Knowledge

Mountain Pine Beetle in Lodgepole Pine

The logic for mountain pine beetle probability in lodgepole is built upon the hazard rating system in General Technical Report INT-36, "Guidelines for reducing losses of lodgepole pine to the mountain pine beetle in unmanaged stands in the Rocky Mountains" (Amman et al. 1977). The interpretation of a combination of a hazard ratings and past processes are based on analyses by silviculturists using the system on sample landscapes. The stand level data used in these hazard rating systems must be replaced by other information that is consistent with the level of available vegetation information. For example, basal area of lodgepole pine is replaced by whether the plant community is only lodgepole pine, or it contains one other species, or two other species. Elevation of the plant community is replaced by the habitat type group assigned. Probabilities are assigned to combinations of hazard ratings and past processes in both the vegetation unit being evaluated and its neighbors. These probabilities are based on analyses by silviculturists using the system on sample landscapes. The user-interface provides the means to change the probabilities, but not the combination of attributes of hazard, past insect and fire activity.

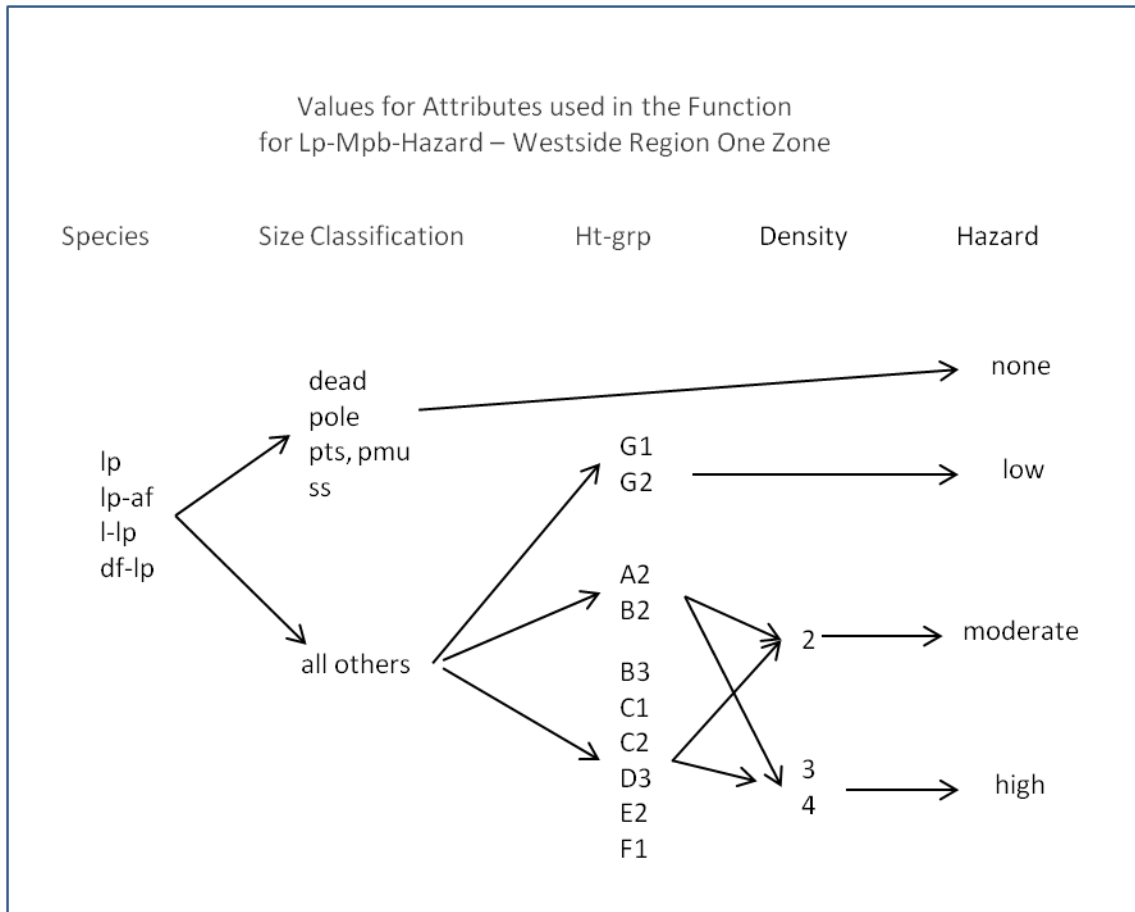


Figure A-2 Hazard Rating for Westside Region One zone, mountain pine beetle in lodgepole pine when lp is the dominant species or occurs with one other species.

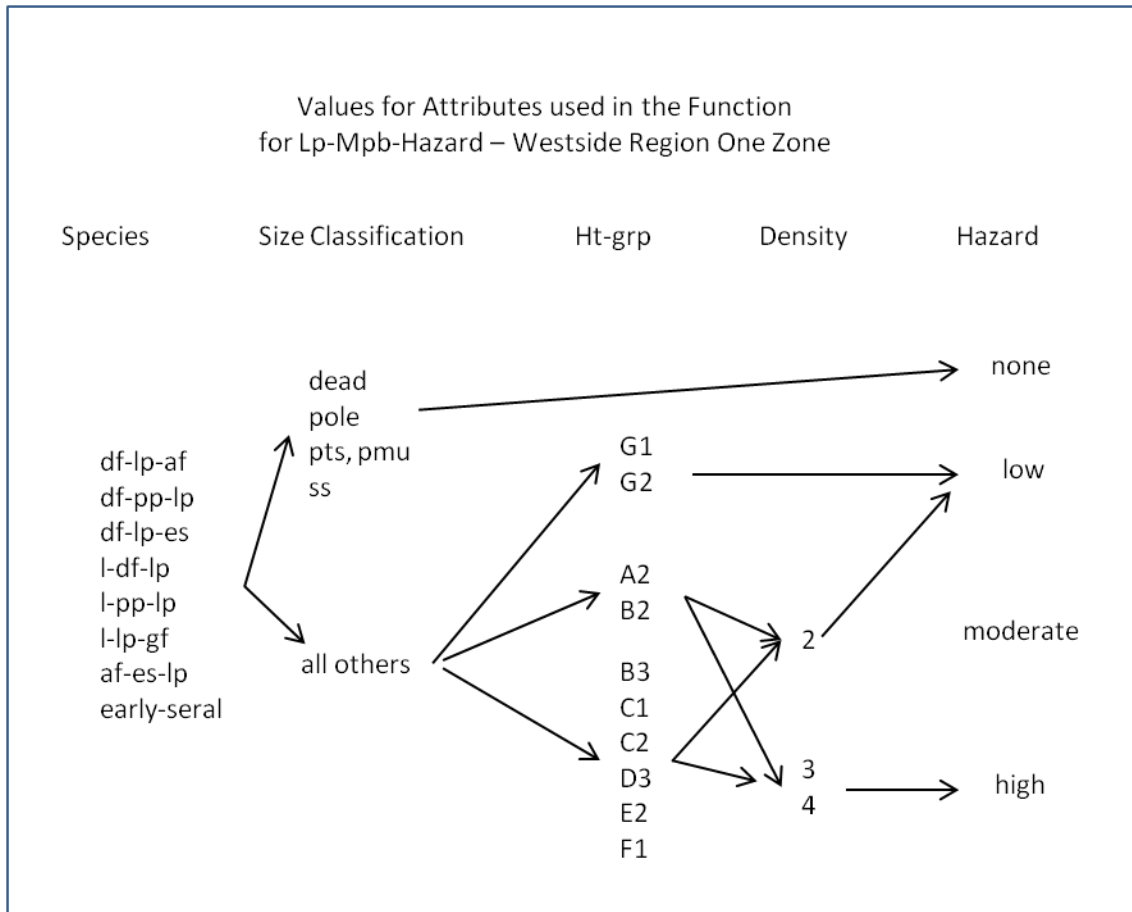


Figure A-3 Hazard Rating for Westside Region One zone, mountain pine beetle in lodgepole pine when lodgepole pine is a minor component occurring with two other species.

Lodgepole pine Mountain Pine Beetle Spread Westside Region One				
Plant Community Current Process	Adjacent Current Process	Species	Size Class	Process Will Spread As light-lp-mpb severe-lp-mpb
light-lp-mpb	succession	lp		X
		df-lp	medium, mts, mmu	
		es-lp	large, lts, lmu	
		lp-af	very-large, vlts, vlmu	
severe-lp-mpb		df-pp-lp		
		df-lp-es l-pp-lp		X
		df-lp-af l-df-lp		
		af-es-lp l-lp-gf		
		early seral		
To provide for an interaction between mpb in lodgepole pine and ponderosa pine				
		Adjacent Plant Community pp-mpb probability		Process Will Spread As pp-mpb
severe-lp-mpb	succession	>= 10		X

Figure A-4 Logic Westside Region One zone for determining if mountain pine beetle will spread to adjacent plant communities.

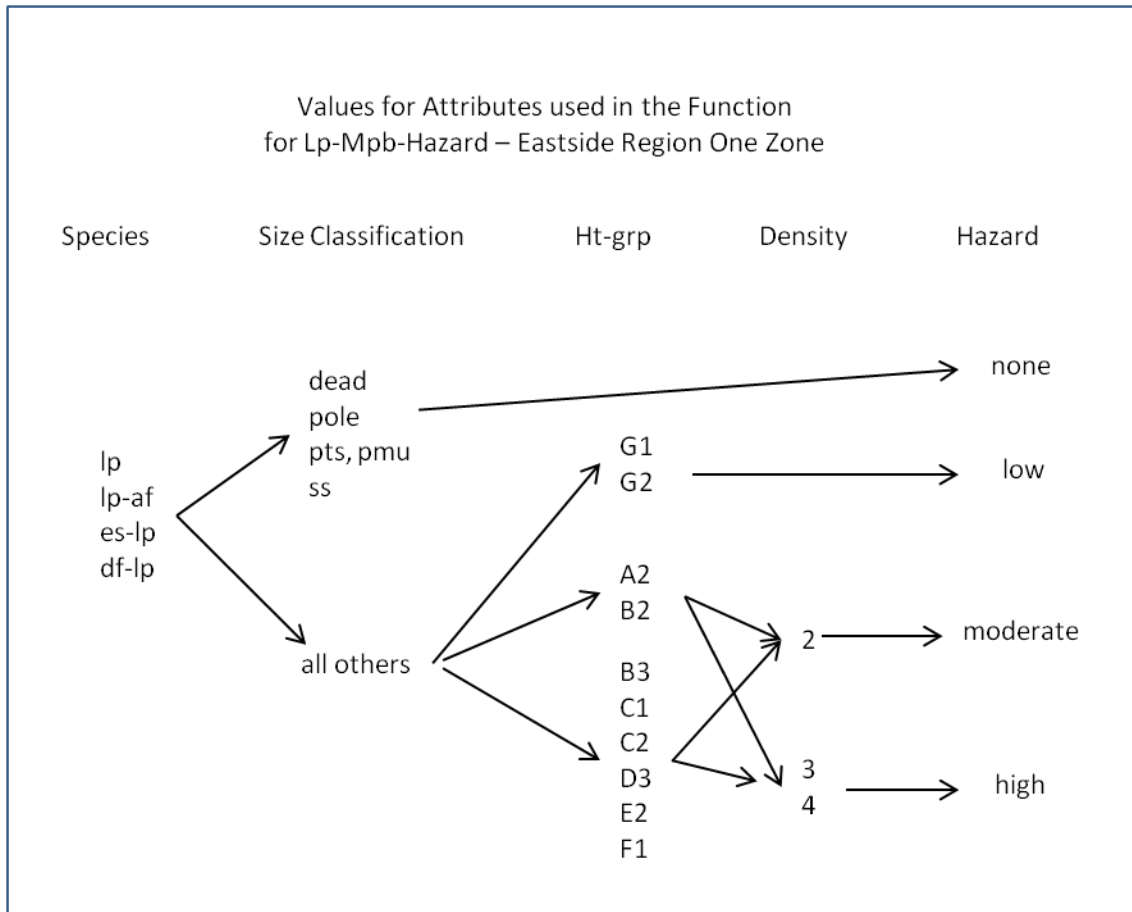


Figure A-5 Hazard Rating for Eastside Region One, mountain pine beetle in lodgepole pine when lodgepole pine is a single species or is one of two species.

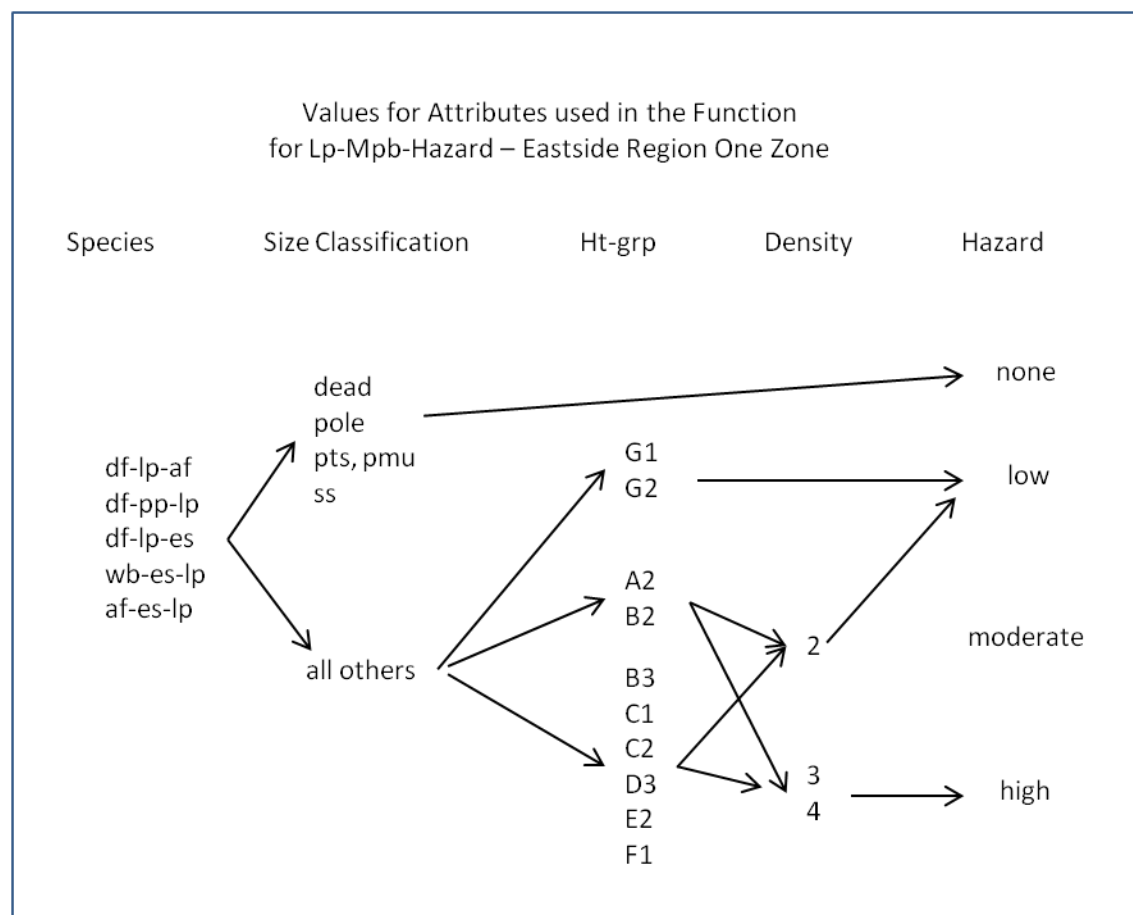


Figure A-6 Hazard Rating for Eastside Region One zone, mountain pine beetle in lodgepole pine when lodgepole pine is a minor component occurring with two other species.

Lodgepole pine Mountain Pine Beetle Spread Eastside Region One				
Plant Community Current Process	Adjacent Current Process	Species	Size Class	Process Will Spread As light-lp-mpb severe-lp-mpb
light-lp-mpb	succession	lp		X
		df-lp	medium, mts, mmu	
		es-lp	large, lts, lmu	
		lp-af	very-large, vlts, vlmu	
severe-lp-mpb		df-pp-lp		
		df-lp-es		X
		df-lp-af		
		af-es-lp		
		wb-es-lp		
To provide for an interaction between mpb in lodgepole pine and ponderosa pine				
		Adjacent Plant Community pp-mpb probability		Process Will Spread As pp-mpb
severe-lp-mpb	succession	>= 10		X

Figure A-7 Logic Eastside Region One zone for determining if mountain pine beetle will spread to adjacent plant communities.

Mountain Pine Beetle in Ponderosa Pine

The basis for the probability of mountain pine beetle in ponderosa pine starts with the determination of a hazard. This hazard is based on the research work documented in “Risk Rating Guide for Mountain Pine beetle in Black Hills Ponderosa Pine” (Stevens et al. 1980). This work uses the number of stories, basal area of ponderosa pine and the ponderosa pine quadratic mean diameter (qmd) to develop a risk of low, moderate, or high. Within SIMPPLLE, the single story, two story, and multi-story designation easily provides the information of one story, two stories, or more than two. The diameter definitions for the size classes used in SIMPPLLE provide the information that we use for the quadratic mean diameter (qmd). The levels of ponderosa pine basal area used in the Risk Rating Guide could not be used directly with SIMPPLLE since we do not carry basal area information. In its place we used a combination of the size-class and canopy-coverage class. The following figures display the logic used within SIMPPLLE.

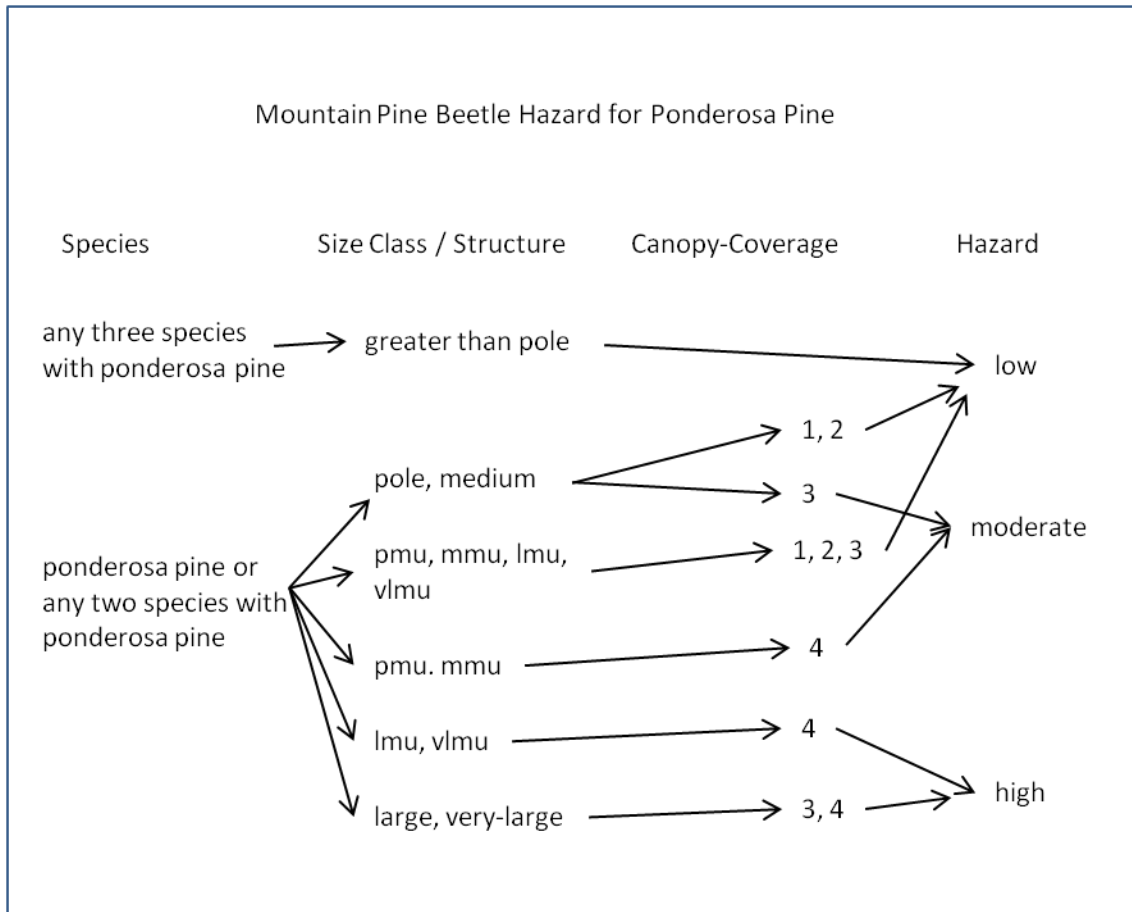


Figure A-8 Determination of mountain pine beetle hazard for ponderosa pine within SIMPPLLE.

In the user interface, we do not display the logic that results in the hazard, only the combination of the hazard and other attributes that are used to assign a probability. Included in the logic is an interaction with mpb in lodgepole pine. These figures are not currently available through the user interface.

Mountain pine beetle is a process that has a spread component to it. That is, it can occur in a plant community without having to have originated in it if one of its neighbors has the disturbance process. Included in the probability logic is an interaction between mountain pine beetle in lodgepole pine and ponderosa pine.

Mountain Pine Beetle in White Pine

The relationships and probabilities in the default logic are the result of workshops with silviculturists, ecologists, and pathologists. The logic for mountain pine beetle in white pine is based on the degree of white pine in the community, the size-class/structure, density, and past fire processes.

Mountain Pine Beetle in Whitebark Pine

The default relationships and probabilities are the result of workshops with silviculturists, ecologists, and pathologists. The logic for mountain pine beetle in whitebark pine is based on the degree of whitebark pine in the community, the size-class/structure, density, and past fire processes.

Blister Rust in White Pine

Blister rust is not identified as a separate process within SIMPPLLE. During the course of our workshops in the Region, the decision was made that it was so common that it should be included within the succession pathways.

From whatever pathway state an existing stand may currently be in, the progression is to lose density until we eventually have a nonstocked condition.

Separate pathways have been developed for rust-resistant white pine (rrwp) to allow for it to be planted in treatments. The presence of blister rust in the pathways for both white pine and whitebark pine presents a problem when the user wants to make long-term simulations to recreate historical conditions. Before these simulations can be made we must recreate the white pine pathways by taking out blister rust. To a certain extent this is already done. Simply change the rust resistance white pine (rrwp) back to white pine (wp) and save these as historic pathways.

Douglas-fir Beetle

The logic for Douglas-fir beetle was derived through a series of workshops with silviculturists, ecologist, and entomologists in the Region. The logic uses a combination of the abundance of Douglas-fir, size-class/structure, density and the occurrence of a past light or mixed severity fire.

No spread logic has been incorporated with this disturbance process.

Spruce Beetle

The relationships and probabilities are the result of workshops with silviculturists, ecologists, and pathologists. The logic is based on habitat type groups, degree of presence of susceptible species, size-class and if a past light- or mixed-severity fire has occurred.

Western Spruce Budworm

The hazard rating system developed by Carlson and Wulf (1989) contains attributes of individual plant communities that were generalized to the landscape scale for use in the SIMPPLLE modeling system. One factor within the hazard rating is a measure of the surrounding suitable host forest. Within SIMPPLLE, this factor is expanded to include not just the adjacent communities, but also the percent of the landscape that is in contiguous, suitable host forest conditions. This is an example where some detail is given up in stand level attributes, but other components are gained in relation to landscape level attributes.

We compute a susceptibility-index as is done in the research work. This index consists of:

- Percent-host-index
- Percent-climax-host-index
- Density-index

- Structure-index
- Stand-vigor-index
- Maturity-index
- Site-climate-index
- Character-of-adjacent-index

Additional information will be added to the documentation in future versions.

Root Disease

Most of the existing research for root disease requires a level of inventory information that is not consistent with what is available at landscape scales. Monitoring on long-term measurement for areas in the Region can provide rates of change due to root disease and other disturbance process. These values have been used in transition matrices in other models but we do not want to lock these values within SIMPPLLE. They should serve as comparisons to what SIMPPLLE produces on similar landscapes through multiple stochastic simulations. Future analysis should be done to compare these values to the ranges that result from multiple simulations.

The relationships and probabilities are the result of workshops with silviculturists, ecologists, and pathologists. The logic is based on habitat type groups, degree of presence of susceptible species and if past partial harvest has been done.

Invasive Species—Eastside Only

Research from Lisa J. Rew, Bruce Maxwell, and Richard Aspinall, Land Resources and Environmental Science Department, Montana State University (Rew et al. 2005) has been incorporated into version 2.5. Their research on “Predicting the Occurrence of Non-indigenous Species Using Environmental and Remotely Sensed Data” uses a log-odds equation with the following variables:

Variable	Definition
ELEV (meters)	Elevation in meters
SLOPE (degrees)	Slope in degrees
COSASP	Cosine of Aspect
SINASP	Sine of Aspect
ANNRAD	Annual Radiation load
DISTROAD (meters)	The distance the EVU is from the nearest road instance that is labeled “road.”

DISTTRAIL (meters)	The distance the EVU is from the nearest trail instance that is labeled "trail."
GRAZING, CLEARCUT, THINNING, PREBURN, WILDFIRE	history
SHRUB, GRASS, TREE	cover type

Table A-12 The variables used in the equations from Rew et al. (2005).

The SIMPPLLE data set will have:

Vegetation

Land units

Manmade units = roads (includes trails)

The cover for the vegetation will have to have a treatment history in it. The user will need to identify the treatments as:

Grazing

Clearcut

Thinning

Prescribe Burning

The land units will have to have slope, elevation, and aspect assigned to them. There is a model coefficient for ANNRAID.

The manmade units will be roads.

Under the system knowledge choice of **Invasive species Logic**, selecting the Montana State University logic will bring up the input screen.

A difference in the logic screen is that the probabilities are computed, thus, there are no values to put in the screen. There are three screens for the MSU logic: the **Probability** tab (identifies the invasive species and what coefficients values go with the parameters), the **Change_rate** tab, and a new **Starting Value** tab (includes for each invasive species a probability range of occurrence, and for this range what the starting value of density would be).

To test SIMPPLLE's calculation of probabilities, a separate output file can be created by adding the following to the end of the SIMPPLLE.lax file in the SIMPPLLE installation directory:
simpplle.comcode.InvasiveSpeciesLogicDataMSU.probFile=true. Note: this output file will have the prefix of the output specified in the simulation parameters dialog.

Using the **Close-roads** treatment.

The treatment will change the status of a road unit to closed from open. And there is a corresponding treatment that can change the status from closed back to open. This change in road status will affect the probability of occurrence of invasive species that have a coefficient for the distance to an open road.

The difficulty in developing this treatment in the current version of SIMPPLLE (2.5) is that there is no user interface access to road units. Road units exist in SIMPPLLE and a distance from each existing vegetation unit (EVU) to the nearest open road is computed for each time step. There is a road status of an EVU that is determined by whether a closed or open road goes through the unit. This relationship of what EVUs have roads in them is determined at the time the SIMPPLLE toolbox spatial relations is run. This relationship is constant for a dataset. At this time we do not allow for "new" roads to be built or existing roads to be completely removed. But this new treatment will allow the user to change the status of a road at a specified time step. This in turn will affect the distance each EVU is from an open road in each time step for the coefficient in the probability calculations. This has to be accomplished without identifying a given road unit(s) in SIMPPLLE.

Our short-term solution for version 2.5 is to apply the treatment to close or open a road unit by identifying the EVUs that are associated with a given road unit.

The steps to apply this treatment are:

1. From the geodatabase, the road feature class, select the road units that you want to close. See the example in following figure.

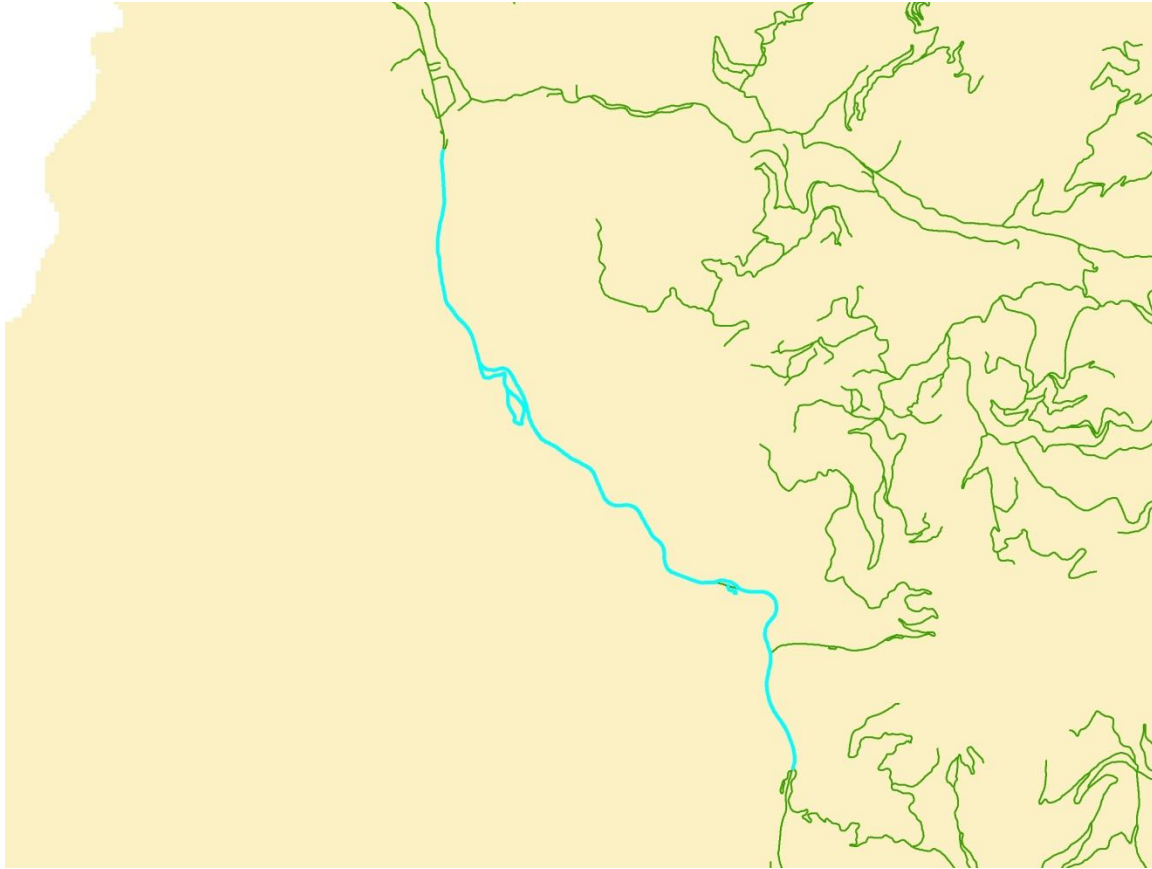


Figure A-9 Selected road units to close.

With the above road units selected go to the ArcGIS toolbox and chose **Analysis Tools, Overlay, and Identity**.

It is necessary to use this combination because it is the same approach utilized in the SIMPPLLE spatial relations tool that determines the relationship between EVUs and road units. Any other approach will result in identifying EVUS that SIMPPLLE does not have with a road through them.

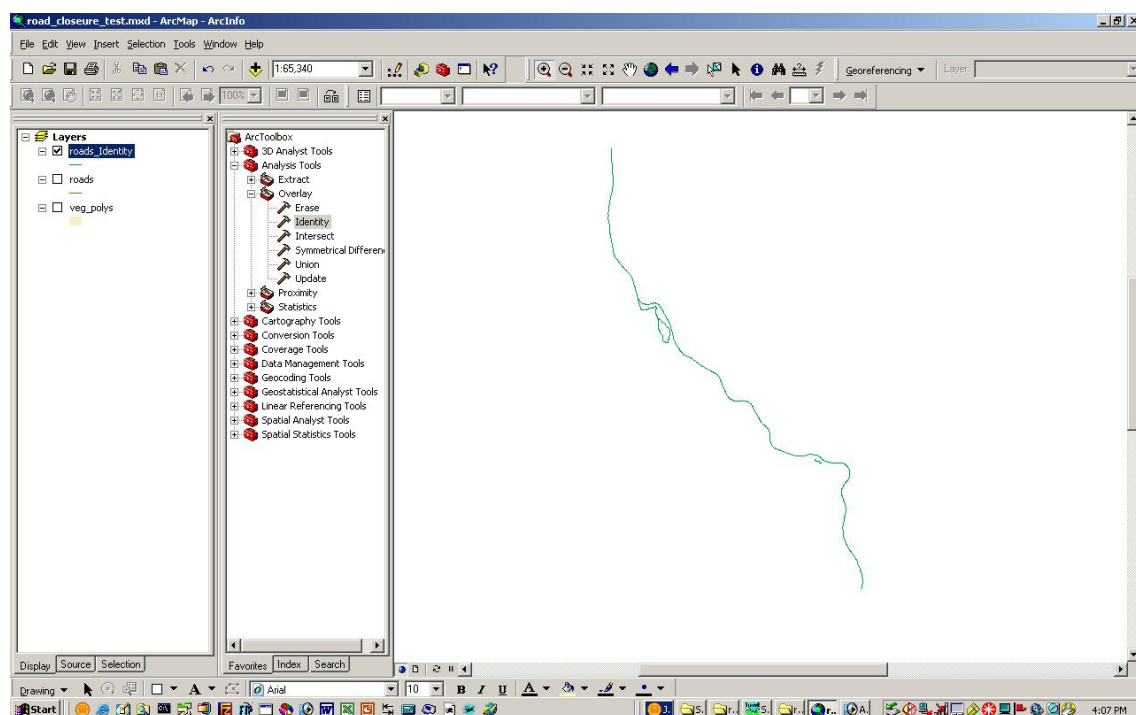


Figure A-10 Selection of identify tool.

This brings up the input screen for this process. The *input features* is the road feature class from the geodatabase with the roads to close selected. The *identify features* is the vegetation feature class from the same geodatabase. The output feature class will be the vegetation polygons that are associated with the selected road units. Within the *join attributes* if you specify *ONLY_FID* it will minimize what is in the table of the feature class of the selected EVUs.

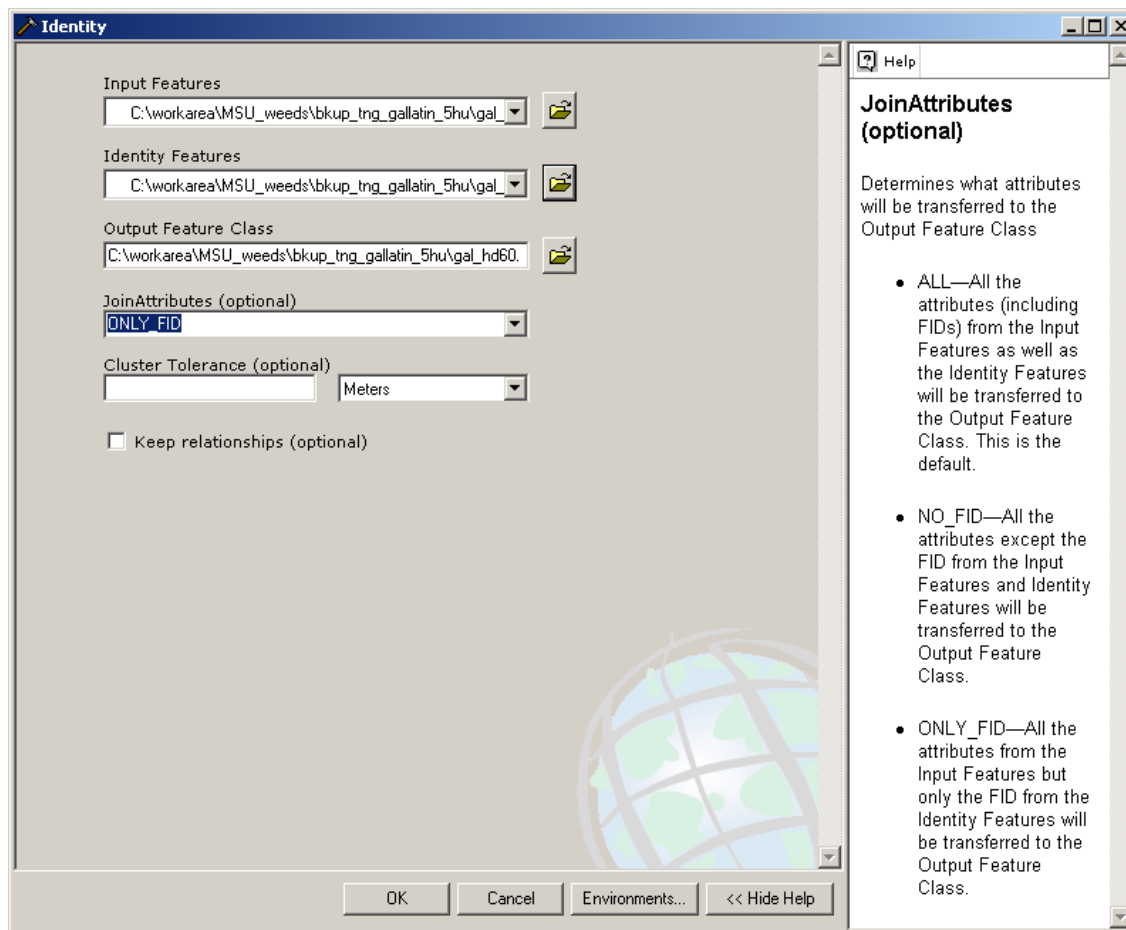


Figure A-11 Input screen for the identify tool.

2. Within the table of the output, export it as a text file.

gis_table_rds_evus.txt - Notepad

File Edit Format Help

```

"OBJECTID","FID_roads","FNODE","TNODE","LPOLY","RPOLY","LENGTH","TMPCOV1","TMPCOV1_ID","FNODE_1","TNODE_1","LPOLY_1","RPOLY_1","LENGTH_1","TMPCOV1_1","TMPCOV1_ID_1"
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```

Figure A-12 The exported text file that contains the combination of selected road units and the EVUs that they are within.

- The exported *.txt file can be imported into an Excel spread sheet as a comma delimited format. With Excel, all of the fields except the SLINK field identifying the EVUs can be deleted and a first line added to contain the time step number and the treatment name. Example: 1, close-roads. The file can be saved as a text file. This is the format for a "unit-id" file that can be loaded into SIMPLLE.

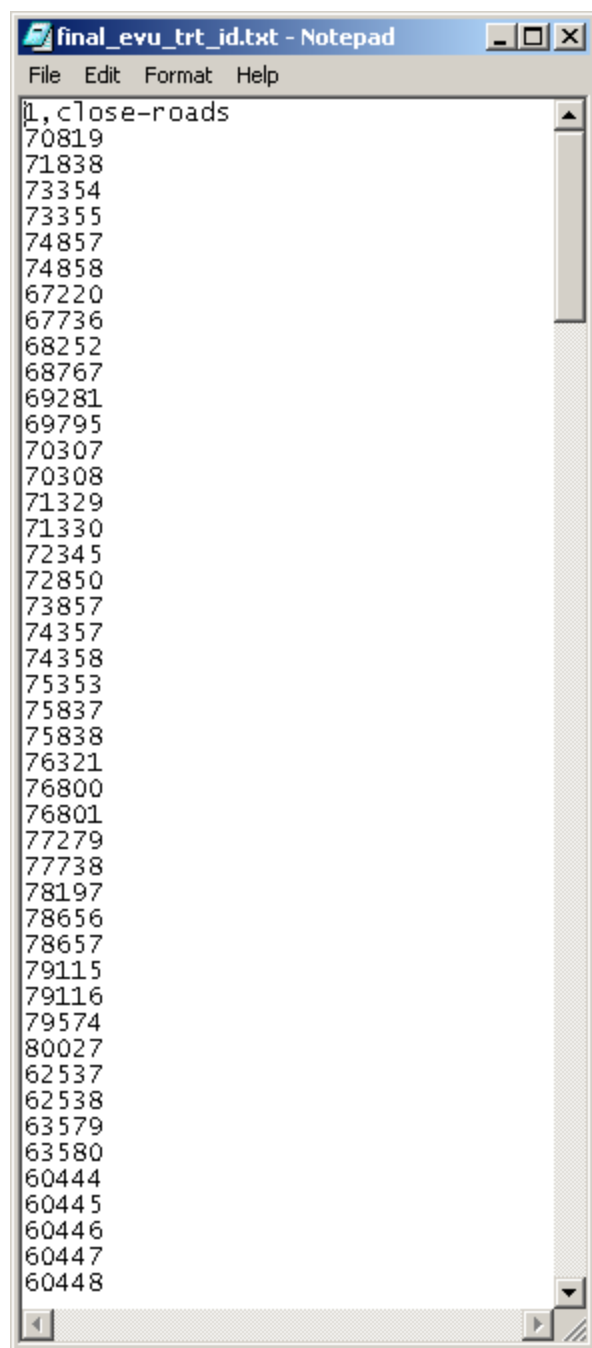


Figure A-13 Final file saved as a text file from Excel.

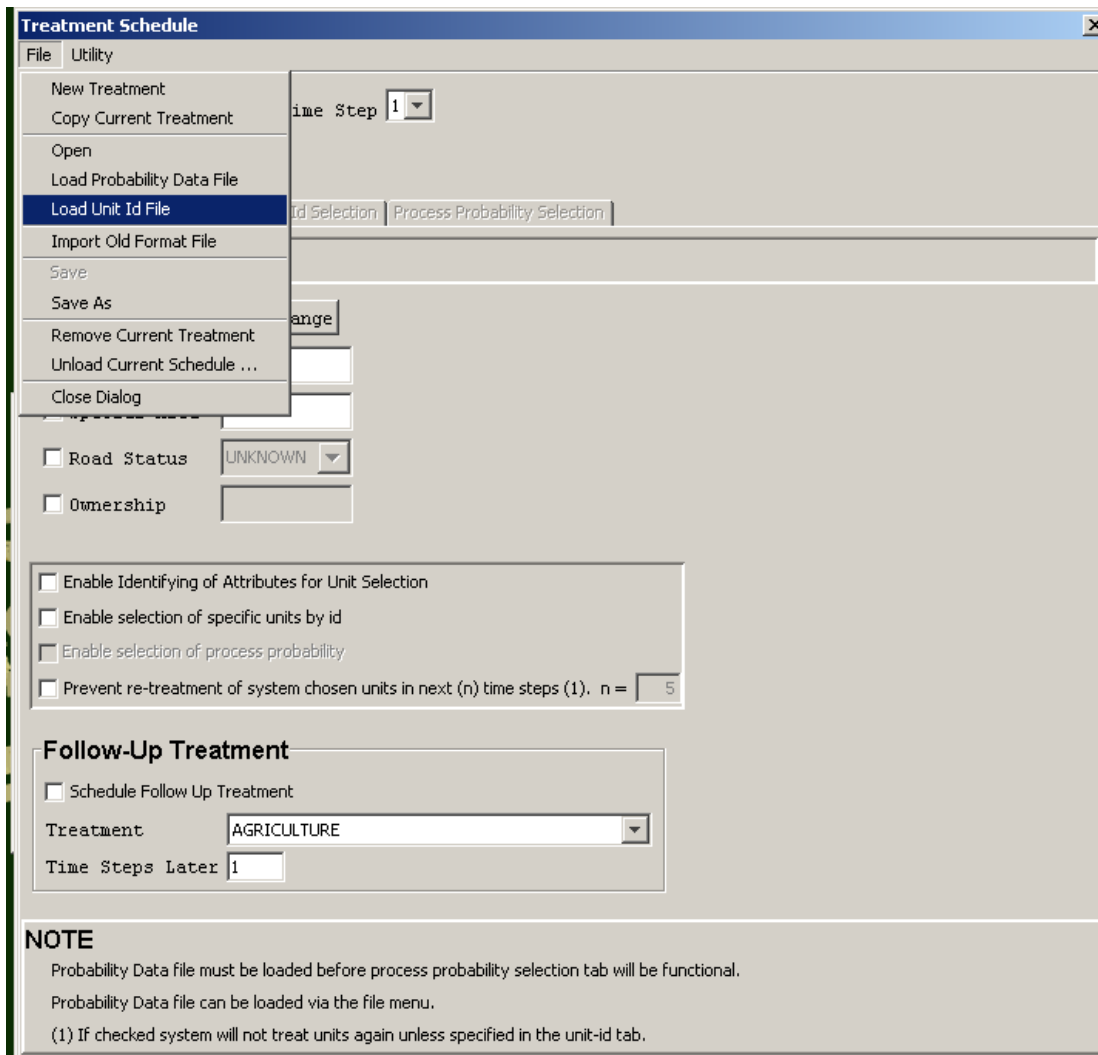


Figure A-14 Loading unit-id file for a treatment.

Within SIMPLLE, under **Treatment Schedule**, schedule a new treatment for the desired time step (must match the number you put in the id text file). Select the **Close-road** treatment. Then select **File > Load Unit Id File**. After it is loaded, select **Save As** to make this a treatment schedule file for future simulations.

No changes are required to the close-roads treatment logic. If you look at the treatment logic you can see there are no restrictions for feasibility of application. There are no rules associated with change, only the use of a function call to close the road unit that is associated with the EVU identified.

This same sequence of steps can be used with other treatments of **Open-roads**, **Close-trails**, and **Open-trails**. A combination of these treatments can be used, closing and opening roads a number of times over a simulation.

Conifer Encroachment—Eastside Only

This system knowledge component was developed before many of the current regeneration features were in the system. The purpose is to account for ecological stratifications, certain habitat types in Region One, that are classified as non-forest, but with the absence of fire certain adjacent conifer species will encroach. The logic screen accounts for the concept that the larger the plant community of non forest habitat type, the longer it must be free of fire before the encroachment can occur. The code that identifies considered habitat type groups is not accessible. However, it can be seen by looking at the pathways for the non-forest habitat type groups. Those pathways have Douglas-fir, Ponderosa Pine, and Limber Pine present. Thus, if a seed source is present in an adjacent plant community it is possible in the absence of fire to get regeneration of the species.

16.2 APPENDIX B—CALIFORNIA: SOUTHERN CALIFORNIA AND SIERRA NEVADA

A California version of SIMPPLLE was created with two initial zones that correspond with Bailey's **Ecological Sections** in California: the **Sierra Nevada** zone containing M261E and M261F and the **Southern California** zone containing M262B (Bailey 1998). These geographic zones were developed with funding from a Joint Fire Sciences Project, 98-1-8-06, A risk-based comparison of potential fuel treatment tradeoff models (Weise et al. 2000, 2003)

Information for pathways and process logic came from the following sources:

- Stephenson, John R., and Gena M. Calcarone. 1999. Southern California Mountains and Foothills Assessment: Habitat and Species Conservation Issues. Gen. Tech. Rep. GTR-PSW-175. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 402 p.
- Sierra Nevada Ecosystem Project: Final Report to Congress. Volume II: Assessments and Scientific Basis for Management Options, Wildland Resources Center Report No. 37 ISBN 1-8-87673-01-6. July 1996
- Meeting with Jo Keeley, University of California, Los Angeles in June 1999
- A variety of publications provided by Richard Minnich, University of California, Los Angeles

Ecological Stratification

Ecological Stratification	Description
Fth-x	Foothills xeric
Fth-m	Foothills mesic
Lm-x	Lower montane xeric
Lm-m	Lower montane mesic
Um-x	Upper montane xeric
Um-m	Upper montane mesic
Sa	subalpine

Table B-1 Ecological stratification used for the Southern California and Sierra Nevada geographic zones.

Vegetation Attributes

Dominant Species Used in SIMPPLLE	
abbreviation	description
AGR	AGRICULTURE
GRASS	GRASS
EXOTIC-GRASSES	EXOTIC-GRASSES
NF	NON-FOREST
NS	NON-STOCKED
CSS	COASTAL SAGE SCRUB
MDS	MIXED DESERT SHRUB
MTN-CHP	MONTANE CHAPARRAL
NM-CHP	NORTHERN MIXED CHAPARRAL
C-CHP	CEANOTHUS CHAPPARRAL
CA-CHP	CHAMISE CHAPARRAL
SD-CHP	SEMI-DESERT CHAPARRAL

BSB	BIG BASIN SAGEBRUSH
SB	SAGEBRUSH
TBR SB	TIMBERLINE SAGEBRUSH
ILO	INTERIOR LIVE OAK
CLO	CANYON LIVE OAK
BO	BLACK OAK
BO-PP	BLACK OAK-PONDEROSA PINE
PC	COULTER PINE
PJ	PINON PINE
JP	JEFFERY PINE
PP	PONDEROSA PINE
LP	LODGEPOLE PINE
WB	WHITEBARK PINE
WJ	WESTERN JUNIPER
WH	WESTERN HEMLOCK
CW	COTTONWOOD
QA	ASPEN
MH	MOUNTAIN HEMLOCK
MC-DF	MIXED CONIFER - DOUGLAS FIR
MC-IC	MIXED CONIFER - INCENSE CEDAR
MC-WF	MIXED CONIFER - WHITE FIR
MC-PP	MIXED CONIFER - PONDEROSA PINE
MC-SEQ	MIXED CONIFER - SEQUOIA

WP	WESTERN WHITE PINE
MC-RF	MIXED CONIFER - RED FIR
LP-RF	LODGEPOLE PINE - RED FIR
DF	DOUGLAS-FIR
RF	RED-FIR
XERIC-SHRUBS	XERIC-SHRUBS
MESIC-SHRUBS	MESIC-SHRUBS
RIP-SHRUBS	RIPARIAN-SHRUBS
ALPINE-SHRUBS	ALPINE-SHRUBS
WATER	WATER

Table B-2 Species in the California zones.

Size-Class, Structure	Description
SS	seedling & sapling < 5-inch DBH
POLE	pole size 5–8.9-inch DBH
PTS	two stories with largest being pole size
PMU	more than two stories, multi-storied, largest being pole size
MEDIUM	medium size 9–14.9-inch DBH
MTS	two stories with largest being medium size
MMU	more than two stories, multi-storied, largest being medium size
LARGE	large size, 15–20.9-inch DBH
LTS	two stories with largest being large size

LMU	more than two stories, multi-storied, largest being large size
VERY-LARGE	very large ≥ 21 -inch
VLTS	two stories with largest being very-large
VLMU	more than two stories, multi-storied, largest being very-large

Table B-3 Size Class, Structure in the California zones.

Density Class	Percent
1	0 - 10
2	11 - 39
3	40 - 69
4	70 - 100

Table B-4 Density in the California zones.

Disturbance Process	Description
srf	stand replacing fire

msf	mixed severity fire
lsf	light severity fire
dm	drought mortality
sbb	severe bark beetles
lbb	light bark beetles
succ	succession
Rd	root disease
bb-rd-mist	root disease, bark beetles, mistletoe complex
wpbr	white pine blister rust

Table B-5 Disturbance Processes in the California zones.

16.3 APPENDIX C—GILA NATIONAL FOREST

This geographic area was developed with funding from a Joint Fire Sciences Project, 98-1-8-06, A risk-based comparison of potential fuel treatment tradeoff models (Weise et al. 2000,. 2003)

Values used came from a meeting with the Forest and Reserve District in May 2001 in Silver City, New Mexico.

Ecological Stratification

Ecological Stratification	Description
NF	Non-forest
W	Woodland
R	Riparian
FW	Forested wet
FD	Forested dry

Table C-1 Ecological stratification used for the Gila Forest.

Vegetation Descriptions

SIMPPLLE Species	Definition
NRK	rockland/talus/scree
NFL	non forested
NPT	strip mine/quarries/gravel pits
PVT	private (no data)
WET	wetlands
WAT	water

SIMPPLLE Species	Definition
GRA	grass
GRA-SMS	grass/shrub mountain mahogany
GRA-TAA	grass/tree quaking aspen
GRA-TAD	grass/tree quaking aspen/Douglas-fir
GRA-TDF	grass/tree Douglas-fir (wet)
GRA-TDO	grass/tree Douglas-fir/oak
GRA-TMC	grass/tree mixed conifer (wet)
GRA-TMC	grass/tree mixed conifer (wet)
GRA-TJW	grass/tree juniper woodland
GRA-TPI	grass/tree pinyon pine
GRA-TPJ	grass/tree pinyon pine/juniper
GRA-FW	grass/forested wet
GRA-FD	grass/forested dry
GRA-TDF	grass/tree Douglas-fir wet
GRA-TOC	grass/tree oak/conifer
GRA-TODF	grass/tree oak/Douglas-fir
GRA-TOPP	grass/tree oak/ponderosa pine
GRA-TMS	grass/tree mountain mahogany
GRA-TOW	grass/tree oak woodland
GMU	grass mountain muhly
GWE	wetland grass
GWE-TCF	wetland grass/tree cottonwood forest
GWE-TCW	wetland grass/tree cottonwood
GWE-TRF	wetland grass/tree riparian forest
SHR	shrub

SIMPPLLE Species	Definition
SHR-TCF	shrub/tree cottonwood forest
SHR-TRF	shrub/tree riparian forest
SHR-TODF	shrub/tree oak/Douglas-fir
SHR-TOPP	shrub/tree oak/ponderosa pine
SHR-TOW	shrub/tree oak woodland
SMS	shrub mountain mahogany
SGO	shrub Gambel oak
SMZ	shrub manzanita/turbinella oak/chaparral
TAA	tree quaking aspen
TADF	tree quaking aspen/Douglas-fir
TDFA	tree Douglas-fir/quaking aspen
TCF	tree cottonwood forest
TCW	tree cottonwood
TDF-OAK	tree Douglas-fir (SS)/oak
TPP-GRA	tree ponderosa pine (SS)/grass
TPP-GRA	tree ponderosa pine (SS)/grass
TDF	tree Douglas-fir (dry)
TDF	tree Douglas-fir (wet)
TPP-TDF	tree ponderosa pine/Douglas-fir
TDF-TPP	tree Douglas-fir/ponderosa pine
TES	tree Engelmann spruce
TJW	tree juniper woodland
TMC	tree mixed conifer (dry)
TMC	tree mixed conifer (wet)
TMS	tree mountain mahogany

SIMPPLLE Species	Definition
TGO	tree Gambel oak
TOC	tree oak/conifer
TODF	tree oak/Douglas-fir
TDFO	tree Douglas-fir/oak
TOPP	tree oak/ponderosa pine
TPPO	tree ponderosa pine/oak
TOW	tree oak woodland
TPI	tree pinyon pine woodland
TPJ	tree pinyon/juniper woodland
TPP	tree ponderosa pine (dry)
TPP	tree ponderosa pine (wet)
TRE	tree (no species data)
TRF	tree riparian forest
TRJ	tree Rocky Mountain juniper
TSF	tree subalpine fir/Engelmann spruce
TWF	tree white fir
TWP	tree white pine

Table C-2 Species used for the Gila Forest.

Size Class	Definition
NF	Non-forest
GRA	Grass

SHR	Shrub
SS	Seedling sapling
POLE	Pole
MEDIUM	Medium
LARGE	Large
VERY-LARGE	Very large

Table C-3 Size class used for the Gila Forest.

Density Class	Definition
1	Non-forest <10%
2	Low 11-49%
3	Medium 50-69%
4	High 70-100%

Table C-4 Density classes used for the Gila Forest.

Disturbance Process	Definition
SUCCESSION	Succession
LSF	Light severity fire
MSF	Mixed severity fire
SRF	Stand replacing fire
ROOT-DISEASE	Root disease
DF-BEETLE	Douglas-fir beetle
PP-MPB	Ponderosa pine mountain pine beetle

Disturbance Process	Definition
LIGHT-WSBW	Light western spruce budworm
SEVERE-WSBW	Severe western spruce budworm
ELK-HERBIVORY	Elk browsing
WP-MPB	White pine mountain pine beetle

Table C-5 Disturbances used for the Gila Forest.

16.4 APPENDIX D—SOUTH CENTRAL ALASKA

This geographic zone was developed with funding from a Joint Fire Sciences Project, 98-1-8-06, A risk-based comparison of potential fuel treatment tradeoff models (Weise et al. 2000, 2003)

Vegetation attributes were based on inventories developed by the Kenai Peninsula Borough through the Spruce Beetle project. Process behavior knowledge was derived from meeting with Marvin Rude from the Borough and individuals from the Forest Service, State and Private Office.

Ecological Stratification

No stratification was used for the Kenai.

Vegetation Attributes

Species	Definition
Tree	
A	aspen
AB	aspen-birch
AB-BS	aspen-birch-black spruce
AB-CW	aspen birch-cottonwood
AB-DLS	aspen birch-dead Lutz spruce
AB-DSS	aspen birch-dead Sitka spruce
AB-DWS	aspen-birch-dead white spruce
AB-HD	aspen birch-hardwood
AB-LS	aspen birch-Lutz spruce
AB-MH	aspen birch-mtn. Hemlock
A-BS	aspen-black spruce
AB-SS	aspen birch-Sitka spruce

Species	Definition
AB-WH	aspen birch-w. hemlock
AB-WS	aspen-birch-white spruce
AC	Alaska cedar
A-CW	aspen-cottonwood
A-DLS	aspen-dead Lutz spruce
A-DSS	aspen-dead Sitka spruce
A-DWS	aspen-dead white spruce
A-HD	aspen-hardwood
A-LS	aspen-Lutz spruce
A-MH	aspen-mtn. Hemlock
A-SS	aspen-Sitka spruce
A-WH	aspen-w. hemlock
A-WS	aspen-white spruce
B	birch
BA	birch-aspen
BA-BS	birch aspen-black spruce
BA-CW	birch aspen-cottonwood
BA-DLS	birch aspen-dead Lutz spruce
BA-DSS	birch aspen-dead Sitka spruce
BA-DWS	birch aspen-dead white spruce
BA-HD	birch aspen-hardwood
BA-LS	birch aspen-Lutz spruce
BA-MH	birch aspen-mtn. Hemlock
BA-SS	birch aspen-Sitka spruce

Species	Definition
BA-WH	birch aspen-w. hemlock
BA-WS	birch aspen-white spruce
B-BS	birch-black spruce
B-CW	birch-cottonwood
B-DLS	birch-dead Lutz spruce
B-DSS	birch-dead Sitka spruce
B-DWS	birch-dead white spruce
B-HD	birch-hardwood
B-LS	birch-Lutz spruce
B-MH	birch-mtn. Hemlock
BS	black spruce
BS-A	black spruce-aspen
BS-AB	black spruce-aspen-birch
BS-B	black spruce-birch
BS-BA	black spruce-birch aspen
BS-CW	black spruce-cottonwood
BS-DLS	black spruce-dead Lutz spruce
BS-DSS	black spruce-dead Sitka spruce
BS-DWS	black spruce-dead white spruce
BS-HD	black spruce-hardwood
BS-LS	black spruce-Lutz spruce
BS-MH	black spruce-mtn. Hemlock
B-SS	birch-Sitka spruce
BS-SS	black spruce-Sitka spruce

Species	Definition
BS-WH	black spruce-w.hemlock
BS-WS	black spruce-white spruce
B-WH	birch-w. hemlock
B-WS	birch-white spruce
CW	cottonwood
CW-A	cottonwood-aspen
CW-AB	cottonwood-aspen birch
CW-B	cottonwood-birch
CW-BA	cottonwood-aspen birch
CW-BS	cottonwood-black spruce
CW-DLS	cottonwood-dead Lutz spruce
CW-DSS	cottonwood-dead Sitka spruce
CW-DWS	cottonwood-dead white spruce
CW-HD	cottonwood-hardwood
CW-LS	cottonwood-Lutz spruce
CW-MH	cottonwood-mtn. Hemlock
CW-SS	cottonwood-Sitka spruce
CW-WH	cottonwood-w. hemlock
CW-WS	cottonwood-white spruce
DLS	dead Lutz spruce
DLS-A	dead Lutz spruce-aspen
DLS-AB	dead Lutz spruce-aspen birch
DLS-B	dead Lutz spruce-birch
DLS-BA	dead Lutz spruce-birch aspen

Species	Definition
DLS-BS	dead Lutz spruce-black spruce
DLS-CW	dead Lutz spruce-cottonwood
DLS-HD	dead Lutz spruce-hardwood
DLS-LS	Dead Lutz spruce-Lutz spruce
DLS-MH	dead Lutz spruce-mountain hemlock
DLS-SS	dead Lutz spruce-Sitka spruce
DLS-WH	dead Lutz spruce-western hemlock
DLS-WS	dead Lutz spruce-white spruce
DSS	dead Sitka spruce
DSS-A	dead Sitka spruce-aspen
DSS-AB	dead Sitka spruce-aspen birch
DSS-B	dead Sitka spruce-birch
DSS-BA	dead Sitka spruce-birch aspen
DSS-BS	dead Sitka spruce-black spruce
DSS-CW	dead Sitka spruce-cottonwood
DSS-HD	dead Sitka spruce-hardwood
DSS-MH	dead Sitka spruce-mountain hemlock
DSS-SS	Dead Sitka spruce-Sitka spruce
DSS-WH	dead Sitka spruce-western hemlock
DWS	dead white spruce
DWS-A	dead white spruce-aspen
DWS-AB	dead white spruce-aspen-birch
DWS-B	dead white spruce-birch
DWS-BA	dead white spruce-birch aspen

Species	Definition
DWS-BS	dead white spruce-black spruce
DWS-CW	dead white spruce-cottonwood
DWS-HD	dead white spruce-hardwood
DWS-MH	dead white spruce-mountain hemlock
DWS-SS	dead white spruce-Sitka spruce
DWS-WH	dead white spruce-western hemlock
DWS-WS	dead white spruce-white spruce
HD	hardwood
HD-A	hardwood-aspen
HD-AB	hardwood-aspen birch
HD-B	hardwood-birch
HD-BA	hardwood-birch aspen
HD-BS	hardwood-black spruce
HD-CW	hardwood-cottonwood
HD-DLS	hardwood-dead Lutz spruce
HD-DSS	hardwood-dead Sitka spruce
HD-DWS	hardwood-dead white spruce
HD-LS	hardwood-Lutz spruce
HD-MH	hardwood-mtn. Hemlock
HD-SS	hardwood-Sitka spruce
HD-WH	hardwood-w. hemlock
HD-WS	hardwood-white spruce
LS	Lutz spruce
LS-A	Lutz spruce-aspen

Species	Definition
LS-A	Lutz spruce-aspen
LS-AB	Lutz spruce-aspen birch
LS-B	Lutz spruce-birch
LS-B	Lutz spruce-birch
LS-BA	Lutz spruce-birch aspen
LS-BS	Lutz spruce-black spruce
LS-CW	Lutz spruce-cottonwood
LS-CW	Lutz spruce-cottonwood
LS-DLS	Lutz spruce-Dead Lutz spruce
LS-HD	Lutz spruce-hardwood
LS-MH	Lutz spruce-mountain hemlock
LS-SS	Lutz spruce-Sitka spruce
LS-WH	Lutz spruce-western hemlock
MH	mountain hemlock
MH-A	mtn. Hemlock-aspen
MH-AB	mtn. Hemlock-aspen birch
MH-AC	mountain hemlock-Alaska cedar
MH-B	mountain hemlock-birch
MH-B	mtn. Hemlock-birch
MH-BA	mtn. Hemlock-birch aspen
MH-BS	mtn hemlock-black spruce
MH-CW	mtn. Hemlock-cottonwood
MH-DLS	mountain hemlock-dead Lutz spruce
MH-DSS	mountain hemlock-dead Sitka spruce

Species	Definition
MH-HD	mtn. Hemlock-hardwood
MH-LS	mountain hemlock-Lutz spruce
MH-SS	mountain hemlock-Sitka spruce
MH-WH	mountain hemlock-western hemlock
MH-WS	mtn. Hemlock-white spruce
SS	Sitka spruce
SS-A	Sitka spruce-aspen
SS-AB	Sitka spruce-aspen birch
SS-B	Sitka spruce-birch
SS-BA	Sitka spruce-birch aspen
SS-BS	Sitka spruce-black spruce
SS-CW	Sitka spruce-cottonwood
SS-DLS	Sitka spruce-dead Lutz spruce
SS-DSS	Sitka spruce-Dead Sitka spruce
SS-DWS	Sitka spruce-dead white spruce
SS-HD	Sitka spruce-hardwood
SS-MH	Sitka spruce-mountain hemlock
SS-WH	Sitka spruce-western hemlock
SS-WS	Sitka spruce-white spruce
WH	western hemlock
WH-A	w. hemlock-aspen
WH-AB	w. hemlock-aspen birch
WH-B	w. hemlock-birch
WH-BA	w. hemlock-birch aspen

Species	Definition
WH-BS	w. hemlock-black spruce
WH-CW	w. hemlock-cottonwood
WH-DLS	western hemlock-dead Lutz spruce
WH-DSS	western hemlock-dead Sitka spruce
WH-DWS	western hemlock-dead white spruce
WH-HD	w. hemlock-hardwood
WH-LS	w. hemlock-Lutz spruce
WH-SS	western hemlock-Sitka spruce
WH-WS	w. Hemlock-white spruce
WS	white spruce
WS-A	white spruce-aspen
WS-AB	white spruce-aspen-birch
WS-B	white spruce-birch
WS-BA	white spruce-birch aspen
WS-BS	white spruce-black spruce
WS-CW	white spruce-cottonwood
WS-DWS	white spruce-dead white spruce
WS-HD	white spruce-hardwood
WS-MH	white spruce-mountain hemlock
WS-SS	white spruce-Sitka spruce
WS-WH	white spruce-western hemlock
Shrub	
Wil	willow
Ald	alder

Species	Definition
mixed tall shrub	mixed tall shrub
mixed low shrub	mixed low shrub
mixed dwarf shrub	mixed dwarf shrub
Grass	
Herb	herbaceous
GH	grasses/herbs
Aqu	aquatic
Non-forest	
OCEAN	ocean
NF	NF
ALP	alp
AGR	agriculture

Table D-1 Species used in the South Central Alaska zone.

Size Class	Definition	Size Limit
Tree		
SS	Seedling-sapling	1–5-inch DBH
SS-SS	Seedling-sapling - seedling-sapling	
SS-POLE	Seedling-sapling - pole	
SS-LARGE	Seedling-sapling-large	
POLE	Pole	5.1–9-inch DBH – conifer 5.1–11-inch DBH - hardwood
POLE-SS	Pole-seedling - sapling	
POLE-POLE	Pole - pole	

POLE-LARGE	Pole - large	
LARGE	Large	>9-inch DBH – conifer >11-inch DBH - hardwood
LARGE-SS	Large – seedling-sapling	
LARGE-POLE	Large – pole	
LARGE-LARGE	Large – large	
SHRUB		
TALL-SHRUB	Tall shrub	
LOW-SHRUB	Low shrub	
DWARF-SHRUB	Dwarf shrub	
GRASS		
HERB	Herbaceous	
GH	Grass or herbaceous	
AQUATIC	Aquatic herbaceous	
NON-FOREST		
NF	Non-forest	

Table D-2 Size Classes used in the South Central Alaska zone.

Density	Definition	Percent of Canopy Closure
Tree		
W	Woodland	10-24%
O	Open	25-59%
C	Closed	60-100%
Shrub		

W	Woodland	10-24%
O	Open	25-59%
C	Closed	60-100%
Herbaceous		
C	Closed	60-100%

Table D-3 Density used in the South Central Alaska zone.

Disturbance Processes

Abbreviation	Definition
LSF	Light severity fire
MSF	Mixed severity fire
SRF	Stand replacing fire
LOW-WINDTHROW	Low windthrow
MEDIUM-WINDTHROW	Medium windthrow
HIGH-WINDTHROW	High windthrow
WILDLIFE-BROWSING	Wildlife browsing in aspen and birch
ROOT-DISEASE	Root disease
LIGHT-SB	Light spruce beetle
MEDIUM-SB	Medium spruce beetle
HIGH-SB	High spruce beetle

Table D-4 Disturbance Processes used in the South Central Alaska zone.

Discussion of System Knowledge

Root Disease is the only process probability logic that is accessible in the user interface. **Windthrow** and **Wildlife Browsing** must be locked-in to be used. The spruce beetle probability comes from the

incorporation of components of the spruce beetle expert system, Reynolds and Holsten (1997). The system knowledge on the spruce beetle probability is not accessible in SIMPPLE version 2.5.

16.5 APPENDIX E—SOUTHWEST UTAH

This geographic zone was developed with funding from a Joint Fire Sciences Project, 98-1-8-06, A risk-based comparison of potential fuel treatment tradeoff models (Weise et al. 2000, 2003)

Values and system behavior were derived from a workshop in Cedar City, Utah and follow up correspondence with local Forest Service and BLM individuals.

Ecological Stratification

Ecological Stratification	Definition
0	Miscellaneous special habitats: scree, forested rock, wet meadow, mountain grassland, deciduous riparian communities
1	Pinyon pine–Juniper communities
2	Montane maple-oak communities
3	Ponderosa pine communities
4	Dry Douglas-fir communities
5	Cool or moist Douglas-fir communities
6	White fir and blue spruce communities (mixed conifer types)
7	Aspen-dominated communities

Table E-1 Ecological Stratification used for Southwest Utah.

Vegetation Attributes

Species	Definition
AGR/URB	Agriculture/urban
AG	Annual grass
A	Aspen

Species	Definition
A-MF	Aspen-montane fir
A-MS	Aspen-mountain sagebrush
A-PG	Aspen-perennial grass
A-SF	Aspen-spruce/fir
GW-PG	Greasewood-perennial grass
MF	Montane fir
MF-A	Montane fir-aspen
MM-OK	Mountain mahogany-oak
MM-OK-PJU	Mountain mahogany-oak-pinyon/juniper
MS-PG	Mountain sagebrush-perennial grass
MS-PJU-PG	Mountain sagebrush-pinyon/juniper-perennial grass
OK	Oak
OK-PJU	Oak-pinyon/juniper
PG	Perennial grass
PJU	Pinyon/juniper
PJU-MM-OK	Pinyon/juniper-mountain mahogany-oak
PJU-MS	Pinyon/juniper-mountain sagebrush
PJU-OK	Pinyon/juniper-oak
PJU-WS	Pinyon/juniper-Wyoming sagebrush
PP	Ponderosa pine
PP-MF	Ponderosa pine-montane fir
RIPARIAN	Riparian
ROCK/BARE	Rock or bare ground
SD-PG	Shadscale-perennial grass
SF	Spruce/fir

Species	Definition
SF-A	Spruce/fir-aspen
WATER	Water
WS-PG	Wyoming sagebrush-perennial grass
WS-PJU-PG	Wyoming sagebrush-pinyon/juniper-perennial grass

Table E-2 Species used for Southwest Utah.

Size Class	Definition
BARREN	Barren
GF	Grass/forbs
SS	Seedling-sapling
POLE	Pole
MEDIUM	Medium
LARGE	Large
WATER	Water
AGR	Agriculture
URBAN	Urban
RIPARIAN	Riparian
ALPINE	Alpine

Table E-3 Size Classes used for Southwest Utah.

Density	Definition
RANGE DENSITY	
1	Open
2	Closed
3	
FOREST DENSITY	
1	< 40 percent cover
2	41 to 70 percent cover
3	> 70 percent cover

Table E-4 Density used for Southwest Utah.

Disturbance Processes

Process	Definition
LSF	Light severity fire
MSF	Mixed severity fire
SRF	Stand replacing fire
PP-MPB	Ponderosa pine mountain pine beetle

Table E-5 Disturbance Processes used for Southwest Utah.

16.6 APPENDIX F—MICHIGAN

This geographic zone is incomplete. The initial work was funded from a Joint Fire Sciences Project, 98-1-8-06, A risk-based comparison of potential fuel treatment tradeoff models (Weise et al. 2000,2003)

No testing of this zone has been made. No sample landscape has been developed.

Ecological Stratification

SIMPPLLE Attribute	Definition
FR1	Landscape ecosystems experiencing frequent, large catastrophic stand replacing fires; dry outwash plains underlain by coarse textured sandy soils; dominant forest types were jack pine and mixed pine forests
FR2	Landscape ecosystems experiencing large catastrophic fires at lower frequencies; dry outwash plains underlain by sandy and sandy loam soils. Dominant vegetation is mixed red, white, and jack pine forests.
FR3W	Wetland ecosystems interspersed or adjoining FR1 and FR2 fire prone landscapes.
FR3	Dry-mesic to mesic areas with sandy or silt loam soils; experienced much less frequent stand replacement fires and dominated by mixed hemlock and white pine forests.
FR4	Moist mesic areas with deep loamy soils. Infrequent fires with long fire rotations; dominated by northern hardwoods (beech, sugar maple) and hardwood-hemlock forests.
FR4W	Wetland ecosystems interspersed or adjoining fire resistant landscapes. These areas are less influenced by fire than FR3W.

Table F-1 Ecological Stratification used for Michigan.

Vegetation Descriptions

SIMPPLLE Attribute	Species Definition
Tree	
QA-PB	Quaking aspen-paper birch
QA-WS-BF	Quaking aspen-white spruce-balsam fir
BF-QA-PB	Balsam fir-quaking aspen-paper birch

SIMPPLLE Attribute	Species Definition
BP	Balsam poplar
BE	Beech
BA	Bigtooth aspen
BO-SO-HL	Black oak-scarlet oak-hemlock
BLA-AE-RM	Black ash-American elm-red maple
BC-WA-YP	Black cherry-white ash-yellow poplar
BS	Black spruce
WC-QA-PB	White cedar-quaking aspen-paper birch
CONIFERS	Conifers
HL	Hemlock
JP	Jack pine
JP-OAK	Jack pine-oak
DEAD-JP	Dead Jack pine
MIXED-HDS	Mixed hardwoods
LOW-HDS	Mixed lowland hardwoods
OAK	Mixed oak
MIXED-SC	Mixed swamp conifer
RO	Red oak
PB	Paper birch
QA	Quaking aspen
RM-DRY	Red maple, dry site
RM-WET	Red maple, wet site
RM-RO	Red maple-red oak
RP	Red pine
RP-OAK	Red pine-oak

SIMPPLLE Attribute	Species Definition
SO	Scarlet oak
SM	Sugar maple
SM-BW	Sugar maple-basswood (linden)
SM-BE-YB	Sugar maple-beech-yellow birch
TR	Tamarack
WO	White oak
WC	White cedar
WP	White pine
WP-HL	White pine-hemlock
WP-RO-WA	White pine-red oak-white ash
WS-BF-NS	White spruce-balsam fir-Norway spruce
YP-WO-RO	Yellow poplar-white oak-red oak
GRASS/SHRUB	
LOW-BRUSH	Lowland brush
OPEN	Grass or shrub mixture
UP-BRUSH	Upland brush
NON-FOREST	
AGR-URBAN	Agriculture or urban
WATER	Water
NF	Non-forest
NS	Non-stocked

Table F-2 Species used for Michigan.

SIMPPLLE Attribute	Size-class Definition
Tree	
SS	Seedling-sapling
POLE	Pole
PMU	Pole-multistory
LARGE	Large
LMU	Large-multistory
GRASS/SHRUB	
GRA-SHR	Open
SHR	Shrub
NON-FOREST	
NF	Non-forest
NS	Non-stocked

Table F-3 Size Classes used for Michigan.

SIMPPLLE Attribute	Density
1	0 to 16 percent
2	16 to 39 percent
3	40 to 69 percent
4	>70 percent

Table F-4 Density used for Michigan.

Disturbance Processes

SIMPPLLE Attribute	Process Definition
LSF	Light severity fire
MSF	Mixed severity fire
SRF	Stand replacing fire
EM-ASH-BORER	Emerald ash borer
LIGHT-GYPSY	Light gypsy moth
SEVERE-GYPSY	Severe gypsy moth
JPBW	Jack pine budworm
FT-CATERPILLAR	Forest tent caterpillar
BB-DISEASE	Beech bark disease

RH-SAWFLY	Red-headed sawfly

Table F-5 Disturbance Processes used for Michigan.

Discussion of System Knowledge

There has been no development of probability logic for disturbance processes.

16.7 APPENDIX G—COLORADO FRONT RANGE

This geographic zone was developed with funding from a Joint Fire Sciences Project–01-1-3-22: Optimizing landscape treatments for reducing wildfire risk and improving ecological sustainability of ponderosa pine forests with mixed severity fire regimes, Kaufmann et al. 2001.

Ecological Stratification

Stratification	Description
PLAINS	Below 5,500 feet elevation, short grass prairie
FOOTHILLS	5,500 to 6,500 feet elevation
LOWER-MONTANE	6,500 to 7,500 feet elevation
UPPER-MONTANE	7,500 to 8,500 feet
SUBALPINE	8,500 to 11,000 feet
ALPINE	Above 11,000 feet elevation

Table G-1 Ecological Stratification used for the Colorado Front Range.

Vegetation Descriptions

Species	Description
NS	nonstocked
WATER	water
NF	non forest
ND	no data
AGR	agriculture
RIPARIAN	riparian
BA	barren
ACHY	Indian rice grass

Species	Description
BOGR2	blue grama
BRTE	cheatgrass
CACA4	blue joint
CAEL3-CARUD	blackroot sedge-Drummond's sedge
CAFO3	dryspike sedge
CAGE2	Geyer's sedge
CAPU	purple reedgrass
CAREX	sedge species
CAREX-JUNCU	sedge species-rush species
CAREXU	upland sedge species
CAREXU-CARU	upland sedge-pinegrass
CARO5	Ross' sedge
CARUD-FEBRC	Drummond's sedge-Colorado fescue
FEAR2	Arizona fescue
FEAR2-BOGR2	Arizona fescue-blue grama
FEAR2-DAPA2	Arizona fescue-Parry's oatgrass
FEAR2-MUMO	Arizona fescue-mountain muhly
FEID	Idaho fescue
FETH	Thurber's fescue
HECO26	needle and thread
JUBAL-CAGE	Baltic rush-Geyer's sedge
LEK12	spike fescue
MUMO	mountain muhly
PASM	western wheatgrass
PHCO9-POAL2	alpine timothy-alpine bluegrass

Species	Description
POAL2-CAEL3	alpine bluegrass-blackroot sedge
POAL2-KOMY	alpine bluegrass-Bellardi bog sedge
POFE	mutton grass
POPR	Kentucky bluegrass
PSSP6	bluebunch wheatgrass
ACGL	Rocky Mountain maple
ALINT	thinleaf alder
AMAL2	Saskatoon serviceberry
ARTR2	big sagebrush
ARTR2-CEMO2	big sagebrush-alderleaf mountain mahogany
ARTR2-JUCO6	big sagebrush-common juniper
ARTRV	mountain big sage
ARTRV-PUTR	mountain big sage-antelope bitterbrush
ARTRW8	Wyoming big sage
ARTRW8-CHVI8	Wyoming big sage-yellow rabbitbrush
ARTRW8-PUTR	Wyoming big sage-antelope bitterbrush
ARUV	kinnikinnick
BEOC2	water birch
CEMO2	alderleaf mountain mahogany
CEMO2-ARTR2	alderleaf mountain mahogany-big sagebrush
CEMO2-ARUV	alderleaf mountain mahogany-kinnikinnick
CEMO2-DAFL3	alderleaf mountain mahogany-shrubby cinquefoil
CEMO2-JUCO6	alderleaf mountain mahogany-common juniper
CEMO2-PHMO4	alderleaf mountain mahogany-mountain ninebark
CEMO2-PUTR2	alderleaf mountain mahogany-antelope bitterbrush

Species	Description
CEMO2-QUGA	alderleaf mountain mahogany-Gambel oak
CEMO2-RIBES	alderleaf mountain mahogany-current species
CEMO2-RICE	alderleaf mountain mahogany-wax currant
CEMO2-SALIXU	alderleaf mountain mahogany-upland willow
CEMO2-SYOR2	alderleaf mountain mahogany-mountain snowberry
CHIV	yellow rabbitbrush
DAFL3	shrubby cinquefoil
ERPA	Parry's rabbitbrush
JAAM	fivepetal cliffbrush
JUCO6	common juniper
JUCO6-ARUV	common juniper-kinnikinnick
JUCO6-SALIXU	common juniper-upland willow species
PHMO	mountain ninebark
PUTR	antelope bitterbrush
PUTR-ARTR	antelope bitterbrush-big sagebrush
PUTR-CEMO2	antelope bitterbrush-alderleaf mountain mahogany
PUTR-RIBES	antelope bitterbrush-currant species
QUGA	Gambel oak
QUGA-ACGL	Gambel oak-Rocky Mountain maple
QUGA-AMAL	Gambel oak-Saskatoon serviceberry
QUGA-ARUV	Gambel oak-kinnikinnick
QUGA-CEMO2	Gambel oak-alderleaf mountain mahogany
QUGA-JUCO6	Gambel oak-common juniper
QUGA-PRVI	Gambel oak-chokecherry
QUGA-SALIX	Gambel oak-upland willow species

Species	Description
QUGA-VASC	Gambel oak-grouse whortleberry
RIBES	currant species
RIBES-PUTR	currant species- antelope bitterbrush
RICE	wax currant
SAGL	grayleaf willow
SALIX	riparian willow species
SALIX-ALIN	riparian willow spp.-thinleaf alder
SALIX-BEOC2	riparian willow spp.-water birch
SALIXU	upland willow species
SALIXU-RIBES	upland willow spp.-currant spp.
SHCA	russet buffaloberry
VASC	grouse whortleberry
ABCO	white fir
ABCO-PIEN	white fir-Engelmann spruce
ABCO-PIFL2	white fir-limber pine
ABCO-PIPO	white fir-ponderosa pine
ABCO-POTR5	white fir-quaking aspen
ABCO-PSME	white fir-Douglas-fir
ABLA	subalpine fir
ABLA-PIAR	subalpine fir-bristlecone pine
ABLA-PICO	subalpine fir-lodgepole pine
ABLA-PIEN	subalpine fir-Engelmann spruce
ABLA-PIFL2	subalpine fir-limber pine
ACNE2	boxelder
ACNE2-PSME	boxelder-Douglas-fir

Species	Description
JUMO	oneseed juniper
JUMO-PIED	oneseed juniper-two-needle pinyon
JUSC2	Rocky Mountain juniper
JUSC2-PIED	Rocky Mountain juniper-two-needle pinyon
JUSC2-PIPO	Rocky Mountain juniper-ponderosa pine
JUSC2-POTR5	Rocky Mountain juniper-quaking aspen
JUSC2-PSME	Rocky Mountain juniper-Douglas-fir
PIAR	bristlecone pine
PIAR-PICO	bristlecone pine-lodgepole pine
PIAR-PIEN	bristlecone pine-Engelmann spruce
PIAR-PIFL2	bristlecone pine-limber pine
PIAR-PIPO	bristlecone pine-ponderosa pine
PIAR-POTR5	bristlecone pine-quaking aspen
PIAR-PSME	bristlecone pine-Douglas-fir
PICO	lodgepole pine
PICO-ABLA	lodgepole pine-subalpine fir
PICO-PIEN	lodgepole pine-Engelmann spruce
PICO-PIFL2	lodgepole pine-limber pine
PICO-POTR5	lodgepole pine-quaking aspen
PICO-PSME	lodgepole pine-Douglas-fir
PIED	two-needle pinyon
PIED-ABCO	two-needle pinyon-white fir
PIED-JUMO	two-needle pinyon-oneseed juniper
PIED-JUSC2	two-needle pinyon-Rocky Mountain juniper
PIED-PIAR	two-needle pinyon-bristlecone pine

Species	Description
PIED-PIPO	two-needle pinyon-ponderosa pine
PIED-POTR5	two-needle pinyon-quaking aspen
PIED-PSME	two-needle pinyon-Douglas-fir
PIEN	Engelmann spruce
PIEN-ABCO	Engelmann spruce-white fir
PIEN-ABLA	Engelmann spruce-subalpine fir
PIEN-PIAR	Engelmann spruce-bristlecone pine
PIEN-PICO	Engelmann spruce-lodgepole pine
PIEN-PIFL2	Engelmann spruce-limber pine
PIEN-PIPU	Engelmann spruce-blue spruce
PIEN-POTR5	Engelmann spruce-quaking aspen
PIEN-PSME	Engelmann spruce-Douglas-fir
PIFL2	limber pine
PIFL2-ABCO	limber pine-white fir
PIFL2-PIAR	limber pine-bristlecone pine
PIFL2-PICO	limber pine-lodgepole pine
PIFL2-PIEN	limber pine-Engelmann spruce
PIFL2-PIPO	limber pine-ponderosa pine
PIFL2-POTR5	limber pine-quaking aspen
PIFL2-PSME	limber pine-Douglas-fir
PIPO	ponderosa pine
PIPO-ABCO	ponderosa pine-white fir
PIPO-JUSC2	ponderosa pine-Rocky Mountain juniper
PIPO-PIAR	ponderosa pine-bristlecone pine
PIPO-PICO	ponderosa pine-lodgepole pine

Species	Description
PIPO-PIED	ponderosa pine-two-needle pinyon
PIPO-PIFL2	ponderosa pine-limber pine
PIPO-PIPU	ponderosa pine-blue spruce
PIPO-POAN3	ponderosa pine-narrowleaf cottonwood
PIPO-POTR5	ponderosa pine-quaking aspen
PIPO-PSME	ponderosa pine-Douglas-fir
PIPU	blue spruce
PIPU-PIPO	blue spruce-ponderosa pine
PIPU-POAN3	blue spruce-narrowleaf cottonwood
PIPU-POTR5	blue spruce-quaking aspen
PIPU-PSME	blue spruce-Douglas-fir
POAN3	narrowleaf cottonwood
POAN3-PIPO	narrowleaf cottonwood-ponderosa pine
POAN3-PIPU	narrowleaf cottonwood-blue spruce
POAN3-POTR5	narrowleaf cottonwood-quaking aspen
POAN3-PSME	narrowleaf cottonwood-Douglas-fir
POTR5	quaking aspen
POTR5-ABCO	quaking aspen-white fir
POTR5-ABLA	quaking aspen-subalpine fir
POTR5-PIAR	quaking aspen-bristlecone pine
POTR5-PICO	quaking aspen-lodgepole pine
POTR5-PIEN	quaking aspen-Engelmann spruce
POTR5-PIFL2	quaking aspen-limber pine
POTR5-PIPO	quaking aspen-ponderosa pine
POTR5-PIPU	quaking aspen-blue spruce

Species	Description
POTR5-POAN3	quaking aspen-narrowleaf cottonwood
POTR5-PSME	quaking aspen-Douglas-fir
PSME	Douglas-fir
PSME-ABCO	Douglas-fir-white fir
PSME-JUSC2	Douglas-fir-Rocky Mountain juniper
PSME-PIAR	Douglas-fir-bristlecone pine
PSME-PICO	Douglas-fir-lodgepole pine
PSME-PIED	Douglas-fir-two-needle pinyon
PSME-PIEN	Douglas-fir-Engelmann spruce
PSME-PIFL2	Douglas-fir-limber pine
PSME-PIPO	Douglas-fir-ponderosa pine
PSME-PIPU	Douglas-fir-blue spruce
PSME-POTR5	Douglas-fir-quaking aspen

Table G-2 Species used for the Colorado Front Range.

Size	SIMPPLLE Abbreviation	Notes
Trees		
Established Seedlings	E	0.0–0.9-inches DBH
Sapling	SS	1–4.9-inches DBH
Medium	MEDIUM	5–8.9-inches DBH
Large	LARGE	9–15.9-inches DBH
Very Large	VERY-LARGE	>16-inches DBH
Non-stocked	NS	
Medium-Multistory	MMU	

Large-Multistory	LMU	
Very Large-Multistory	VLMU	
Shrubs		
Small	SMALL-SH	< 2.5 feet
Medium	MEDIUM-SH	2.5–6.4 feet
Large	LARGE-SH	> 6.5 feet
Unknown	UNKNOWN	
Grasses		
Clumped	CLUMPED	
Uniform	UNIFORM	
Non forest		
Non forest	NF	

Table G-3 Size Classes used for the Colorado Front Range.

SIMPPLLE Abbreviation	Density
1	0 to 10 percent
2	11 to 40 percent
3	41 to 70 percent
4	71 to 100 percent

Table G-4 Density used for the Colorado Front Range.

Disturbance Processes

SIMPPLLE Abbreviation	Process
LSF	LIGHT SEVERITY FIRE
MSF	MIXED SEVERITY FIRE
SRF	STAND REPLACING FIRE
PP-MPB	PONDEROSA PINE MOUNTAIN PINE BEETLE
LIGHT-LP-MPB	LOGEPOLE MOUNTAIN PINE BEETLE
SEVERE-LP-MPB	LOGEPOLE MOUNTAIN PINE BEETLE
SPRUCE-BEETLE	SPRUCE BEETLE
DF-BEETLE	DOUGLAS FIR BEETLE
LIGHT-WSBW	LIGHT WESTERN SPRUCE BUDWORM
SEVERE-WSBW	SEVERE WESTERN SPRUCE BUDWORM
WILDLIFE-BROWSING	WILDLIFE BROWSING
PIED-BB	PINYON BARK BEETLE
PRAIRIE-DOG	PRAIRIE DOG
WINDTHROW	WINDTHROW
WET-SUCCESSION	WET SUCCESSION
DRY-SUCCESSION	DRY SUCCESSION
SUCCESSION	SUCCESSION
ROOT-DISEASE	ROOT DISEASE

Table G-5 Disturbance Processes used for the Colorado Front Range.

Discussion of System Knowledge

The system knowledge in pathways is based on the work done by Thad Jones as a Master's degree thesis, Development and Evaluation of Successional Pathways for SIMPPLLE: Simulating Vegetation Along the Colorado Front Range, University of Montana, 2005.

16.8 APPENDIX H—GRASSLANDS

Western Great Plains Steppe, Mixed Grass Prairie, and Great Plains Steppe were developed together and have many common features. The development was done with funding and expertise provided by the Ecosystem Research Management Institute (EMRI) of Seeley Lake, Montana. The initial use of the system in these geographic zones was to assist in developing a representation of historical conditions. Thus, an emphasis was placed on including the process of bison grazing. No treatment logic has been developed yet.

16.8.1 Western Great Plains Steppe

Ecological Stratification

Ecosites
Clayey, Dense Clay
Shallow Clayey
Clayey Overflow, Overflow
Loamy
Shallow Loamy
Sands, Sandy
Shallow Sandy
Very Shallow
Saline Upland
Saline Lowland

Table H-1 Ecology Stratifications for the Western Great Plains Steppe.

Vegetation Descriptions

CLAYEY
PASM-BOGR2-NAVI4/NA/NA
BOGR2-OPPO/NA/NA
NAVI4-PASM/NA/NA
PASM-NAVI4-BOGR2-ARTR2/NA/NA
BOGR2-ARTR2-OPPO/NA/NA
NAVI4-PASM-ARTR2/NA/NA
SHALLOW_CLAYEY
PASM-BOGR2-NAVI4/NA/NA
BOGR2-OPPO/NA/NA
PASM-NAVI4/NA/NA
PASM-NAVI4-BOGR2-ARTR2/NA/NA
BOGR2-PASM-ARTR2/NA/NA
NAVI4-PASM-ARTR2/NA/NA
CLAYEY_OVERFLOW
PASM-NAVI4-LECI4/NA/NA
BOGR2-PASM/NA/NA
LECI4-PASM-NAVI4/NA/NA
PASM-BOGR2-ARTR2/NA/NA
BOGR2-PASM-ARTR2/NA/NA
WATER/NA/NA
LECI4-PASM-ARTR2/NA/NA
OVERFLOW
PASM-NAVI4-LECI4/NA/NA
BOGR2-PASM/NA/NA

LECI4-PASM-NAVI4/NA/NA
PASM-BOGR2-ARTR2/NA/NA
BOGR2-PASM-ARTR2/NA/NA
LECI4-PASM-ARTR2/NA/NA
LOAMY
PASM-BOGR2-PLME/NA/NA
PASM-VUOC-BOGR2/NA/NA
PASM-BOGR2-HECO26/NA/NA
BOGR2-CAFI/NA/NA
HECO26-PASM/NA/NA
PASM-BOGR2-ARTR2/NA/NA
BOGR2-CAFI-ARTR2/NA/NA
HECO26-PASM-ARTR2/NA/NA
SHALLOW_LOAMY
PASM-BOGR2-PSSP6/NA/NA
BOGR2-CAFI/NA/NA
PSSP6-HECO26-PASM/NA/NA
PASM-BOGR2-ARTR2/NA/NA
BOGR2-CAFI-ARTR2/NA/NA
PSSP6-HECO26-ARTR2/NA/NA
SANDS_SANDY
HECO26-BOGR2-YUGL/NA/NA
BOGR2-CAFI/NA/NA
CALO-HECO26-POSE/NA/NA
HECO26-BOGR2-ARTR2/NA/NA
BOGR2-CAFI-ARTR2/NA/NA

CALO-HECO26-ARTR2/NA/NA
SHALLOW_SANDY
HECO26-BOGR2-YUGL/NA/NA
BOGR2-CAFI/NA/NA
CALO-HECO26-POSE/NA/NA
HECO26-BOGR2-ARTR2/NA/NA
BOGR2-CAFI-ARTR2/NA/NA
CALO-HECO26-ARTR2/NA/NA
VERY_SHALLOW
PASM-BOGR2-CALO/NA/NA
BOGR2-CAFI/NA/NA
CALO-PSSP6-PASM/NA/NA
PASM-BOGR2-JUSC2/NA/NA
BOGR2-CAFI-JUSC2/NA/NA
CALO-PSSP6-JUSC2/NA/NA
SALINE_UPLAND
SPAI-DISP-ATGA/NA/NA
SAVE4-DISP/NA/NA
ATGA-SPAI/NA/NA
SALINE_LOWLAND
SAVE4-PASM-SPAI/NA/NA
SAVE4-DISP/NA/NA
PASM-SPAI/NA/NA

Table H-2 Vegetation Descriptions used for the Western Great Plains Steppe.

Size class and density are not utilized. The value “NA” is used for the above species. The single state pathway format was developed for these ecosystems.

Disturbance Processes

Processes
SUCCESSION
LIGHT-BISON-GRAZING
MODERATE-BISON-GRAZING
HEAVY-BISON-GRAZING
STAND-REPLACING-FIRE
WET-SUCCESSION
DRY-SUCCESSION
PRAIRIE-DOG-ACTIVE
PRAIRIE-DOG-INACTIVE

Table H-3 Disturbance Processes for the Western Great Plains Steppe.

16.8.2 Great Plains Steppe

Ecological Stratification

Ecosites
Porous Clay
Dense Clay
Clayey
Claypan
Loamy

Shallow
Badlands
Sandy
Thin Sands
Saline Upland
Overflow

Table H-4 Ecological Stratification for the Great Plains Steppe.

Vegetation Descriptions

POROUS CLAY	
SCSC-CALO-PASM	little bluestem - prairie sandreed - Western wheatgrass
CALO-SCSC-PASM-CAINH2	prairie sandreed - little bluestem - Western wheatgrass - sun sedge
CAINH2-KOMA-BOGR2	sun sedge - prairie junegrass - blue grama
SCSC-CALO-JUCO6-AMCA6	little bluestem - prairie sandreed - juniper - leadplant
SCSC-PASM-AMCA6-JUCO6	little bluestem - Western wheatgrass - leadplant - juniper
CAINH2-BOGR2-AMCA6-JUCO6	sun sedge - blue grama - leadplant - juniper
DENSE CLAY	
ACMIO-VUOC	Western yarrow - six weeks fescue
PASM-NAVI4	Western wheatgrass - green needlegrass
PASM-NAVI4-BOCU-BOGR2	Western wheatgrass - green needlegrass- sideoats grama - blue grama
PASM-BOGR2	Western wheatgrass -blue grama
NAVI4-PASM-ARTR2-KOMA	green needlegrass - Western wheatgrass - Wyoming big sagebrush - prairie junegrass
PASM-NAVI4-BOGR2-ARTR2	Western wheatgrass - green needlegrass - blue grama - Wyoming big sagebrush
PASM-BOGR2-ARPE6-ARTR2	Western wheatgrass - blue grama - birdfoot sagebrush - Wyoming big sagebrush
CLAYEY	

HECO26-ARPUL-GRSQ	needle and thread - Fendler threeawn - Curly cup gumweed
NAVI4-PASM-HECO26-HESP11	Green needlegrass - Western wheatgrass - needle and thread - porcupine grass
PASM-NAVI4-BOCU-BOGR2	Western wheatgrass - green needlegrass - sideoats grama - blue grama
BOGR2-BUDA-CAFI-PASM	blue grama - buffalograss - threadleaf sedge - Western wheatgrass
NAVI4-PASM-HECO26-SYOC	green needlegrass - Western wheatgrass - needle and thread - Western snowberry
PASM-NAVI4-BOGR2-SYOC	Western wheatgrass - green needlegrass - blue grama - Western snowberry
BOGR2-PASM-POSE-SYOC	blue grama - Western wheatgrass - Sandberg bluegrass - Western snowberry
CLAYPAN	
HECO26-KOMA-GRSQ	needle and thread - prairie junegrass - curly cup gumweed
ARPUF-VUOC-GRSQ	threeawn - six weeks fescue - curly cup gumweed
PASM-NAVI4-HECO26-CALO	Western wheatgrass - green needlegrass - needle and thread - prairie sandreed
PASM-BOGR2-HECO26	Western wheatgrass - blue grama - needle and thread
BOGR2-BUDA-OPPO-CAFI	blue grama - buffalograss - plains prickley pear - threadleaf sedge
PASM-NAVI4-HECO26-ARTR2	Western wheatgrass - green needlegrass - needle and thread - Wyoming big sagebrush
PASM-BOGR2-NAVI4-ARTR2	Western wheatgrass - blue grama - green needlegrass - Wyoming big sagebrush
BOGR2-BUDA-OPPO-ARTR2	blue grama - buffalograss - plains prickley pear - Wyoming big sagebrush
LOAMY	
HECO26-ARPUF-GRSQ	needle and thread - threeawn - curly cup gumweed
ARPUF-BOGR2-DYPA	threeawn - blue grama - fetid marigold
NAVI4-PASM-HECO26-ANGE	green needlegrass - Western wheatgrass - needle and thread - big bluestem
PASM-HECO26-BOCU-BOGR2	Western wheatgrass - needle and thread - sideoats grama - blue grama
BOGR2-BUDA-CAFI	blue grama - buffalograss - threadleaf sedge
NAVI4-PASM-HECO26-ARTR2	Western wheatgrass - needle and thread - needle and thread - Wyoming big sagebrush
PASM-HECO26-BOCU-ARTR2	Western wheatgrass - needle and thread - sideoats grama - Wyoming big sagebrush
BOGR2-BUDA-CAFI-ARTR2	blue grama - buffalograss - threadleaf sedge - Wyoming big sagebrush
SHALLOW	

ARPUF-HECO26-SCSC	threeawn - needle and thread - little bluestem
HECO26-SCSC-NAVI4-BOCU	needle and thread - little bluestem - green needlegrass - sideoats grama
SCSC-HECO26-BOCU-BOGR2	little bluestem - needle and thread - sideoats grama - blue grama
BOGR2-BOHI2-CAFI	blue grama - hairy grama - threadleaf sedge
SCSC-HECO26-KOMA-ARTR2	little bluestem - needle and thread - prairie junegrass - Wyoming big sagebrush
HECO26-SCSC-BOCU-ARTR2	needle and thread - little bluestem - sideoats grama - Wyoming big sagebrush
BOGR2-BOHI2-CAFI-ARTR2	blue grama - hairy grama - threadleaf sedge - Wyoming big sagebrush
SANDY	
ARPUF-HECO26-SPCR	threeawn - needle and thread - sand dropseed
ANHA-CALO-HECO26-SCSC	sand bluestem - prairie sandreed - needle and thread - little bluestem
PASM-HECO26-SPCR-BOGR2	Western wheatgrass - needle and thread - sand dropseed - blue grama
BOGR2-BOHI2-CAFI	blue grama - hairy grama - threadleaf sedge
ANHA-CALO-YUGL-ARCA13	sand bluestem - prairie sandreed - yucca - silver sagebrush
PASM-HECO26-YUGL-ARCA13	western wheat grass - needle and thread - yucca - silver sagebrush
BOGR2-BOHI2-ARCA13-YUGL	blue grama - hairy grama - silver sagebrush - yucca
THIN SANDS	
CALO-ANHA-SCSC-ANGE	prairie sandreed - sand bluestem - little bluestem - big bluestem
BOGR2-CAFI-SCSC-HECO26	blue grama - threadleaf sedge - little bluestem - needle and thread
HECO26-PASM-DIOLS-SPCR	needle and thread - Western wheatgrass - Scribner panicum - sand dropseed
CALO-SCSC-OPPO-YUGL	Prairie sandreed - little bluestem - plains prickley pear - yucca
HECO26-BOGR2-OPPO-JUHO2	needle and thread - blue grama - plains prickley pear - creeping juniper
HECO26-PASM-JUHO2-ROAR3	needle and thread - Western wheatgrass - Creeping/Rocky Mtn. juniper - prairie rose
SALINE UPLAND	
PASM-DISP-SPAI-ACHY	Western wheatgrass - inland saltgrass - alkali sacaton - indian ricegrass
PASM-DISP-SPAI-CAFI	Western wheatgrass - inland saltgrass - alkali sacaton - threadleaf sedge
DISP-CAFI-KOMA-BOGR2	inland saltgrass - threadleaf sedge - prairie junegrass -blue grama

PASM-DISP-SPAI-ATGA	Western wheatgrass - inland saltgrass - alkali sacaton - Gardner's saltbush
PASM-DISP-ATGA-SAVE4	Western wheatgrass - inland saltgrass - Gardner's saltbush - greasewood
DISP-CAFI-KOMA-SAVE4	inland saltgrass - threadleaf sedge - prairie junegrass - greasewood
BADLANDS	
ARPUF-HECO26-SPCR	Fendler threeawn - Needle and thread - sand dropseed
CALO-SCSC-PASM-ANGE	prairie sandreed - little bluestem - Western wheatgrass - big bluestem
PASM-SCSC-CALO-DISP	Western wheatgrass - little bluestem - prairie sandreed - inland saltgrass
DISP-PASM	inland saltgrass - Western wheatgrass
CALO-SCSC-PASM-ARTR2	prairie sandreed - little bluestem - Western wheatgrass - silver/big sagebrush
PASM-SCSC-DISP-ARTR2	western wheatgrass - little bluestem - inland saltgrass - silver/big sagebrush
DISP-PASM-ARTR2	inland saltgrass - Western wheatgrass - silver/big sagebrush
OVERFLOW	
ANGE-NAVI4-PAVI2-PASM	big bluestem - green needlegrass - switchgrass - Western wheatgrass
BOGR2-PASM	blue grama - Western wheatgrass
ANGE-NAVI4-PAVI2	big bluestem - green needlegrass - switchgrass
PASM-ARCA13-ARTR2	Western wheatgrass - silver sagebrush - big sagebrush
BOGR2-PASM-ARTR2	blue grama - Western wheatgrass - big sagebrush
SYOC-ARTR2-PASM	Western snowberry - big sagebrush - Western wheatgrass
WATER	water

Table H-5 Vegetation Descriptions by Ecological Stratification used in the Great Plains Steppe.

Disturbance Processes

Processes
SUCCESSION
LIGHT-BISON-GRAZING
HEAVY-BISON-GRAZING
STAND-REPLACING-FIRE
WET-SUCCESSION
DRY-SUCCESSION
PRAIRIE-DOG-ACTIVE
PRAIRIE-DOG-INACTIVE

Table H-6 Disturbance Processes used in the Great Plains Steppe.

16.8.3 Mixed Grass Prairie

Ecological Stratification

Ecosites
Dense Clay
Clayey
Shallow Clayey
Claypan
Loamy
Sandy
Shallow
Very Shallow
Water
Gullied Land

Table H-7 Ecological Stratification used in the Mixed Grass Prairie.

Vegetation Descriptions

MIXED GRASS PRAIRIE	
DENSE CLAY	
NAVI4-PASM	green needlegrass - Western wheatgrass
PASM-NAVI4-CAREX	Western wheatgrass - green needlegrass - sedges
CAREX-PASM	sedges - Western wheatgrass
NAVI4-PASM-SYOC	green needlegrass - Western wheatgrass - Western snowberry

MIXED GRASS PRAIRIE	
PASM-NAVI4-CAREX-SYOC	Western wheatgrass - green needlegrass - sedges - Western snowberry
CAREX-PASM-SYOC	sedges - Western wheatgrass - Western snowberry
CLAYEY	
ARPU9-VUOC-KOMA	purple threeawn - six weeks fescue - prairie junegrass
NAVI4-PASM-HESP11	green needlegrass - Western wheatgrass - porcupine grass
PASM-HECO26-BOGR2	Western wheatgrass - needle and thread - blue grama
BOGR2-CAREX-PASM	blue grama - sedges - Western wheatgrass
NAVI4-PASM-HESP11-SYOC	green needlegrass - Western wheatgrass - porcupine grass - Western snowberry
PASM-HECO26-BOGR2-SYOC	Western wheatgrass - needle and thread - blue grama - Western snowberry
BOGR2-CAREX-SYOC	blue grama - sedges - Western snowberry
SHALLOW CLAYEY	
ARPU9-VUOC-KOMA	purple threeawn - six weeks fescue - prairie junegrass
NAVI4-PASM-ANGE-SCSC	green needlegrass - Western wheatgrass - big bluestem - little bluestem
PASM-BOCU-ANGE	Western wheatgrass - sideoats grama - big bluestem
BOGR2-POA-CAREX	blue grama - bluegrasses - sedges
NAVI4-PASM-ANGE-QUMA2	green needlegrass - Western wheatgrass - big bluestem - bur oak
PASM-BOCU-ANGE-QUMA2	Western wheatgrass - sideoats grama - big bluestem - bur oak
BOGR2-CAREX-QUMA2	blue grama - sedges - bur oak
CLAYPAN	
VUOC-HECO26-GRSQ	six weeks fescue - needle and thread - curly cup gumweed
NAVI4-PASM-HECO26	green needlegrass - Western wheatgrass - needle and thread
PASM-BOGR2-HECO26	Western wheatgrass - blue grama - needle and thread
BOGR2-POSE-BUDA	blue grama - Sandberg bluegrass - buffalograss
HECO26-PASM-NAVI4-GUSA2	needle and thread - Western wheatgrass - green needlegrass - broom snakeweed

MIXED GRASS PRAIRIE	
PASM-BOGR2-HECO26-GUSA2	Western wheatgrass - blue grama - needle and thread - broom snakeweed
BOGR2-POSE-BUDA-GUSA2	blue grama - Sandberg bluegrass - buffalograss - broom snakeweed
LOAMY	
ARPU9-VUOC-HECO26	purple threeawn - six weeks fescue - needle and thread
NAVI4-PASM-HESP11	green needlegrass - Western wheatgrass - porcupine grass
PASM-HECO26-BOCU	Western wheatgrass - needle and thread - sideoats grama
BOGR2-CAFI	blue grama - threadleaf sedge
NAVI4-PASM-HESP11-SYOC	green needlegrass - Western wheatgrass - porcupine grass - Western snowberry
PASM-HECO26-BOCU-SYOC	western wheatgrass - needle and thread - sideoats grama - Western snowberry
BOGR2-CAREX-SYOC	blue grama - sedges - Western snowberry
SANDY	
ARPU9-SPCR-GRSQ	purple threeawn - sand dropseed - curlycup gumweed
ANHA-CALO-ANGE	sand bluestem - prairie sandreed - big bluestem
HECO26-PASM-BOGR2	needle and thread - Western wheatgrass - blue grama
CAFI-BOGR2-HECO26	threadleaf sedge - blue grama - needle and thread
ANHA-CALO-ANGE-SYOC	sand bluestem - prairie sandreed - big bluestem - Western snowberry
HECO26-PASM-BOGR2-SYOC	needle and thread - Western wheatgrass - blue grama - Western snowberry
CAFI-BOGR2-HECO26-SYOC	threadleaf sedge - blue grama - needle and thread - Western snowberry
SHALLOW	
ARPU9-VUOC	purple threeawn - six weeks fescue
NAVI4-SCSC-MUCU3	green needlegrass - little bluestem - plains muhly
PASM-NAVI4-BOCU	Western wheatgrass - green needlegrass - sideoats grama
BOGR2-CAREX	blue grama - sedges
NAVI4-SCSC-MUCU3-SYOC	green needlegrass - little bluestem - plains muhly - Western snowberry

MIXED GRASS PRAIRIE	
PASM-NAVI4-SYOC	Western wheatgrass - green needlegrass - Western snowberry
BOGR2-CAREX-SYOC	blue grama - sedges - Western snowberry
VERY SHALLOW	
ARPU9-VUOC-GRSQ	purple threeawn - six weeks fescue - curlycup gumweed
HECO26-SCSC-MUCU3	needle and thread - little bluestem - plains muhley
HECO26-PASM-BOGR2	needle and thread - Western wheatgrass - blue grama
BOGR2-CAFI	blue grama - threadleaf sedge
HECO26-SCSC-MUCU3-SYOC	needle and thread - little bluestem - plains muhley - Western snowberry
HECO26-PASM-BOGR2-SYOC	needle and thread - Western wheatgrass - blue grama- Western snowberry
BOGR2-CAFI-SYOC	blue grama - threadleaf sedge - Western snowberry
note: Not including Bare Ground in species code. POA is used for Bluegrasses CAREX is used for sedges species starting point on coverage is 1.2	

Table H-8 Vegetation Descriptions by Ecological Stratification used for the Mixed Grass Prairie.

Disturbance Processes

Processes
SUCCESSION
LIGHT-BISON-GRAZING
HEAVY-BISON-GRAZING
STAND-REPLACING-FIRE
WET-SUCCESSION
DRY-SUCCESSION
PRAIRIE-DOG-ACTIVE
PRAIRIE-DOG-INACTIVE

Table H-9 Disturbance Processes used in the Mixed Grass Prairie.

Discussion of System Knowledge

Ecological Stratification

The use of NRCS soil ecosystems as ecological stratification is common in all three geographic zones.

Vegetative Descriptions by Ecological Stratification

For non forest communities, a sizeclass-structure or density is not used. These two attributes are coded as "NA." Thus, the pathway diagrams contain only one state. Upon editing the state, there are two new choices: **Inclusion Rule** and **Species to Track**. Both of these can be edited through the screens, not only changing the percents, but species can be added or deleted. The values in rate of change for species may be less than whole percents.

If the species value in the attributes file that came from the cover is greater than zero but there is no species change information for it within the pathway files, it will be brought in, but the species value will not change in simulations. In this case, the user can edit the pathway file, adding in change values for this new species.

These values can also be entered in by reading from an Excel spreadsheet by selecting **File > Import Species Change File**.

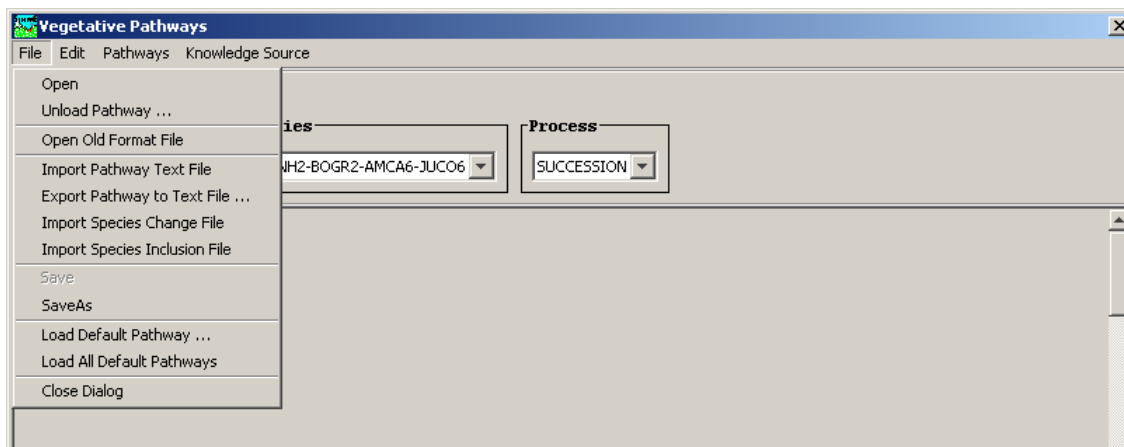


Figure H-10 File options of Importing Species Change File and Inclusion File.

Aquatic Unit Representation

Aquatic units were utilized to provide a water source for the bison grazing logic. The class uses the stream layer plus the polygons of water that are converted to a line to go with the streams. Each has to be identified as either perennial or intermittent. The logic for what is considered a water source in normal, dry, or wet time steps is not accessible for user change in this version.

There is no report that gives the total water source at any time step. But the existing vegetation unit history will show, for each vegetation unit, the distance to the nearest water source (distance used in bison grazing logic) and the aquatic unit that is the source and its status.

The intermittent aquatic units will only be considered a water source in wet time steps. In normal or dry time steps, they are not a water source. Future versions may have additional logic for changes in the size of water sources that are polygons.

Current logic for determining water source:

Time step with “normal succession” water sources are:

Water/water/1 polygons

Plant communities on clayey-overflow

Existing aquatic units that are “perennial”

Time step with “wet succession” water sources are:

Water/water/1 polygons

Plant communities on clayey-overflow

Existing aquatic units that are “perennial” or “intermittent”

Time step with “dry succession” water sources are:

Water/water/1 polygons

Existing aquatic units that are “perennial”

Time Steps

By default, these three zones use yearly time steps. Within the year, all four seasons are accounted for. This makes it possible for the grass communities to be more responsive to seasonal moisture changes. This makes a significant change in the display for EVU history.

The screenshot shows the 'Vegetative Unit Analysis' window. At the top, there are navigation buttons: 'Search', 'Result Units Only -->', 'Prev', and 'Next'. The current unit is 11705. Below this, the 'Attributes' section is divided into two columns. The left column shows: Current State (NAVI4-PASM-HECO26-SYOC/NA/NA), Habitat Type Group (CLAYEY), Acres (10), and Fire Management Zone (all). The right column shows: Road Status (UNKNOWN), Ownership (UNKNOWN), Special Area (CLAYEY), Unit Number (16166.000), and Associated Landtype. Below the attributes, there are three lists: 'Adjacent Units' (11564, 11565, 11566, 11704, 11706, 11844, 11845), 'Landform Units' (empty), and 'Aqua Units' (7228-A2-REF). At the bottom, the 'History' tab is selected, showing a table of unit history.

Time	Season	Lifeform	Resulting State	Process	Prob	Distance to Water	Tracking Species
0	YEAR	herbaceous	PASM-NAVI4-B0CU-B0GR2/NA/NA	SUCCESSION	NA		N/A ARTR2 8.0 B0GF
1	SPRING	shrubs	PASM-NAVI4-B0GR2-SYOC/NA/NA	SUCCESSION	100	128767ft EAU-78	(P) ARTR2 10.0 B0G
1	SUMMER	shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	LIGHT-BISON-GRAZING	100	128767ft EAU-78	(P) ARTR2 12.0 B0G
2	SPRING	shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	SUCCESSION	100	128767ft EAU-78	(P) ARTR2 14.0 B0G
2	SUMMER	herbaceous	NAVI4-PASM-HECO26-HESP11/NA/NA	STAND-REPLACING-FIRE	S	128767ft EAU-78	(P) ARTR2 0.0 B0GF
3	SPRING	herbaceous	NAVI4-PASM-HECO26-HESP11/NA/NA	SUCCESSION	100	128767ft EAU-78	(P) ARTR2 2.0 B0GF
3	SUMMER	herbaceous	NAVI4-PASM-HECO26-HESP11/NA/NA	HEAVY-BISON-GRAZING	100	128767ft EAU-78	(P) ARTR2 5.0 B0GF
4	SPRING	herbaceous	NAVI4-PASM-HECO26-HESP11/NA/NA	SUCCESSION	100	128767ft EAU-78	(P) ARTR2 7.0 B0GF
4	SUMMER	shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	HEAVY-BISON-GRAZING	100	128767ft EAU-78	(P) ARTR2 10.0 B0G
5	SPRING	shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	SUCCESSION	100	128767ft EAU-78	(P) ARTR2 12.0 B0G
5	SUMMER	shrubs	NAVI4-PASM-HECO26-SYOC/NA/NA	LIGHT-BISON-GRAZING	100	128767ft EAU-78	(P) ARTR2 14.0 B0G

Figure H-11 Unit display showing differences with seasons for disturbance processes.

It also has an impact on the reports. For processes we report all of them, so for a time step the sum of the acres of processes can be greater than the total landscape. For other attributes we take the only the last vegetation state at the end of the time step.

Processes

Bison Grazing

The **Bison Grazing Logic** screen makes the distinction between temporary and permanent water sources. The first step in editing bison grazing is to decide if the basic probability for all acres will be 100 percent or not. Specific exceptions can be listed. If you do not want any bison grazing you must change the default probability to zero. Changing the probabilities of the weights for each component, but still keeping the default with some value, is not the correct method. This will still result in Light Bison Grazing. The three components can have their weight spread in given distribution. One can even shift all the weight to one component.

Bison Grazing Logic

File Action

Default Probability

This probability will be used for all existing vegetation units unless a different value is specified below.

Species Specific Probabilities

Species	Probability
BARREN	0
RIPARIAN	0
WATER	0
PASM-VUOC-SPCD	0

Time Since Fire Table

This weight must be distributed to the three grazing intensities for each value of the component.
Each row must total to the weight.

Min Time Since Fire	Max Time Since Fire	Heavy Grazing	Moderate Grazing	Light Grazing
1	2	40	0	0
3	4	0	40	0
4	9999	0	40	0

Distance to Water Probability Adjustment Table

This weight must be distributed to the three grazing intensities for each value of the component.
Each row must total to the weight.

Min Distance	Max Distance	Perm. Heavy	Perm. Moderate	Perm. Light	Temp Heavy	Temp Moderate	Temp Light
0	700	35	0	0	35	0	0
701	1400	0	35	0	0	35	0
1401	2147483647	0	35	0	0	35	0

Percent Landscape Burned Table

This weight must be distributed to the three grazing intensities for each value of the component.
Each row must total to the weight.

Min % Land Burned	Max % Land Burned	Heavy Grazing	Moderate Grazing	Light Grazing
0	9	0	0	0
10	24	0	0	0
25	100	0	0	0

Figure H-12 System knowledge screen for the probability of bison grazing.

A cell cannot have less than the percent assigned as the weight.

Fire—Season of Fire

Although there is a screen for assigning the probability of the season that a fire may occur, it is not operational yet. All fires occur in the Fall in version 2.5.

Season	Probability
Spring	30
Summer	50
Fall	15
Winter	5
Total	100

Figure H-13 Screen for setting the probability of the season of the fire process.

Prairie Dog

This process must be locked in. There is no logic for predicting its occurrence.

Regeneration logic

If there is any **Species to Track Information** available we will not call the Regeneration logic as a result of SRF.

For the case of **Heavy-bison-grazing** and **Prairie-dog-active** processes the “fire-event” logic is expanded so it is not just dependent on the probability of an event occurring. If the past time step process has been one of these processes, the plant community cannot get a fire event. In the long run we will have a screen to edit the logic that goes along with the fire-event.

The valid values are given for the three zones. All values are for non forested species. Future landscapes within these geographic zones can include tree species. Version 2.5 can represent landscapes with both forms of pathways. Non forest species with single states, not using size class and density, and forest species with multiple states using Sizeclass and density.

16.9 APPENDIX I—COLORADO PLATEAU

The development of this geographic zone was accomplished in connection with USGS's FRAMES project for Mesa Verde National Park. This effort involved a number of scientists and managers from USGS, Mesa Verde National Park, Colorado State University, Northern Arizona University, and Prescott College.

Ecological Stratification

Soils information from a range of surveys was used to provide a stratification that used a combination of soil depth, slope steepness, and moist or xeric aspect.

SIMPPLLE Descriptor	Substrate	Slope	Aspect
MSM	Mancos	Steep	Mesic
MSX	Mancos	Steep	Xeric
MMM	Mancos	Moderate	Mesic
MMX	Mancos	Moderate	Xeric
MGM	Mancos	Gentle	Mesic
MGX	Mancos	Gentle	Xeric
DSM	Deep-soils	Steep	Mesic
DSX	Deep-soils	Steep	Xeric
DMM	Deep-soils	Moderate	Mesic
DMX	Deep-soils	Moderate	Xeric
DGM	Deep-soils	Gentle	Mesic
DGX	Deep-soils	Gentle	Xeric
SSM	Shallow-soils	Steep	Mesic
SSX	Shallow-soils	Steep	Xeric
SMM	Shallow-soils	Moderate	Mesic
SMX	Shallow-soils	Moderate	Xeric
SGM	Shallow-soils	Gentle	Mesic

SGX	Shallow-soils	Gentle	Xeric

Table I-1 Ecological Stratification used for the Colorado Plateau.

Vegetation Descriptions

A combination of inventories from State gap program and Mesa Verde National Park were used. Narrative descriptions from documentation that was developed for RMLands modeling efforts were used to identify common combinations of trees, shrubs, and grasses.

Numerous workshops with scientists, resource specialists, and managers were used to get agreement on final assignment within SIMPPLLE. The following three tables display the combinations used for each life form.

Inventory Assignment	SIMPPLLE Trees		
	Species	Size	Density
Aspen	POTR5	LARGE	3
Aspen- Douglas-fir- spruce-fir	PSME-PIEN-ABLA-POTR5	VERY-LARGE	3
Cool-moist mixed conifer	PSME-PIEN-ABLA	VERY-LARGE	3
Greasewood			
High elevation sagebrush			
Low elevation sagebrush	PIED-JUOS	LARGE-MULTISTORY	1
Meadow (high elevation)			
NS (Spruce-fir forest)			
NS (Aspen- Douglas-fir)			
Oak-service berry shrubland			
PJ oak-serviceberry woodland	PIED-JUOS	LARGE-MULTISTORY	2
PJ Woodland	PIED-JUOS	LARGE-MULTISTORY	3
Ponderosa pine-oak	PIPO	LARGE	3
Riparian			

Inventory Assignment	SIMPPLLE Trees		
	Species	Size	Density
(high elevation above 9,000)			
Riparian (mid-elevation 6,500 to 9,000)			
Riparian (low elevation below 6,500)			
Semi-desert grassland			
Semi-desert savannah	PIED-JUOS	LARGE-MULTISTORY	2
Sparse PJ woodland	PIED-JUOS	LARGE-MULTISTORY	1
Spruce-fir forest	PIEN-ABLA	VERY-LARGE	3
Agriculture	AGR	AGR	1
Urban	URBAN	URBAN	1
Non-forest	NF	NF	1
Barren	BA	BA	1
Water	WATER	WATER	1

Table I-2 Trees used for the Colorado Plateau.

Inventory Assignment	SIMPPLLE Shrubs		
	Species	Size	Density
Aspen	SYORO	MEDIUM-SH	1
Aspen- Douglas-fir- spruce-fir	LOIN5	LARGE-SH	1

Inventory Assignment	SIMPPLLE Shrubs		
	Species	Size	Density
Cool-moist mixed conifer	LOIN5	LARGE-SH	1
Greasewood	SAVE4	MEDIUM-SH	2
High elevation sagebrush	ARTR2-PUTR2	MEDIUM-SH	3
Low elevation sagebrush	ARBI3	MEDIUM-SH	2
Meadow (high elevation)			
NS (Spruce-fir forest)			
NS (Aspen- Douglas-fir)			
Oak-service berry shrubland	QUGA	LARGE-SH	3
PJ oak-serviceberry woodland	QUGA	MEDIUM-SH	2
PJ Woodland	ARNO4-PUTR2	MEDIUM-SH	2
Ponderosa pine-oak	QUGA-AMUT	MEDIUM-SH	2
Riparian (high elevation above 9,000)	SAGE2	MEDIUM-SH	3
Riparian (mid-elevation 6,500 to 9,000)	ALINT	LARGE-SH	3
Riparian (low elevation below 6,500)	SAEX	LARGE-SH	3
Semi-desert grassland	ATCO-ARBI3	MEDIUM-SH	2
Semi-desert savannah	ATCO-ARBI3	MEDIUM-SH	2
Sparse PJ woodland	ARBI3	MEDIUM-SH	2
Spruce-fir forest	VAMY2-RIMO2	MEDIUM-SH	1

Inventory Assignment	SIMPPLLE Shrubs		
	Species	Size	Density
Agriculture			
Urban			
Non-forest			
Barren			
Water			

Table I-3 Shrubs used for the Colorado Plateau.

Inventory Assignment	SIMPPLLE Herbaceous		
	Species	Size	Density
Aspen	THFE	UNIFORM	2
Aspen- Douglas-fir- spruce-fir	ORSE	CLUMPED	1
Cool-moist mixed conifer	ORSE	CLUMPED	1
Greasewood	SPAI	CLUMPED	1
High elevation sagebrush	POPR-VIAM	UNIFORM	2
Low elevation sagebrush			
Meadow (high elevation)	THFE	UNIFORM	3
NS (Spruce-fir forest)	GERI	CLUMPED	3
NS (Aspen- Douglas-fir)	ORSE	UNIFORM	3
Oak-service berry shrubland	POFE	CLUMPED	2

Inventory Assignment	SIMPPLLE Herbaceous		
	Species	Size	Density
PJ oak-serviceberry woodland	POFE	CLUMPED	2
PJ Woodland	POSE-PASM	UNIFORM	1
Ponderosa pine-oak	FEAR2	CLUMPED	1
Riparian (high elevation above 9,000)			
Riparian (mid-elevation 6,500 to 9,000)			
Riparian (low elevation below 6,500)			
Semi-desert grassland	ACHY	CLUMPED	2
Semi-desert savannah	HECO26-PLJA	UNIFORM	2
Sparse PJ woodland			
Spruce-fir forest	GERI	CLUMPED	1
Agriculture			
Urban			
Non-forest			
Barren			
Water			

Table I-4 Herbaceous used for the Colorado Plateau.

Size	SIMPPLLE Abbreviation	XXXX
Trees		
Established Seedlings	E	0.0–0.9-inches DBH
Sapling	SS	1–4.9-inches DBH
Medium	MEDIUM	5–8.9-inches DBH
Large	LARGE	9–15.9-inches DBH
Very Large	VERY-LARGE	>16-inches DBH
Non-stocked	NS	
Medium-Multistory	MMU	
Large-Multistory	LMU	
Very Large-Multistory	VLMU	
Shrubs		
Small	SMALL-SH	< 2.5 feet in height
Medium	MEDIUM-SH	2.5–6.4 feet in height
Large	LARGE-SH	> 6.5 feet in height
Grasses		
Clumped	CLUMPED	
Uniform	UNIFORM	
Non forest		
Non forest	NF	
barren	ba	
urban	urban	
agriculture	agr	

Table I-5 Size Classes used for the Colorado Plateau.

SIMMPPLLE Abbreviation	Density
1	0–10 percent
2	11–40 percent
3	41–70 percent
4	71–100 percent

Table I-6 Density used for the Colorado Plateau.

PROCESS
LIGHT SEVERITY FIRE
MIXED SEVERITY FIRE
STAND REPLACING FIRE
PONDEROSA PINE MOUNTAIN PINE BEETLE
SPRUCE BEETLE
DOUGLAS FIR BEETLE
LIGHT WESTERN SPRUCE BUDWORM
SEVERE WESTERN SPRUCE BUDWORM
WILDLIFE BROWSING
PINYON BARK BEETLE
HIGH MORTALITY PRAIRIE DOG
LOW MORTALITY PRAIRIE DOG
WINDTHROW
WET SUCCESSION
DRY SUCCESSION
SUCCESSION
BLACK-STAIN ROOT DISEASE
DROUGHT

Table I-7 Disturbance Processes used for the Colorado Plateau.

Invasive Species

The logic in SIMPPLLE was based on research funded by Joint Fire Science Program, project number 1469-BLM2-454, Non-Native Invasions Following Fire in Southwestern Colorado: Long-Term Effectiveness of Mitigation Treatments and Future Predictions, Hanna et al. 2004.

16.10 APPENDIX J—BASIC PROCESSING EXCEL SPREADSHEET AND MACRO

INSTRUCTIONS:

This macro is designed to work with the results from multiple simulations on **the same landscape**. The purpose is to enable comparisons between differences in simulations due to changes in the system logic or changes due to different management scenarios. It is not intended to compare different landscapes.

It does not work with a single simulation. It utilizes the file that contains the results from a set(s) of multiple simulations.

This macro processes each data type (processes, species, sizeclass / structure, and density) separately. There is no correlation between these values. If you want to process specific combinations of species/sizeclass/density then use the “all-states-report,” the “SIMPPLLE MACRO - ALL-STATES-REPORT-26Aug12006.xls”.

USING THE MACRO

Open spreadsheet (SIMPPLLE V2-2_90205.xls)

Enable macros in the opening

Select **NEW DATA**

Browse to find the desired “-ls.txt” file(s)

Select **OK**

(In future versions we may add the option to put together ls.txt files from different sets of simulations when it takes too much memory to do all the desired number in one set)

Then select individual data types or all of them

After the macro is complete, save results as a spreadsheet *.xls, don't save over the

*-ls.txt file

This will put the results from each set of multiple simulations in a separate spreadsheet

with each data type being in a workbook. It calculates the following values for each time step using all f simulations:

- Maximum
- Minimum

- Average
- Standard Deviation
- Medium
- Mode

A line plot of the values for each time step for each simulation is automatically created.

Two additional graphic displays can be selected.

The Maximum, Minimum, and Average values for each attribute (each individual process, species, size class, or density) can be created. The values are for the entire set of time steps for the entire number of simulations. This graphic is generated using the “stock chart type,” using the High (Maximum), Low (Minimum) and Close (Average, or Medium, or Mode) values. The user needs to specify what attributes from each type should be plotted as one will probably not want to see the graphic for all processes, species, or sizeclass.

Column graphs for the percent (based on Mean, Medium, or Mode) that each species, sizeclass, or density is of the total landscape acres by time step can be generated. This uses the average or medium or modal value as specified by the user. The user needs to specify what attributes from each type should be plotted as one will probably not want to see graphics for all processes, species, or sizeclass.

If you want to save the results as a spreadsheet (don’t save by overriding the original *-ls.txt file), you have to specify that when you close the file. The saved results can be used later in the “COMPARISON” option.

If you want to compare two or more sets of multiple simulations with the results from above:

- Open spreadsheet **Simpplle_Output_Macros.xls**
- Enable macros in opening
- Select **Create Comparison**
- Browse to find saved Excel (*.xls) files (*results from New Data*)
- Select as many as you would like (*two minimum*)
- Save (*name must be in quotes*)
- Select **OK**

The graphics automatically created in the OVERVIEW will only be line plot comparisons for each process, species, sizeclass and density. The user needs to select where the comparison is done with the Average, Medium, or Modal values.

An optional stacked column chart comparing the percent distribution of the fire process into its three components (stand replacing fire, mixed severity fire, and light severity fire) can be chosen. User can select if the Average across all time steps, all simulations in used, or if the Average for only the last time step of all simulations is used.

CHART OPTIONS—Summary

Options vary by whether you are doing “basic processing” or the “overview” comparison.

Basic—Processing:

Standard --- A line plot of each value of each data type, all time steps for each simulation.

Optional --- A Max, Min, Average (or Median or Modal) plot for selected values of selected data types. Values are taken from all time steps, all simulations.

A column chart showing percent of total landscape acres by time step for selected species, sizeclass, or density values.

Overview:

Standard --- A line plot that compares the average value over the time steps between each set of multiple simulations. Plot is made for each value for each data type (process, species, sizeclass and density)

Optional --- Change the above line plot to use Median or Modal value.

A stacked column chart using percent distribution of the fire processes between the stand replacing fire, mixed severity fire, and light severity fire. Within this choice, an option to display for all time steps, or just the last time step. The percents are averages across all time steps, all simulations, or just the last time step, across all simulations.

16.11 APPENDIX K—ALL STATES EXCEL SPREADSHEET AND PIVOT TABLES

CREATING THE REPORT

The **All States Report** was designed to provide the capability to track all individual states, each combination of species/size class—structure/density. The report is designed to identify the maximum, minimum, average, and standard deviation for each state; the results from multiple simulations. This report requires an output file generated by SIMPPLLE and the use of an Excel template. **You must have Excel 2002 to run the macros in the Report Template.**

If the report is run on all individual states, it may take considerable time to complete. Most likely the report will be done on “groupings” of the states (i.e., the grouping used for the standard Regional Diversity Matrix).

The current version of SIMPPLLE does not have a complete user interface to query the user for the desired grouping. Instead, the system asks for the name of a text (*.txt) file that contains the information to create groups. Many text files for different groupings may be made.

Steps:

1. Create a text (*.txt) file that contains grouping information.
- 2a. Make multiple simulations. From the main menu select **Reports > All States Report** (Figure K1) *if you are not discarding any simulation data. If you have made the choice to **Discard Unnecessary Simulation Data**, then you have to check the **All States Report** and identify the input text file prior to making the simulations.*

OR

- 2b. Reload the saved simulation that is the last one made in the sequence of multiple simulations and run the report—*only if the simulations were made without discarding information.*

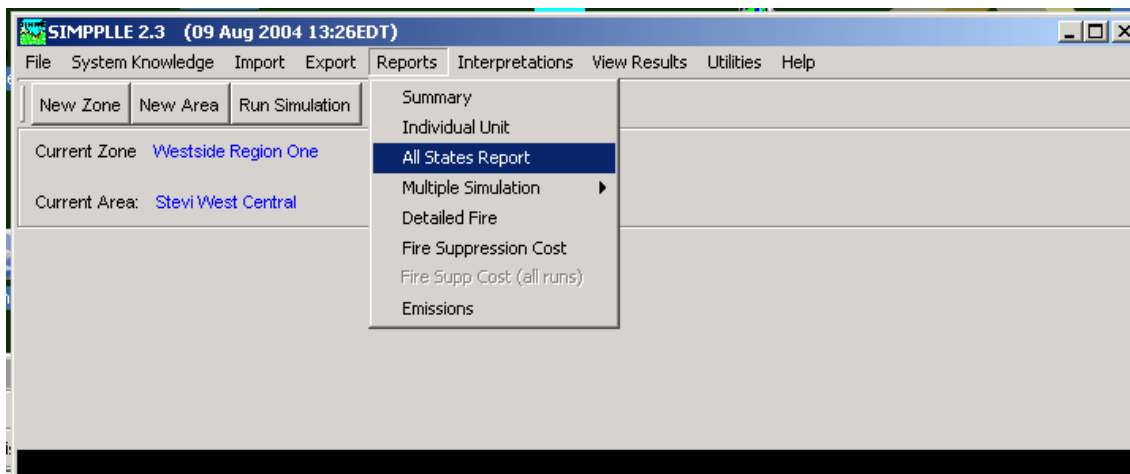


Figure K-1 The choice of the All States Report from the SIMPPLLE Reports pulldown menu.

3. In running the report, provide the name of the text (*.txt) file that has the grouping information, and provide a name for the resulting output file that will have a text (*.txt) extension.
4. Execute the Report Template spreadsheet. Make sure macros are enabled.

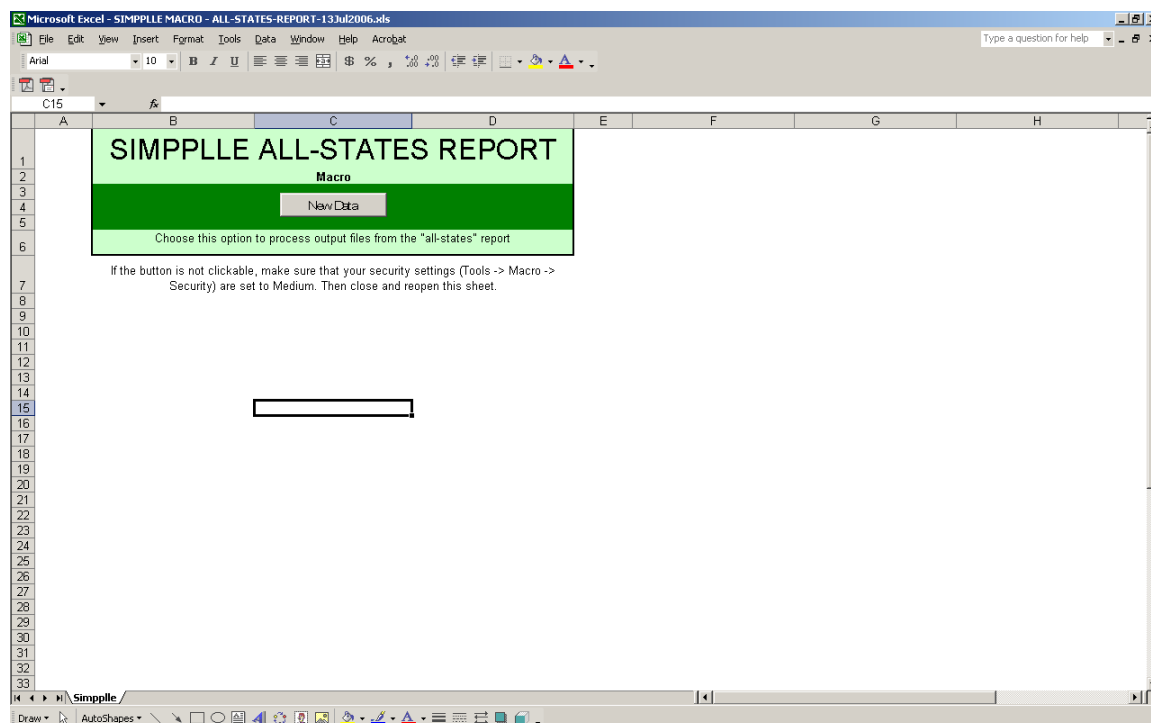


Figure K-2 The main screen for the All States Report Macro.

5. Select choices available for the All States Report.
6. Save the results as an Excel (*.xls) file.

THE "GROUPING TXT FILE"

If values were missed when the groups were created, the missed individuals will show up in the reports in the Template.

A title can be used by entering information beyond the "BEGIN" key word.

All states report customization file format (*.txt):

Valid Keywords:

SPECIES

SIZE-CLASS

DENSITY

HABITAT-TYPE-GROUP

SPECIAL-AREA

OWNERSHIP

{ and } server to illustrate format and are not part of it.

{< or >}{ITEM} means either < or > followed by ITEM (e.g. <9)

{comma} means insert a Comma.

There can be as many keywords as you like and each can be listed multiple times.

-----File format -----

{BEGIN}{comma}{OPTIONAL DESCRIPTION}

{KEYWORD}{space}{OPTIONAL-DESCRIPTION}

{ITEM1}{comma}{ITEM2}{comma}{ITEM3}...

{KEYWORD}{space}{OPTIONAL-DESCRIPTION}

{ITEM1}{comma}{ITEM2}{comma}{ITEM3}...

{AGE}{space}{OPTIONAL-DESCRIPTION}

{ITEM1}{comma}{ITEM2}{comma}{ITEM3}...

END

Example :

BEGIN

HABITAT-TYPE-GROUP For

A1,A2,B1,B2,B3,C1,C2,D1,D2,D3,E1,E2,F1,F2,G1,G2

HABITAT-TYPE-GROUP NonFor

NF1A,NF1B,NF1C,NF2A,NF2B,NF2C,NF2D,NF3A,NF3B,NF3C,NF3D,NF4A,NF4B,NF4C,NF4D,NF4E,NF5A,NF5B

SPECIES TASH

AF,ES,WB,MH,AF-ES-MH,ES-AF

SPECIES TGCH

GF,C,WH,WH-C,WH-C-GF

SPECIES IMXS

L-DF,L-DF-AF,L-DF-ES,L-DF-GF,L-DF-PP,L-DF-WP,L-DF-LP,L-DF-RRWP,L-ES,L-ES-AF,L-GF,L-LP,L-LP-GF,L-PP,L-PP-LP,L-RRWP-GF,L-WP,L-WP-GF,WB-ES-AF,AL,AL-AF,AL-WB-AF

SPECIES DF-PP-MIX

PP-DF,PF

SPECIES LP

LP,LP-AF,LP-GF

SPECIES DF

DF,DF-ES,DF-AF,DF-LP,DF-GF,DF-LP-AF,DF-LP-ES,DF-LP-GF,DF-PP-GF,DF-WP,DF-WP-GF,DF-RRWP,DF-RRWP-GF,DF-PP-GF,DF-PP-LP

SPECIES PP

PP

SPECIES WL

L

SPECIES UMD

QA,QA-MC

SPECIES RIPHD

CW,CW-MC

SPECIES GFS

ALPINE-GRASSES,ALTERED-GRASSES,NATIVE-FORBS

SPECIES MMS

MESIC-SHRUBS

SPECIES MXS

XERIC-SHRUBS

SIZE-CLASS 1-5

ss

SIZE-CLASS 5-9

pole,pts,pmu

SIZE-CLASS 9+

medium,mts,mmu,large,lmu,lts,very-large,vlmu,vlts

SIZE-CLASS

closed-herb,closed-low-shrub,clumped,open-herb,open-low-shrub,open-mid-shrub,open-tall-shrub,scattered,uniform

END

You can make multiple sets of keywords within one text file. SIMPPLLE will produce separate output files for each set.

BEGIN

SPECIAL-AREA s

suitable

HABITAT-TYPE-GROUP For

A1,A2,B1,B2,B3,C1,C2,D1,D2,D3,E1,E2,F1,F2,G1,G2

HABITAT-TYPE-GROUP NonFor

NF1A,NF1B,NF1C,NF2A,NF2B,NF2C,NF2D,NF3A,NF3B,NF3C,NF3D,NF4A,NF4B,NF4C,NF4D,NF4E,NF5A,NF5B

SPECIES TASCH

AF,ES,WB,MH,AF-ES-MH,ES-AF

SPECIES TACH

GF,C,WH,WH-C,WH-C-GF

SPECIES IMXS

L-DF,L-DF-AF,L-DF-ES,L-DF-GF,L-DF-PP,L-DF-WP,L-DF-LP,L-DF-RRWP,L-ES,L-ES-AF,L-GF,L-LP,L-LP-GF,L-PP,L-PP-LP,L-RRWP-GF,L-WP,L-WP-GF,WB-ES-AF,AL,AL-AF,AL-WB-AF

SPECIES DF-PP-MIX

PP-DF,PF

SPECIES LP

LP,LP-AF,LP-GF

SPECIES DF

DF,DF-ES,DF-AF,DF-LP,DF-GF,DF-LP-AF,DF-LP-ES,DF-LP-GF,DF-PP-GF,DF-WP,DF-WP-GF,DF-RRWP,DF-RRWP-GF,DF-PP-GF,DF-PP-LP

SPECIES PP

PP

SPECIES WL

L

SPECIES UMD

QA,QA-MC

SPECIES RIPHD

CW,CW-MC

SPECIES GFS

ALPINE-GRASSES,ALTERED-GRASSES,NATIVE-FORBS

SPECIES MMS

MESIC-SHRUBS

SPECIES MXS

XERIC-SHRUBS

SIZE-CLASS 1-5

SS

SIZE-CLASS 5-9

pole,pts,pmu

SIZE-CLASS 9+

medium,mts,mmu,large,lmu,lts,very-large,vlmu,vlts

SIZE-CLASS

closed-herb,closed-low-shrub,clumped,open-herb,open-low-shrub,open-mid-shrub,open-tall-shrub,scattered,uniform

END

BEGIN

SPECIAL-AREA ns

UNKNOWN

HABITAT-TYPE-GROUP For

A1,A2,B1,B2,B3,C1,C2,D1,D2,D3,E1,E2,F1,F2,G1,G2

HABITAT-TYPE-GROUP NonFor

NF1A,NF1B,NF1C,NF2A,NF2B,NF2C,NF2D,NF3A,NF3B,NF3C,NF3D,NF4A,NF4B,NF4C,NF4D,NF4E,NF5A,NF5B

SPECIES TASCH

AF,ES,WB,MH,AF-ES-MH,ES-AF

SPECIES TACH

GF,C,WH,WH-C,WH-C-GF

SPECIES IMXS

L-DF,L-DF-AF,L-DF-ES,L-DF-GF,L-DF-PP,L-DF-WP,L-DF-LP,L-DF-RRWP,L-ES,L-ES-AF,L-GF,L-LP,L-LP-GF,L-PP,L-PP-LP,L-RRWP-GF,L-WP,L-WP-GF,WB-ES-AF,AL,AL-AF,AL-WB-AF

SPECIES DF-PP-MIX

PP-DF,PF

SPECIES LP

LP,LP-AF,LP-GF

SPECIES DF

DF,DF-ES,DF-AF,DF-LP,DF-GF,DF-LP-AF,DF-LP-ES,DF-LP-GF,DF-PP-GF,DF-WP,DF-WP-GF,DF-RRWP,DF-RRWP-GF,DF-PP-GF,DF-PP-LP

SPECIES PP

PP

SPECIES WL

L

SPECIES UMD

QA,QA-MC

SPECIES RIPHD

CW,CW-MC

SPECIES GFS

ALPINE-GRASSES,ALTERED-GRASSES,NATIVE-FORBS

SPECIES MMS

MESIC-SHRUBS

SPECIES MXS

XERIC-SHRUBS

SIZE-CLASS 1-5

ss

SIZE-CLASS 5-9

pole,pts,pmu

SIZE-CLASS 9+

medium,mts,mmu,large,lmu,lts,very-large,vlmu,vlts

SIZE-CLASS

closed-herb,closed-low-shrub,clumped,open-herb,open-low-shrub,open-mid-shrub,open-tall-shrub,scattered,uniform

END

16.12 APPENDIX L—TRACKING SPECIES EXCEL SPREADSHEET AND MACRO

The Excel spreadsheet and macro are designed to provide the acres of the species being tracked by percent categories that the user identifies.

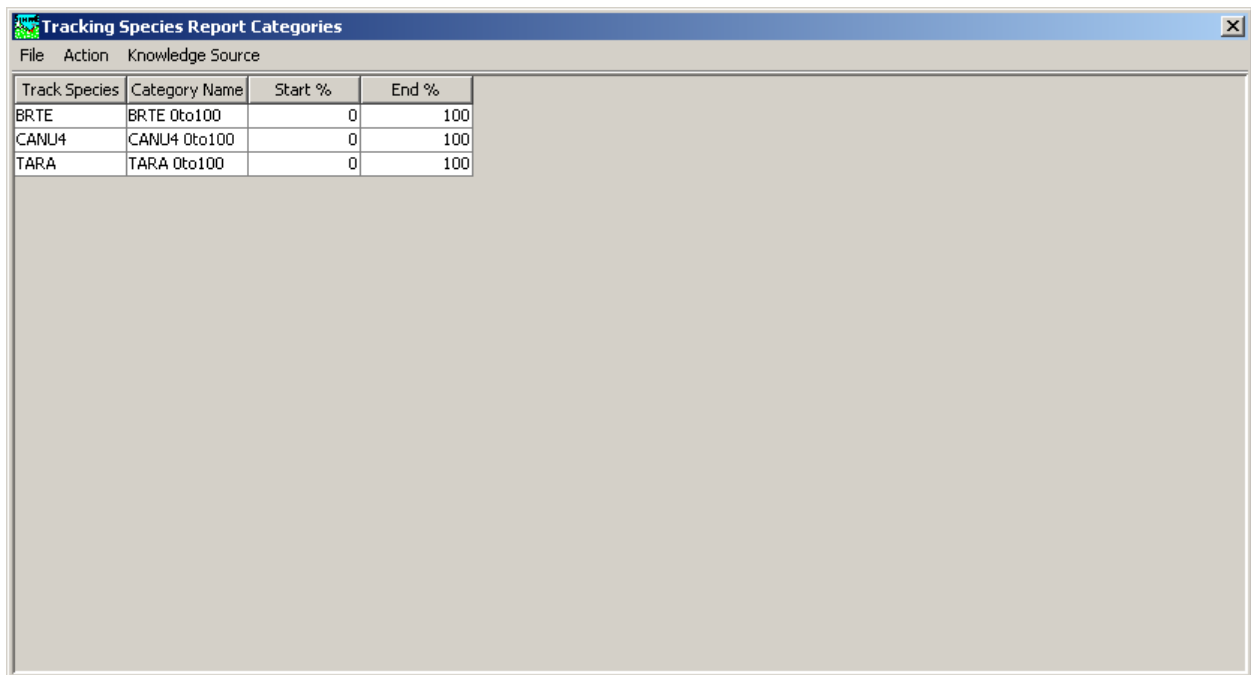
The **Set Simulation Parameters** screen (Figure L-1) has a check box for selecting an output file to be generated that provides input for this spreadsheet.

The screenshot shows the 'Set Simulation Parameters' dialog box with the following sections and controls:

- File** section:
 - Number of Simulations: 1
 - Number of Time Steps: 5
 - Simulation Method: STOCHASTIC (dropdown)
 - Invasive Species Logic: NONE (dropdown)
- Options** section:
 - ☐ Yearly Time Steps
 - ☐ Fire Suppression
 - ☐ Discounted Cost: 1.04
 - ☐ Track Ownership
 - ☐ Track Special Area
- Results Output Options** section:
 - File icon and text box for output file.
 - ☐ GIS Update/Spread Files
- Memory Saving Options** section:
 - ☐ Use Database (saves memory, slows run)
 - ☐ Discard Unnecessary Simulation Data, needed for extremely long term simulations.
 - 10 Time Steps kept in memory (minimum 10)
- All States Report** section:
 - ☐ Enable All States Report (needed if above discard option is checked or doing multiple runs)
- Rules File (optional)** section:
 - File icon and text box for rules file.
- Tracking Species Report** section:
 - ☒ Generate Tracking Species Report (needed if discarding data or multiple runs)
 - Adjust Categories button
- Buttons** at the bottom: Run Simulation, Cancel

Figure L-1 Set Simulation Parameters Screen.

Selecting **Adjust Categories** brings up the **Tracking Species Report Categories** screen (Figure L-2), allowing the user to make changes in the percent categories by species.



Track Species	Category Name	Start %	End %
BRTE	BRTE 0to100	0	100
CANU4	CANU4 0to100	0	100
TARA	TARA 0to100	0	100

Figure L-2 Tracking Species Report Categories.

The file resulting from the simulation must be identified as input in the spreadsheet.

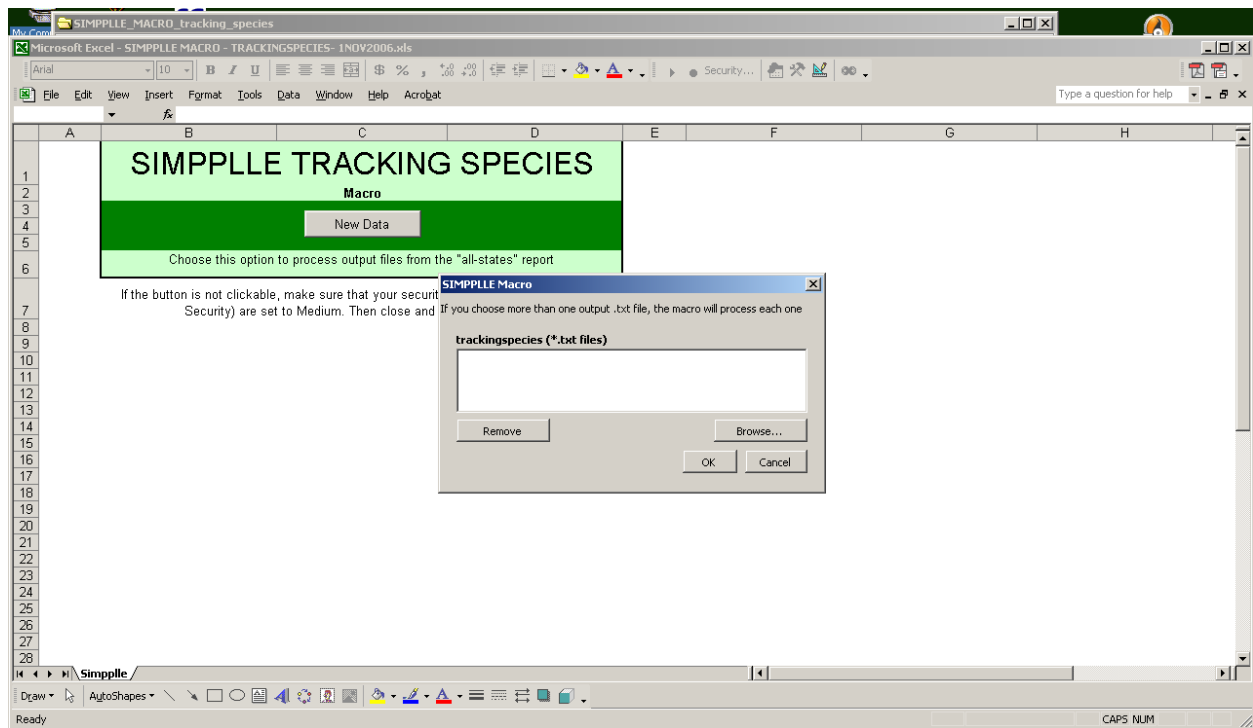


Figure L-3 Main Screen for the SIMPPLLE macro for Tracking Species.

16.13 APPENDIX M—MULTI-RESPONSE PERMUTATION PROCEDURES

A statistical test can be used to estimate the number of simulations necessary to provide a complete range of outcomes that capture the high and low extremes in the output (range of variability), as well as to provide a method of testing for real differences among sets of simulations that may represent different management alternatives. Standard parametric statistical methods to evaluate modeled output from multiple stochastic simulations are not reasonable since the modeled output is based on unknown multivariate distributions. Multi-response Permutation Procedures (MRPPs) provide techniques which allow the use of multi-response data that are ordinal, to compare a priori classified groups of objects. The applicability of MRPP is not dependent on the assumptions of normal population or homogeneous variances but on the internal variability of the existing data (Zimmerman et al. 1985). Using a permutation approach eliminates the need to adhere to the assumptions of normality and homogeneity (Mielke et al. 1976). Due to the size of landscapes, the number of polygons representing the landscapes, and the high variability of associated terrain of individual landscapes among the areas under analysis, there is uncertainty of the influence this would have on the range of variability over multiple simulations.

The template is provided with the installation. Sample simulation results are included in the template. Additional instructions will be provided in a separate publication.

16.14 APPENDIX N—GLOSSARY

ANNRAD. The annual radiation load for a specific vegetation unit computed for use in the invasive species logic developed by Montana State University.

ArcGIS. A group of geographic information system software products produced by Environmental Systems Research Institute.

ArcGIS Extension. [ESRI software] In ArcGIS, an optional software module that adds specialized tools and functionality to ArcGIS Desktop. ArcGIS Network Analyst, ArcGIS StreetMap, and ArcGIS Business Analyst are examples of ArcGIS extensions. A SIMPPLLE Extension has been created.

ArcView. The entry level licensing of the geographic information system software product produced by Environmental Systems Research Institute.

Build on Line (Node). [ESRI software] An ArcToolbox command in the Coverage toolbox that creates or updates feature attribute tables and polygon topology. Build is also used to synchronize polygon User-IDs with label point User-IDs.

Cover. [ESRI software] A data model for storing geographic features. A coverage stores a set of thematically associated data considered to be a unit. It usually represents a single layer, such as soils, streams, roads, or land use. In a coverage, features are stored as both primary features (points, arcs, polygons) and secondary features (tics, links, annotation).

Data structures. The organization of data within a specific computer system that allows the data to be stored and manipulated effectively; a representation of a data model in computer form.

Digital elevation model (DEM). The representation of continuous elevation values over a topographic surface by a regular array of z-values, referenced to a common datum. DEMs are typically used to represent terrain relief.

Double. When you create feature classes and tables in ArcGIS a data type has to be selected for each field. The available types include a variety of number types and text. Double represents the precision level chosen to store fractional numbers with decimal places.

Empirical models. Statistical or correlational models (e.g., regression models). Lack biological mechanisms. Empirical models are those that are based entirely on data. Empirical models are not derived from assumptions concerning the relationship between variables and they are not based on physical principles. They are based on statistical analysis of observed data, and they are usually applicable only to the same conditions under which the observations were made.

ESRI. Environmental Systems Research Institute.

Float. When you create feature classes and tables in ArcGIS a data type has to be selected for each field. The available types include a variety of number types and text. A float data type is for numeric values with fractional values.

Feature class. [ESRI software] In ArcGIS, a collection of geographic features with the same geometry type (such as point, line, or polygon), the same attributes, and the same spatial reference. Feature classes can be stored in geodatabases, shapefiles, coverages, or other data formats.

File geodatabase. [ESRI software] A database or file structure used primarily to store, query, and manipulate spatial data. Geodatabases store geometry, a spatial reference system, attributes, and behavioral rules for data. Various types of geographic datasets can be collected within a geodatabase, including feature classes, attribute tables, raster datasets, network datasets, topologies, and many others.

FMZ – fire management zone. A spatial delineation that has the same values for the probability of a fire ignition within SIMPPLLE. Fire suppression logic in SIMPPLLE can be varied by these zones.

Geographic zone / area. A geographic extent defined for SIMPPLLE that utilizes the same set of system knowledge for defining vegetation, disturbance processes, and their probabilities.

GIS environment. The collection of methods, techniques, models, and approaches of a geographic information systems to store, select, manipulate, explore, analyze, and display georeferenced data.

Hibernate. Hibernate is a library for the Java language. It provides a framework for mapping the SIMPPLLE java objects to a traditional relational database.

Hydrologic code unit (HUC). A sequence of numbers or letters that identify a hydrological feature like a drainage basin.

Inclusion rule. A rule within SIMPPLLE that identifies what percentage of species has to exist to identify a species mixture label to individual vegetation units.

Invalid units. A landscape unit in SIMPPLLE is identified as “invalid” when it has attributes assigned that do not match the values created for a specific geographic area.

Java Max Heap Size. The maximum memory reserved for data that is created when SIMPPLLE is executing. The maximum memory that can be allocated to a Java Virtual Machine process.

Landtype association. An association of interpreted landtype map units based on the Forest Service, Region One Landtype Association Mapping.

Life form. Within SIMPPLLE the distinction is made between trees, shrubs and herbaceous life forms as the dominate plant species.

Light severity fire. The intensity of a fire event in which only surface fuels are consumed. No mortality in plant species occurs.

Long. When you create feature classes and tables in ArcGIS a data type has to be selected for each field. The available types include a variety of number types and text. A long data type is selected for integer numbers that are large enough they require 4 bytes (outside the range of -32,768 to 32,767).

Management scenario. A unique combination of management treatments applied over time and space within SIMPPLLE that is designed to achieve specific objectives.

Mechanistic models. Often called “process-based” models. System of interest is broken-down into different levels representing a hierarchy of biological or ecological units. The *state* of the system is determined by submodels describing lower levels of organization (or units); interactions between levels may be described. Models often include some degree of, for example, (bio)physical or (bio)chemical detail. The interactions and mutual constraints among ecological processes are simulated with a mathematical model.

Mixed severity fire. A wildfire fire intensity in which some mortality occurs in the plant species.

Monte Carlo. Monte Carlo simulation performs risk analysis by building models of possible results by substituting a range of values—a *probability distribution*—for any factor that has inherent uncertainty. It then calculates results over and over, each time using a different set of random values from the probability functions.

Nonspatial attributes. Attributes assigned to units within SIMPPLLE that do not depend upon spatial relationships to other units. For vegetation units these are attributes such as species and size class.

Null. A value used in computer programming for an uninitialized, undefined, empty, or meaningless value. Creating new data fields in an ArcGIS feature class often results in “null” being initially assigned. This value is not acceptable for some SIMPPLLE tools and must be changed.

Object oriented design. A software development paradigm to design systems by modeling them based on the real-world objects that they were trying to represent. The paradigm uses objects data structures consisting of data fields and methods together with their interactions.

Operating system – 32-bit vs. 64-bit. The terms *32-bit* and *64-bit* refer to the way a computer's processor handles information. The 64-bit version of Windows handles large amounts of random access memory (RAM) more effectively than a 32-bit system which relate to memory accessibility and memory management.

Pathways. One form of system knowledge within SIMPPLLE. Pathways contain the sequence of state changes as a result of disturbance processes.

Phnenomological model. Like empirical models, these models focus on a single level related to the system of interest. In contrast to mechanistic models, lower levels of organization or function are not considered. But, these models can incorporate “ecological processes” that operate at the system level. The models can be dynamic and some aspects of the model may not be directly informed by data.

Plant communities. Vegetation units unique in both vegetation attributes and spatial location that are taken from a GIS feature and represented within SIMPPLLE.

Projection. A method by which the curved surface of the earth is portrayed on a flat surface. All GIS features have to have a defined projection.

Python scripts. Python is a general-purpose high-level programming language often used as a scripting language. Some of the tools in the SIMPPLLE ArcGIS toolbox utilizes python scripts.

Raster. A spatial data model that defines space as an array of equally sized cells arranged in rows and columns, and composed of single or multiple bands. Each cell contains an attribute value and location coordinates. Unlike a vector structure, which stores coordinates explicitly, raster coordinates are contained in the ordering of the matrix.

Rosgen type. The Rosgen classification system, a widely-used method for classifying streams and rivers based on common patterns of channel morphology.

Rule-based model. A model in which the relationships between combinations of system variables and outcomes are expressed in the form of logic “If then rules”.

Shapefile. [ESRI software] A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.

SIMPPLLE tool box. In ArcGIS, a toolbox contains toolsets and geoprocessing tools. It takes the form of a .tbx file on disk, or a table in a geodatabase. A SIMPPLLE toolbox has been created that contains the processing tools unique for SIMPPLLE.

Simulation parameters. The parameters within SIMPPLLE that can be set at the time simulations are made. These include the number of simulations, the length of the simulation, whether fire suppression will be used, and choices of output files to generate and save.

Spatial attributes. Attributes in SIMPPLLE that depend upon a unit’s spatial relationship with other units. The collection of neighboring vegetation units or land units, the distance to a water unit, and what units are downwind from a vegetation units are all spatial attributes.

Spatially explicit. Landscape elements have map coordinates and are placed within their geographic context.

Spatially interactive. A model transfers energy, matter, or information across the landscape. Examples of spatial interactions include the dispersal of seeds or a spreading fire.

Stand replacing fire. A wildfire intensity in which all of the above ground biomass is killed.

State and Transition models. Models used to describe possible ranges of vegetation states and the transitions between the states.

Stochastic. A stochastic model is a tool for estimating probability distributions of potential outcomes by allowing for random variation in one or more inputs over time.

System knowledge. The knowledge used by SIMPPLLE that is unique to each geographic area. This knowledge is accessible to the user through interface screens. Examples of this knowledge are the vegetation pathways, the probability logic for disturbance processes, the logic for fire suppression, and the logic for type of fire and fire spread.

Text . When you create feature classes and tables in ArcGIS a data type has to be selected for each field. The available types include a variety of number types and text. A text field represents a series of alphanumeric symbols.

Transition matrix. A matrix format for capturing the transition rates that are part of a state and transition model.

Valley bottom groupings. A portion of the Rosgen Stream Classification System. The valley type classification influences the hydrologic processes that help determine stream channel form.

Vector. A coordinate-based data model that represents geographic features as points, lines, and polygons. Each point feature is represented as a single coordinate pair, while line and polygon features are represented as ordered lists of vertices. Attributes are associated with each vector feature, as opposed to a raster data model, which associates attributes with grid cells.

Vegetation unit. The individual vegetation unit that has unique spatial and nonspatial attributes simulated by SIMPPLLE. These are often referred to as “existing vegetation units”.

Working directory – SIMPPLLE. A directory that indicates the appropriate location on disk to place system knowledge and results from an analysis. This is not the same location as the installation directory for SIMPPLLE.



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