DRAFT

**United States
Department of
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Forest Service

**Rocky Mountain
Research Station**

**General Technical Report
RMRS- xxx**

USER GUIDE FOR SIMPPLLE, Version 2.5

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DISCLAIMER OF WARRANTIES

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INTRODUCTION – OVERVIEW OF SIMPPLLE

SIMPPLLE is an acronym for SIMulating Patterns and Processes at Landscape scaLEs. SIMPPLLE was initially developed for USDA Forest Service, Region One as a management tool to integrate disturbance processes and vegetation conditions at a range of spatial scales. Additional funding has came from Joint Fire Sciences program, Bureau of Land Management (BLM), US Geological Services (USGS), Ecosystem Management Research Institute (EMRI), and Montana State University to support development and use in other ecosystems. 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 are in Chew 1993, 1995, 1997.

The objective of SIMPPLLE is to help provide an understanding of the dynamics of landscapes. SIMPPLLE is not designed to provide a precise prediction of when and where processes will occur, but it is spatially explicit. The spatial interaction between landscape features and disturbance processes is considered important enough that for the type of applications SIMPPLLE is designed for a nonspatial approach would not be desired. A range of possible outcomes for landscapes can be quantified by multiple simulations. Multiple simulations can provide a prediction of general trends for the processes on a specific landscape. Results from multiple simulations can be expressed as a probability of occurrence for the disturbance processes as well as the attributes by which plant communities are described. Individual simulations can be used as an example of one possible outcome for a given landscape. 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 a user with the ability to:

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

There are many features of SIMPPLLE that are designed to provide for 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.
A user can make many choices in the system 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 a landscape interacting, 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's design gives up some detail that is found in other modeling systems such as FARSITE (Finney 1998) or the Forest Vegetation Simulator (FVS) (Stage 1973, Wykoff and others 1982) but provides for the interaction between disturbance processes and the vegetative pattern of a unique landscape. SIMPPLLE uses process probabilities in a stochastic fashion, rather than a transition matrix approach. The probability of a disturbance process originating or spreading from a vegetation unit is determined not just by a plant community's attributes, but also by what exists around it, what processes are occurring around it and what processes have occurred in the past. Disturbance processes with a low probability for occurrence are often the ones that determine the pattern of a landscape and future events for an extended period of time.

The initial versions of SIMPPLLE, a customized ArcView project exists. For version 2.5 an ArcGIS extension is available. Both are included in the downloaded executable to facilitate displaying results for additional spatial analysis on output from both individual and multiple simulations. Within some of the SIMPPLLE user interface screens there are choices that are shaded out. These are features that are either not fully developed yet, or not available for the stage a user is at with the system. In using SIMPPLLE there are key choices that are related to the analysis objectives, the issues, and the inventories available that have to be made. 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. Version 2.5 provides choices in making the simulations that should enable a user to tailor the combination to the types of output needed to address the management issues.

Our goal is to have a system that for most levels of analysis, current trends, exploring alternatives, evaluating alternatives, can be modeled in interactive sessions with a planning team and the simulations made entirely in memory. It is only when one needs to make very long simulations or a large number of simulations to capture and quantify a range of variability that the simulation time becomes a consideration and choices may need to be made to make them possible with the computer platform available.

Two separate reviews of landscape models have been made that include SIMPPLLE. Barrett 2001, reviewed FETM, LANDSUM, VDDT, and SIMPPLLE. The Washington Office, Inventory and Monitoring Institute conducted an independent panel review of VDDT, RMlands, and SIMPPLLE (Lee and others 2003).

SIMPPLLE consists of the necessary GIS tools, the SIMPPLLE modeling environment, and Excel spreadsheets with macros for processing simulation output. Since the initial release of SIMPPLLE 1.0 in 1997 for the Westside and Eastside of Region One, Forest Service, it has been expanded to cover additional geographic zones. Each of these areas brought unique conditions that required changes and new features in SIMPPLLE. The objective of version 2.5 is to bring all of these features together in the common code portion of SIMPPLLE so they would be available for use in any geographic zone. The appendices contain the "legal" values for the nonspatial attributes for all the geographic zones and some discussion of the system knowledge. . Not all zones are covered in the same level of detail. Our plans are to produce publications specific to each zone that covers the detail.

GEGORAPHIC ZONES AVAILABLE

Geographic area	Sample landscape
Forest Service – Westside Region One	Bitterroot National Forest
Forest Service – Eastside Region One	Helena National Forest
Sierra Nevada	Yosemite National Park
Southern California	Angeles National Forest
South Central Alaska	Kenai Peninsula
Gila	Gila National Forest
South West Utah	Beaver Creek Drainage
Michigan	No sample landscape
Colorado Front Range	Portions of two National Forests
Colorado Plateau	Mesa Verde National Park
Western Great Plains Steppe	Thunderbasin National Grasslands
Mixed Grass Prairie	Landscape from South Dakota
Great Plains Steppe	Landscape from South Dakota

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 the two California zones, South Central Alaska, the Gila Forest, South West Utah and Michigan. A second Joint Fire Sciences funded project, (Kaufmann et al., date) provided the basic for developing the Colorado Front Range zone. Funding and expertise from the Ecosystem Management Research Institute of Seeley Lake, MT. provided the basis for the development of the three grassland zones. USGS's project of Framing Research for Adaptive Management of Ecosystems (FRAMES) provided the funding to participate in their effort on Mesa Verde National Park to develop the Colorado Plateau zone. The "Zone Builder" represents the long term goal of the system 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.

All zones come with a “sample landscape” that can be loaded and simulated. Many of the sample landscapes have gis files available which can be downloaded separately from the website download page, “GIS extras installer (GIS datasets for sample areas)”

INSTALLING SIMPPLLE

The executable for installing SIMPPLLE version 2.5 can be obtained from the SIMPPLLE website - http://www.fs.fed.us/rm/missoula/4151/SIMPPLLE/

The executable available from the web site is currently only for windows operating system. We can provide executables for Mac OS X, AIX, Solaris, Linux, and HP-UX upon request.

To install SIMPPLLE from the executable after downloading it to your computer, execute the “SIMPPLLE-2_5_2_6-install.exe”, and follow the instructions, accepting the defaults recommended.

We have found that some operating systems have problems with blank windows, a SIMPPLLE screen, but not text, appearing when running SIMPPLLE. This is most likely caused by out of date or corrupted video drivers or possibly an older version of DirectX. We are still researching this issue. However this can be corrected by editing the “SIMPPLLE.lax” file in the SIMPPLLE installation directory.

The following figure displays the location of “SIMPPLLE.lax”

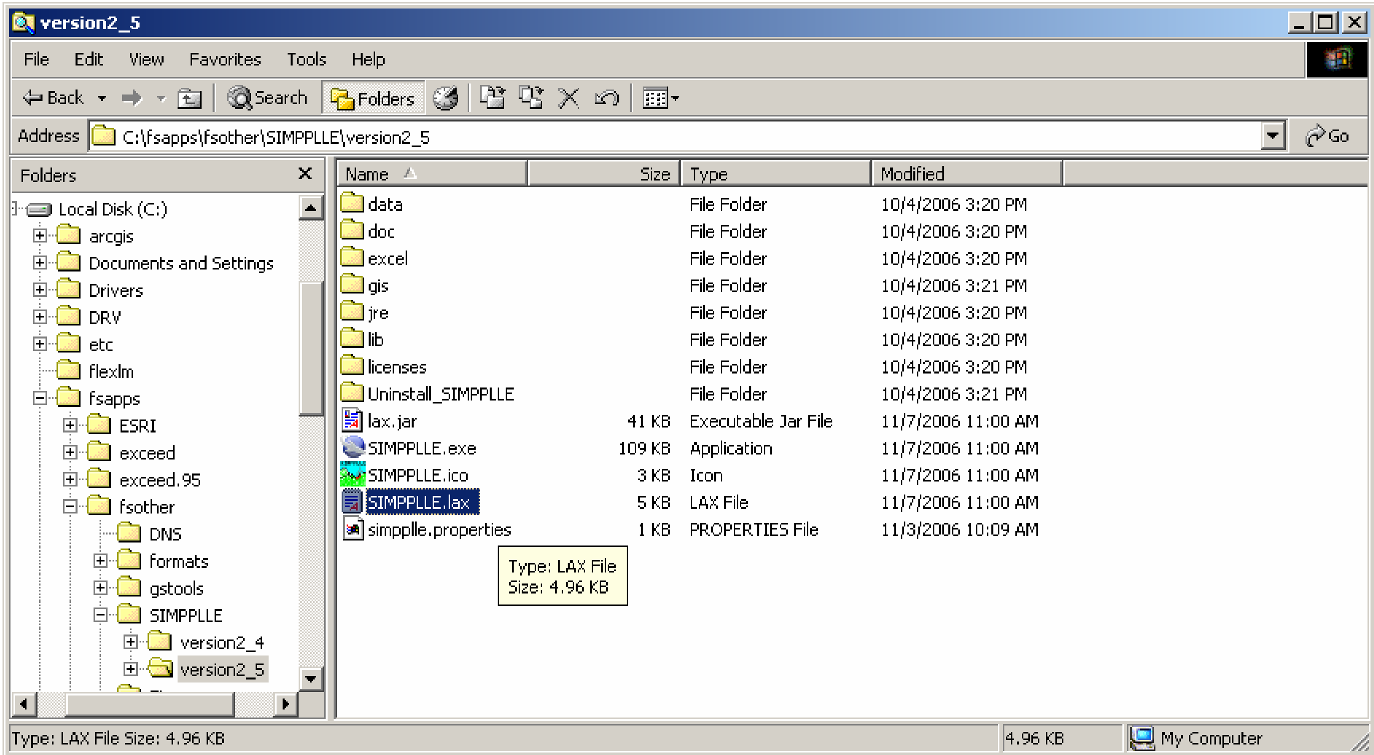


Figure 1the location of "SIMPPLLE.lax file

The following lines are the comment lines in the "SIMPPLLE.lax" file and the single line to be edited.

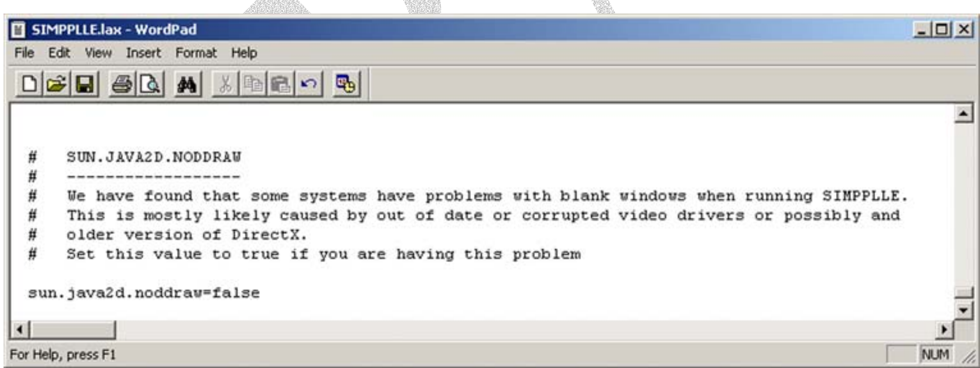


Figure 2 line in SIMPPLLE.lax file to be edited

MEMORY MANAGEMENT

SIMPPLLE makes an initial assignment of your computer system's memory to the "Java Max Heap Size" when the installation is made. The default is set for a machine with 2 GB's RAM which means the application could use about a max of 1350 MB. If your machine has less than 2 GBs you will need to reduce this amount. This may result in an error when starting SIMPPLLE.

Go to Utilities on the main menu and select "change Java Heap Size"

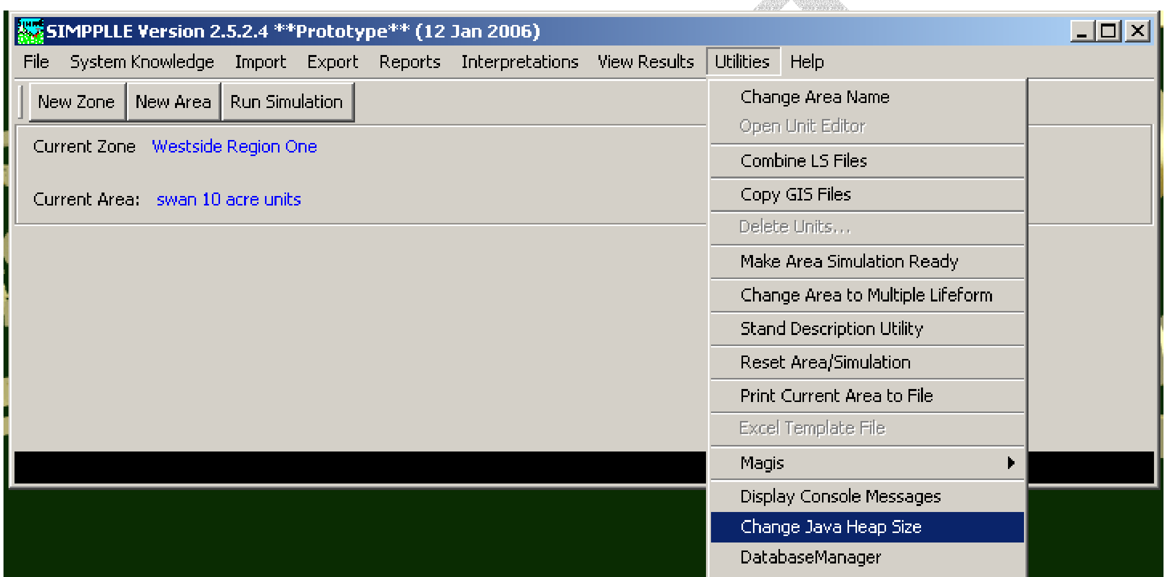
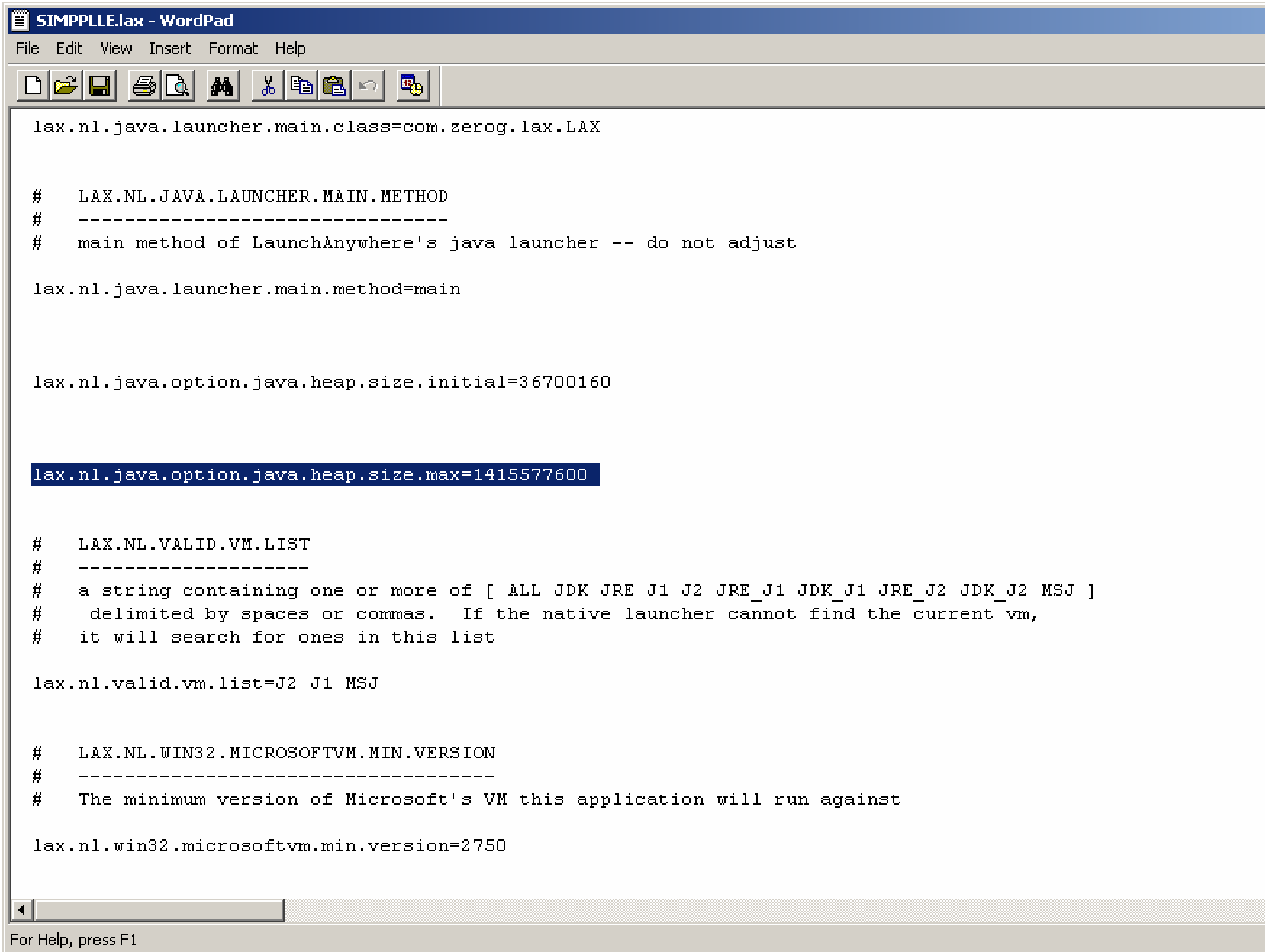


Figure 3 Location of "Change Java Heap Size" choice in user interface

The following dialog window will appear.

Figure 4 Dialog box for changing Java Heap Size

You may have to lower this value to 512. Sometimes this memory problem may make it impossible to start SIMPPLLE, you will get a Java error. If this is the case you will have to edit the SIMPPLLE.lax file first.




```
lax.nl.java.launcher.main.class=com.zerog.lax.LAX


#   LAX.NL.JAVA.LAUNCHER.MAIN.METHOD
#   --------------------------------
#   main method of LaunchAnywhere's java launcher -- do not adjust

lax.nl.java.launcher.main.method=main



lax.nl.java.option.java.heap.size.initial=36700160



lax.nl.java.option.java.heap.size.max=1415577600


#   LAX.NL.VALID.VM.LIST
#   --------------------
#   a string containing one or more of [ ALL JDK JRE J1 J2 JRE_J1 JDK_J1 JRE_J2 JDK_J2 MSJ ]
#    delimited by spaces or commas.  If the native launcher cannot find the current vm,
#   it will search for ones in this list

lax.nl.valid.vm.list=J2 J1 MSJ


#   LAX.NL.WIN32.MICROSOFTVM.MIN.VERSION
#   ------------------------------------
#   The minimum version of Microsoft's VM this application will run against

lax.nl.win32.microsoftvm.min.version=2750
```

Figure 5 Line in the SIMPPLLE.lax file to be edited for changing the Java Heap Size

Change the number to be: 536870912, (or alternatively multiple the number of Megabytes by 1024 twice (e.g. 512 * 1024 * 1024 = 536870912))

As simulations are being made the amount of memory used is displayed at the bottom of the main screen. It is possible when running very large landscapes (large number of existing-vegetation-units) or making very long simulations, or making many multiple simulations to run out of memory. There are options on the simulation parameter screen to help avoid that problem. The basic option to avoid running out of memory is to "discard unnecessary simulation data". If simulation data is not discarded, all the information for each landscape unit, for each time step, all the information for fire events is kept in memory. This provides for maximum flexibility in producing reports after the simulations are made, however it does come at the cost of memory. If the option is made to "discard" some of this information, there are limitations on the reports that can be made. Writing to a database can help to reduce these limitations however these feature has not been fully developed yet and does have an impact on simulation time.

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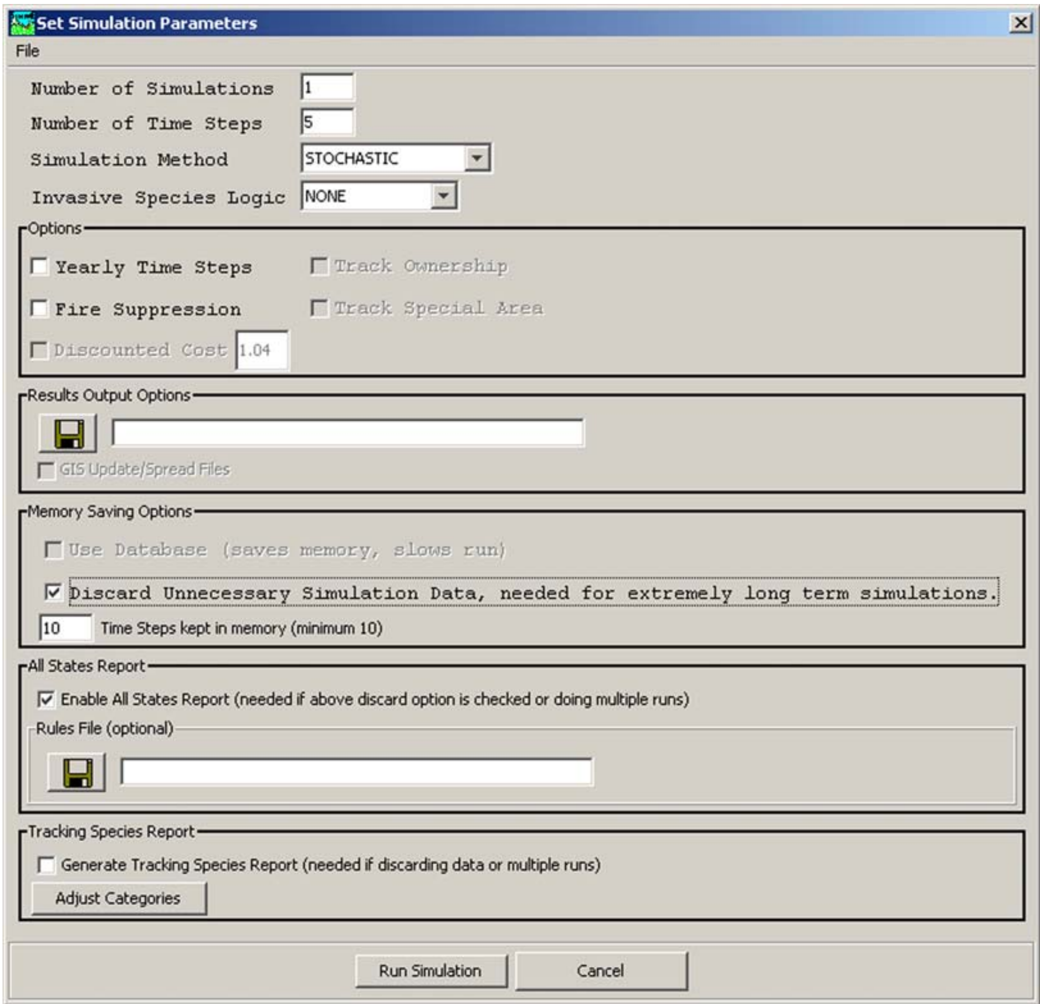


Figure 6 Simulation parameters input screen showing choice made for discarding unnecessary simulation data.

The database is written using Hibernate 3.1 and Hypersonic SQL 1.8 Release Candidate 8. The beta releases are used as they allow a database larger than 2GB (max is now 8GB). There is an item on the Utilities menu called DatabaseManager. This starts up a utility that comes with hibernate for working with the database. We have not developed any standard utilities to work with the database yet.

SIMPPLLE INPUT FILES

When SIMPPLLE was first designed very few users had the vegetative attributes associated with the polygon coverages in a GIS system. A two step process was created

to add nonspatial attributes to the spatial attributes coming from a GIS environment. Two files are used within SIMPPLLE to create the input file that represents a landscape; a file of spatial attributes and a file of nonspatial attributes: area_name.attributesall and area_name.spatialrelate. For versions prior to 2.5, the development of these files remains a two step process. However for version 2.5, it can all be done in one step through using the customized tools in the ArcGIS SIMPPLLE toolbox.
The spatial attributes are the relationships between the components carried in SIMPPLLE, which can be vegetation, land units, aquatic units, and manmade units. We have made the choice not to run the model within a GIS environment, but to obtain the spatial relationships from the GIS and carry them in SIMPPLLE. The range of spatial relationships depends on the landscape components being modeled. If landscape components in addition to vegetation are utilized, aquatics, land, manmade features, their associated spatial relationships and attributes are included in the two files.

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 that has the option of "add toolbox". In the resulting dialog window enter the pathway and file name to where the SIMPPLLE toolbox is located under the installed directory.

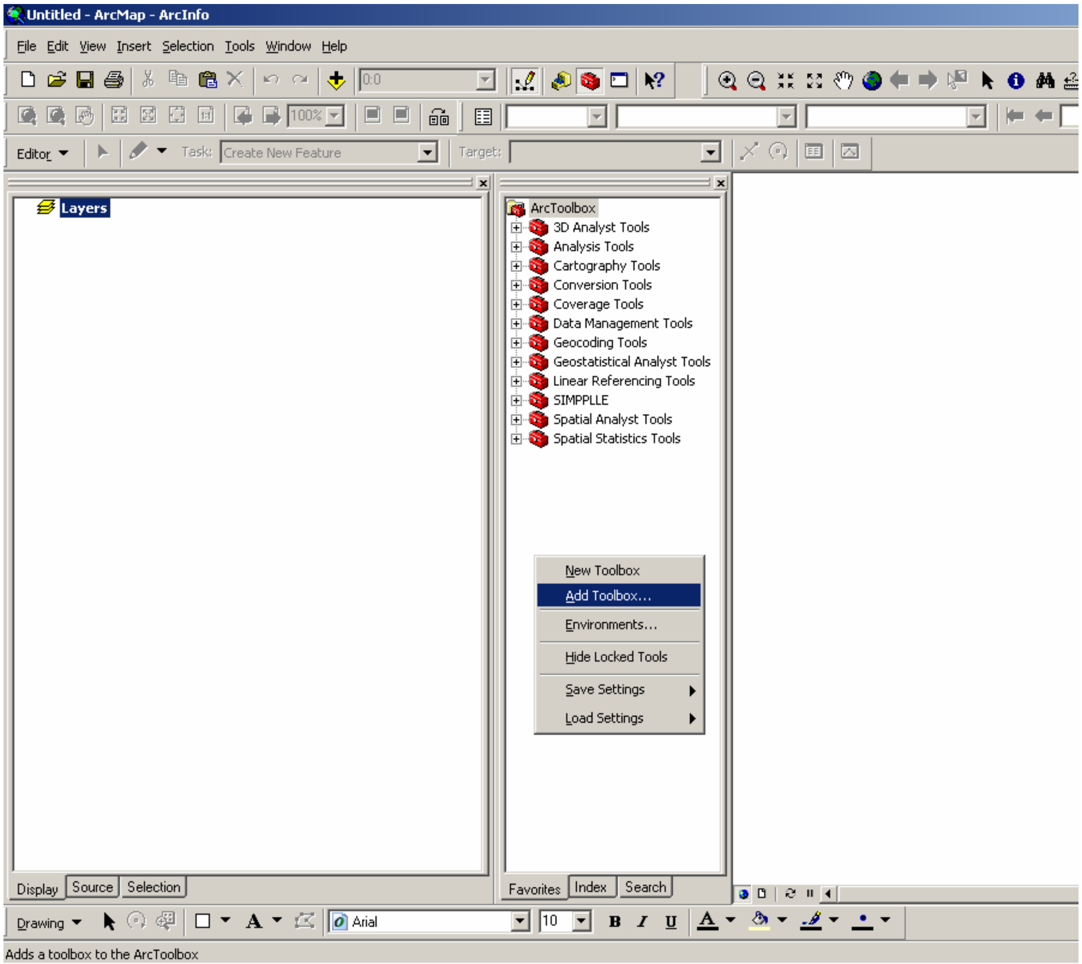


Figure 7 ArcMap display to add SIMPPLLE toolbox

The toolbox is located in the following directory created in the installation.

C:/fsapps/fsother/SIMPPLLE/version2_5/gis/python

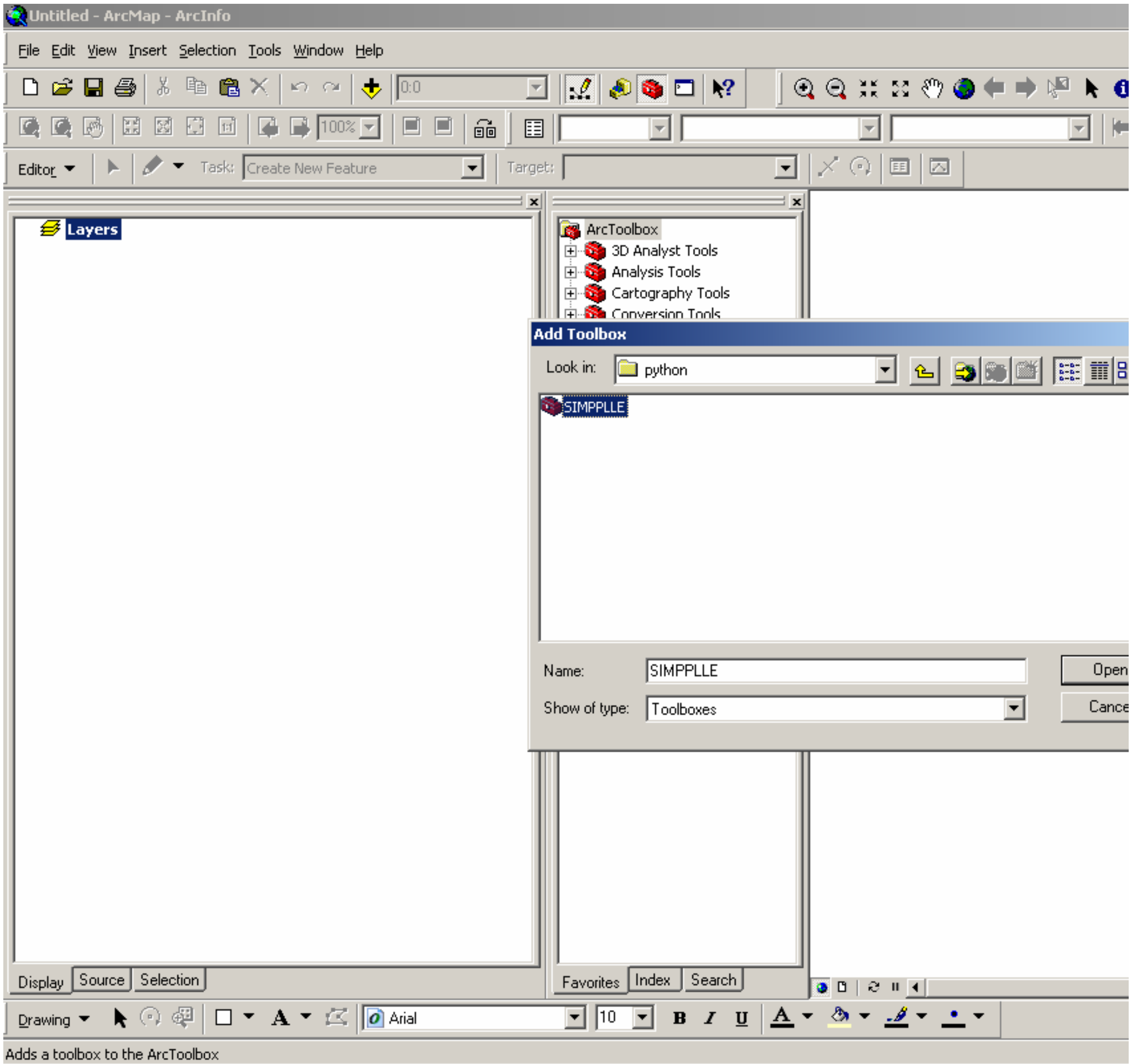


Figure 8 Dialog box showing location of SIMPPLLE toolbox for adding to ArcMap or ArcCatalog

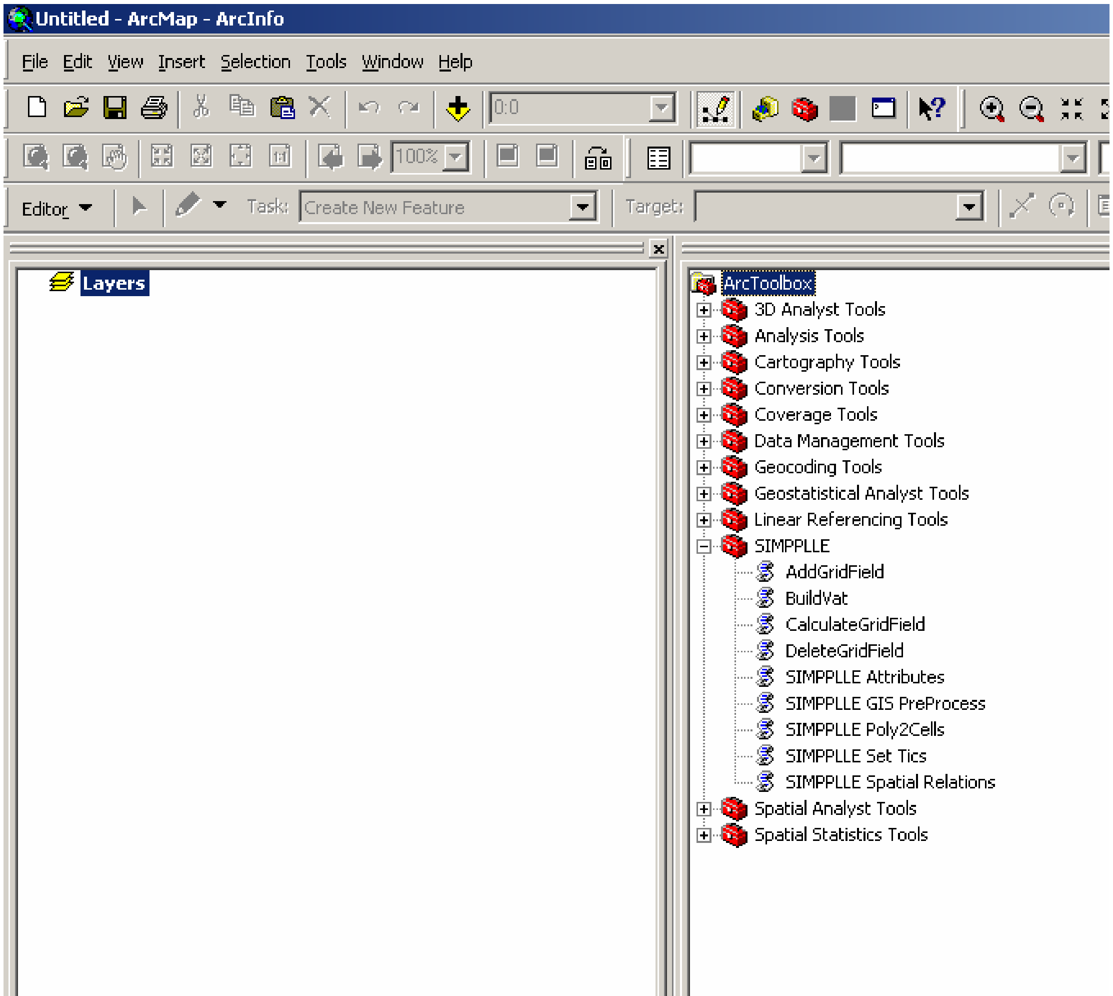


Figure 9 The choices available in the SIMPPLLE toolbox under ArcMap.

Within the toolbox, the "SIMPPLLE spatial relations" is the selection used to create the input files. It creates the two files. The interface screen for it asks for the name of the feature class for each landscape component to be used.

At this time the following spatial relationships are used in SIMPPLLE are:

For Vegetation we identify the set of adjacent neighbors for each vegetation unit. If using irregular polygons it is any unit that shares an arc. If uniform polygons user can specify if it's a set of four or 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 we identify the upstream predecessor and the successor aquatic unit in the network. We identify what vegetation units are "adjacent" to each aquatic unit.

For manmade features of roads and trails, we identify the predecessor and successor in the network

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

NONSPATIAL ATTRIBUTES

There has to be attributes for each class that is used to represent the landscape, vegetation, land, aquatics, and man-made features. Each class has to be represented in a separate feature class or cover in ArcGIS. The valid values for the nonspatial attributes for each geographic area are covered in an appendix for each area. These fields have to be manually added to the feature classes. At some future time we will have a python script available in the toolbox to make this step easier. For Version 2.5 the field names have to be identical to what is shown. There is no required order within the gis files.

VEGETATION:

SIMPPLLE can represent the dominant vegetation lifeform for each plant community or any combination of three lifeforms, trees, shrubs, and herbaceous. Each can be used as the dominant vegetation for an existing plant community. All the species belonging to each lifeform will have separate pathways in the system.

Their pathways are since separate, but an additional component allows for interaction between those lifeforms that are present, allows for the density of one lifeform to be impacted by the density of the others. (see – system knowledge, vegetation processes, lifeform interaction).

There are many ways to create files of the vegetation attributes and other optional fields for the polygons in the coverage. The most common has been to use data from a vegetation management record system, satellite imagery, or a combination of the two. Whatever the source of the nonspatial attributes, they have to be entered in the attribute table associated with a ArcGIS cover or feature class. The fields necessary for SIMPPLLE version 2.5 input and their structure required in ArcGIS varies from previous versions.

The question of the accuracy of inventory data and the assignment of attributes to individual plant communities has to be left to the user to resolve. We stress that a user is making choices on "how to represent" a landscape for modeling purposes when the SIMPPLLE data files are attributed. It is the user's responsibility to express the limitations of making choices about the representation of spatially explicit plant communities.

The fields required depend on if you are using single life form or multiple life forms and if you are using “tracking species”. The order in a cover or feature class attributes table is not important, but the spelling is.

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

Slink
(created by script)
This field provides the link between the unit in SIMPPLLE and the GIS environment. It is added by the ArcGIS script, if the field already exists it will be recalculated by the script. It is important to use the geodatabase created by running the script so that the SLINK field will properly match what SIMPPLLE is using as identifiers for units.

Ht_grp
(required):
This field for ecological stratification started as habitat type group values in the first geographic zones developed. It has been broadened in concept and varies for each geographic zone (see appendices). It ranges from no stratification, to broad classes of elevation and aspect, to specific soil types. Most of the system knowledge can now be varied by this stratification by adding a column for this field to the probability and logic tables. The field name will be changed in a future version.

Acres
(required)
Acres of the individual unit

Stand_ID
(required)
A number that can be tied to other record keeping systems. For vegetation is this often a vegetation management record keeping number. It has to be set to zero if it is not used.

Ownership
(optional)
To utilize the fire suppression logic ownership needs to be one of the three: National Forest Wilderness, NF-WILDERNESS, National Forest Other, NF-OTHER, and OTHER. The 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 vs. non wilderness, but the system does provide the capability

Roads
(optional)
The road status can be identified in two ways. If road units are not created for the landscape file a 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.

Elev
(optional)
If this field is not used then a digital elevation model must be identified when running the SIMPPLLE spatial relations python script. The system uses an absolute difference of 100 in the mean elevation of a unit to determine if a neighbor is above or below a vegetation unit. If the dem or value is in feet, the difference is 100 feet, if it is in meters, the difference is 100 meters. We have not made this code accessible yet so a user could change it.

Fmz
(required)
This field is for designating the Fire Management Zone. These are delineations that have 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. If no zone value is used, "all" is interpreted for the field.

Fire
(not used)
This field is no longer being used. It needs to be left blank. It will be removed in a future version.

Sp_Area
(optional)
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 nonforest ecological types used. It cannot be blank, have a space in the name, or be a dash. All of these cause problems in either our Excel macros or ArcGIS. An underscore can be used.

Landtype
(not used)
This value needs to be left blank, it is not currently used in this version. It is an old field that will be removed in future versions. If we need attributes from the land, we should be incorporating an existing land unit.

Vegetation fields for single lifeform:

Species
(required)
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)
There is variability in how this attribute is represented across zones. One has to use what is tied to inventories and what is needed for a combination of interpretation and influence on disturbance processes. Must be aware that if structure is build into pathways, but because of limitations from an inventory it is not shown in initial states, that a simulation will "add" structure from the pathways over time steps.

Density
(required)
There is variability by zones, but it stays with canopy cover because most easily obtained from remote sensing and most commonly found in inventories.

Process
(optional)
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 also has to 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 any disturbance process, each plant community starts out as if succession was occurring.

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

Process_t
(optional)
The number of time steps past that the process occurred. Currently although you can put values of more than 1, SIMPPLLE currently always uses a value of 1.

Treat_t
(optional)
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 is an item that will be changed in a future version.

Multiple life form input fields

To use multiple life forms requires additional fields in the GIS files. If the inventories do not contain it can often be added by extrapolating from sources such as 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 thought no additional values exist. This will have an impact on the summary report and a user must keep this in mind. See notes under reports.

The species, Sizeclass, density, process, and treatment have to be expanded to account for each lifeform. The following abbreviations used are:

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

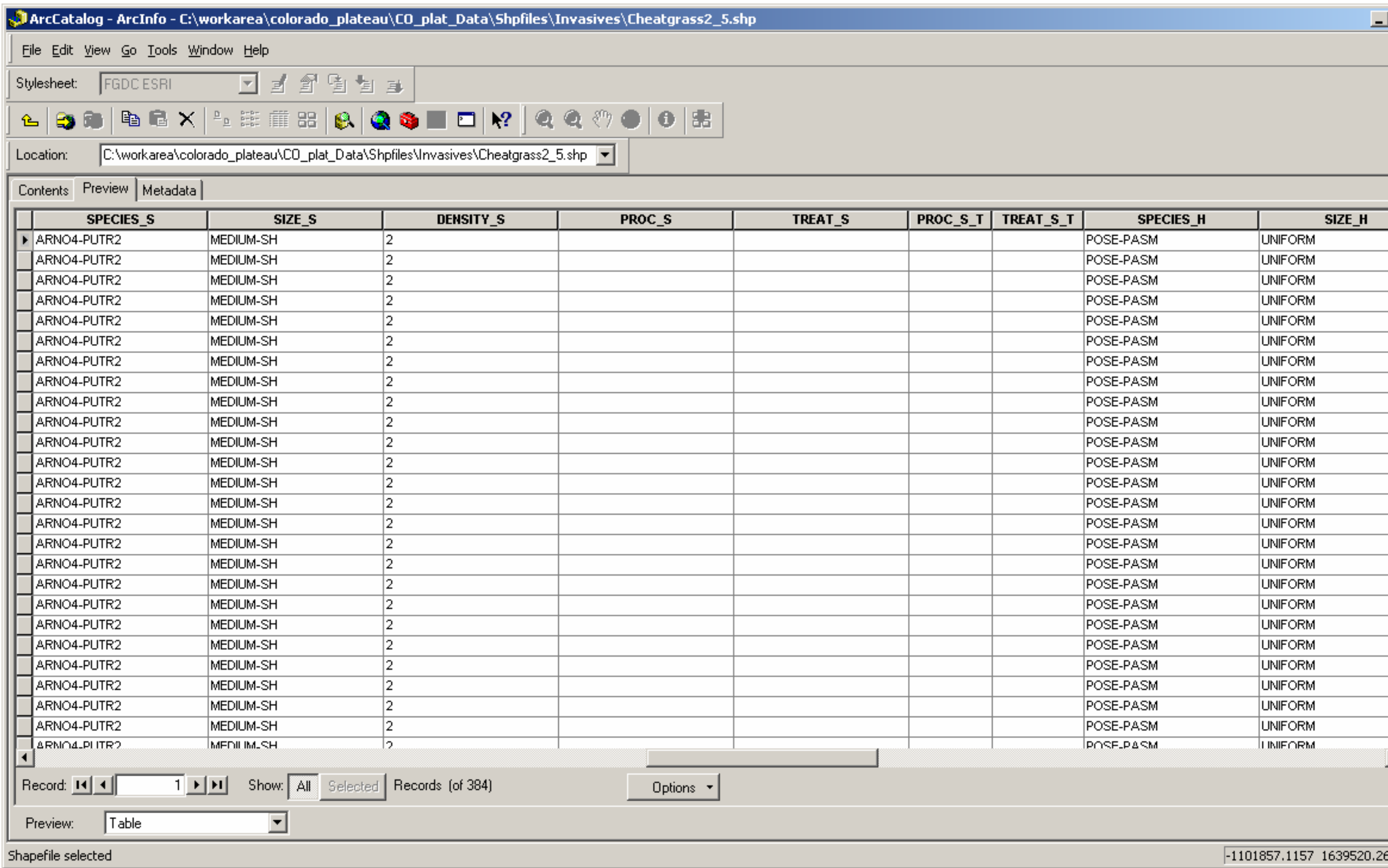
Table 2 Abbreviations used with multiple lifeforms.

The fields 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

The following figure displays these fields in use.



SPECIES_S	SIZE_S	DENSITY_S	PROC_S	TREAT_S	PROC_S_T	TREAT_S_T	SPECIES_H	SIZE_H
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM
ARNO4-PUTR2	MEDIUM-SH	2					POSE-PASM	UNIFORM

Figure 10 Required fields for multiple lifeforms in table for polygon cover.

Tracking species input fields

Tracking species can be used with single and multiple lifeforms and any lifeform (trees shrubs, and herbaceous). This is used for two cases. One case is with grass communities where users don't want to use a size and density, but an aggregate of species. The second is to account for invasive species.

To use tracking species as a means to represent plant communities then 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 for all the species for all the 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 use can edit the pathway file, adding in change values for this new species.

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.

Sp_count the number of species tracking (there is a maximum of ten species that can be tracked.

Each species being tracked has to have a field for the species name and a field for the percent of cover.

Example: Say we have 3 tracking species. The three species could be all of one or any combination of trees, shrubs, herbaceous, agriculture or nonforest. The following fields are needed.

SPTK_TR1	SPTK_TR1PER
SPTK_S1	SPTK_S1PER
SPTK_H1	SPTK_H1PER
SPTK_A1	SPTK_A1PER
SPTK_N1	SPTK_N1PER
SPTK_TR2	SPTK_TR2PER
SPTK_S2	SPTK_S2PER
SPTK_H2	SPTK_H2PER
SPTK_A2	SPTK_A2PER
SPTK_N2	SPTK_N2PER
SPTK_TR3	SPTK_TR3PER
SPTK_S3	SPTK_S3PER
SPTK_H3	SPTK_H3PER
SPTK_A3	SPTK_A3PER
SPTK_N3	SPTK_N3PER

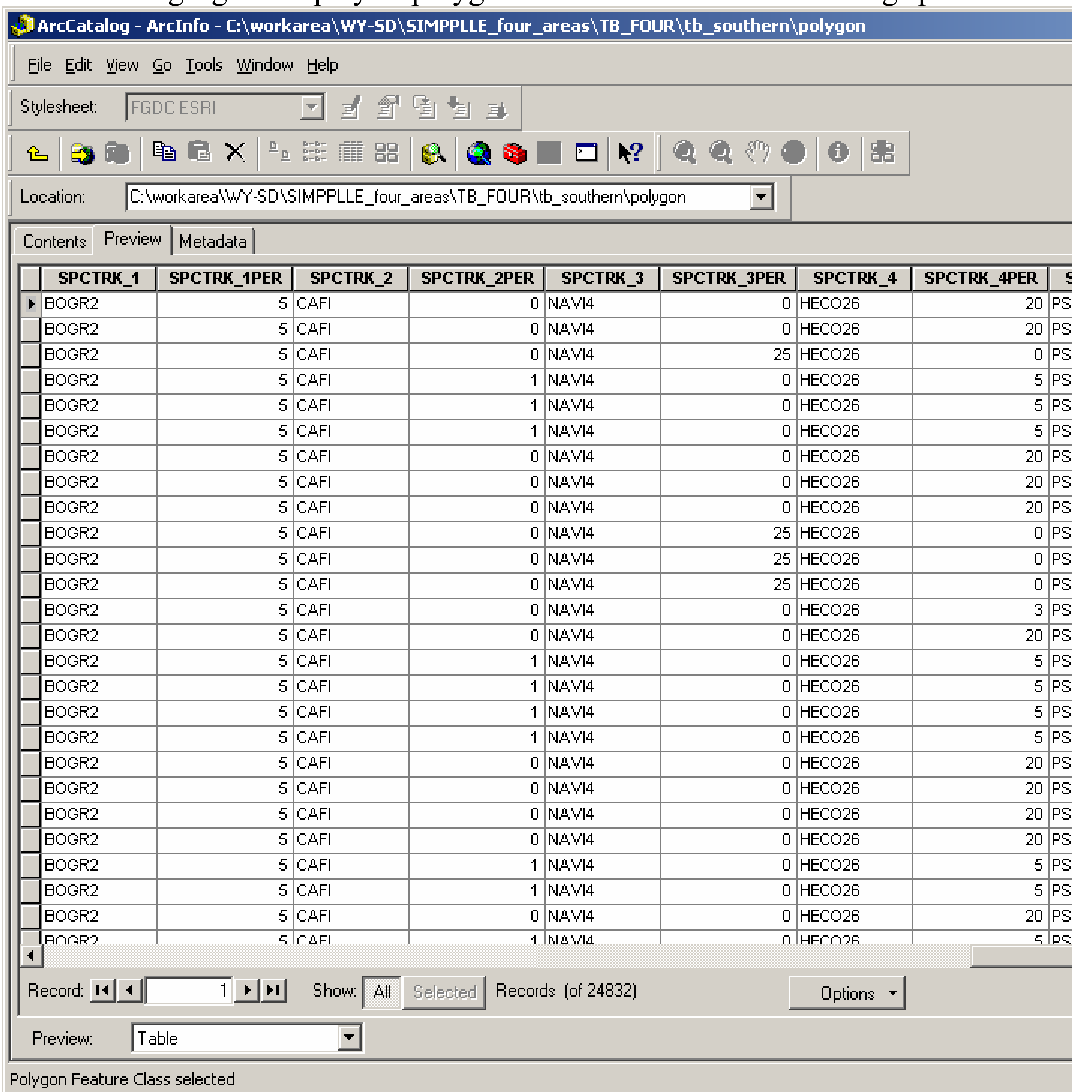
So basically we need:

SPTK_TR***x***	SPTK_TR***x***PER
SPTK_S***x***	SPTK_S***x***PER
SPTK_H***x***	SPTK_H***x***PER
SPTK_A***x***	SPTK_A***x***PER

SPTK_N***x*** SPTK_N***x***PER

Where ***x*** is the tracking species number from 1 to the number of tracking species.

The following figure displays a polygon cover with fields for tracking species.



SPCTRK_1	SPCTRK_1PER	SPCTRK_2	SPCTRK_2PER	SPCTRK_3	SPCTRK_3PER	SPCTRK_4	SPCTRK_4PER	S
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	0	NAVI4	25	HECO26	0	PS
BOGR2	5	CAFI	1	NAVI4	0	HECO26	5	PS
BOGR2	5	CAFI	1	NAVI4	0	HECO26	5	PS
BOGR2	5	CAFI	1	NAVI4	0	HECO26	5	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	0	NAVI4	25	HECO26	0	PS
BOGR2	5	CAFI	0	NAVI4	25	HECO26	0	PS
BOGR2	5	CAFI	0	NAVI4	25	HECO26	0	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	3	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	1	NAVI4	0	HECO26	5	PS
BOGR2	5	CAFI	1	NAVI4	0	HECO26	5	PS
BOGR2	5	CAFI	1	NAVI4	0	HECO26	5	PS
BOGR2	5	CAFI	1	NAVI4	0	HECO26	5	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	1	NAVI4	0	HECO26	5	PS
BOGR2	5	CAFI	1	NAVI4	0	HECO26	5	PS
BOGR2	5	CAFI	0	NAVI4	0	HECO26	20	PS
BOGR2	5	CAFI	1	NAVI4	0	HECO26	5	PS

Figure 11 Table for a polygon cover of plant communities showing the fields needed for tracking species.

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

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 of Region One to provide topographic information used in the prediction of the probability of invasive species.

Required fields

- SLINK (added by ArcGIS python script)
- ACRES
- SOIL_TYPE
- LANDFORM
- SLOPE
- ASPECT
- PARENT_MAT
- DEPTH

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 legal value in the field and make it the same for all units.

AQUATIC UNITS

These fields for this 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

- SLINK (added by ArcGIS python script)
- LENGTH
- LTA_GRP
- AQ_CLASS
- AQ_ATTRIB
- SEG_NUM
- INT_PROCESS
- STATUS

Until further development of the Aquatic component of the landscape is done in a geographic zone, the only legal values available are those from the initial prototype study that was done in the Westside Region One zone.

The LTA_GRP has values that represent Landtype Association, valley bottom groupings. Any of the following values 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 INT_PROCESS 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 INTERMITANT.

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 legal values:

Required fields:

- STATUS
  - Values
    - OPEN
    - CLOSED
    - PROPOSED
    - ELIMINATED

        - UNKNOWN
- KIND
    - Values
        - SINGLE_LANE
        - DOUBLE_LANE
        - UNIMPROVED
        - SYSTEM
        - NONSYSTEM
        - UNKNOWN

TRAILS

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:

- STATUS
    - Values
        - OPEN
        - CLOSED
        - PROPOSED
        - ELIMINATED
        - UNKNOWN
- KIND
    - Values
        - HIKE

GIS PROCESSING OF INPUT DATA

Landscape files cannot be created without executing a combination of amls / python scripts in the ArcGIS environment in order to create the spatial relationships.

A vector, (polygon) coverage or feature class of the plant communities (and any other landscape component) must exist in ArcInfo regardless of the source of the polygons. A digital elevation model (DEM) for the landscape also must exist (or an elevation field must be in the covers). All must be in the same projection. The elevation from a field or from a dem is used to determine if each plant communities neighbors are "above", "below", or "next-to" it. This is computed by taking the elevation difference for the center of each unit and see if it exceeds an absolute value of 100.

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 a user may not like how SIMPPLLE spreads the processes in irregular size steps. A user has a choice to model irregular polygons, or convert them to uniform, rectangular size polygons, essentially a grid.

A choice in the SIMPPLLE toolbox executes an aml (Poly2cells) to create a coverage of uniform rectangular size polygons of whatever acreage a user desires (see GIS files).

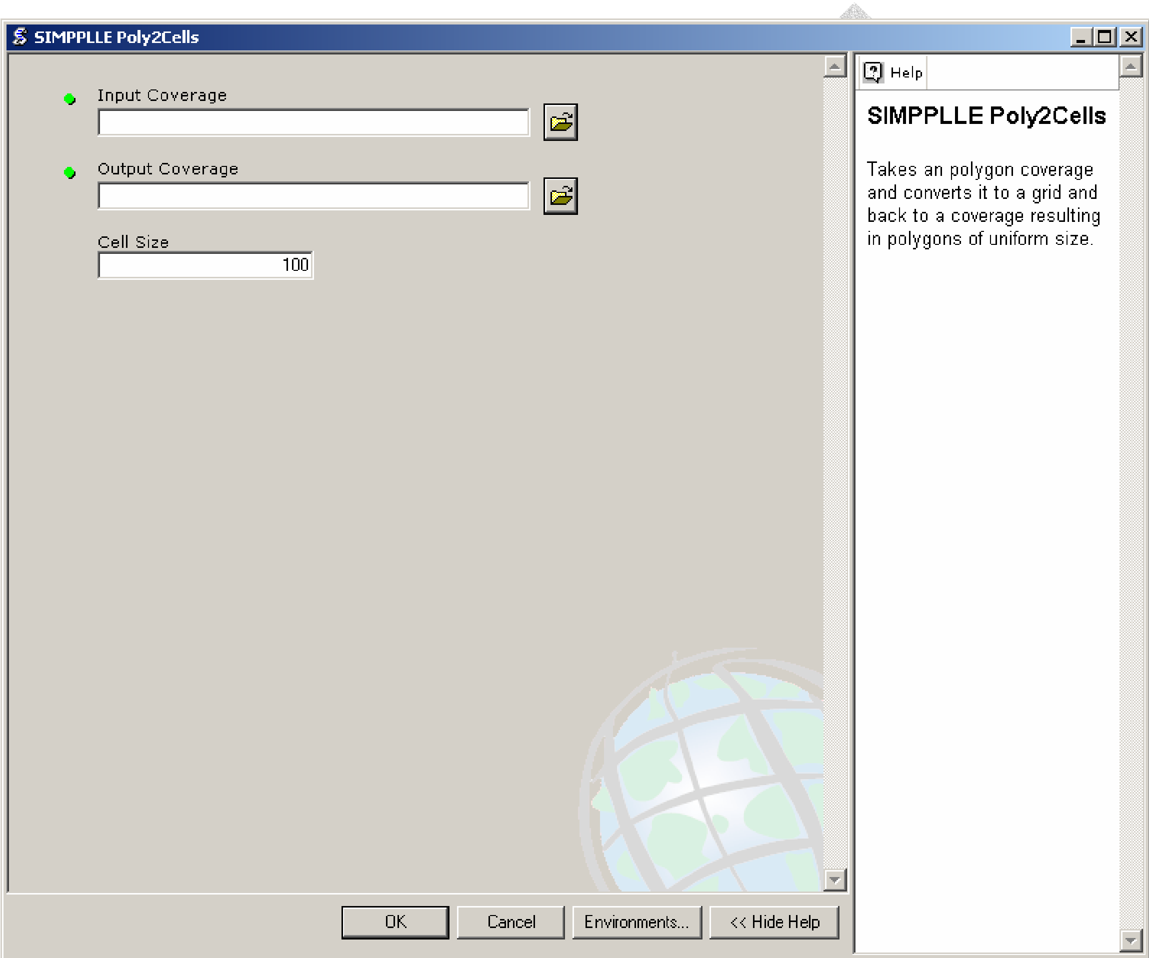


Figure 12 Dialog box to provide input for running the SIMPPLLE poly2cells from the toolbox.

The cell size that is asked for is the length of a side of the square polygon in meters. If a ten acre polygon, (9.88 acre cells) are desired the value to specify is 200 meters. If 5 acre polygons are desired, the length specified is 142 meters. A specified value of 100 meters results in 2.47 acre polygons. If poly2cells is executed on an input cover, a new slink field will automatically be created for the output cover. The resulting coverage has the appearance of being a grid. However we stay with a polygon coverage for the advantages it provides in spatial display of output, and the need for developing a number of spatial relationships between units.

After all of the desired landscape components have been attributed for the desired size units, the SIMPPLLE Spatial Relations from the toolbox has to be run.

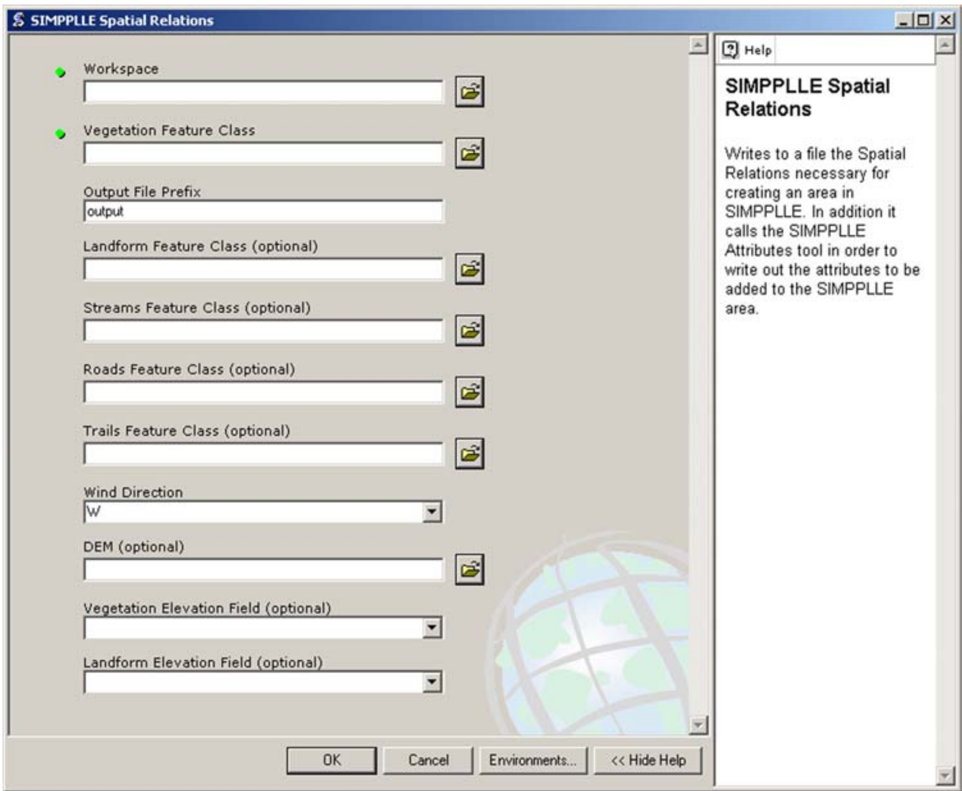


Figure 13 interface screen for SIMPPLLE spatial relations started from the toolbox in ArcMap

IMPORTING FILES within SIMPPLLE:

This can only be done after the SIMPPLLE Spatial Relations tool is ran in the GIS environment. From the IMPORT choice on the SIMPPLLE main menu bar, select 'Create New Area' from the list on the pull down menu.

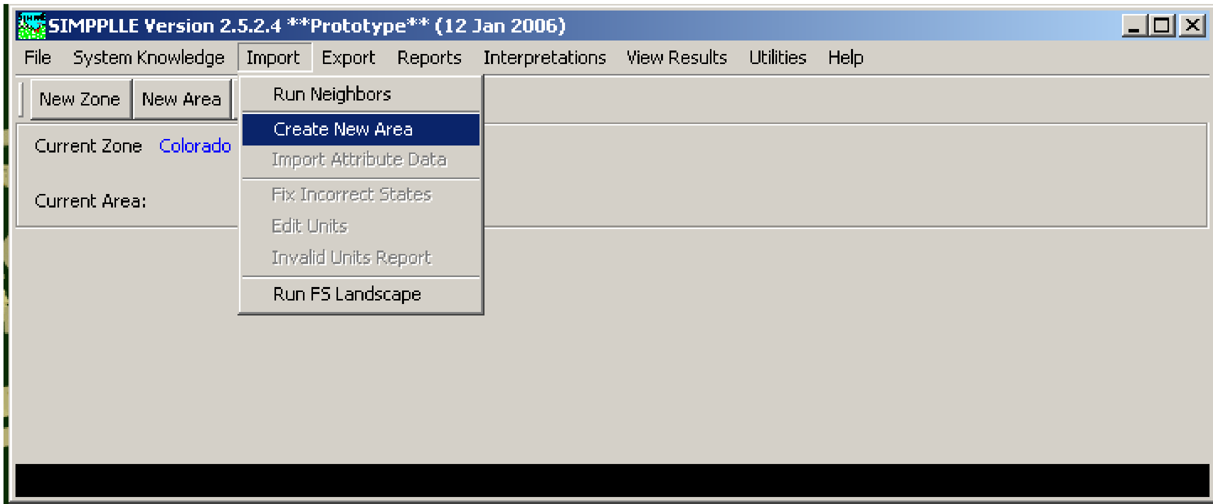


Figure 14 Selecting the "Create New Area" from the SIMPPLLE interface.

The user will be prompted for the name of the file that resulted from executing the SIMPPLLE spatial relations tool. If you have designated a working directory under the "FILE" pulldown menu and if you have placed the results 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.

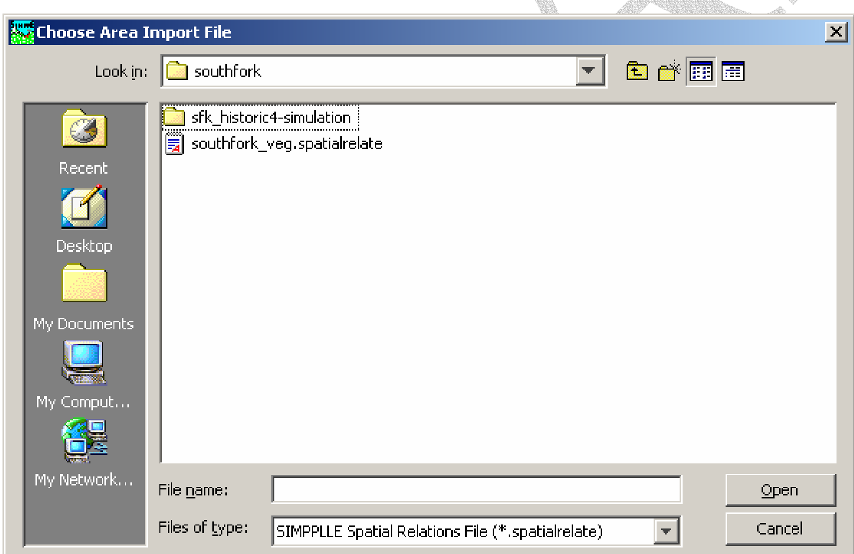


Figure 15 SIMPPLLE dialog box to provide the name of the file containing the spatial attributes.

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 combined the existing vegetation attributes that are created are compared to the system knowledge for the geographic area.

Other invalid states can be the result of mismatches between the initial combination of vegetation attributes and the states within pathways. Some of these can be as minor as nonforest states needing to be described as NF/NF/1. However it is common that the density class assigned from other sources in the GIS coverage, such as satellite imagery may show a higher class. It is often common for the attributes in the GIS coverage to have a species that isn't represented for a specific habitat type group. The user needs to decide how to resolve these. For example with a mismatch between a species and habitat type does one change the habitat type to a group that does include the species? Or does one change the species to a closely associated one that is represented in the habitat type group. A user has to consider what attribute is most accurate; the species or the habitat type group. For the Eastside of Region One zone there is a utility that uses logic from our previous work with satellite imagery conversion to SIMPPLLE states to automatically correct these mismatches. A utility does not exist for the Westside Zone. A primary consideration when changing attributes to handle mismatches with SIMPPLLE states is to retain the original values within the coverage, to maintain a record of the changes made.

Any incompatibilities will result in "invalid units". Having fmz values in the fields but not having an fmz (fire occurrence) file loaded that recognizes the zone values or if the combined existing vegetation states do not match potential states in the pathway files are just two problems that will result in the following Figure being displayed.

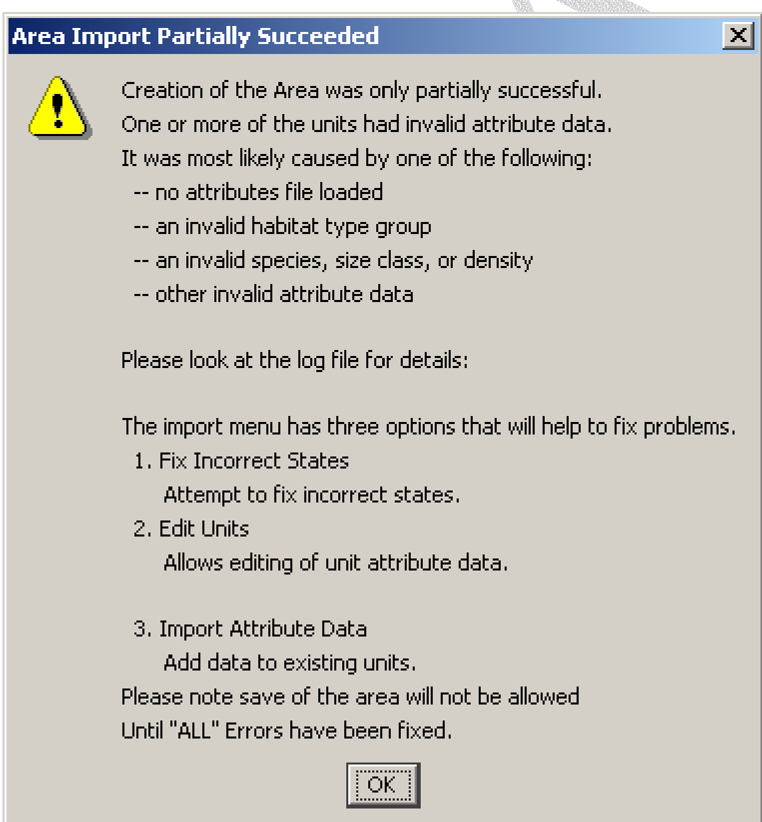
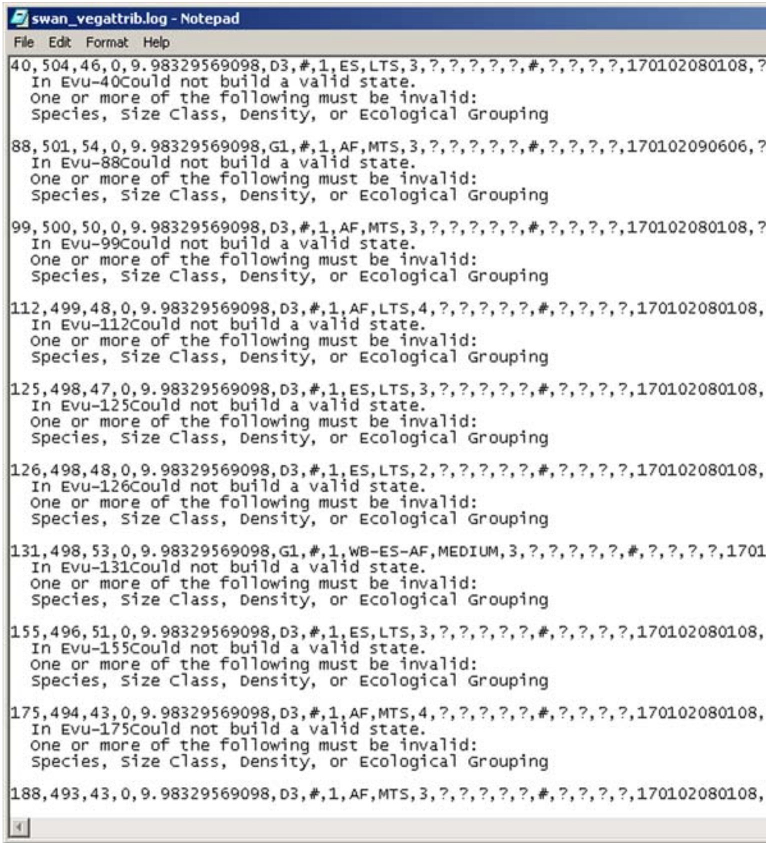


Figure 16– SIMPPLLE screen that identifies the creation of area was only partially successful. Options are provided to fix the problems.

The example of the log file mentioned above is displayed in the following figure.




```
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,?,?,?,?,?,#,?,?,?,?,1701
  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 17 Log file identifying invalid units

The editing options on the import screen are shown below.

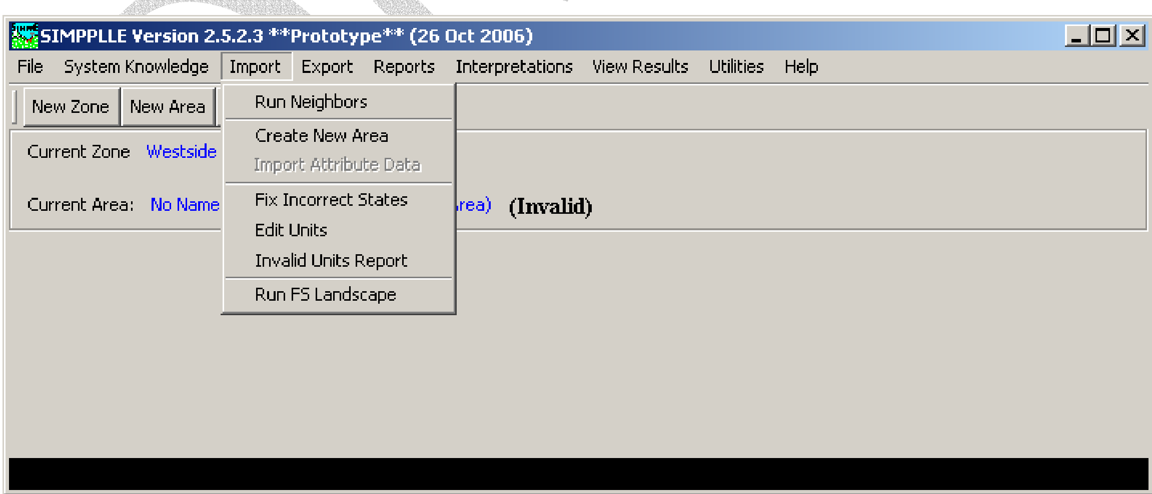


Figure 18 SIMPPLLE Import choices with edit options after an attempt to create a new area file was only partially successful

The “fix incorrect states” is not available in all geographic areas. It was developed in one geographic area to test logic that was an attempt to automatically correct invalid states.

The “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 “Edit units” is selected, the following figure is displayed. This same editor can be opened by making the choice of “open unit editor” under the Utilities choice from the main menu (discussed latter under Utilities).

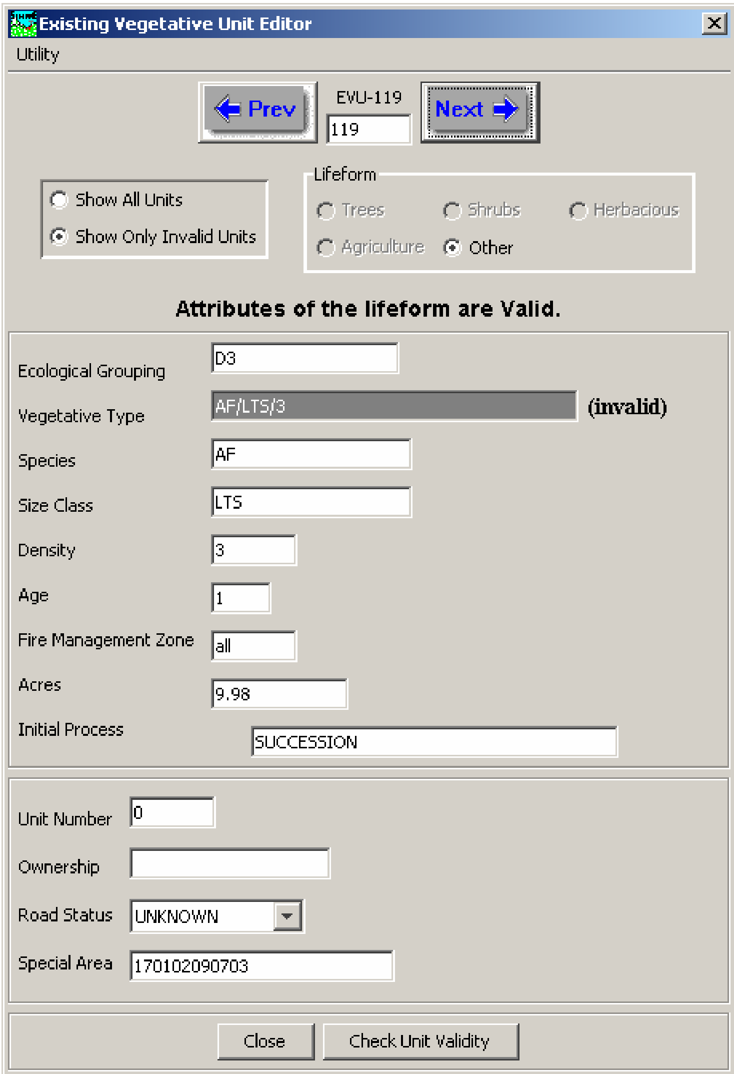


Figure 19 SIMPPLLE screen identifying an invalid vegetative unit

In this case the state is invalid because we have ‘LTS”, large, two storied, for a sizeclass / structure combination. In the pathways for this zone two storied stands are not identified for AF, but MU, multistoried is. We can either go back and modify the pathway, (or if we have loaded the wrong pathway files, load new ones) or edit this invalid state through the user interface by selecting and “utility” in the upper left corner making “global changes” for all units that has the same invalid attributes. This process can be repeated for all invalid units and then the “corrected” landscape file can be changed.

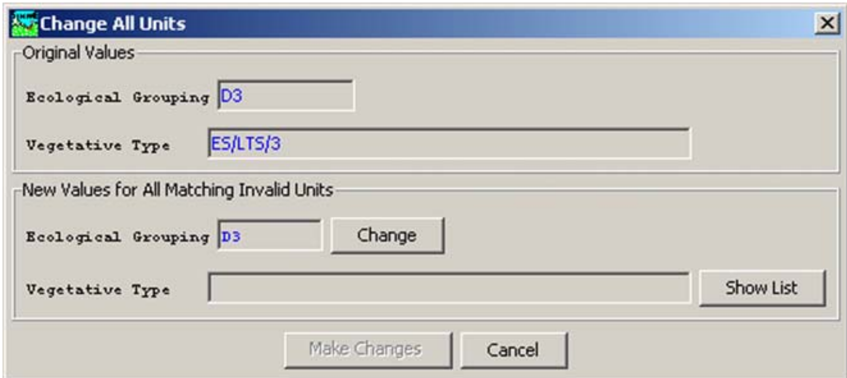


Figure 20 The global change screen to correct invalid attributes.

However any changes made through the user interface are not made in the attributesall file, in the geodatabase that was created, or in 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, the following message will appear.

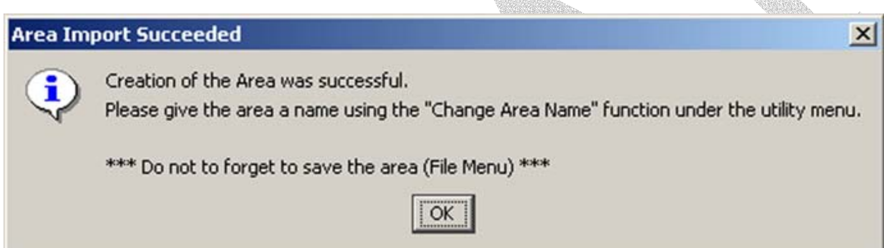


Figure 21 Message box that is displayed when the Area Import Succeeded.

If we “close” the “import successful screen” we will have a new “current area” but it has no name as seen below.

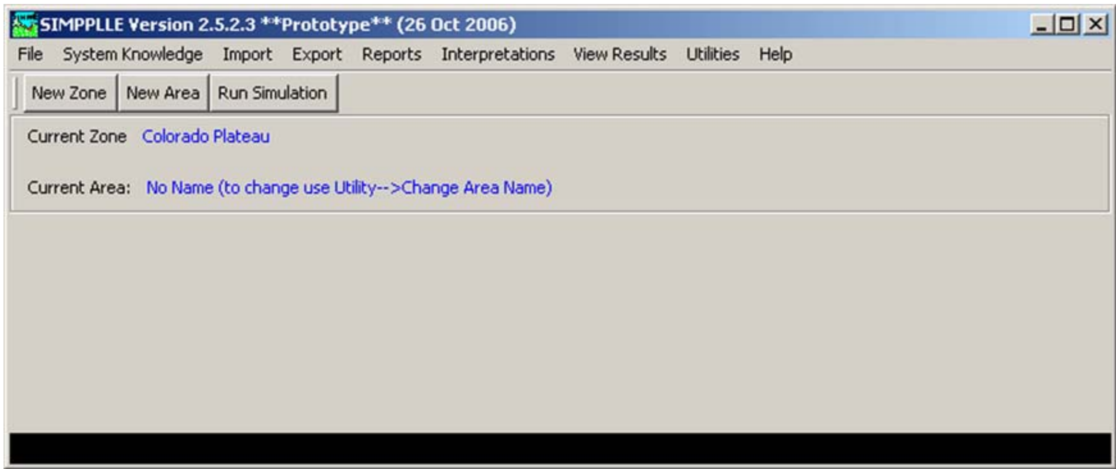


Figure 22 – The main SIMPPLLE screen after the successful creation of a new area but before it has been given a name.

The choice of “Change Area Name” under “Utilities” 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 this screen 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.

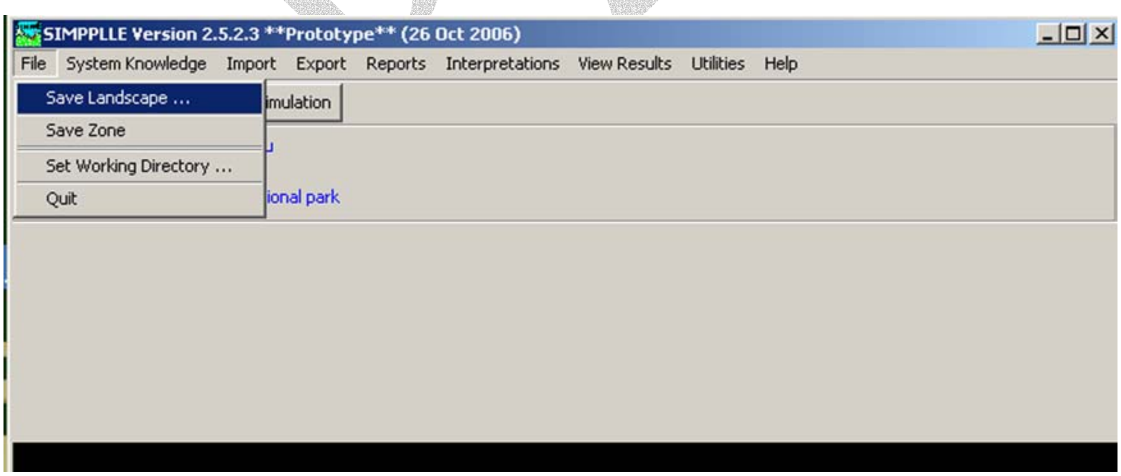


Figure 23 Main SIMPPLLE screen with the choice to save the landscape file.

The system will open a dialog box at the working directory level for the user to provide a name. The extension of "area" will be automatically added to the saved landscape file name.

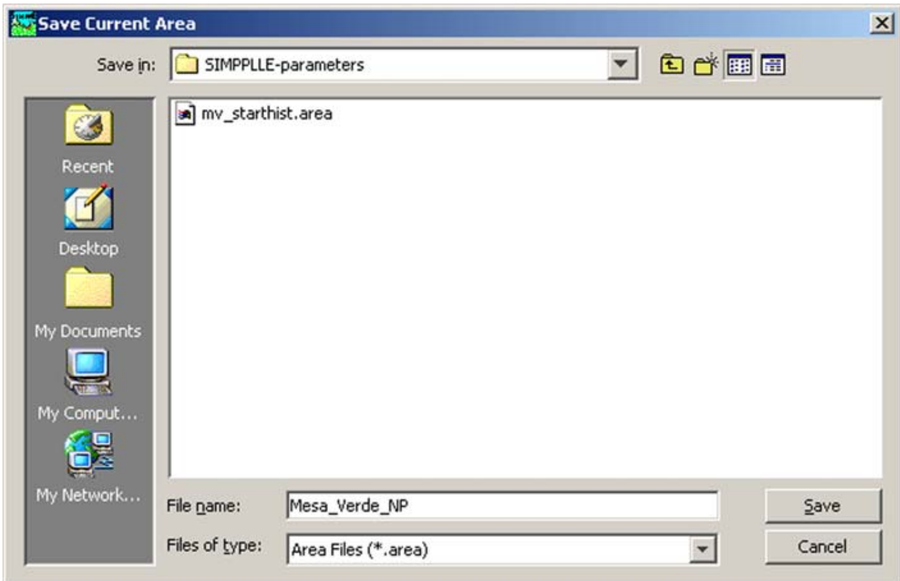


Figure 24 – SIMPPLLE dialog box opened at the working directory to allow the user to specify a name for the landscape file that is being saved.

Simulations can be made now, or you can exit SIMPPLLE and reload the landscape later as a user defined landscape.

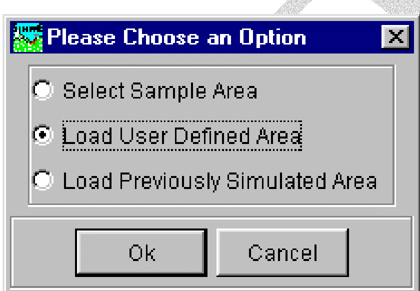


Figure 25 – SIMPPLLE screen that provides the three options for loading a landscape file. The choice of loading a user defined area is selected.

DECISIONS TO MAKE PRIOR TO SIMULATIONS

Many choices have to be made, not just prior to making the simulation, but also prior to the steps discussed above that involve creating and attributing the GIS files required. All of these are based on your objectives for using SIMPPLLE, what issues you are trying to address. A basic decision is are the simulations to be used to quantify trends with current conditions and management alternatives or are the simulation to be used to create a quantification of historic conditions.

What size area to simulate

Based on prior analyses, 6^{th} code hydrologic units appear to be too small to simulate by themselves. 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 6^{th} code or a 5^{th} code 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 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. Currently 4^{th} level subbasins represented by 10 acre uniform polygons is are reasonable upper limit. We have simulated entire ecological sections, 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.

Vegetation - single or multiple lifeforms

The use of multiple lifeforms is necessary if the system is to be used to address invasive species

Vegetation – irregular polygons or uniform

The choice is dependent upon whether a user accepts SIMPPLLE spreading disturbance processes through irregular sized polygons and if any analysis with spatial statistic is planned for the output.

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 that 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 on Excel spreadsheet MRPP) 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, if using ownership and special area within the data set you have the option of "tracking" by these. This enables the file used the Excel macro to be stratified by these levels. When making multiple simulations you have to identify a location and a prefix to go with the files that are created.

Number of time steps

Simulations can be made with only 1 time step. Short term simulations are considered 1 to 5 decade time steps, and often used to provide a means to compare alternative management scenarios or current trends.

Long term, greater than 5 decade time steps, simulations are most often used to help quantify the interaction and cycling of disturbance processes and vegetation conditions. Long term simulations, 500 to 1000 years, without fire suppression are one way to help provide a quantification of historic conditions for a specific landscape.

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, thirty simulations appear to be adequate to capture the variability created within SIMPPLLE (a separate GTR is being produced to document this work). 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 on MRPP).

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. Can incorporate fire suppression cost but it's very simplistic.

Simulation Method

The use of the "stochastic" choice is the most common method used. 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 very specific location of treatment choice, 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. The choice of "highest probability" can be used 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. The choice of "succession" in simulation eliminates any disturbance processes. This will create a landscape in which all plant communities will simply grow older.

The choice of "succession" as a simulation method can be used to eliminate all disturbance processes. But by changing the system knowledge for the individual processes it is possible to set the probability to zero for each process. This can make it easier to evaluate the system behavior for an individual process.

Decade, yearly or seasonal time steps

Decade time steps are the most common choice. However some of the interactions between processes such as fire and insects, or the response of grasses to yearly moisture changes, may make more sense if the system is ran 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 a user can chose between yearly or decade timesteps most system knowledge is automatically adjusted. Two system knowledge components that a user has to adjust are:

- Regeneration delay --- this has to match the users' 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.

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.

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 a 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. Disturbance processes can be locked in while the system models others stochastic. Or by choosing the “succession” choice 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.

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.

Tracking by ownership or special area

Special area field has been used to summarize conditions and processes and to schedule treatments by watershed, management areas, or simply a break between nonforest ecological stratification and forested ecological stratification.

This choice has to be identified prior to making any simulations.

MAKING SIMULATIONS

Making a simulation for an existing landscape file starts with selecting the SIMPPLLE icon on your desktop and going through the following steps.

- Select a working directory
- Select a zone – geographic area
- Load a landscape
- Set simulation parameters
- Run simulation.

Select 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. The choice of “Set Working Directory” opens a dialog box to allow the user to “browse” to the desired location.

Do not put working files in the installation directory that installing SIMPPLLE created.

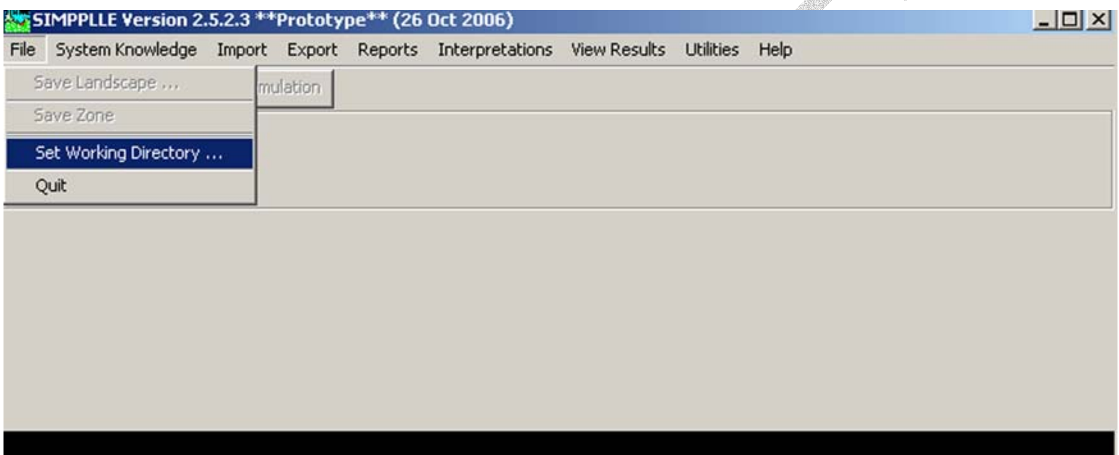


Figure 26 SIMPPLLE main menu with choice under the File selection to set the working directory.

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

Select a Zone – geographic zone

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

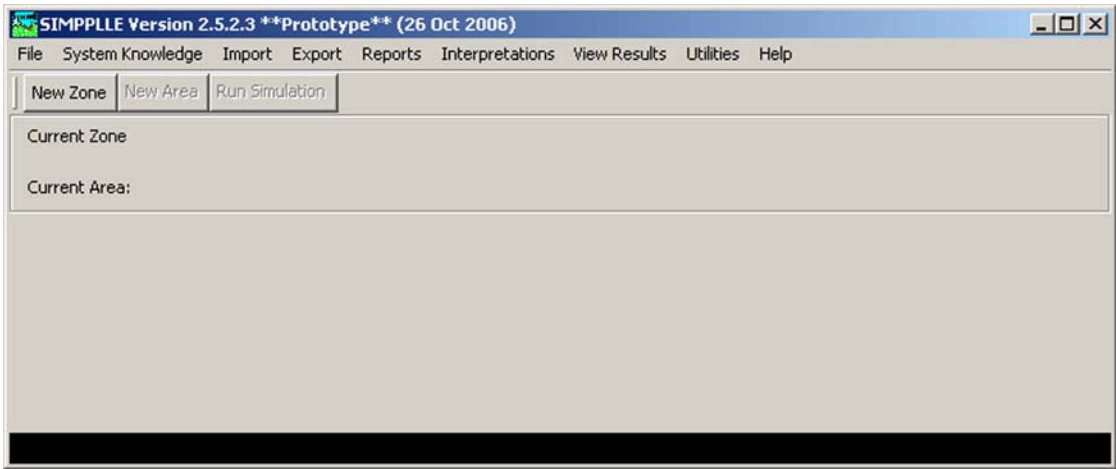


Figure 27 SIMPPLLE main screen before a Zone has been selected

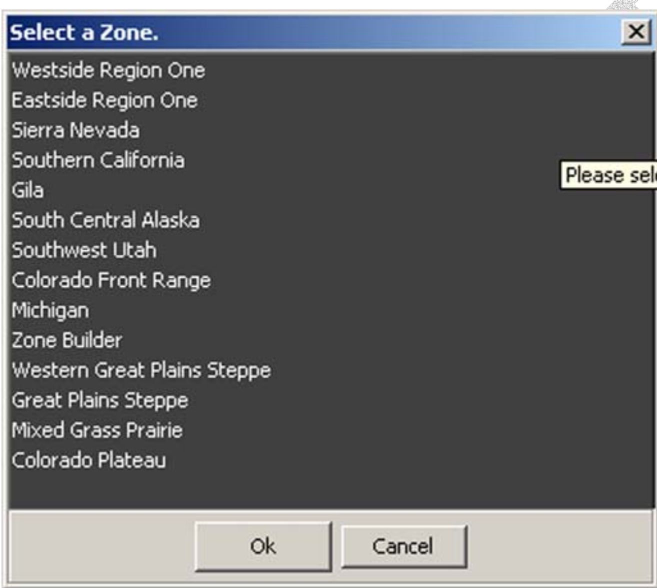


Figure 28 SIMPPLLE screen for selection of Zones.

After the zone is loaded its name is displayed on the screen as the “current zone” and the choice to load a “New Area” is enabled.

Load a Landscape

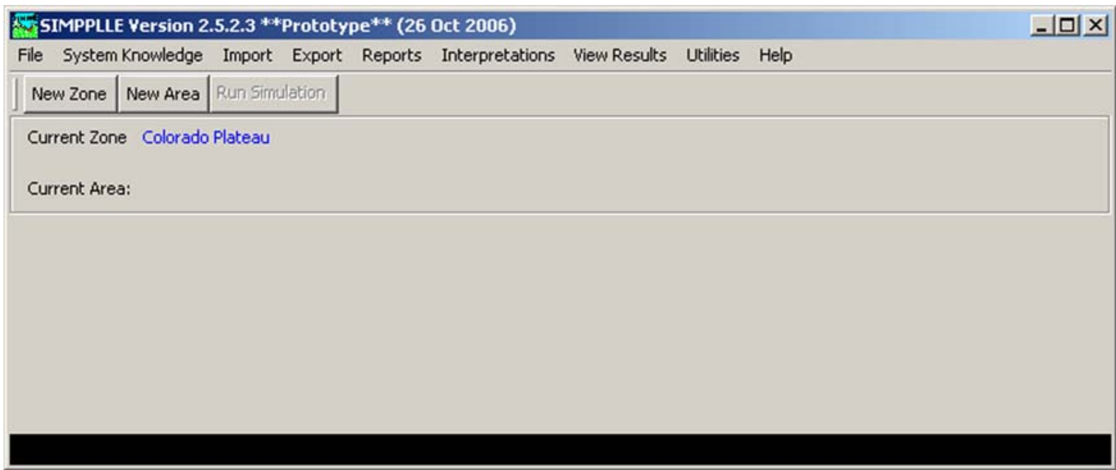


Figure 29 SIMPPLLE main screen with a Zone loaded and the choice to load a new area is available.

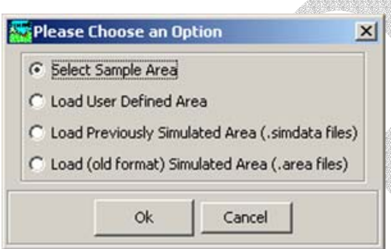


Figure 30 Different types of SIMPPLLE area files that can be loaded.

There are three choices a user can make. 1) Use the sample landscape that comes with the Zone, 2) load one you have created, or 3) you load a landscape file that contains the results of a previous simulation. Loading the saved file from a previous simulation can be used to create additional reports or GIS files that were not created at the time of the initial simulation. Or it can be used to create reports for a saved file from a set of multiple simulations (see section on overview of system output). All the landscape files are identified by an extension of "area". Landscape files that contain the results of a simulation and can be loaded as "previously simulated landscape" have the extension of *.simdata

Set Simulation Parameters

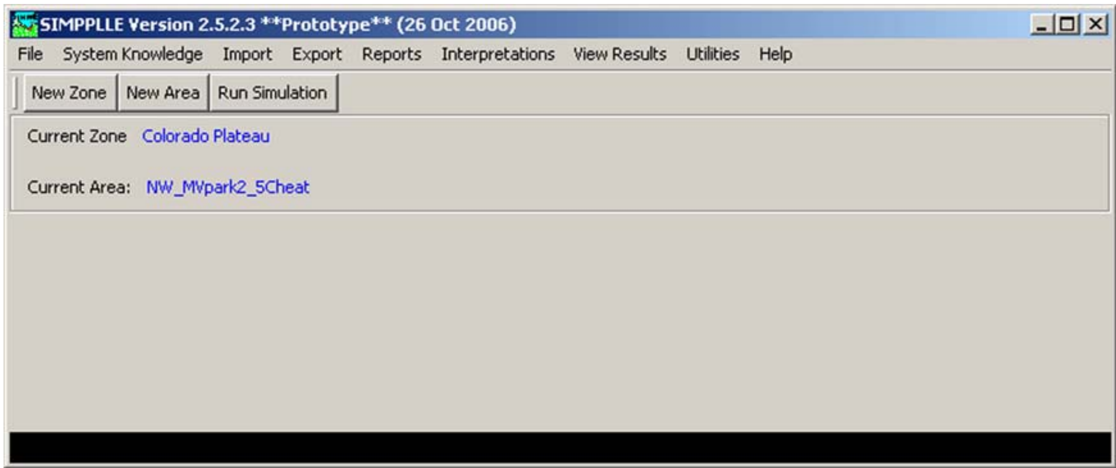


Figure 31 – SIMPPLLE main screen with both a Zone and Area loaded. The choice to "Run Simulation" is now available

There are a number of choices available within the Simulation Parameters screen.

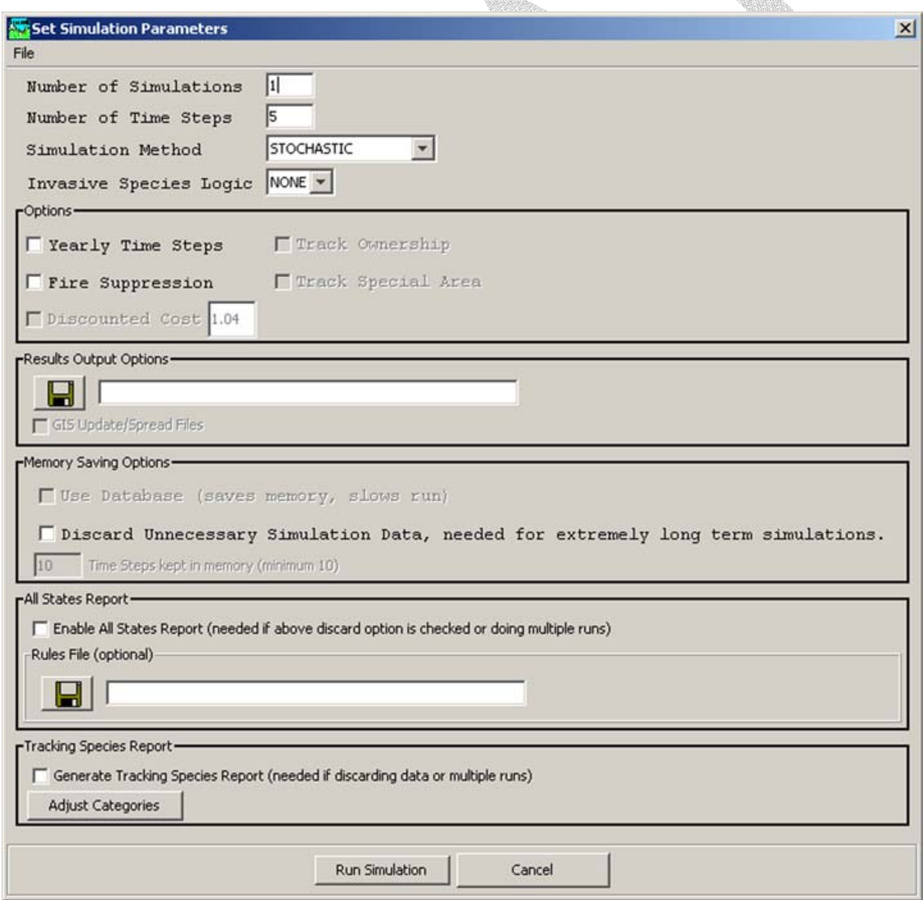


Figure 32 SIMPPLLE screen for the simulation parameters that can be changed by a user

The number of simulations can be set from one to one hundred. There is no limit on the number of time steps. The method of using process probabilities can be set to stochastic or highest probability or not used at all by changing to apply the succession process to all plant communities.

The choice for invasive species logic has to match the geographic area being used. At this time only the Colorado Plateau and the Eastside Region One have logic for predicting invasive species.

The time steps can be set as yearly or decade. The default is decade. The three grassland geographic areas have to use a yearly time step. There is no user choice.

The box next to fire suppression must be checked or no fire suppression logic is used. With fire suppression, the suppression costs can be discounted. The discount rate can be changed.

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 to "track" the attribute. For a single simulation no output files are automatically created and saved so no file names have to be entered. 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 checked the only GIS files generated for the multiple simulations will be those that provide the basis of making probability maps. The update files which show 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 to not check it, generating only the probability files. After an analysis of the multiple simulations a user can check 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 management options that are based on trying to keep SIMPPLLE's application to the type of PC's in common use at the field level in many organizations. The simulation results can be written to a database or old 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 has to be set to 20 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 have to be ran during the simulation. If simulation data is not discarded these reports can be ran after the simulations.

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

Run Simulation

After all parameters have been set click the left mouse button on "Run Simulation". A message for the projection of each time step as it simulated is displayed at the bottom of the screen. This also displays the amount of memory being used from what is available.

Figure 33 – SIMPPLLE screen displaying message that identifies as each time step as is projected and the amount of memory being used.

Once the simulation is completed a "finished simulation" screen is displayed and the user has to click on the "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 "interpretations" choices from the main menu (see output section). If no reports are desired, another simulation can be started by going back to the "Run Simulation" choice 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, using "Utilities", "Make Area Simulation Ready" will set the landscape to the end point to enable starting a simulation from those conditions. The last timestep disturbance process is also saved for each vegetation unit so the landscape is starting with a one time step history.

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 used in GIS displays two Excel macros. 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, to test ideas, to 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.

The following table summarizes what is currently available for outputs by the type of simulation.

	Single Simulation	Multiple Simulations no memory mgt choices	Multiple With database[1]	Multiple Discarding data
View Results – 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		Must specify at beginnin
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[3]		

*

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

[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 recreate these files later.

[3] These files are created automatically with multiple simulations. It is impossible to recreate these files later.

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 location C:\fsapps\fsother\SIMPPLLE\version2_5\excel created when SIMPPLLE is installed.

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. For example is the level of a disturbance process different between two or more management alternatives? A GTR on the use of this test is under development.

Many of the reports, interpretations, and GIS files for single simulations can be created at a future time if at the end of a single simulation the user decides to save the landscape from the file menu.

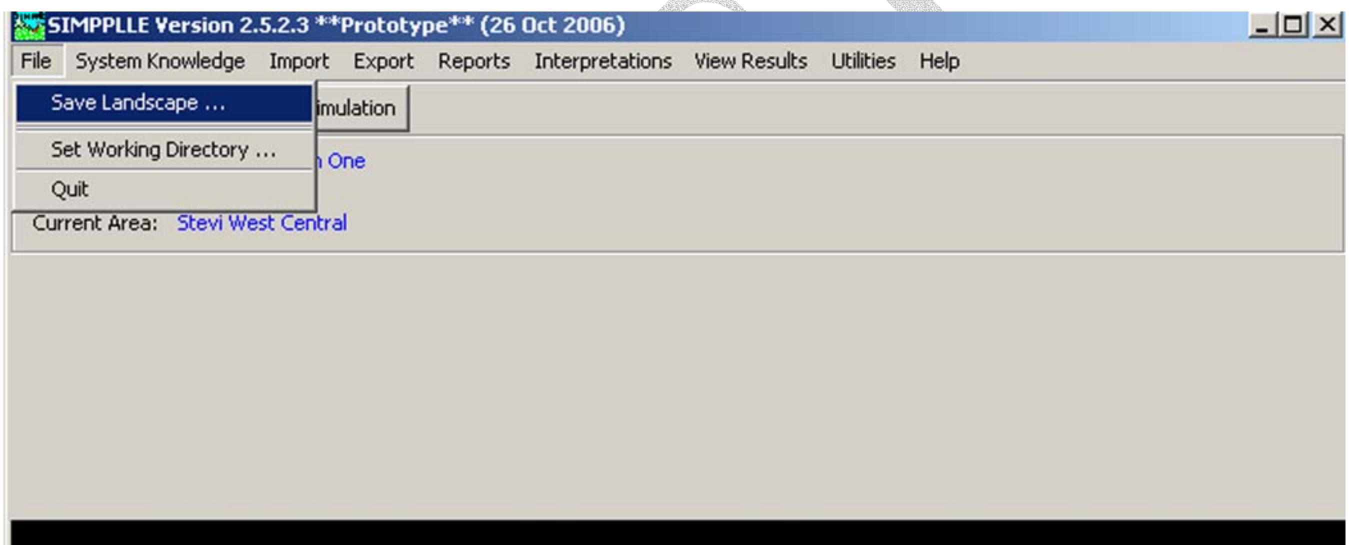


Figure 34 Main SIMPPLLE screen with the "save-landscape" choice made after a simulation to save the results for the option of future processing.

The "Save Landscape" choice saves the landscape file with all the changes by each plant community over the duration of the simulation. This saved file is what is loaded when a user makes the choice of "Load a Previously Simulated Area". Each of the simulations from a set of multiple simulations is automatically saved in a similar fashion. Each can be reloaded. However remember if the simulations were made with the discard simulation data option, there are limitations to what can be generated after reloading.

	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	-
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

GRAPHICAL USER INTERFACE - output

There are two options within the user interface for viewing the results of the simulations. One option looks at individual units. The second 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.

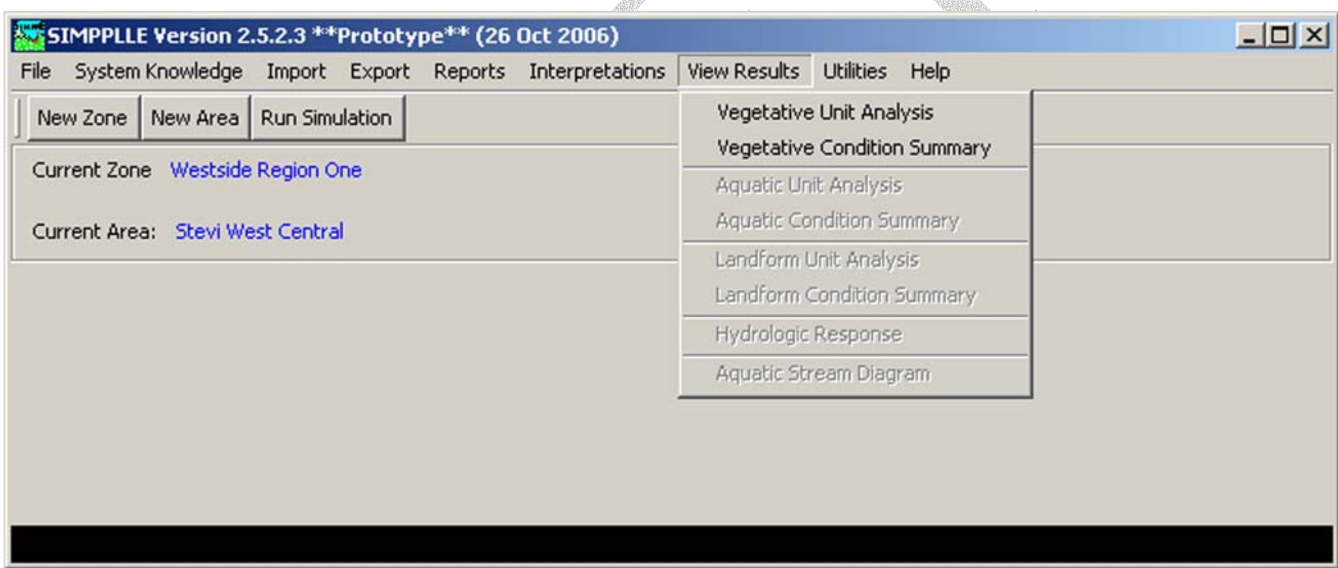


Figure 35 Main SIMPPLLE screen with the choices under "View Results" for looking at simulation output

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

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 habitat type group and the acres of the plant community. The neighboring plant communities are shown as the identifying number, its position relative to this unit, and if it is "downwind" or not according to the dominant wind direction associated with a weather front passage for this landscape. The history for the simulation is displayed by individual vegetative units showing the sequence of vegetation conditions and the disturbance processes.

The “Prev” and “Next” buttons can be used to move to other plant communities or the desired number of a plant community can be typed in. The vegetation units in the “adjacent units” can be “clicked on” and the interface will move to that unit.

The following figure shows the history for a 5 decade simulation. Since the time step was decade, seasons don’t occur and are represented by “Year”. Time 0 represents starting conditions. The data set was for a single lifeform representation of plant community 32 so “no classification” is used with lifeform. 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. But 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 this fire event being suppressed at the Class A level (less than .25 acres). 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.

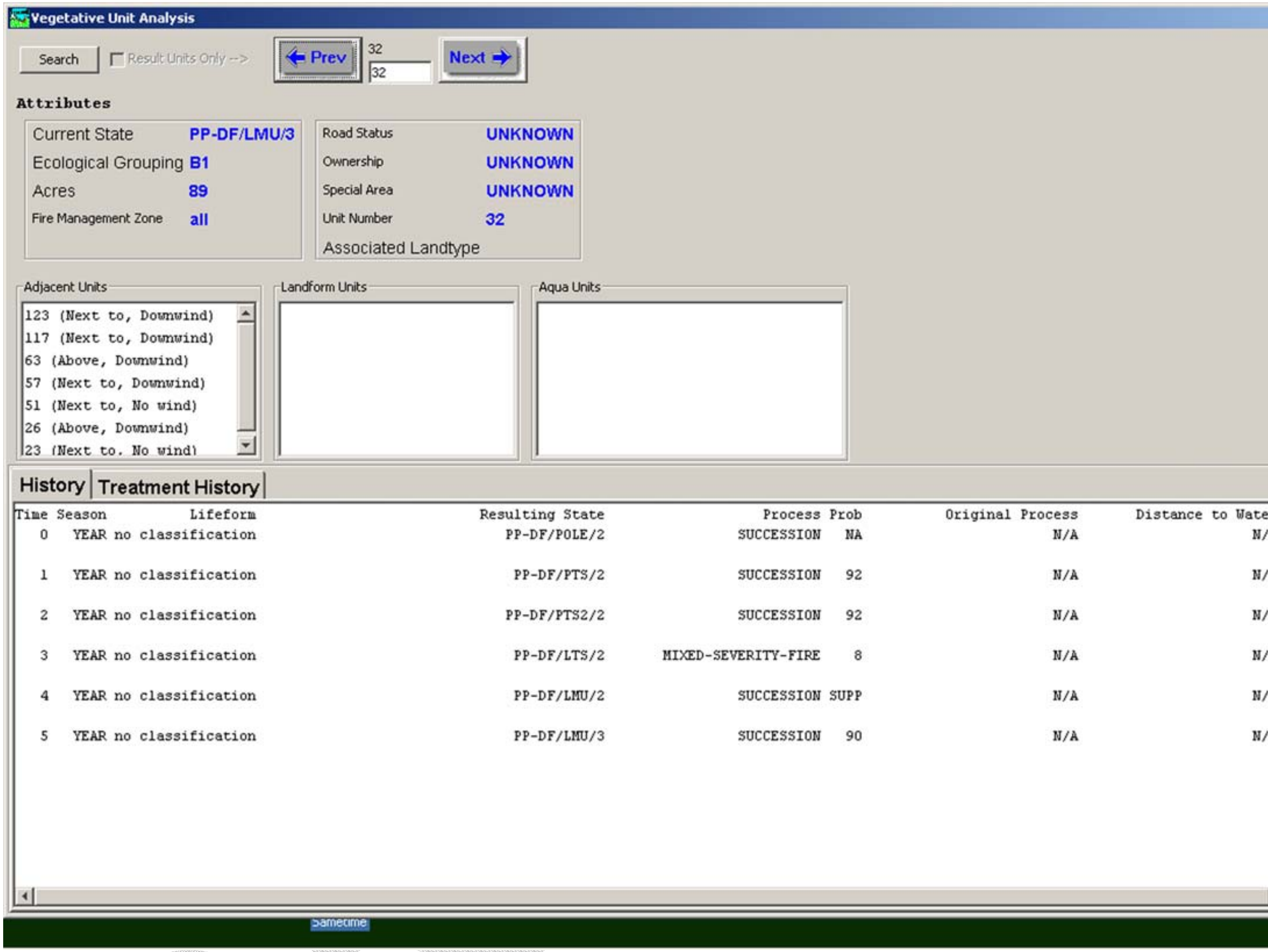


Figure 36 View Results screen for individual vegetative unit number 32 displaying the history of state changes for a simulation.

The values that may occur in the Prob column are:

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

There are additional fields to the right that are used depending on the mix of landscape components used.

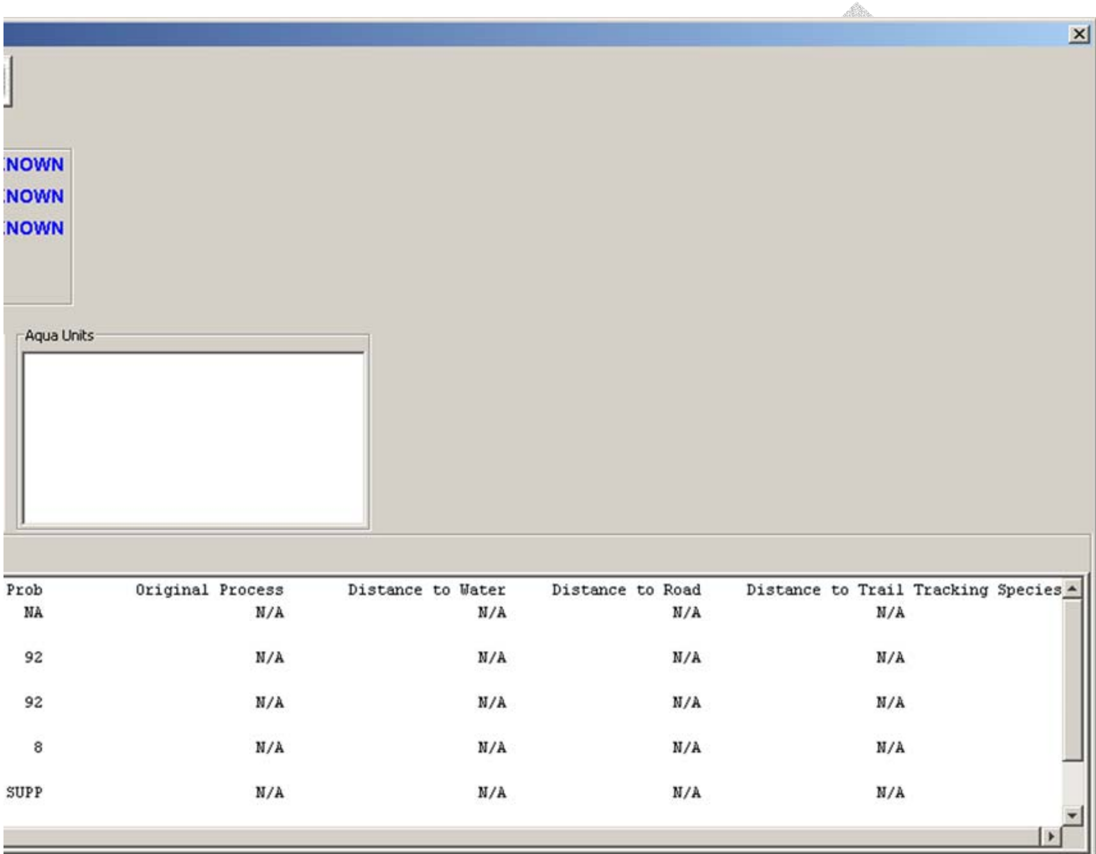


Figure 37 Individual vegetation unit display showing the fields distance to water, distance to road, distance to trail, and tracking species that may be used.

The below figure is from a landscape that is still represented by single lifeform, but yearly timesteps are made in which the season of the disturbance process is modeled. Tracking species is used.

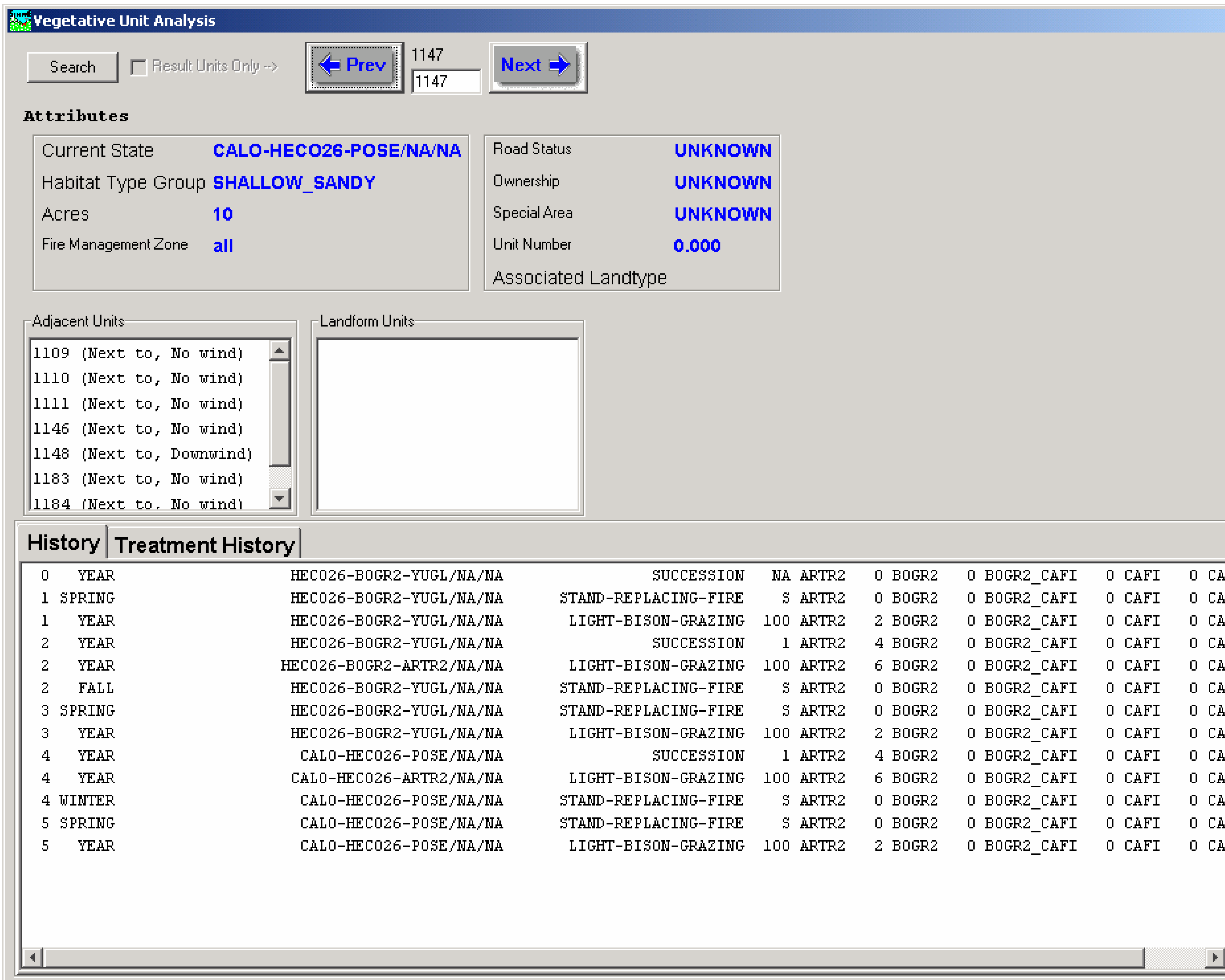


Figure 38 Individual vegetation unit display with processes occurring by seasons and tracking species utilized.

The following is still a single lifeform, but notice that a distance to water is displayed with a (P) indicating it is a "perennial" water source.

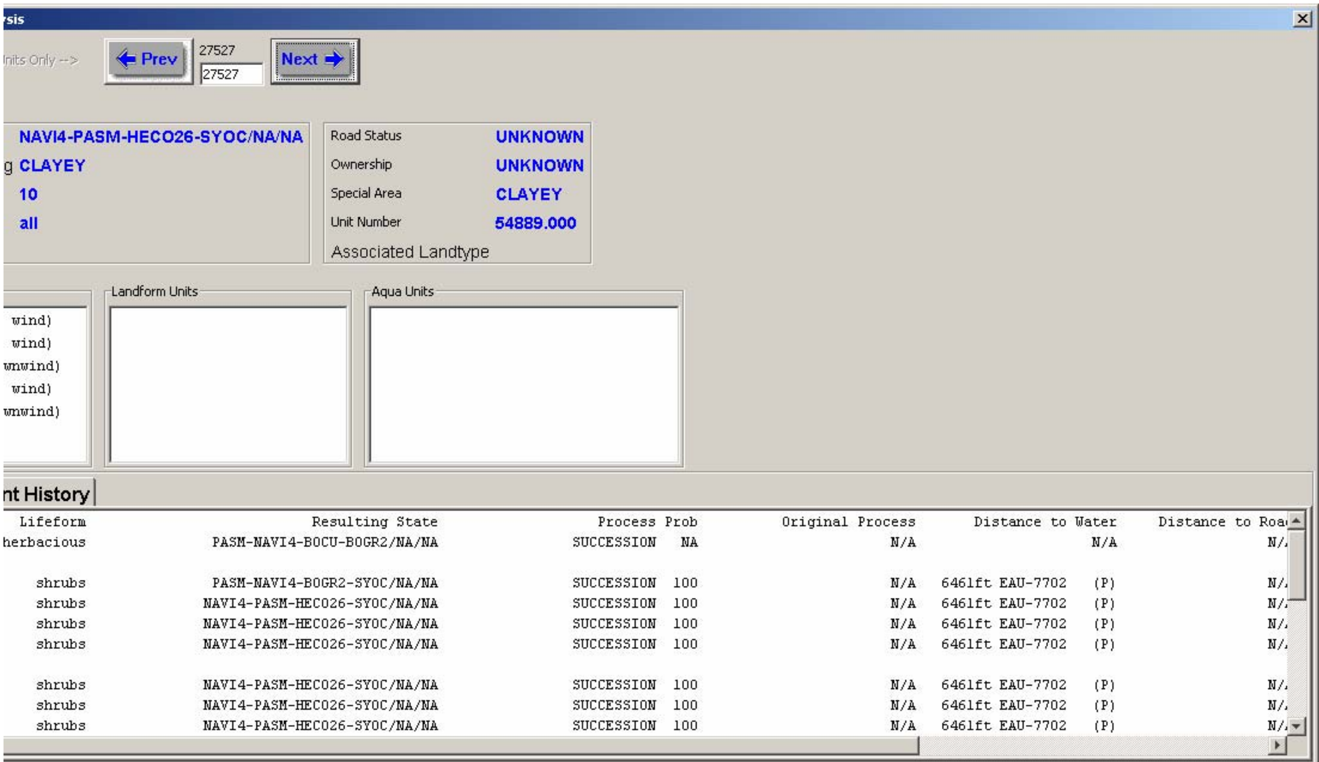


Figure 39 Individual vegetation unit display showing a distance and number to the aquatic unit that is the nearest perennial water source for each time step

A display for an aquatic unit is shown below.

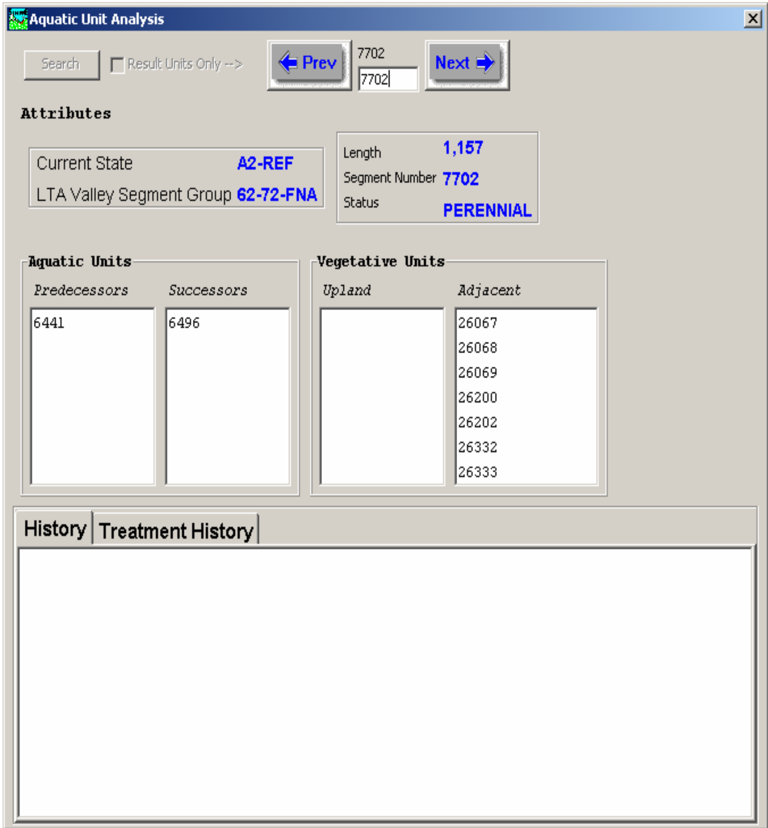


Figure 40 Display for an individual aquatic unit showing its status as Perennial.

Multiple lifeform

Notice in the below figure that shows just the initial time step – before any simulation is made, three lifeforms are used to represent the vegetation unit. The current state in the attributes section is the dominant lifeform only. Both land and aquatic units are represented in this landscape.

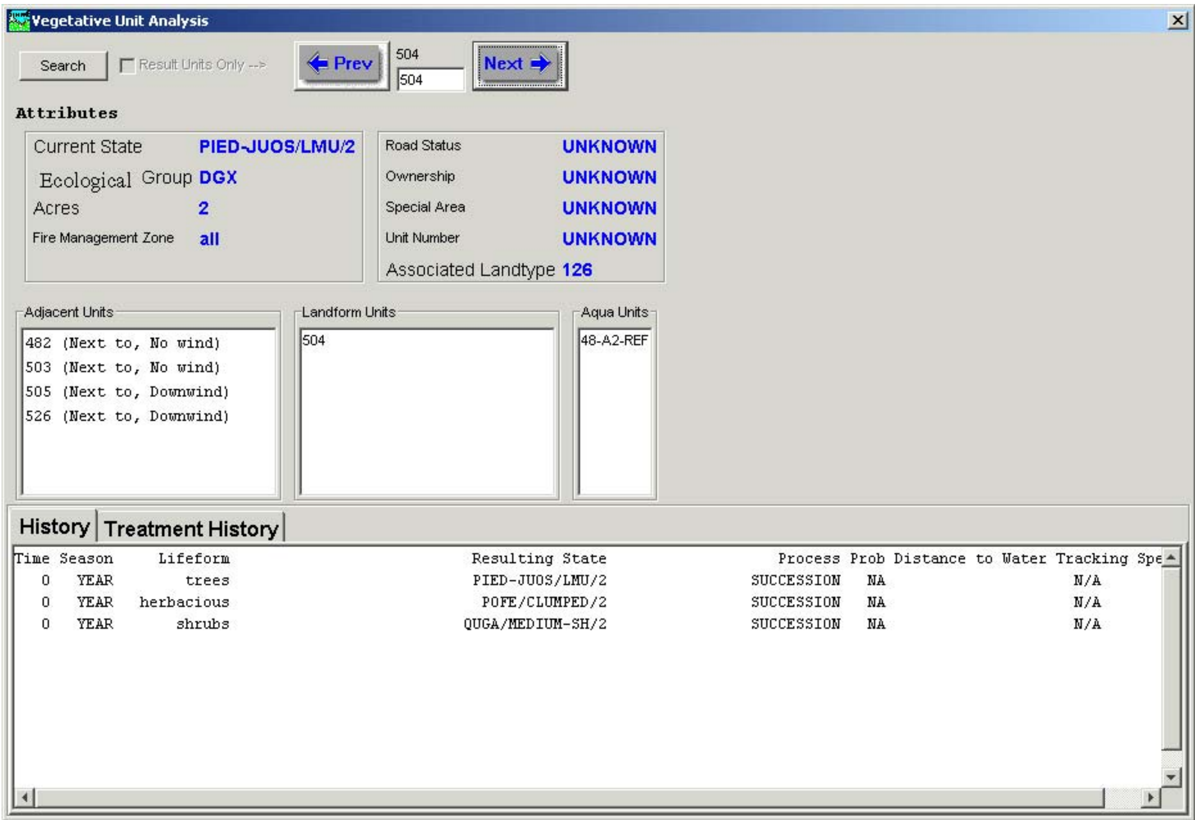


Figure 41 Individual vegetation unit display when vegetation is represented by multiple lifeforms and land units and aquatic units are part of the SIMPPLLE data set for the landscape.

By "clicking the mouse" on the land or aquatic units, the interface switches to the display for the selected unit. Neither of these units have any dynamic processes associated with them in this version of SIMPPLLE.

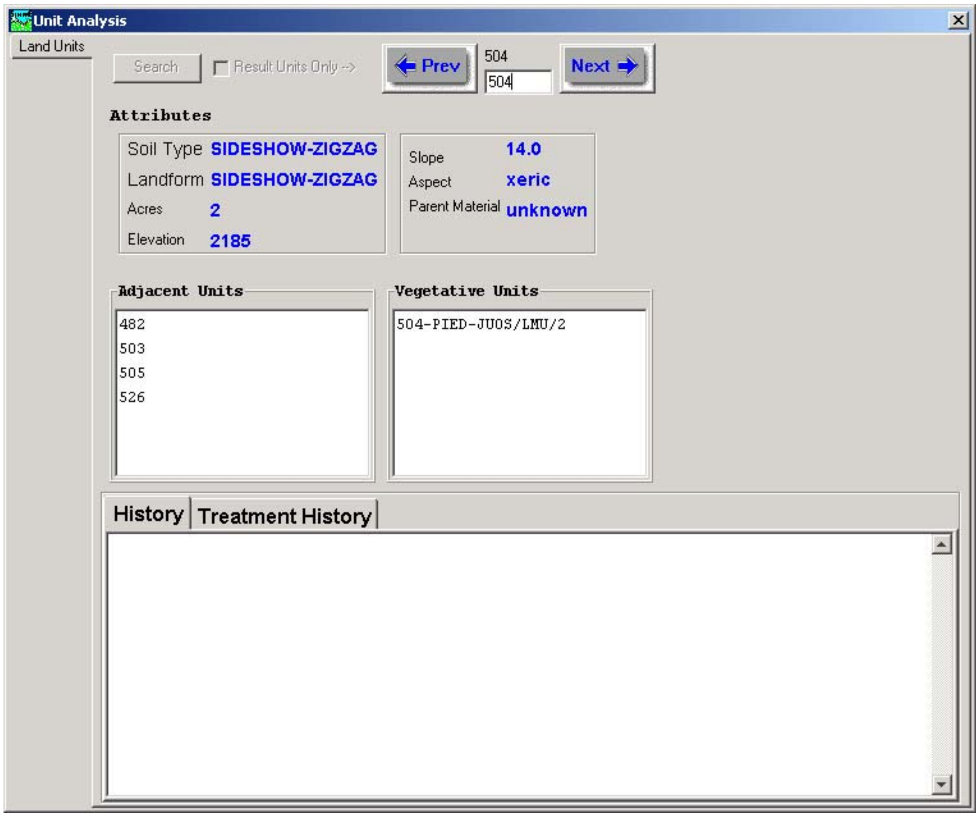


Figure 42 Display for an individual land unit showing its attributes and spatial relationship to other land and vegetation units.

In the following figure there is a change in the tree lifeform in timestep one, changing from large, multi-storied, density 3 to a single story at density 1. The disturbance process was succession.

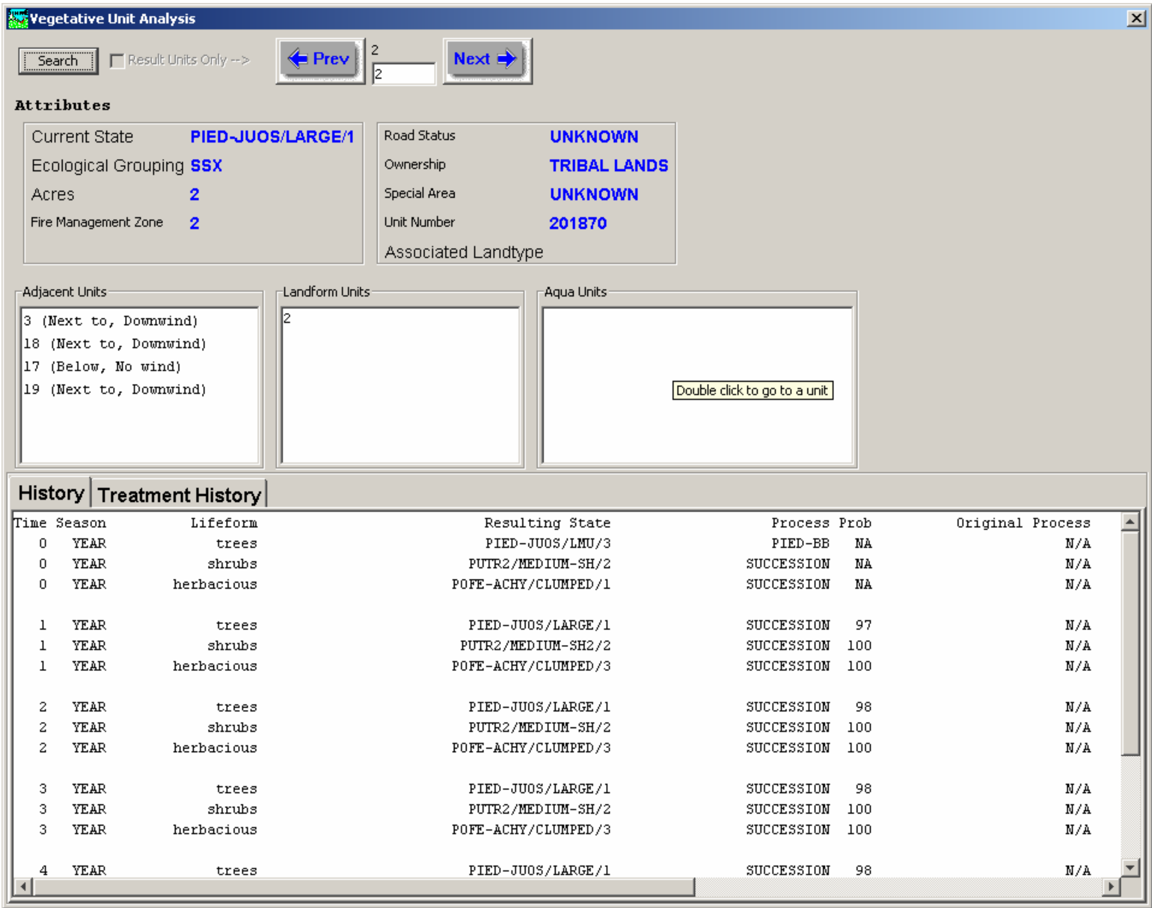


Figure 43 Display for an individual vegetation unit that shows only the tree life form has a disturbance in time step one.

If the “treatment history” tab is selected the follow screen is displayed. This shows in timestep one a mechanical thinning was applied and the change it made.

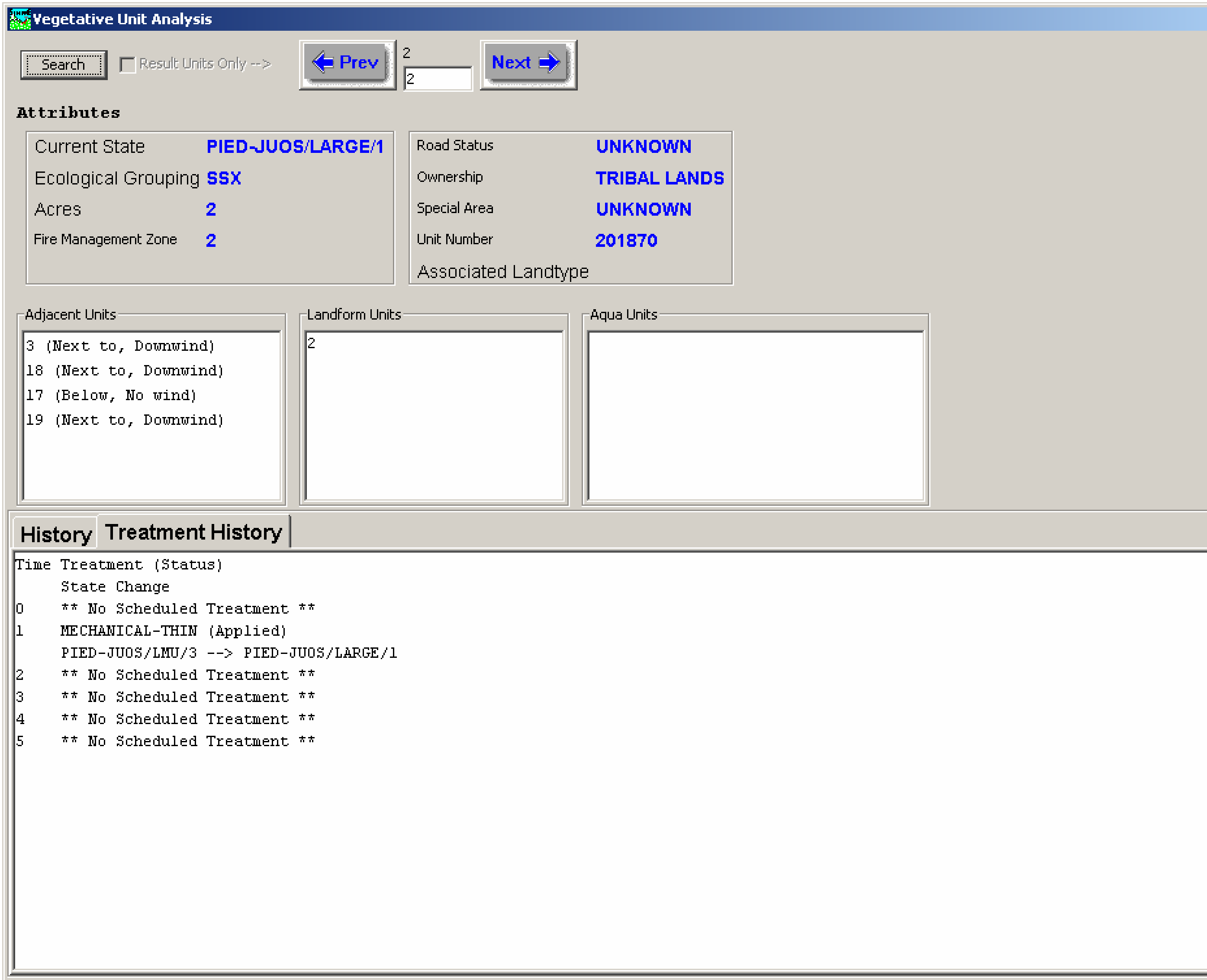


Figure 44 The individual vegetation unit display showing treatment history for an individual unit. Mechanical thinning was applied in time step one and it changed the size class and density.

A useful feature of the individual vegetation unit analysis is the “search” capabilities. By selecting the “search” button in the upper left corner of the analysis screen the following screen is available.

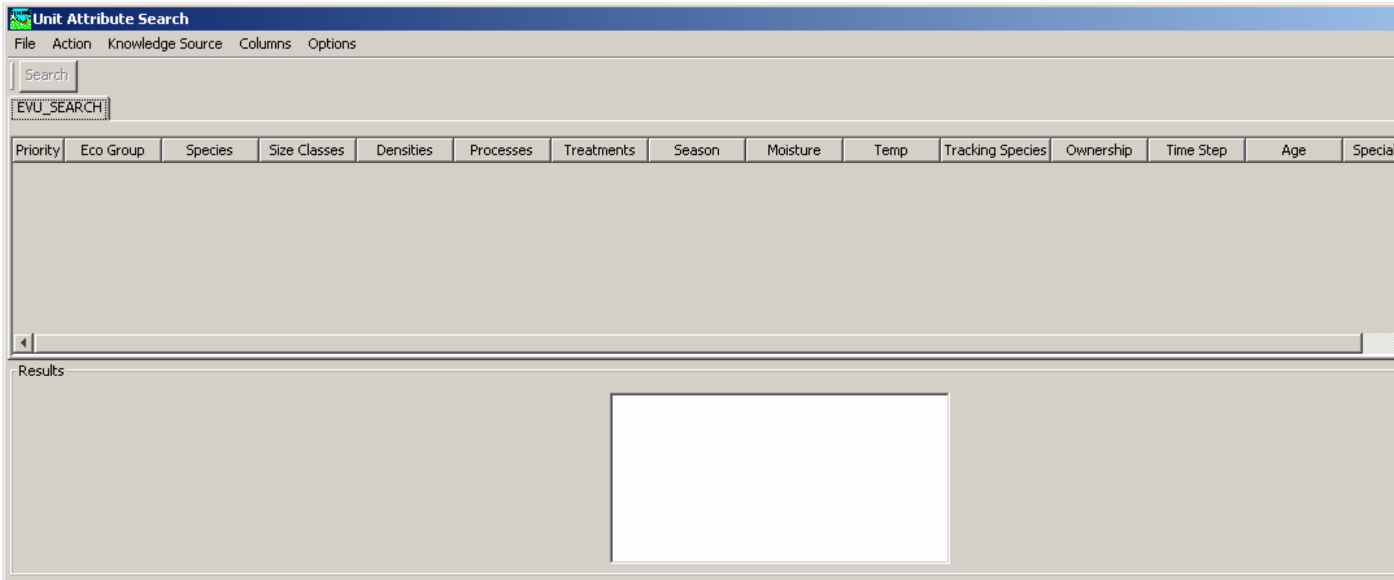


Figure 45 The blank search screen that can be used to find vegetation units that meet the conditions specified in logic rules.

This screen allows one to create logic that can be used to search for vegetation units that meet the requirements. The columns available to use in the logic are the basic set available to use throughout the system for all other logic screens. The following shows a search done for the occurrence of stand-replacing fire in timestep two. The result was 321 acres. The “window” lists all units that met the criteria. Clicking on any of the units will move the screen to the units display.

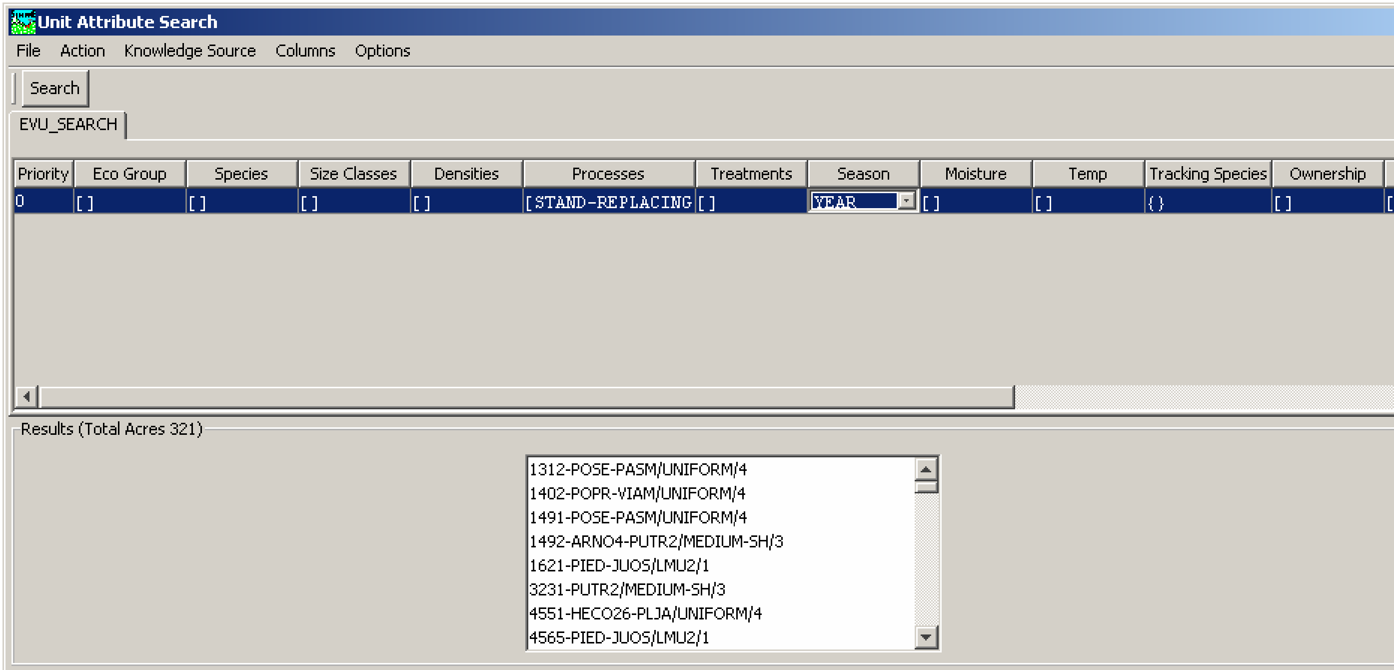


Figure 46 Results from searching the simulation for the conditions in the selected rule.

The choice under options allows a user to build a treatment schedule or lock in process schedule from the units that were selected.

If one double clicks with the mouse on a unit with the results window, the individual unit screen will open to that unit. There is a 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.

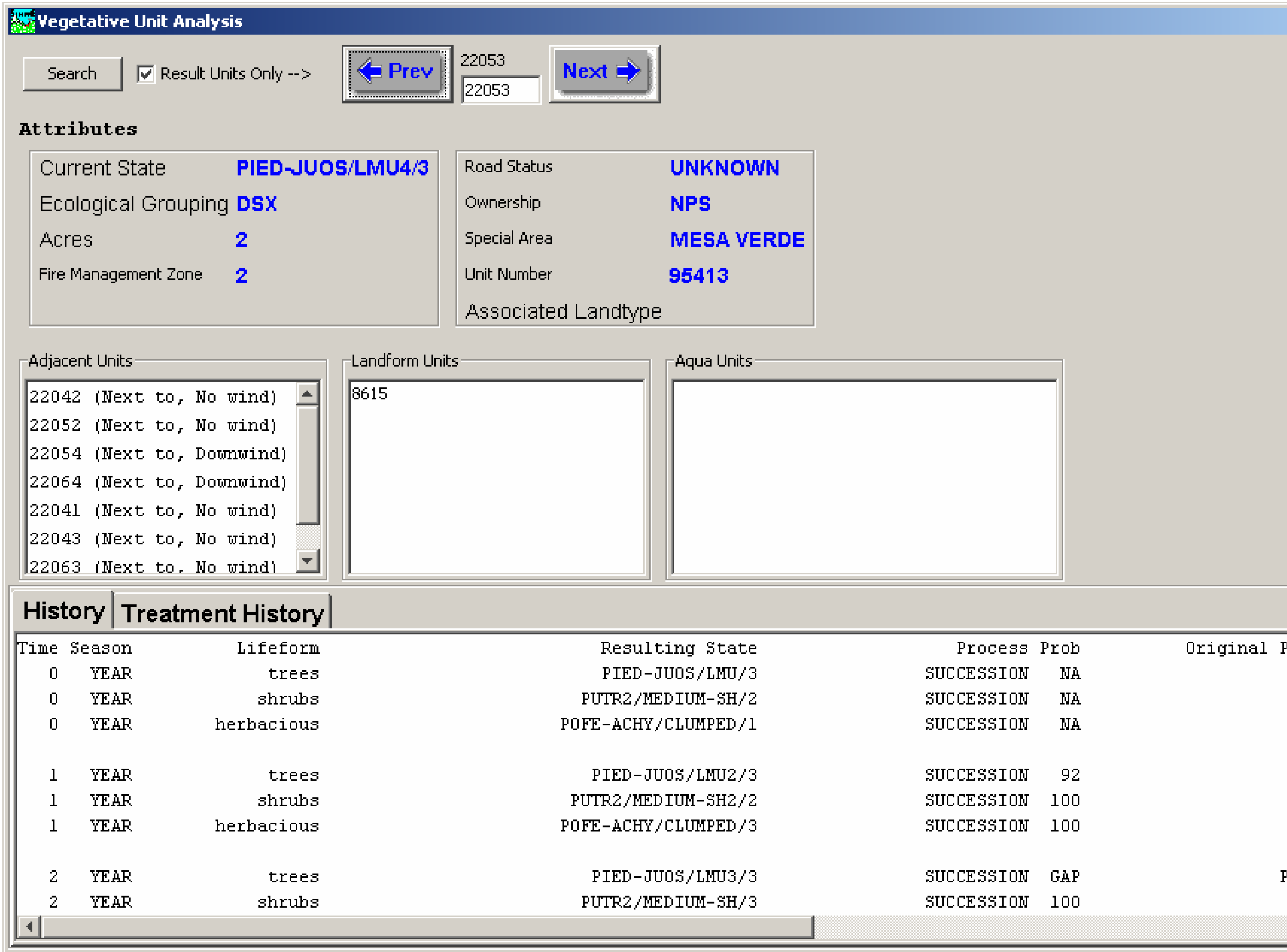
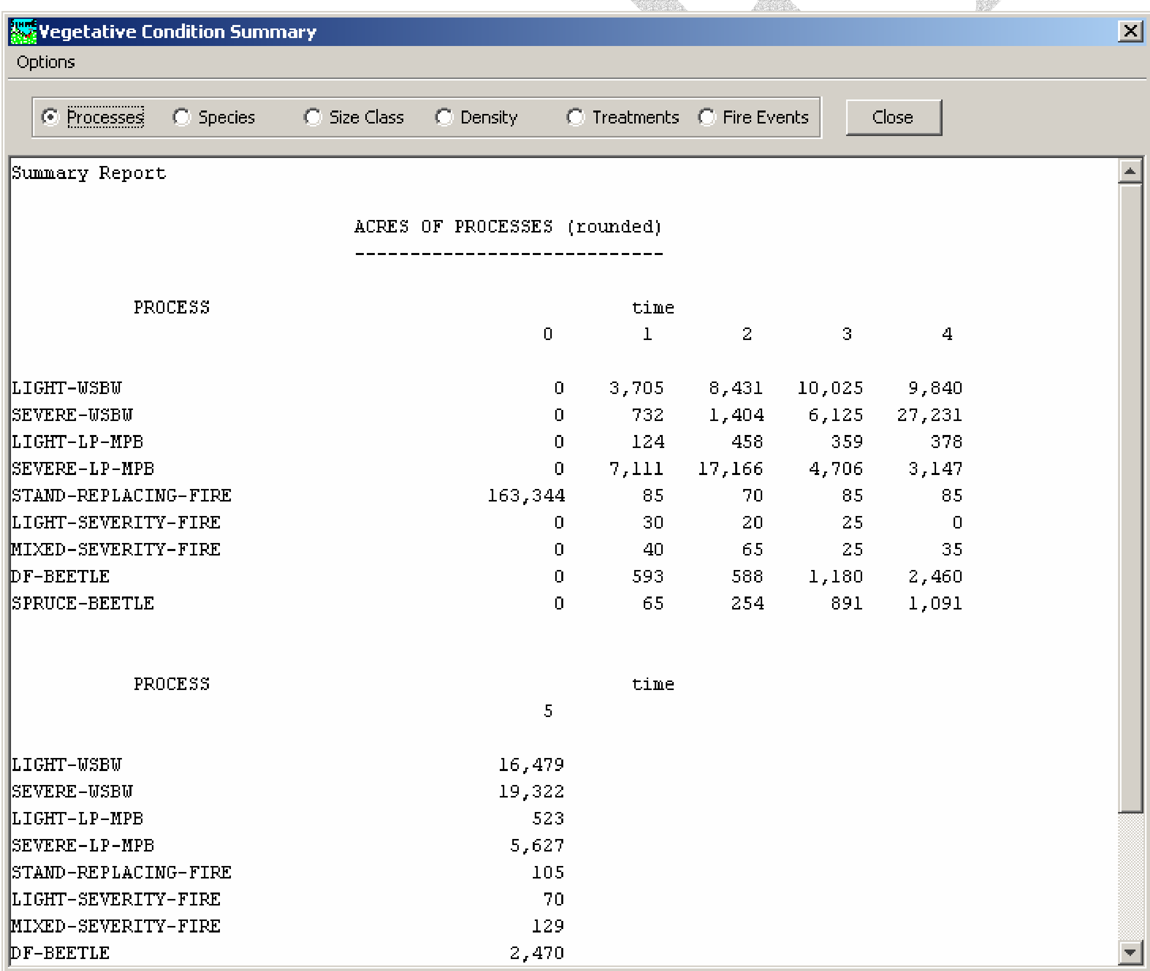


Figure 47 Display the check in the "Result Units Only" box in the upper right next to the Search tab that allows the "prev" and "next" buttons to move through the selected set of units.

Single Simulation – Vegetation Condition Summary

The conditions for the entire landscape are displayed in the vegetation condition summary. Acres of disturbance processes, each of the vegetation attributes of species, size class and density; and treatments are given. A break down of the acres of fire is given by their distribution in fire event sizes.

Time step zero 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 timestep 0, of succession. In the below summary, 163,344 acres of stand replacing fire occurred in the past decade and was entered into the GIS layer for this landscape. The acres of disturbance processes are only for the dominant lifeform if the landscape file is described using multiple lifeforms.



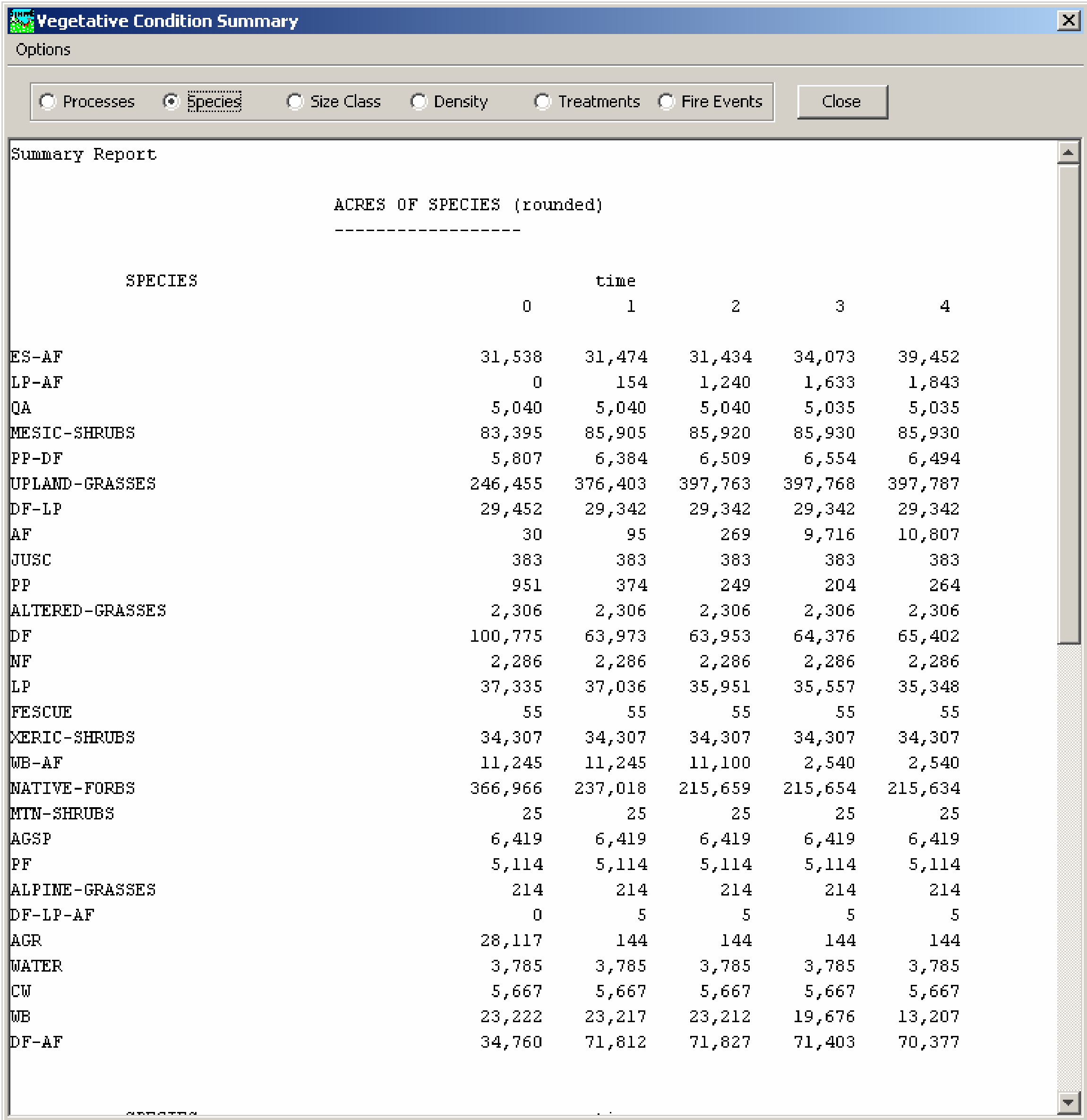
Summary Report

ACRES OF PROCESSES (rounded)

PROCESS	time 0	1	2	3	4
LIGHT-WSBW	0	3,705	8,431	10,025	9,840
SEVERE-WSBW	0	732	1,404	6,125	27,231
LIGHT-LP-MPB	0	124	458	359	378
SEVERE-LP-MPB	0	7,111	17,166	4,706	3,147
STAND-REPLACING-FIRE	163,344	85	70	85	85
LIGHT-SEVERITY-FIRE	0	30	20	25	0
MIXED-SEVERITY-FIRE	0	40	65	25	35
DF-BEETLE	0	593	588	1,180	2,460
SPRUCE-BEETLE	0	65	254	891	1,091

PROCESS	time 5
LIGHT-WSBW	16,479
SEVERE-WSBW	19,322
LIGHT-LP-MPB	523
SEVERE-LP-MPB	5,627
STAND-REPLACING-FIRE	105
LIGHT-SEVERITY-FIRE	70
MIXED-SEVERITY-FIRE	129
DF-BEETLE	2,470

Figure 48 Vegetation Condition Summary for a single simulation displaying the acres of each process by time step



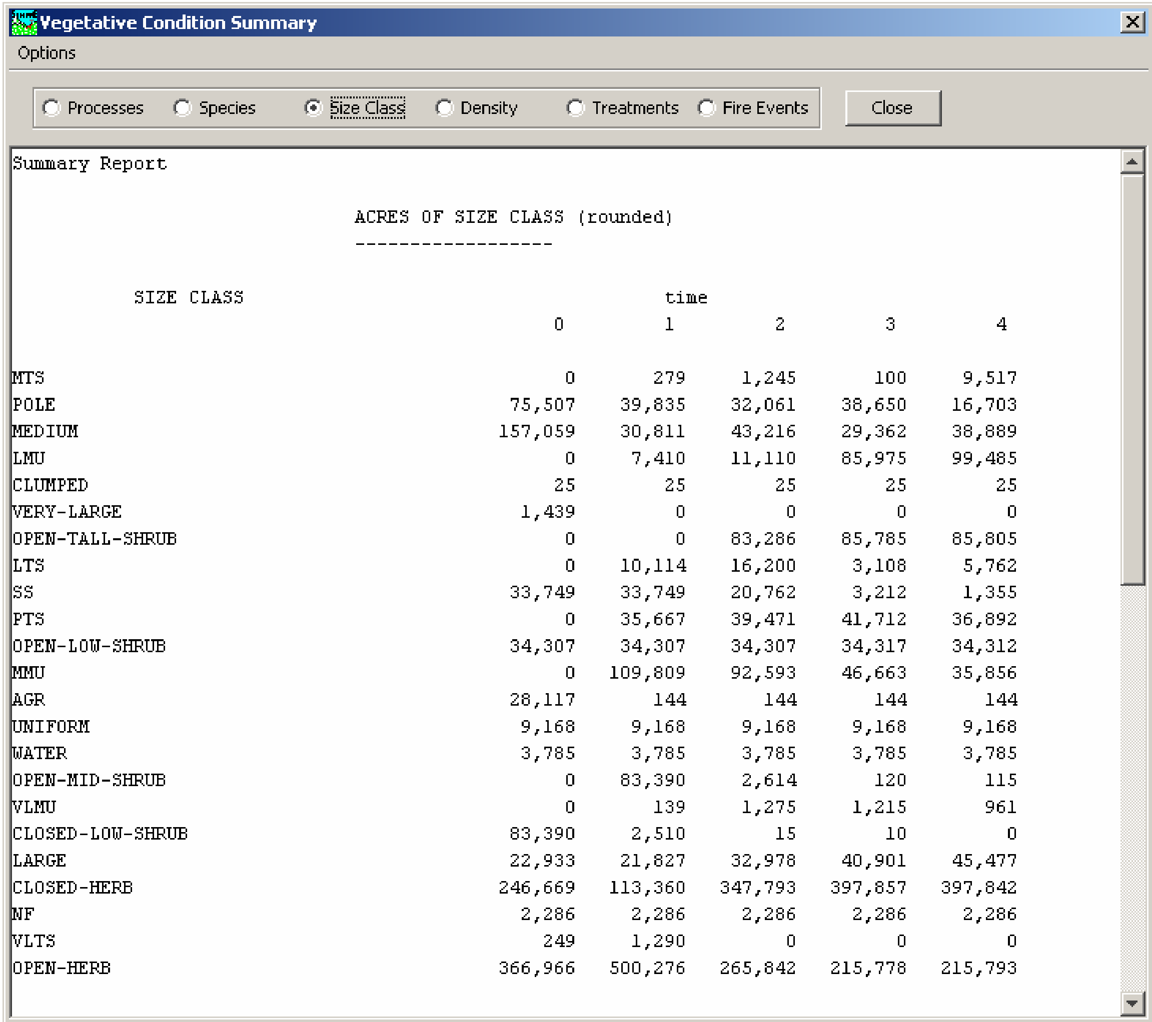
Summary Report

ACRES OF SPECIES (rounded)

SPECIES	time 0	1	2	3	4
ES-AF	31,538	31,474	31,434	34,073	39,452
LP-AF	0	154	1,240	1,633	1,843
QA	5,040	5,040	5,040	5,035	5,035
MESIC-SHRUBS	83,395	85,905	85,920	85,930	85,930
PP-DF	5,807	6,384	6,509	6,554	6,494
UPLAND-GRASSES	246,455	376,403	397,763	397,768	397,787
DF-LP	29,452	29,342	29,342	29,342	29,342
AF	30	95	269	9,716	10,807
JUSC	383	383	383	383	383
PP	951	374	249	204	264
ALTERED-GRASSES	2,306	2,306	2,306	2,306	2,306
DF	100,775	63,973	63,953	64,376	65,402
NF	2,286	2,286	2,286	2,286	2,286
LP	37,335	37,036	35,951	35,557	35,348
FESCUE	55	55	55	55	55
XERIC-SHRUBS	34,307	34,307	34,307	34,307	34,307
WB-AF	11,245	11,245	11,100	2,540	2,540
NATIVE-FORBS	366,966	237,018	215,659	215,654	215,634
MTN-SHRUBS	25	25	25	25	25
AGSP	6,419	6,419	6,419	6,419	6,419
PF	5,114	5,114	5,114	5,114	5,114
ALPINE-GRASSES	214	214	214	214	214
DF-LP-AF	0	5	5	5	5
AGR	28,117	144	144	144	144
WATER	3,785	3,785	3,785	3,785	3,785
CW	5,667	5,667	5,667	5,667	5,667
WB	23,222	23,217	23,212	19,676	13,207
DF-AF	34,760	71,812	71,827	71,403	70,377

Figure 49 Vegetation Condition Summary for a single simulation displaying the acres of each species by time step

If single lifeforms 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 lifeforms 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.



Summary Report

ACRES OF SIZE CLASS (rounded)

SIZE CLASS	time 0	1	2	3	4
MTS	0	279	1,245	100	9,517
POLE	75,507	39,835	32,061	38,650	16,703
MEDIUM	157,059	30,811	43,216	29,362	38,889
LMU	0	7,410	11,110	85,975	99,485
CLUMPED	25	25	25	25	25
VERY-LARGE	1,439	0	0	0	0
OPEN-TALL-SHRUB	0	0	83,286	85,785	85,805
LTS	0	10,114	16,200	3,108	5,762
SS	33,749	33,749	20,762	3,212	1,355
PTS	0	35,667	39,471	41,712	36,892
OPEN-LOW-SHRUB	34,307	34,307	34,307	34,317	34,312
MMU	0	109,809	92,593	46,663	35,856
AGR	28,117	144	144	144	144
UNIFORM	9,168	9,168	9,168	9,168	9,168
WATER	3,785	3,785	3,785	3,785	3,785
OPEN-MID-SHRUB	0	83,390	2,614	120	115
VLMU	0	139	1,275	1,215	961
CLOSED-LOW-SHRUB	83,390	2,510	15	10	0
LARGE	22,933	21,827	32,978	40,901	45,477
CLOSED-HERB	246,669	113,360	347,793	397,857	397,842
NF	2,286	2,286	2,286	2,286	2,286
VLTS	249	1,290	0	0	0
OPEN-HERB	366,966	500,276	265,842	215,778	215,793

Figure 50 Vegetation Condition Summary for a single simulation displaying the acres of each size class by time step

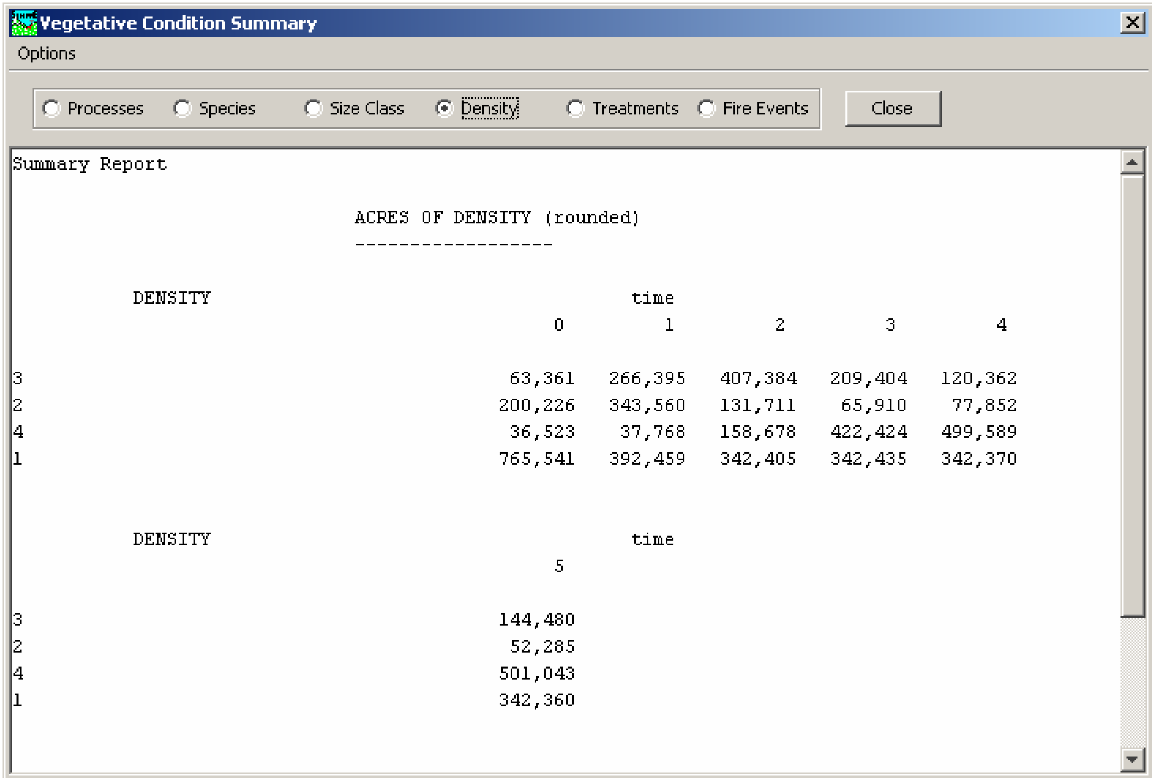


Figure 51 Vegetation Condition Summary for a single simulation displaying the acres of each density class by time step

Acres of treatments scheduled by time step can be displayed. If any scheduled treatments are infeasible because of 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 timestep in which the treatment is scheduled for. Latter sections on treatments will address the logic for treatment feasibility.

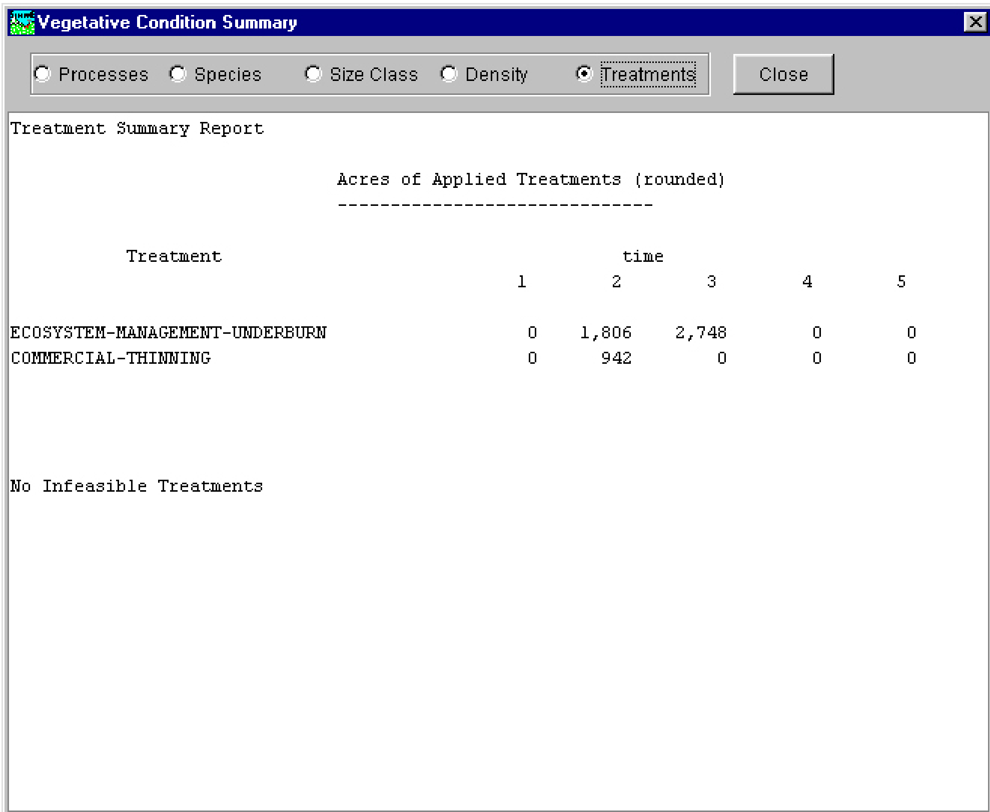
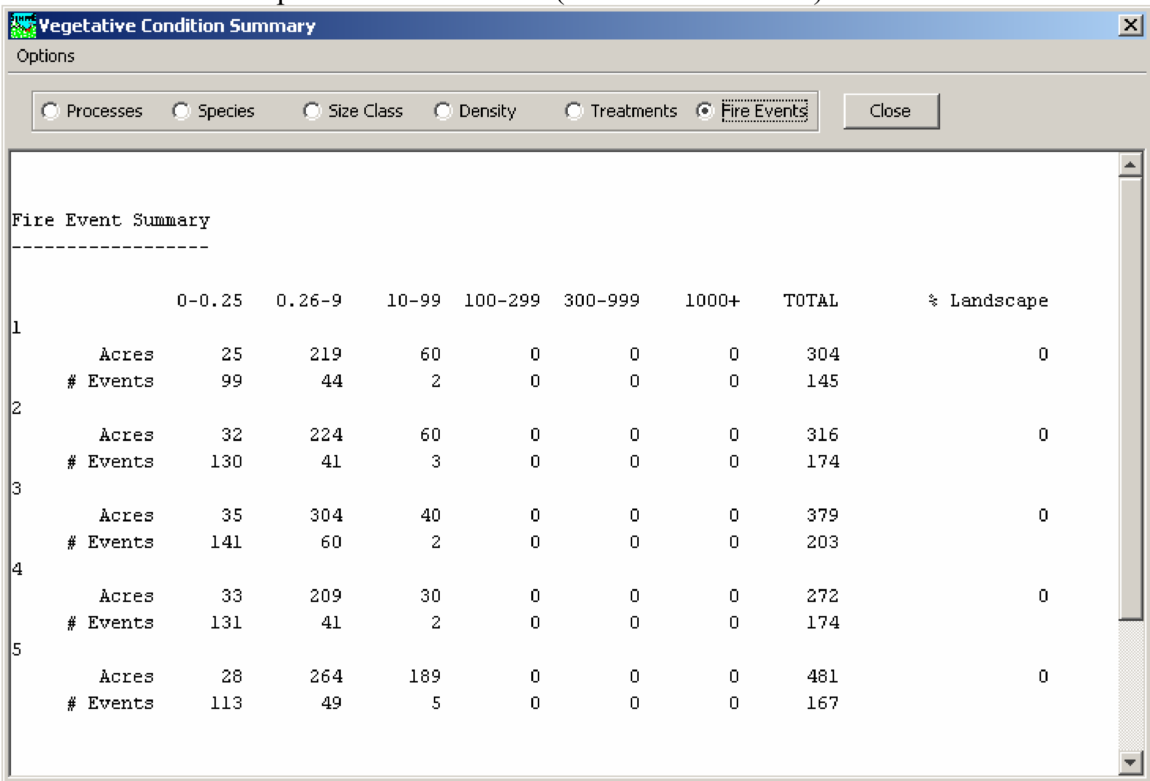


Figure 52 Vegetation Condition Summary for a single simulation displaying the acres of each treatment applied by time step

The single simulation was made with fire suppression so there is a significant number of fire events that are kept at the Class A size (less than 0.25 acres)



Fire Event Summary

		0-0.25	0.26-9	10-99	100-299	300-999	1000+	TOTAL	% Landscape
1									
	Acres	25	219	60	0	0	0	304	0
	# Events	99	44	2	0	0	0	145	
2									
	Acres	32	224	60	0	0	0	316	0
	# Events	130	41	3	0	0	0	174	
3									
	Acres	35	304	40	0	0	0	379	0
	# Events	141	60	2	0	0	0	203	
4									
	Acres	33	209	30	0	0	0	272	0
	# Events	131	41	2	0	0	0	174	
5									
	Acres	28	264	189	0	0	0	481	0
	# Events	113	49	5	0	0	0	167	

Figure 53 The display for Fire Events that shows the number and acres of fire by fire size class. Total are given for each time step as well as the percent of the landscape burned.

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

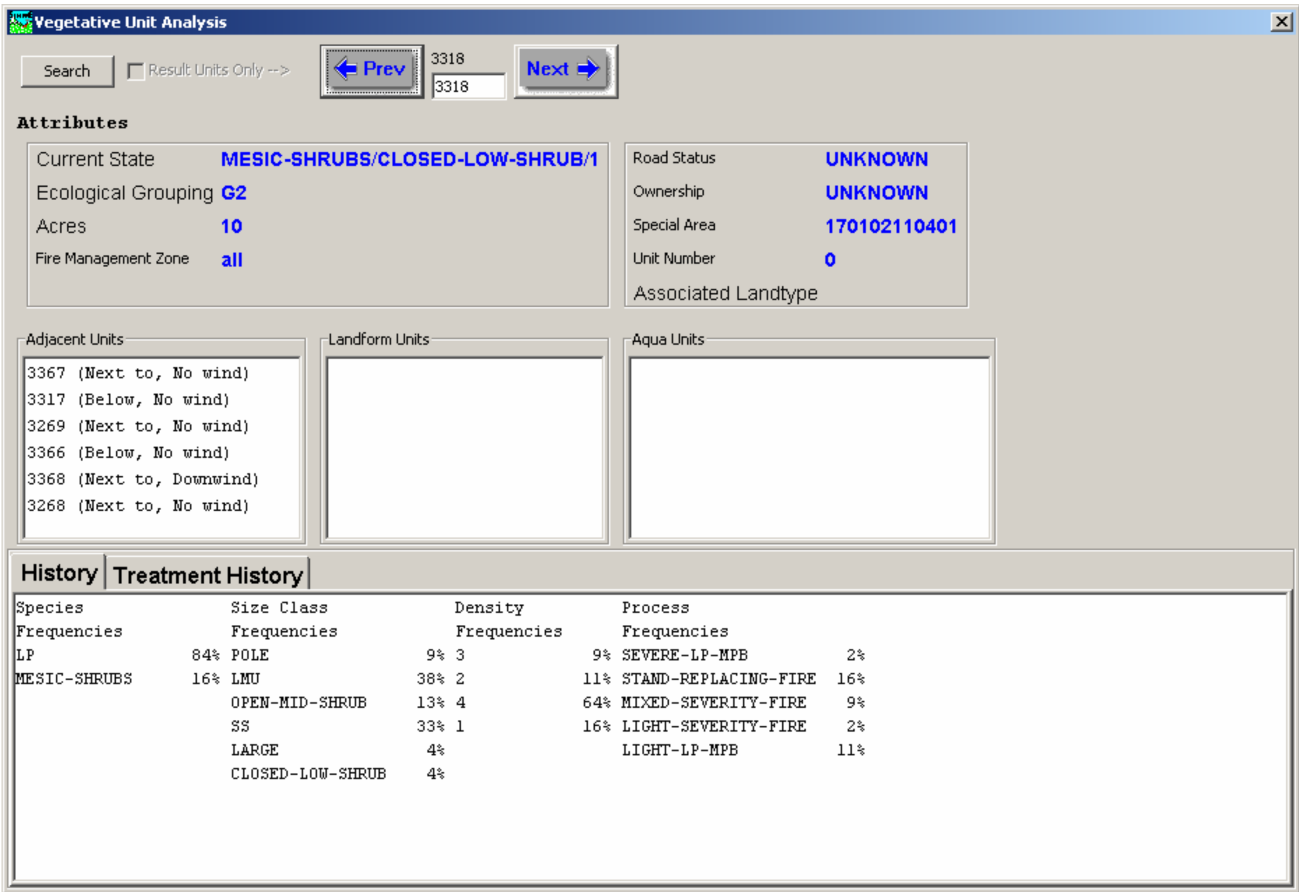
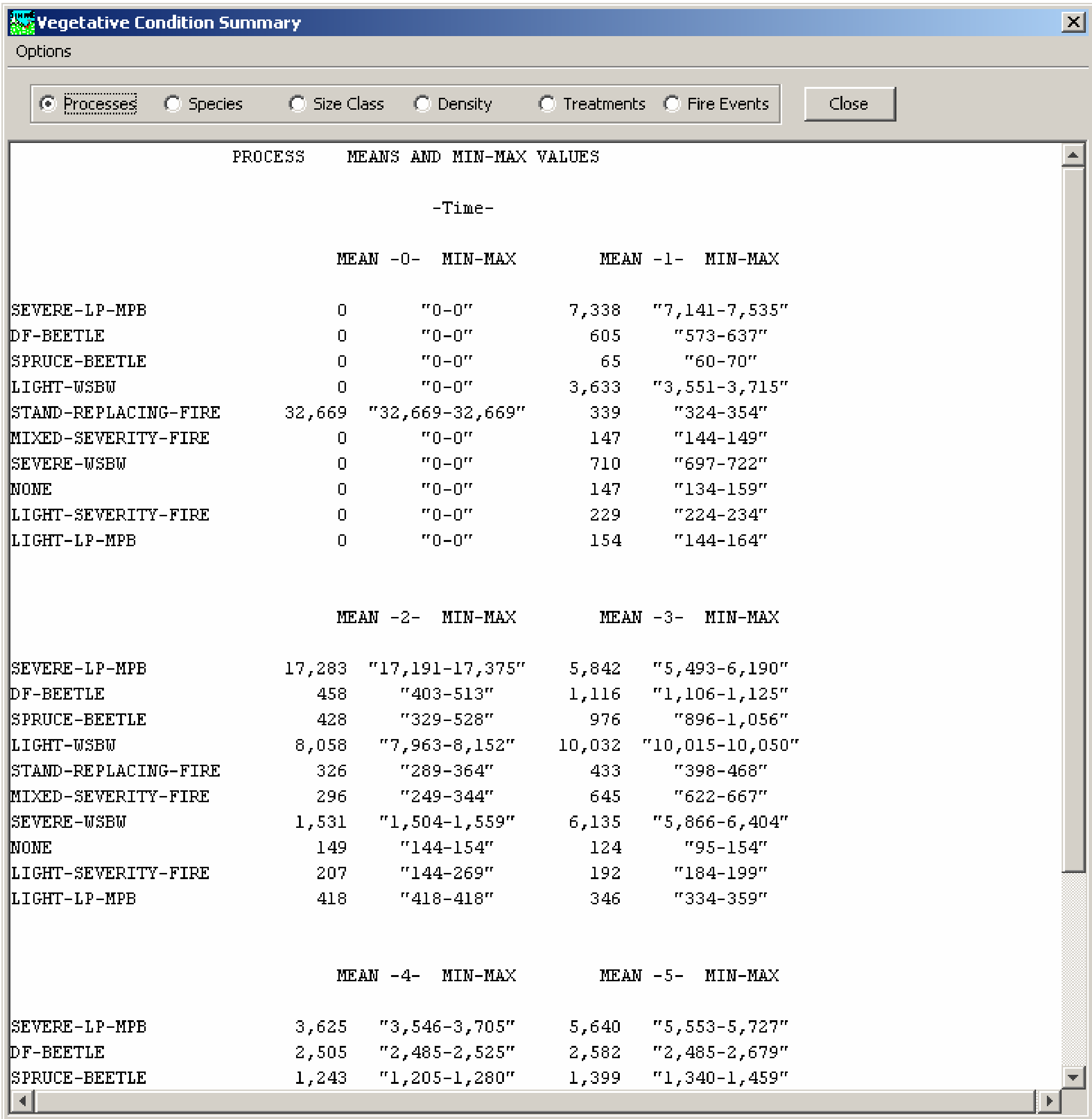


Figure 54 Individual vegetative unit display for a multiple simulation. Display shows the frequency of each attribute Individual vegetative unit display for a multiple simulation. Display shows the frequency of each attribute

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 value is also provided.



PROCESS MEANS AND MIN-MAX VALUES

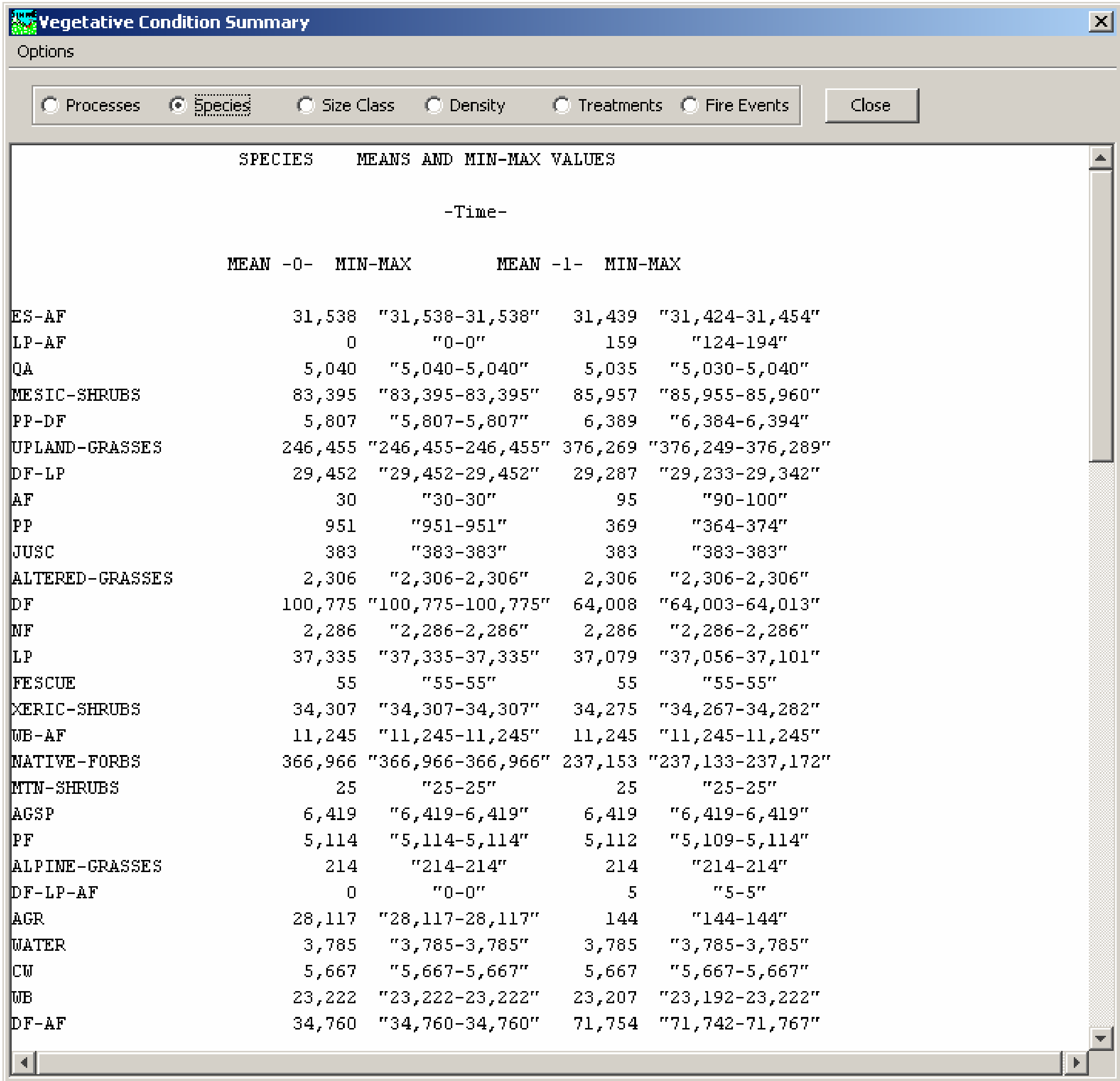
-Time-

	MEAN -0-	MIN-MAX	MEAN -1-	MIN-MAX
SEVERE-LP-MPB	0	"0-0"	7,338	"7,141-7,535"
DF-BEETLE	0	"0-0"	605	"573-637"
SPRUCE-BEETLE	0	"0-0"	65	"60-70"
LIGHT-WSBW	0	"0-0"	3,633	"3,551-3,715"
STAND-REPLACING-FIRE	32,669	"32,669-32,669"	339	"324-354"
MIXED-SEVERITY-FIRE	0	"0-0"	147	"144-149"
SEVERE-WSBW	0	"0-0"	710	"697-722"
NONE	0	"0-0"	147	"134-159"
LIGHT-SEVERITY-FIRE	0	"0-0"	229	"224-234"
LIGHT-LP-MPB	0	"0-0"	154	"144-164"

	MEAN -2-	MIN-MAX	MEAN -3-	MIN-MAX
SEVERE-LP-MPB	17,283	"17,191-17,375"	5,842	"5,493-6,190"
DF-BEETLE	458	"403-513"	1,116	"1,106-1,125"
SPRUCE-BEETLE	428	"329-528"	976	"896-1,056"
LIGHT-WSBW	8,058	"7,963-8,152"	10,032	"10,015-10,050"
STAND-REPLACING-FIRE	326	"289-364"	433	"398-468"
MIXED-SEVERITY-FIRE	296	"249-344"	645	"622-667"
SEVERE-WSBW	1,531	"1,504-1,559"	6,135	"5,866-6,404"
NONE	149	"144-154"	124	"95-154"
LIGHT-SEVERITY-FIRE	207	"144-269"	192	"184-199"
LIGHT-LP-MPB	418	"418-418"	346	"334-359"

	MEAN -4-	MIN-MAX	MEAN -5-	MIN-MAX
SEVERE-LP-MPB	3,625	"3,546-3,705"	5,640	"5,553-5,727"
DF-BEETLE	2,505	"2,485-2,525"	2,582	"2,485-2,679"
SPRUCE-BEETLE	1,243	"1,205-1,280"	1,399	"1,340-1,459"

Figure 55 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



SPECIES MEANS AND MIN-MAX VALUES

-Time-

	MEAN -0-	MIN-MAX	MEAN -1-	MIN-MAX
ES-AF	31,538	"31,538-31,538"	31,439	"31,424-31,454"
LP-AF	0	"0-0"	159	"124-194"
QA	5,040	"5,040-5,040"	5,035	"5,030-5,040"
MESIC-SHRUBS	83,395	"83,395-83,395"	85,957	"85,955-85,960"
PP-DF	5,807	"5,807-5,807"	6,389	"6,384-6,394"
UPLAND-GRASSES	246,455	"246,455-246,455"	376,269	"376,249-376,289"
DF-LP	29,452	"29,452-29,452"	29,287	"29,233-29,342"
AF	30	"30-30"	95	"90-100"
PP	951	"951-951"	369	"364-374"
JUSC	383	"383-383"	383	"383-383"
ALTERED-GRASSES	2,306	"2,306-2,306"	2,306	"2,306-2,306"
DF	100,775	"100,775-100,775"	64,008	"64,003-64,013"
NF	2,286	"2,286-2,286"	2,286	"2,286-2,286"
LP	37,335	"37,335-37,335"	37,079	"37,056-37,101"
FESCUE	55	"55-55"	55	"55-55"
XERIC-SHRUBS	34,307	"34,307-34,307"	34,275	"34,267-34,282"
WB-AF	11,245	"11,245-11,245"	11,245	"11,245-11,245"
NATIVE-FORBS	366,966	"366,966-366,966"	237,153	"237,133-237,172"
MTN-SHRUBS	25	"25-25"	25	"25-25"
AGSP	6,419	"6,419-6,419"	6,419	"6,419-6,419"
PF	5,114	"5,114-5,114"	5,112	"5,109-5,114"
ALPINE-GRASSES	214	"214-214"	214	"214-214"
DF-LP-AF	0	"0-0"	5	"5-5"
AGR	28,117	"28,117-28,117"	144	"144-144"
WATER	3,785	"3,785-3,785"	3,785	"3,785-3,785"
CW	5,667	"5,667-5,667"	5,667	"5,667-5,667"
WB	23,222	"23,222-23,222"	23,207	"23,192-23,222"
DF-AF	34,760	"34,760-34,760"	71,754	"71,742-71,767"

Figure 56 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.

REPORTS

Single Simulation

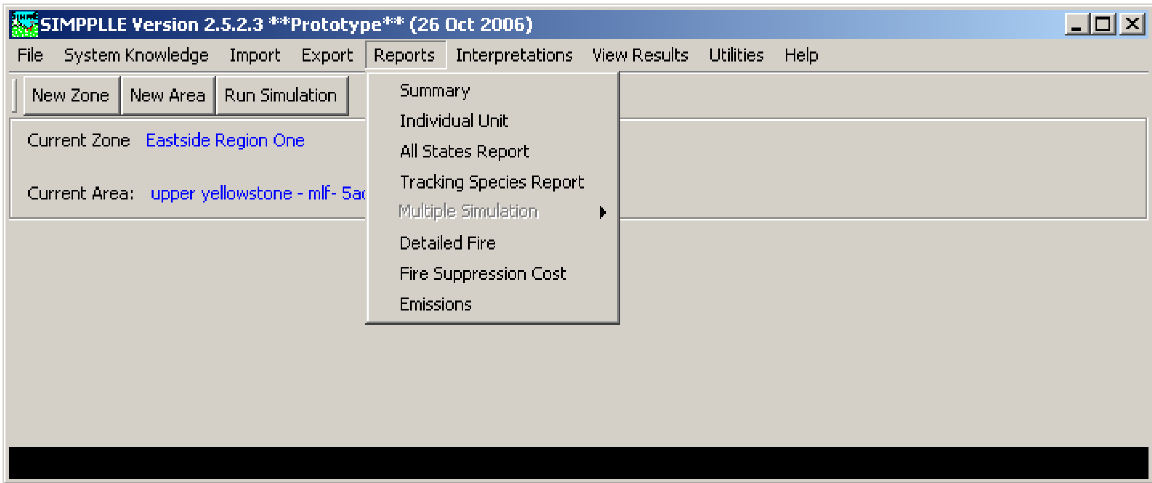


Figure 57 – SIMPPLLE main screen showing the choice available for "Reports" for single simulations

Both the "Summary" and the "Individual Unit" reports provide the same information that can be seen through the "View Results". You can make an "individual unit" report but it is a very large file displaying the history for each plant community in the landscape for the simulation. When a choice is made for a "summary" report the following screen is displayed with options for the report.

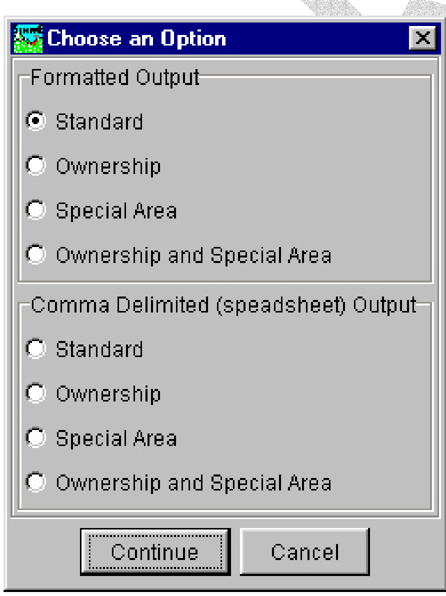


Figure 58 Additional options to choose from when making a "summary" report for a single simulation.

There are two basic options. The report can be provided in a "formatted output", an easy to read format that looks similar to what is seen in the view-results. The report can also be provided in a comma-delimited format that is 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). The "standard" choice provides for no additional breakdown of the information. The other choices will result in the information being stratified by ownership, special area or both. See Input Requirements for explanation of "special area". With the choice of "Continue" a dialog window opens to the working directory and a file name for the report can be selected.

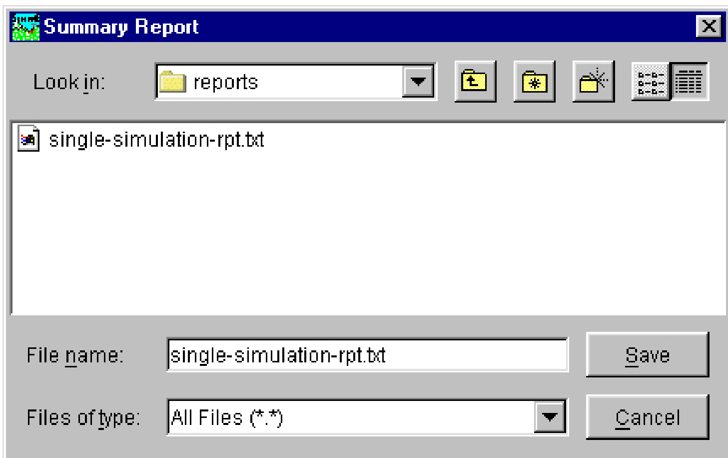


Figure 59 SIMPPLLE dialog window providing for the user to enter the name to be used for a summary report

When providing a name for the reports use an extension of .txt to make it possible to read the report with a variety of applications such as notepad or wordpad.

A summary of the fire events is provided in this report

Fire Event Summary

		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

This report 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 a user has created a 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 0-0.25 class because of either fire suppression or weather events occurring at the time of the ignition event.

All States Report

This report provides the acres for any specified combination of vegetation attributes.

If desired for a single simulation this reports is available after the simulation. One does not have to check in the Simulations Parameters screen that you want them. 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 the appendix for this report for the detailed description.

Tracking Species Report

This report is designed to give the acres for the species being tracked.

If desired for a single simulation this reports is available after the simulation. One does not have to check in the Simulations Parameters screen that you want them. 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 the appendix for the Excel spreadsheet that contains the macro for this report for the detailed description.

Detailed Fire

The "Detailed Fire" report provides more information on the fire events. It identifies the plant community each event originated in and the communities it spreads to, and what type of fire it was. An asterisk beside a unit number means the fire spread under extreme, wind driven events by spotting to this unit. Table 15 displays part of a detailed fire report.

Fires Were Suppressed:

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 reports for the detailed fire 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.

The following table is a “Suppression Cost” report. In this example the costs are not discounted and not identified by fire management zones (FMZ). If fire management zones are used the cost is displayed by each FMZ in addition to the total.

Fire Suppression Costs

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 cost report showing undiscounted costs for the entire landscape that was simulated.

At the time this report is selected the user can change the default discount rate from 1.04 percent. The suppression costs utilizes 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 2000, 2003). Data is taken from Hardy, Burgan, and Ottmar 2000. The emissions values were developed for the Westside Region One, Southern California, Sierra Nevada, SC Alaska, Gila, and SW 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. We have no user interface access to this system knowledge. 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. The following table is an example of an Emissions Report.

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.

Multiple Simulations Report

When making multiple simulations one report file is created automatically. This is a file that uses the name that was provided by the user and is "user-name-ls.txt". This report file provides the results from each time step for each simulation for the 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 as with a single simulation. But if they are made, they are for the last simulation of the multiple set. For example if you made 10, 5 decade simulations the reports made from the user interface will be for the 10th simulation. The additional report that shows up as a choice on the menu after a set of multiple simulations is the "Multiple Simulation". If ownership and special area are identified within the plant communities, then the report can be stratified by these areas. Without them no stratification is given, only the "normal" choice is available.

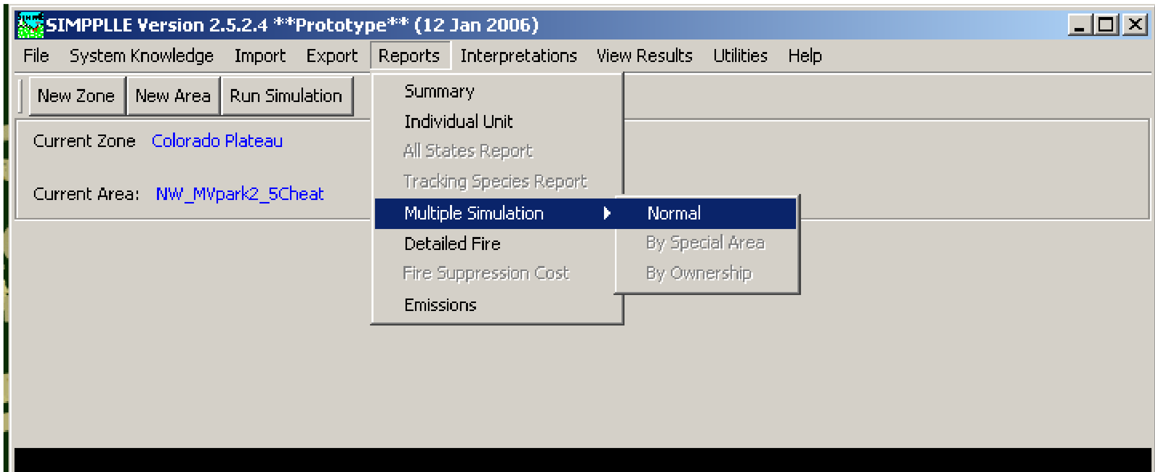


Figure 60 Report option for Multiple Simulation

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

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 pull down menu for Interpretations 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 SIMPPLLE 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 gird 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.

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.

Single Simulations

For single simulations only one choice is currently active, wildlife habitat, the ecosystem restoration is highlighted because it can be ran at this time using information from previous simulations, but it does require probability files from multiple simulations.

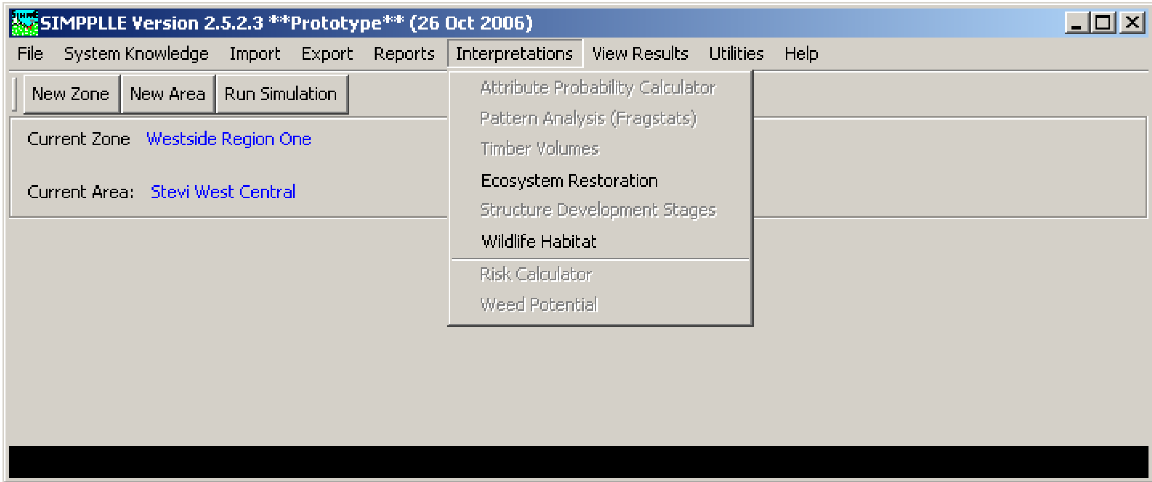


Figure 61 Interpretation Choices available for current version.

Wildlife Habitat Report

This 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 (see GTR under development by Caratti, Chew, and Samson). 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.

The choice of "wildlife habitat" from under "Interpretations" on the main menu results in the following screen that gives a user the choice a report for the entire group or individuals within it.

Figure 62 Main Screen for Wildlife Habitat Interpretations.

If the choice of selecting individuals from a group is made that group is highlighted and upon clicking on it additional choices must be made on which species and gap model to use as displayed in following figure.

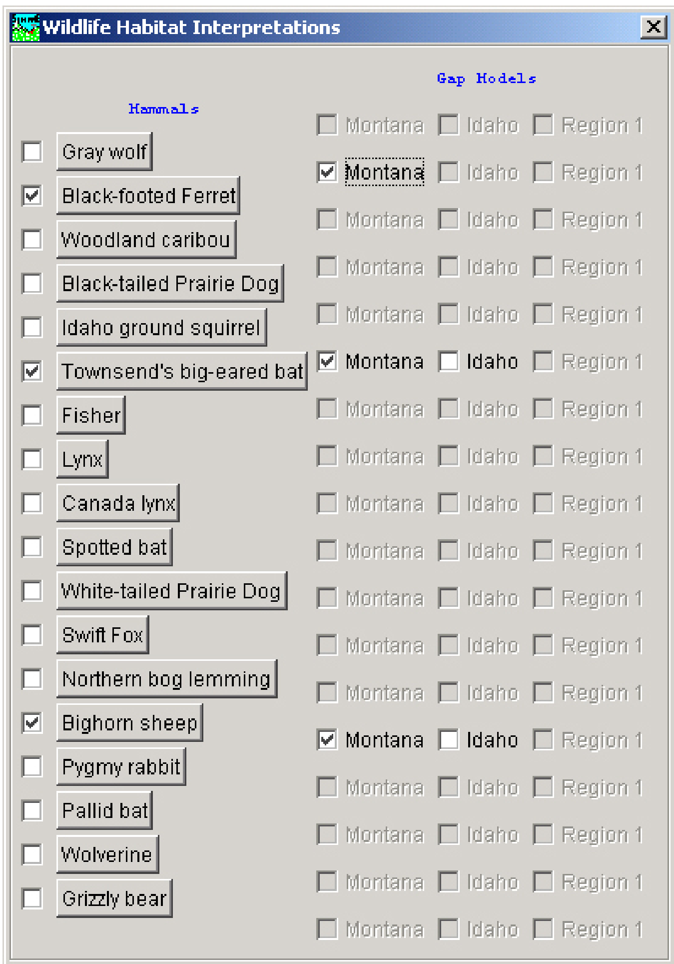


Figure 63 Display of choices for individual species within a group.

The report format is displayed in the following figure.

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  12383.0  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 64 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 has to be addressed through using numerous output files in a GIS environment.

Multiple Simulations

Both the attributes probability calculator and the Ecosystem restoration require multiple simulations as probabilities are generated from multiple simulations.

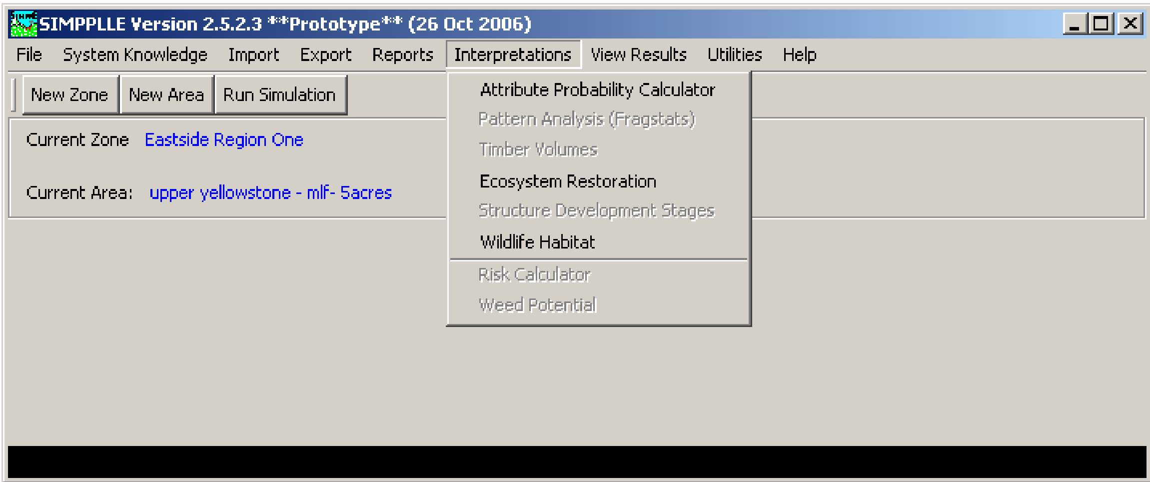


Figure 65 The single choice available under "Interpretations" before any simulations are made

The 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 the following figure 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.

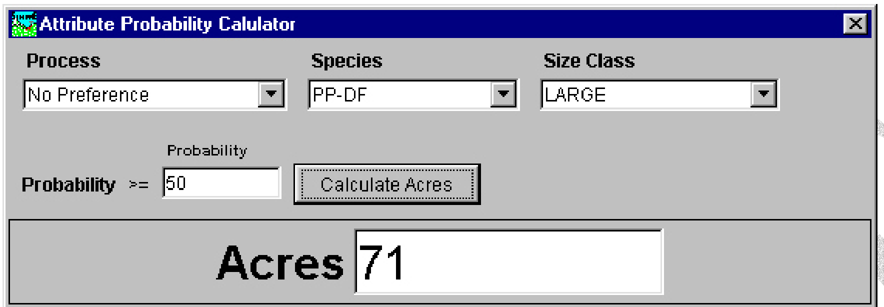


Figure 66 Acres that meet the criteria of being PP-DF and Large greater than or equal to 50 percent of the time for a set of multiple simulations.

Ecosystem Restoration

This choice uses probability files from two different sets of multiple simulations that have to have been made previously.

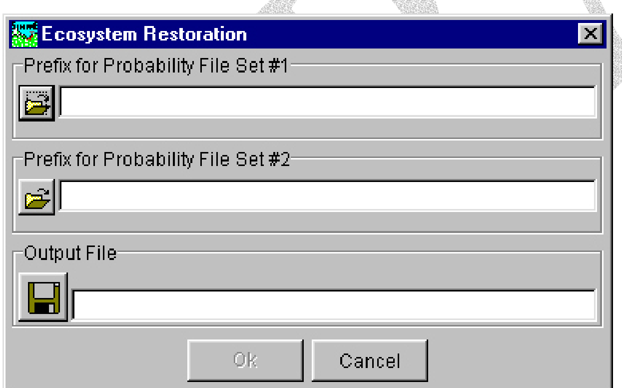


Figure 67 The SIMPPLLE dialog screen used to identify two sets of probability files used to identify Ecosystem Restoration needs

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 has 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 has 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 existing vegetation unit (EVU) number, and assigned value of C, R, or M is created that 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 is documented in Chew 2003.

EXPORT FILES

Area Creation Files

A user can correct for mismatches that occur when files are imported through the user interface (see previous section). To reflect these changes in the ArcInfo coverage you can export the attributes file and then within ArcView "join" it back to the coverage.

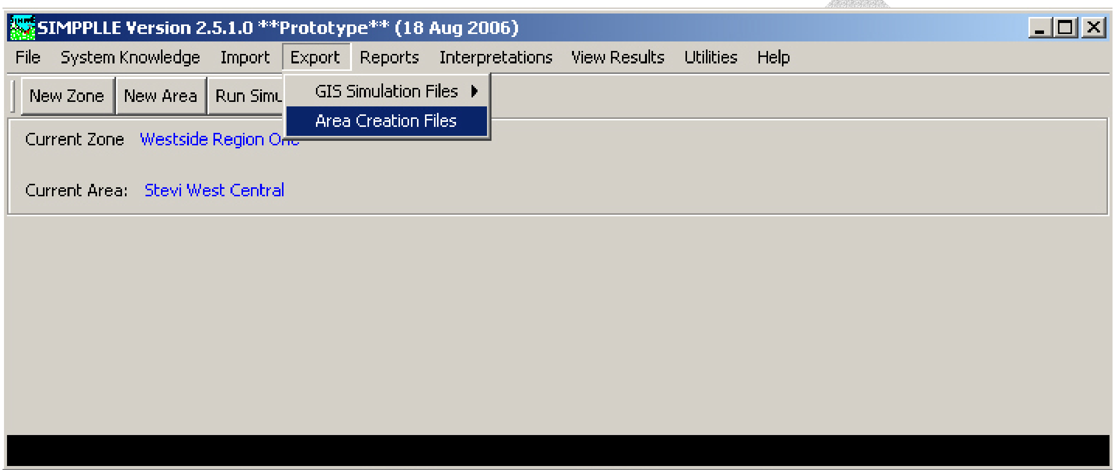


Figure 68 Choice to create an attributes file that can be joined to the ArcInfo coverage to account for changes made through the user interface.

This choice brings up a dialog box for the area creation files choice.

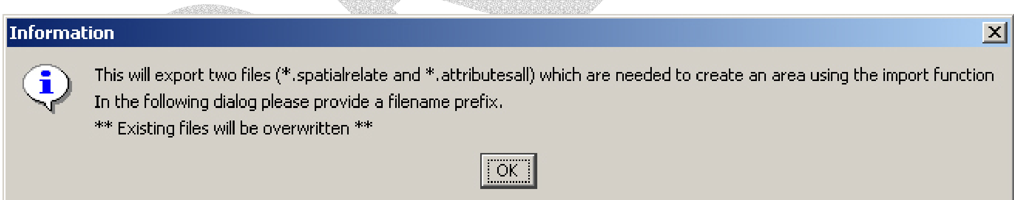


Figure 69 Identification of the files that SIMPPLLE is going to use.

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 no files are automatically created from single simulations. This lets the user make many single simulations without having to worry about file cleanup. For multiple simulations there are some files that are created without a user 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 the basic ArcGIS tools.

GIS Simulation Files - Single Simulation

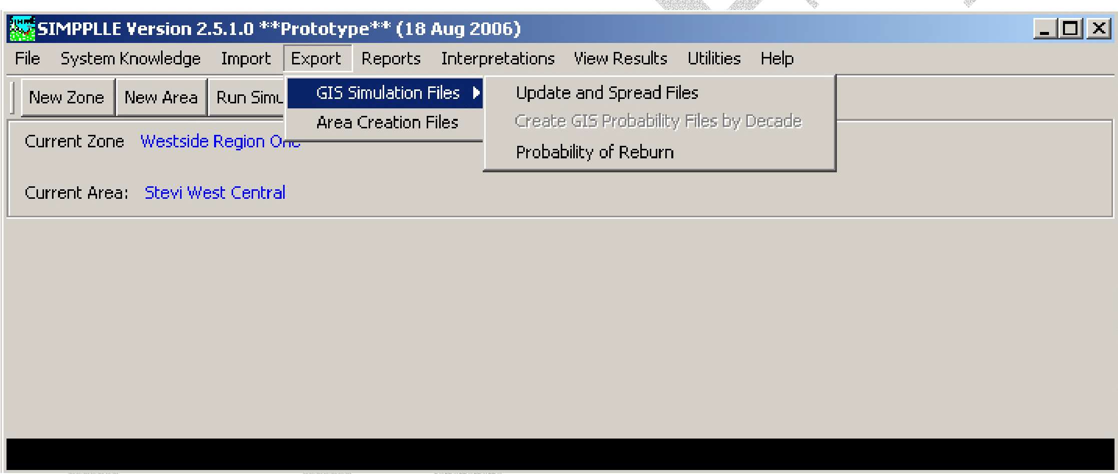


Figure 70 Choices available for GIS output files under the "Export" main menu choice.

With the expansion to include multiple lifeforms, there are more choices that have to be made with these files. Selecting the “update and spread files” brings up the additional dialog screen:

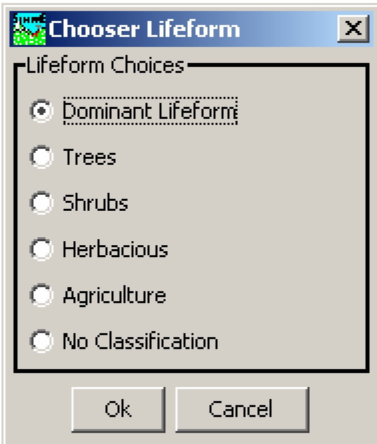


Figure 71 Choice available when exporting GIS files for a simulation if multiple life forms are used to describe the vegetation in the landscape.

Update Files - Single Simulation

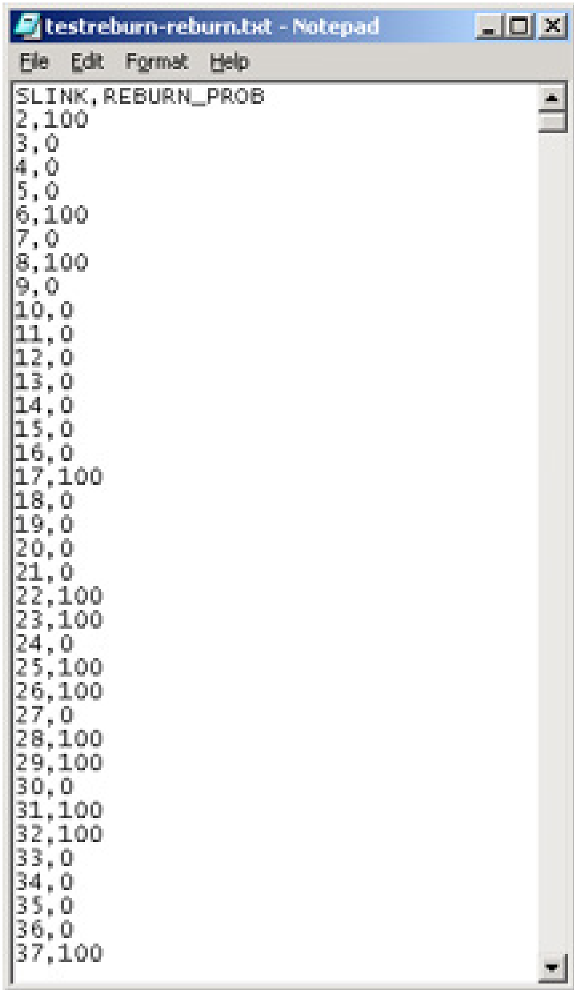
The Update Files are used to map the individual time steps which includes the processes that occurred, the vegetation attributes and the treatments. The files are named with the user provided prefix with a file for each time step of the simulation; user-prefix-#.txt. The files are created by choosing “Export” from the main menu after a single simulation is made or a single simulation file has been reloaded.

Spread Files – Single Simulation

The 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

The report generated by this choice 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.



testreburn-reburn.txt - Notepad

File Edit Format Help

```
SLINK,REBURN_PROB
2,100
3,0
4,0
5,0
6,100
7,0
8,100
9,0
10,0
11,0
12,0
13,0
14,0
15,0
16,0
17,100
18,0
19,0
20,0
21,0
22,100
23,100
24,0
25,100
26,100
27,0
28,100
29,100
30,0
31,100
32,100
33,0
34,0
35,0
36,0
37,100
```

Figure 72 Portion of the report for Reburn Probability. The units that burn more than once within a simulation show a 100 percent probability for reburning.

GIS Simulation Files – Multiple Simulations

Three types of GIS files are created automatically from multiple simulations; probability files, time step attribute update files and spreadfiles, and an area files for each simulation, The probability files are for the processes and each attribute of species, sizeclass, and density. There are two sets of probabilityl one set of files based on the entire simulation, and one set of files for each time step The probability files for the total duration of the simulation uses 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 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 .

The user also has the choice of creating other files used in connection with the GIS ArcView project file provided (an extension to ArcGIS 9.x has been developed).

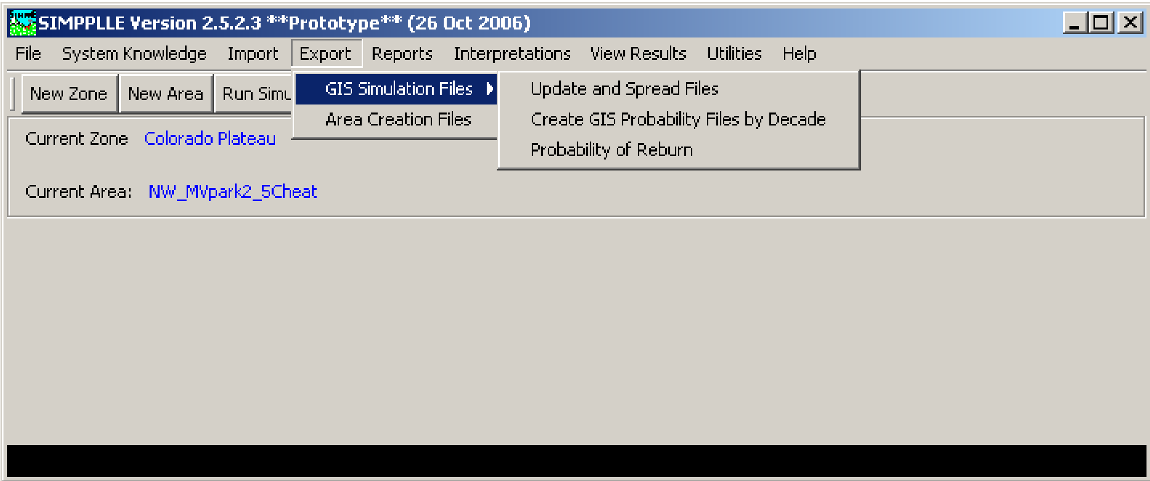


Figure 73 Choices of GIS files that can be created after multiple simulations.

The update and spread files can not be done if the choice was made to "discard simulation information". If you want to discard information, then GIS files have to 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 a user wants to create files from many of the simulations in the set, the saved area file that contains the simulation results ,*.simdata, file 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 are 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 lifeform.

EXCEL SPREADSHEETS with macros and pivot tables

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 past 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 an Appendix.

All States Report

This report is most commonly used with multiple simulations.

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 "average", 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. **You must have Excel 2002 or newer to run the macros in the Report Template.**

If the report is done 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.

To accomplish groupings we have not had the time to create a complete user interface to query the user for the desired grouping. Instead we have the system asking 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 within Excel with this report.

Instructions are included in an Appendix.

Tracking Species Macro

This macro was created to provide support for using the tracking species feature for invasive species. Instructions are in an Appendix.

Statistical Analysis - MRPP

An Excel spreadsheet template with macros for statistically testing differences in values between alternatives is included. Instructions are in an appendix, A separate GTR publication is being prepared for the use of the statistical test.

DATABASE –

The option exists on the Set Simulation Parameter screen under Memory Saving Options to write to a database. The database is written using Hibernate 3.1 and Hypersonic SQL 1.8 Release Candidate 8. The beta releases are used as they allow a database larger than 2GB (max is now 8GB). There is an item on the Utilities menu called DatabaseManager. This starts up a utility that comes with Hibernate for working with the database. We have not developed any standard utilities to work with the database yet. These capabilities will be in a future build of version 2.5.

Database

In running a Simulation in SIMPPLLE the user has an option to output data to a database. The data that is output to the database is all 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 possibilities are nearly endless.

The database currently used in called Hypersonic SQL. It is an open source free to use database. Currently this database has a size limitation of about 8GB. As you will see in looking at the database tables, all of the primary tables 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 in very large.

The database is written using software call Hibernate, which allows us if needed to be able to fairly easily switch to using 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 some built in report queries to make it easier for the use 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.

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 This database table holds 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 A table provided to show users what the probability values found in the database mean.

SEASON ID REFERENCE TABLE

SPRING	0
SUMMER	1
FALL	2
WINTER	3
YEAR	4

Table 12 A table which show what 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	Lifeform 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	

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	Lifeform Name

Table 18 A database table used to assign numeric ID's to Lifeform 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.

Example

Show EVU_SIM_DATA Table with the Process Names where the process is Stand Replacing Fire.

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

```
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 74 Results from querry on the database.

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. 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 that can be viewed as rules. 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 a user. Changes in the system knowledge beyond what is accessible by a user require changes by the system developers. The "System Knowledge" choice from the main menu provides access to the knowledge components. There are many reasons why a 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 serves 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.

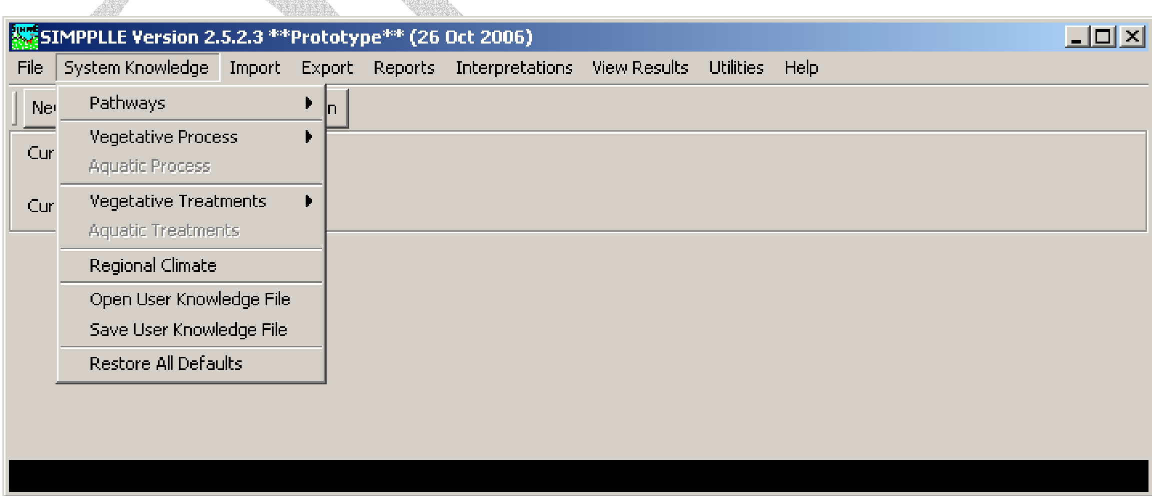


Figure 75 System knowledge choice from the main SIMPPLLE menu

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 using the “save as” choice under File. 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 a user must first load the files individually once and then the choice is made to “Save User Knowledge File”.

The next time SIMPPLLE is started after the zone and area is loaded the choice of “Open User Knowledge File” is made to load the changed knowledge files. The following table identifies the file extensions for each type of system knowledge and whether it is loaded by the “user knowledge” file.

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_firesuppspreadratelogic
Fire suppression production rate	sk_firesupproductionratelogic
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_firesuppbeyondclassalogic
Fire suppression class A	Sk_firesuppclassalogic
Class A fire suppression due to weather	sk_firesuppweathera
Fire suppression beyond Class A due to weather	sk_firesuppweather
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_vegunitfiretypelogic
Invasive species logic	sk_invasivespecieslogic
Lifeform 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.

Version 2.5 offers more consistency in the knowledge screens for each component than in previous versions. The user has a choice of “columns” that can be added to the screens to have as much or as little system knowledge utilized. The following displays the list of the system components that can be used in a logic screen.

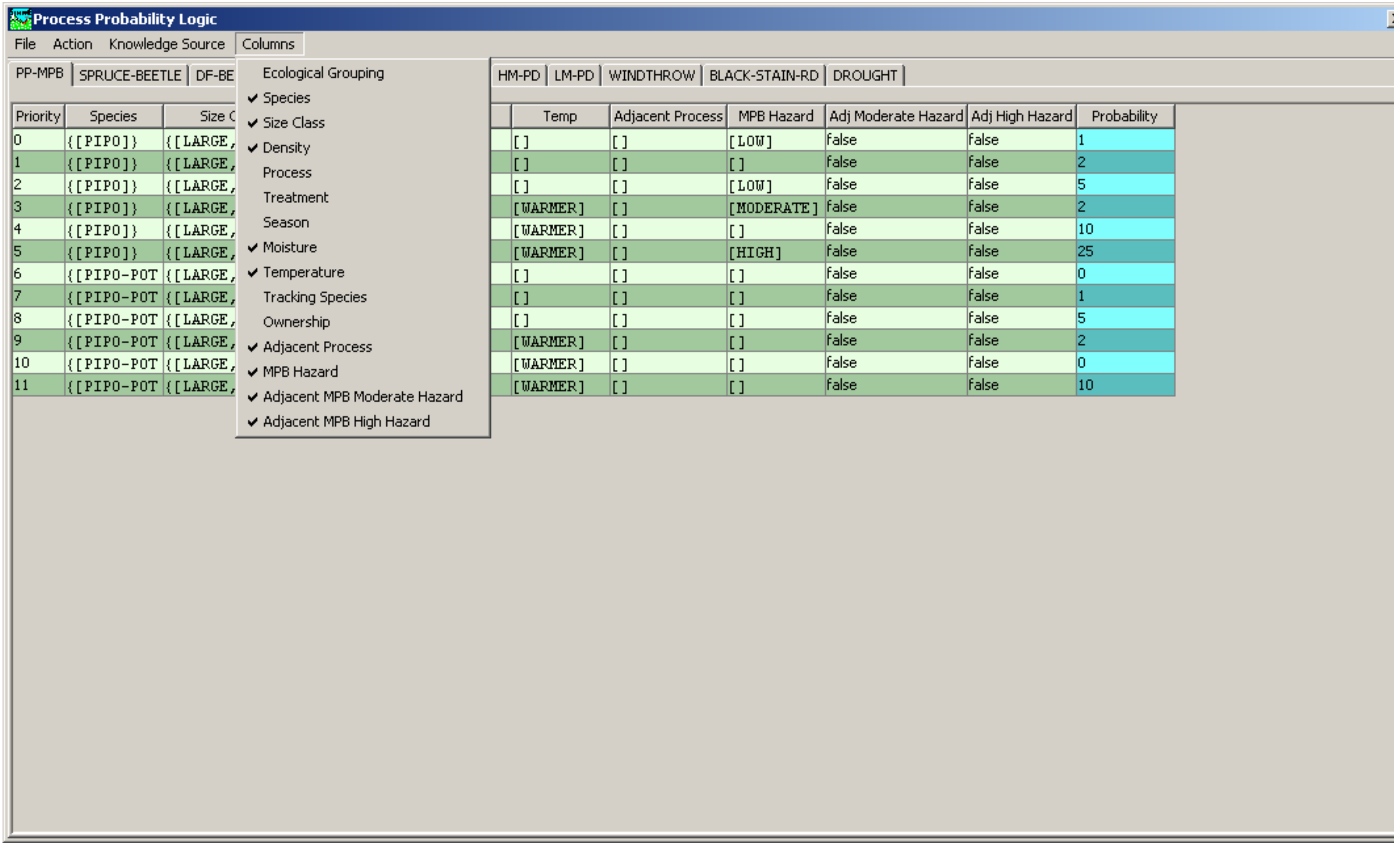
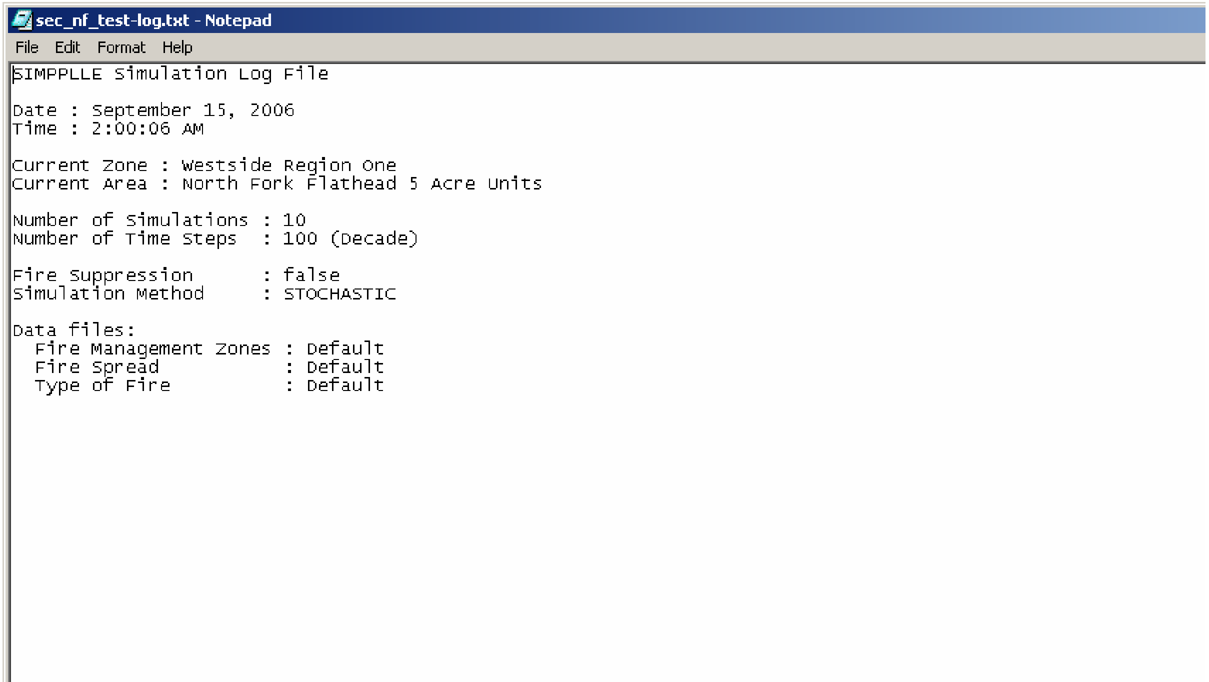


Figure 76 The basic disturbance process probability logic screen showing the pull down menu for columns. This displays the system knowledge that a user can choose to utilize.

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 screens in the Colorado Plateau area each are unique screens. A very important point to remember in building the logic "rules" for any screen is that the more detailed combinations, the more specific knowledge requirements have to be listed first. For any given screen the system goes through the rules in order. The first one that matches it utilizes. If a very generalized rule in 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 a user to keep records on what comprises each simulation. Following figure 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 77 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. The following identifies system knowledge that a user cannot access at this time.

- code on emissions
- reburn probability
- fire spotting under extreme fire spread
- computation of neighboring unit's position, above, below or next-to
- the hazard rating systems for mountain pine beetle in lodgepole and ponderosa pine
- the spruce beetle expert system incorporated into the SC 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

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 have changes based on a decade time between states.
Shrubs and herbaceous have 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 that are discrete includes the processes that are applicable for each state and the resulting state.

Within this collection of states we identify:

The time spent within a size-class
Density changes over time
How long/soon it takes for tolerant species to fill in
How long seral species stay in a mixture
Influence of density on time within states
Influence of habitat type

For the initial geographic areas of the Westside and Eastside of Region One , this information was provided by relationships in the “Regional Stocking Charts” (Forest Service Handbook 2409.17 Silvicultural Practices, Region 1 Supplement No.6, Oct 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 (Forest Inventory and Assessment) plots with FVS (or the 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. The spatial patterns of plant communities that can be unique to each area simulated impacts the probability and spread of the processes. For the most part 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.

There is a difference between the tree life forms and the other two in that for the most part there are very specific rules tied to the processing of inventory data that identifies when a single species or two or three species are used to identify the dominant species. For shrubs and grasses it appears these types of rules are not that common. But there are combinations of species that are generally thought of occurring together even though only one name may show up as the dominant species. For these cases it would be appropriate to show a species change for the state as a result of a process such as srf or msf. With the tree life form we “usually” do not show those types of changes within the pathways. For example if a stand is identified as PP, but we know there is a small amount of DF present, we do not change the stand to DF when PP-mpb kills all the pine. It goes to a general shrub or grass state. It’s just as possible that there are other species present and we cannot make a decision from the inventory data. If the shrubs are grasses are more generally accepted as occurring in mixtures then we work with the difference.

The complete concept of change requires the use of more than one “knowledge component” within SIMPPLLE. Vegetation change in SIMPPLLE requires the use of not only “pathways”, but also “regeneration logic table” and “disturbance process probability logic”.

Viewing Pathway State Diagrams

Pathways files can be viewed by choosing "SYSTEM-KNOWLEDGE", "PATHWAYS", and "VEGETATIVE-PATHWAYS" from the main menu bar.

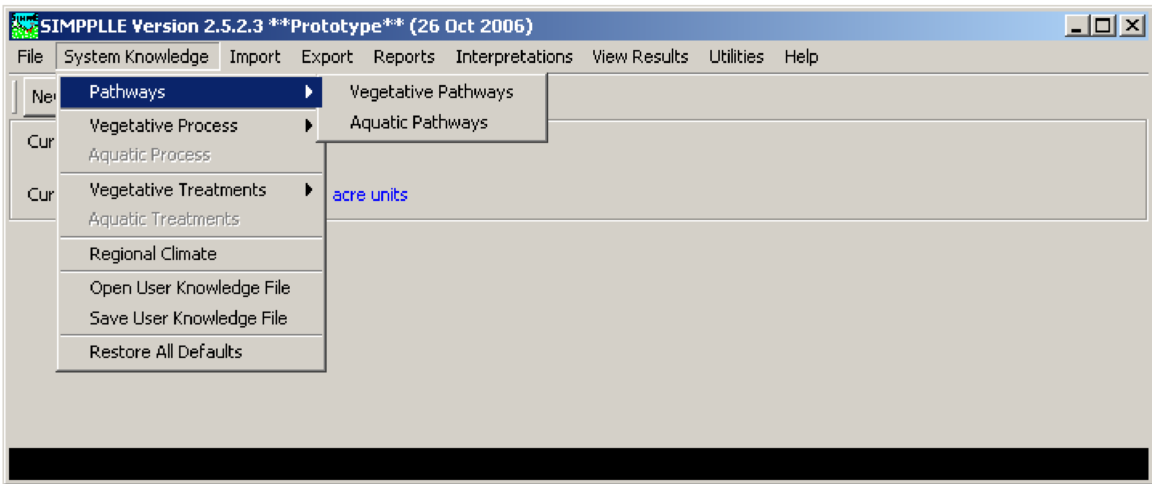


Figure 78 Sequences of choices from the main menu to access the knowledge stored in the vegetation pathways

A display opens up to one of the ecological stratifications. For the Westside of Region One area, this is habitat type group, D3, and the first vegetative type of alpine fir, AF, with the process of succession.

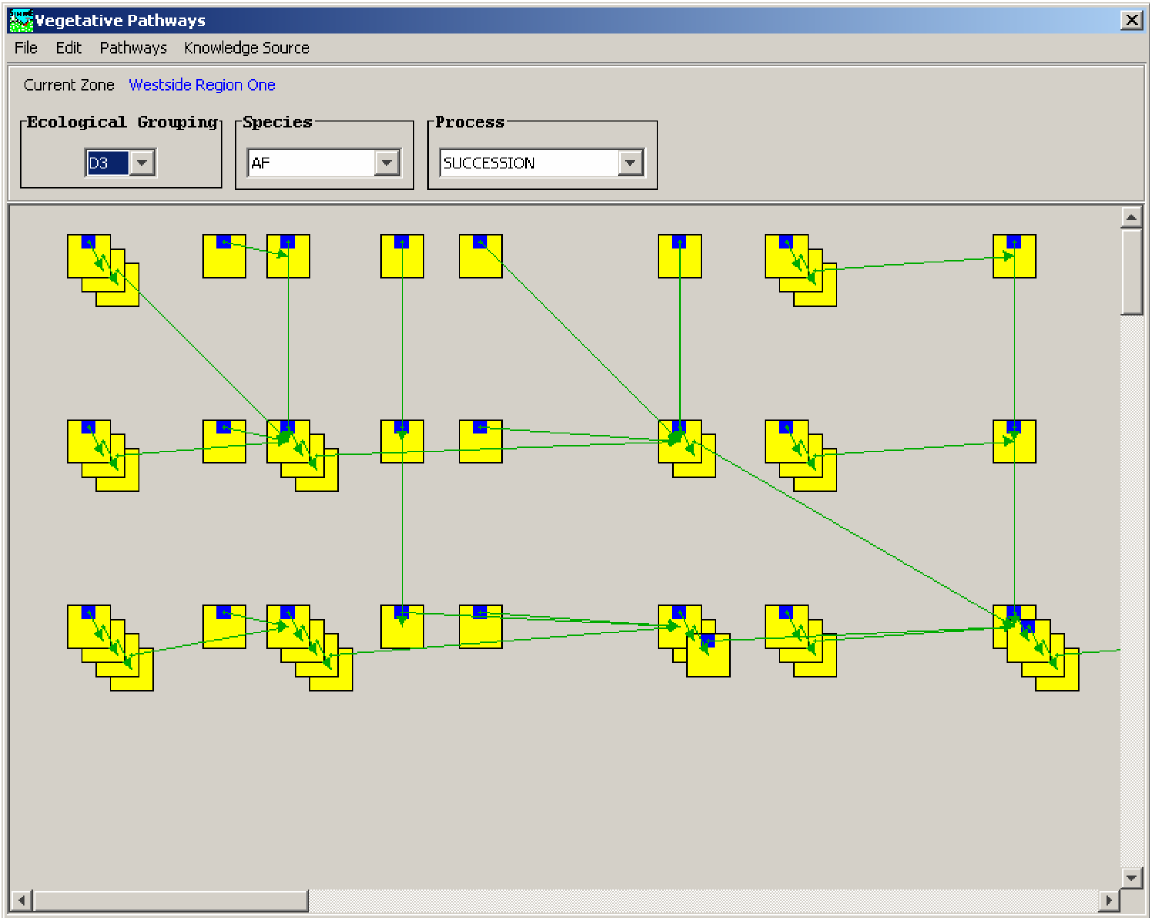


Figure 79 Diagrams of vegetation states for habitat group D3, alpine fir for the dominant species and succession as the process of change

A choice of the ecological grouping to display is selected from the drop down menu. Place the cursor on the down arrow associated with the habitat type group and select the left mouse button. Moving the cursor down the list highlights different groups. Clicking with the left mouse button will switch the display to the new group diagram at the same species and process that is displayed in the current group.

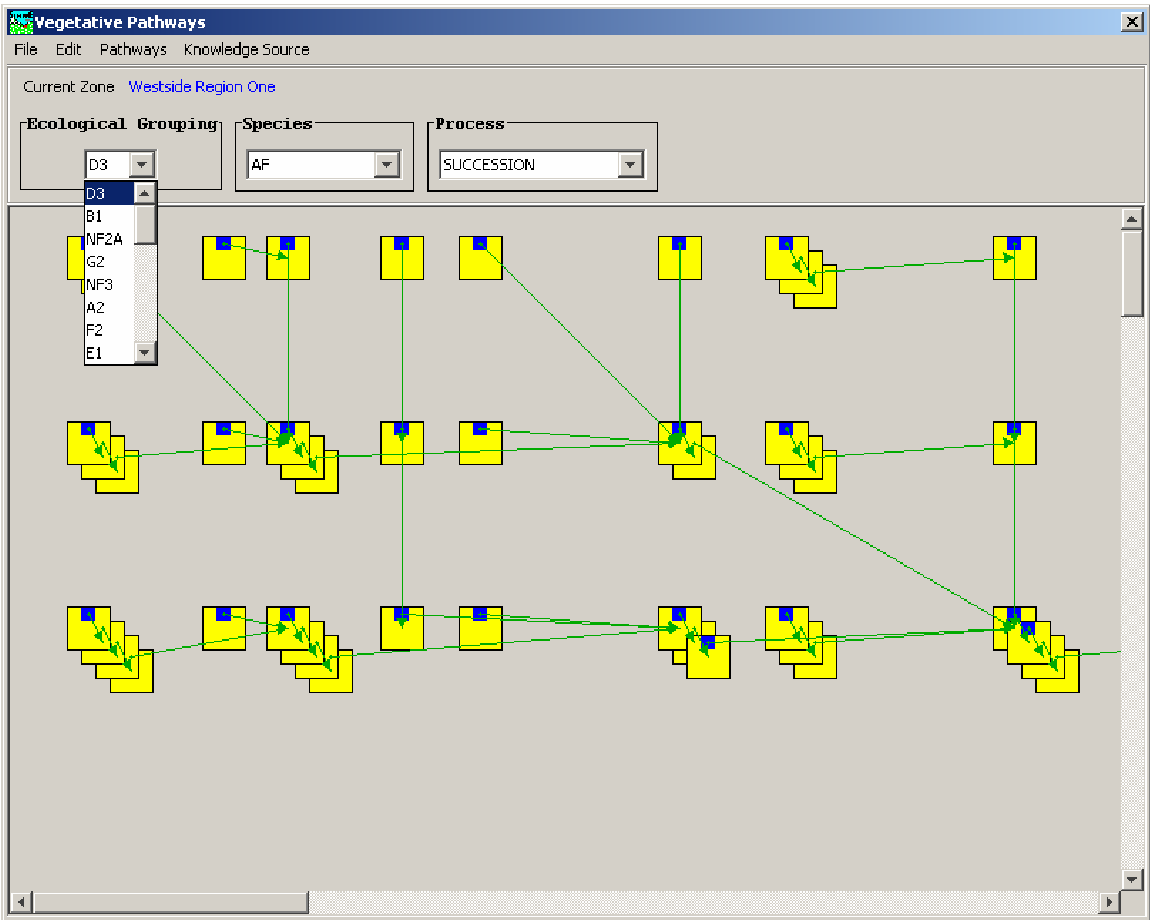


Figure 80 The pull down menu that provides access to other habitat type groups

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 pull down menu enables one to select the dominate species diagram to view. Selection of a new dominant species is made in the same way a different habitat type group was selected.

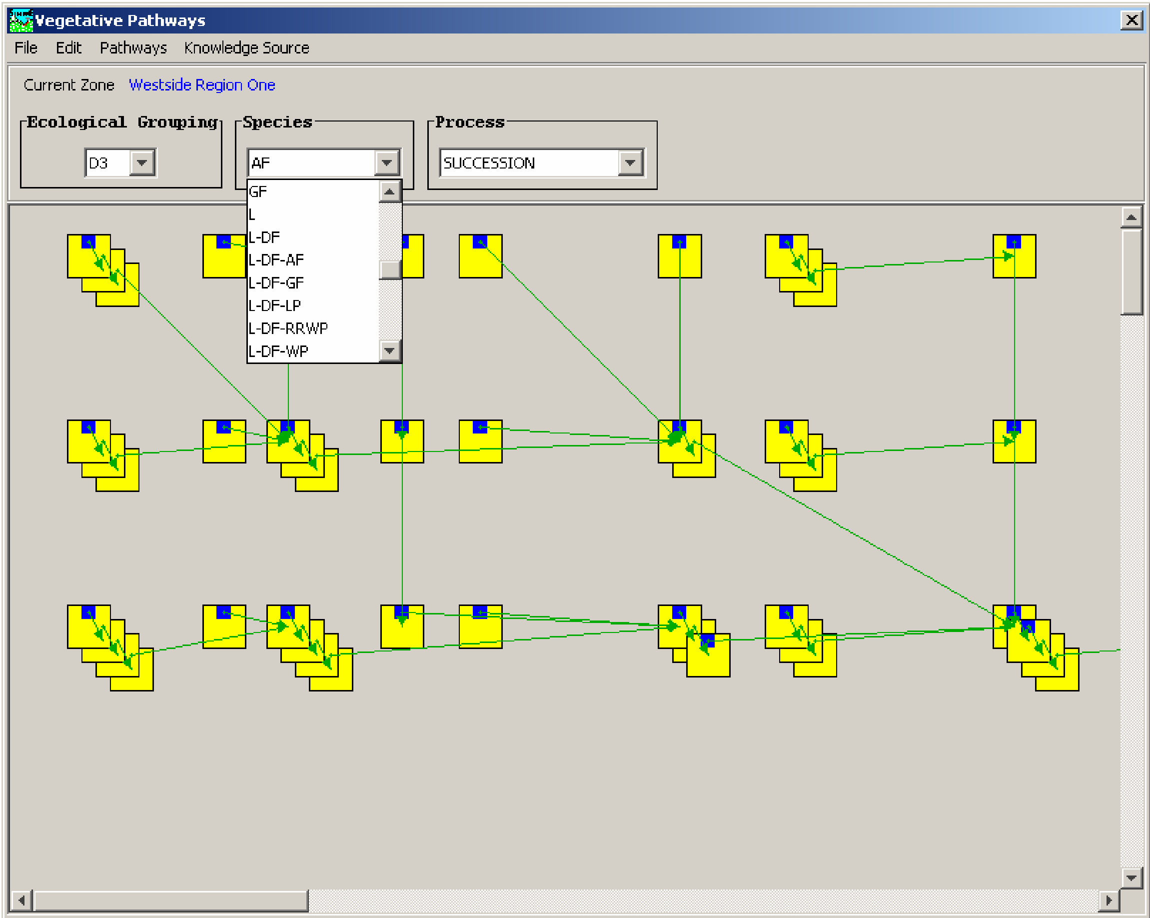


Figure 81 The pull down menu to provide access to the dominant species within the group

As displayed in following figure, the states are arranged with the youngest and smallest, seedling/saplings on the left and the oldest and largest, very-large 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 states (boxes) that are "shaded" represent different species combinations that processes change a plant community to. A 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 going up to the drop down menu, or simply double clicking the left mouse button 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 the choice can be made under "pathways" on the menu bar to "show all labels".

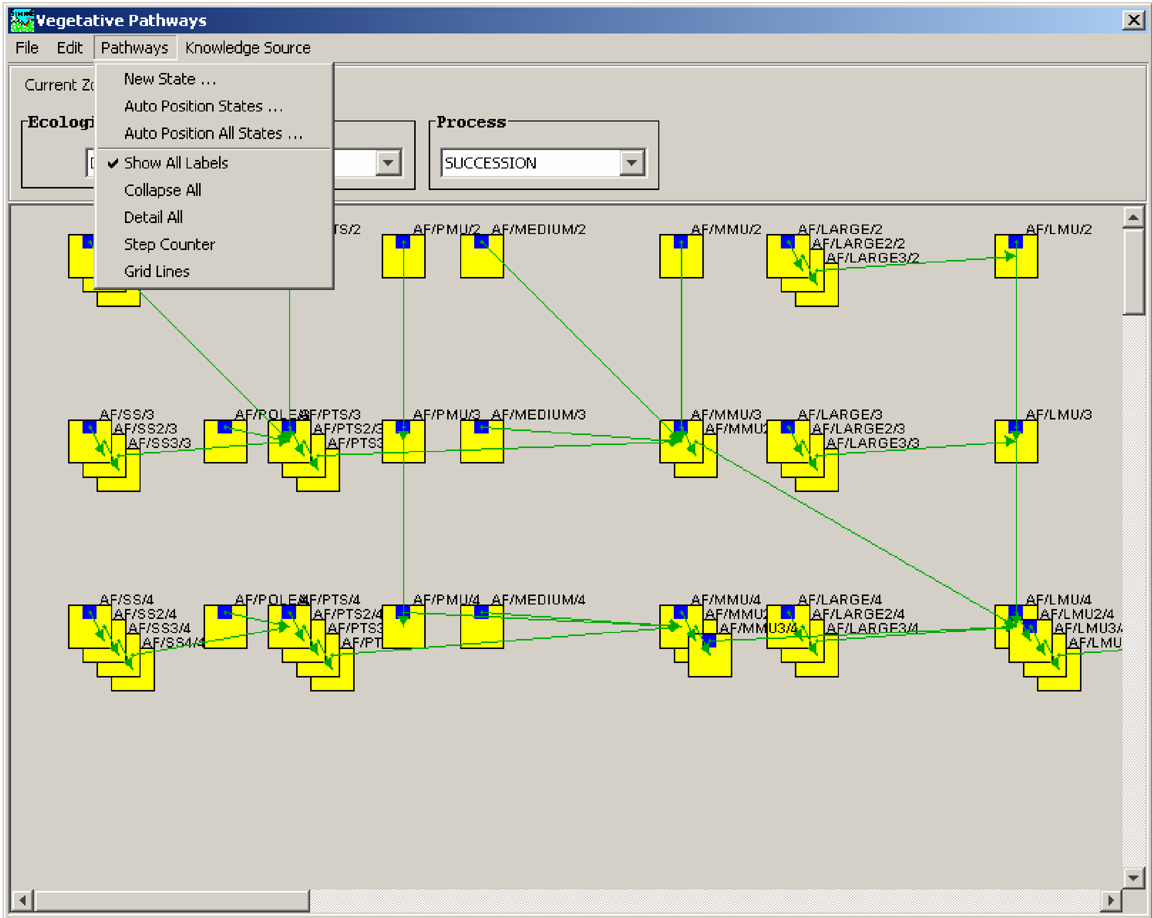


Figure 82 Diagram of all possible states of the dominant species af on habitat type group D3. The process linking all the displayed states in succession

Other choices 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 – This choice will reduce the pathway to a single state for each size class. The separate states for age within a size class will be collapsed.

Detail All – This choice will expand each size class to display all the states for each decade within it.

Step Counter - This feature will determine the number of years between two selected states in the pathway. This is very useful in the editing process.

Grid Lines - This feature will add 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 pull down menu for "PROCESS". 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 communities neighbors and place in the landscape.

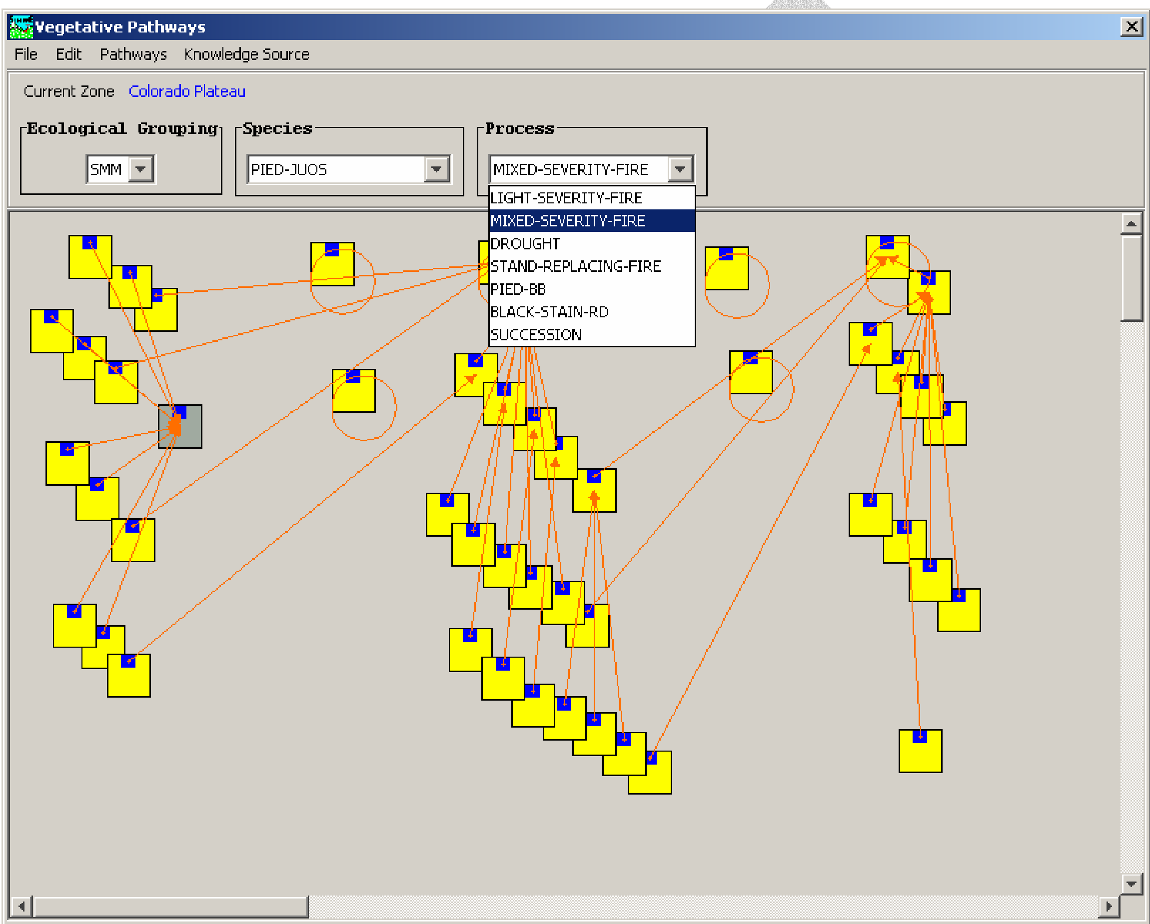


Figure 83 Display of the process drop down menu for changing the disturbance process linking all of the states in the diagram.

Creating State Diagrams

In the current version new pathways diagrams, 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 can be done by creating a text file of the pathways and importing it through the menu choice as shown in the following figure. Existing pathway files can be exported as text files to use as a format.

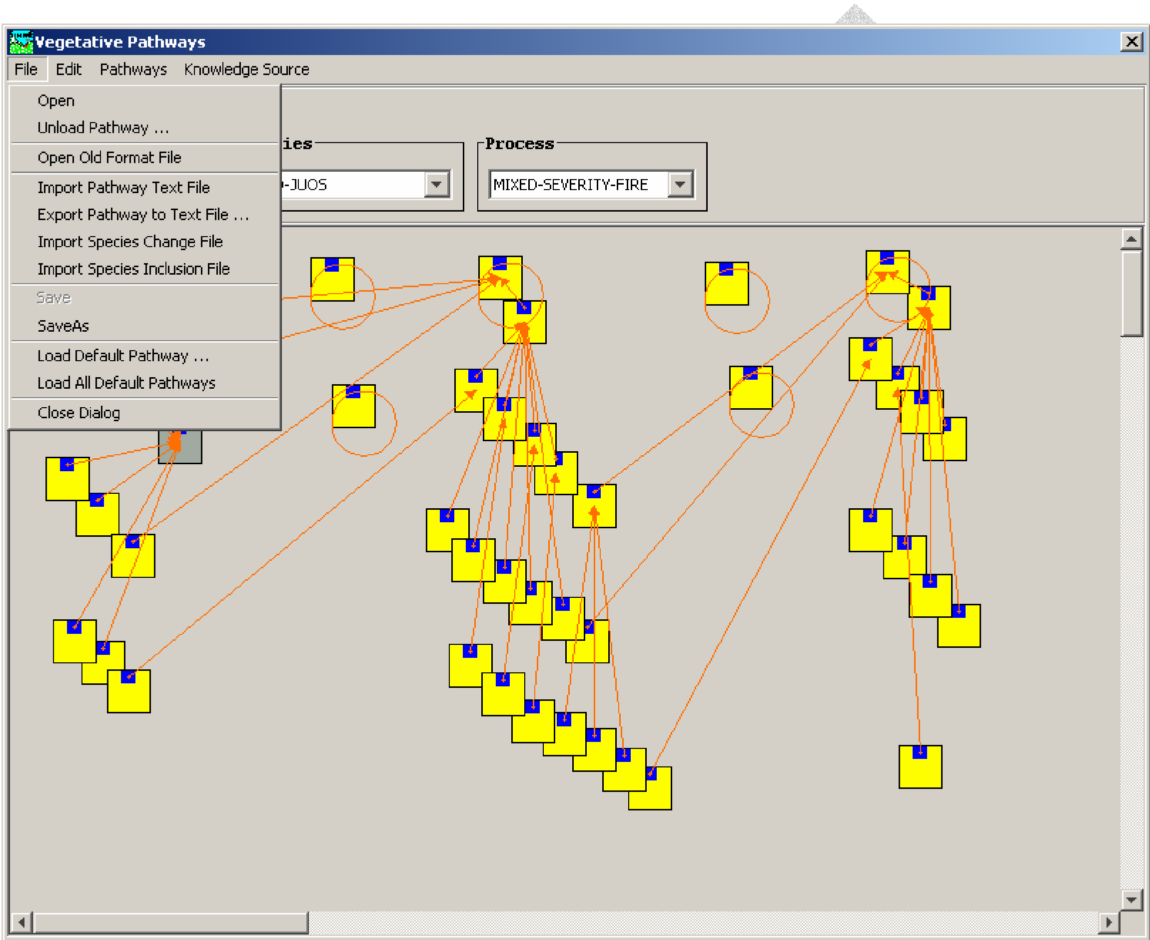


Figure 84 Pull down menu from "file" that gives the option of importing and exporting pathways as text files.

Adding a new species pathway also requires that the new species be added to the system through the system knowledge, species editor.

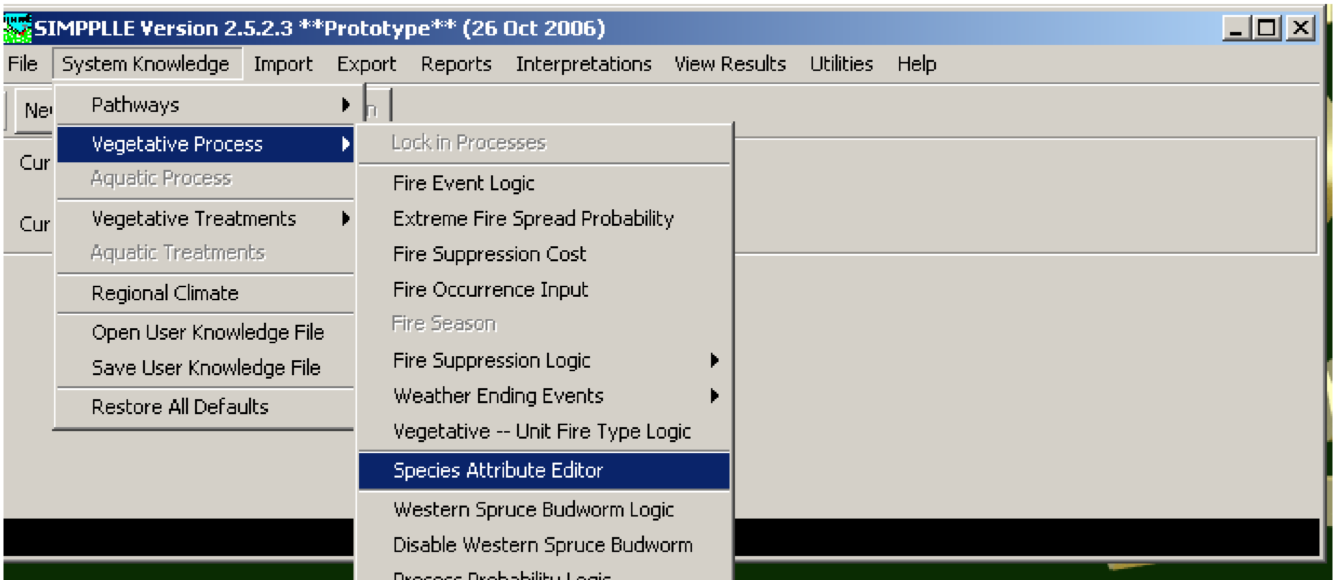


Figure 85 Access to the Species Attribute Editor

Editing State Diagrams

The default pathway relationships are developed for each Zone. It's 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 the Forest Vegetation Simulator 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. Editing within the SIMPPLLE environment is done by putting the cursor on a state and clicking the right mouse button to bring up the dialog box.

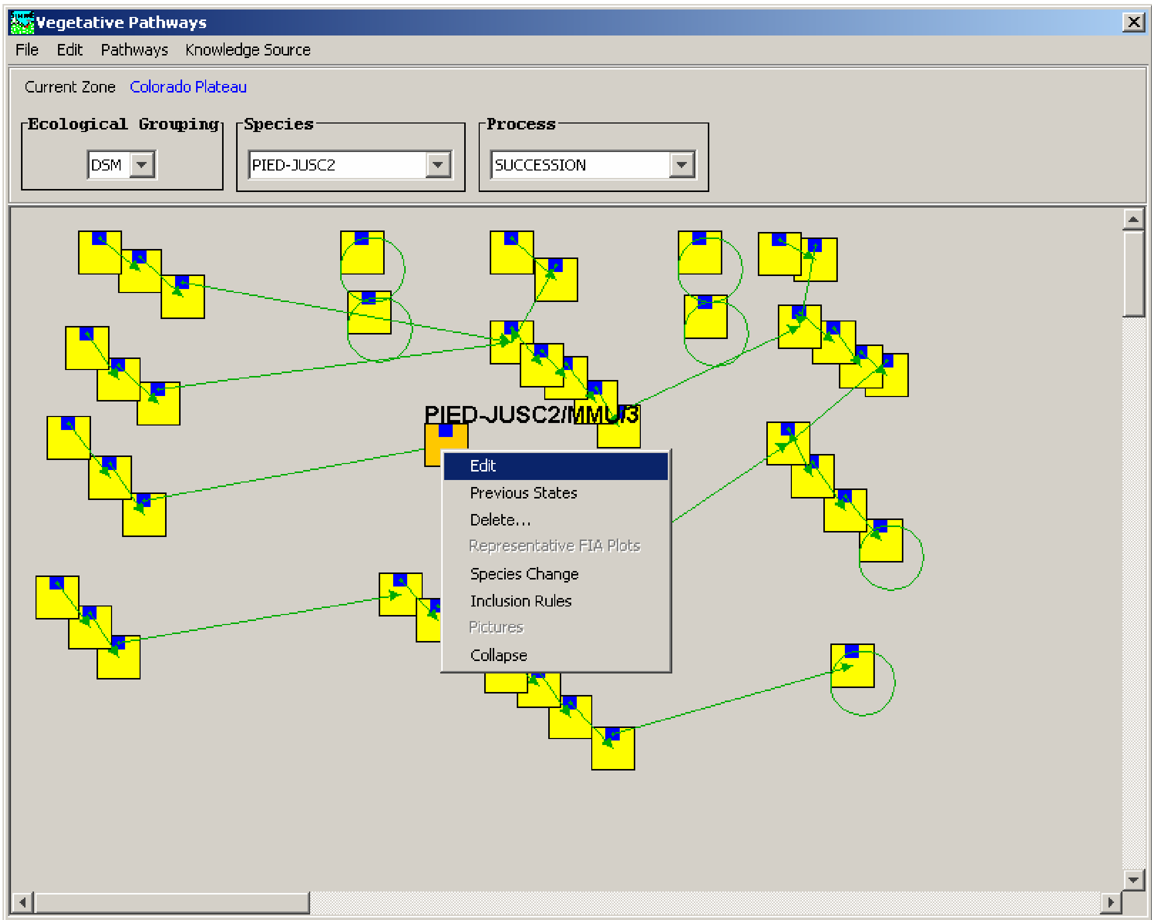


Figure 86 The choices for editing a state that are accessed by clicking with the right mouse button with the cursor on the state.

Selecting the "edit" choice brings up the following screen

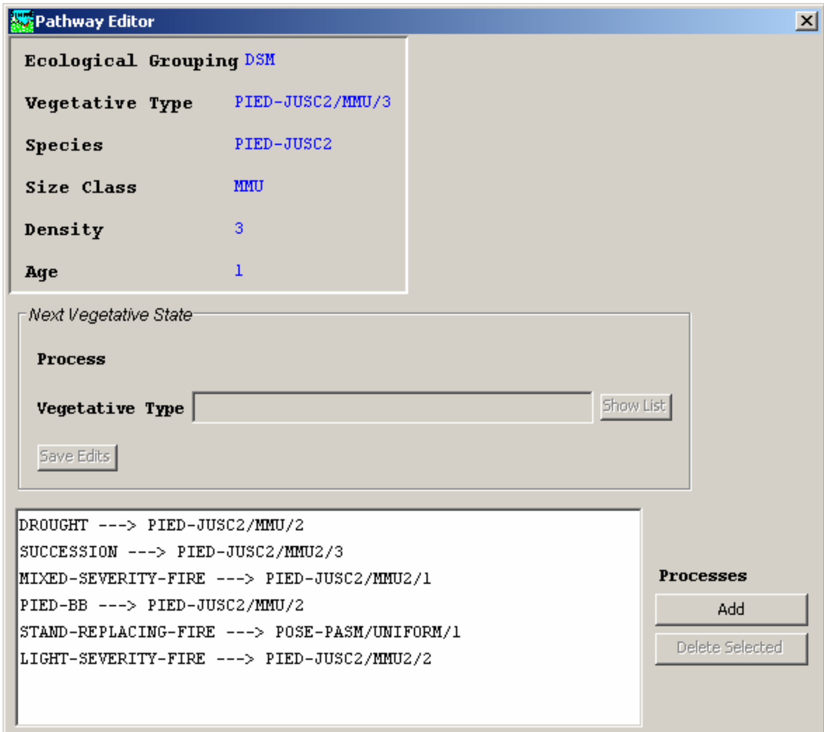


Figure 87 The editor screen that is accessed by choosing the edit option when the right mouse button is clicked on the state in a diagram.

Within this editor select the process / next state combination that requires editing. In this example we have selected the mixed-severity-fire process.

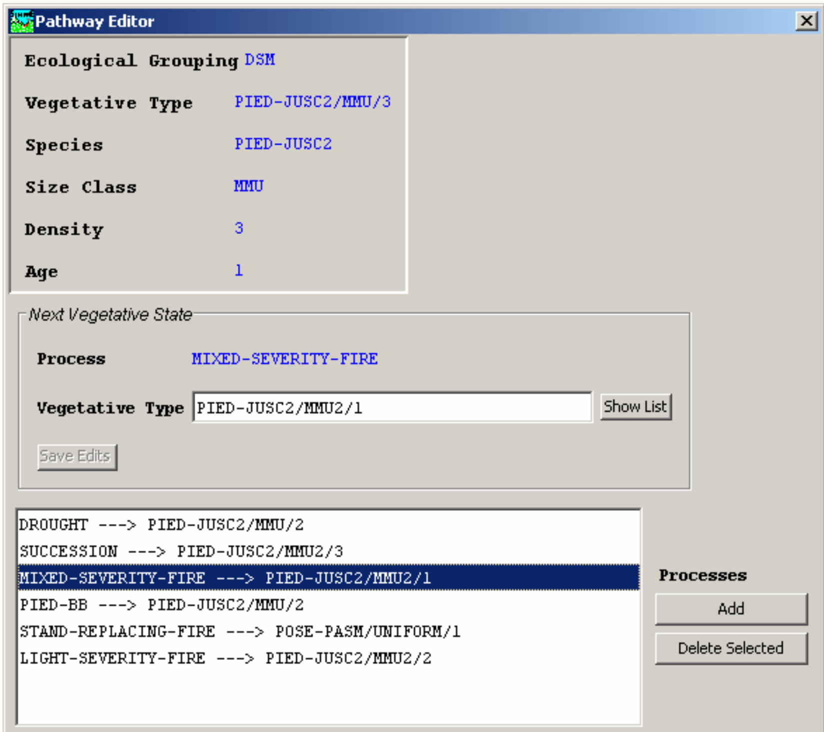


Figure 88 Editor screen for a L/PTS2/3 state. The Process of Mixed-Severity-Fire is select and the next vegetative type is ready to be edited.

We can select the "show list" to see what other valid states exist to which the current state might be changed.

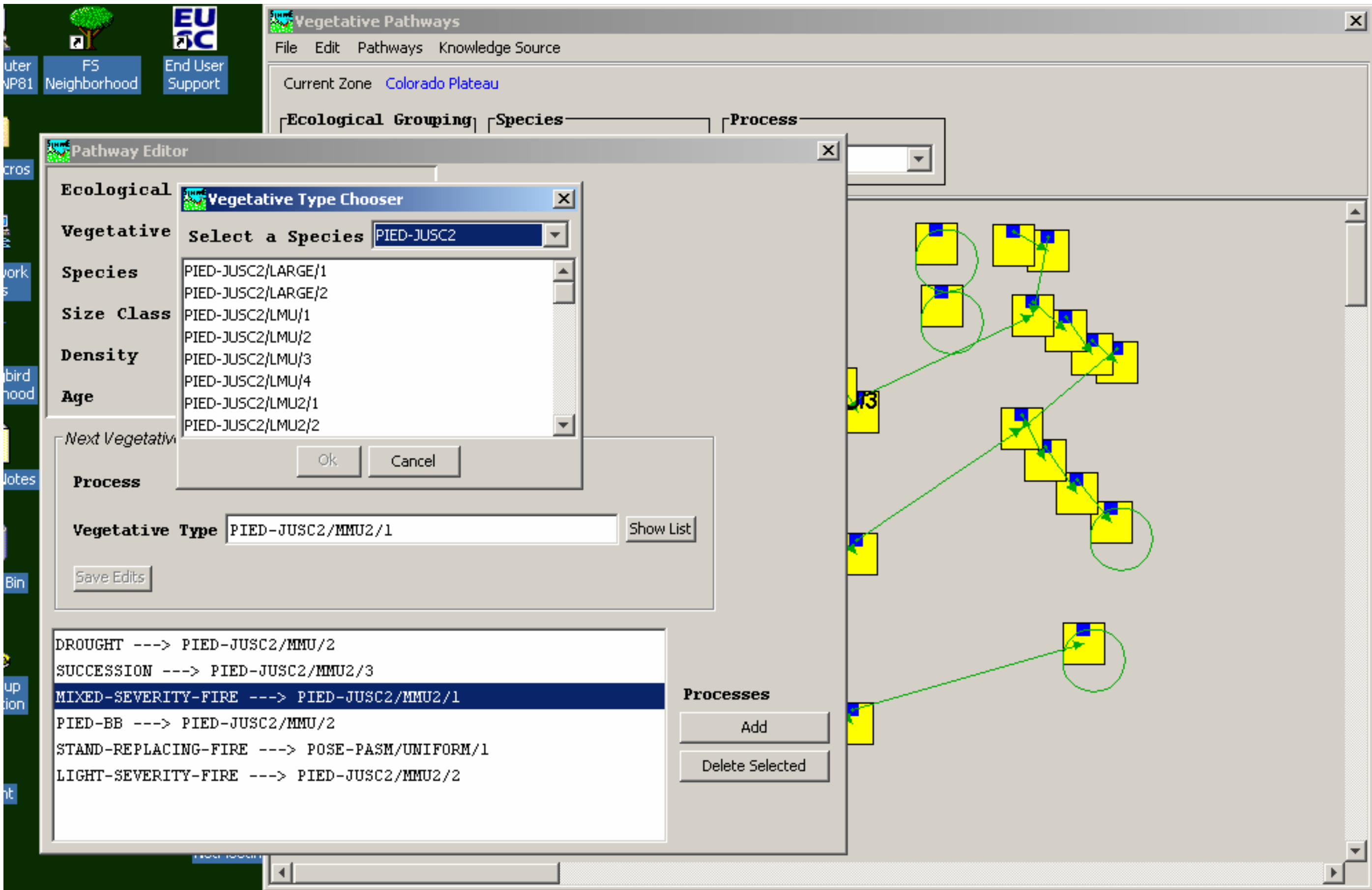


Figure 89 The selection of the "show list" provides an additional drop down screen that provides a list of all valid states within the same dominant species that could be selected from for the new next state.

We can also make the change within the diagram by placing the cursor on the line where it comes from a state, the blue area, holding down with left mouse button and dragging it to the new one we want to go to. In the below example we are changing the state following succession from larch/pts/4 to larch/medium/4. Moving the line will make the corresponding changes in the file.

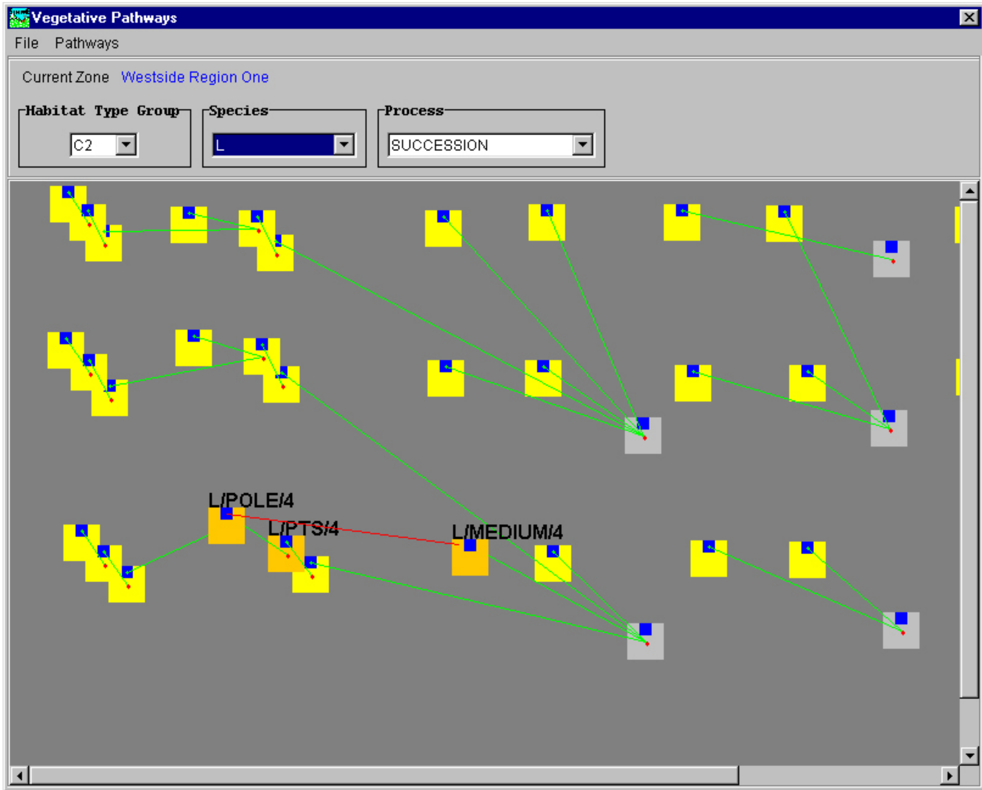


Figure 90 Use of "dragging" the link to a new state to change the next state as a result of the process displayed. In this diagram the red line is the leads to the new next state from L/POLE/4 to L/MEDIUM/4 instead of L/PTS/4.

We could also select the "add" option to open additional process choices to add to this state.

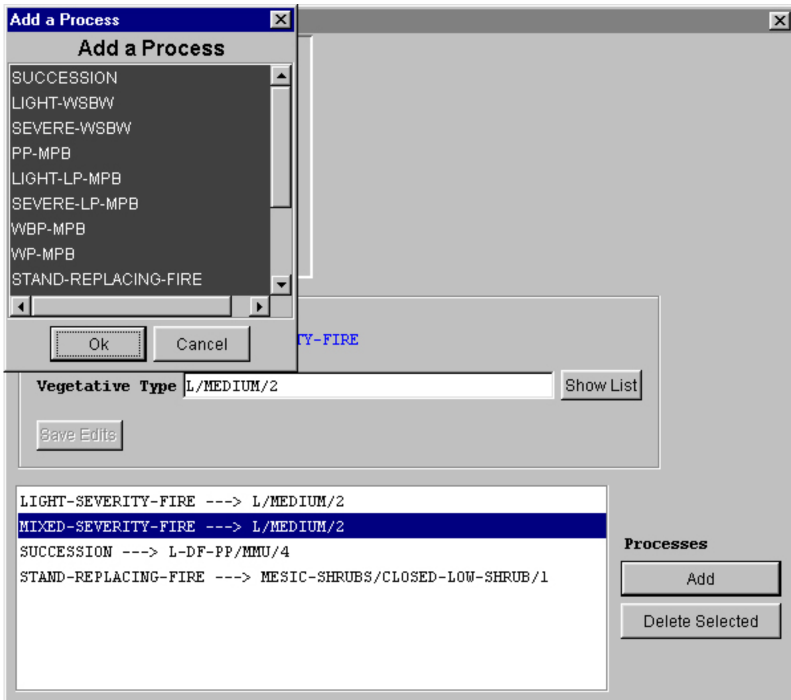


Figure 91 Use of the editor for a state to add a process from the list of those available within the system.

Or we could simply "delete selection" that we had made.

The initial right mouse click on the state provides two other choices besides "edit." We could delete the state at this time. However, deleting a state can create problems if there are other states that exist with processes that lead to this state. To check this use the third choice of "previous states" that appears with a right mouse click.

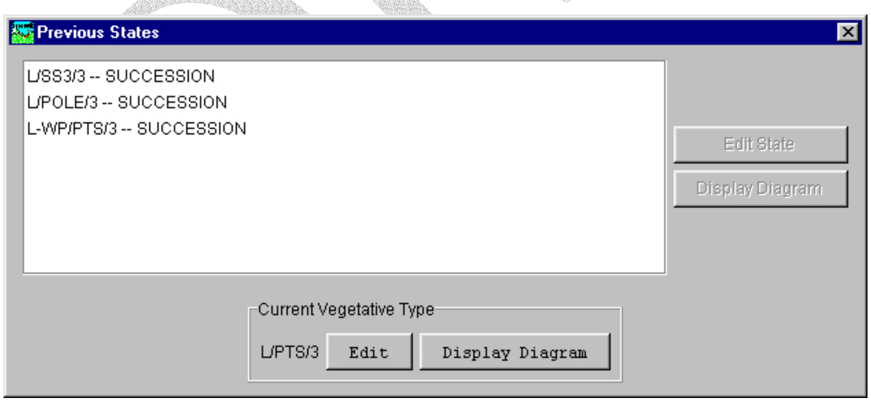


Figure 92 The list of all previous states and the process that leads to the current vegetative type displayed a the bottom of the screen

From this screen a user can edit the other states so the process takes them to a state other than the one to be deleted. After editing all previous states, the desired state can be deleted.

If one needs to add a new state, but not an entirely new species, place the cursor on "Pathways" at the top of the vegetative pathways screen and click the left mouse button. The New State option is displayed.

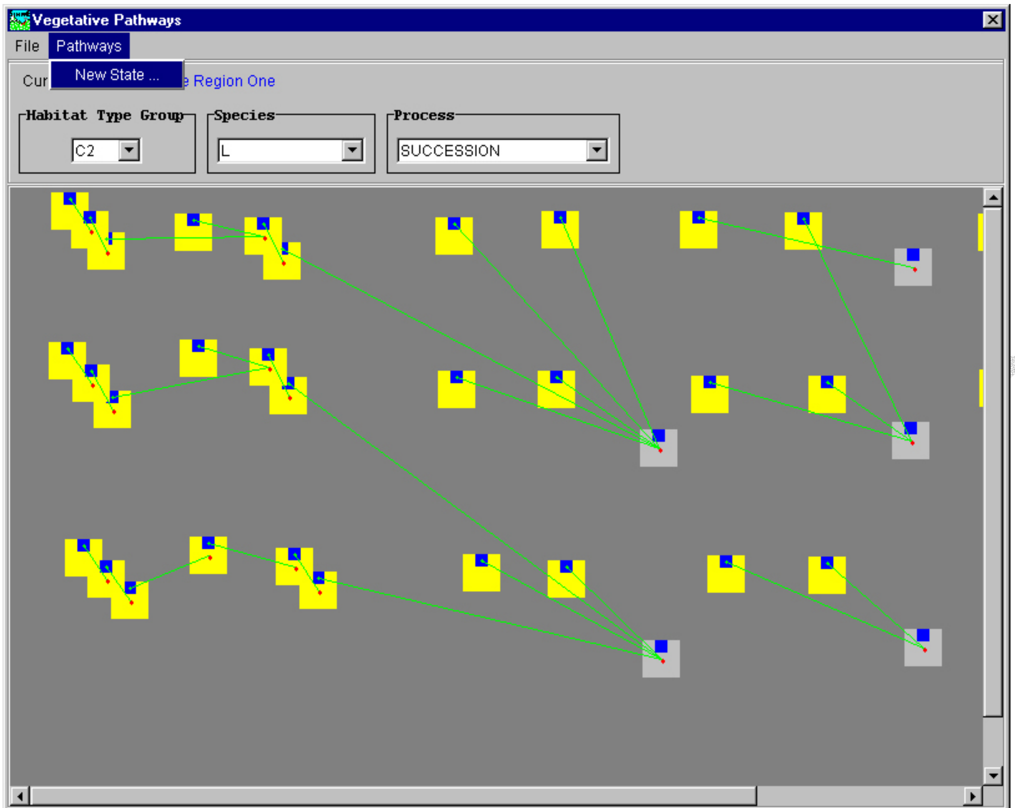


Figure 93 The option to add a new state to a species diagram

This opens up a dialog box to allow a user to add a new state. The following figure shows the addition of a time step 4 to larch /large /3.

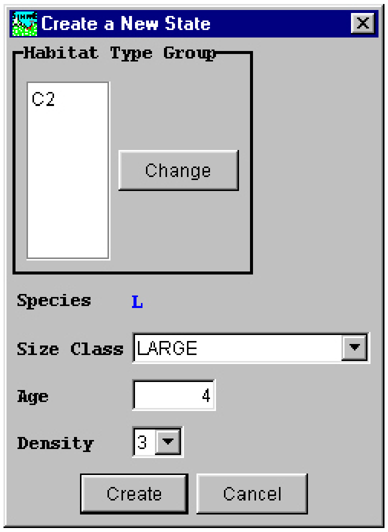


Figure 94 The Create a New State screen

The process of editing can be started by looking at the diagrams. It's often easy to spot errors in logic by turning on the arrows for the different processes. The following screen contains a number of errors. The third decade of the pole, density 3 does not seem to go any where. 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's 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 we were going to call these states larch only, we would never get multi-story stands. If multi-story stands developed, we would have to add another species to the larch.

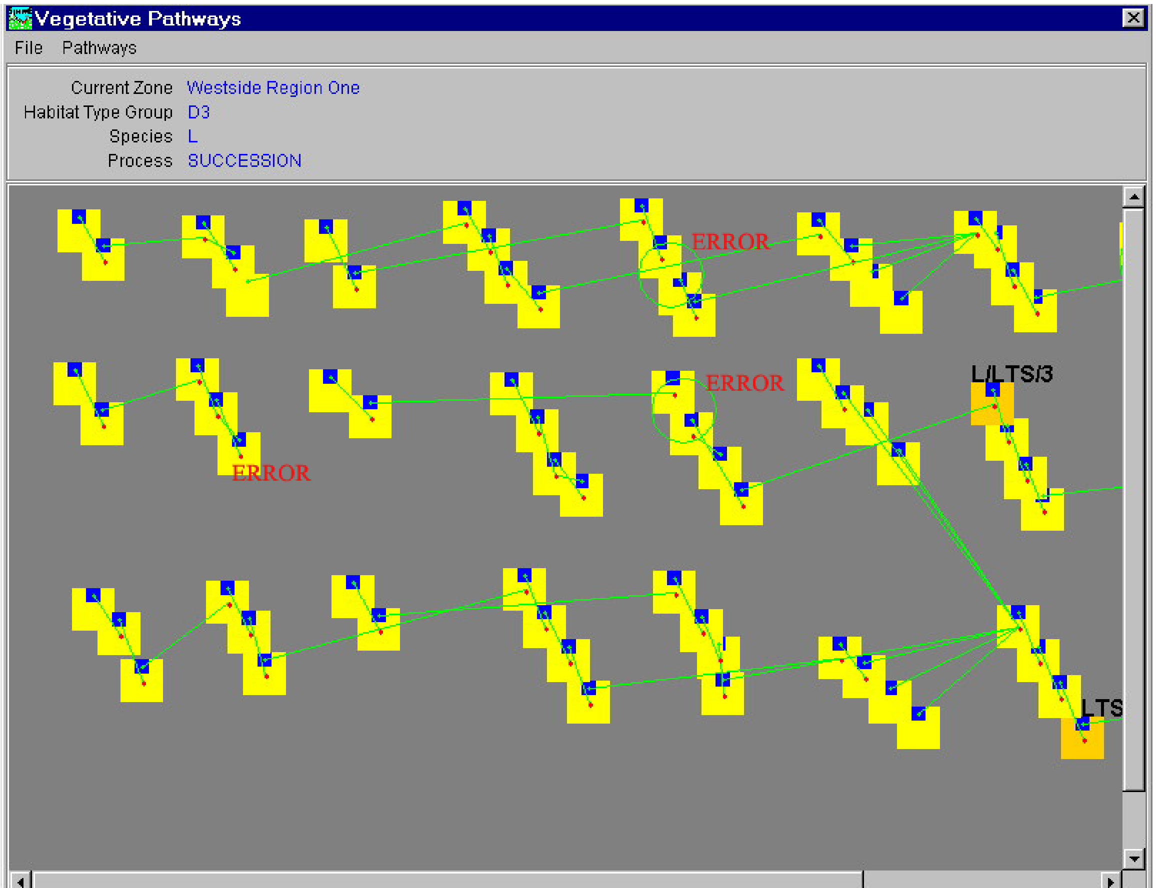


Figure 95 Pathway display showing errors in three different locations. One state that does not have a next-state. Two states that cycle when they should be going to another state.

The red "ERROR" in the above figure has been added by editing the image. The system does not automatically recognize these types of errors and adds the text to the screen.

In the following screen the process displayed is severe-mpb in lodgepole pine. The arrows display that the occurrence in most states completely kills the lodgepole 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 coming in over time 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.

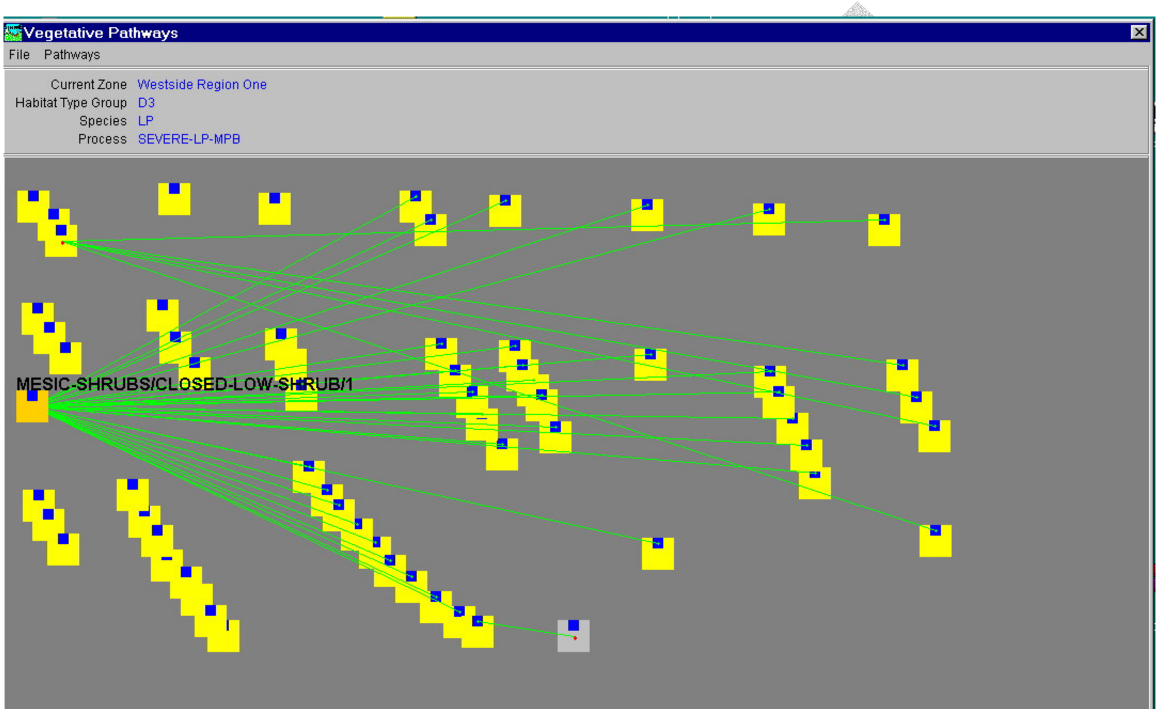
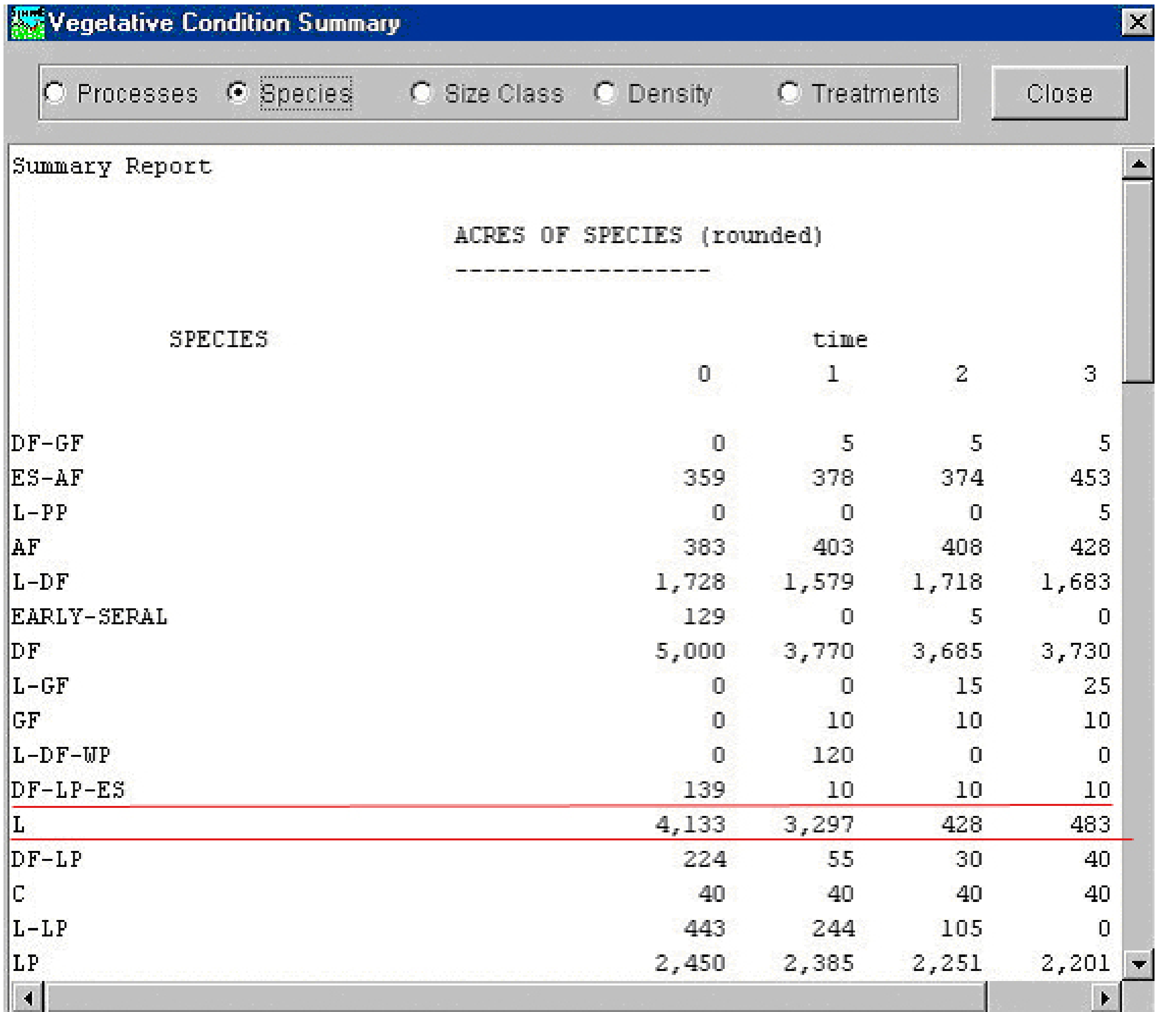


Figure 96 Pathway display showing variability in the next-states resulting from severe lodgepole pine mountain pine beetle.

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 don't appear logical (or even if they do) look at individual units to see how they are responding to disturbance processes.

The "vegetative condition summary" below was selected from the "view results" option shows a rapid loss in larch in the first few decades of the 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 97 Summary display of species showing a rapid loss of acres in larch (L).

The following figure represents a state that changed from a larch type to a larch mixture in two decades as a result of succession.

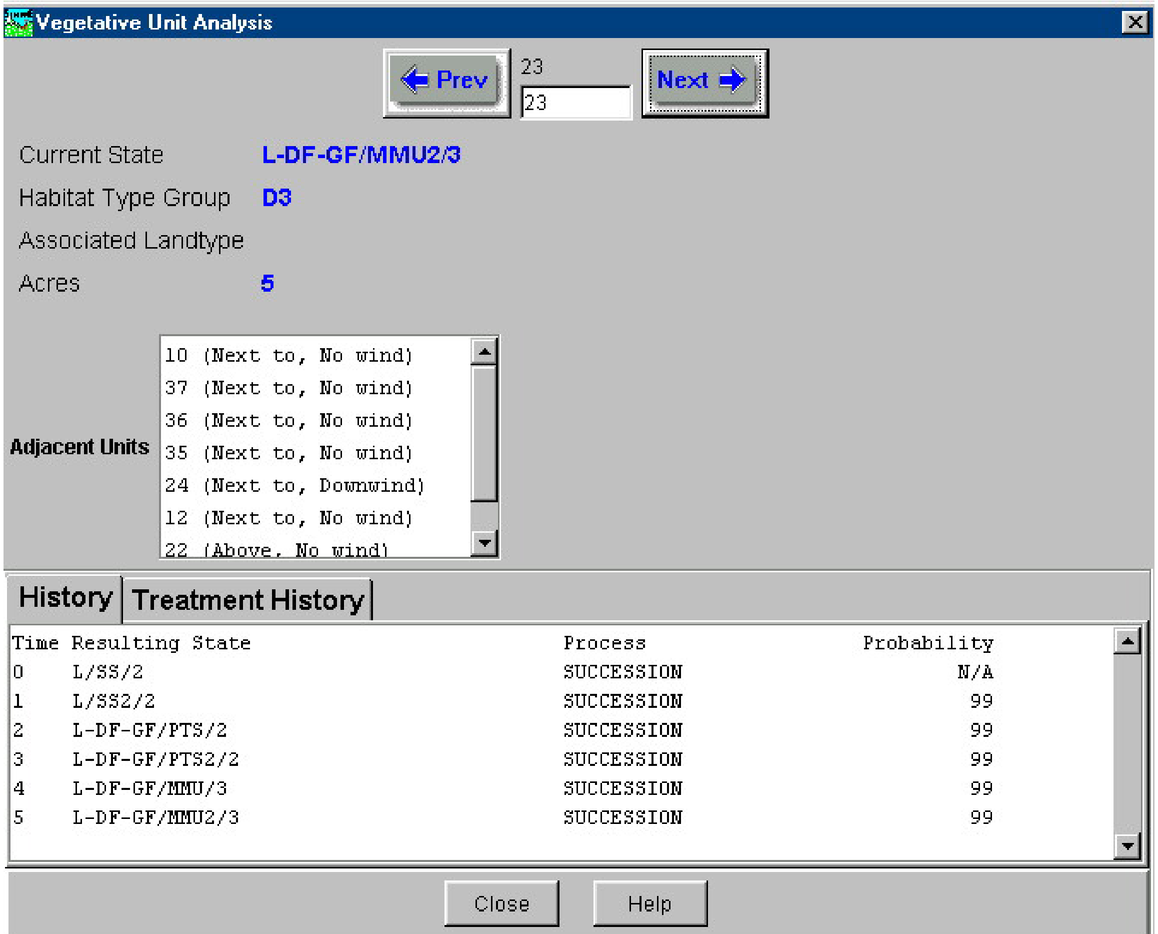


Figure 98 History display showing a change in species in the second time step from L to L-DF-GF.

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 following screen 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. Is this an appropriate impact of severe mpb? Does it kill all of the larger trees? This impact or change of states due to severe-lp-mpb is separate from the probability that the disturbance would occur.

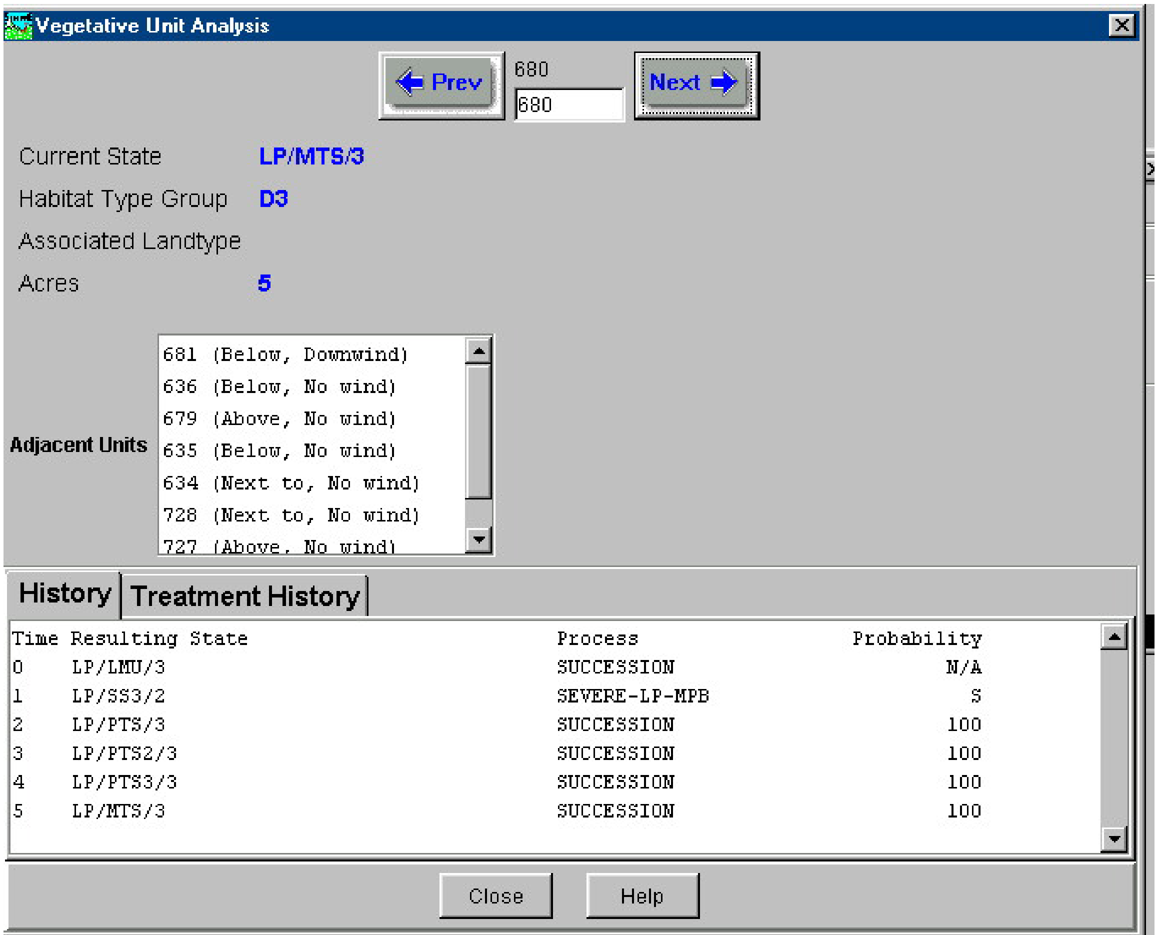


Figure 99 Individual unit history display showing the impact of severe-lp-mpb that spread into this existing-vegetation-unit.

The following example 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. Is this an appropriate time?

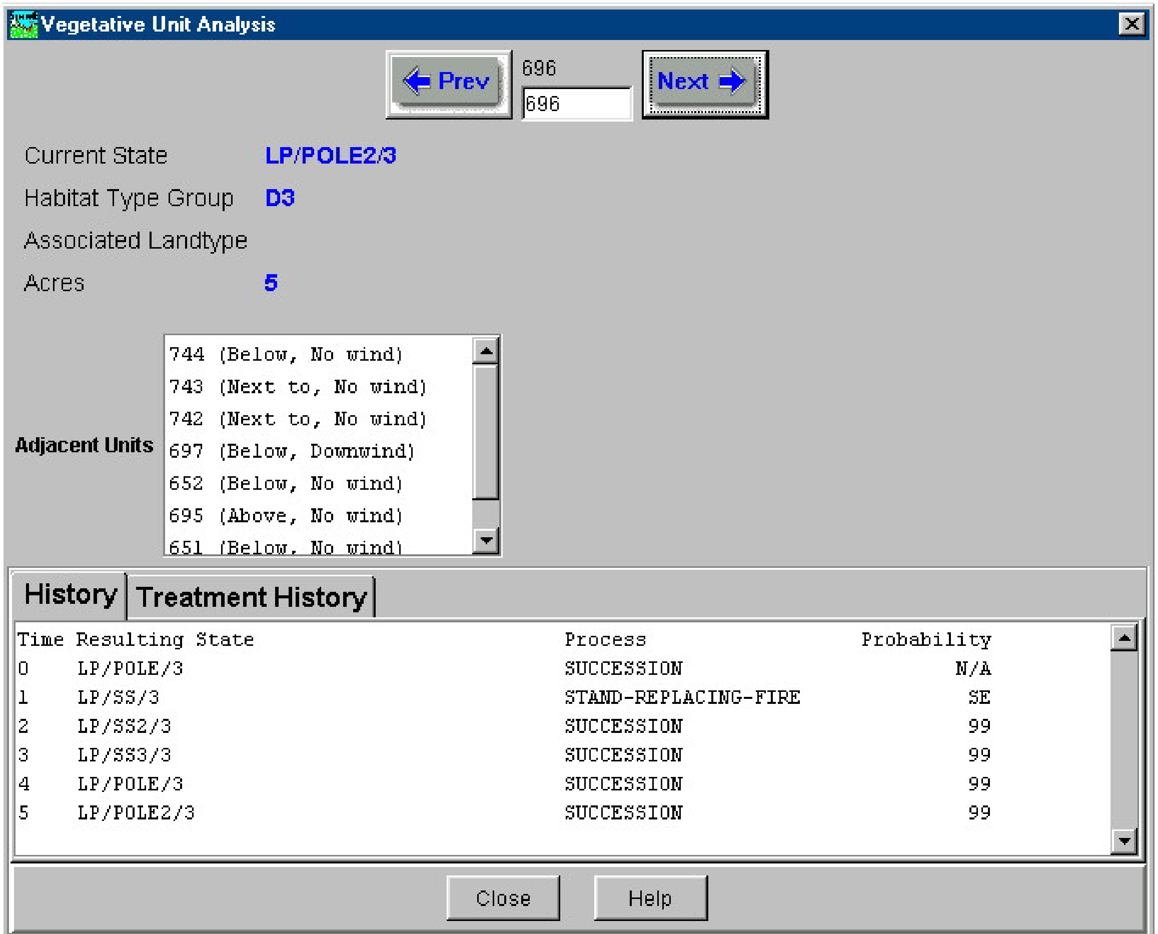


Figure 100 Individual unit history display showing the time to move through seedling and sapling size following a stand replacing fire.

The following plant community is subalpine fir, pole two story. When it burns the pole size subalpine fir is identified as being a seed source. But when it burns again there is no seed source in the stand and apparently none in any of its neighbors so it regenerates to mesic shrubs. It will stay in a shrub state until an adjacent seed source becomes available.

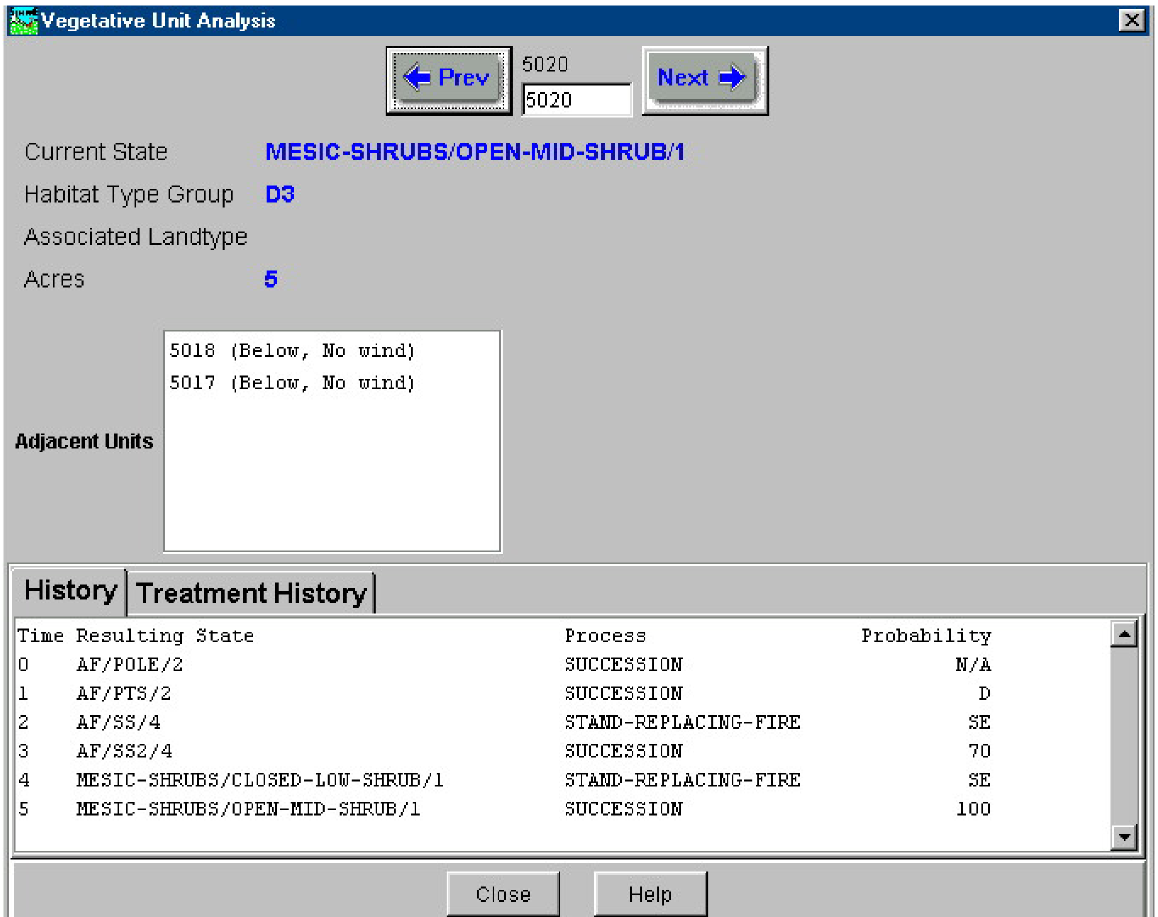


Figure 101 Individual unit history display showing repeated stand replacing fires resulting in a shrub community.

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 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. On many ecological / habitat types we expect to see subalpine fir under lodgepole pine. How many decades does it take until it has developed enough to change our abstraction label from lp/medium/3 to lp-af/mts/3 ?

The second option for editing pathway files is in the text format. "Export pathway to text file" and work within an editor to make changes, then import "import pathway text file" the new file back into SIMPPLLE.

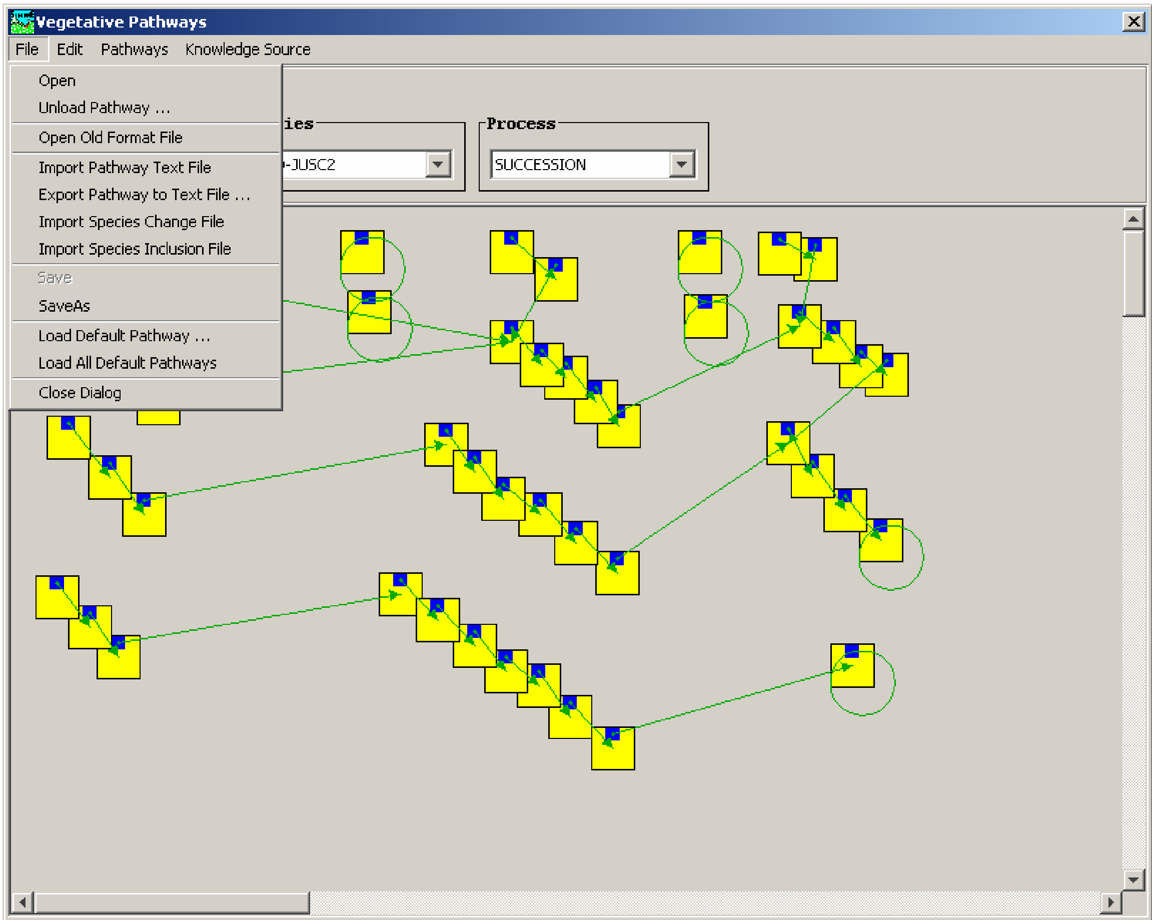


Figure 102 Pathway screen showing the file choice of "Import Pathway Text File".

Once the file is loaded back into SIMPPLLE it must be saved as a "pathway" file using the "SaveAs" choice so it can be loaded in the future by using the "Open" choice.

The format of the exported pathway files is:

```
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 103 Text format of an exported pathway file.

Viewing and Editing Pathways that are Single States

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

The single state represent a species aggregate in which certain species are within defined percentages. The size class and density attributes are not used and are code NA. The following figure represents a single state pathway. The screen provides access to the detailed information on the species aggregate.

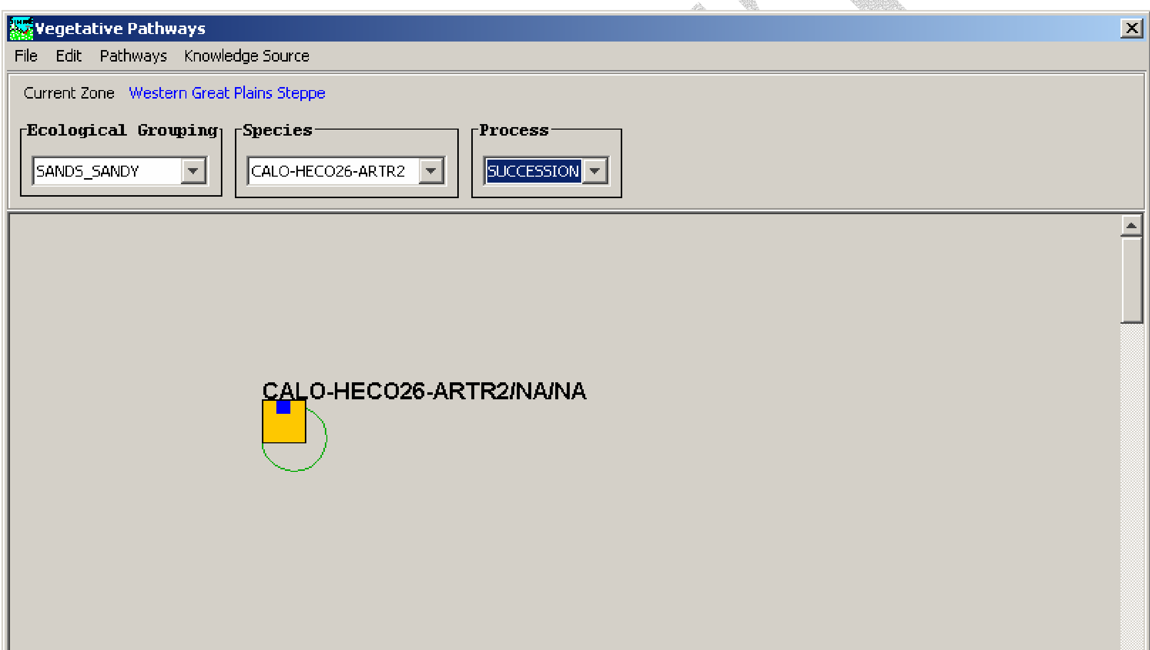


Figure 104 The pathway for the species aggregate of CALO-HECO26-ARTR2.

The only process shown with the pull down arrow under process is succession. By placing the mouse cursor on the state and clicking with the right button access is provided to the information in the pathway. The following figure shows the access to “species change” and “inclusion rules”.

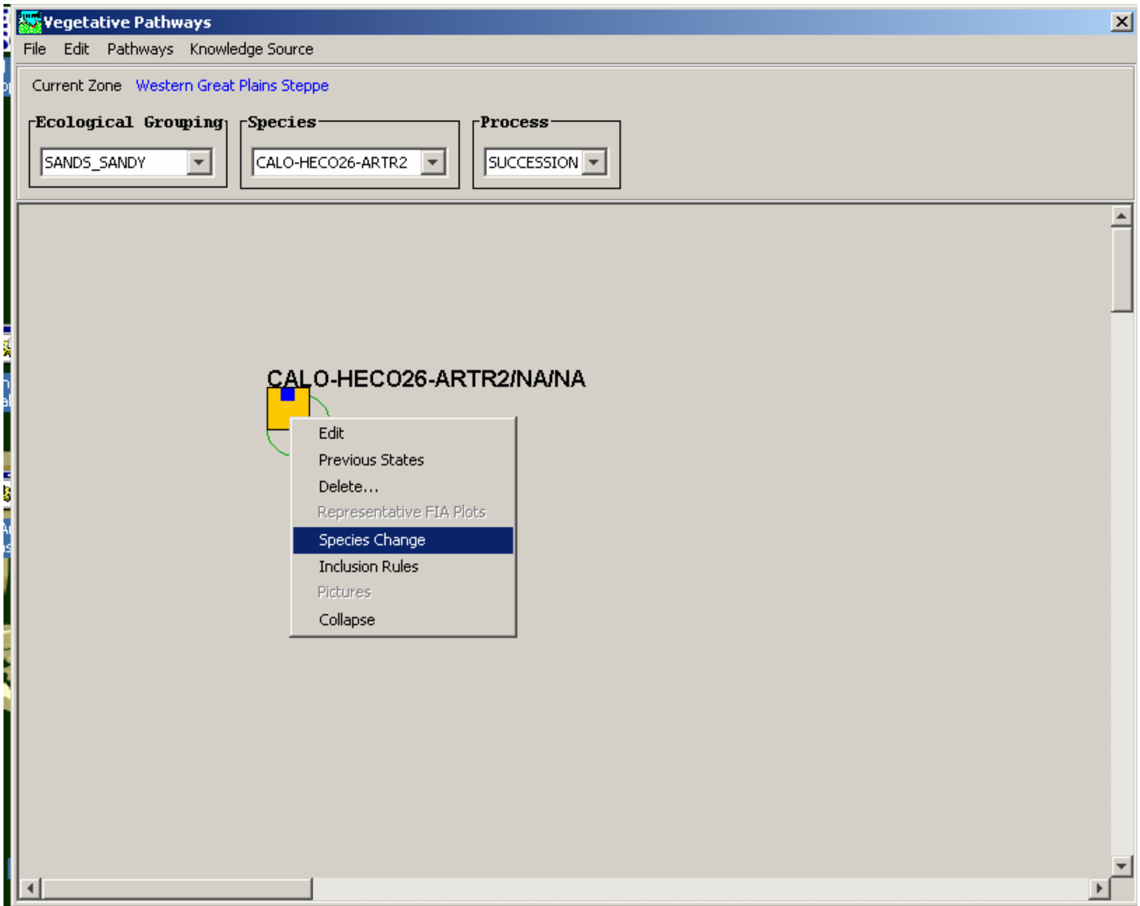


Figure 105 Access to the information stored in a single state pathway format.

The inclusion rule identifies the species and the percents they have to be within for a plant community to be identified as this state. The following figure shows the inclusion rule format. The percentages can be edited in the screen. The Action choice on the menu bar allows a user to "add" an entry which makes a line for a species that already exists in the system. 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.

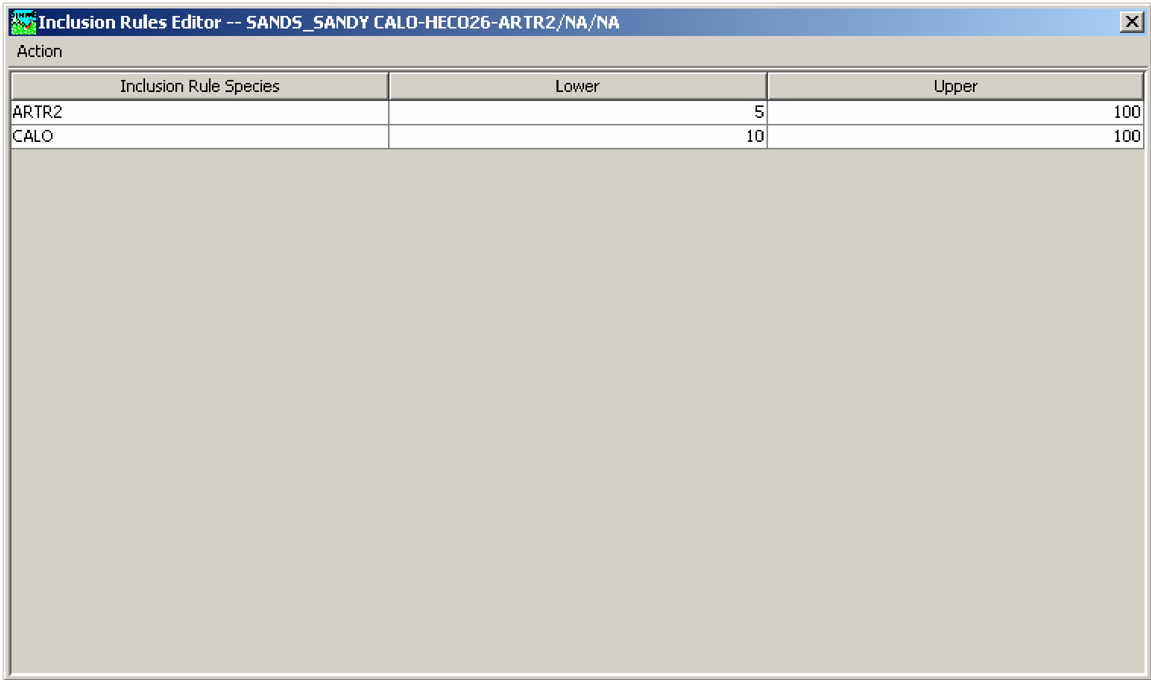
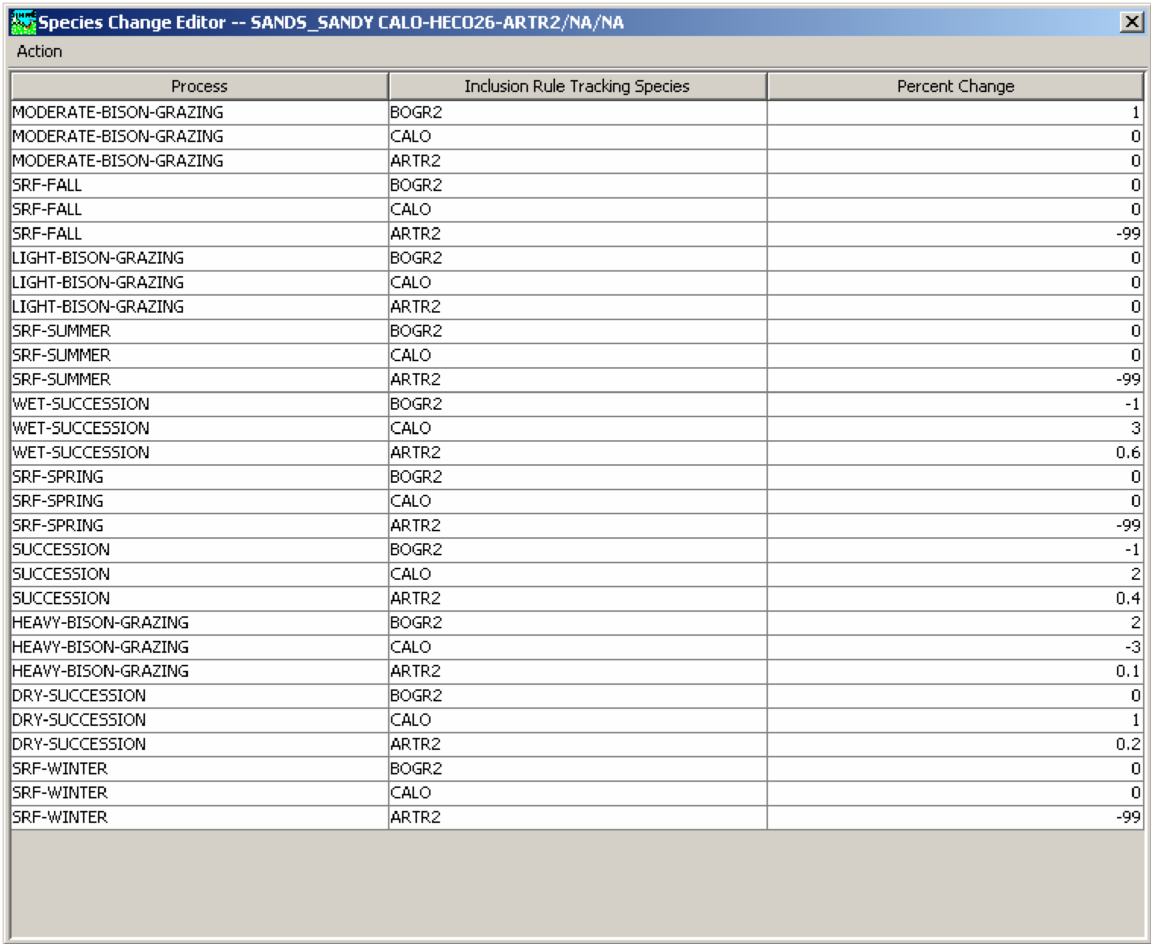


Figure 106 Inclusion rule for a specific state identifying what species at what percents are required for a plant community to be identified as this state.

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. The following figure 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 changes put 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 yearly. It is not cumulative. The values can be less than whole percents. Future version may provide more complexity to the change by making it possible to assign functions.



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 107 The rate of change for each species by each process.

The “Action” choice provides editing capability. Changing the percents can be done directly.

The pathway files can be built outside of SIMPPLLE and imported by the choices shown in the following figure. Once they have been loaded into SIMPPLLE it is best to save them out with the “Save As” that puts them in the SIMPPLLE format with an extension of *.sk_pathway.

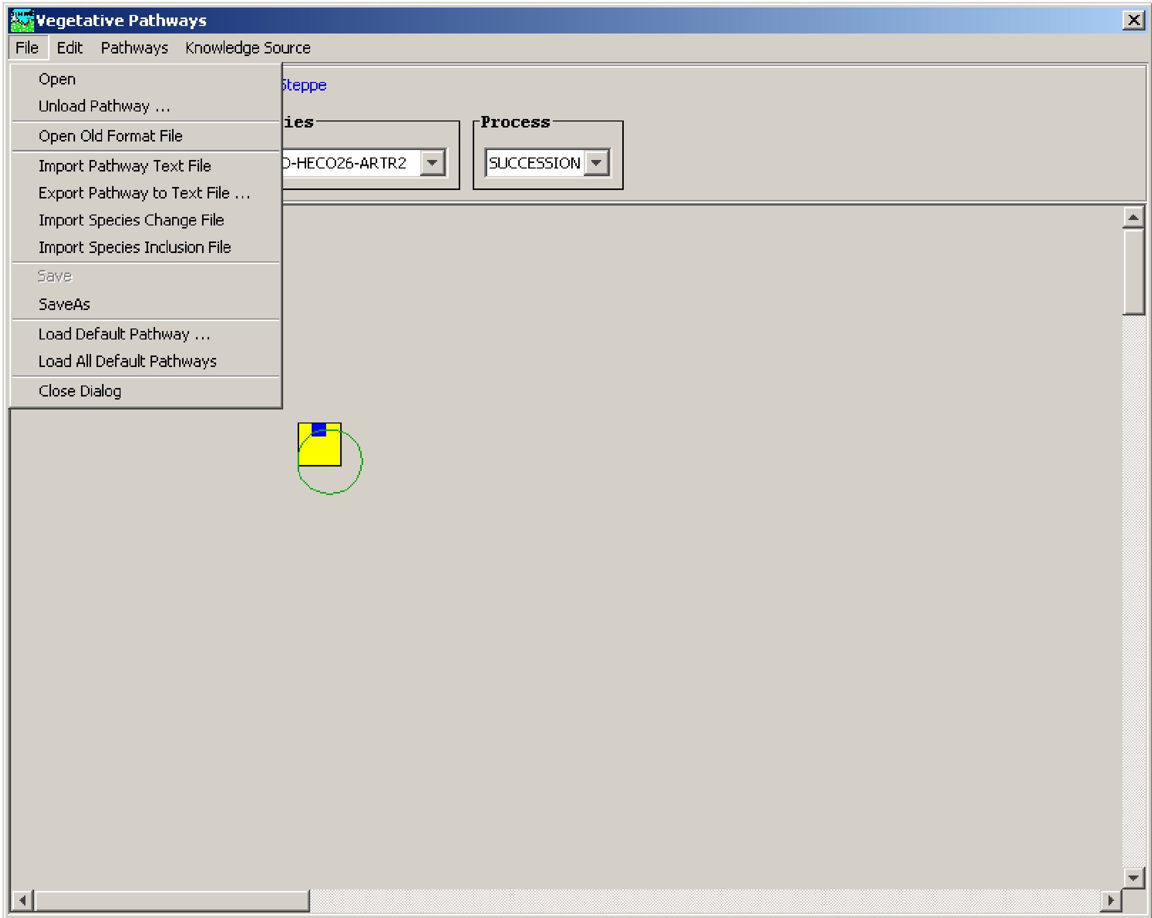


Figure 108 Shows the choices of importing change and inclusion files that are built outside of SIMPPLLE.

Using this pathway format requires 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 cover 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 be easily 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. The files for both the species change and inclusion rule can be build in an Excel spread sheet, saved out as a text file and imported into SIMPPLLE using options that can be seen in the above figure. The text file for the species changes has to be tab delimited (txt) and the file for the inclusion rule has to be comma delimited (.csv)

PATHWAYS - AQUATICS

Only used in early version for a prototype, Westside Region One geographic zone. A limited discussion is in the appendix for the Westside Region One zone.

PROCESSES – VEGETATION

There are some differences between zones. We will go through the sequence seen in the pull down screens. Not all of the processes exist for all zones. Examples from different zones will be used.

Locking in disturbance processes

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 stochastic. Or by choosing the “succession” choice 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.

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 a 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.
The system choices needed to lock-in a specific disturbance process to a plant community and time step can be seen in the following figure.

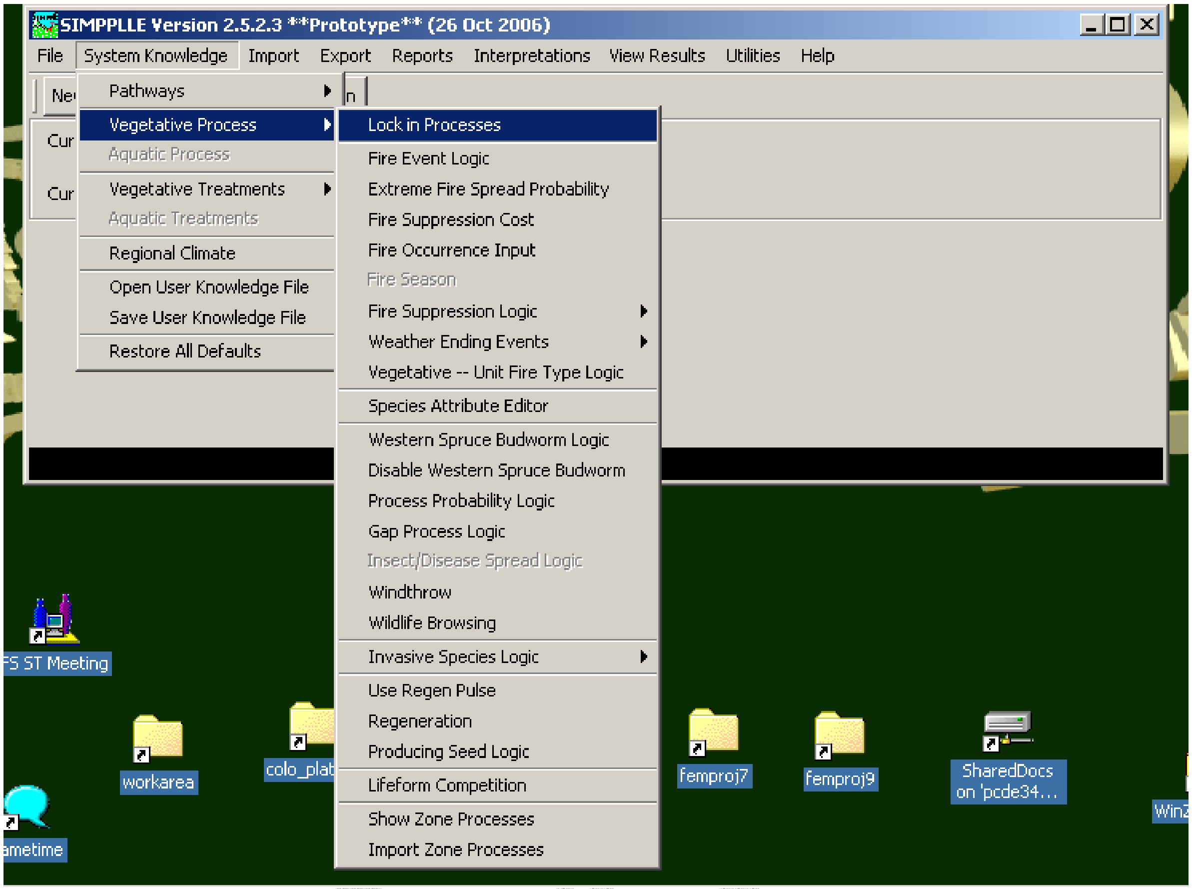


Figure 109 Choices made in SIMPPLLE menus to get to the screen needed to lock-in specific disturbance processes

In using the screen for "process schedule" the user creates combinations of "time step, process, and unit ids. Each combination represents an entry that is created by using the "new" file choice or the "copy current process" file choice. The "prev" and "next" can be used to move through the combinations you have created.

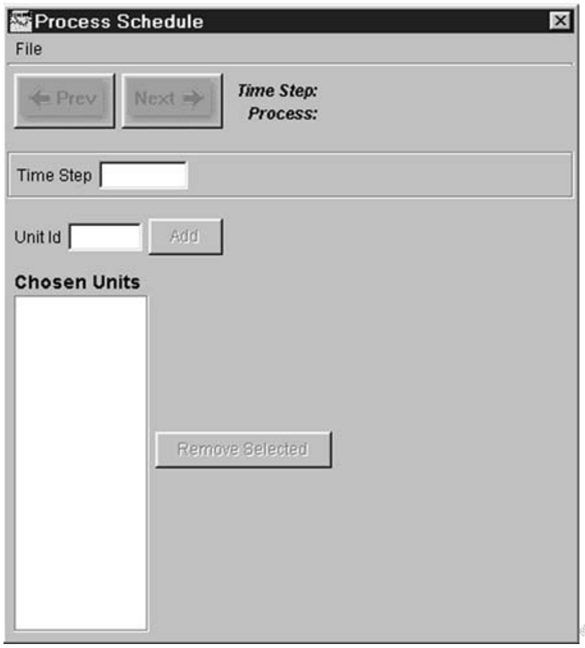


Figure 110 SIMPPLLE screen for scheduling disturbance processes

To create a schedule for the first time, select “New” from the “File” drop down menu as shown in Figure 22.

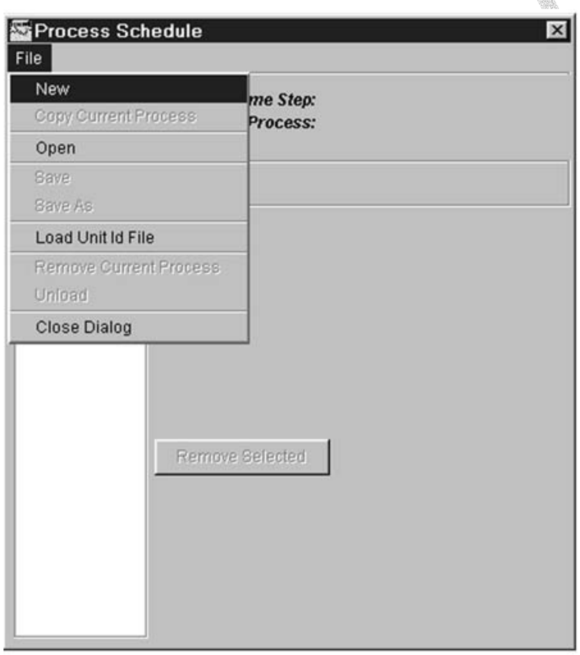


Figure 111 Choices under the “File” pull down menu on the “Process Schedule” main screen

This combination of choices opens up a dialog box from which a user can choose a process

Figure 112 SIMPPLLE screen listing all disturbance process that can be locked-in for a specific zone

The selected process is added to the screen. Notice with the fire processes a choice of "fire-event" shows up as a process. 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 needs to be entered followed by the "enter" key. The plant community id values (slink numbers) are then entered in by typing the number and selecting the "Add" button.

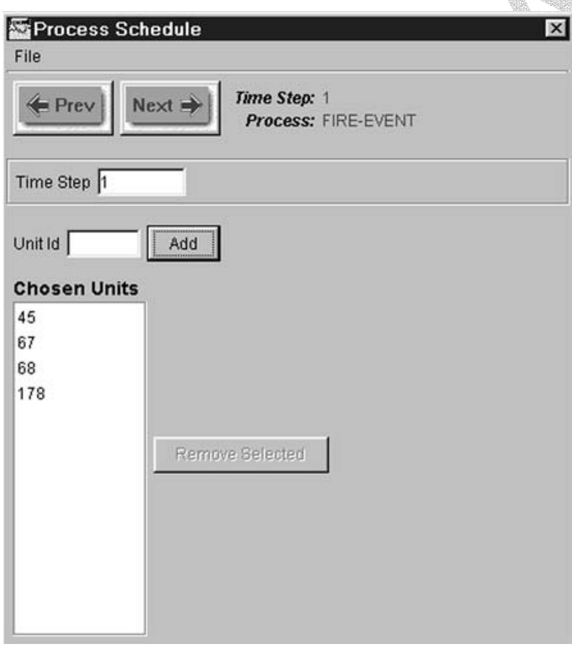


Figure 113 A completed SIMPPLLE screen that locks-in the "fire-event" process for time step 1 for four vegetation units

If a user wants to schedule the same process for additional time steps, the choice of "copy current process" from the "File" drop down menu is used.

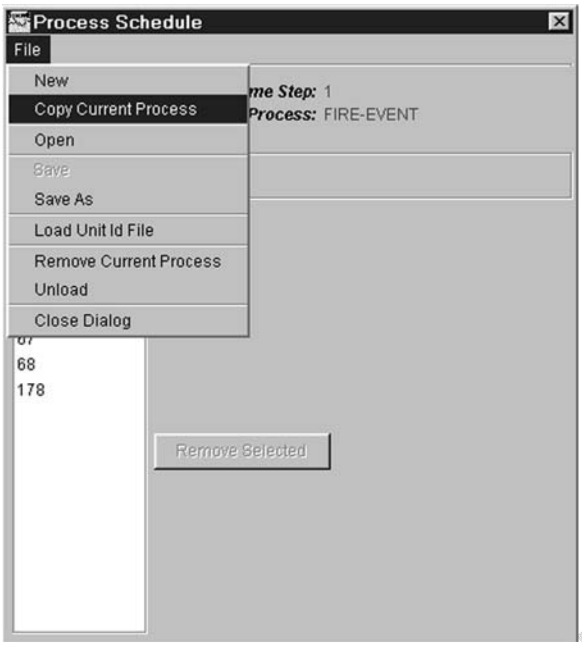


Figure 114 The choice needed to copy a locked-in process to apply to another time step.

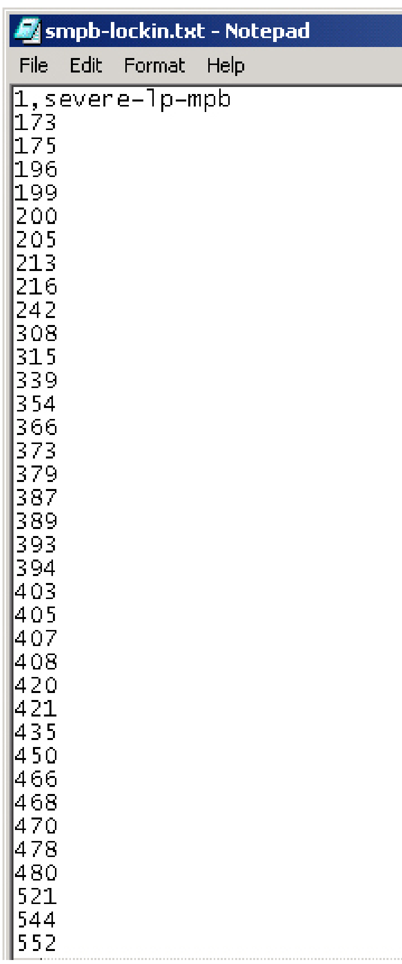
This choice changes the screen to have the same process and the same units scheduled, but the time step is blank and you need to enter the desired time step. If you don't want the same exact units scheduled you can use the "add" or the "remove selected" buttons to modify. You can repeat this process to create as many combinations of "times step, process and unit id lists" as desired. The "Prev" and "Next" buttons can be used to move between these combinations you have created if you want to do any additional editing of the unit ids. If you want to add a different process, this amounts to creating a "new" combination of the "time step, process, and unit id list" so you have to go back to the "File" drop down menu". Choose the desired process from the next screen that appears and you're back to the point of having to add the time step and the unit ids.

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, go to the "file" drop down menu and choose "close-dialog". If at any time in the process of creating a lock-in schedule you want to remove all the combinations you made and start over, or just forget it, or remove them to make simulations without them, under the "file" drop down menu, choose "unload". If you want to remove a combination currently displayed you can select "remove current process".

If you want to save this lock-in schedule so it can be loaded in the future for other SIMPPLLE sessions, without having to reenter everything, you will need to save using the "SAVE AS" choice under the "file" drop down menu. 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 the "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 if you want to use it you will have to go to the "file" drop down menu and select "open". This opens a screen at the working directory and identifies all the *.process files you have created and saved.

Another option under the file pull down menu is "Load Unit Id File". This is a file that can be created outside of SIMPPLLE and is in a text format. It should be named with a file extension of ".txt". The format for the file is shown in the following figure.




```
1,severe-lp-mpb
173
175
196
199
200
205
213
216
242
308
315
339
354
366
373
379
387
389
393
394
403
405
407
408
420
421
435
450
466
468
470
478
480
521
544
552
```

Figure 115 Example of a text formatted file for locking-in a process to specific plant communities

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. The following figure illustrates how SIMPPLLE models the fire process and identifies where information can be adjusted by the user.

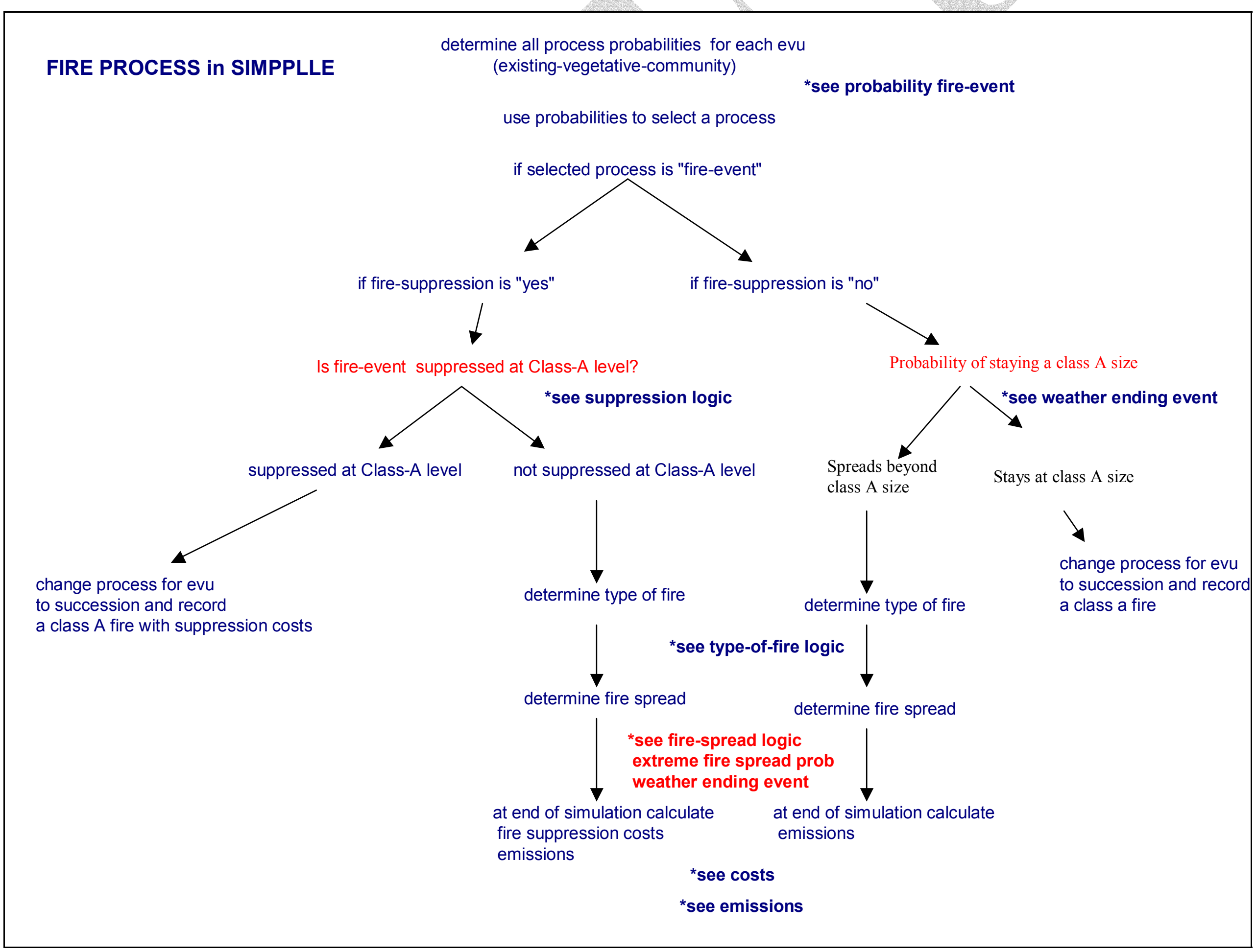


Figure 116 Diagram of the steps used by SIMPPLLE in modeling the fire process

All of the fire logic is accessible through the user interface screens.

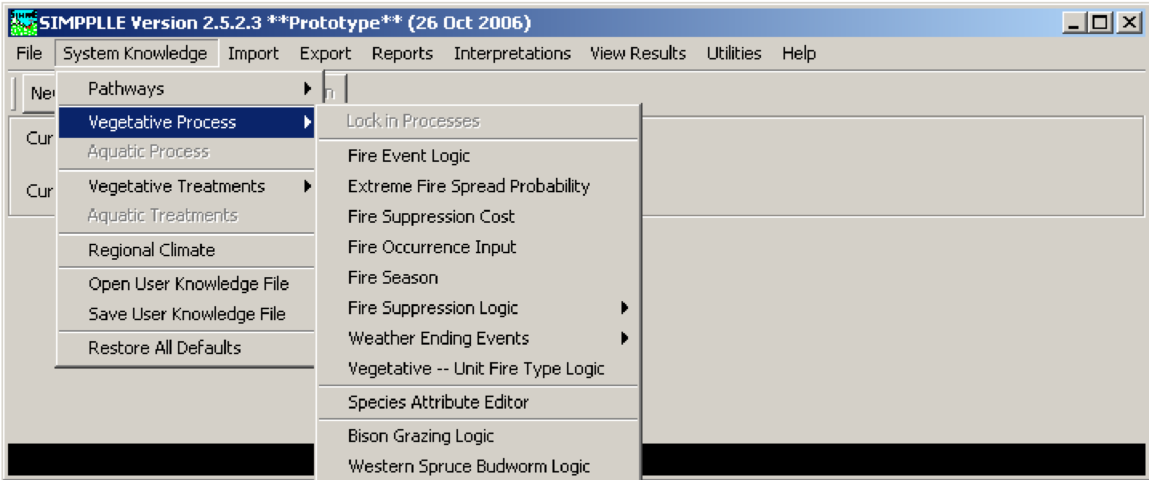


Figure 117 Access to the fire process logic

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). 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. SIMPPLLE uses the number of fires for a past ten year period divided by the total acres that the number of fires occurred on. The fires are listed by size class but the 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. The distribution of past fires is used to provide the basis for suppression costs which usually varies by fire size class.

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.

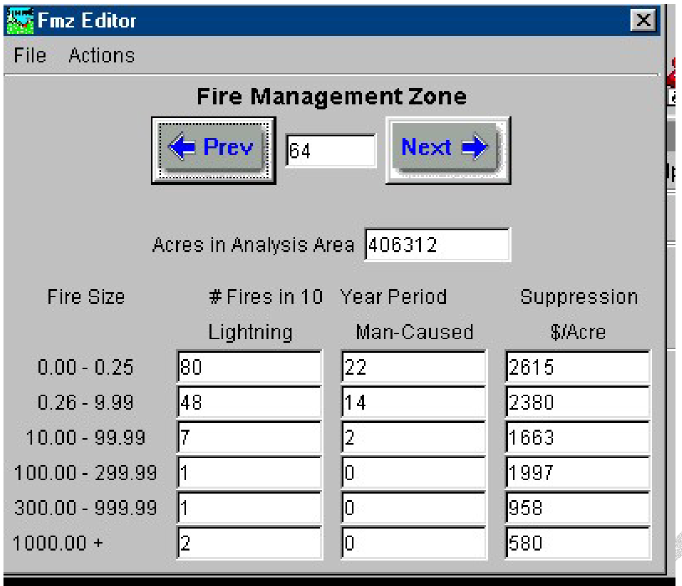


Figure 118 The fmz editor screen showing both the number of fires for a past 10 year period and the suppression cost per acre. The values can vary by fire management zone

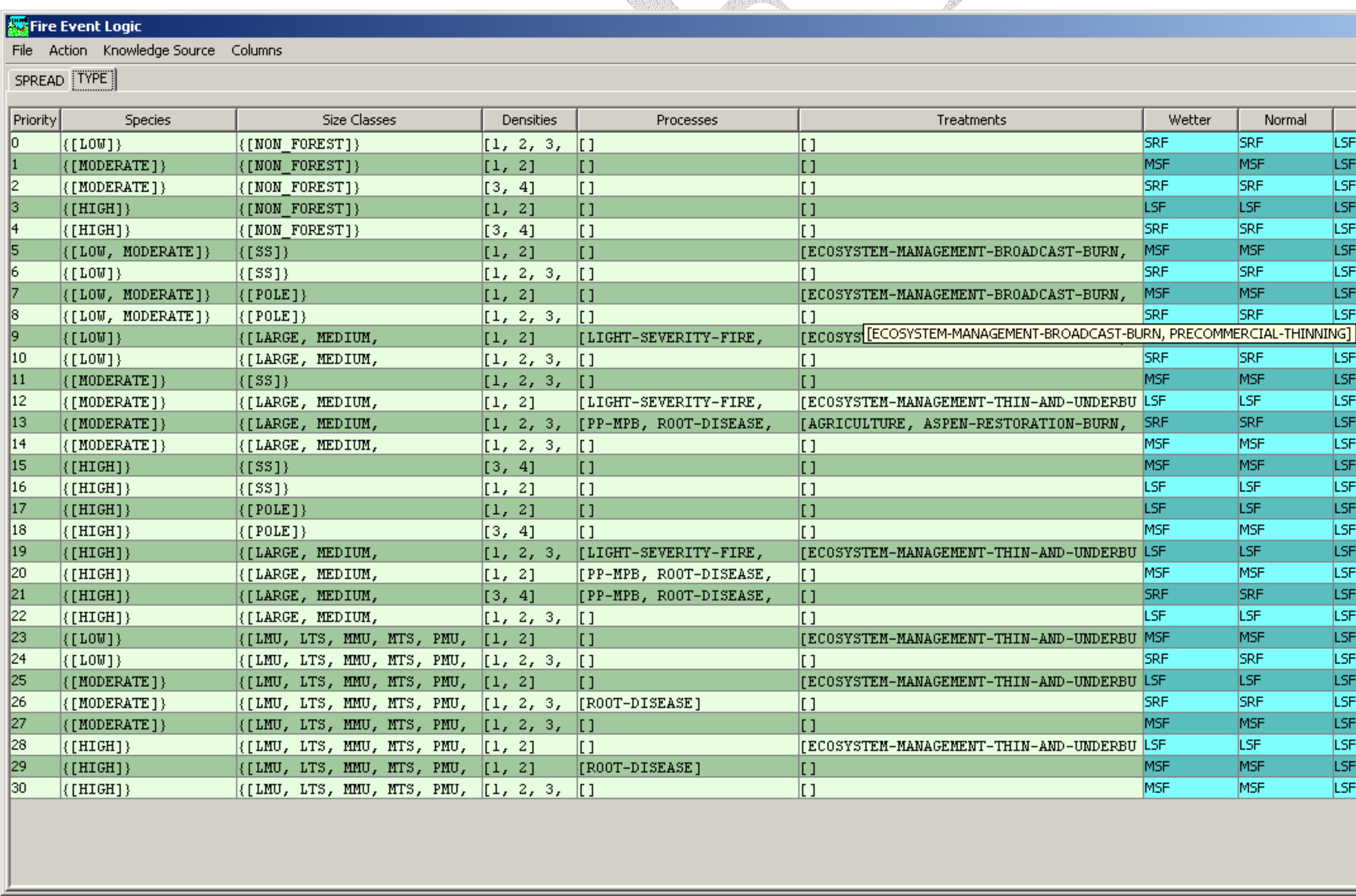
As the demand for utilizing fire suppression costs increases, we will create a separate screen for the interaction of costs with other variables.

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

Fire Event Logic

Fire event logic is separated into two components, type of fire and fire spread. The user interface screens used for representation of this knowledge have evolved significantly over the SIMPPLLE versions. The intent is to capture from what ever source, using fine scale models on sample plant communities and landscape and expert opinion from fire specialist, in a set of logic rules.

If a “fire event” is not kept at less than .25 acres by either suppression or weather ending events, the logic utilizes what is in the “type of fire” screens to identify the type of fire in the plant community that has the origin of the event.

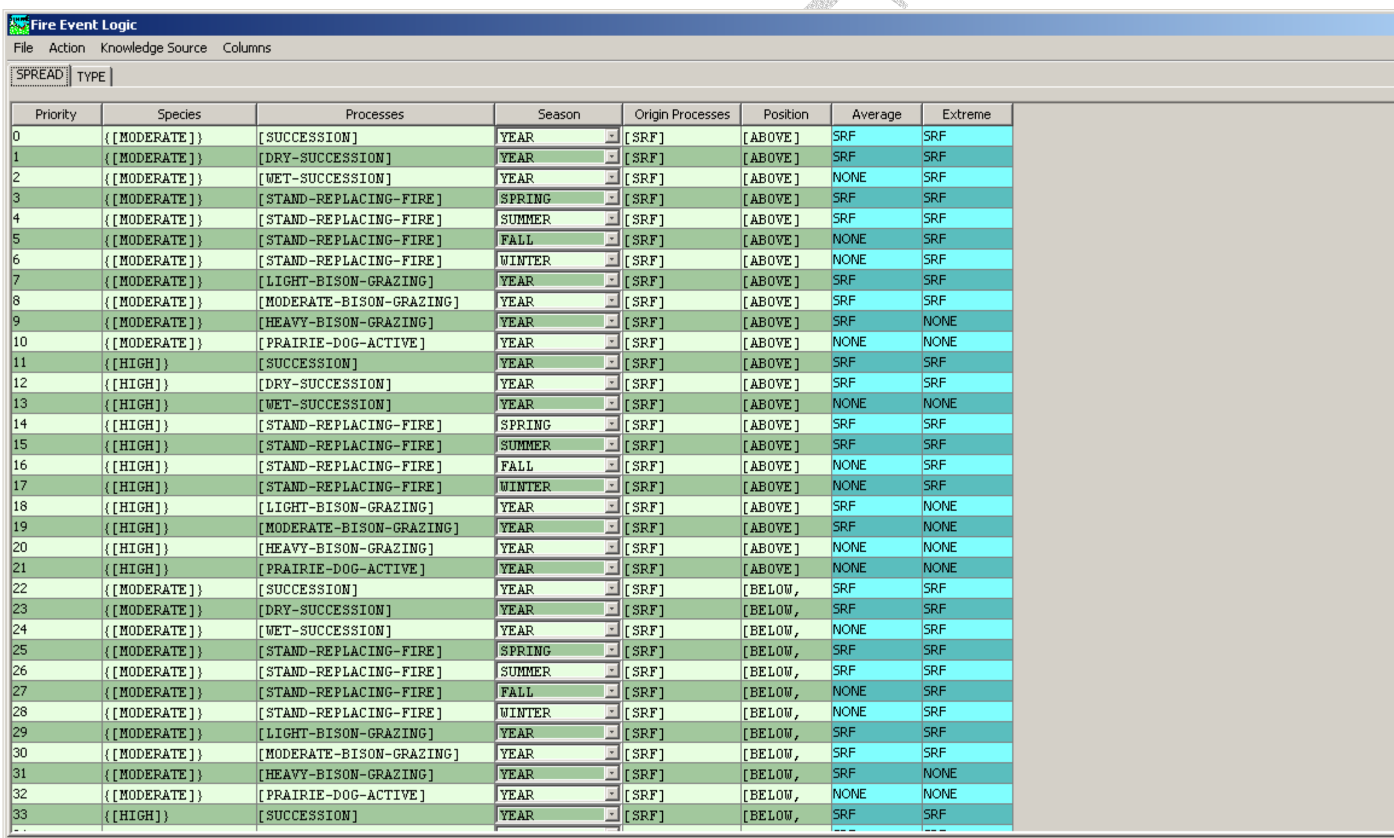


Priority	Species	Size Classes	Densities	Processes	Treatments	Wetter	Normal	
0	{[LOW]}	{[NON_FOREST]}	[1, 2, 3,	[]	[]	SRF	SRF	LSF
1	{[MODERATE]}	{[NON_FOREST]}	[1, 2]	[]	[]	MSF	MSF	LSF
2	{[MODERATE]}	{[NON_FOREST]}	[3, 4]	[]	[]	SRF	SRF	LSF
3	{[HIGH]}	{[NON_FOREST]}	[1, 2]	[]	[]	LSF	LSF	LSF
4	{[HIGH]}	{[NON_FOREST]}	[3, 4]	[]	[]	SRF	SRF	LSF
5	{[LOW, MODERATE]}	{[SS]}	[1, 2]	[]	[ECOSYSTEM-MANAGEMENT-BROADCAST-BURN,	MSF	MSF	LSF
6	{[LOW]}	{[SS]}	[1, 2, 3,	[]	[]	SRF	SRF	LSF
7	{[LOW, MODERATE]}	{[POLE]}	[1, 2]	[]	[ECOSYSTEM-MANAGEMENT-BROADCAST-BURN,	MSF	MSF	LSF
8	{[LOW, MODERATE]}	{[POLE]}	[1, 2, 3,	[]	[]	SRF	SRF	LSF
9	{[LOW]}	{[LARGE, MEDIUM,	[1, 2]	[LIGHT-SEVERITY-FIRE,	[ECOSYS [ECOSYSTEM-MANAGEMENT-BROADCAST-BURN, PRECOMMERCIAL-THINNING]			
10	{[LOW]}	{[LARGE, MEDIUM,	[1, 2, 3,	[]	[]	SRF	SRF	LSF
11	{[MODERATE]}	{[SS]}	[1, 2, 3,	[]	[]	MSF	MSF	LSF
12	{[MODERATE]}	{[LARGE, MEDIUM,	[1, 2]	[LIGHT-SEVERITY-FIRE,	[ECOSYSTEM-MANAGEMENT-THIN-AND-UNDERBU	LSF	LSF	LSF
13	{[MODERATE]}	{[LARGE, MEDIUM,	[1, 2, 3,	[PP-MPB, ROOT-DISEASE,	[AGRICULTURE, ASPEN-RESTORATION-BURN,	SRF	SRF	LSF
14	{[MODERATE]}	{[LARGE, MEDIUM,	[1, 2, 3,	[]	[]	MSF	MSF	LSF
15	{[HIGH]}	{[SS]}	[3, 4]	[]	[]	MSF	MSF	LSF
16	{[HIGH]}	{[SS]}	[1, 2]	[]	[]	LSF	LSF	LSF
17	{[HIGH]}	{[POLE]}	[1, 2]	[]	[]	LSF	LSF	LSF
18	{[HIGH]}	{[POLE]}	[3, 4]	[]	[]	MSF	MSF	LSF
19	{[HIGH]}	{[LARGE, MEDIUM,	[1, 2, 3,	[LIGHT-SEVERITY-FIRE,	[ECOSYSTEM-MANAGEMENT-THIN-AND-UNDERBU	LSF	LSF	LSF
20	{[HIGH]}	{[LARGE, MEDIUM,	[1, 2]	[PP-MPB, ROOT-DISEASE,	[]	MSF	MSF	LSF
21	{[HIGH]}	{[LARGE, MEDIUM,	[3, 4]	[PP-MPB, ROOT-DISEASE,	[]	SRF	SRF	LSF
22	{[HIGH]}	{[LARGE, MEDIUM,	[1, 2, 3,	[]	[]	LSF	LSF	LSF
23	{[LOW]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[]	[ECOSYSTEM-MANAGEMENT-THIN-AND-UNDERBU	MSF	MSF	LSF
24	{[LOW]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2, 3,	[]	[]	SRF	SRF	LSF
25	{[MODERATE]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[]	[ECOSYSTEM-MANAGEMENT-THIN-AND-UNDERBU	LSF	LSF	LSF
26	{[MODERATE]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2, 3,	[ROOT-DISEASE]	[]	SRF	SRF	LSF
27	{[MODERATE]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2, 3,	[]	[]	MSF	MSF	LSF
28	{[HIGH]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[]	[ECOSYSTEM-MANAGEMENT-THIN-AND-UNDERBU	LSF	LSF	LSF
29	{[HIGH]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[ROOT-DISEASE]	[]	MSF	MSF	LSF
30	{[HIGH]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2, 3,	[]	[]	MSF	MSF	LSF

Figure 119 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.

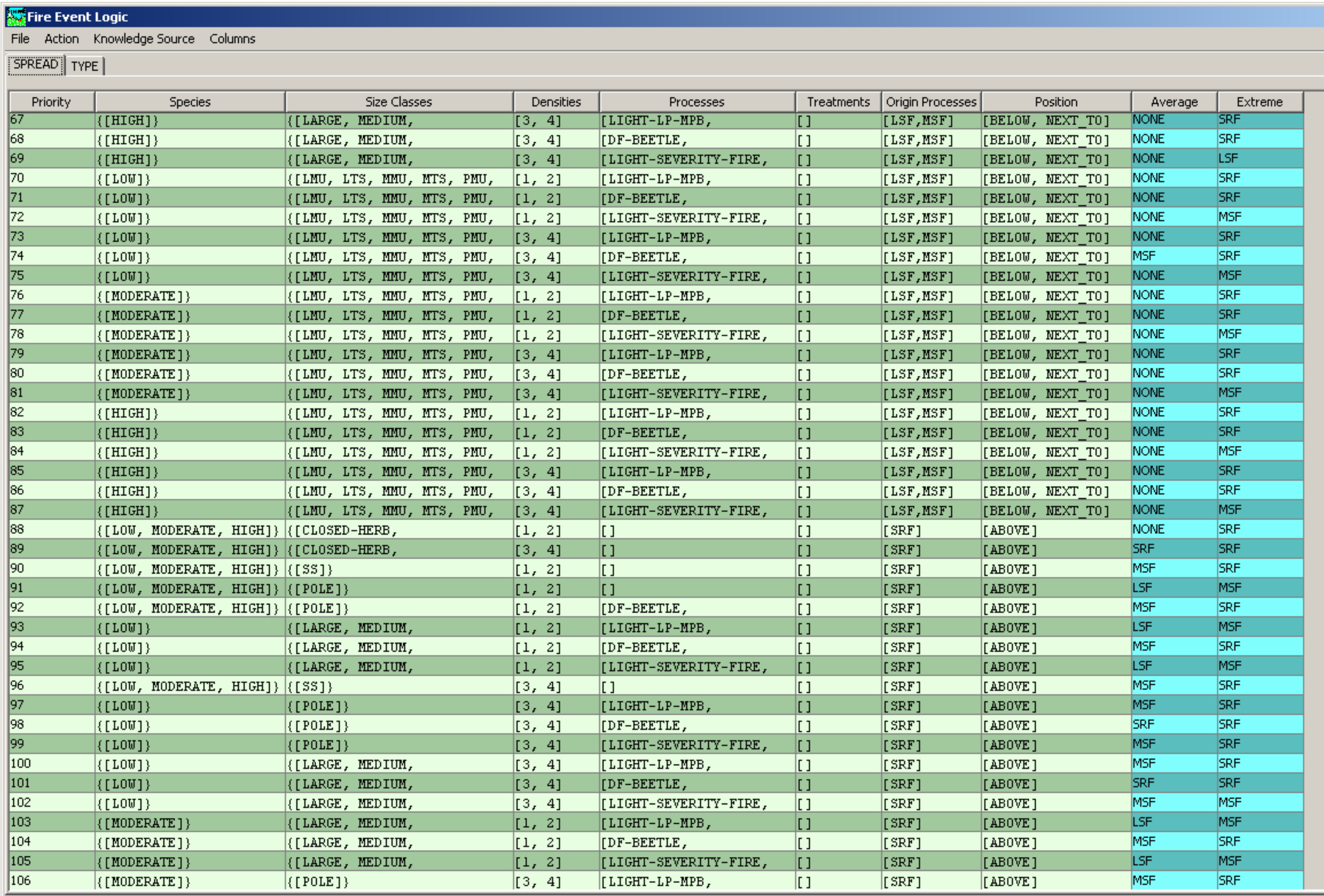
As the fire event spreads to adjacent plant communities, the logic in the fire spread screen is used. As with any of the system’s logic screens, they can be as simply as desired or made rather complex. The “columns” choice is available on the menu bar for including as much of the system knowledge as is appropriate. For example the below figure is for one of the grassland areas in which the only type of fire is stand replacing fire (srf).



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

The following figure displays a greater number of logic rules 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]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
71	{[LOW]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
72	{[LOW]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF
73	{[LOW]}	{[LMU, LTS, MMU, MTS, PMU,	[3, 4]	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
74	{[LOW]}	{[LMU, LTS, MMU, MTS, PMU,	[3, 4]	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	MSF	SRF
75	{[LOW]}	{[LMU, LTS, MMU, MTS, PMU,	[3, 4]	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF
76	{[MODERATE]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
77	{[MODERATE]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
78	{[MODERATE]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF
79	{[MODERATE]}	{[LMU, LTS, MMU, MTS, PMU,	[3, 4]	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
80	{[MODERATE]}	{[LMU, LTS, MMU, MTS, PMU,	[3, 4]	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
81	{[MODERATE]}	{[LMU, LTS, MMU, MTS, PMU,	[3, 4]	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF
82	{[HIGH]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
83	{[HIGH]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
84	{[HIGH]}	{[LMU, LTS, MMU, MTS, PMU,	[1, 2]	[LIGHT-SEVERITY-FIRE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	MSF
85	{[HIGH]}	{[LMU, LTS, MMU, MTS, PMU,	[3, 4]	[LIGHT-LP-MPB,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
86	{[HIGH]}	{[LMU, LTS, MMU, MTS, PMU,	[3, 4]	[DF-BEETLE,	[]	[LSF,MSF]	[BELOW, NEXT_TO]	NONE	SRF
87	{[HIGH]}	{[LMU, LTS, MMU, 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 121 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).

Extreme Fire Spread Probability

Burning conditions within SIMPPLLE have been simplified to represent "average conditions" and extreme conditions that represent wind driven fire events. If users request it, the average conditions could be expanded in future version to represent a range of burning conditions. 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 a screen displayed in the following figure.

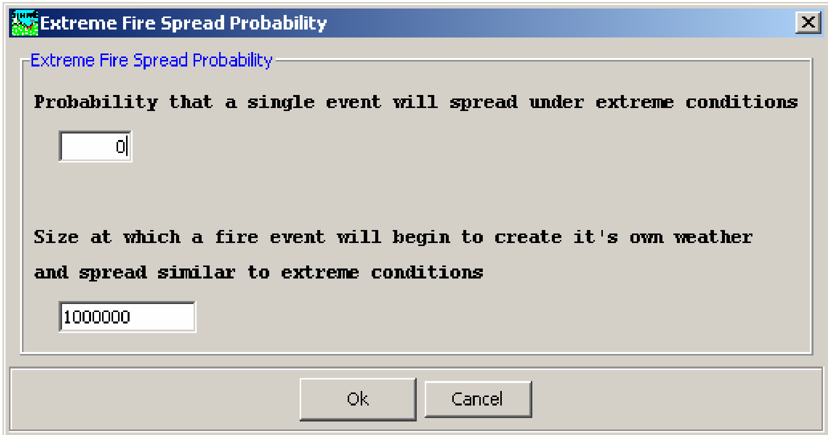


Figure 122 Screen that provides the means to change default values controlling the probability that a fire event will spread under extreme conditions.

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.

Fire Suppression

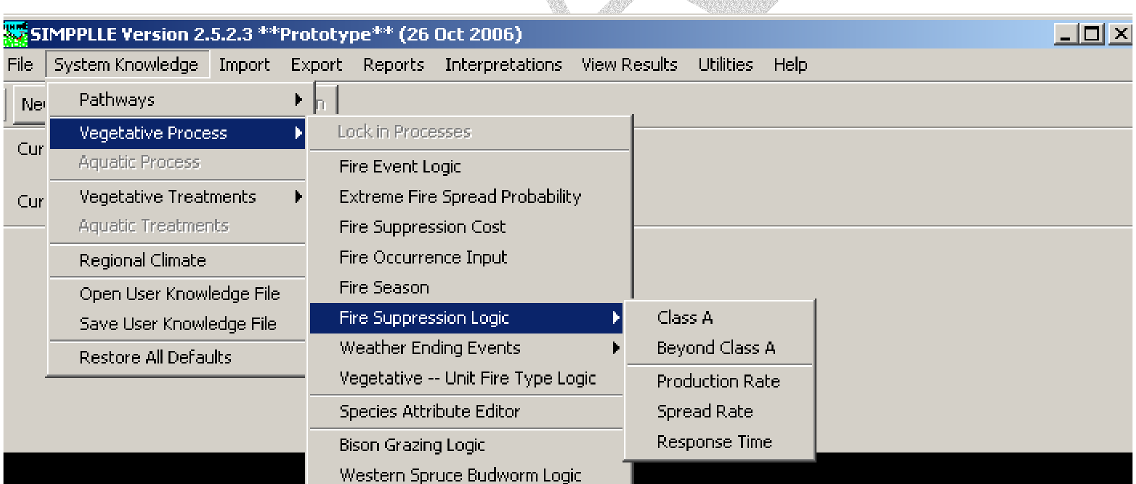
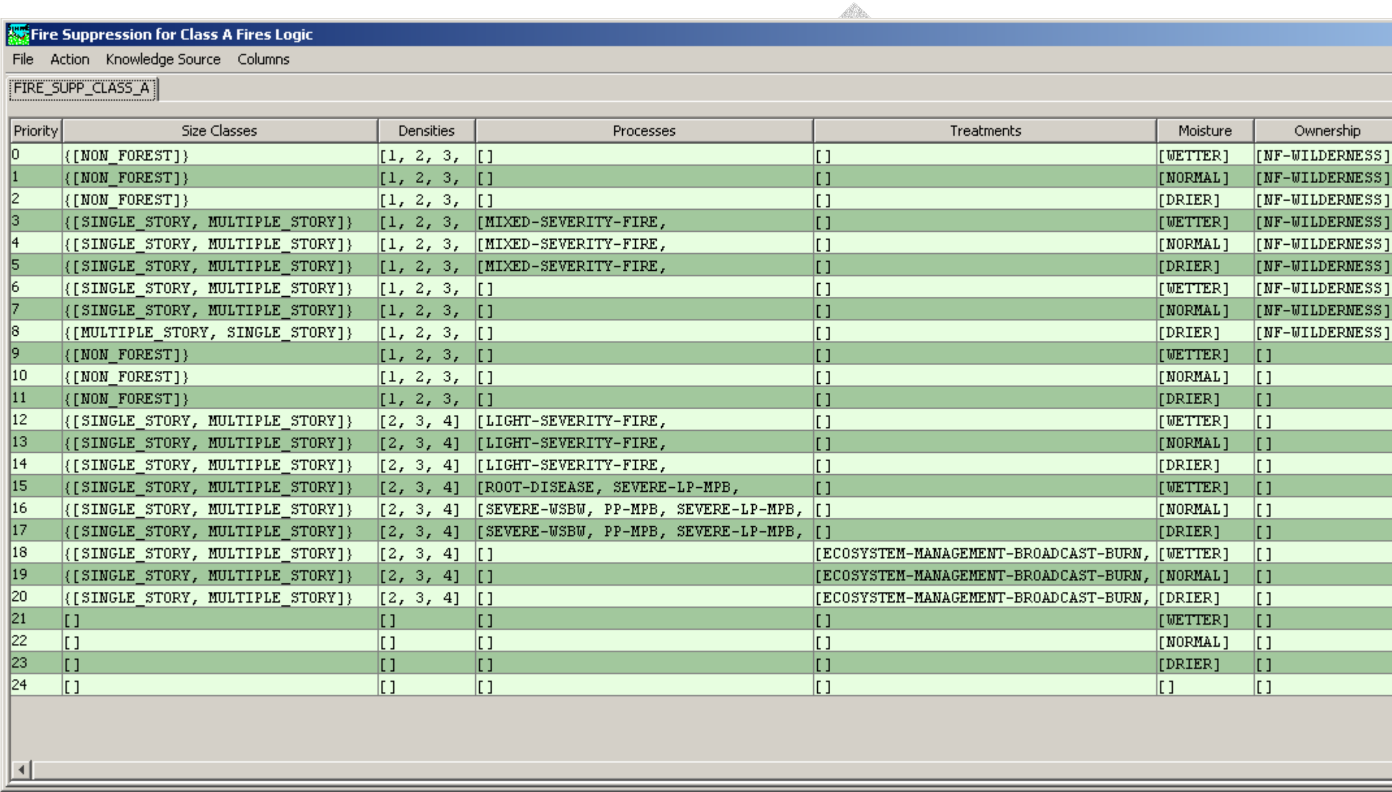


Figure 123 Access to the fire suppression logic through the user interface

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 SIMPPLLE 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. The “columns” choice is available from the menu bar to utilize as many variables as desired. But remember all of the variables used they have to be attributes of each plant community in the landscape (see input requirements).



Fire Suppression for Class A Fires Logic

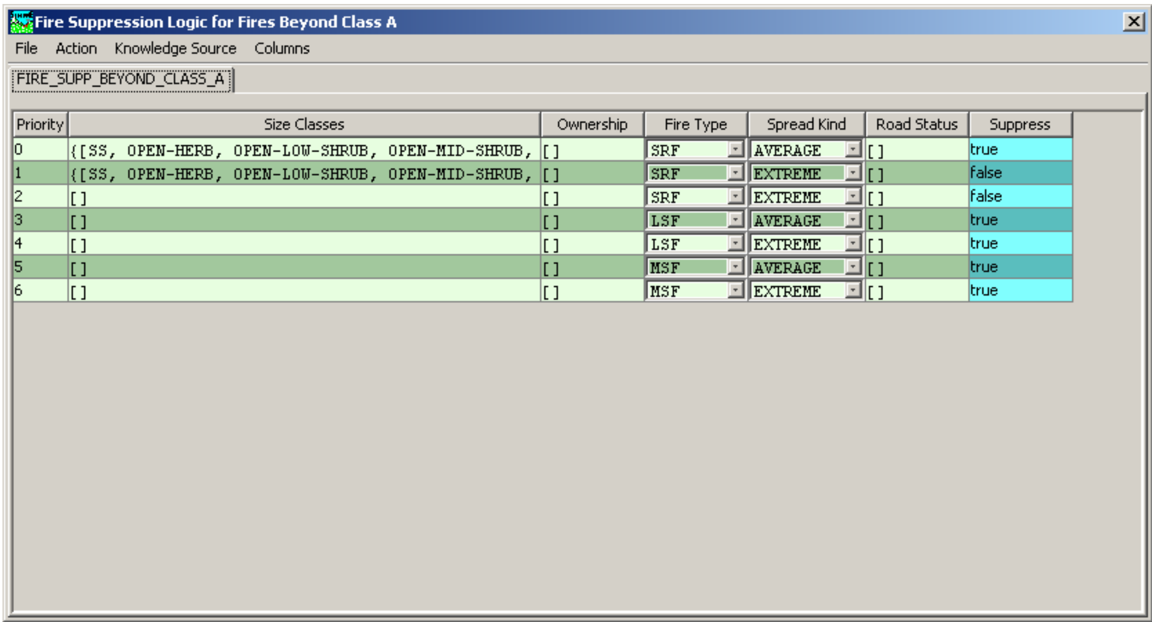
File Action Knowledge Source Columns

FIRE_SUPP_CLASS_A

Priority	Size Classes	Densities	Processes	Treatments	Moisture	Ownership
0	{[NON_FOREST]}	[1, 2, 3,	[]	[]	[WETTER]	[NF-WILDERNESS]
1	{[NON_FOREST]}	[1, 2, 3,	[]	[]	[NORMAL]	[NF-WILDERNESS]
2	{[NON_FOREST]}	[1, 2, 3,	[]	[]	[DRIER]	[NF-WILDERNESS]
3	{[SINGLE_STORY, MULTIPLE_STORY]}	[1, 2, 3,	[MIXED-SEVERITY-FIRE,	[]	[WETTER]	[NF-WILDERNESS]
4	{[SINGLE_STORY, MULTIPLE_STORY]}	[1, 2, 3,	[MIXED-SEVERITY-FIRE,	[]	[NORMAL]	[NF-WILDERNESS]
5	{[SINGLE_STORY, MULTIPLE_STORY]}	[1, 2, 3,	[MIXED-SEVERITY-FIRE,	[]	[DRIER]	[NF-WILDERNESS]
6	{[SINGLE_STORY, MULTIPLE_STORY]}	[1, 2, 3,	[]	[]	[WETTER]	[NF-WILDERNESS]
7	{[SINGLE_STORY, MULTIPLE_STORY]}	[1, 2, 3,	[]	[]	[NORMAL]	[NF-WILDERNESS]
8	{[MULTIPLE_STORY, SINGLE_STORY]}	[1, 2, 3,	[]	[]	[DRIER]	[NF-WILDERNESS]
9	{[NON_FOREST]}	[1, 2, 3,	[]	[]	[WETTER]	[]
10	{[NON_FOREST]}	[1, 2, 3,	[]	[]	[NORMAL]	[]
11	{[NON_FOREST]}	[1, 2, 3,	[]	[]	[DRIER]	[]
12	{[SINGLE_STORY, MULTIPLE_STORY]}	[2, 3, 4]	[LIGHT-SEVERITY-FIRE,	[]	[WETTER]	[]
13	{[SINGLE_STORY, MULTIPLE_STORY]}	[2, 3, 4]	[LIGHT-SEVERITY-FIRE,	[]	[NORMAL]	[]
14	{[SINGLE_STORY, MULTIPLE_STORY]}	[2, 3, 4]	[LIGHT-SEVERITY-FIRE,	[]	[DRIER]	[]
15	{[SINGLE_STORY, MULTIPLE_STORY]}	[2, 3, 4]	[ROOT-DISEASE, SEVERE-LP-MPB,	[]	[WETTER]	[]
16	{[SINGLE_STORY, MULTIPLE_STORY]}	[2, 3, 4]	[SEVERE-WSBW, PP-MPB, SEVERE-LP-MPB,	[]	[NORMAL]	[]
17	{[SINGLE_STORY, MULTIPLE_STORY]}	[2, 3, 4]	[SEVERE-WSBW, PP-MPB, SEVERE-LP-MPB,	[]	[DRIER]	[]
18	{[SINGLE_STORY, MULTIPLE_STORY]}	[2, 3, 4]	[]	[ECOSYSTEM-MANAGEMENT-BROADCAST-BURN,	[WETTER]	[]
19	{[SINGLE_STORY, MULTIPLE_STORY]}	[2, 3, 4]	[]	[ECOSYSTEM-MANAGEMENT-BROADCAST-BURN,	[NORMAL]	[]
20	{[SINGLE_STORY, MULTIPLE_STORY]}	[2, 3, 4]	[]	[ECOSYSTEM-MANAGEMENT-BROADCAST-BURN,	[DRIER]	[]
21	[]	[]	[]	[]	[WETTER]	[]
22	[]	[]	[]	[]	[NORMAL]	[]
23	[]	[]	[]	[]	[DRIER]	[]
24	[]	[]	[]	[]	[]	[]

Figure 124 Fire Suppression logic for the probability of keeping a fire event at a Class A level, less than .25 acres

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. If irregular sized plant communities are used this logic can be rather simple. As seen in the below figure the logic is basically stand replacing fire in plant communities other than nonforested conditions is not suppressed. There has to be a change in vegetation conditions that changes the type of fire to mixed severity or stand replacing fire for it to be suppressed in a plant community that the fire has spread to.

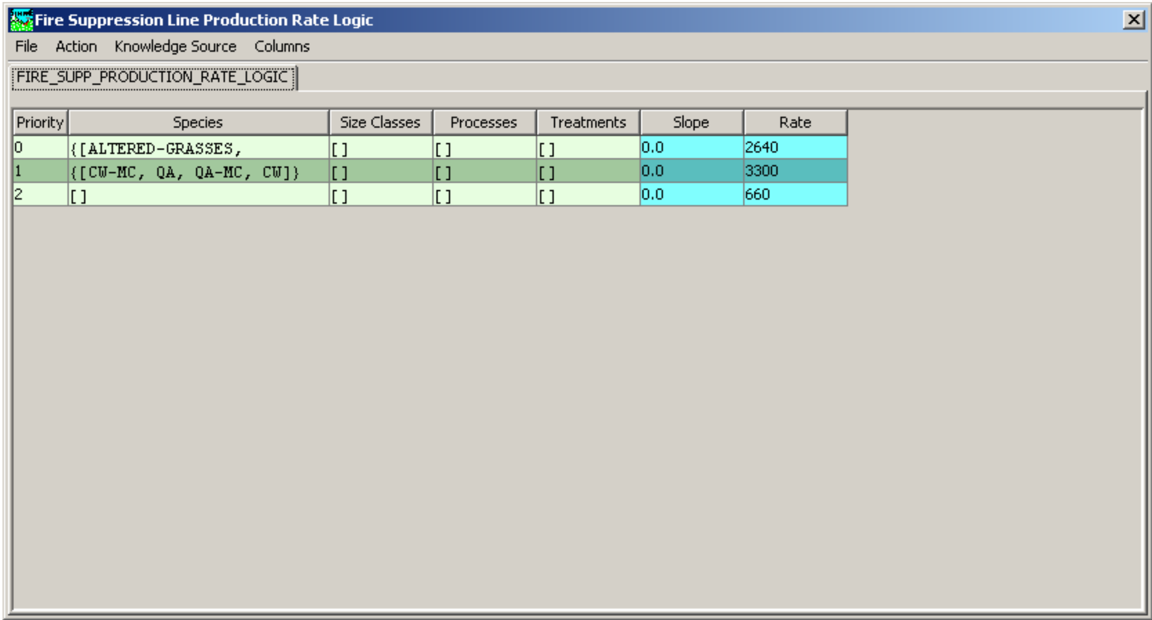


Priority	Size Classes	Ownership	Fire Type	Spread Kind	Road Status	Suppress
0	{[SS, OPEN-HERB, OPEN-LOW-SHRUB, OPEN-MID-SHRUB,	[]	SRF	AVERAGE	[]	true
1	{[SS, OPEN-HERB, OPEN-LOW-SHRUB, OPEN-MID-SHRUB,	[]	SRF	EXTREME	[]	false
2	[]	[]	SRF	EXTREME	[]	false
3	[]	[]	LSF	AVERAGE	[]	true
4	[]	[]	LSF	EXTREME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

Figure 125 Logic used to determine how fire suppression is applied to fire events that exceed initial suppression at a class A level

There are three components to fire suppression if uniform size units are being used; they are a spread rate, a production rate for the suppression forces, and a delay time for the suppression forces arriving at the fire event. This approach has been greatly simplified. Only one production rate is allowed. The spread and production values can be derived from other fire analyses done by Federal Land owners.

The below figure is for 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 126 Production rates used for uniform size plant communities.

However if one wants to capture the same concept that was used with irregular size plant communities, no direct suppression against stand replacing fire, then the following figure shows the addition of a rule showing no production if time step 0 has stand replacing fire.

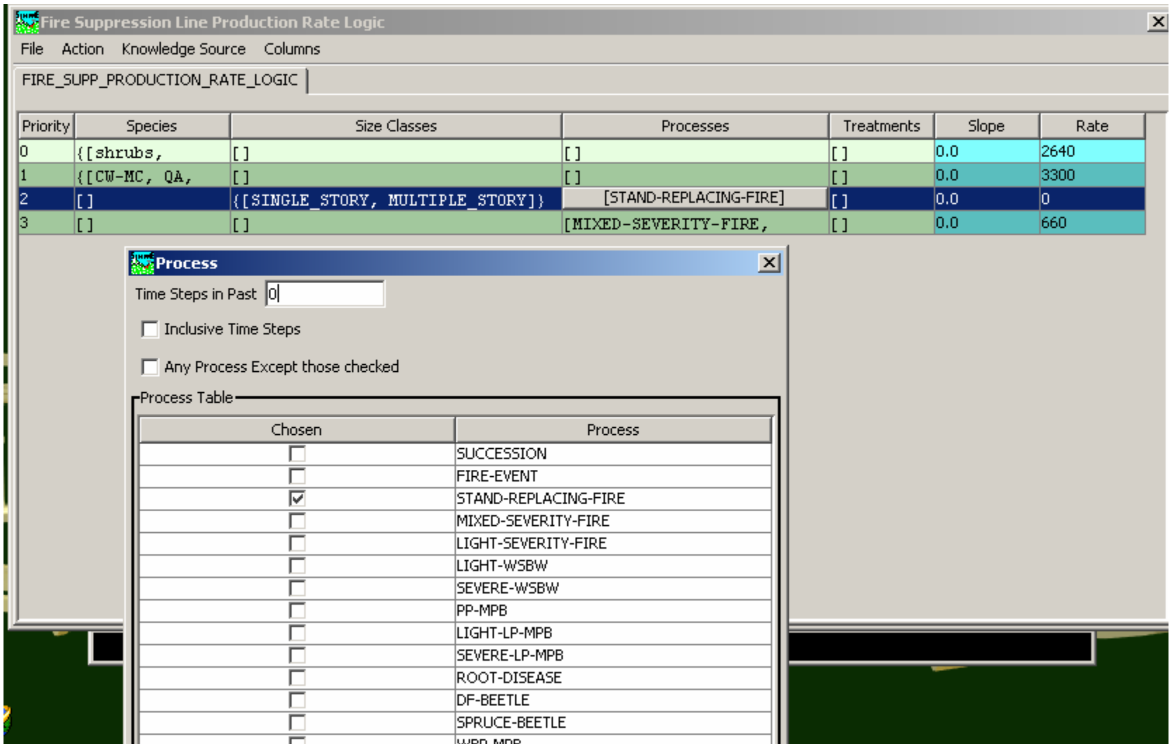


Figure 127 A set of production rates that includes a combination that states for a plant community that has stand replacing fire in the current time step, 0, there will be no production. Or in other words direct fire suppression activity is not taken against stand replacing fire, only mixed severity and light severity.

The spread rates for the same zone are shown below.

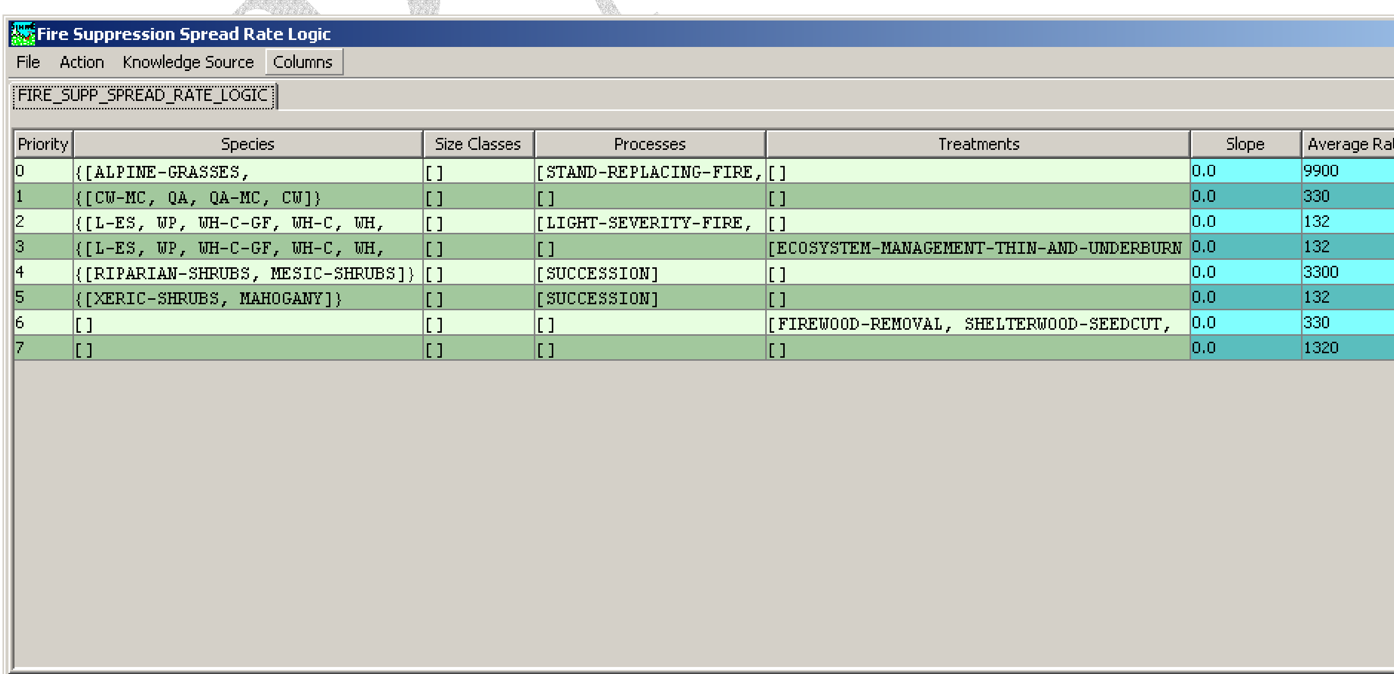


Figure 128 Fire spread rates for use with uniform sized plant communities.

The third component allows the user to specify a delay time by fire management zone (fmz) if the landscape is stratified by them.

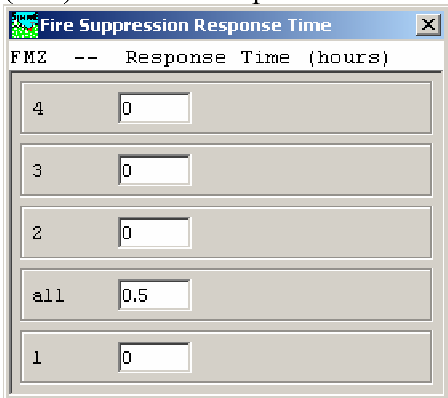
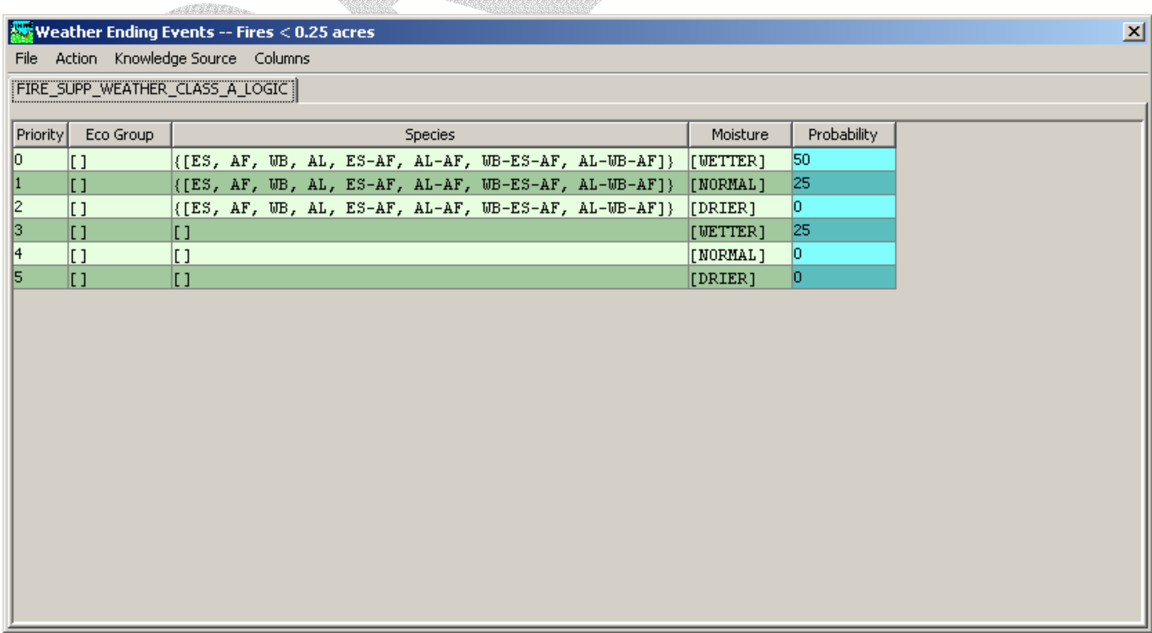


Figure 129 Delay time in response of suppression forces by fmz. Time is utilized in the calculation of fire spread and suppression forces production to determine size of fire events that are suppressed.

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 less that a Class A and greater than a Class A size.

Many fires do not develop beyond the Class A (less than .25 acres) 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.

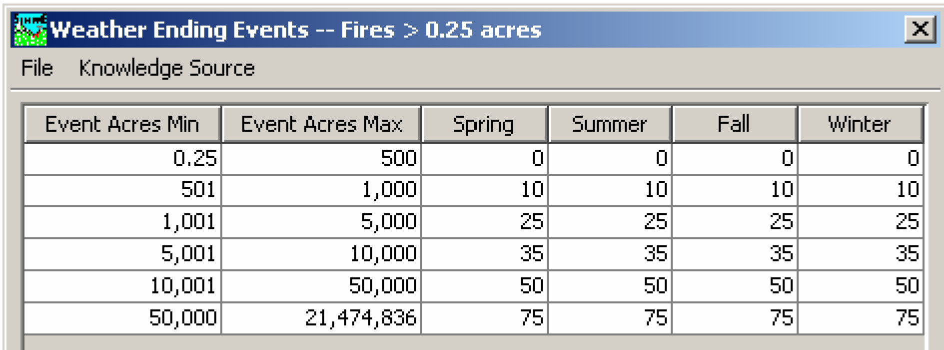


Priority	Eco Group	Species	Moisture	Probability
0	[]	{[ES, AF, WB, AL, ES-AF, AL-AF, WB-ES-AF, AL-WB-AF]}	[WETTER]	50
1	[]	{[ES, AF, WB, AL, ES-AF, AL-AF, WB-ES-AF, AL-WB-AF]}	[NORMAL]	25
2	[]	{[ES, AF, WB, AL, ES-AF, AL-AF, WB-ES-AF, AL-WB-AF]}	[DRIER]	0
3	[]	[]	[WETTER]	25
4	[]	[]	[NORMAL]	0
5	[]	[]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

Figure 130 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 the Class A size, as SIMPPLLE is spreading a fire event, as each set of neighbors is evaluated for spread, the following probabilities are used to see if the spread continues.


Weather Ending Events -- Fires > 0.25 acres

File Knowledge Source

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 131 Screen for providing probabilities to link a weather ending event to the size of a fire event.

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 is some of the logic.

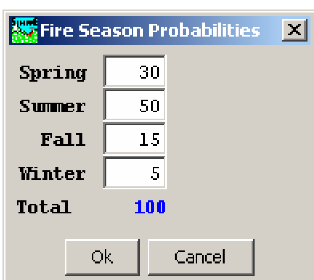
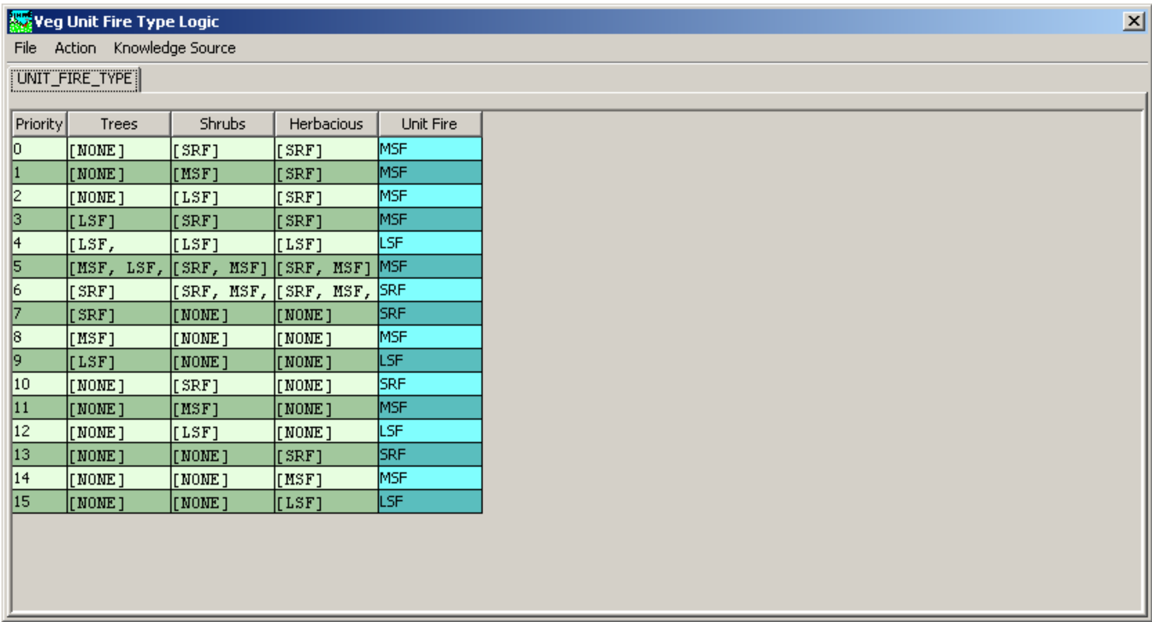


Figure 132 Screen that gives user access to changing the probability of the season of a fire event.

Vegetation Unit – Fire type logic

In a landscape that multiple life forms are being utilized, the logic for deciding what type of fire to assign to an entire unit has to be included.



Priority	Trees	Shrubs	Herbacious	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 133 Logic to be used with multiple lifeforms descriptions of vegetation to decide what type of fire to assign to the entire plant community.

Editing 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 a user refines the defaults 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 we have a history of disturbance processes to check against. To assess whether the logic in any of the screens needs to be adjusted a user should start by looking at the number of fire events in a simulation. This is displayed in the summary report (see previous section on reports).

If the number of fires appears reasonable, the acres associated with individual fire events can be evaluated by examining the Detailed Fire report (see previous 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 the extreme fire probability to 100% or the probability set to zero and 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.

SPECIES ATTRIBUTES EDITOR

This logic identifies all of the species, species combinations used in SIMPPLLE, by the abbreviations used, a description, the lifeform, a fire resistance rating, 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.

Species Knowledge Editor

File Action

Species	Description	Lifeform Type	Fire Resistance	Conditional Fire Resistance	Invasive	Pathway Present
JUMO	JUMO	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-JUMO	PIED-JUMO	trees	LOW		false	Yes
PIED-JUOS	PIED-JUOS	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
ARNO4	ARNO4	shrubs	LOW		false	Yes
ARNO4-PUTR2	ARNO4-PUTR2	shrubs	LOW		false	Yes
ARTR2	big sagebrush	shrubs	MODERATE		false	Yes
ARTR2-PUTR2	big sagebrush - bitterbush	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 134 The species attribute editor

Under “file” and “Action” from the menu bar there are a number of choices

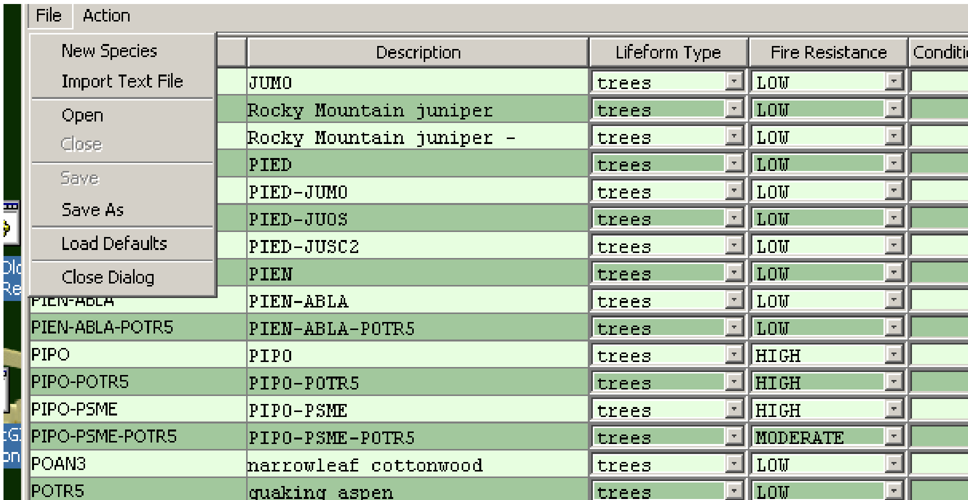


Figure 135 Choices available from the File pull down menu on the Species Attribute Editor.

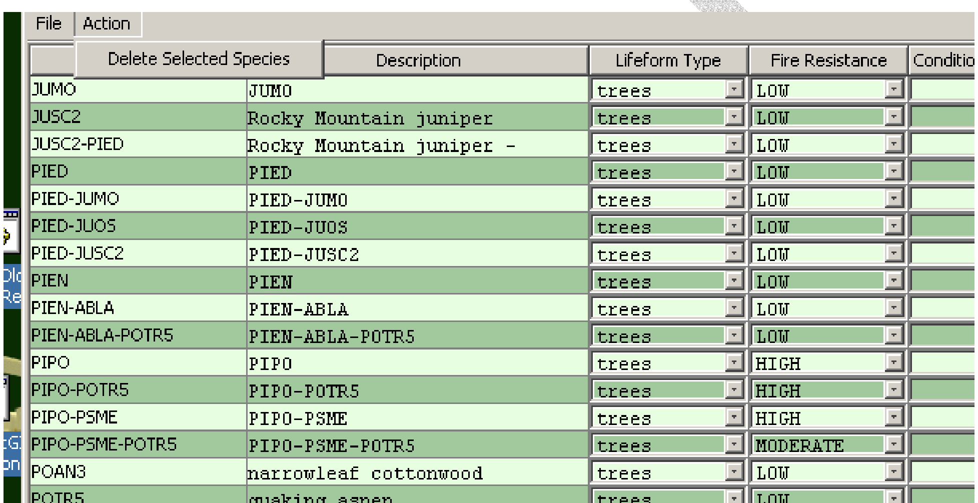


Figure 136 Choice under the Action is to Delete a selected species

DISTURBANCE PROCESS PROBABILITIY (other than fire)

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

- -which processes had significant knowledge that could be used to predict a probability of occurrence.
- -which processes made significant changes in the attributes that we are using to describe vegetation or
- -their presence has a significant impact on the occurrence of other processes

- -which processes required data for predictions that could be derived from the inventory data we could expect to find in a geographic area.

Many of the processes required significant modifications of the existing research 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 SC 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 can provide 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.

Although there is considerable variability in this section of the system knowledge screens by geographic zone we have tried to create a base logic screen which the user can change by choices under the “Columns” pull down menu. The user can decide how much or how little of the system knowledge can be used.

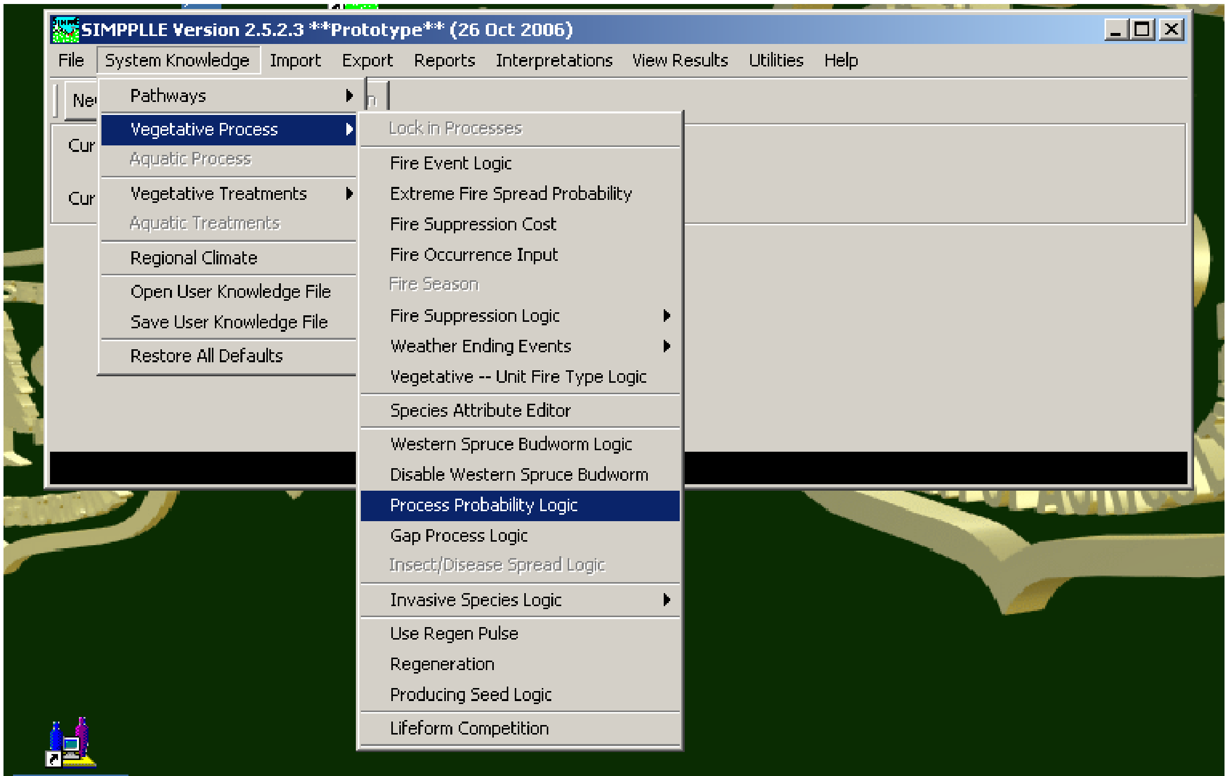
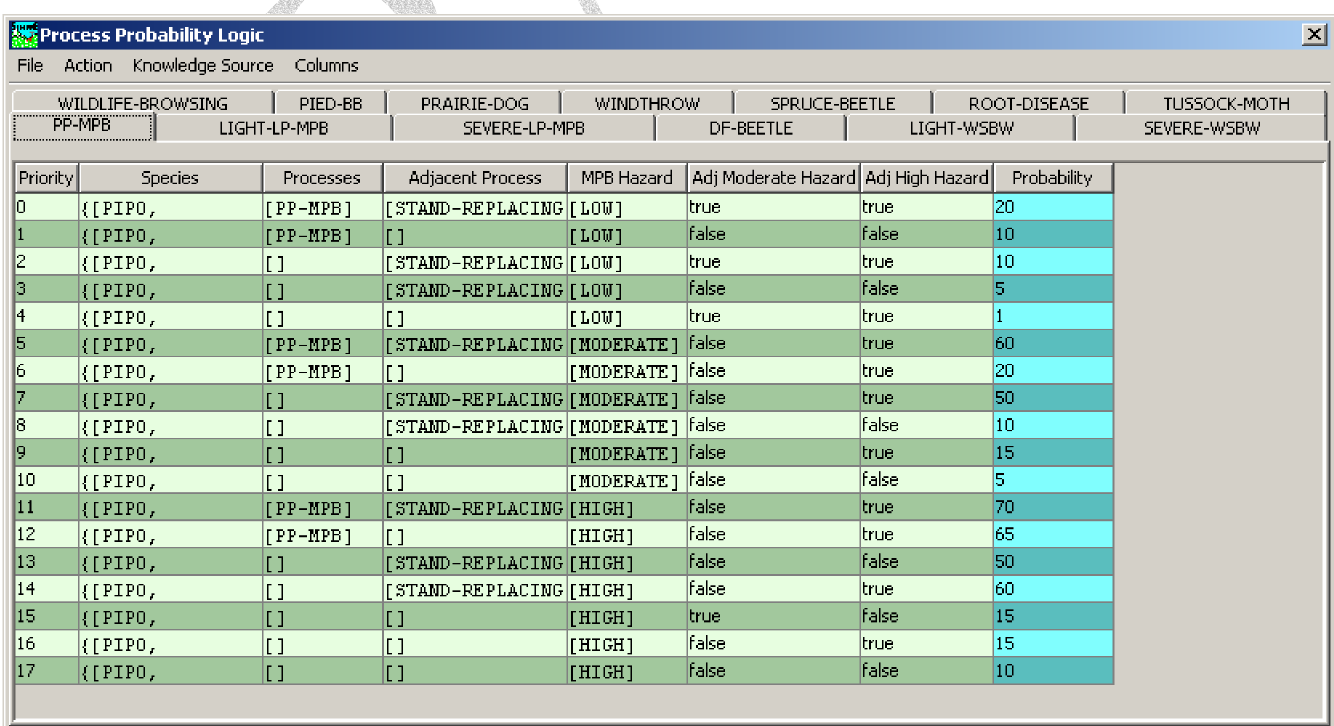


Figure 137 Access to the disturbance process probability logic that includes insects and disease processes.



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

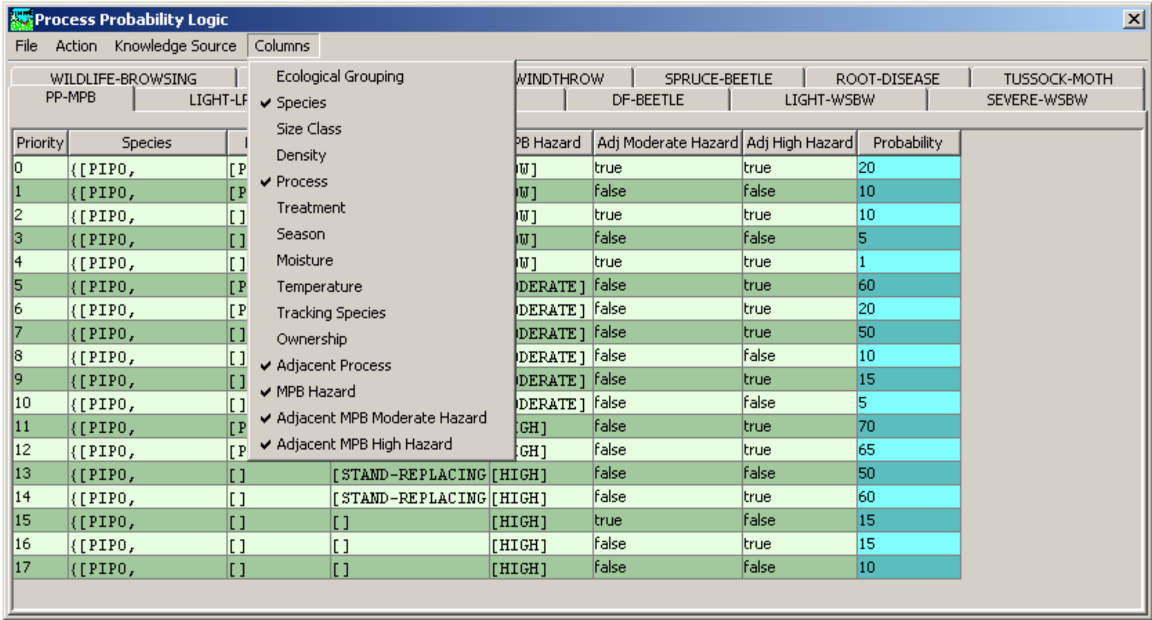


Figure 139 The choice of columns of system knowledge that can be used in a process logic screen.

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

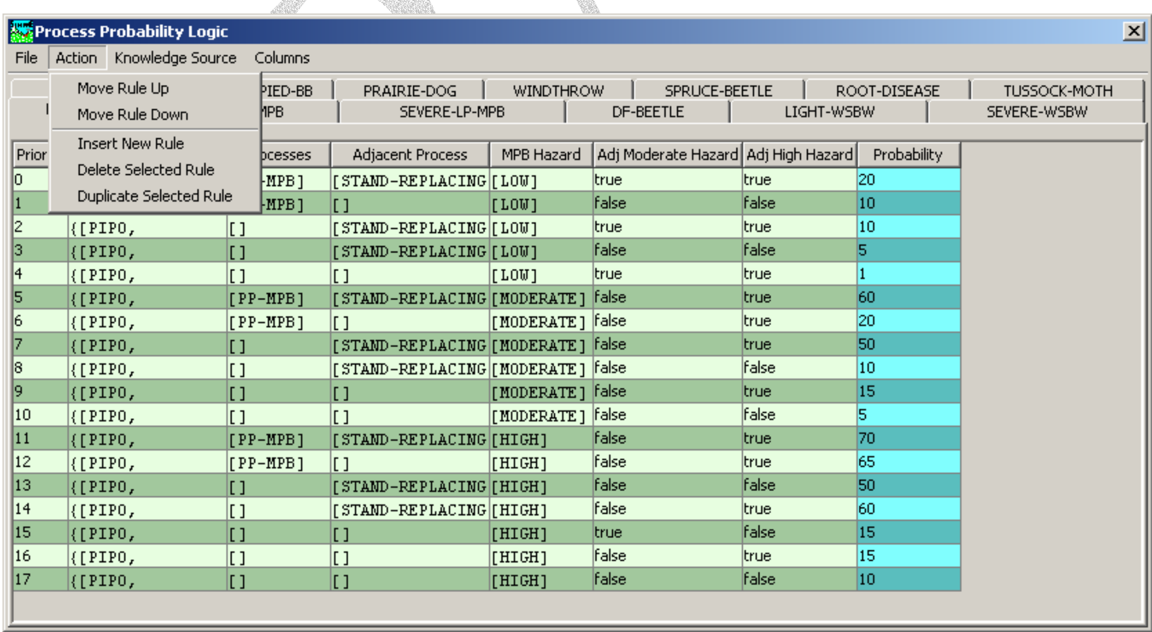


Figure 140 Choices available for working with logic rules.

There are a number of processes that have either unique screens such as Bison Grazing and are accessed separately. There are some processes in which the screen has no probability logic such as windthrow . The only way the process can be used is by "locking it in" to specific plant communities.

The insect and disease spread logic is shaded out. The only spread now is within the probability logic screens how adjacent unit occurrence or occurrence within the landscape may increase the probability of other units getting the process provides for spread across a landscape.

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. A user can create logic rules to account for some processes happening at scale less than the plant community being simulated.

The following screen displays two logic rules for having pinyon pine bark beetles and stand replacing fire occur at a gap scale. For the scale we made it parallel to fire events that are kept at the 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.

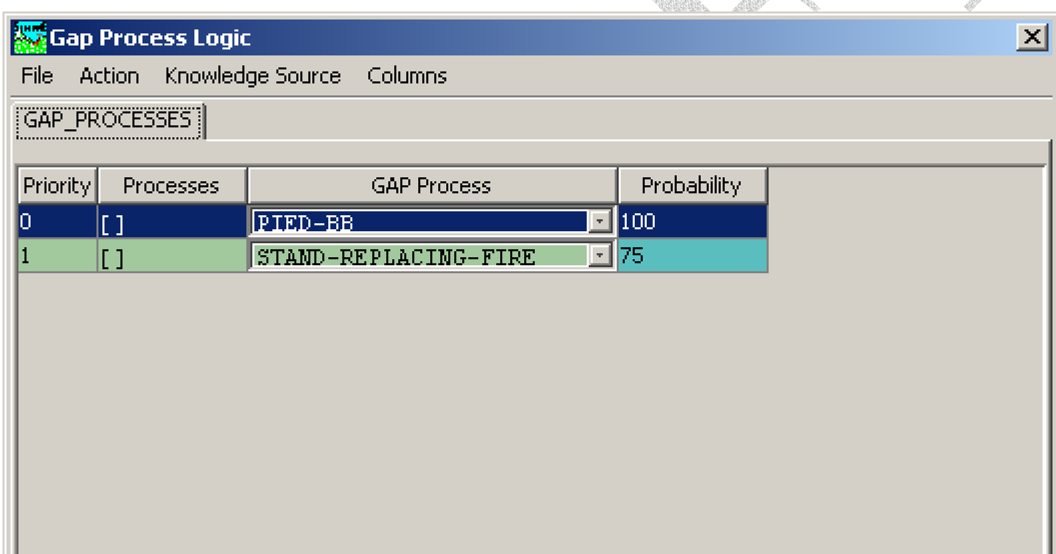


Figure 141 Two logic rules for having disturbance process occur at a scale of 0.25 acres.

The following figure displays a plant community that has had a gap process. The word “gap” occurs in the Probability column. The disturbance process for the entire plant community is succession, but the original process column shows “stand-replacing-fire”.

The figure also shows another feature in time step 2. For probability, the herbaceous life form shows “comp”. This indicates that the density of this lifeform 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. But the logic in the “lifeform interaction” system knowledge results in the density at a level 3 due to “competition”.

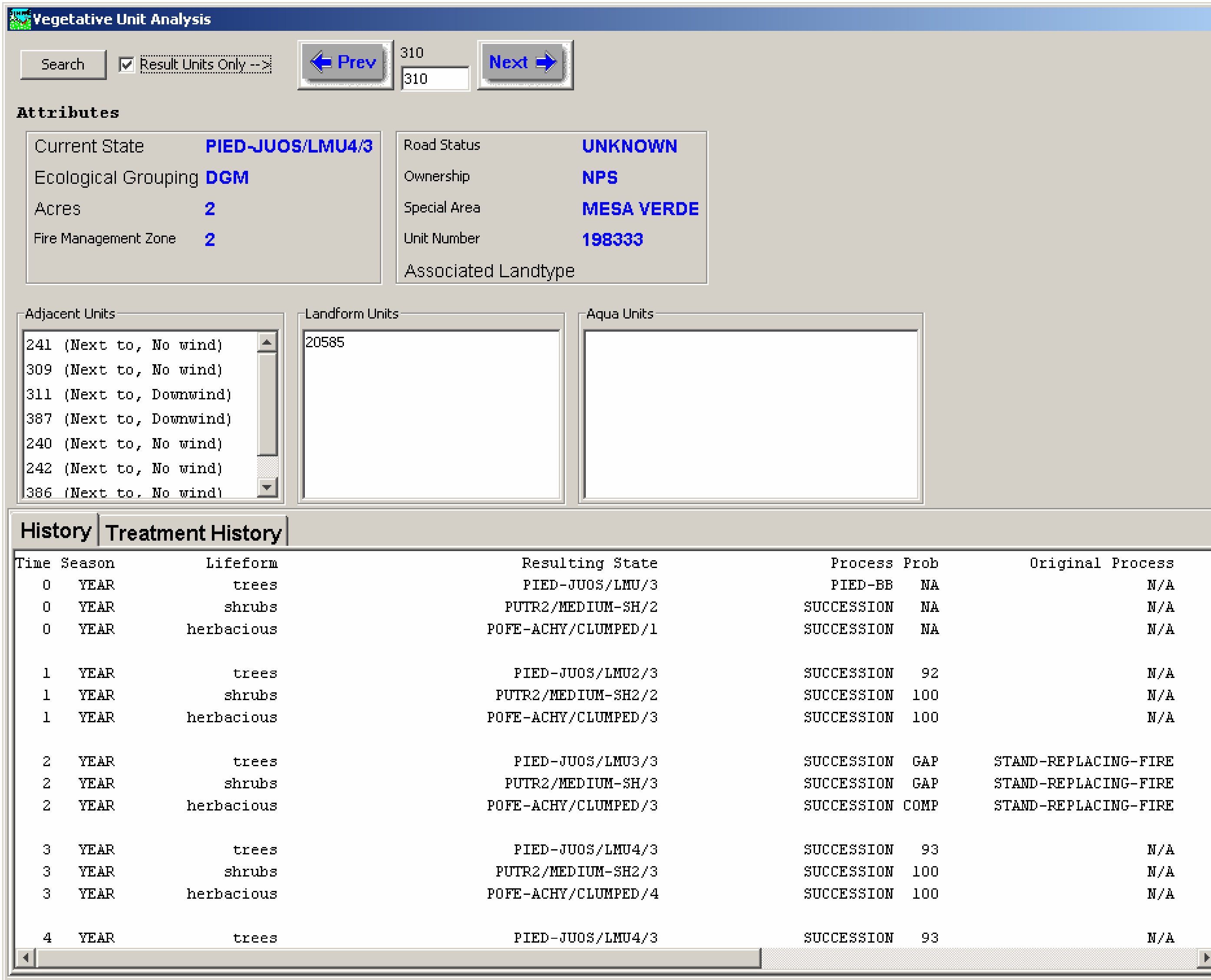


Figure 142 Displays the occurrence of a fire event at a gap level in this 2 acre plant community in time step 2.

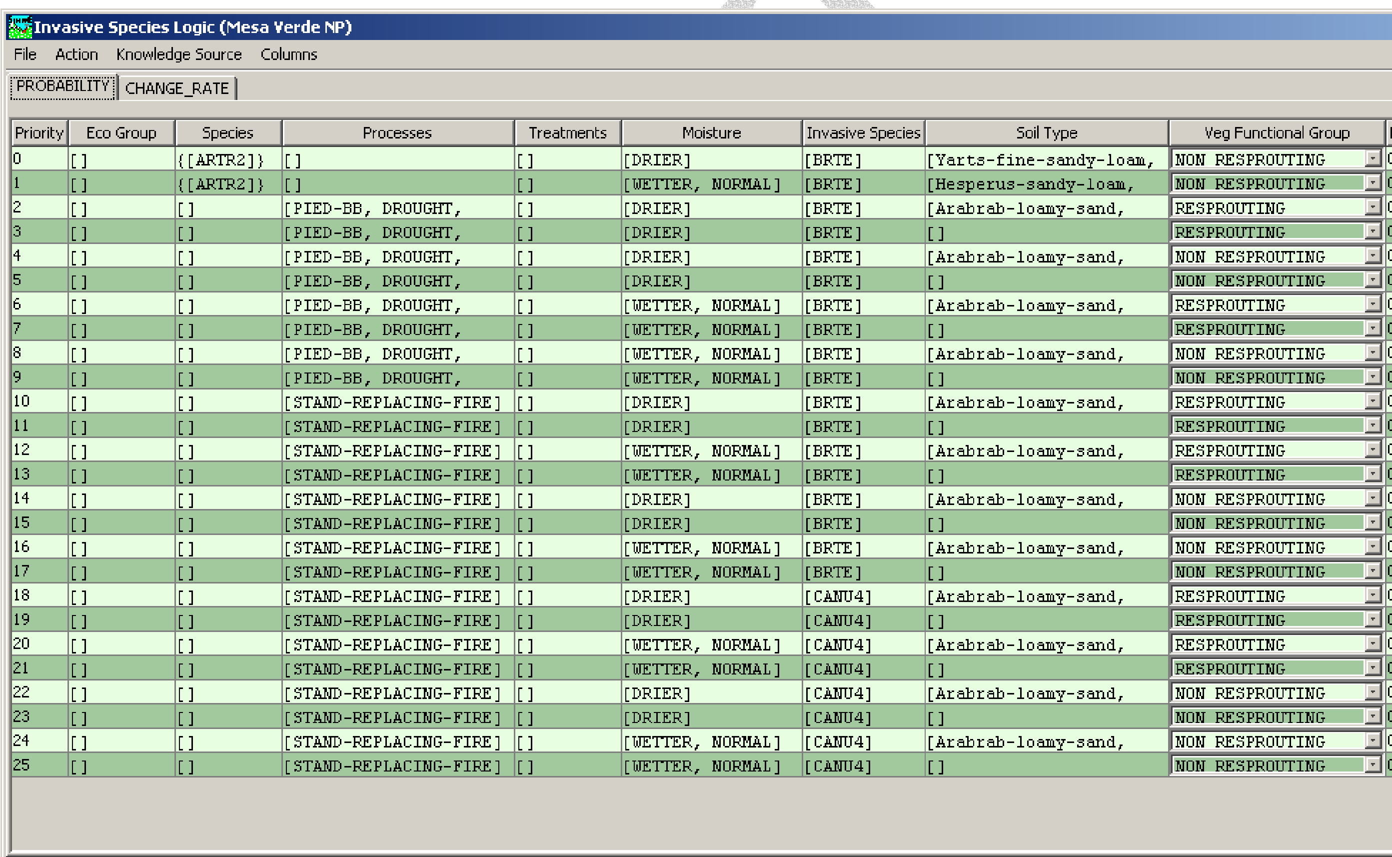
The gap processes do contribute acres to the reports at the rate of .25 acres per occurrence.

In a future version of SIMPPLLE we will expand this logic 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 process is different.

INVASIVE SPECIES

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.

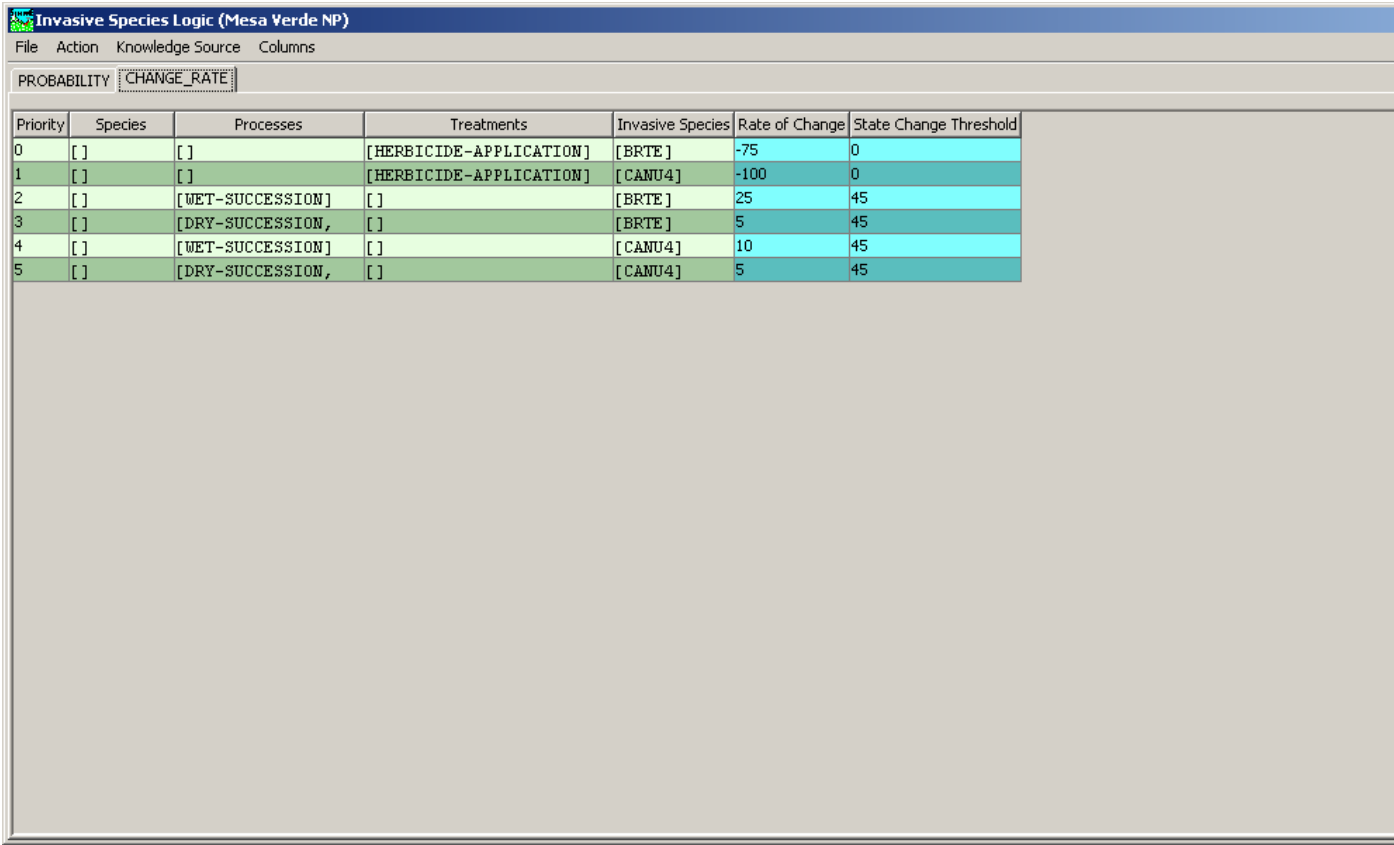
Regardless of the difference in the research, the screens have two parts in common. One part for the probability logic and one part for the change rate logic. The probability screen contains the information from the research necessary to link to a probability of occurrence and a starting canopy density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



Priority	Eco Group	Species	Processes	Treatments	Moisture	Invasive Species	Soil Type	Veg Functional Group
0	[]	{[ARTR2]}	[]	[]	[DRIER]	[BRTE]	[Yarts-fine-sandy-loam,	NON RESPROUTING
1	[]	{[ARTR2]}	[]	[]	[WETTER, NORMAL]	[BRTE]	[Hesperus-sandy-loam,	NON RESPROUTING
2	[]	[]	[PIED-BB, DROUGHT,	[]	[DRIER]	[BRTE]	[Arabrab-loamy-sand,	RESPROUTING
3	[]	[]	[PIED-BB, DROUGHT,	[]	[DRIER]	[BRTE]	[]	RESPROUTING
4	[]	[]	[PIED-BB, DROUGHT,	[]	[DRIER]	[BRTE]	[Arabrab-loamy-sand,	NON RESPROUTING
5	[]	[]	[PIED-BB, DROUGHT,	[]	[DRIER]	[BRTE]	[]	NON RESPROUTING
6	[]	[]	[PIED-BB, DROUGHT,	[]	[WETTER, NORMAL]	[BRTE]	[Arabrab-loamy-sand,	RESPROUTING
7	[]	[]	[PIED-BB, DROUGHT,	[]	[WETTER, NORMAL]	[BRTE]	[]	RESPROUTING
8	[]	[]	[PIED-BB, DROUGHT,	[]	[WETTER, NORMAL]	[BRTE]	[Arabrab-loamy-sand,	NON RESPROUTING
9	[]	[]	[PIED-BB, DROUGHT,	[]	[WETTER, NORMAL]	[BRTE]	[]	NON RESPROUTING
10	[]	[]	[STAND-REPLACING-FIRE]	[]	[DRIER]	[BRTE]	[Arabrab-loamy-sand,	RESPROUTING
11	[]	[]	[STAND-REPLACING-FIRE]	[]	[DRIER]	[BRTE]	[]	RESPROUTING
12	[]	[]	[STAND-REPLACING-FIRE]	[]	[WETTER, NORMAL]	[BRTE]	[Arabrab-loamy-sand,	RESPROUTING
13	[]	[]	[STAND-REPLACING-FIRE]	[]	[WETTER, NORMAL]	[BRTE]	[]	RESPROUTING
14	[]	[]	[STAND-REPLACING-FIRE]	[]	[DRIER]	[BRTE]	[Arabrab-loamy-sand,	NON RESPROUTING
15	[]	[]	[STAND-REPLACING-FIRE]	[]	[DRIER]	[BRTE]	[]	NON RESPROUTING
16	[]	[]	[STAND-REPLACING-FIRE]	[]	[WETTER, NORMAL]	[BRTE]	[Arabrab-loamy-sand,	NON RESPROUTING
17	[]	[]	[STAND-REPLACING-FIRE]	[]	[WETTER, NORMAL]	[BRTE]	[]	NON RESPROUTING
18	[]	[]	[STAND-REPLACING-FIRE]	[]	[DRIER]	[CANU4]	[Arabrab-loamy-sand,	RESPROUTING
19	[]	[]	[STAND-REPLACING-FIRE]	[]	[DRIER]	[CANU4]	[]	RESPROUTING
20	[]	[]	[STAND-REPLACING-FIRE]	[]	[WETTER, NORMAL]	[CANU4]	[Arabrab-loamy-sand,	RESPROUTING
21	[]	[]	[STAND-REPLACING-FIRE]	[]	[WETTER, NORMAL]	[CANU4]	[]	RESPROUTING
22	[]	[]	[STAND-REPLACING-FIRE]	[]	[DRIER]	[CANU4]	[Arabrab-loamy-sand,	NON RESPROUTING
23	[]	[]	[STAND-REPLACING-FIRE]	[]	[DRIER]	[CANU4]	[]	NON RESPROUTING
24	[]	[]	[STAND-REPLACING-FIRE]	[]	[WETTER, NORMAL]	[CANU4]	[Arabrab-loamy-sand,	NON RESPROUTING
25	[]	[]	[STAND-REPLACING-FIRE]	[]	[WETTER, NORMAL]	[CANU4]	[]	NON RESPROUTING

Figure 143 Screen for the Colorado Plateau Zone invasive species logic.

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



Priority	Species	Processes	Treatments	Invasive Species	Rate of Change	State Change Threshold
0	[]	[]	[HERBICIDE-APPLICATION]	[BRTE]	-75	0
1	[]	[]	[HERBICIDE-APPLICATION]	[CANU4]	-100	0
2	[]	[WET-SUCCESSION]	[]	[BRTE]	25	45
3	[]	[DRY-SUCCESSION,	[]	[BRTE]	5	45
4	[]	[WET-SUCCESSION]	[]	[CANU4]	10	45
5	[]	[DRY-SUCCESSION,	[]	[CANU4]	5	45

Figure 144 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 the below figure.

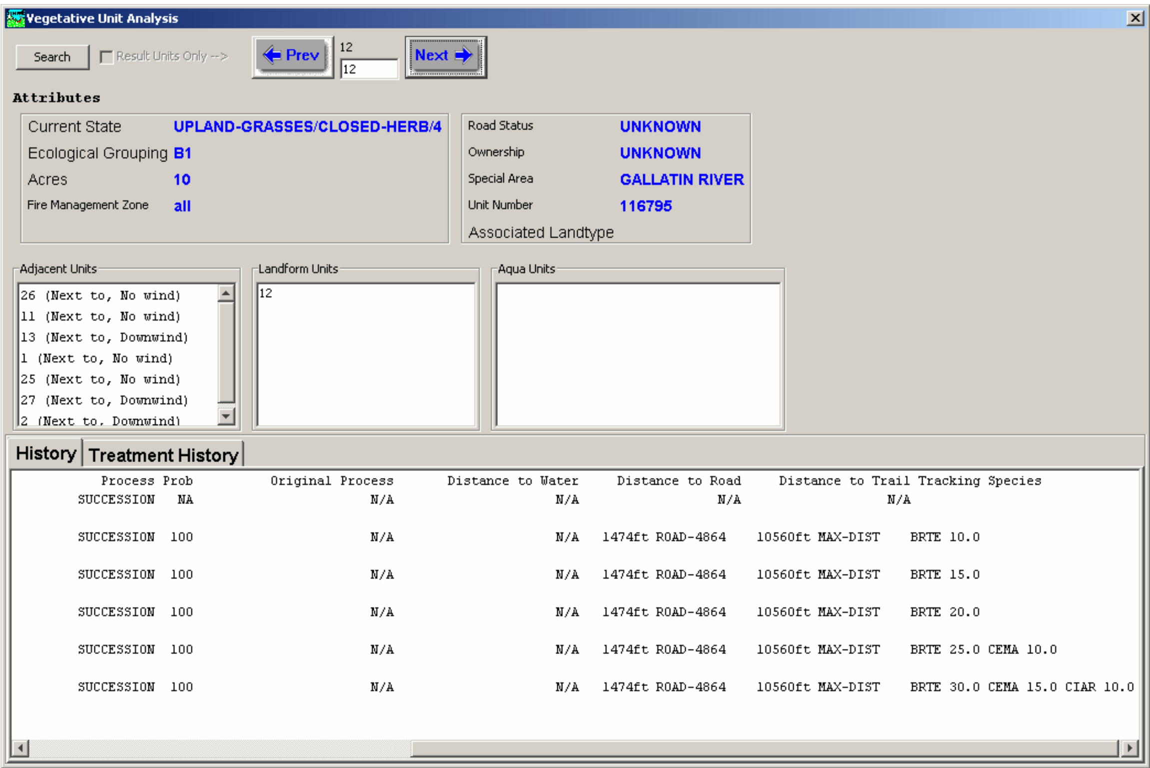
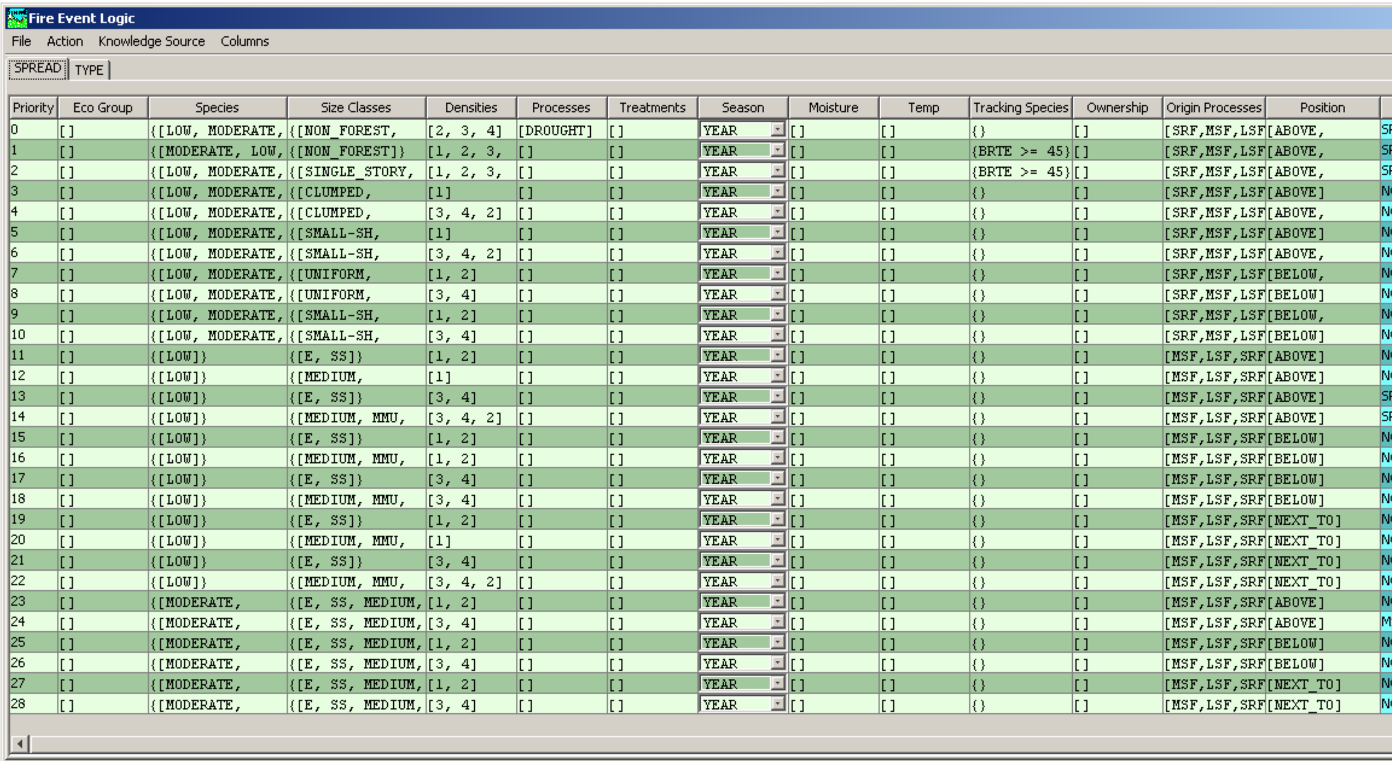


Figure 145 Individual plant community display showing invasive species as tracking species by time step for a simulation.

Acres of invasive species will show up in the Summary Report when the percent of canopy density exceeds the threshold value. To get acres of invasive species at the full range of different densities the 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 the "columns" in the logic screen for fire spread tracking species of cheatgrass, BRTE, greater that or equal to 45 percent canopy cover made a difference in how fire spread as shown in the below figure.



Fire Event Logic

File Action Knowledge Source Columns

SPREAD TYPE

Priority	Eco Group	Species	Size Classes	Densities	Processes	Treatments	Season	Moisture	Temp	Tracking Species	Ownership	Origin Processes	Position
0	[]	{[LOW, MODERATE,	{[NON_FOREST,	[2, 3, 4]	[DROUGHT]	[]	YEAR	[]	[]	{}	[]	[SRF,MSF,LSF	[ABOVE,
1	[]	{[MODERATE, LOW,	{[NON_FOREST]}	[1, 2, 3,	[]	[]	YEAR	[]	[]	{BRTE >= 45}	[]	[SRF,MSF,LSF	[ABOVE,
2	[]	{[LOW, MODERATE,	{[SINGLE_STORY,	[1, 2, 3,	[]	[]	YEAR	[]	[]	{BRTE >= 45}	[]	[SRF,MSF,LSF	[ABOVE,
3	[]	{[LOW, MODERATE,	{[CLUMPED,	[1]	[]	[]	YEAR	[]	[]	{}	[]	[SRF,MSF,LSF	[ABOVE]
4	[]	{[LOW, MODERATE,	{[CLUMPED,	[3, 4, 2]	[]	[]	YEAR	[]	[]	{}	[]	[SRF,MSF,LSF	[ABOVE,
5	[]	{[LOW, MODERATE,	{[SMALL-SH,	[1]	[]	[]	YEAR	[]	[]	{}	[]	[SRF,MSF,LSF	[ABOVE]
6	[]	{[LOW, MODERATE,	{[SMALL-SH,	[3, 4, 2]	[]	[]	YEAR	[]	[]	{}	[]	[SRF,MSF,LSF	[ABOVE,
7	[]	{[LOW, MODERATE,	{[UNIFORM,	[1, 2]	[]	[]	YEAR	[]	[]	{}	[]	[SRF,MSF,LSF	[BELOW,
8	[]	{[LOW, MODERATE,	{[UNIFORM,	[3, 4]	[]	[]	YEAR	[]	[]	{}	[]	[SRF,MSF,LSF	[BELOW]
9	[]	{[LOW, MODERATE,	{[SMALL-SH,	[1, 2]	[]	[]	YEAR	[]	[]	{}	[]	[SRF,MSF,LSF	[BELOW,
10	[]	{[LOW, MODERATE,	{[SMALL-SH,	[3, 4]	[]	[]	YEAR	[]	[]	{}	[]	[SRF,MSF,LSF	[BELOW]
11	[]	{[LOW]}	{[E, SS]}	[1, 2]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[ABOVE]
12	[]	{[LOW]}	{[MEDIUM,	[1]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[ABOVE]
13	[]	{[LOW]}	{[E, SS]}	[3, 4]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[ABOVE]
14	[]	{[LOW]}	{[MEDIUM, MMU,	[3, 4, 2]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[ABOVE]
15	[]	{[LOW]}	{[E, SS]}	[1, 2]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[BELOW]
16	[]	{[LOW]}	{[MEDIUM, MMU,	[1, 2]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[BELOW]
17	[]	{[LOW]}	{[E, SS]}	[3, 4]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[BELOW]
18	[]	{[LOW]}	{[MEDIUM, MMU,	[3, 4]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[BELOW]
19	[]	{[LOW]}	{[E, SS]}	[1, 2]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[NEXT_TO]
20	[]	{[LOW]}	{[MEDIUM, MMU,	[1]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[NEXT_TO]
21	[]	{[LOW]}	{[E, SS]}	[3, 4]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[NEXT_TO]
22	[]	{[LOW]}	{[MEDIUM, MMU,	[3, 4, 2]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[NEXT_TO]
23	[]	{[MODERATE,	{[E, SS, MEDIUM,	[1, 2]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[ABOVE]
24	[]	{[MODERATE,	{[E, SS, MEDIUM,	[3, 4]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[ABOVE]
25	[]	{[MODERATE,	{[E, SS, MEDIUM,	[1, 2]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[BELOW]
26	[]	{[MODERATE,	{[E, SS, MEDIUM,	[3, 4]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[BELOW]
27	[]	{[MODERATE,	{[E, SS, MEDIUM,	[1, 2]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[NEXT_TO]
28	[]	{[MODERATE,	{[E, SS, MEDIUM,	[3, 4]	[]	[]	YEAR	[]	[]	{}	[]	[MSF,LSF,SRF	[NEXT_TO]

Figure 146 Fire spread screen for the Colorado Plateau showing the use of the presence of an invasive species BRTE at greater than or 45 percent cover to make a difference in how a fire event will spread.

Remember in order for the logic to be used in a simulation, the choice has to be made on the "set simulations parameters" screen.

REGENERATION

As with all components of the system, regeneration has evolved since the first version. There are three components to it that are accessible from the user interface, pulse regeneration, regeneration, and producing seed.

Pulse Regeneration

This logic has been made available for portions of a landscape that are dry enough that regeneration occurs only periodically. Not accessible through the user interface yet. Work in connection with the pathways on ecologically stratification (see specific appendices for zones). If the pathways show a progression of structure, moving from single stories to multiple stories over time – this has to be removed on these drier sites. The recruitment of another "cohort" of regeneration only occurs when a combination of events happens – a good seed source, favorable moisture conditions, and an event that prepares the site. Then it happens over the landscape, not just evu specific. So a probability is used – but when that comes up the evu must have had a recent mixed or light severity fire – then the change in structure and density as reflected in the pathways will occur.

Regeneration

A significant part of the variability that exists over time in a landscape can come from regeneration being a process that is highly variable, depending on not just the regeneration mechanisms of the species that is killed by a fire event, by 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. The regeneration knowledge is applied under two specific conditions. It is applied if a nonforest state exists on a forested habitat type. This application is referred to as "succession regeneration". And it is applied following a stand-replacing-fire in a plant community as "fire regeneration". This is represented by a system knowledge screen with two tabs for regeneration.

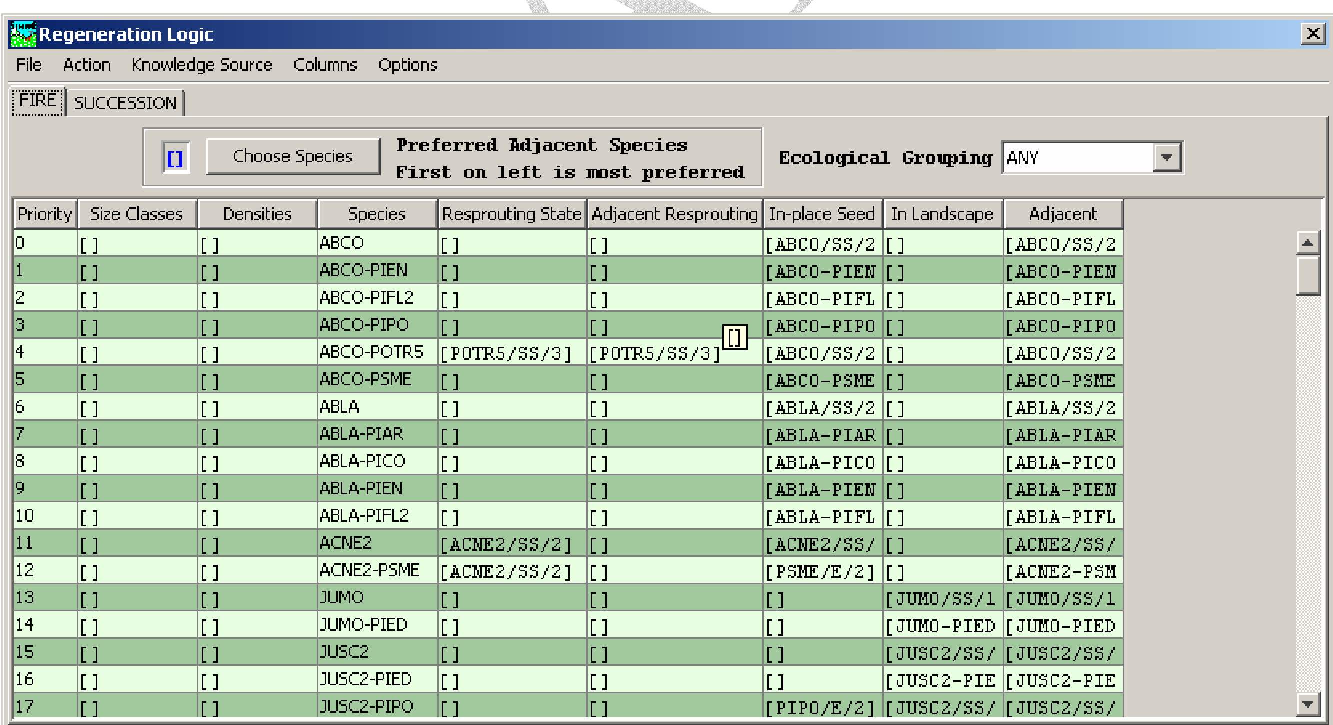


Figure 147 The Regeneration logic screen for the fire regeneration.

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. Both screens have the “columns” in the menu bar that enable 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, the knowledge consists of five different components used to determine how a plant community can regenerate. These components are if the species resprouts in place, resprouts from adjacent communities, seed is produced by the plants that burned, seed is provided from adjacent communities, or seed is transported from communities within the landscape. Through the interface screen, the user can specify by species the appropriate means. 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. lacing the cursor in a cell will open up a dialog box that enables a user to select what species and what state regenerates as shown in the following figure.

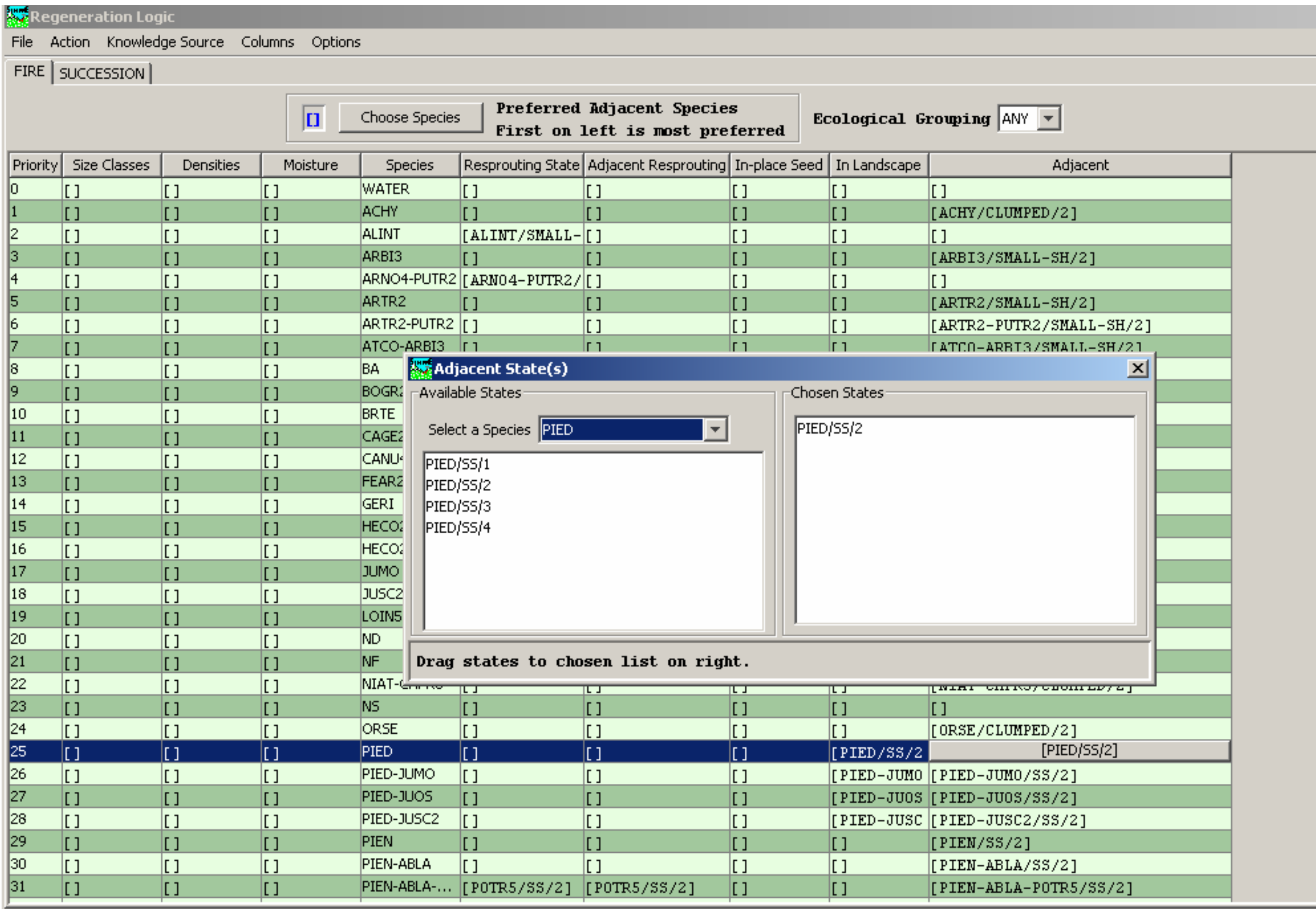


Figure 148 Selecting what species and what state to result from PIED providing adjacent seed as a seed source for a neighboring plant community impacted by a stand replacing fire event.

.

Regeneration following fire evaluates the possible means in the order they are in the screen from left to right.
If none of the above criteria result in a community being regenerated to a tree life form, the nonforest 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 stand that has the greatest areas, not the most shared boundary, to determine adjacent seed source is not accessible in this version.

Succession Regeneration

The Succession Regeneration uses only the "adjacent communities" logic, it is looking for adjacent seed sources. The logic in this screen 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 species 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-RIMO2=>VAMY2-RIMO2/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	[]	[]	[]	NS	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	[]	[]	[]	PIPO	false	[]

Figure 149 Succession logic screen showing what species can have other species regenerate within them and what the resulting state would be.

Producing Seed

The following screen enables the user to identify the criteria under which a species will be considered producing seed. The columns choice is available. In the following figure the column for process 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. But at this time all default probabilities are either zero or 100 percent.

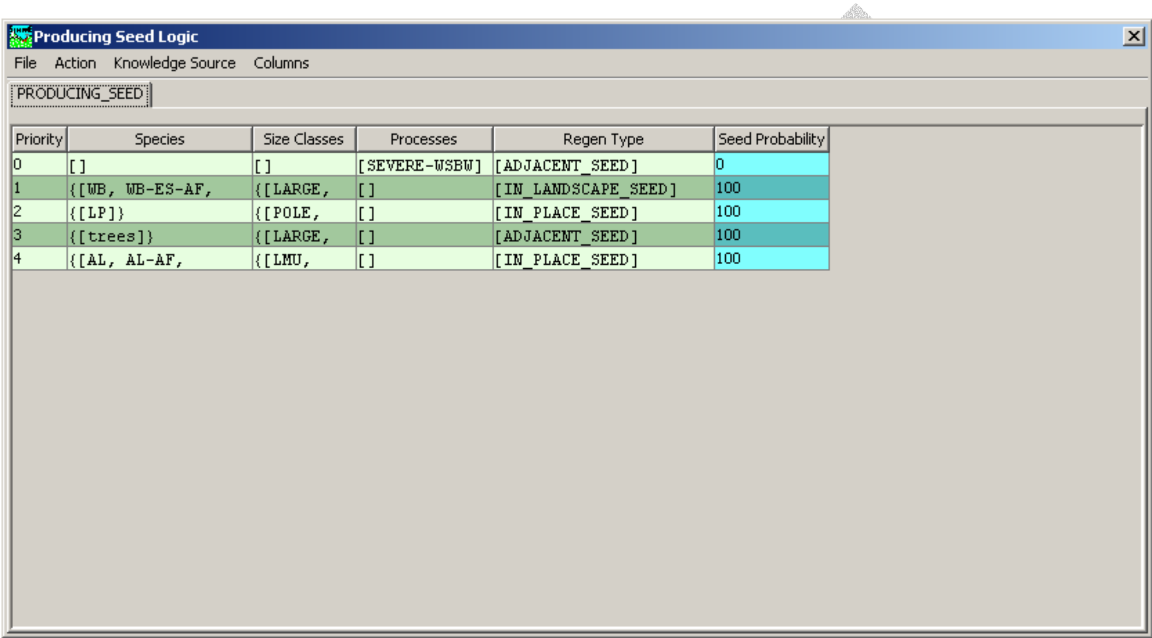


Figure 150 Screen for the logic for requirements for a species to be producing seed.

Regeneration delay

Under options on the menu bar the choice of "delay" is available. This provides access to knowledge to account for regeneration having a delay on many ecological sites. The following figure is the delay for the Eastside Region One geographic area. This displays for a set of ecological groups, habitat types, that there is a 3 time step delay in the regeneration process. The system will wait 3 time steps before evaluating the fire regeneration logic. The original logic with the Eastside zone was developed with using decade time steps. In this case the 3 time steps are intended to be decades. If a user changes to making simulations with yearly time steps the regeneration delay must be changed to 30 to be consistent with the original logic.

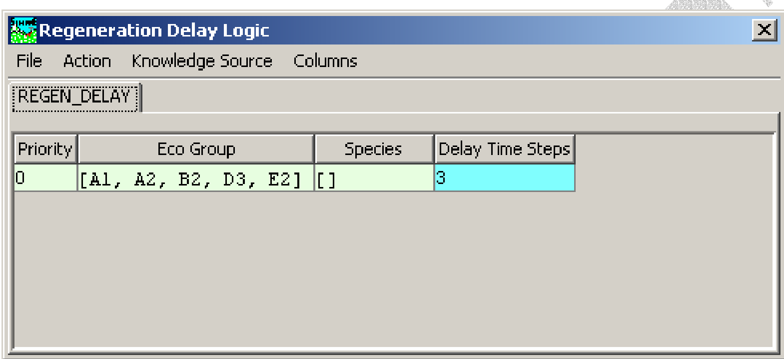


Figure 151 Regeneration delay screen. The time steps have to match yearly or decade time steps used in a simulation.

Other Regeneration

Encroachment on Non Forest Habitat Types

This is a special case developed for the Eastside Region One zone before the other regeneration capabilities were in the system.

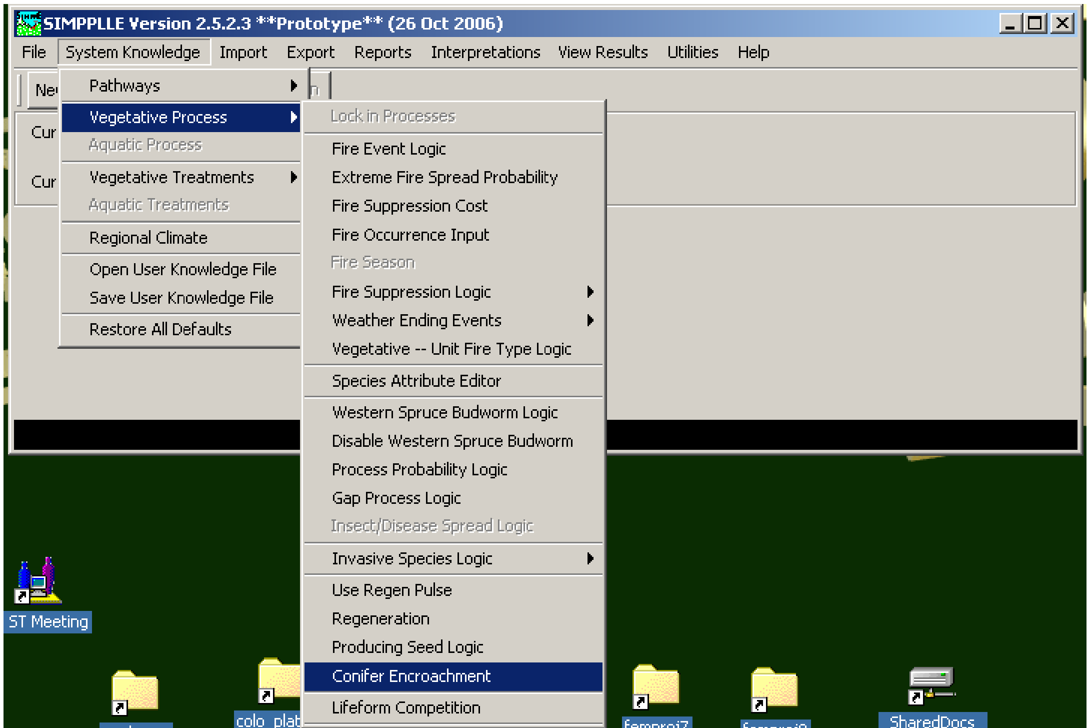


Figure 152

The ecological stratification utilized in the Eastside Region One zone uses habitat types that make a distinction between forested and nonforested sites. The conifer encroachment logic allows for the regeneration of confers on some of the nonforested 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 nonforest 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.

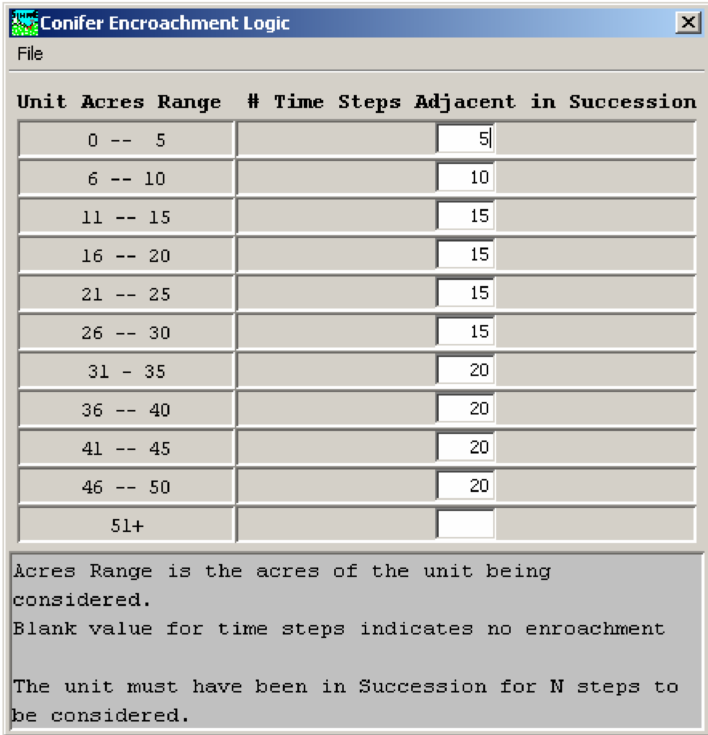
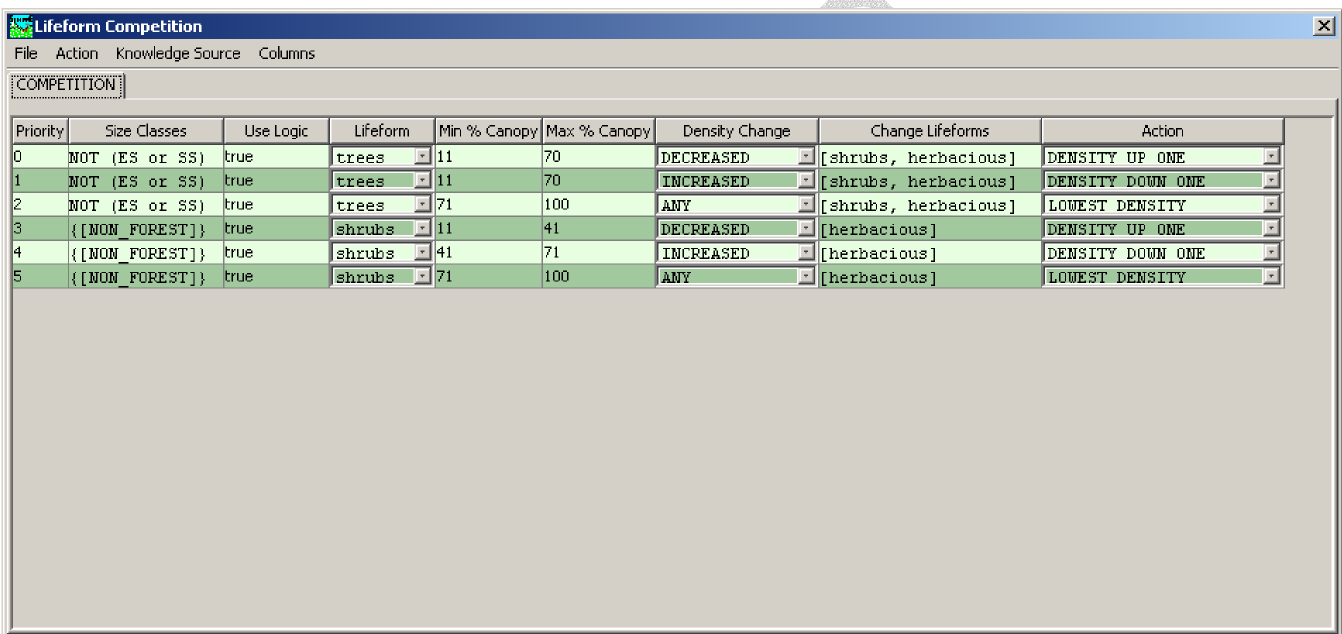


Figure 153 Logic for conifer encroachment in the Eastside Region One Zone.

Lifeform competition

With the expansion to include multiple lifeforms 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 lifeforms. 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 154 Logic screen to account for changes in density because of interaction between multiple lifeforms.

MANAGEMENT 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 has to be created by the user by scheduling acres of treatments.

To represent specific management emphases or scenarios in SIMPPLLE a user has to create combinations of schedules of treatments and fire suppression choices. SIMPPLLE can utilize treatment schedules developed by other modeling systems such as MAGIS (Zuuring and others 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 a user.

Treatments are applied at the beginning of a time step, then the changed plant community is evaluated for the probability of a disturbance processes. 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. The following figure is an example of treatments from a simulation summary report.

```
File  Edit  Format  Help
           Treatment                                      time
                                             1        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                                      time
                                             1        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                                      time
                                             1        2        3        4        5

ASPEN-RESTORATION-CUT-AND-BURN               6        0        0        0        0



Special Area BLM-NF

           Treatment                                      time
                                             1        2        3        4        5

ASPEN-RESTORATION-BURN                   3,074        0        0        0        0
```

Figure 155 Output display for treatments from a simulation.

The choice of "Vegetative Treatments" from the "System Knowledge" pull down menu displays a schedule choice and a logic choice. The shaded out choice of "Desired Future Conditions" is an option under development that will let the user 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. The choice of 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 in the landscape a file must be loaded first.

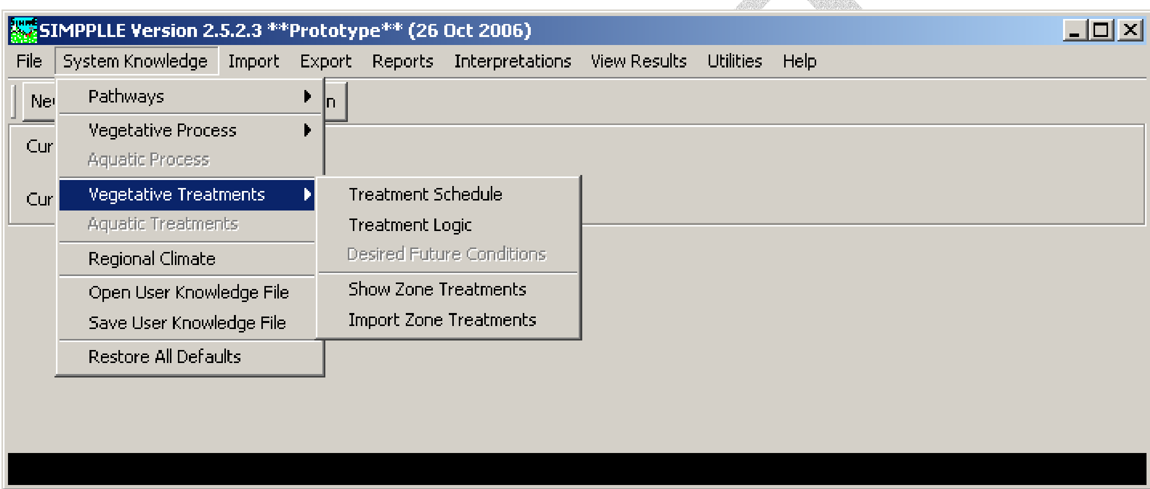


Figure 156 Access to the treatment schedule and treatment logic in SIMPPLLE.

Treatment Scheduling

Treatments can be scheduled in three different ways. The user can specify individual units by treatment type and time step. The user can 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 the user can 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 build 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.

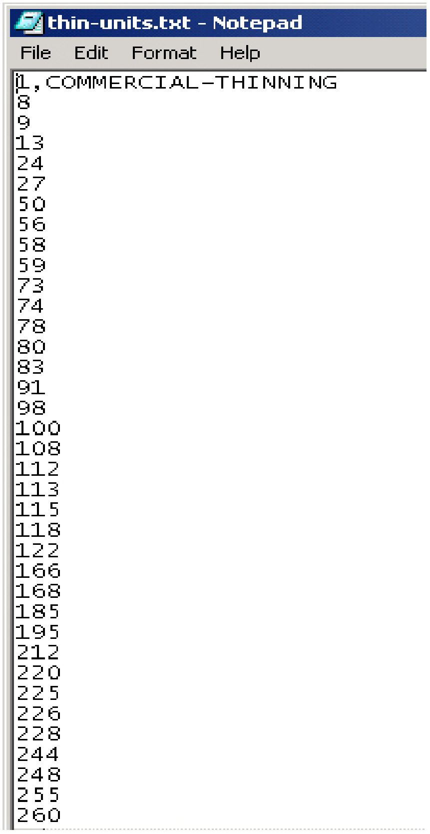
At this time no costs have been associated with any treatment. If a user desires to include treatment costs and other resource objectives and constraints as part of the scheduling of treatments SIMPPLLE can be used with scheduling and optimization modeling systems such as MAGIS (Zuuring, H.R.; W.L.Wood, J.G. Jones. 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 SIMPPLLE user interface and outside of it.

Outside of SIMPPLE:

Working outside of SIMPPLLE 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. The following figure is an example of a text file. Notice that it is named with a "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 157 WordPad text editor displaying the format for a file of treatments scheduled

Within the file the time step is specified first, in this case it is the first time step, followed by the treatment type and the units to which the treatments are to be applied to 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.

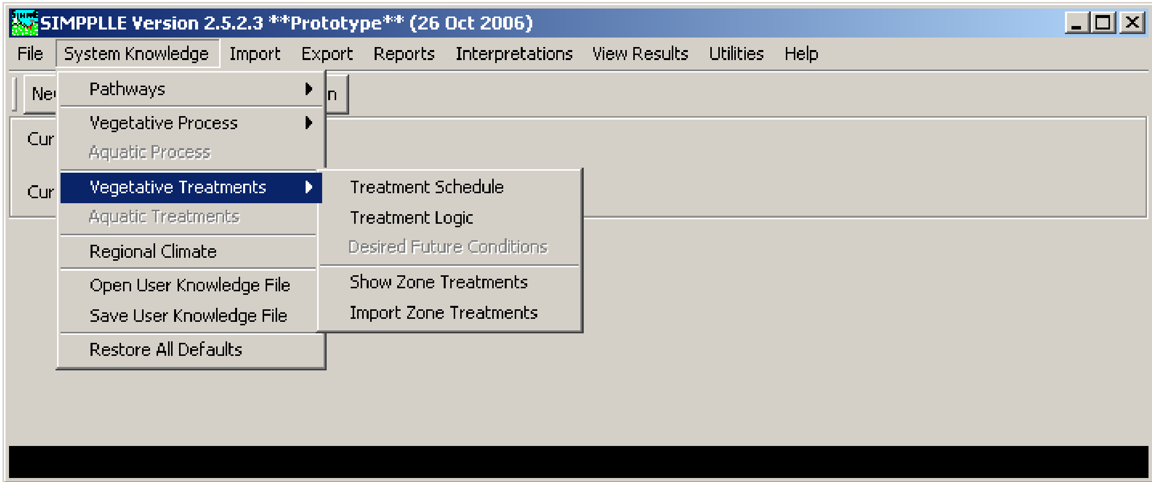


Figure 158 SIMPPLLE screen showing the selections necessary to get to the main screen for scheduling treatments.

From the main screen for "treatment schedule" use the "File" pull down menu to select the "Load Unit ID File" as shown in the following figure.

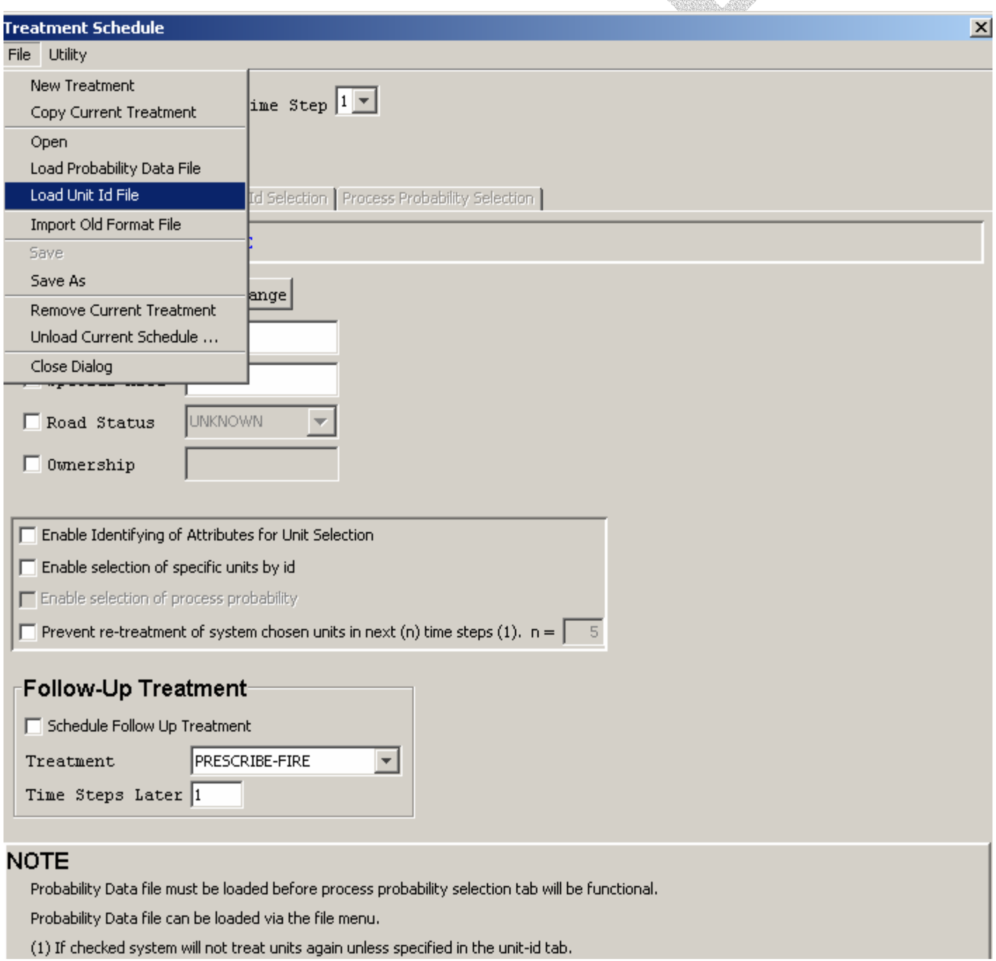


Figure 159 – SIMPPLLE screen displaying the choice to load a unit id file of treatments to be scheduled that has been created outside of the SIMPPLLE user interface

Within SIMPPLE:

In the Treatment Scheduler screen the “File” drop down menu provides the choice to select “New Treatment” as seen below.

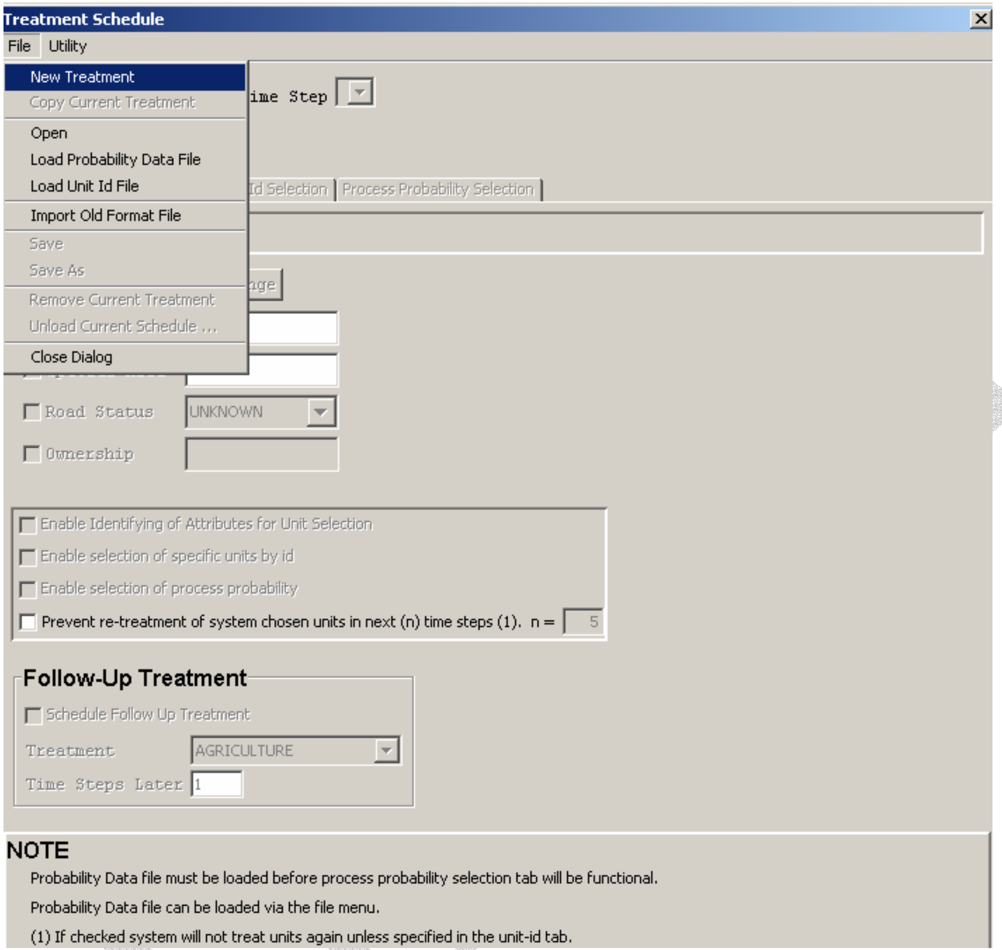


Figure 160 The choice of “New Treatment” necessary to start scheduling treatments within SIMPPLLE

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. The following figure displays the selection of mechanical-thinning for time step 1. By default the acre figure in the “desired acres” field is the entire landscape acres.

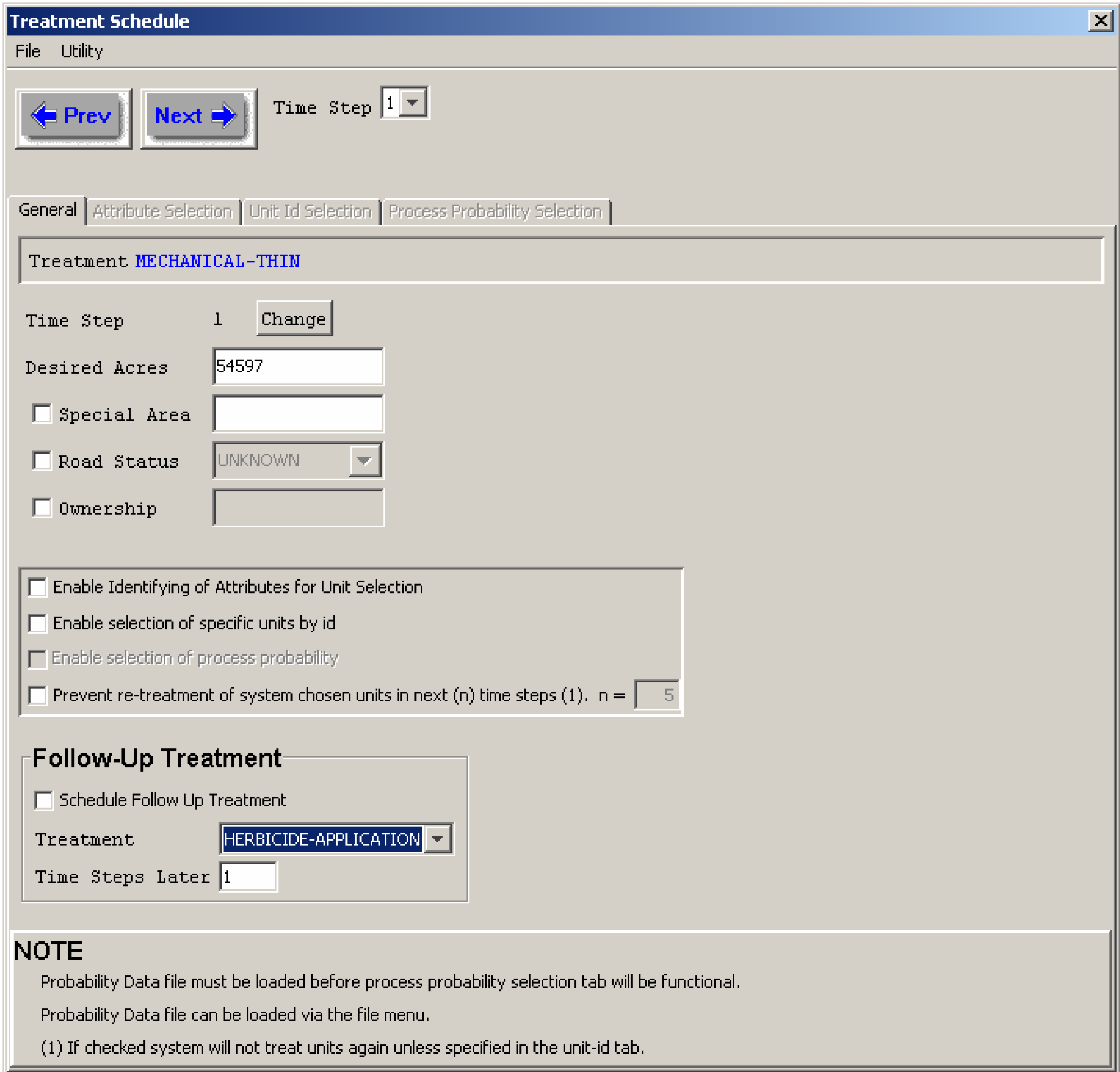


Figure 161 Treatment schedule screen that displays the selected treatment choice of mechanical-thinning.

To identify the treatments by entering in individual unit numbers we have to click on the box for "Enable selection of specific units by id" in the middle of the screen. This activates the "tab" labeled "unit id selection" as shown below.

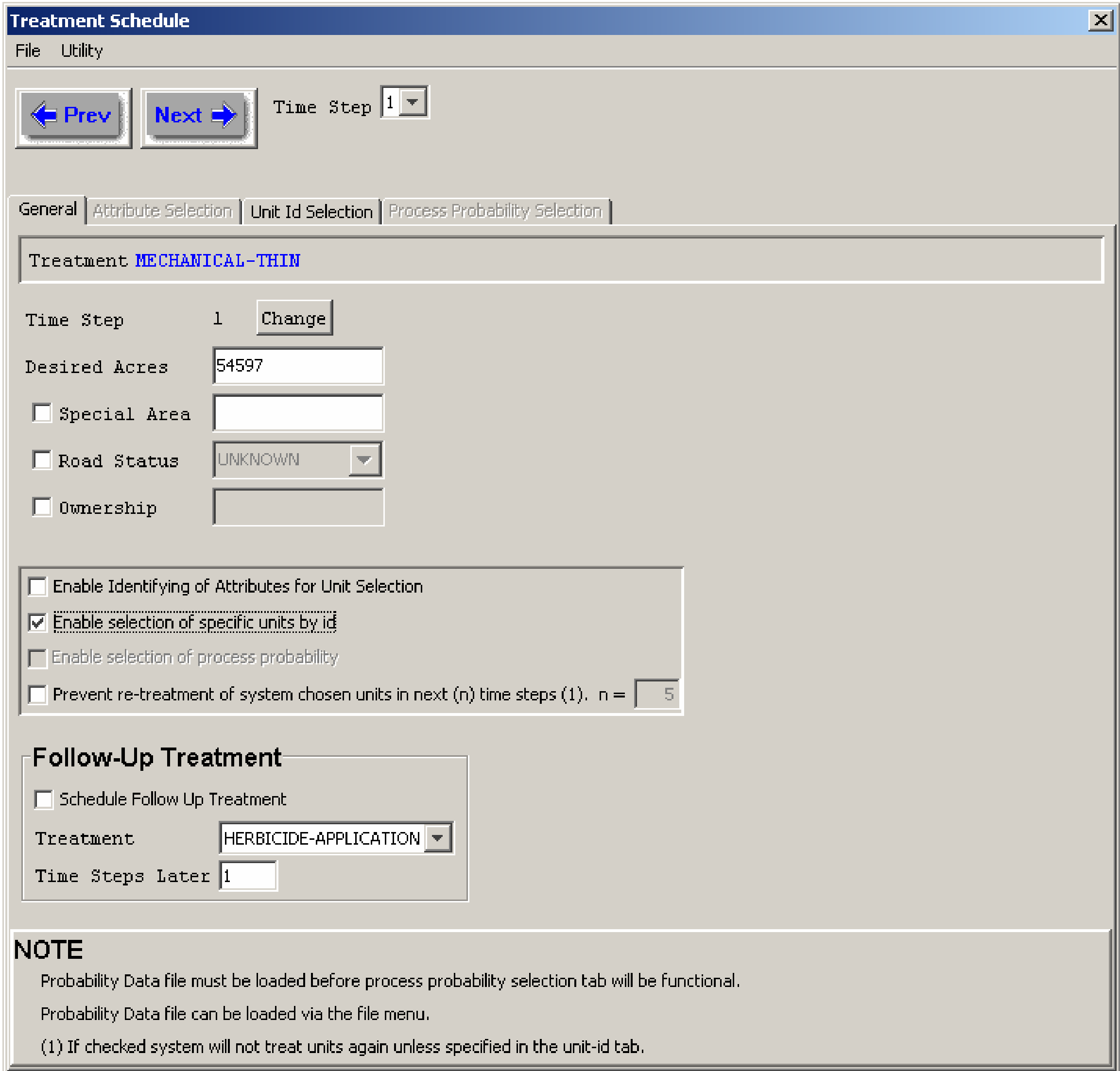


Figure 162 Main Treatment Schedule screen with the choices made for treatment, time step, and selection of specific units by id

The screen that is associated with the “unit id selection” enables the plant community id values (slink numbers) to be typed in and entered by hitting the “add” button.

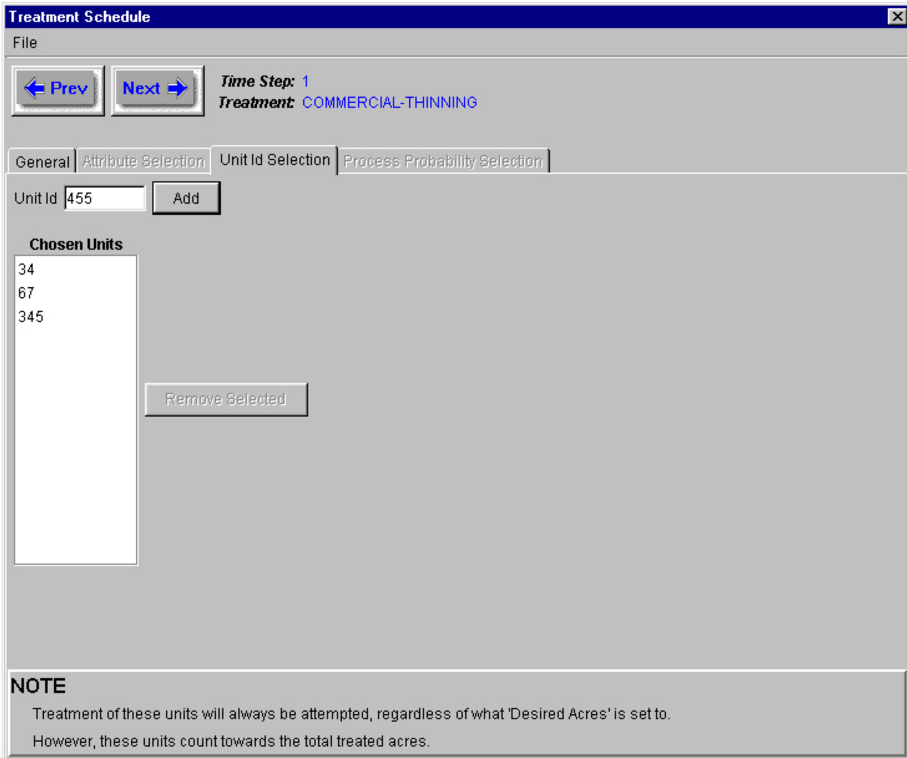


Figure 163 Completed “unit id selection” screen for scheduling treatments within the SIMPPLLE interface.

If you want to schedule the same process for additional time steps, you can go back to the “file” drop down menu and choose “copy current process”.
This changes the screen to have the same process and the same units scheduled, but the time step is blank and you need to enter the desired time step. If you don’t want the same exact units scheduled you can use the “add” or the “remove selected” buttons to modify. You can repeat these steps to create as many treatments for a time step or combinations of “time step, process and unit id lists” as desired. The “Prev” and “Next” buttons can be used to move between these combinations you have created if you want to do any additional editing of the unit ids. You can add a different process, by creating a “new” combination of the “time step, process, and unit id list.” You have to return to the “File” drop down menu. After you have created all the combinations of “time step, process, and unit id lists” that you want and you are ready to make a simulation with these treatments, select the “file” drop down menu and choose “close-dialog”. If at any time you want to remove all the combinations you made and start over, or remove them to make simulations without them, under the “file” drop down menu, choose “unload”.
If you want to just remove a combination currently displayed you can select “remove current treatment”. If you want to save this treatment schedule for other SIMPPLLE sessions you will need to save using the “SAVE AS” choice under the “File” drop down

menu. 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 the "Save as" opens a screen to the working directory you have identified. The system will add the extension of "treatment" to the name you have provided.

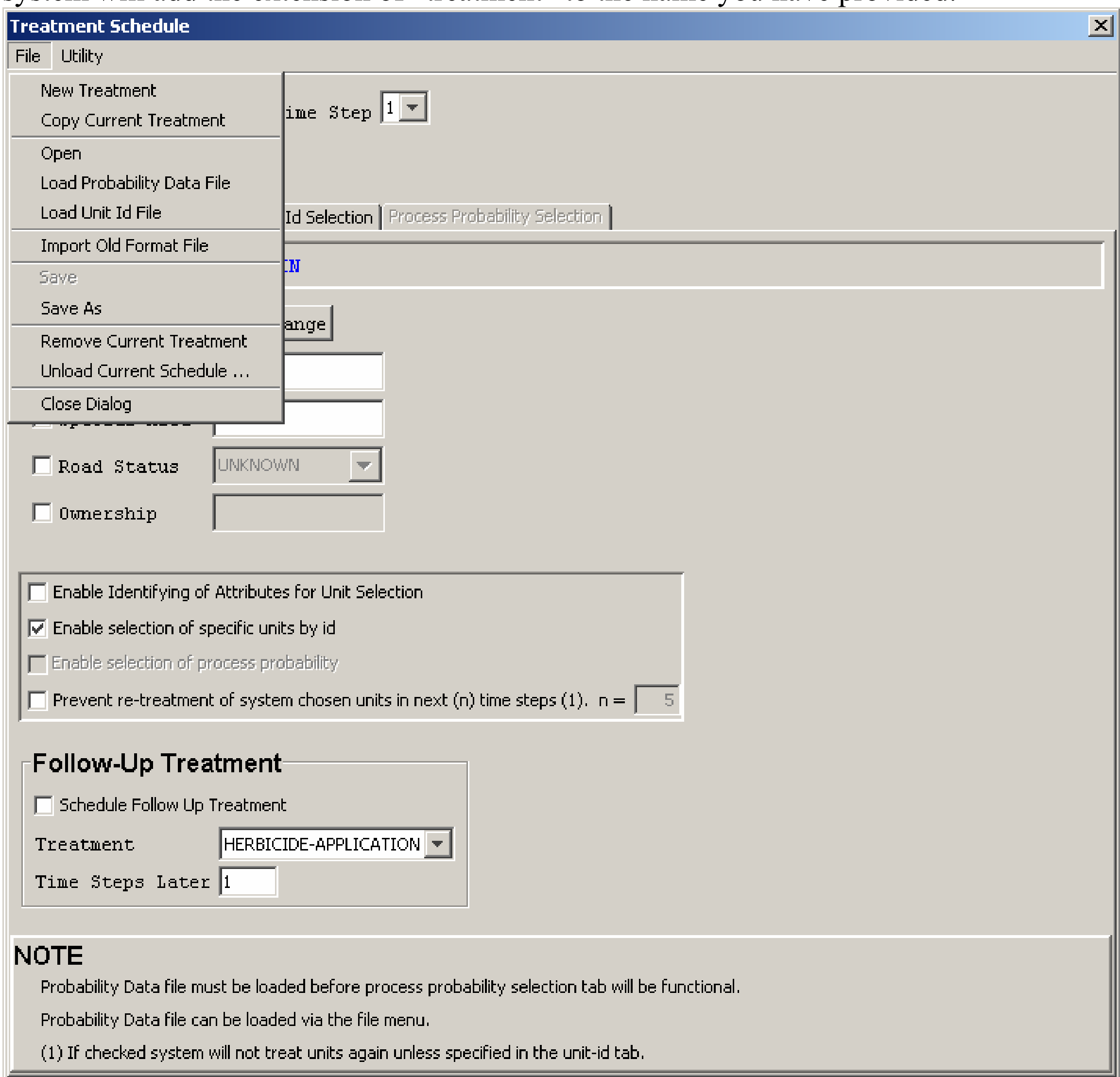


Figure 164 Choices under the "File" drop down menu associated with the "Treatment Schedule" screen.

The file that gets saved cannot be viewed or edited outside of SIMPPLLE. To use it again you will have to go to the "File" drop down menu and select "Open" and load the saved file.

When some treatments are scheduled they involve a "follow-up" treatment. The user can schedule these, or some are already build 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. Some examples are a group-selection-cut is an example where it 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.

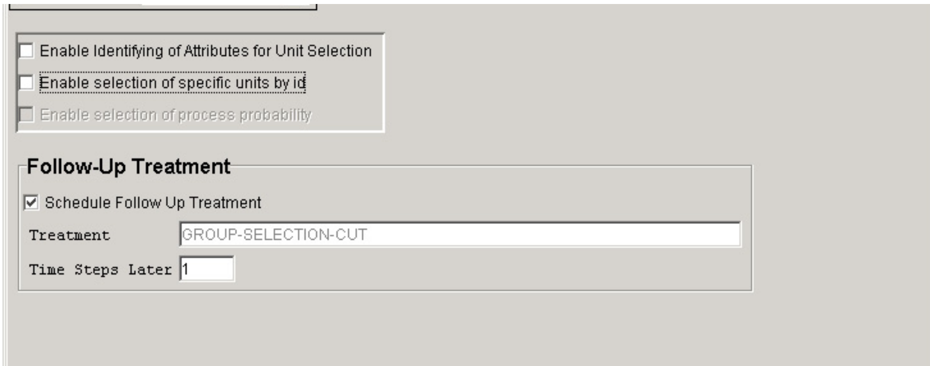


Figure 165 Treatment Schedule screen that shows if a group-selection-cut treatment is scheduled it will be followed in the next time step by another group-selection-cut treatment

Schedule by 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. You have the option of specifying a desired level of acres to have the treatment applied to. In this case SIMPPLE 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 simply put in a list and SIMPPLLE randomly selects from this list till it meets your acreage goal. Additional selection criteria can be added in future version if they are requested by users.

In the following example we are ready to select the tab “attribute selection”.

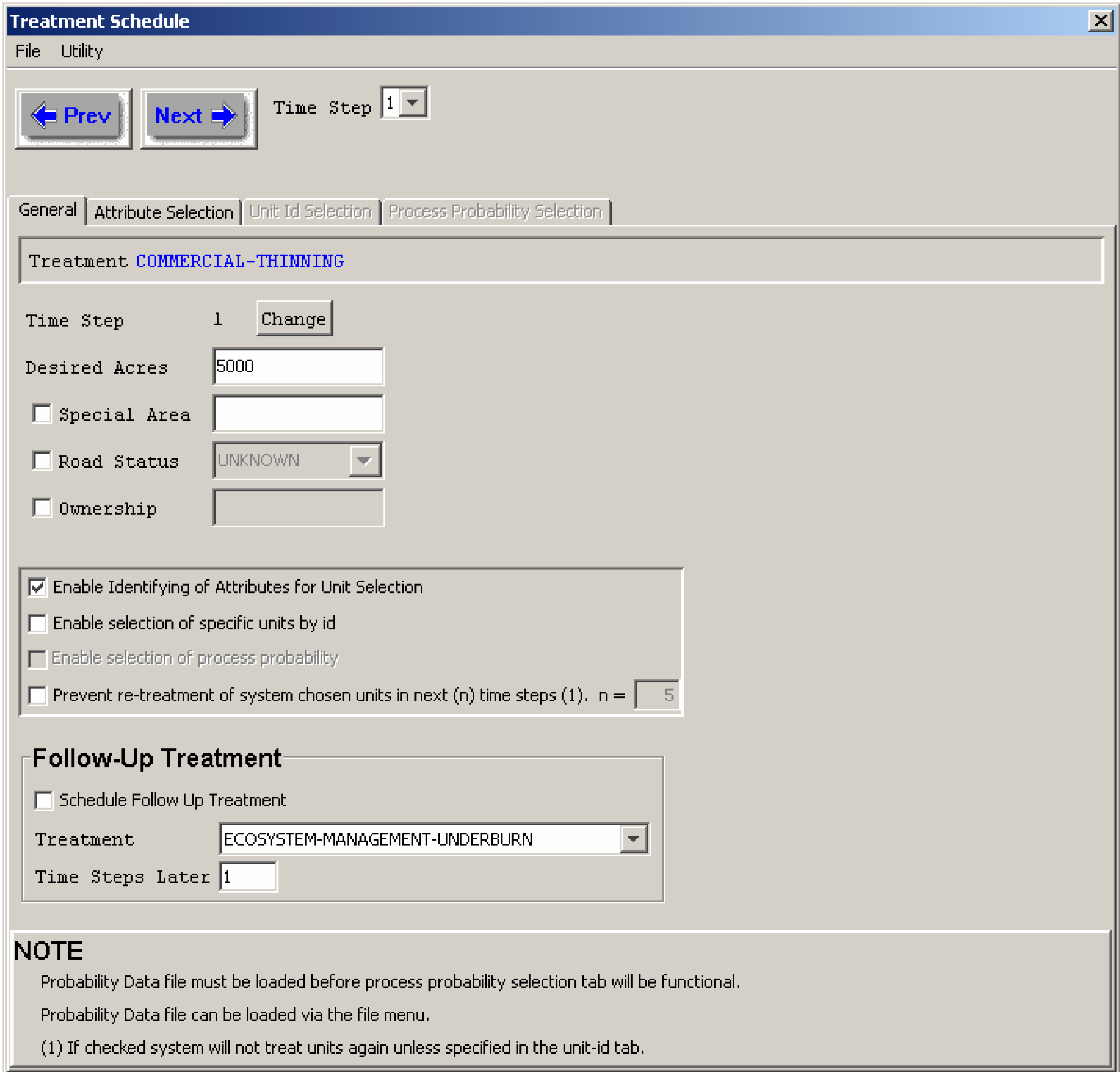


Figure 166 Screen within the "Treatment Schedule" with the choices made to activate the "Attribute Selection" screen to provide the information to enable SIMPPLLE to select units to apply a treatment to

In the following figure three habitat type groups, some combinations of lodgepole pine species, size classes of medium and above, the highest two density classes, plus an additional requirement that the units have had a previous process of light mountain pine beetle in them have been identified to be potentially selected for treatment.

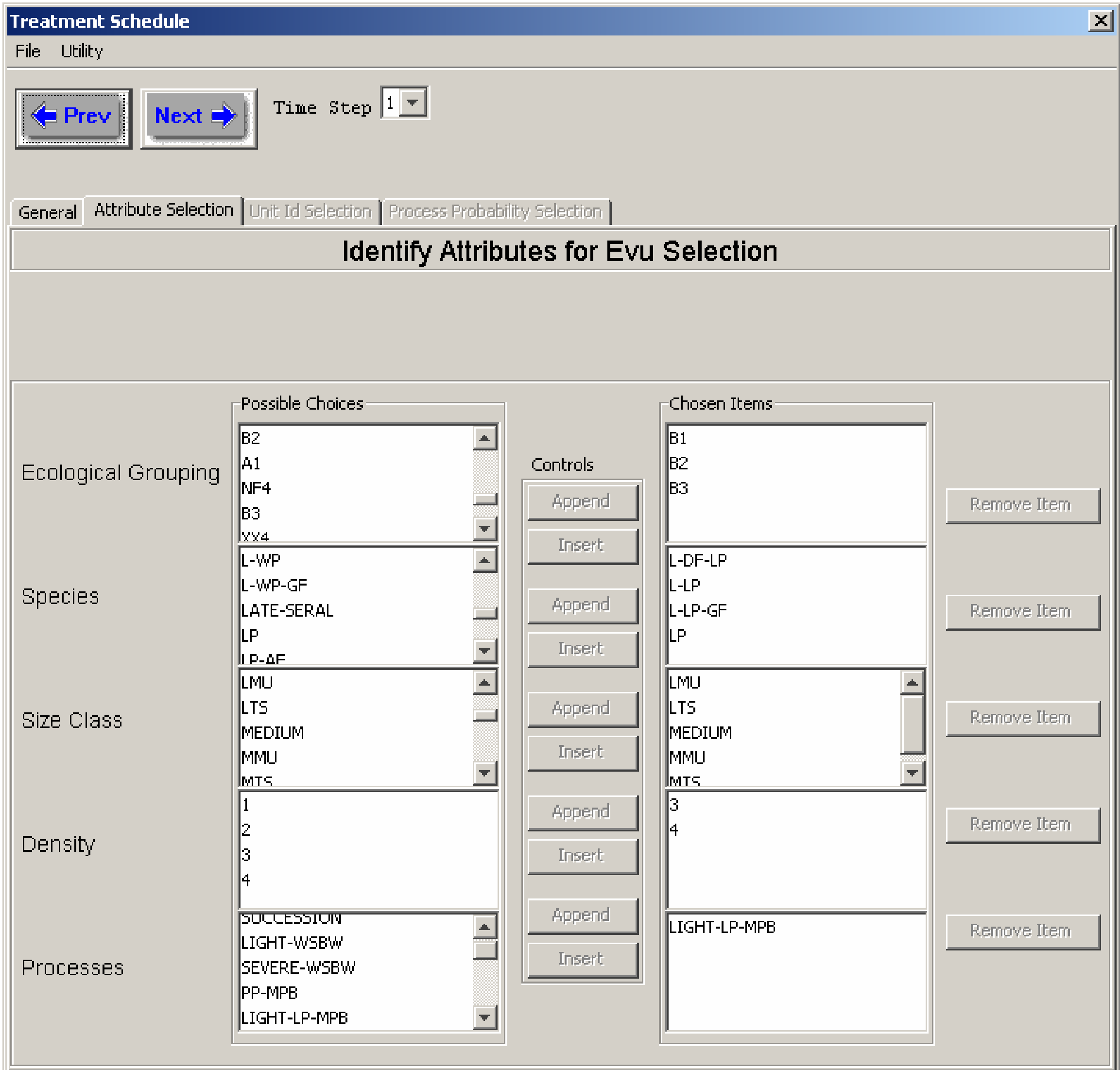


Figure 167 Combinations of attributes that have been identified to provide SIMPPLLE the basis for selecting units to assign treatments to

We did set an upper limit of 5000 acres (see previous figure) but we did not set any limits by ownership or special areas within the landscape.

Selection by Probability

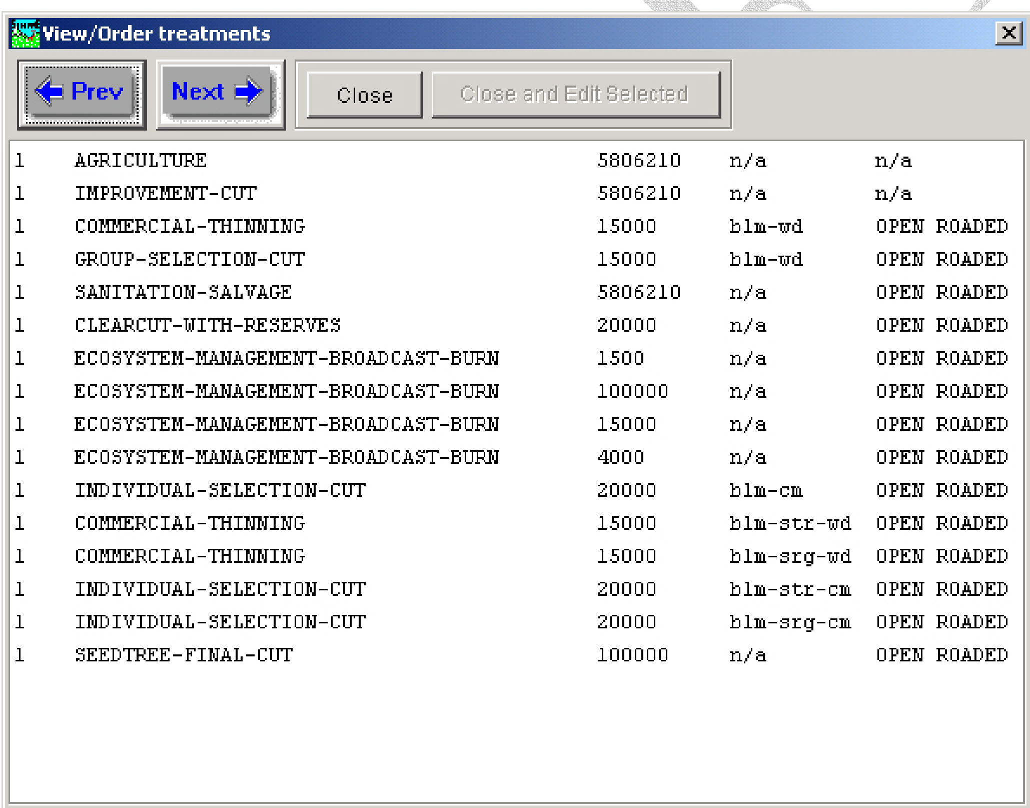
The choice of this attribute to schedule treatments involves making multiple simulations to create a probability file and using these probabilities to let the system guide the selection of units to treat. This choice is currently not functional.

Prevent Retreatment

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 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. The total treatments scheduled can be view by selecting the “view/order treatments” from the “utility” choice on the main menu for treatment schedule. All the treatments for a time step are shown. The “prev” and “next” buttons 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. The following 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



1	AGRICULTURE	5806210	n/a	n/a
1	IMPROVEMENT-CUT	5806210	n/a	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 168 The treatments scheduled for time step one. The order can be changed to represent a priority for SIMPPLLE. The system starts at the top of the schedule.

Treatment Logic

From the main menu choice of “system knowledge”, the treatment logic can be accessed.

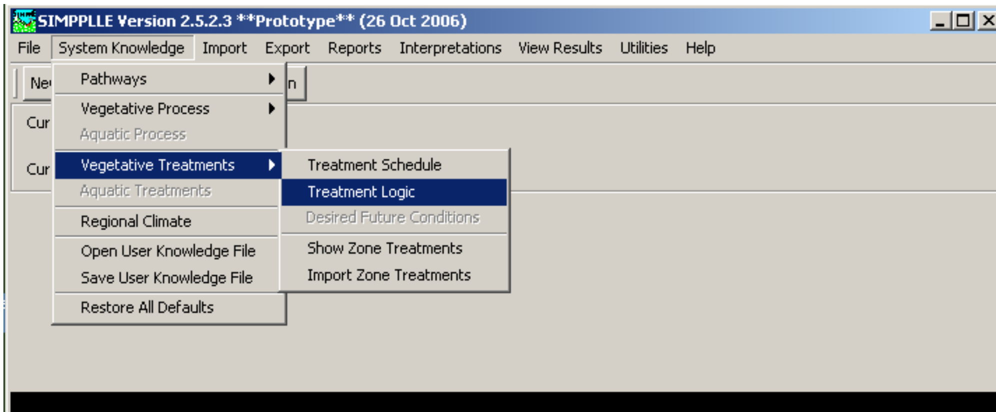


Figure 169 Accessing Treatment Logic under System Knowledge.

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 results 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. A user can create a treatment that doesn’t already exist.

Within the treatment logic screen, the pull down on the current treatment allows you to select a treatment. In the below figure we have selected “mechanical-thinning”. The “feasibility tab” is the part of the screen active. Six items can be used to define the feasibility of this treatment. In this example, in the figure below, 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” is check meaning both conditions have to be met. The species tab is open showing that a vegetation community has to be “one of” the listed species.

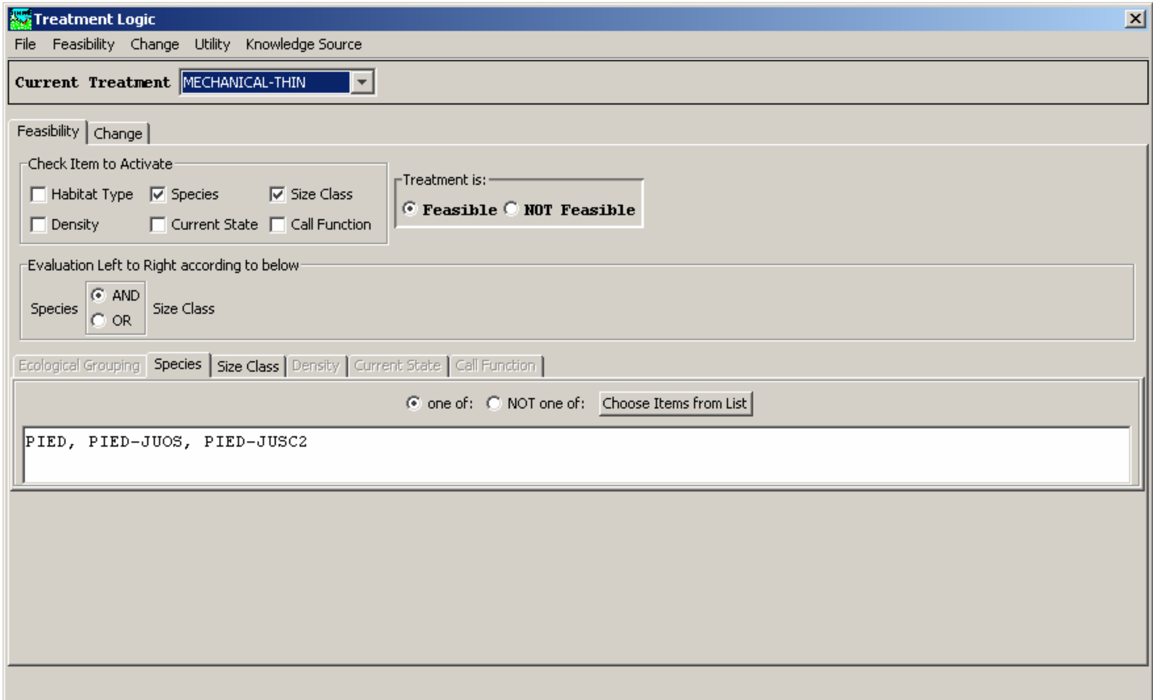


Figure 170 Feasibility screen for the Mechanical-thin treatment showing the species that have to exist to be feasible.

If you select the size class tab in the bottom part of the screen you will see the values that the size class has to be.

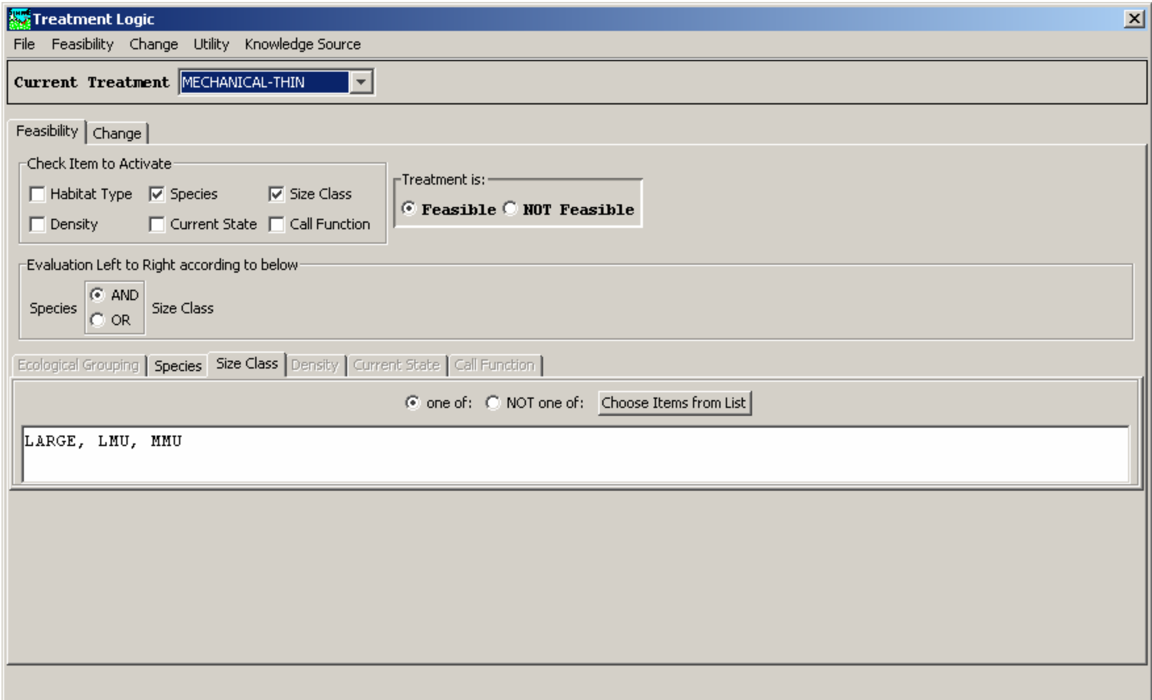


Figure 171 Feasibility screen for the treatment of mechanical-thin showing the size classes that have to exist to be feasible.

The following figure 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 sizeclass / structure.

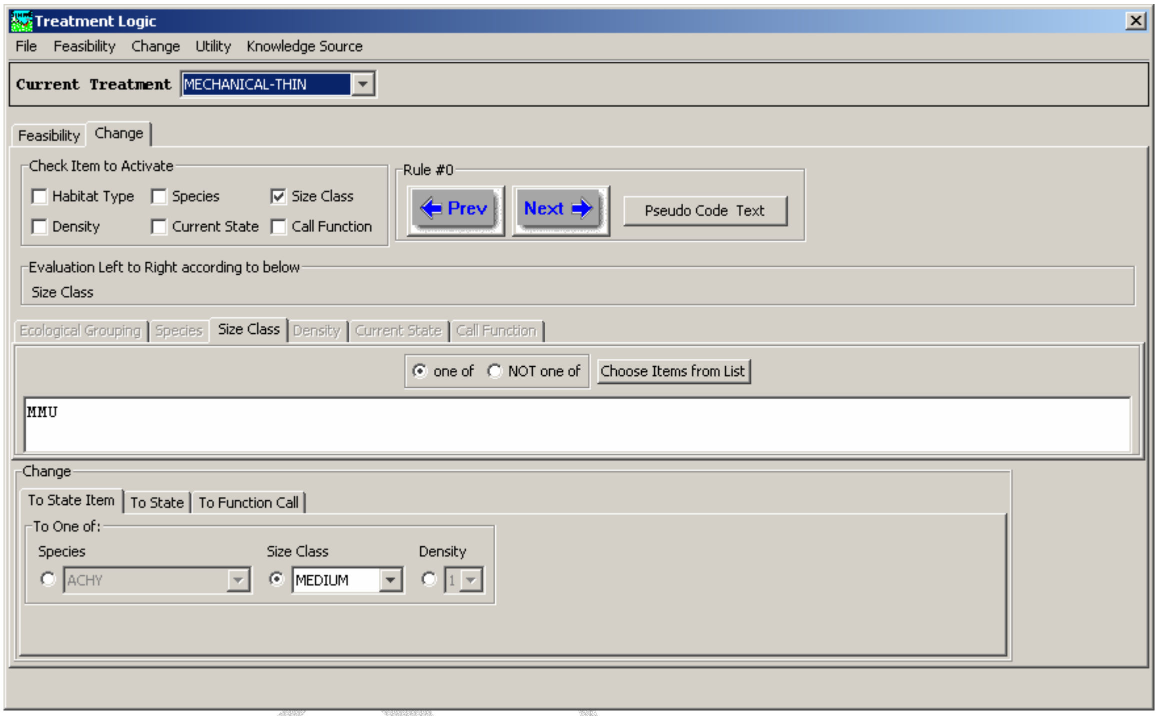


Figure 172 The change rule for the change in size class that mechanical-thin makes to a mmu plant community.

The next rule is for the large multi story size class. The change is to a single story, large size class

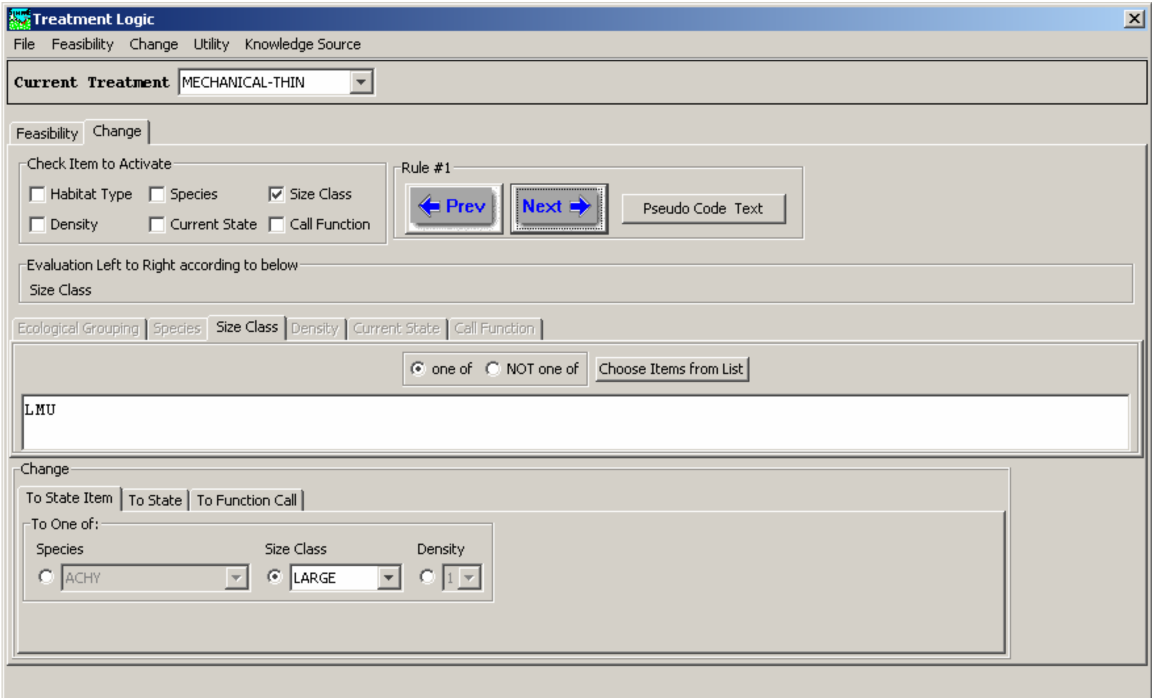


Figure 173 Change rule for mechanical-thin treatment for the lmu size class.

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.

The following figure shows the change to the “density” attribute and the rule associated with it.

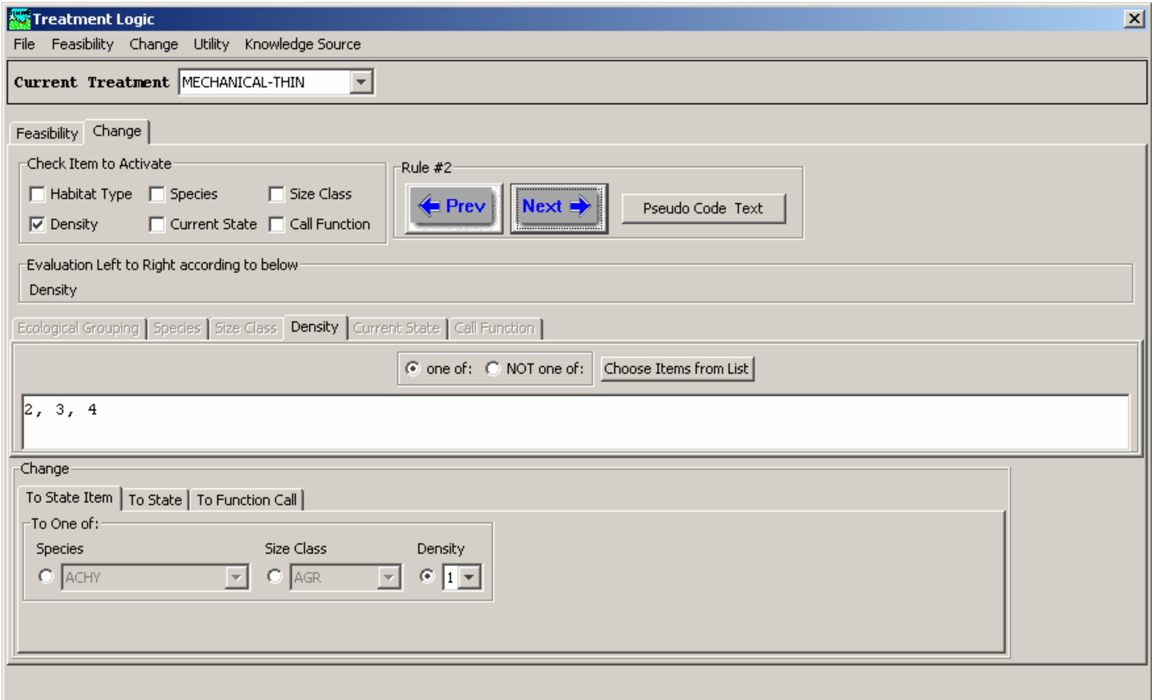


Figure 174 Change rule for density for the mechanical-thin treatment showing densities 2, 2, and 4 all go to level 1.

The following figure shows a species change rule for a treatment.

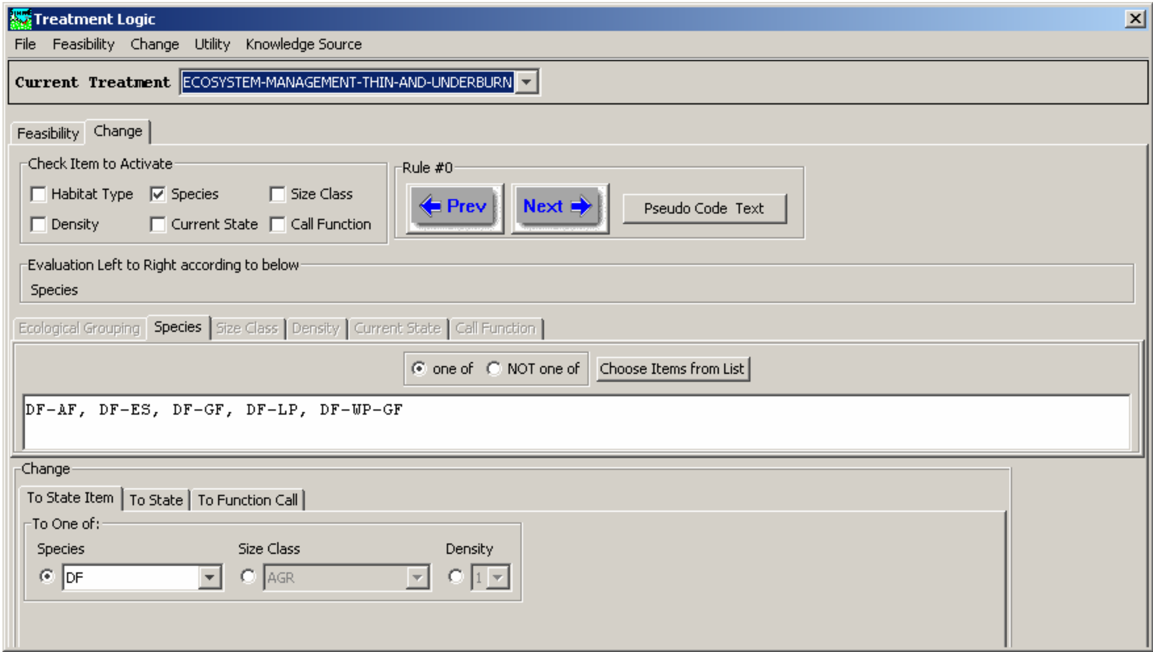


Figure 175 Species change rule for the ecosystem management thin and underburn treatment showing the removal of the more tolerant understory species from Douglas-fir mixtures.

In addition to showing the treatment change individually by one of the vegetation state attributes of species, size class or density, (to state item) an entire state can be specified (to state). The “to function call” is a third way to represented change. The following figure shows the use of the ”typeofFireNextState” function call.

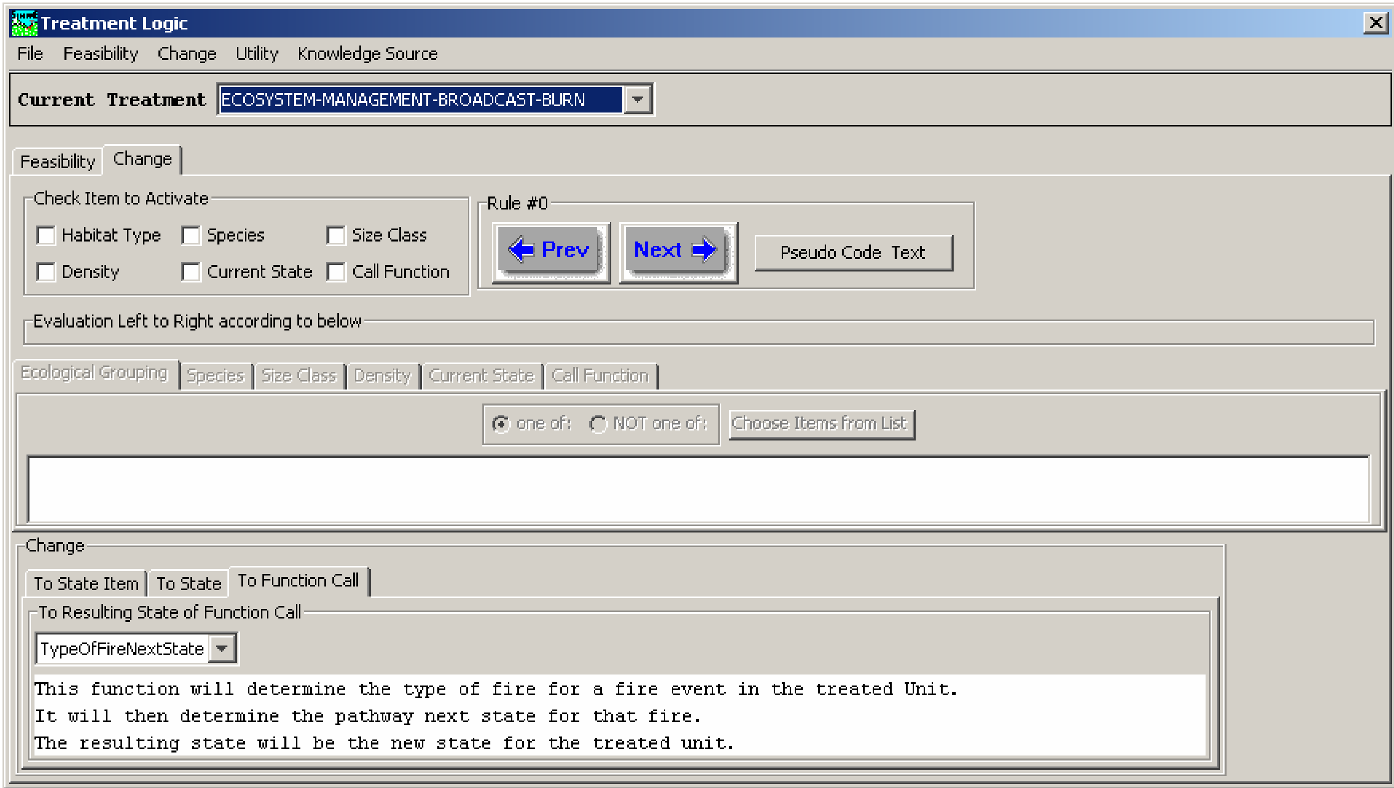
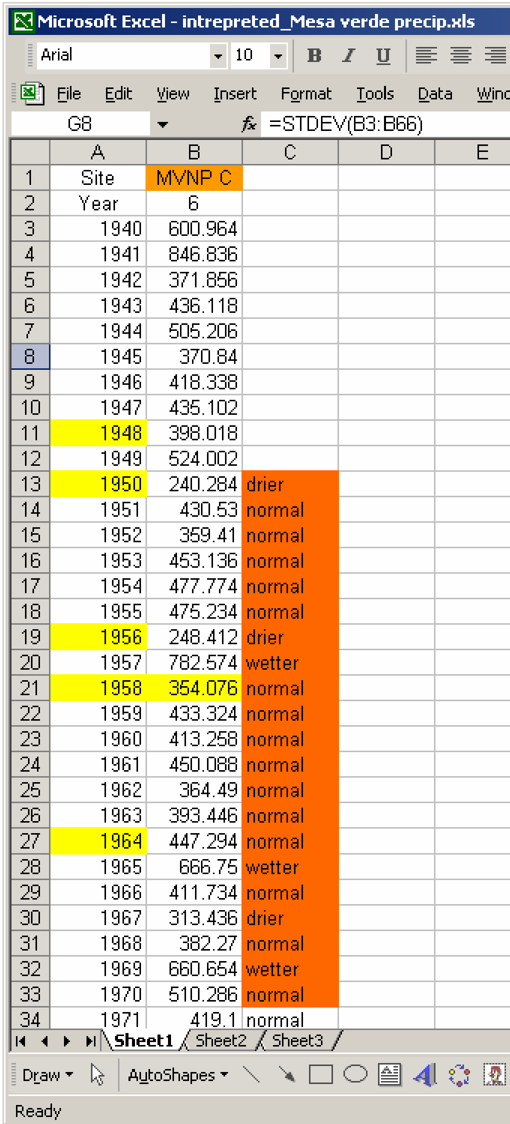


Figure 176 Change rule for a treatment showing the use of the Function Call to identify the state following the treatment.

A limited number of functions have been developed for specific case and are available to use with both the feasibility and change logic. Those available can be seen by using the pulldown arrow on the right. The description is given in the text box below. New function calls can not be created by a user in this version

REGIONAL CLIMATE

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 is described as being “normal”, “warmer”, or “cooler”. Moisture is described as “normal”, wetter” or “drier”. The following figure represent 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 begining 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 177 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 from for all logic screens.

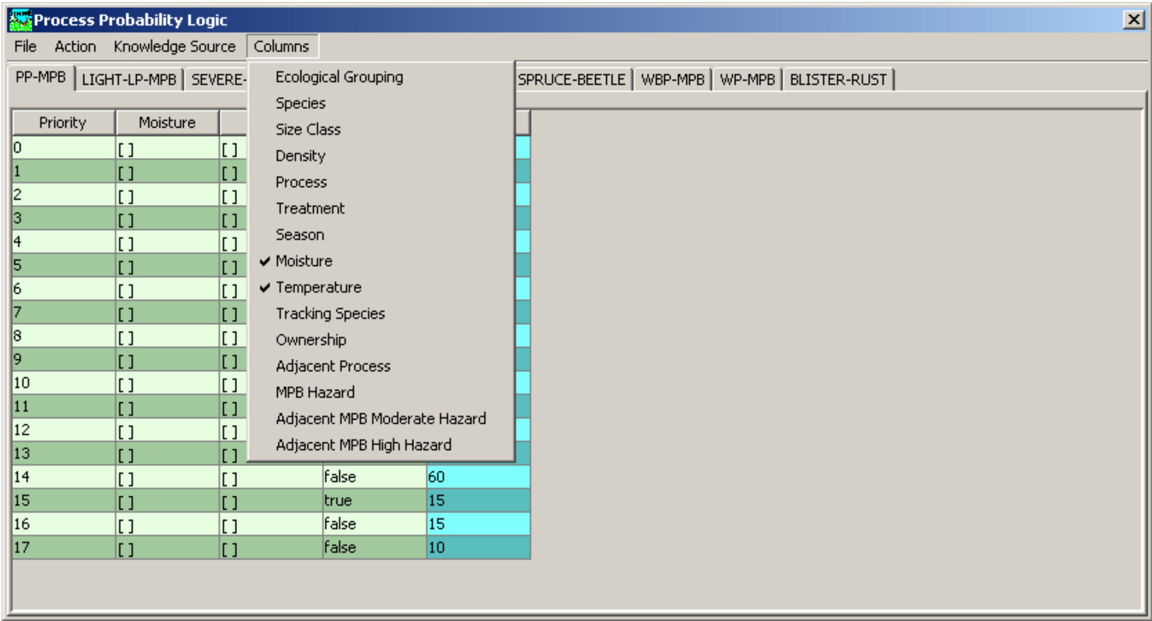


Figure 178 The Columns choice on the basic logic screen that lets a user include the Moisture and Temperature for a time step in the logic.

SYSTEM KNOWLEDGE FILES

If a 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 "save user knowledge file" can be selected from the pull down menu from system knowledge.

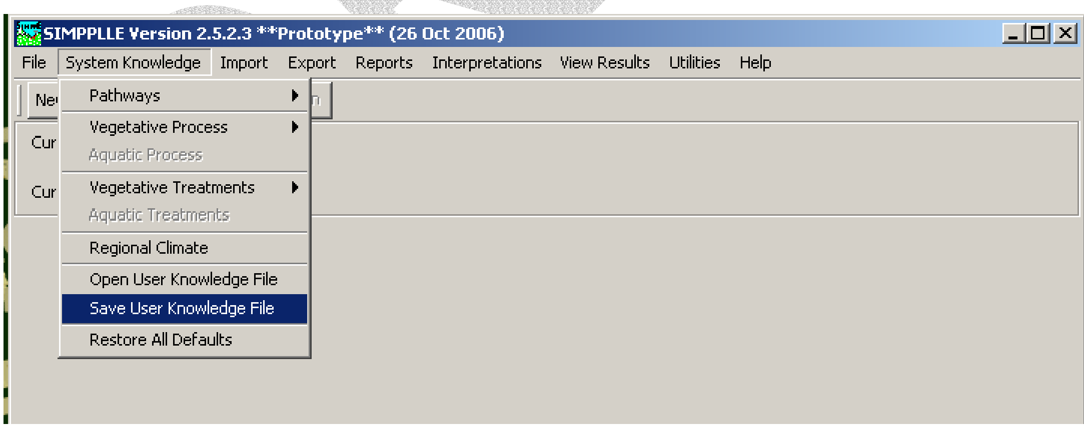


Figure 179 The choice of "save user knowledge file" on the pull down menu from System Knowledge.

The following screen allows a user to save as much as desired and provide a name for the system knowledge file. This file contains all the modified system knowledge, it doesn't just point to the individual files. Thus the individual files may be located in separate directories.

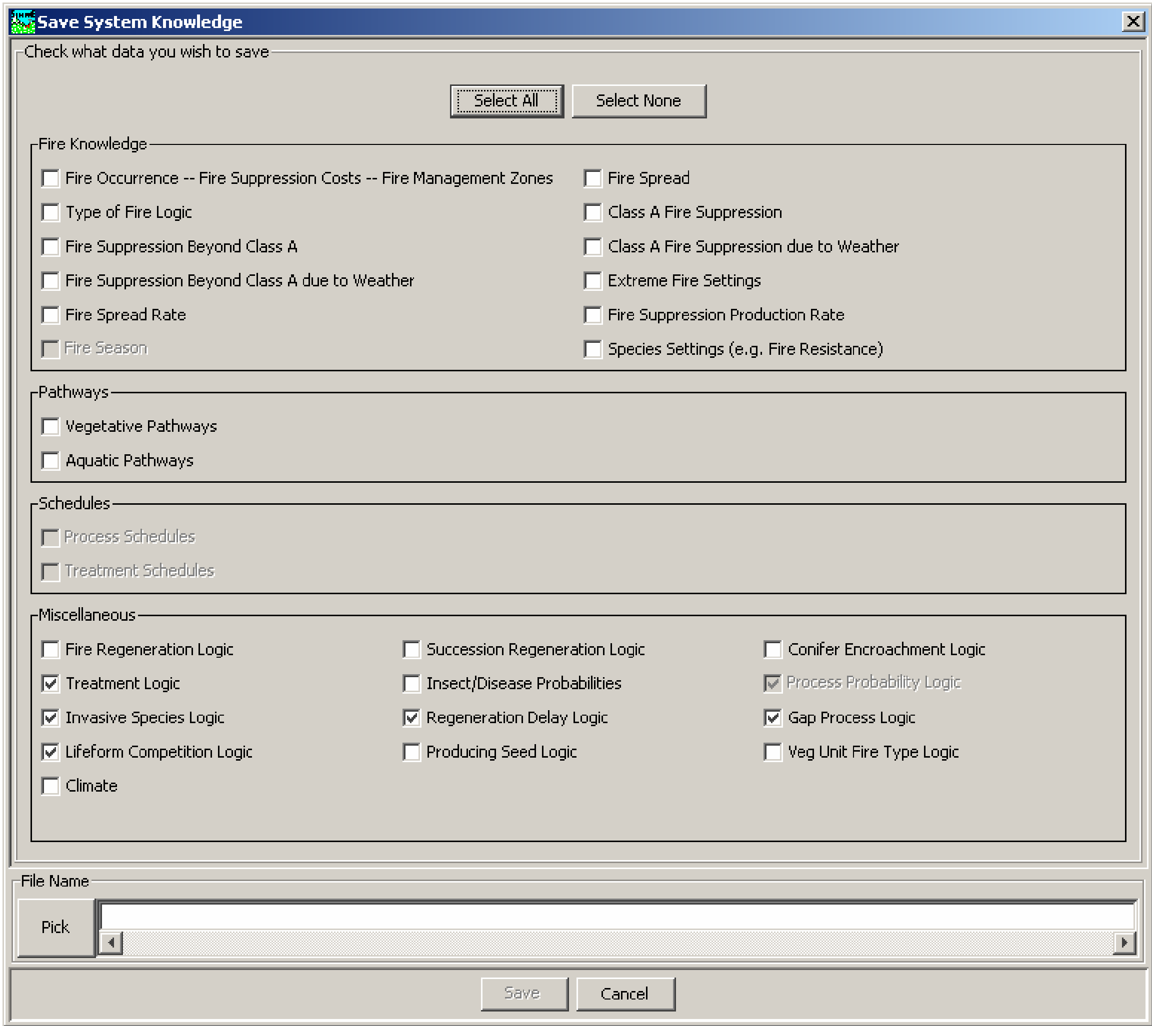


Figure 180 The save system knowledge screen that lets a user specify what modified system knowledge should be included.

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

UTILITIES

The "Utilities" choice on the main menu bar 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.

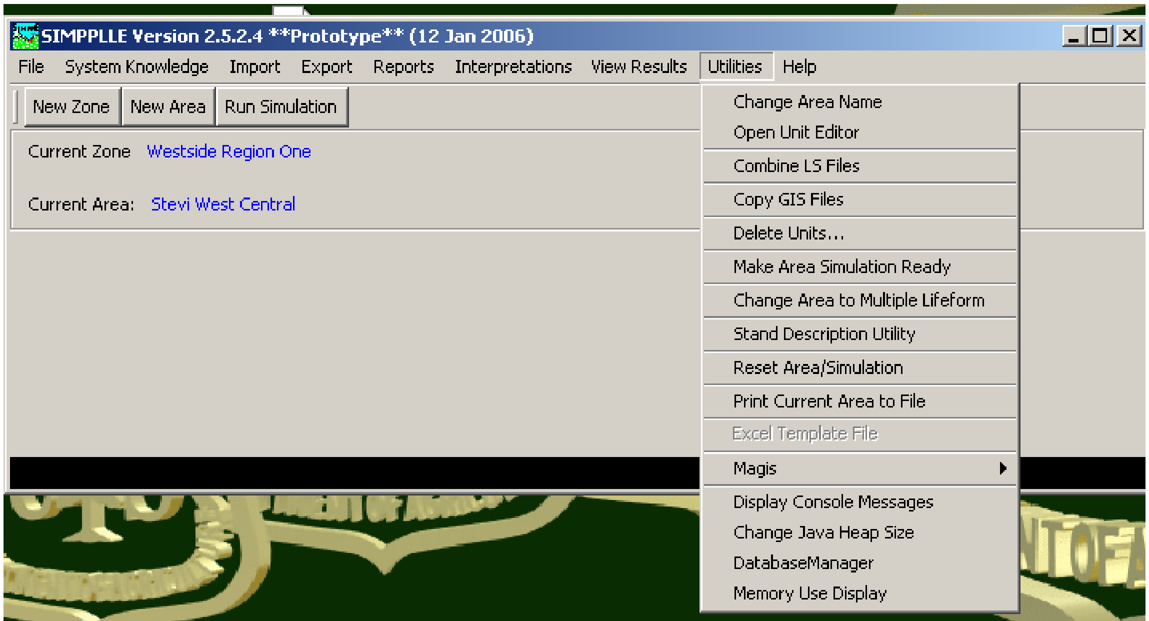


Figure 181 Choices under the Utility menu

CHANGE AREA NAME

This choice provides a dialog box to provide a name for the landscape being simulated. This is not the name of the *.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.

OPEN UNIT EDITOR

Only available when first loads an area file or make changes that results in invalid units. Identical to the "edit units" that is under the Import file menu

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. This utility has been created for the situation where memory constraints do not allow a 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 a user combine all 6 *-ls.txt files into one for processing.

COPY GIS FILES

This utility lets one move the files that come with SIMPPLLE to a desired location.

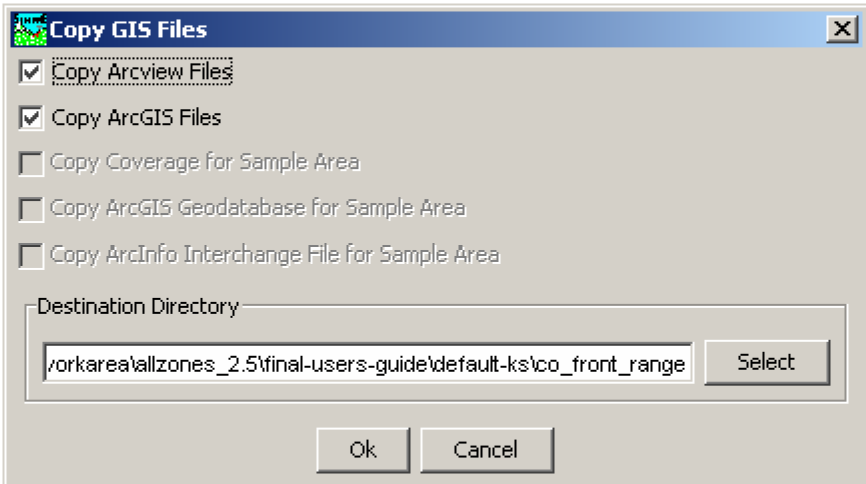


Figure 182 Dialog box for copying GIS files

The three choices for sample areas 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.

DELETE UNITS

This choice 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 a user goes to the File main menu choice and selects "save landscape".

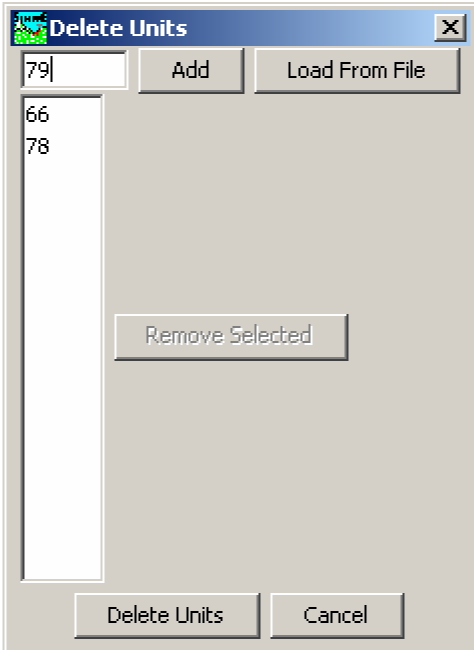


Figure 183 Dialog box for identifying units to delete from the file.

MAKE AREA SIMULATION READY

This choice 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 made 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.

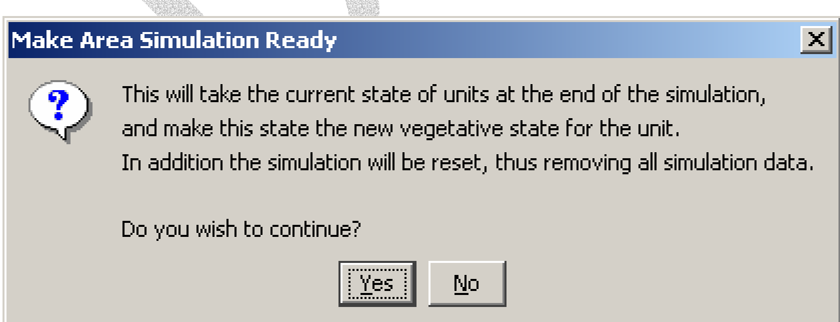


Figure 184 Dialog box describing the "Make Area Simulation Ready" choice.

CHANGE AREA TO MULTIPLE LIFEFORMS

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

STAND DESCRIPTION UTILITY

This is a feature that has not been developed yet.

RESET AREA / SIMULATION

This choice will delete all the simulation results and leave the landscape file as it initially existed. This is automatically implemented if a user starts a new simulation again.

PRINT CURRENT AREA TO FILE

This will create a text file listing each plant community and its attributes.

EXCEL TEMPLATE FILE

This choice is no longer functional. It has been replaced by the Excel spreadsheets with macros that are available with the installation.

MAGIS

These choices create files that are utilized in running the MAGIS modeling system.

Risk Rating

This choice 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 a interface screen that utilized vegetation attributes along with the probabilities of disturbances from a set of multiple simulations.

Process and Treatment Files

This choice creates two text files (in the dialog box for naming the files, make sure you assign a .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

This choice 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 the publications of:

> Jones, J.G. and Chew, J.D. 1999
> Jones, J. Greg; Chew, Jimmie D.; Zuuring, Hans R. 1999
> Chew, J; Jones, J; Stalling, C; Sullivan, J; Slack, S. 2000
> Jones, J.G., and J.D. Chew. 2000

DISPLAY CONSOLE MESSAGES

If a user is having problems executing SIMPPLLE, opening the window for console messages can provide information that can be sent to the developers to help identify the problem.

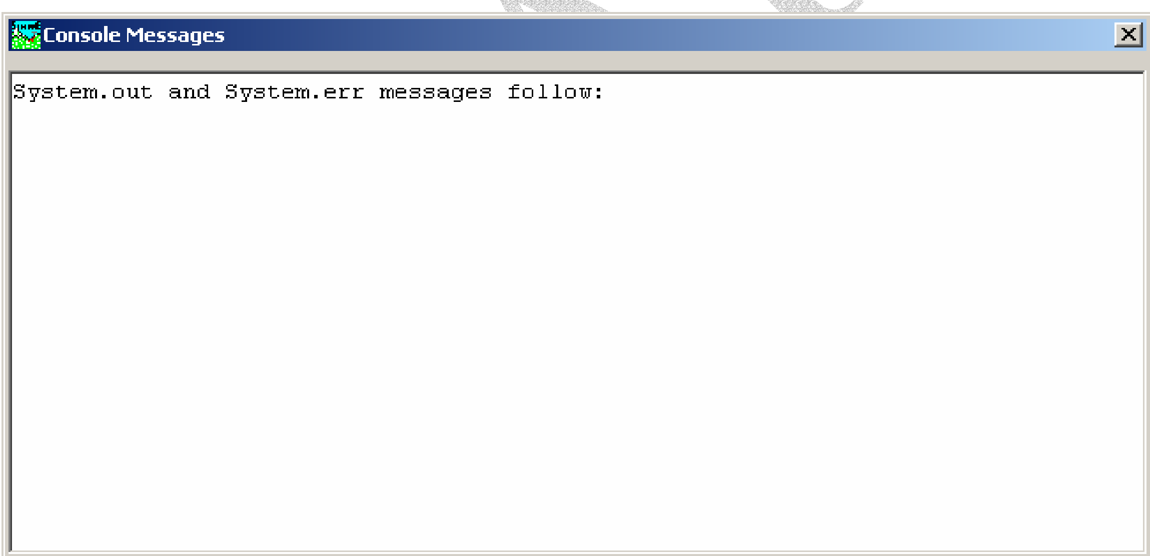


Figure 185 Console Message window that can provide useful messages for identifying problems in running SIMPPLLE.

CHANGE JAVA HEAP SIZE

This feature has already been discussed under Memory Management. It allows the user to match the maximum Java Heap size to the memory available on the computer in use.

DATABASEMANAGER

This starts up a utility that comes with hibernate 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.

MEMORY USE DISPLAY

This choice 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.

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.

ArcView Project

Locating the ArcView Project file and legend files

1. Startup up SIMPPLLE.
2. Go to the Utilities Menu
3. Select *Copy Arcview files.*
4. 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 simpplle_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 "/" 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 in shown via colors which correspond to a 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 (no value, nil none).

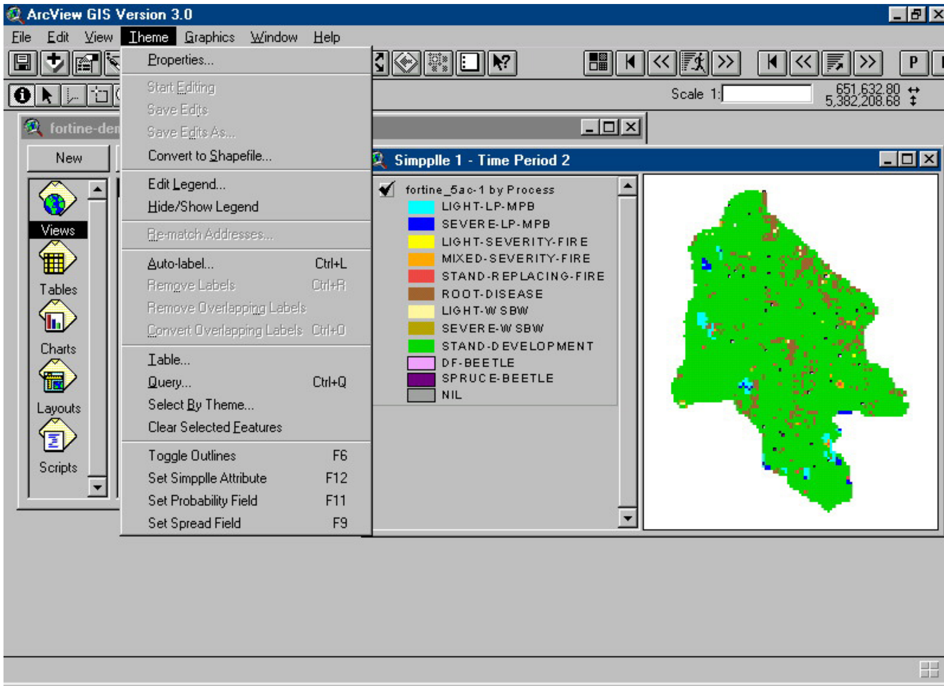


Figure 186 – SIMPPLLE ArcView Project displaying processes for the second time step.

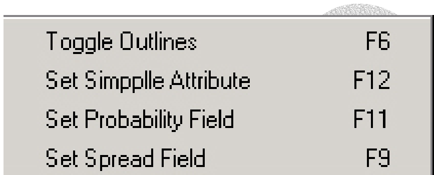


Figure 187 Choices under the Theme Menu that serve specific functions in the SIMPPLLE project file.

Figure 187 is a part of the Theme menu. The items function as follows.

Toggle Outlines:

This will toggle the display of polygon outlines on and off. By default, all of the legend for use with SIMPPLLE have the polygon outlines turned off.

Set Simpplle Attribute:

This menu item is used with the SIMPPLLE Display and the probability displays. It display a list asking you to choose from a list of attributes to view for a particular theme. The list is: *(Process, Species, Size Class, Canopy Coverage,Treatment)*

Treatment is not available for use with the probability display. This attribute must be set in order to run the Simpplle Display or Probability Display setups.

Set Probability Field:

This menu item is used to choose which field to display probabilities for in the currently selected theme. For example if you choose "Process" for the SIMPPLLE attribute, then this would display a list of processes to display probabilities for. This is only used to change the field to a different one than chosen during probability setup.

Set Spread Field:

This menu item 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.

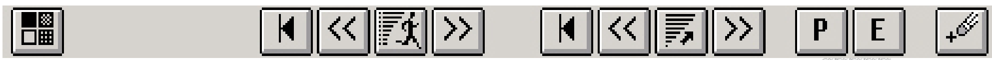


Figure 188 Choice of customized buttons in the SIMPPLLE ArcView project file.

Figure 188 shows all of the view buttons that are currently used for SIMPPLLE.

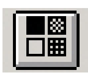


Figure 189 The customized button that will zoom all displays to the same extent

The button in Figure 189 will zoom all display 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 view to the same area.

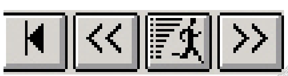


Figure 190 The set of buttons used to display attributes by time steps.

Figure 190 shows the set of buttons is 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 this dialog:

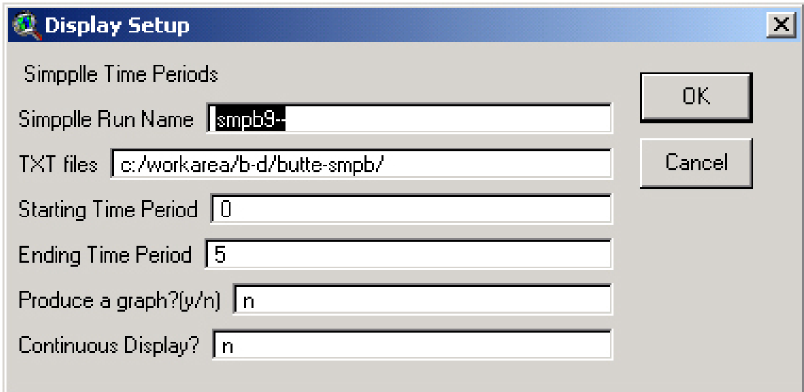


Figure 191 Dialog box for information required to display time steps.

The dialog shown in figure 100 is used to get information needed to create the display for time steps.

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.

Starting & Ending Time:

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 step 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 192

The set of buttons shown in Figure 192 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 102.

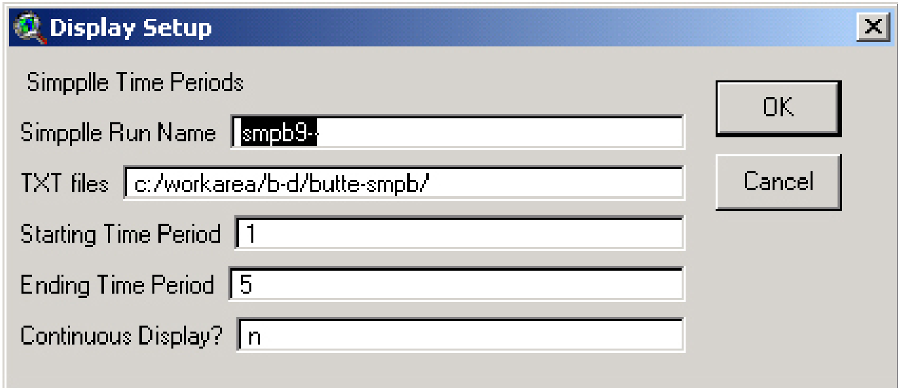


Figure 193 Dialog box for information needed for display of process spread and origin.

The dialog in figure is very similar to the one used for the timestep information. The data requirements are identical.

Button 4:

This is the same as button 2, except it moves forward one time step.

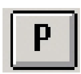


Figure 194 This Button Display the setup dialog for Probability Displays.

Figure 194 is the button used to bring up the following dialog box to provide information required to display probability maps.

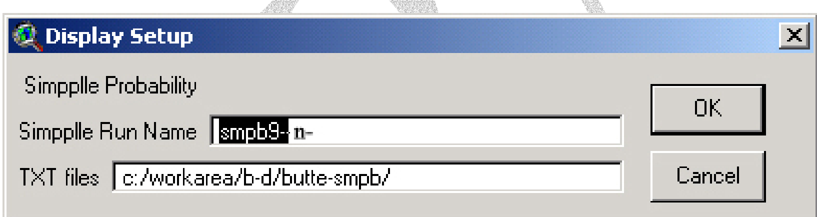


Figure 195 Dialog box for information required for probability map displays.

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.

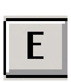


Figure 196 Button for exporting the current theme to a new cover.

The button in Figure 196 allows you to export the currently selected theme to a new coverage. Upon pressing this button you will be presented with a file dialog asking for the output coverage a name.

Figure 197 Button to return a selected theme(s) to the starting state.

The button in Figure 197 allows you to return a selected theme(s) to the state they were in when you first added it 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 lets assume the following:

1. You have made a simulation for 5 time steps.
2. You have created GIS output files with the prefix of **test-**
3. You have used SIMPPLLE to copy the Arcview project file and necessary legend files to the following location: *C:/work1/gisdev*
4. You have put the GIS output files in the following location: *C:/work1/gisdev*. Keep in mind this need not be the same directory as in #3 It it the same here for simplicity of illustration.
5. We wish to look at the processes occurring in our area for each of the time steps.

Step 1: Starting ArcView

Step 2: Opening the SIMPPLLE Project file

In step 1 if you successfully started Arcview you should see a window similar to below. Use the mouse to select the File Menu as indicated below and click on "Open Project".

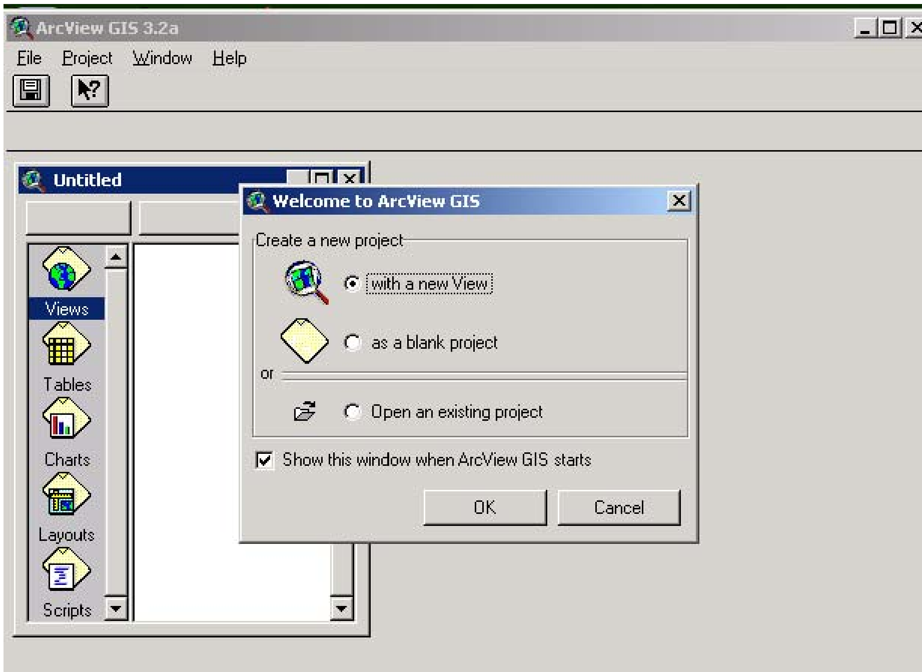


Figure 198 Dialog box for opening a new project file.

When you click on "Open Project" you should see a dialog similar to the following:

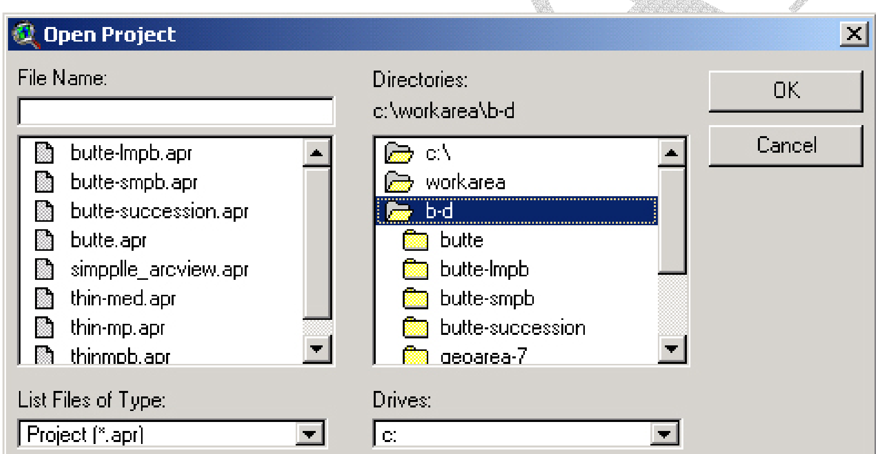


Figure 199 Dialog box for locating project files.

Change to the directory where the project file is located and select it, as in the above picture. Press Ok.

Step 3: Providing the Data and Project Pathnames

After pressing Ok in Step 2 you should see a dialog similar to the following except the boxes with the pathnames will be empty.

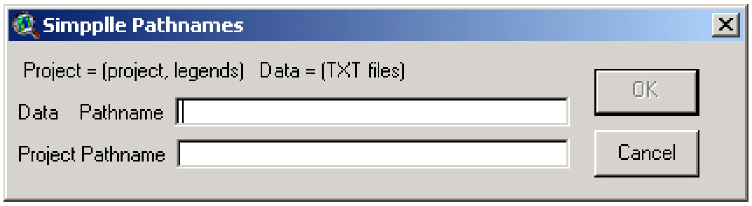


Figure 200 Dialog box for identifying pathnames for SIMPPLLE project.

In this dialog you need to type the Data and Project pathnames as shown in the above example.
The project pathname is where the output from SIMPPLLE is stored (i.e. the TXT files).
The Data pathname is where the legend files and the project file you just opened is stored.

One special note be sure to include a / at the end of the pathname.

Once you press Ok, assuming you entered valid pathnames, you are ready to move on to creating a view and looking at the SIMPPLLE data.

The next couple of steps involve creating a view and adding a theme to the view. If you already know how to do this feel free to skip ahead to setting the Simpplle Attribute.

Step 4: Creating a New View
After completing Step 3 you should see a window that looks similar to below.
This window was purposely made small to save space in this document.
When the actual project is opened the result window will be much larger.

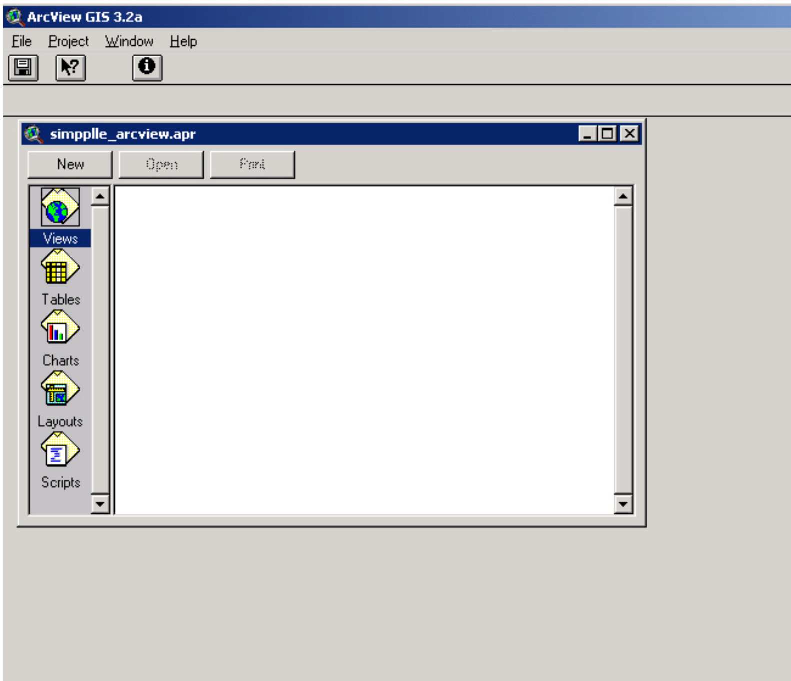


Figure 201 Basic opening screen for the SIMPPLLE project

In the above window Click the icons with a picture of Earth that is label "Views". Next Click on the New button, this should result in a window such as the following:

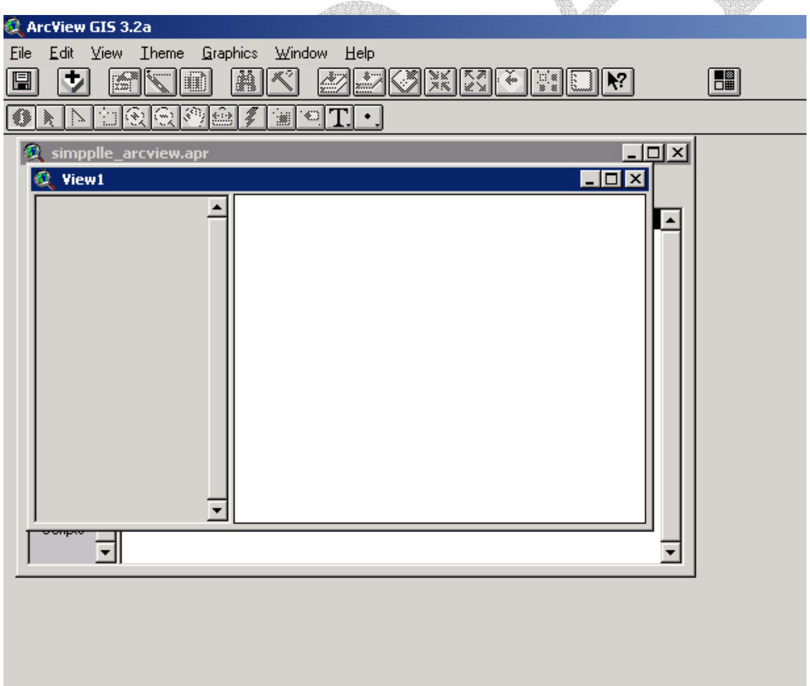


Figure 202 Display for adding a new view.

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. Now find the button with a Plus sign, its in the top row of buttons, 2nd from the left. This button is used to add a theme to a view. Alternatively Go to the View menu and select *"Add Theme..."* This will result in a file dialog being displayed similar to below:

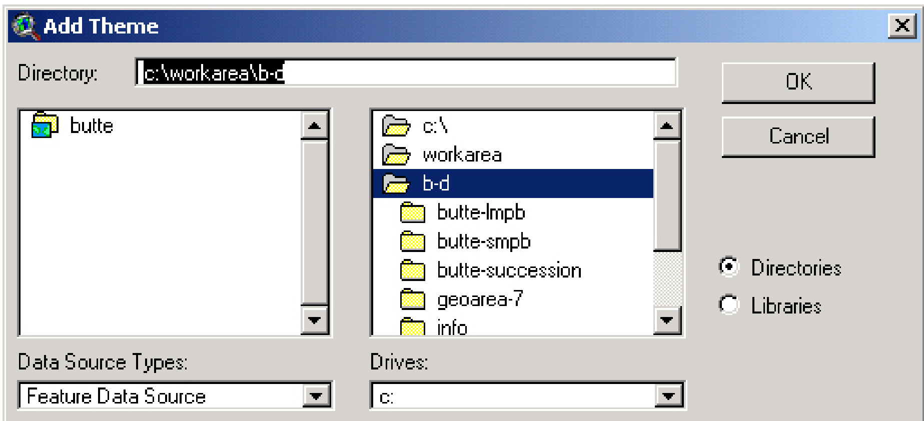


Figure 203 Display for adding a theme.

Navigate to the directory containing the coverage associated with the landscape you ran in SIMPPLLE, 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. The window should look similar to the following, except of course your coverage will undoubtedly look different than this example.

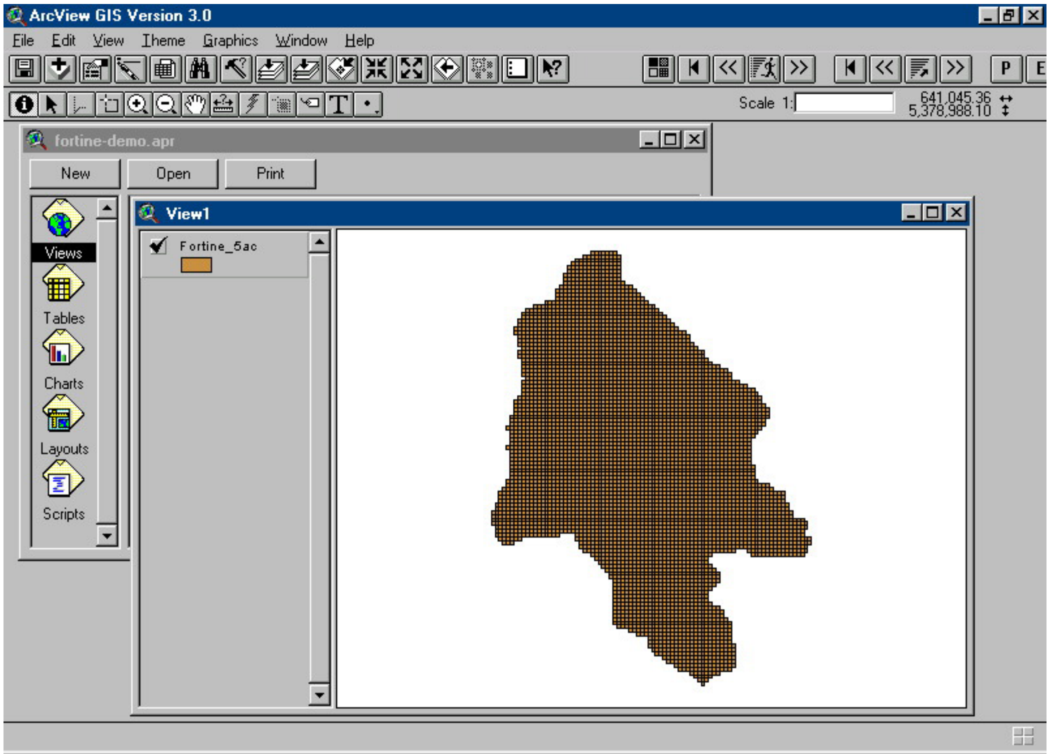


Figure 204 Display of plant community coverage added to the view.

Step 6: Setting the Simpplle Attribute
To set the Simpplle Attribute Make sure your new theme is select in the view by clicking it. Now you can either press the F12 key or select the menu item "Set Simpplle Attribute" on the theme menu as shown in the following picture.

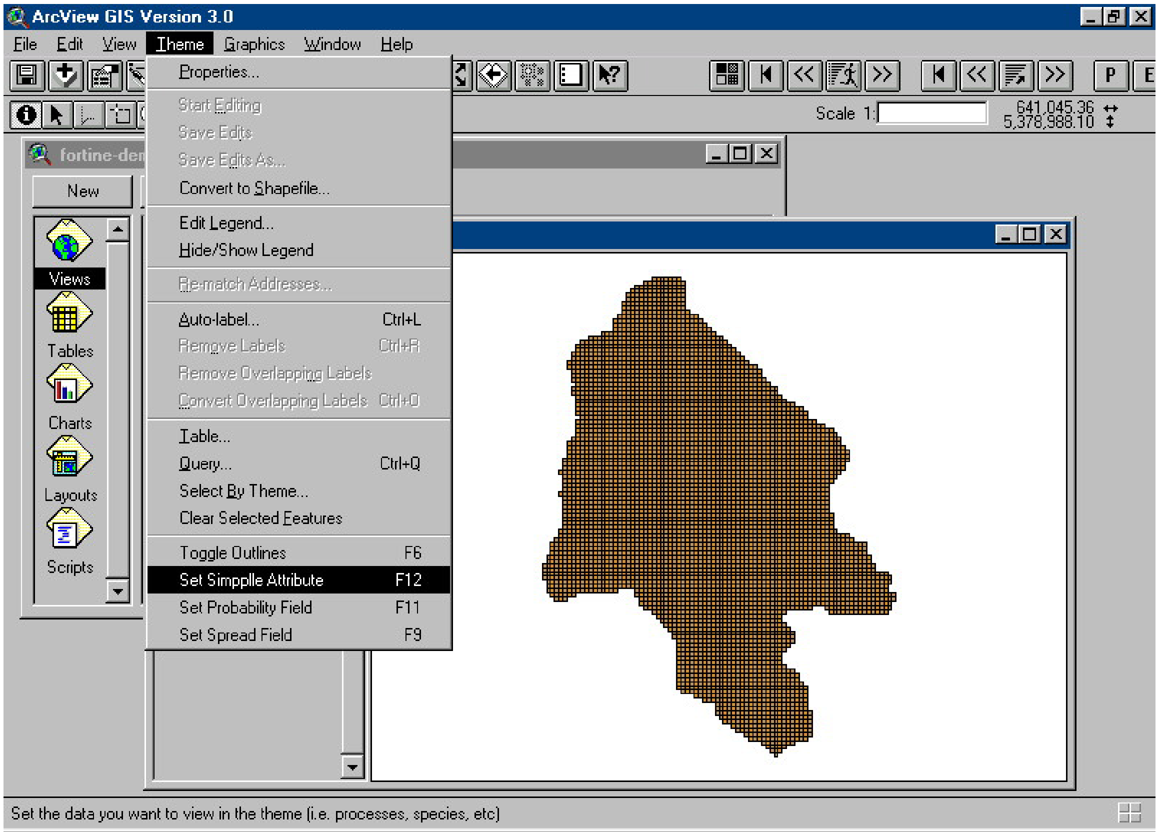


Figure 205 Display for selecting the attribute to show.

Once you have either clicked the menu item or pressed F12 you should see a dialog such as the following:

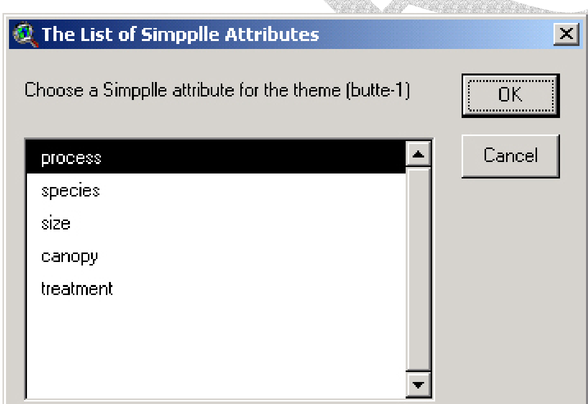


Figure 206 Choice of attributes to display.

Select Process as indicated above and click on Ok.
Your view window should now similar to the following:

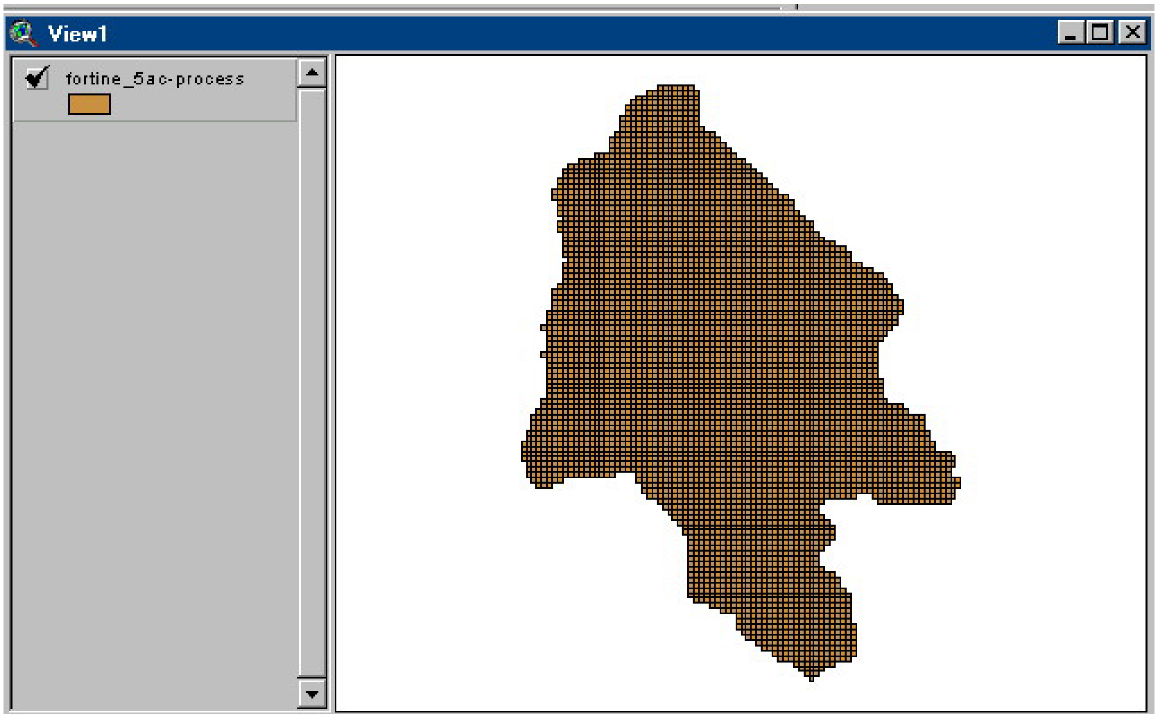


Figure 207 View with the process attribute selected.

Step 7: Running the Simpplle Setup

Upon completing the above steps you are now ready to run the SIMPPLLE Setup. The setup is run by pressing the "running man" button as show in the picture below.

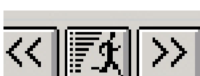


Figure 208 Customized button for displaying attributes by time step.

Upon pressing the button you are presented with the following dialog:

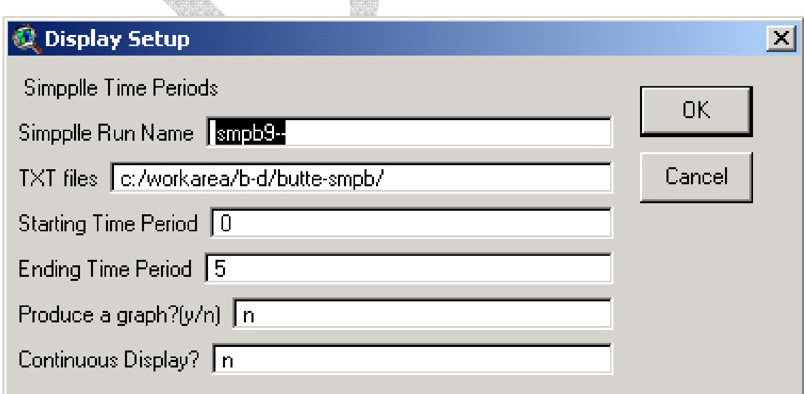


Figure 209 Dialog box for providing information needed to display attribute by time step.

In this example the information show in the dialog is correct, however when you run the setup your 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 completing this is will load the legend appropriate for the Simpplle Attribute chosen to display, in this case Processes.

If all goes well you should see a display similar to below:

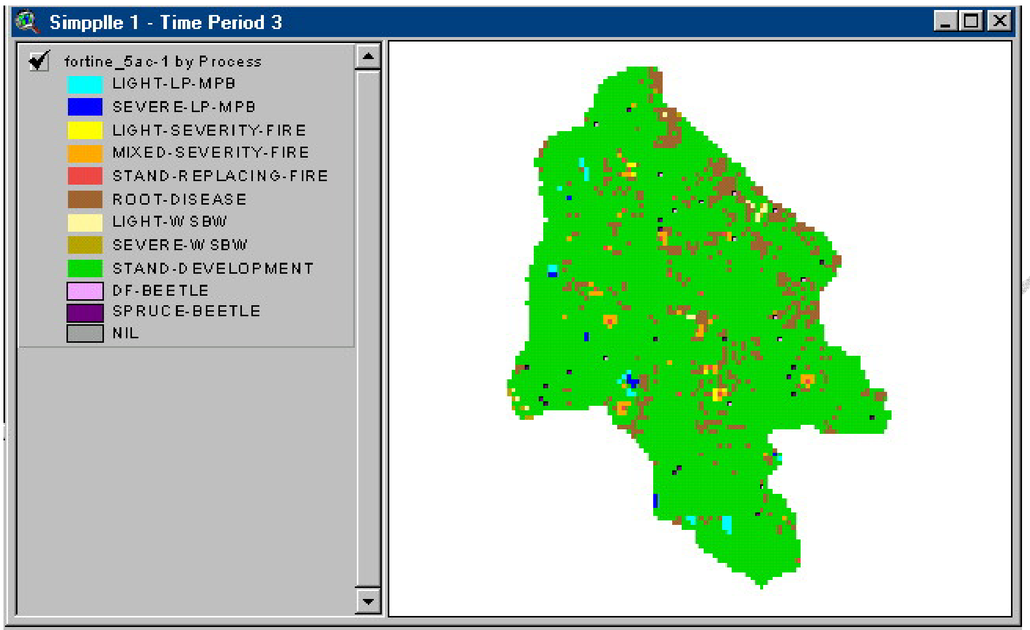


Figure 210 View with processes displayed for the third time step.

Step 8: Moving to a different time step

Moving to a different time step Can be achieved by pressing either the << or >> buttons in the picture below.

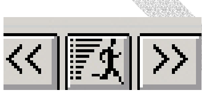


Figure 211 Customized button to move from one time step to another.

The << Button moves back a step.
The >> 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 is in this example time step 0.

Additional features of the customized Arcview project are given in Exercise 2 and 3.

ArcGIS Extension

In addition to the SIMPPLLE toolbox that has to be added to the ArcGis environment (see section on Spatial Attributes) a 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 following window in which the ArcGIS SIMPPLLE Extension must be checked.

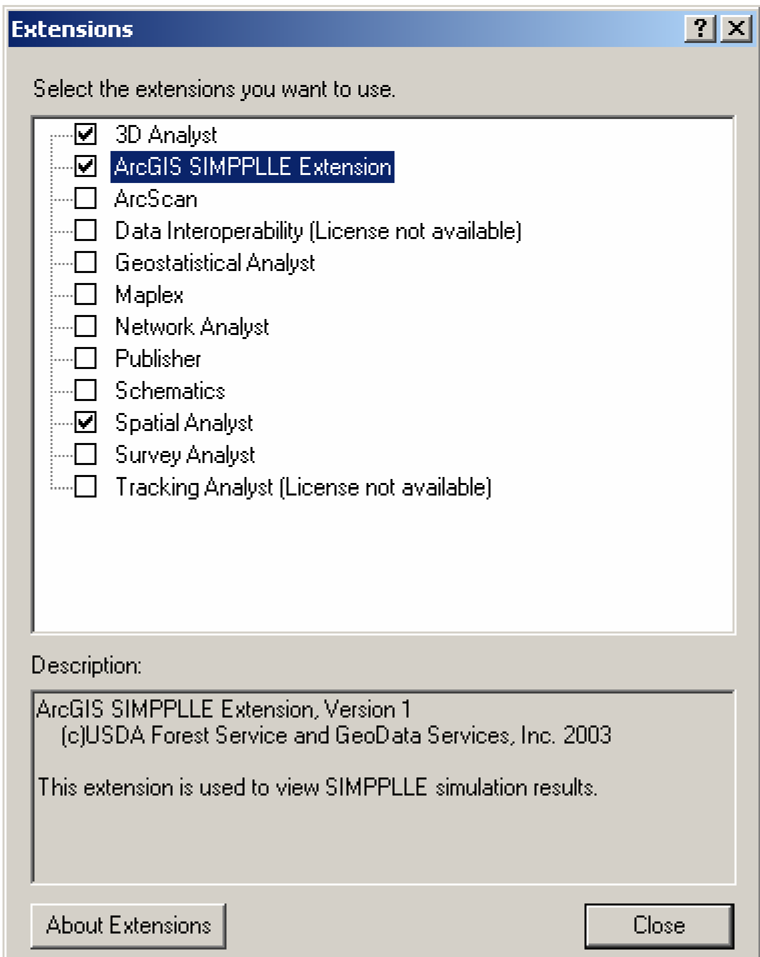


Figure 212 Selection that must be made to enable the SIMPPLLE extension

To enable the SIMPPLLE toolbar for this extension, from the ArcMap screen select "view > Toolbars" and click in the box for the SIMPPLLE toolbar to enable it.

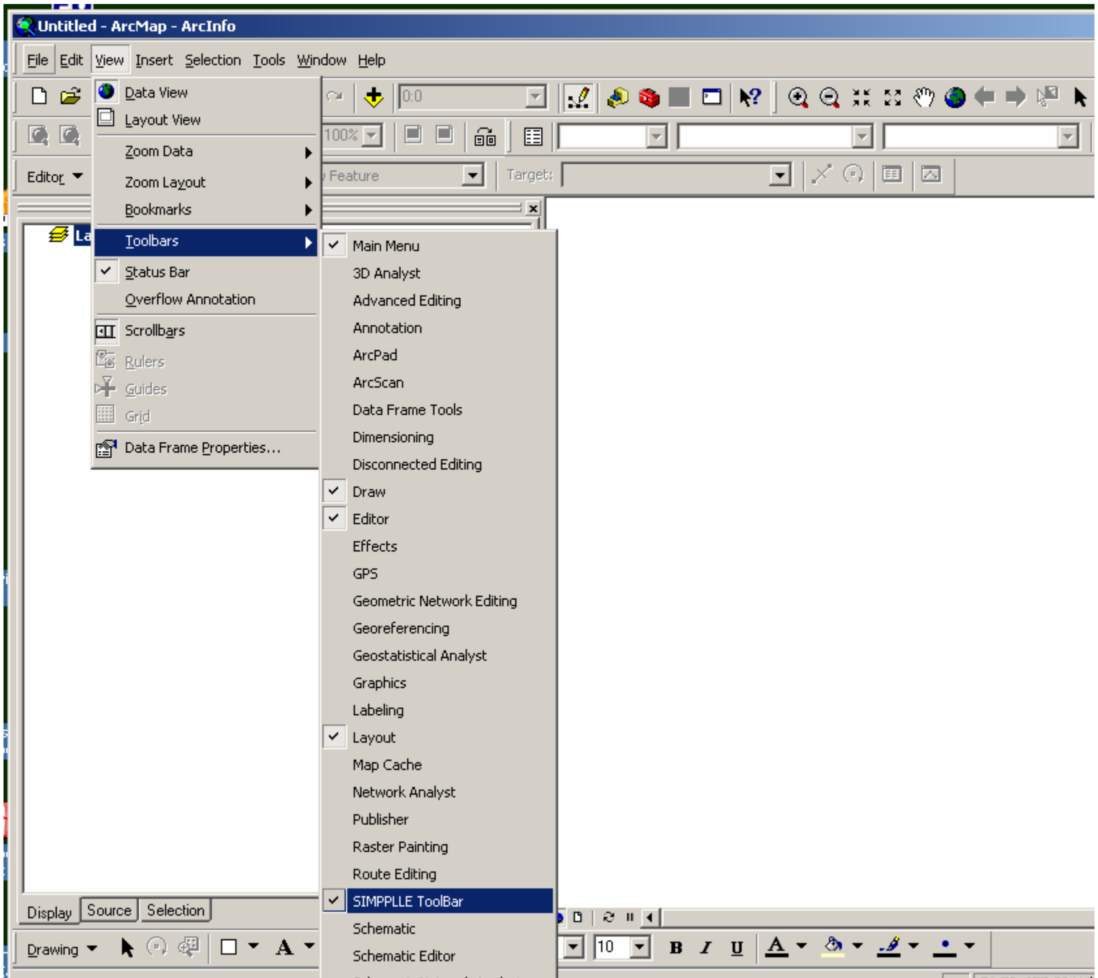


Figure 213 Choices that must be made to enable the SIMPPLLE toolbar

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 specific 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 want 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 files (*.lyr) 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 the "copy ArcView Files" leaving the "copy ArcGIS files" checked and provide a destination directory.

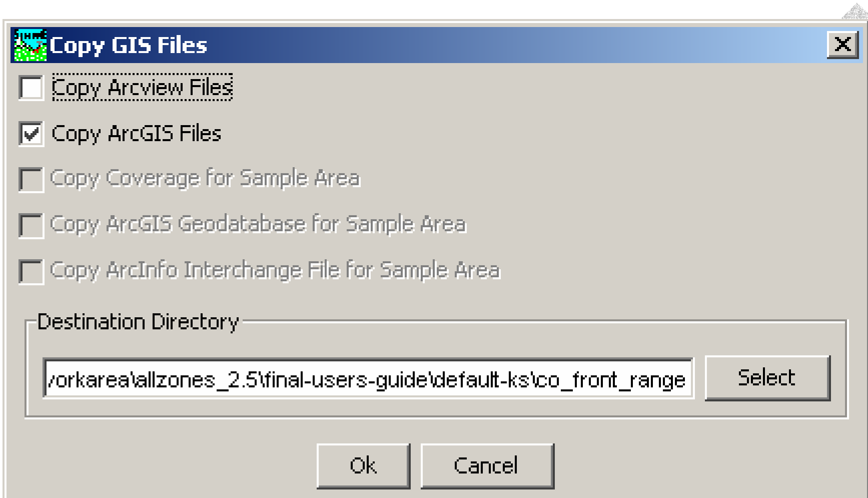


Figure 214 Choice to download the lyr files for the ArcGis extension

All of the layer files begin with a prefix "sim_". At this time we have the system looking for the probability layer filed named as "probability_legend.lyr". Until the next release of SIMPPLLE you will have to manually edit the name of just the probability file to drop the "sim_" prefix. If you forget to do this now, latter in the process you will get an error message that the probability lyr file can't be found.

Once you have the layer files in the desired location and have made the simulations the next step is use the "SIMPPLLE GIS PreProcess" from the SIMPPLLE toolbox.

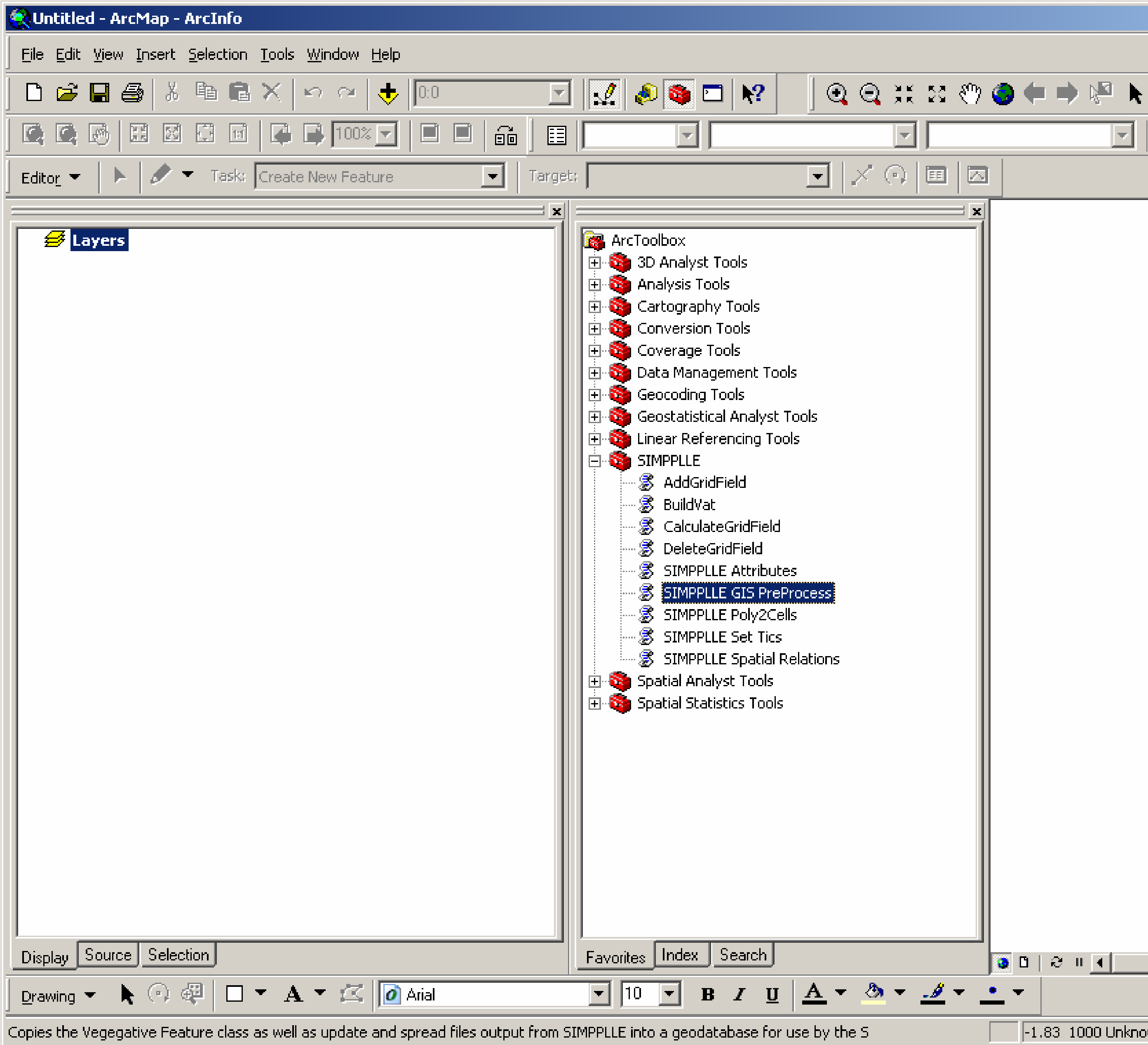


Figure 215 The SIMPPLLE GIS PreProcess tool

This creates a geodatabase that combines the polygon layer feature class with the txt 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". It will load all the files with prefix name used in the simulation.

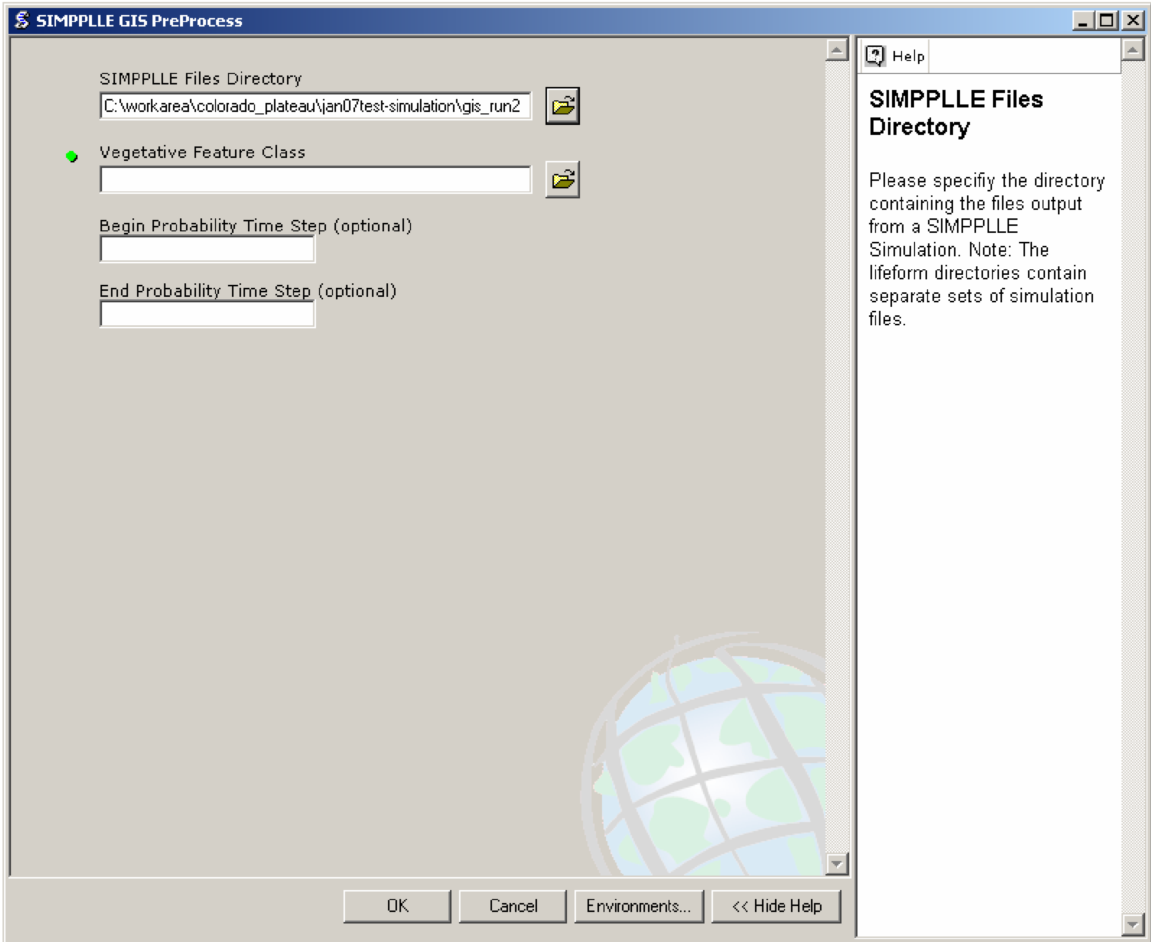


Figure 216 Specifying the location of the gix txt files that were the output from a single or set of multiple simulations

It is essential that you use the correct vegetative feature class as specified in the help screen. This must be the veg polygons in the feature class that was the result of running SIMPPLLE Spatial Relations.

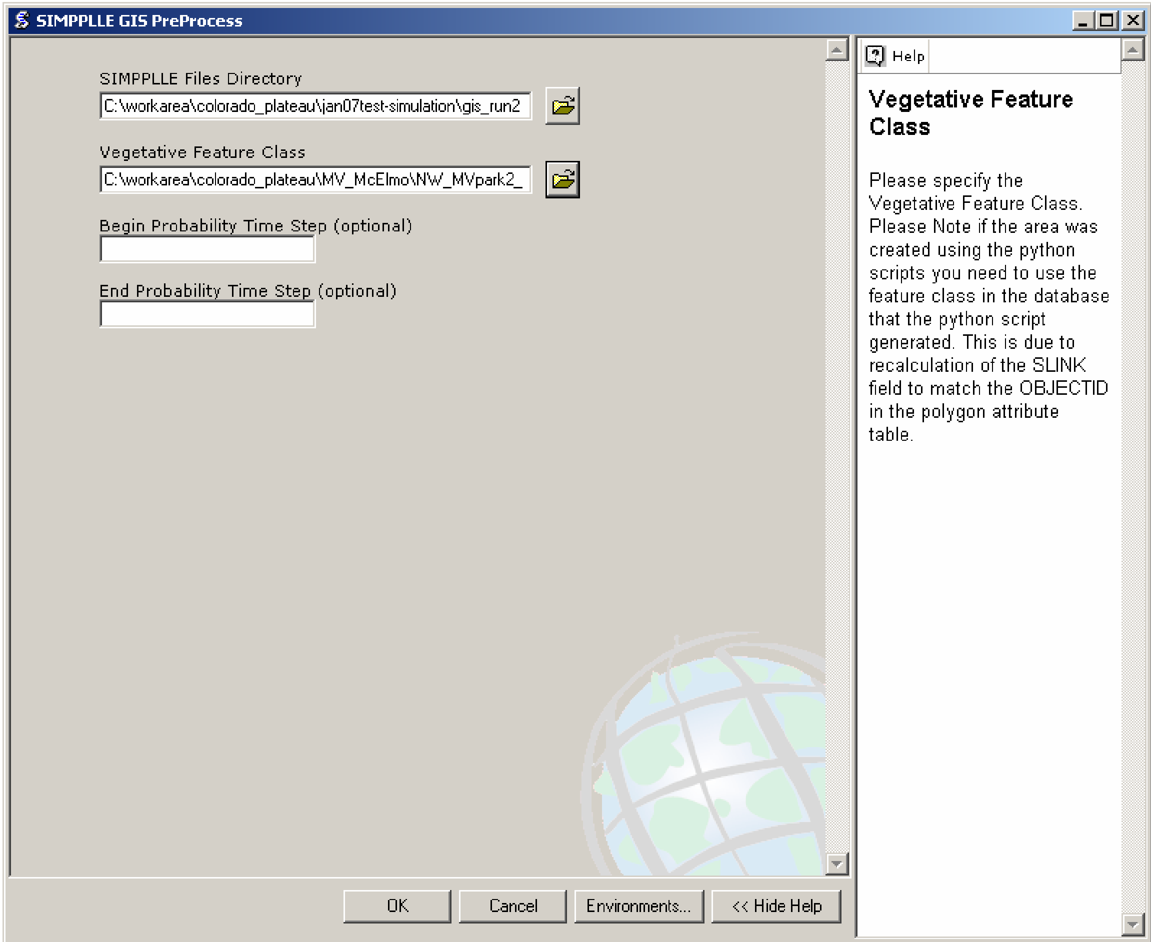


Figure 217 Specifying the vegetation feature class.

If you don't 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. The following screen will be displayed showing the status of the process.

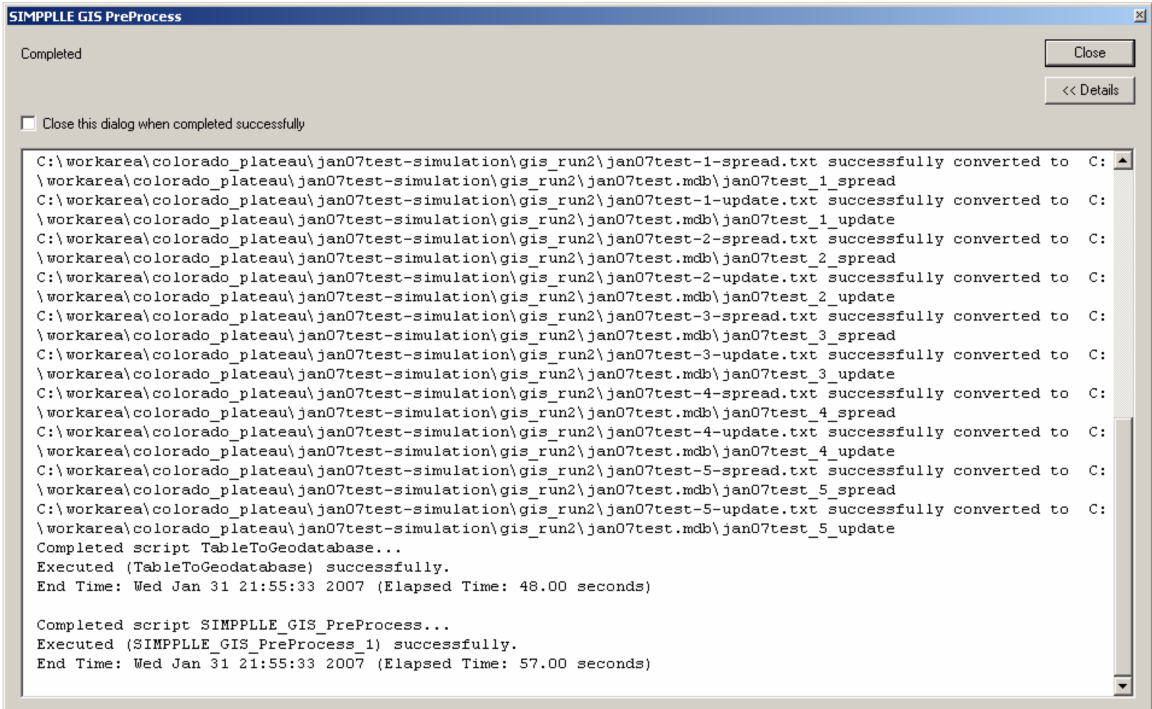


Figure 218 Status display for the PreProcess tool.

This tool creates a new geodatabase that has the original veg 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 the following figure.

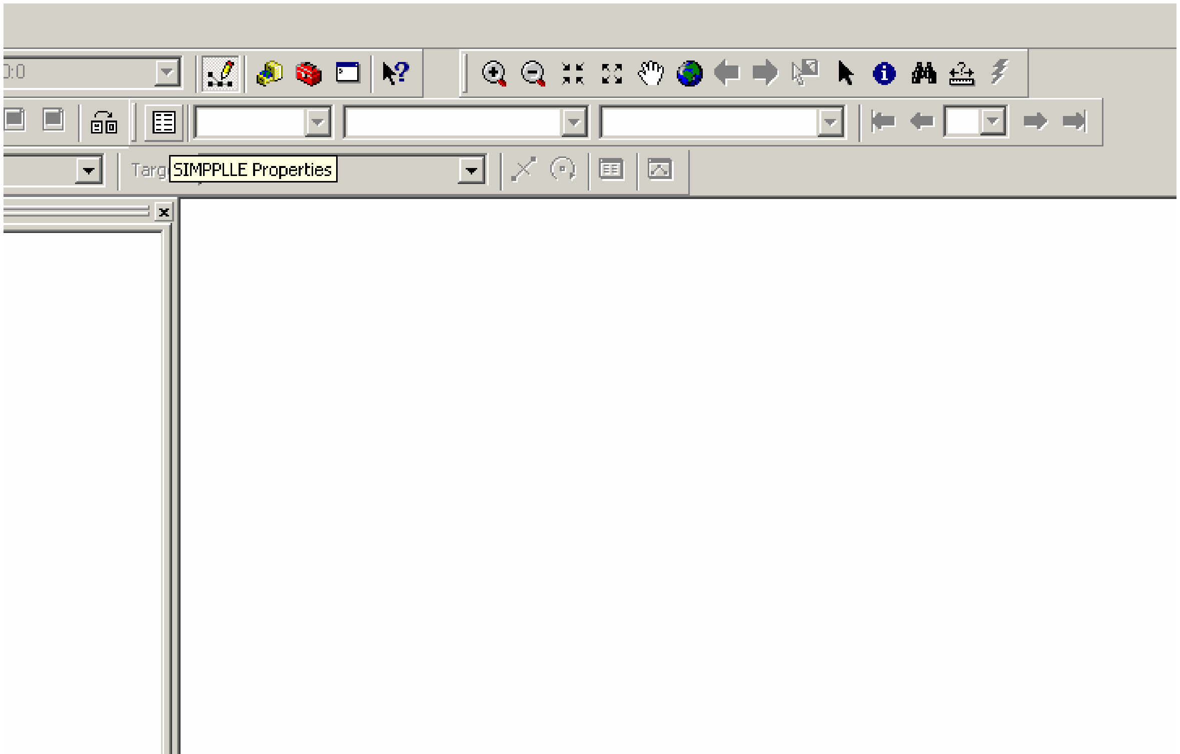


Figure 219 The SIMPPLLE toolbar. "SIMPPLLE Properties" only shows up when the cursor is placed on the "text" symbol.

Placing the cursor on the small symbol for SIMPPLLE Properties will open the initial window of the extension.

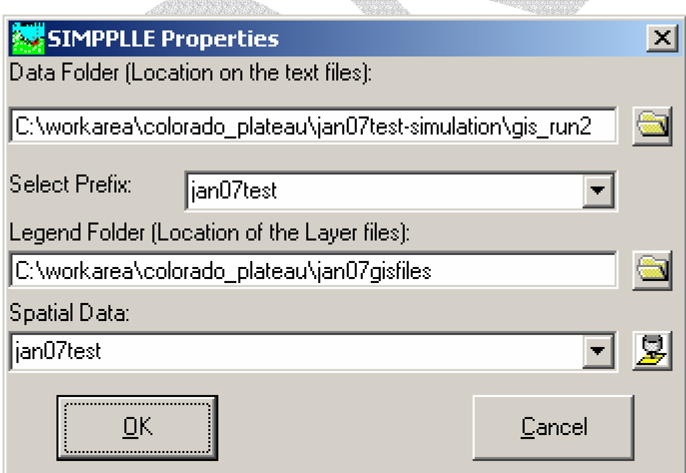


Figure 220 Information required in the SIMPPLLE properties dialog box.

The spatial data in this case is the new geodatabase that was created with the PreProcess tool. Upon completing all the fields it will 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 shown for the polygons.

The extension choices are made by making choices on the pulldown arrow with the boxes. The first pulldown 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 simulated species, sizeclass, density, process, treatment, or probability. The third pulldown choices depend on the first two. With the choice as shown in the following figure of "update" the attribute of "sim_species" at time step 0 (the initial pre simulation conditions) is displayed.

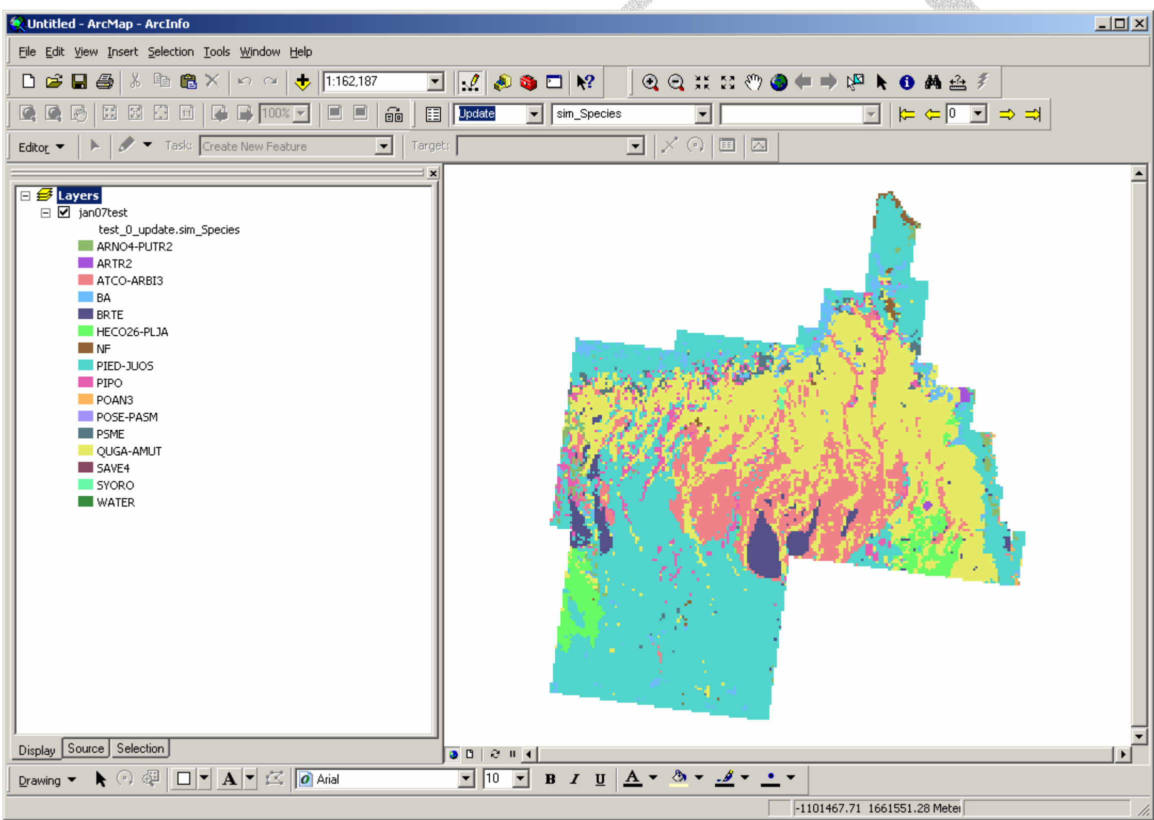


Figure 221 SIMPPLLE extension display of species for time step 0.

The arrows on either side of time step display can be used to move through the simulation. 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 pull down.

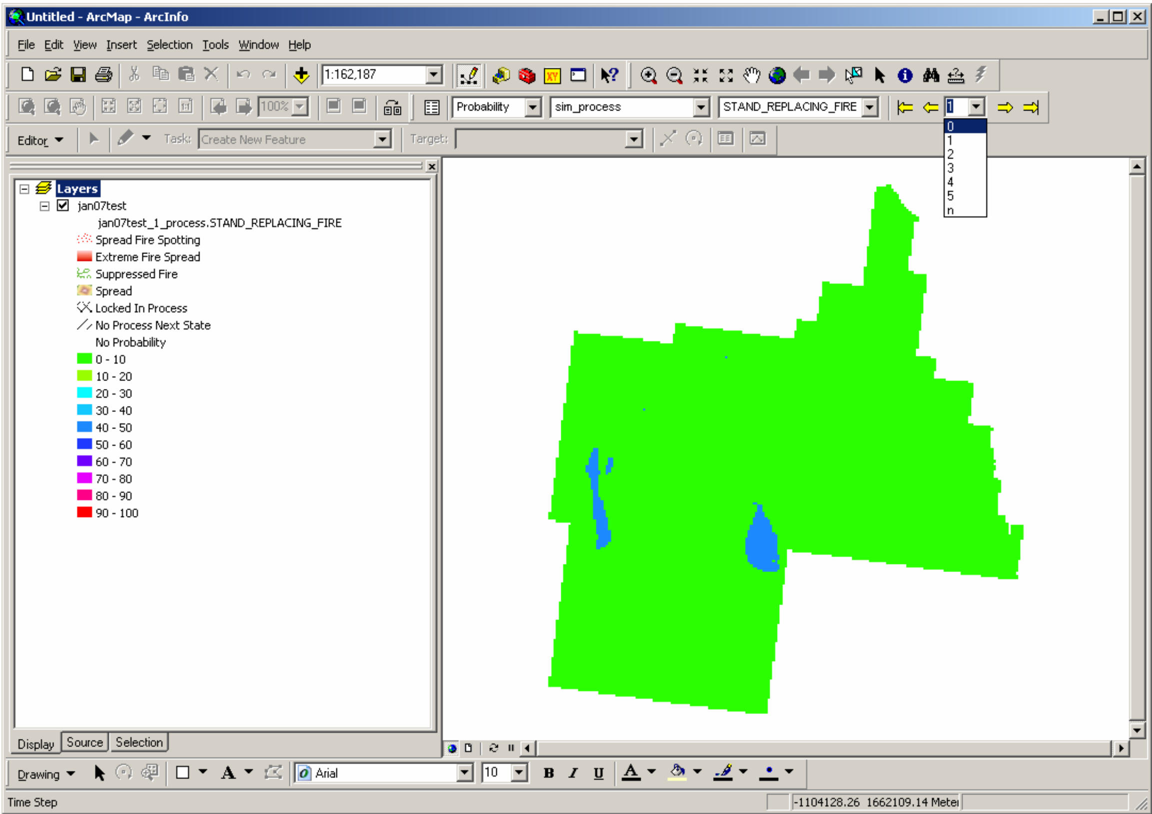


Figure 222 Pulldown showing choice of time steps for proability, or "n" for the entire simulation.

If you have made only single simulations then the only files you had to load were the update and spread files and your extension does not have the probability choice. If you made a set of multiple simulations and either 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 that was 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 ran again using the feature class in the geodatabase make with the previous extension, all of the choices, of 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.

SYSTEM REQUIREMENTS

System Requirements:

Java Runtime Environment version 1.3.1 or later (included in downloads)
Windows (Uses Java 1.4 included in download)
128MB Memory (areas with large #'s 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 95/98/2000/XP, Mac OS X, AIX
Windows XP: Recommend 1.5Ghz+ with 512MB+ RAM.

Ideal System:

Windows 2000 Professional
1.5 GB RAM
60 GB Hard Drive

2.2 GHz Processor
ArcGIS 8.1 Software

As the number of polygons or the number of simulations increases the software will move into Virtual Memory on the computer system. This can have a dramatic effect of performance. To monitor memory usage on Windows 2000 systems:
Hit Control-Alt-Delete
Click on "Task List"
Click on Performance tab
If memory usage is more than the total physical memory then you are using virtual memory.

The greatest impact on virtual memory will occur if landscape with a large number of plant communities, 100,000 plus, is simulated without fire suppression. The significant amount of information on fire events stored can rapidly use up the virtual memory. Version 2.5 has two memory management options, discarding unnecessary simulation results and writing to a database.

SYSTEM DOCUMENTATION

This user's manual is no longer installed automatically with SIMPPLLE as the selection of "help" and "user's guide" states. The pdf file can be downloaded from the SIMPPLLE web site. There is documentation located at the directory structure identified:

“C:\fsapps\fsother\SIMPPLLE\version2_5\doc” This is a “Release Notes.htm”. This file contains developer’s notes on the changes made over the last two years in developing this version.

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APPENDICES

The following appendices provide a limited amount of information on each geographic zone. For all zones we provide a listing of the "legal" values for the attributes for SIMPPLLE. Some zones have a limited discussion on the system knowledge components. Further details for the zones is planned to be covered in separate publications for each zone.

APPENDIX A – Forest Service Region One

Westside Region One and Eastside Region One

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 that 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-fied	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
		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/pham	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
		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
		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
		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-	674	abla1

		vasc		
		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	abla/caru	750	abla1

	dry			
		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	drytgrass
		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
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
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	;arch - 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
NATIVE-FORBS	native forbs
ND	no data
NS	non stocked
PF	limber pine
PP	ponderosa pne
PP-DF	ponderosa pine - Douglas fir
QA	quaking aspen
QA-MC	quaking aspen - mixed conifers
RRWP	rust resistence 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
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 Easttside Zone, Region One

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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
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 decidious
RIP-DECID-MC	riparian decidious - mixed confiers
RIP-GRAMS	riparian graminoids
RIPARIAN-GRASSES	riaprian 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 nonforest habitat type groups for the Westside and Eastside Zones, Region One

Size Class

size class - structure	name
NS	non stocked
UNIFORM	
SCATTERED	
CLUMPED	
OPEN-HERB	
CLOSED-HERB	
OPEN-LOW-SHRUB	
OPEN-MID-SHRUB	
OPEN-TALL-SHRUB	
CLOSED-LOW-SHRUB	
CLOSED-MID-SHRUB	
CLOSED-TALL-SHRUB	
WOODLAND	
SS	seedling and saplings, less than 5 inches dbh
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, and OTHER. The 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 interpertated 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 nonforest habitat type groups used.

Landtype: This value needs to be left 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 a 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.

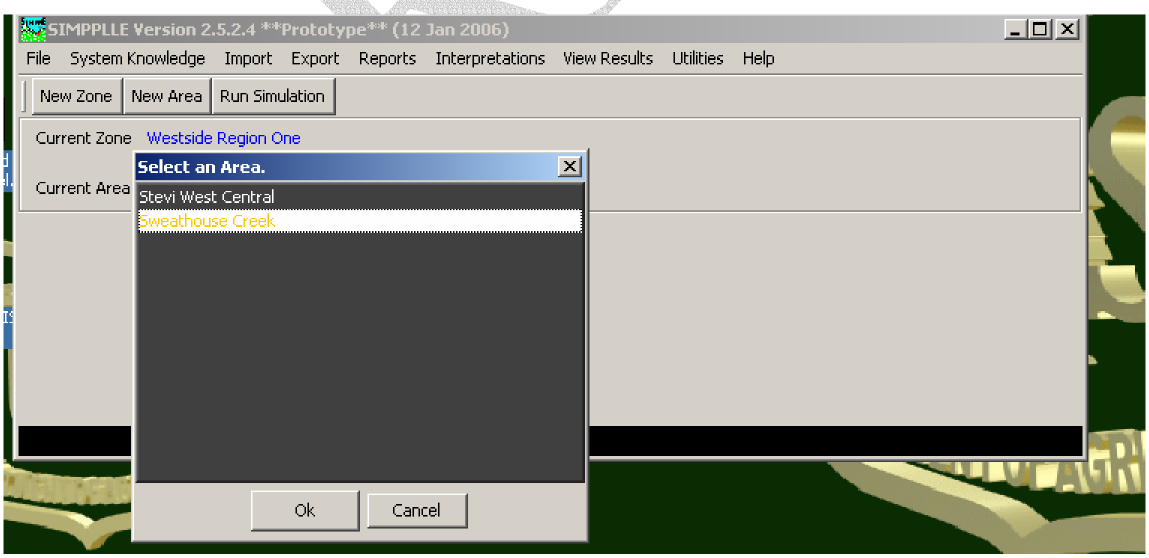

Figure A-1

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.

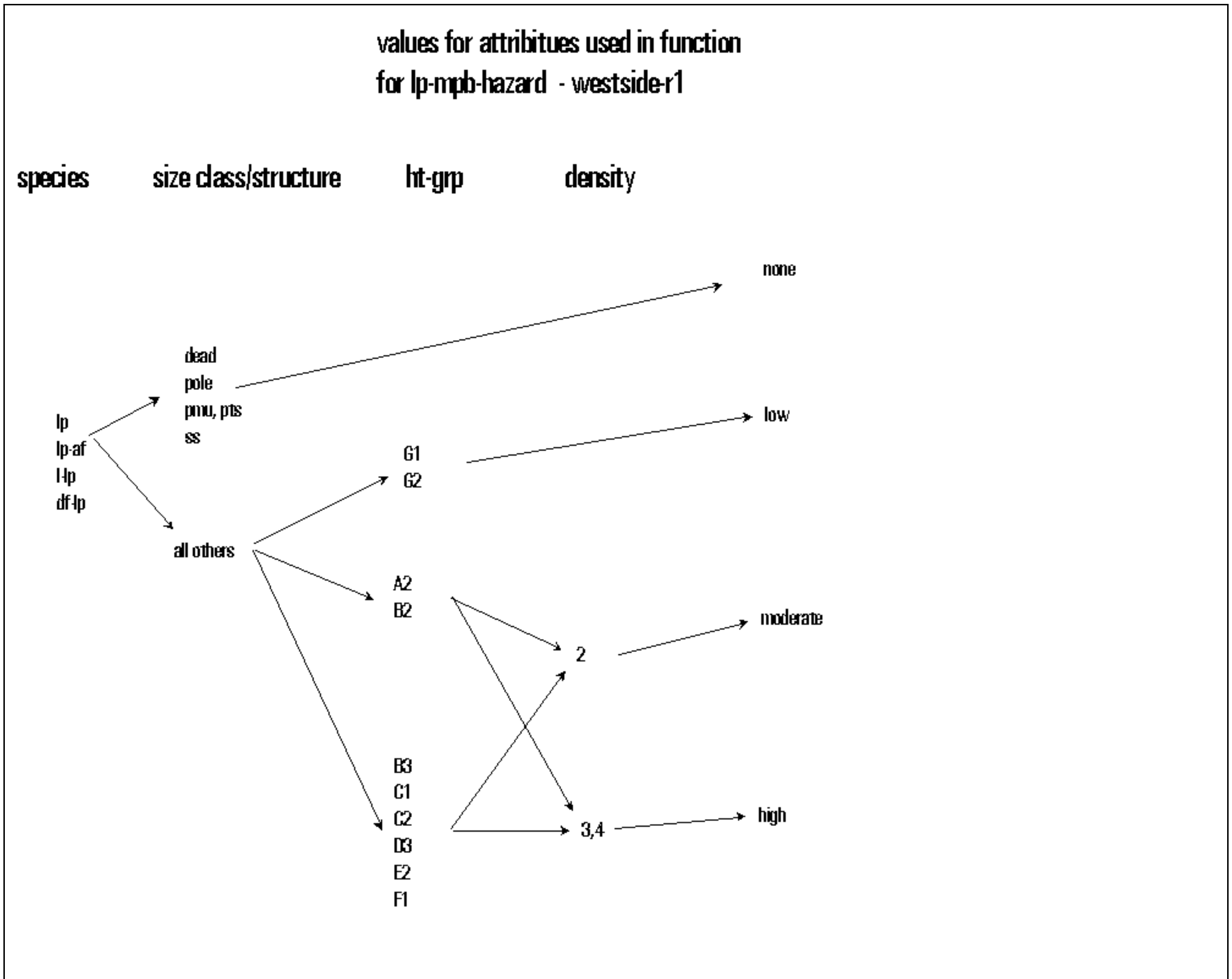

Figure A-2 – Hazard Rating for Westside Region One Zone, mountain pine beetle in lodgepole pine when lp is the dominant species or occurs with one other species.

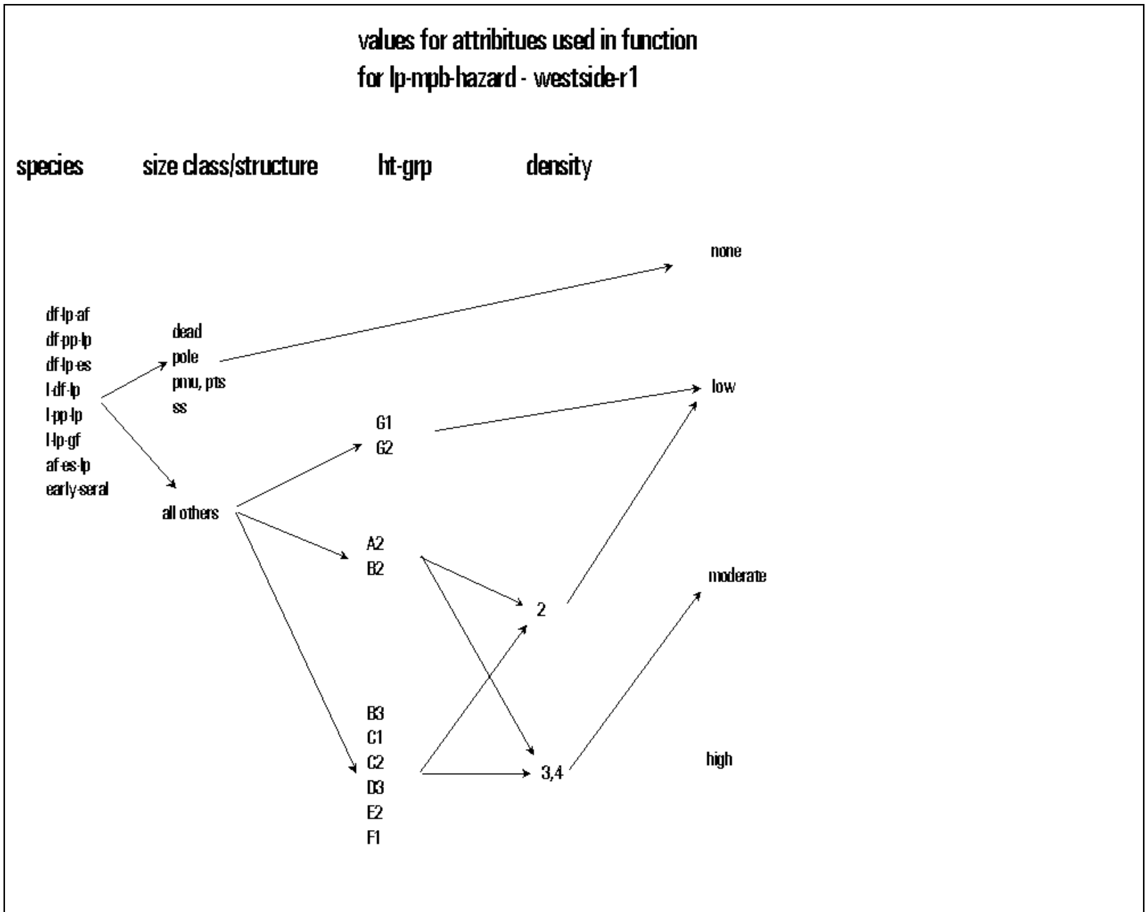

Figure A-3 – Hazard Rating for Westside Region One Zone, mountain pine beetle in lodgepole pine when lodgepole pine is a minor component occurring with two other species.

spread - westside-r1

plant community current process	adj plant community current process	plant community species	plant community size-class	process will spread as light-lp-mpb	severe-lp-mpb	pp-mpb
light-lp-mpb	succession	lp df-lp es-lp lp-af df-pp-lp df-lp-es l-pp-lp df-lp-af l-df-lp af-es-lp l-lp-gf early-seral	medium, mts, mmu large, lts, lmu very-large, vlts, vlmu	X		
severe-lp-mpb					X	

To provide for an interaction between mpb in lodgepole and ponderosa pine, the following allows for ponderosa pine stands adjacent to lodpole pine stand that get severe mpb activity to have the mpb spread into them.

plant community current process	adj plant community current process	adj plant community pp-mpb-probability	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.

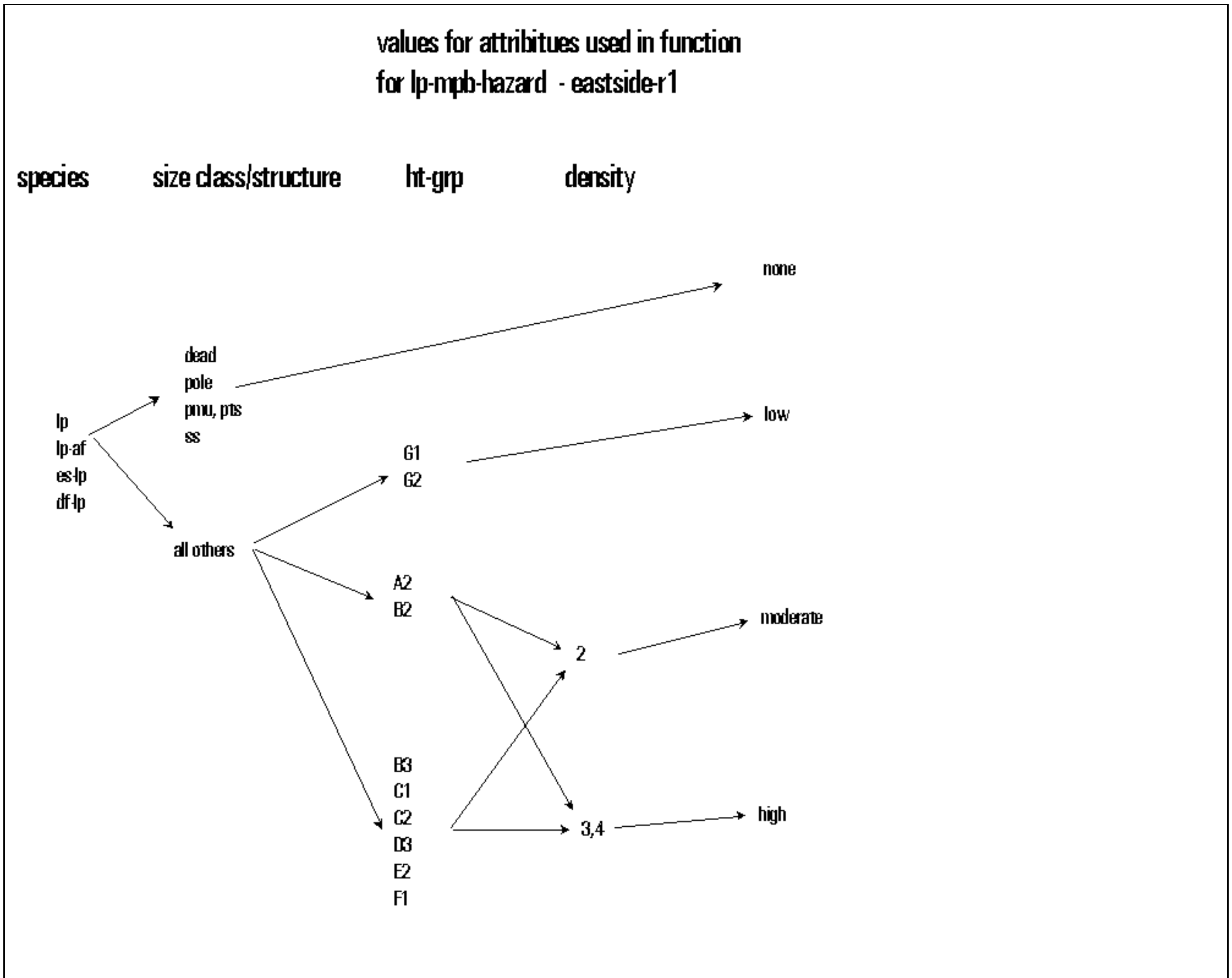

Figure A -5 – Hazard Rating for Eastside Region One, mountain pine beetle in lodgepole pine when lodgepole pine is a single species or is one of two species.

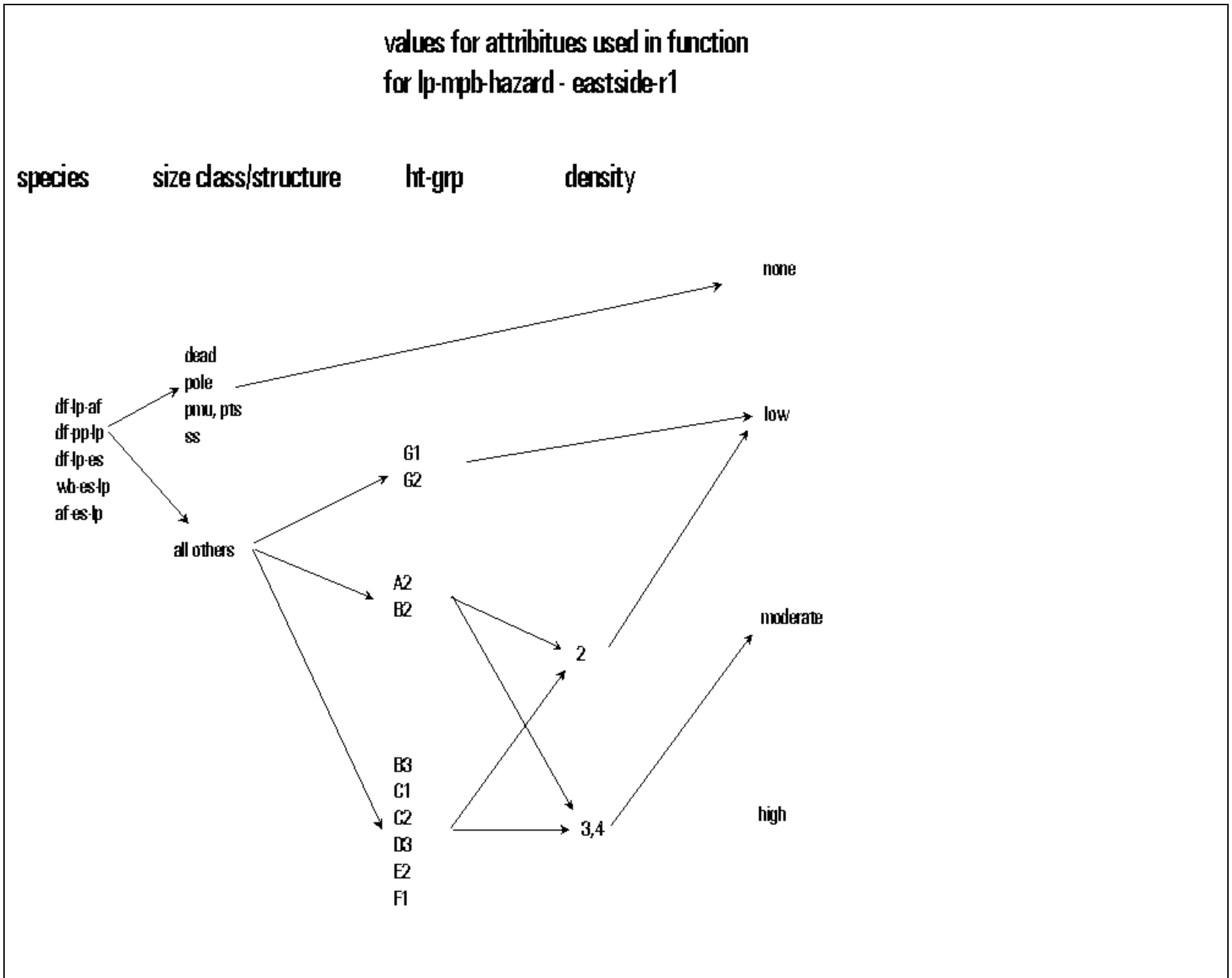

Figure A-6 Hazard Rating for Eastside Region One Zone, mountain pine beetle in lodgepole pine when lodgepole pine is a minor component occurring with two other species.

spread

plant community current process	adj plant community current process	plant community species	plant community size-class	process will spread as light-lp-mpb	severe-lp-mpb	pp-mpb
light-lp-mpb		lp		X		
		df-lp				
		es-lp				
	succession	lp-af	medium, mts, mmu			
		df-pp-lp	large, lts, lmu			
severe-lp-mpb		df-lp-es	very-large, vlts, vlmu		X	
		df-lp-af				
		af-es-lp				
		wb-es-lp				

To provide for an interaction between mpb in lodgepole and ponderosa pine, the following allows for ponderosa pine stands adjacent to lodpole pine stand that get severe mpb activity to have the mpb spread into them.

plant community current process	adj plant community current process	adj plant community pp-mpb-probability	light-lp-mpb	severe-lp-mpb	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, McCambridge, and Edminster 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 provides the information that we use for the 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 diagrams display the logic used within SIMPPLLE.

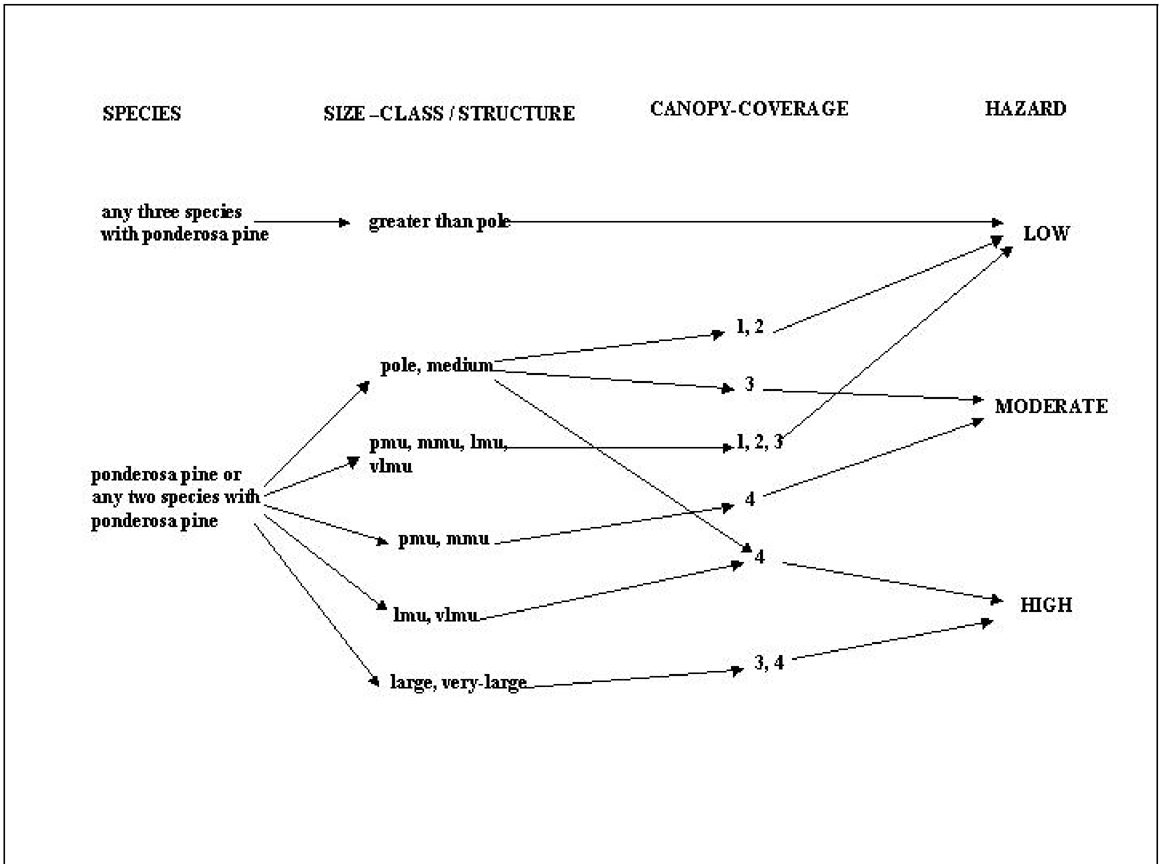

Figure A-8 Determination of mountain pine beetle hazard for ponderosa pine within SIMPPLLE

In the user interface we don't display the logic that results in the risk, only the combination of the risk 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.

adjust hazard - convert to probability

plant community past process	plant community hazard	adj community past process of light-mpb or pp-mpb	number of adj communities with low hazard	number of adj communities with moderate hazard	number of adj communities with high hazard	PROBABILITY
no activity	low			>0	>0	1 pp-mpb
light-mpb	low			0	0	10 pp-mpb
no activity	low	pp-mpb or light-mpb		0	0	5 pp-mpb
light-mpb	low	light-mpb			>2	20 light-mpb
no activity	moderate				>0	5 light-mpb 5 severe-mpb
light-mpb	moderate				>0	15 light-mpb 10 severe-mpb
light-mpb	moderate	light-mpb			0	60 light-mpb 45 severe-mpb
light-mpb	moderate	light-mpb			>0	80 light-mpb 65 severe-mpb

Figure A-9 Logic for deriving a probability for mountain pine beetle in ponderosa pine when the hazard is low and moderate.

adjust hazard - convert to probability

plant community past process	plant community hazard	adj community past process of light-mpb	number of adj communities with low hazard	number of adj communities with moderate hazard	number of adj communities with high hazard	PROBABILITY
no activity	high				0	5 light-mpb
no activity	high			>0	0	10 light-mpb 5 severe-mpb
no activity	high				>0	10 light-mpb 10 severe-mpb
no activity	high	light-mpb		0	0	50 light-mpb 40 severe-mpb
light-mpb	high	light-mpb		0	0	75 light-mpb 60 severe-mpb
no activity	high	light-mpb		>0	0	60 light-mpb 45 severe-mpb
light-mpb	high	light-mpb		>0	0	80 light-mpb 65 severe-mpb
no activity	high	light-mpb		0	>0	85 light-mpb 70 severe-mpb
light-mpb	high	light-mpb			>0	95 light-mpb 80 severe-mpb

Figure A-10 Logic for deriving a probability for mountain pine beetle in ponderosa pine when the hazard is high

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 in 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 what ever 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 a users wants to make long-term simulations to recreate historic 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 (need a reference) 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:

ELEV (meters)	
SLOPE (degrees)	
COSASP	
SINASP	
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

Complete documentation will be completed in a future publication.

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 encroachment. The logic screen accounts for the concept that the large 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 what habitat type groups are considered 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.

The newer regeneration features in version 2.5 may do a better job of capturing this behavior.

APPENDIX B– California

A “California” version of SIMPPLLE was created with two initial zones that correspond with the “Ecological Sections” in California. The “Sierra Nevada” zone that contains M261E and M261F ; and the “Southern California” zone that contains M262B. 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:

- Southern California Mountains and Foothills Assessment, PSW-GTR-172, Dec 99
- Status of the Sierra Nevada, Volume II, Assessments and Scientific Basis for Management Options, July 96
- Meeting with John Keeley in June 99
- A variety of publications provided by Richard Minnich

Southern California and Sierra Nevada

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:

Species:

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
TBRSB	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

Size-Class, Structure:

Size-Class, Structure	Description
SS	seedling & sapling < 5" DBH
POLE	pole size 5 to 8.9" DBH
PTS	two stories with largest being pole size
PMU	more than two stories, multi-storied, largest being pole size
MEDIUM	medium size 9 to 14.9" DBH
MTS	two stories with largest being medium size
MMU	more than two stories, multi-storied, largest being medium size
LARGE	large size, 15 to 20.9" 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" +
VLTS	two stories with largest being very-large
VLMU	more than two stories, multi-storied, largest being very-large

Table B-3

Density

Density Class	Percent
1	0 - 10
2	11 - 39
3	40 - 69
4	70 - 100

Table B-4

Disturbance processes:

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

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, NM.

Ecological stratification

A mapped classification of 5 types of sites:

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
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
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
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:

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:

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 processes

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
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.

APPENDIX D– South Central Alaska

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)

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:

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
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
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
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
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
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
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
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
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
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

Size Classes:

Size class	DEFINITION	SIZE LIMIT
TREE		
SS	Seedling-sapling	1-5” dbh
SS-SS	Seedling-sapling - seedling-sapling	
SS-POLE	Seedling-sapling - pole	
SS-LARGE	Seedling-sapling-large	
POLE	Pole	5.1-9” dbh – conifer 5.1-11” dbh - hardwood
POLE-SS	Pole-seedling - sapling	
POLE-POLE	Pole - pole	
POLE-LARGE	Pole - large	
LARGE	Large	+9” dbh – conifer +11” 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

Densities:

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

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

Discussion of system knowledge:

Root disease is the only process probability logic that is accessible in the user interface. The windthrow and wildlife browsing all have to be locked-in to be used. The spruce beetle probability comes from the incorporation of components of the spruce beetle expert system, Reyonlds and Holsten 1997. The system knowledge on the spruce beetle probability is not accessible in version 2.5.

APPENDIX E – Southwest Utah

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 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

Vegetation Attributes

Species:

Species	DEFINITION
AGR/URB	Agriculture/urban
AG	Annual grass
A	Aspen
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
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

Size-classes:

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

Density:

Density	**DEFINITION**
RANGE DENSITY	
1	Open
2	Closed
3	
FOREST DENSITY	
1	< 40% cover
2	41-70% cover
3	> 70% cover

Table E-4

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

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

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
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
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

Size-classes:

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

Density:

SIMPPLLE ATTRIBUTE	DENSITY DEFINITION
1	0-16% cover
2	16-39% cover
3	40-69% cover
4	+70% cover

Table F-4

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

Discussion of system knowledge:

There has been no development of probability logic for disturbance processes.

APPENDIX G – Colorado Front Range

This geographic area 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. 2002

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

Vegetation descriptions

Species	description
NS	nonstocked
WATER	water
NF	nonforest
ND	no data
AGR	agriculture
RIPARIAN	riparian
BA	barren

ACHY	indian rice grass
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
LEKI2	spike fescue
MUMO	mountain muhly
PASM	western wheatgrass
PHCO9-POAL2	alpine timothy-alpine bluegrass
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
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

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
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
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
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
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

Size class

TREES

SIZE	SIMPPLLE ABBREVIATION	NOTES
Established Seedlings	**E**	0.0" to 0.9"
Sapling	**SS**	1 to 4.9"
Medium	**MEDIUM**	5 to 8.9"
Large	**LARGE**	9 to 15.9"
Very Large	**VERY-LARGE**	16"+
Non-stocked	**NS**	
Medium-Multistory	**MMU**	
Large-Multistory	**LMU**	
Very Large-Multistory	**VLMU**	

SHRUBS

SIZE	SIMPPLLE ABBREVIATION	NOTES
Small	**SMALL-SH**	< 2.5'
Medium	**MEDIUM-SH**	2.5' to 6.4'
Large	**LARGE-SH**	> 6.5'
Unknown	**UNKNOWN**	

GRASSES

SIZE	SIMPPLLE ABBREVIATION	NOTES
Clumped	**CLUMPED**	
Uniform	**UNIFORM**	

NONFOREST

SIZE	SIMPPLLE ABBREVIATION	NOTES
Nonforest	**NF**	

Table G-3

Density

SIMPPLLE ABBREV.	DENSITY
1	0 to 10 percent
2	11 to 40 percent
3	41 to 70 percent
4	71 to 100 percent

Table G-4

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	LODGEPOLE MOUNTAIN PINE BEETLE
SEVERE-LP-MPB	LODGEPOLE 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

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.

APPENDIX H – Grassland Geographic Areas

The three geographic areas of 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 of Seeley Lake, MT. The initial use of the system in these geographic areas was to assist in developing a representation of historic conditions. Thus an emphasis was placed on including the process of bison grazing. No treatment logic has been developed yet.

A separate publication documenting the development and use of these zones is planned with EMRI.

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

Vegetation descriptions by ecological stratifications

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

Sizeclass and density are NA 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

Great Plains Steppe

Ecological stratification

Ecosites
Porous Clay
Dense Clay
Clayey
Claypan
Loamy
Shallow
Badlands
Sandy
Thin Sands
Saline Upland
Overflow

Table H-4

Vegetation descriptions by ecological stratification

POROUS CLAY	
SCSC-CALO-PASM	little bluestem - praire 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 snowber
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 sagebru
BOGR2-BUDA-CAFI-ARTR2	blue grama - buffalograss - threadleaf sedge - Wyoming big sagebrush

SHALLOW

ARPUF-HECO26-SCSC	threeawn - needle and thead - 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 r
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

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

Mixed Grass Prairie

Ecological stratification

Ecosites
Dense Clay
Clayey
Shallow Clayey
Claypan
Loamy
Sandy
Shallow
Very Shallow
Water
Gullied Land

Table H-7

Vegetation descriptions by ecological stratification

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
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
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
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

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

Discussion of system knowledge

Ecological Stratification

The use of NCRS soil ecosystems as ecological stratification is common in all three areas.

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 (right mouse button) there are two new choices; an “inclusion rule and species to track. Both of these are fully editable 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 use 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 using the choice under the file option, under pathways, import species change file.

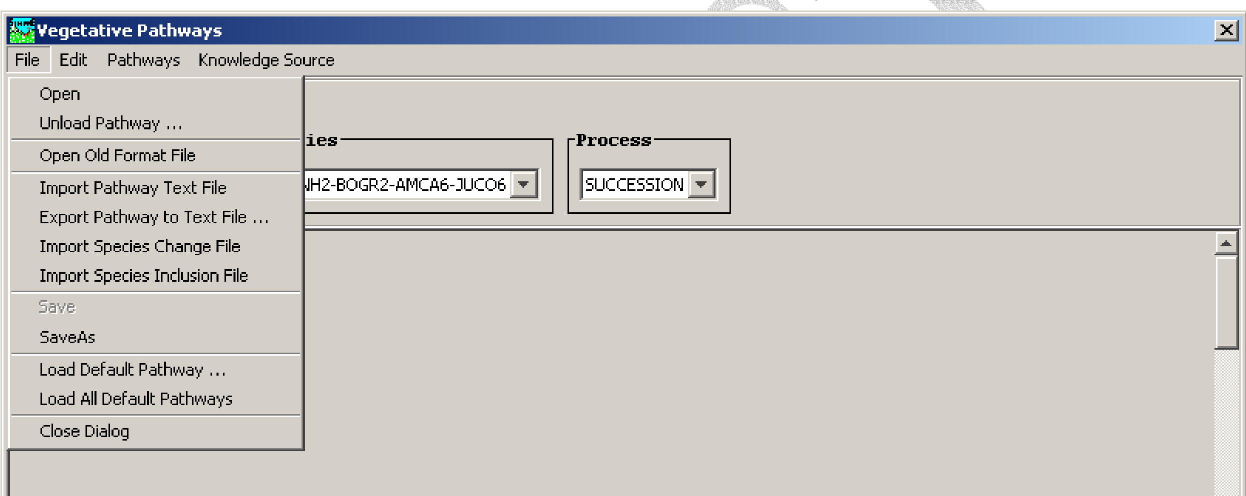

Figure H-10 File options of Importing Species Change File and Inclusion File.

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) 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. In future may have some 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 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.

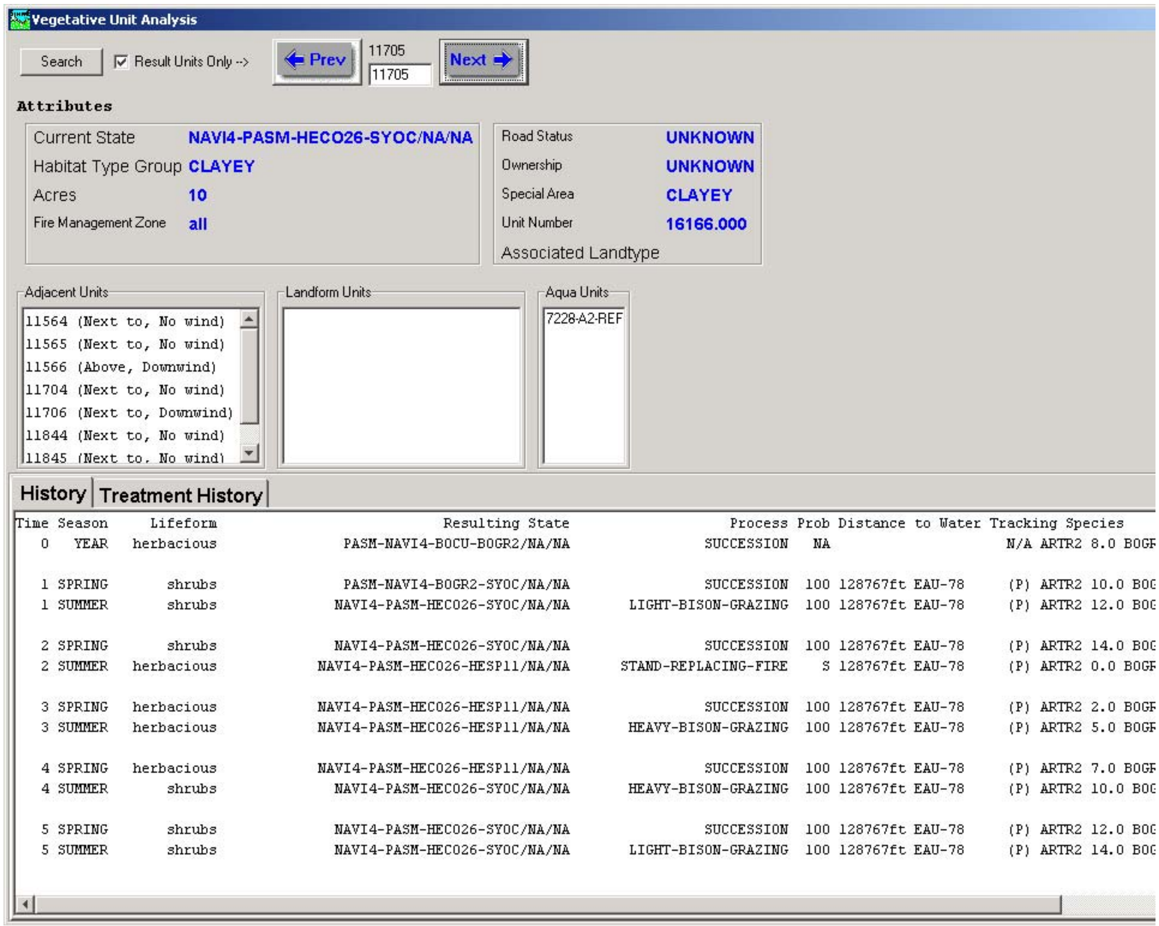

Figure H-11 Unit display showing differences with seasons for disturbance processes.

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

In the bison grazing screen the distinction is made between temporary and permanent water sources. The first step in editing the 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 have to 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.

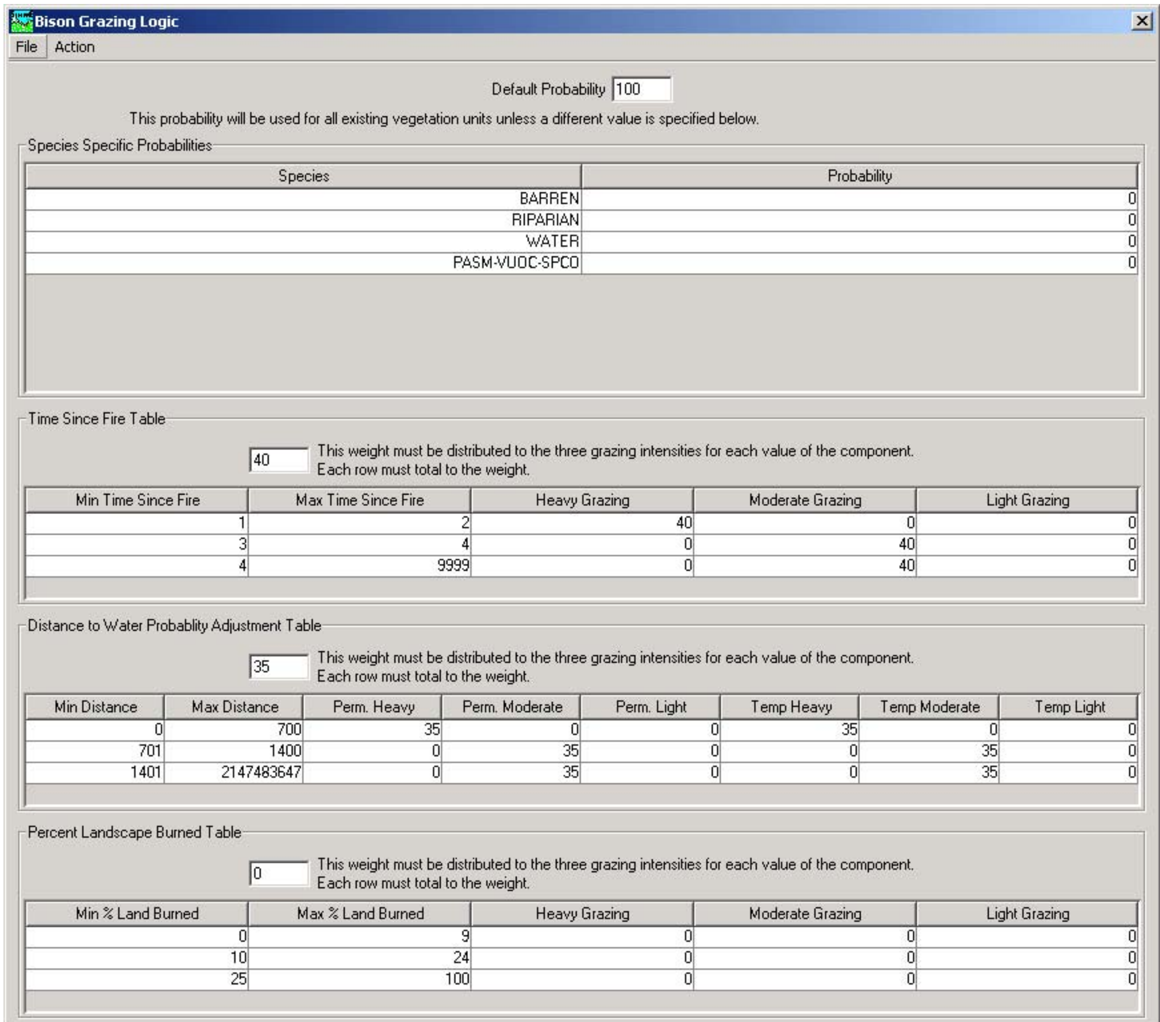

Figure H-12 System knowledge screen for the probability of bison grazing.

The wording as to the percents having to total should say "cell" not row. A cell cannot have less than the percent assigned as the weight.

Fire - Season of Fire

Although we do have 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.

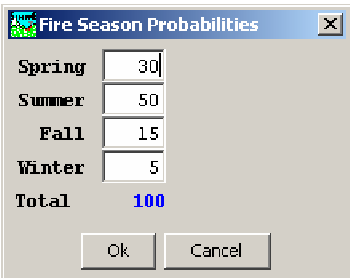

Figure H-13 Screen for setting the probability of the season of the fire process.

Prairie Dog

This process has to be locked in. There is no logic for predicting it's occurrence.

<u>Regeneration logic</u>

If there is any "species to track information" available we will not call the Regeneration logic as a result of SRF. In the long run we may want to have it tied to a threshold level of percent change in the species, but for now we won't call it at all for those pathways that have the more detailed information.

We'll make sure we don't have any of these species in the regen logic table with the "succession" regen checked.

For the case of "Heavy-bison-grazing" and "prairie-dog-active" processes we will expand the "fire-event" logic so it isn't 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 legal values are given for the three zones. All values are for non forested species. Future landscapes within theses 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.

APPENDIX I – Colorado Plateau

The development of this geographic area was accomplished in connection with USGS's FRAMES project for Mesa Verde National Park (need reference). This effort involved a number of scientists and managers from USGS, Mesa Verde National Park, Colorado State University, Northern Arizona University, and Prescott College.

A separate publication will provide detailed documentation of this effort.

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

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 was used to identify common combinations of trees, shrubs, and grasses.

Numerous workshop with scientist, 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.

Trees

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 (high elevation above 9,000)			
Riparian (mid-elevation 6,500 to 9,000)			

Inventory assignment	SIMPPLLE Trees		
	Species	Size	Density
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

shrubs

Inventory assignment	SIMPPLLE Shrubs		
	Species	Size	Density
Aspen	SYORO	MEDIUM-SH	1
Aspen- douglas-fir- spruce-fir	LOIN5	LARGE-SH	1
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

Inventory assignment	SIMPPLLE Shrubs		
	Species	Size	Density
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
Agriculture			
Urban			
Non-forest			
Barren			
Water			

Table I-3

Herbaceous

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

	SIMPPLLE Herbaceous		
Inventory assignment	Species	Size	Density
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
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

Size Class

TREES

SIZE	SIMPPLLE ABBREVIATION	
Established Seedlings	**E**	0.0" to 0.9" dbh
Sapling	**SS**	1 to 4.9" dbh
Medium	**MEDIUM**	5 to 8.9" dbh
Large	**LARGE**	9 to 15.9" dbh
Very Large	**VERY-LARGE**	16"+ dbh
Non-stocked	**NS**	
Medium-Multistory	**MMU**	
Large-Multistory	**LMU**	
Very Large-Multistory	**VLMU**	

SHRUBS

SIZE	SIMPPLLE ABBREVIATION	
Small	**SMALL-SH**	< 2.5' height
Medium	**MEDIUM-SH**	2.5' to 6.4' height
Large	**LARGE-SH**	> 6.5' height

GRASSES

SIZE	SIMPPLLE ABBREVIATION
Clumped	**CLUMPED**
Uniform	**UNIFORM**

NONFOREST

SIZE	SIMPPLLE ABBREVIATION
Nonforest	**NF**
barren	**ba**
urban	**urban**
agriculture	**agr**

Table I-5

Density

DENSITY	SIMPPLLE ABBREV.
0 to 10 percent	1
11 to 40 percent	2
41 to 70 percent	3
71 to 100 percent	4

Table I-6

Disturbance processes

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

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. Lisa Floyd-Hanna, David Hanna, William Romme, and Tim Crews.

Detailed documentation will be included in a separate publication of the application of SIMPPLLE to the Colorado Plateau.

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-26Augl2006.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 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 for each time step across all the number of simulations the following values:

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 Average, 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 you’re saved *.xls files (results from NEW DATA option)
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 Medium 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.

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 “average”, 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. **You must have Excel 2002 to run the macros in the Report Template.**

If the report is done 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 the standard Regional Diversity Matrix.

To accomplish groupings we have not had the time to create a complete user interface to query the user for the desired grouping. Instead we have the system asking for the name of a text file (*.txt) that contains the information to create groups. Many text files for different groupings may be made.

Steps:

1. Create a text file that contains grouping information.

2A. Make multiple simulations and at the end under main menu of “reports” select “all states report” - 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.

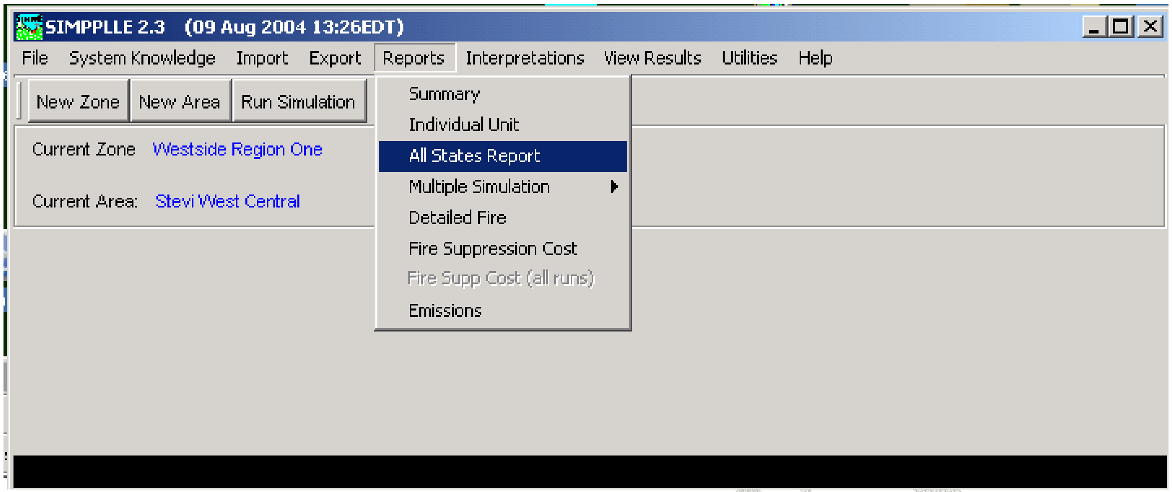

Figure K-1

3. In running the report, provide the name of the text file that has the grouping information, and provide a name for the resulting output file that will also have a ".txt" extension

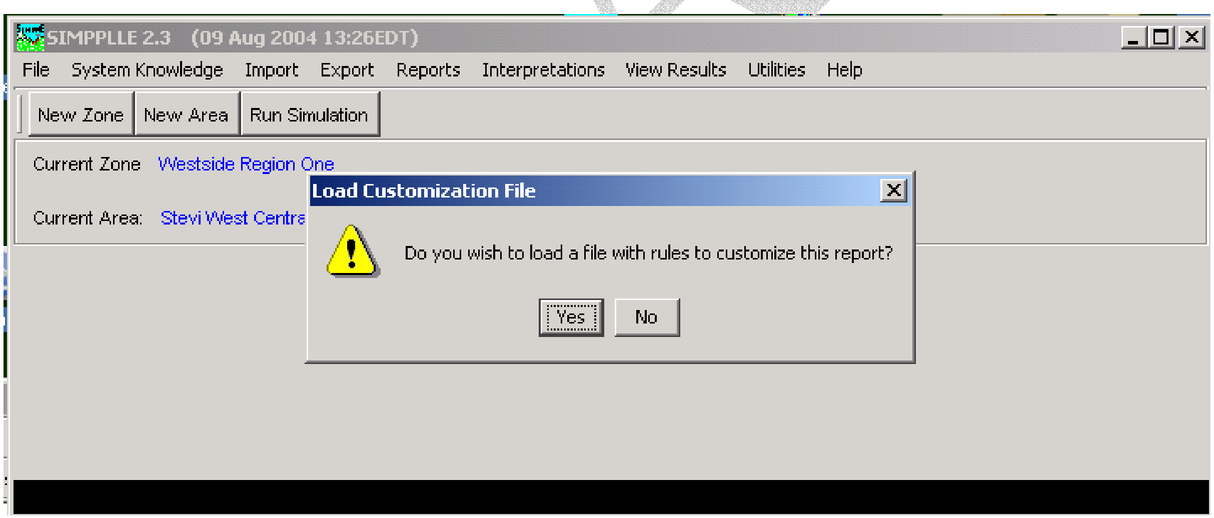

Figure K-2

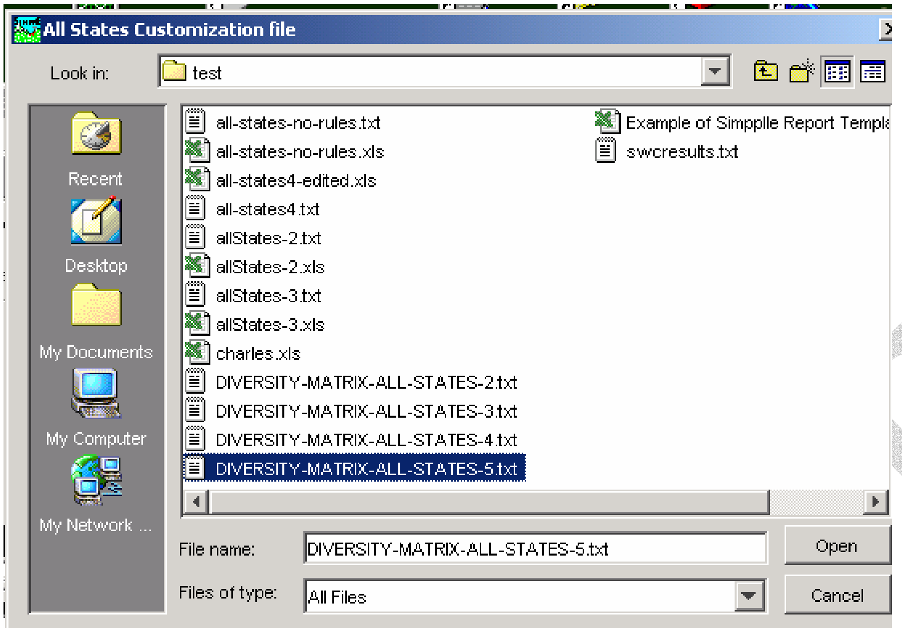

Figure K-3

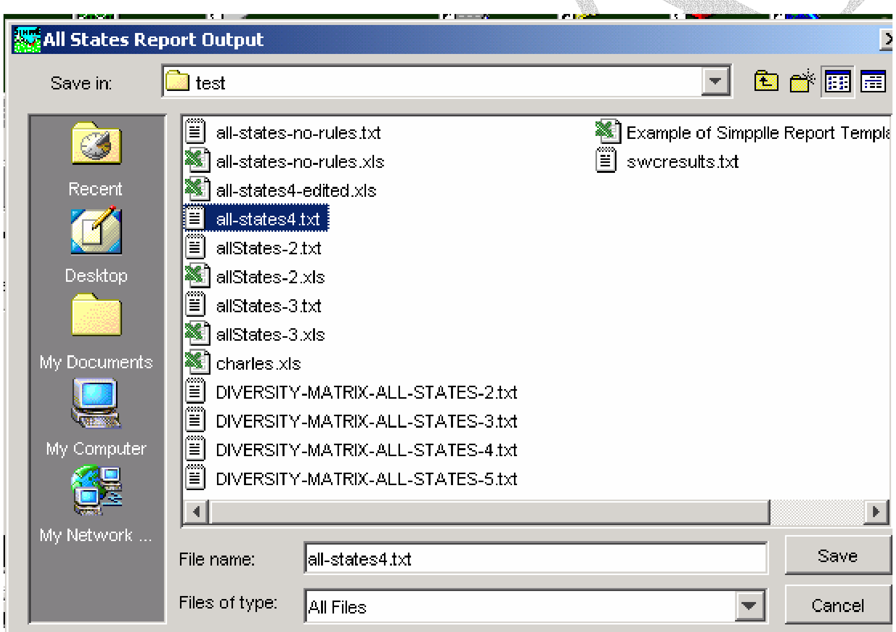

Figure K-4

4. Execute the Report Template spreadsheet. Make sure you chose to "enable macros".

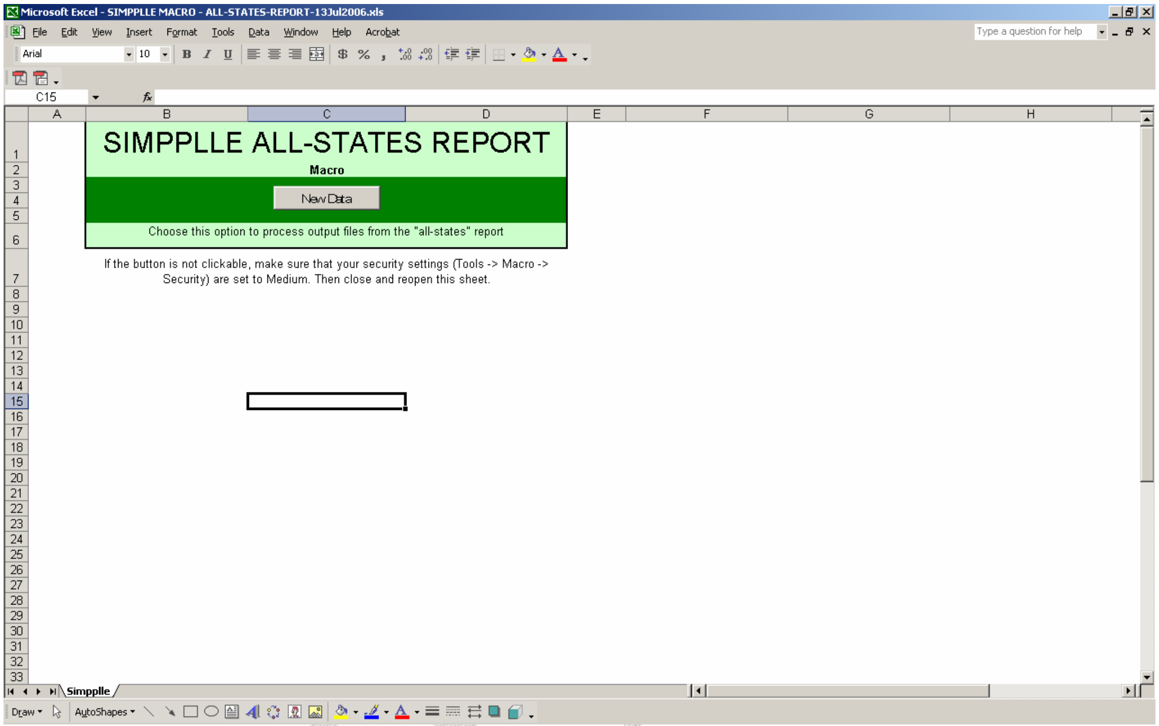

Figure K-5

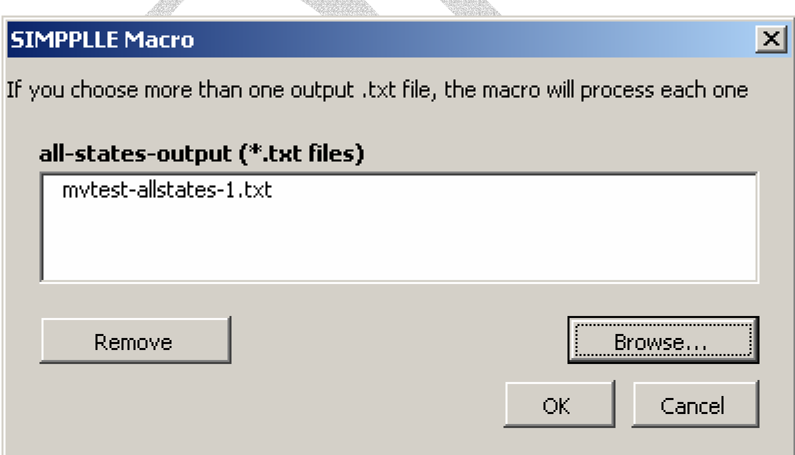

Figure K-6

5. Select choices

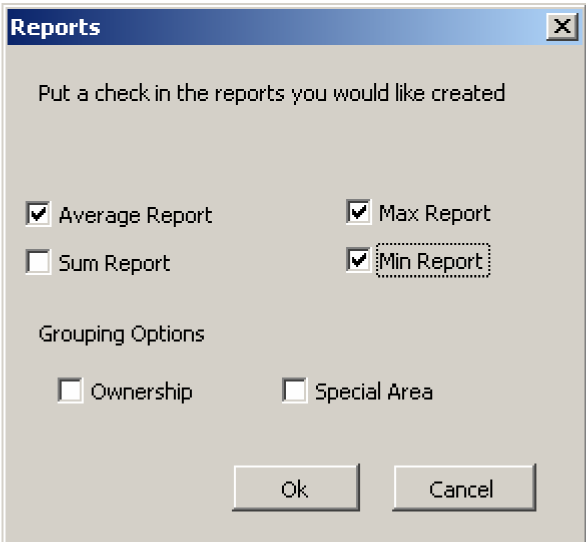

Figure K-7

6. Save the results as an xls file

THE “GROUPING TXT FILE”

It’s easy to see if you have missed values in creating the groups because these individuals will show up in the reports in the Template.

Can have a title by entering information beyond the “BEGIN” key word

All states report customization file format (the *.txt file):

<u>Legal Keywords:</u>

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

APPENDIX L – Tracking Species Excel Spreadsheet and Macro

This Excel spreadsheet and macro are designed to provide the acres of the species being tracked by percent categories that a user identifies.

The following figure for the Simulation Parameters, has a check box for selecting an output file to be generated that provides input for this spreadsheet.

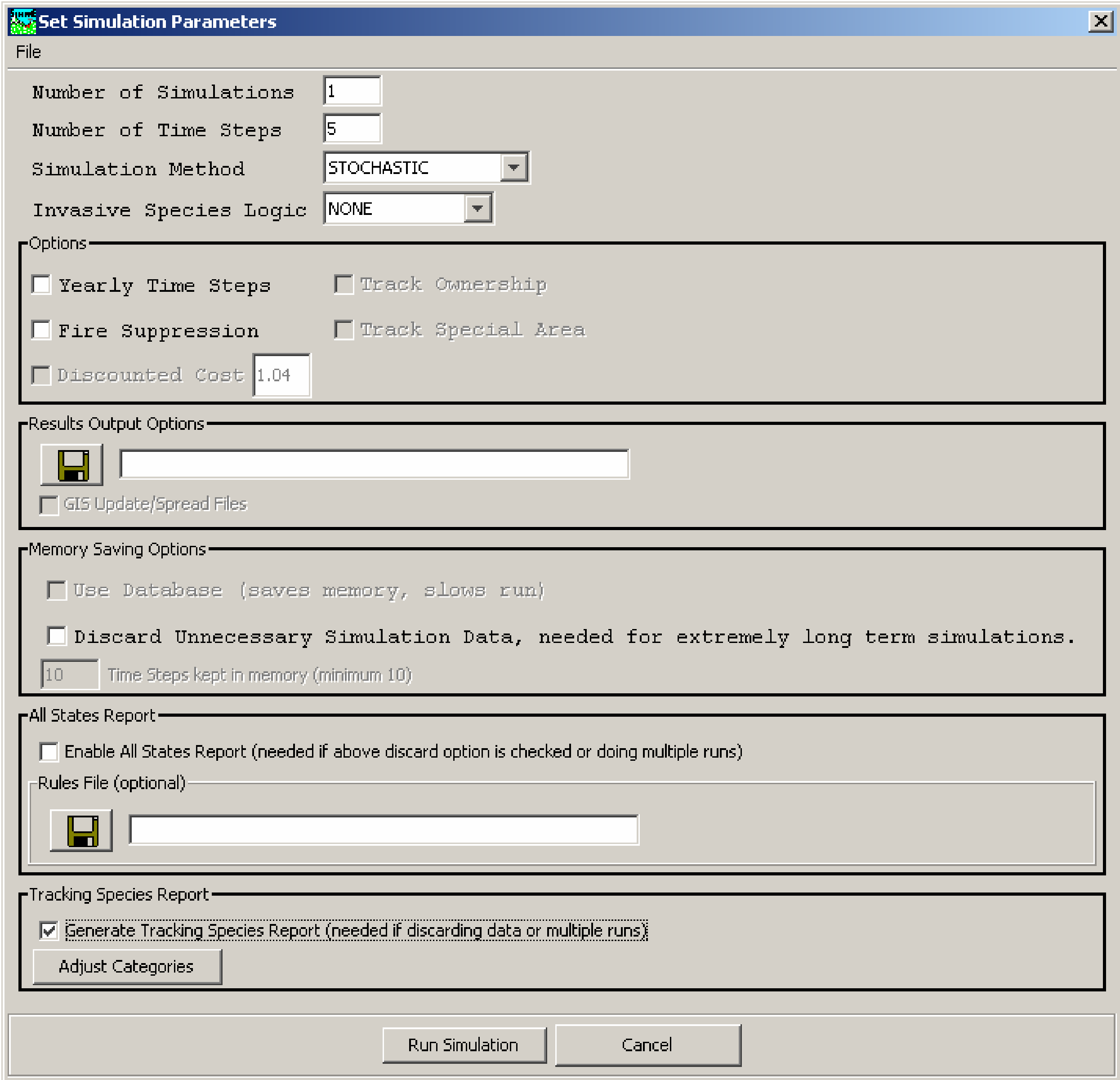

Figure L-1

Selecting the “adjust categories” brings up the below screen that allows the user to make changes in the percent categories by species.

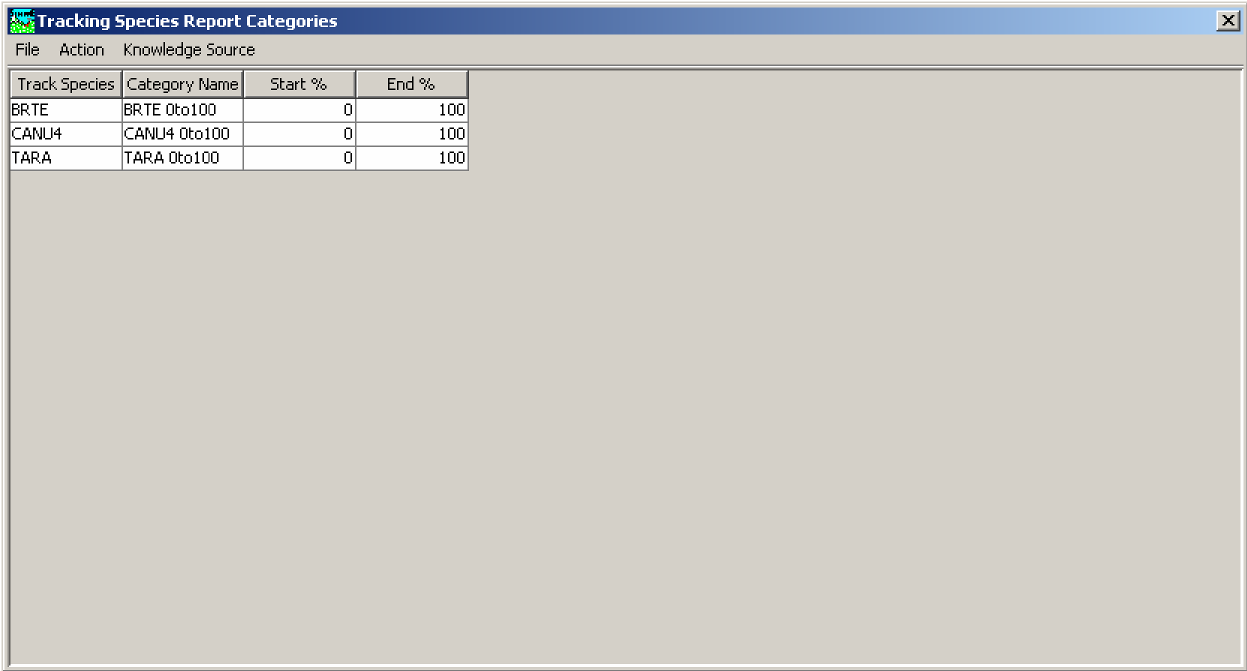

Figure L-2

The file resulting from the simulation has to be identified as input in the spreadsheet.

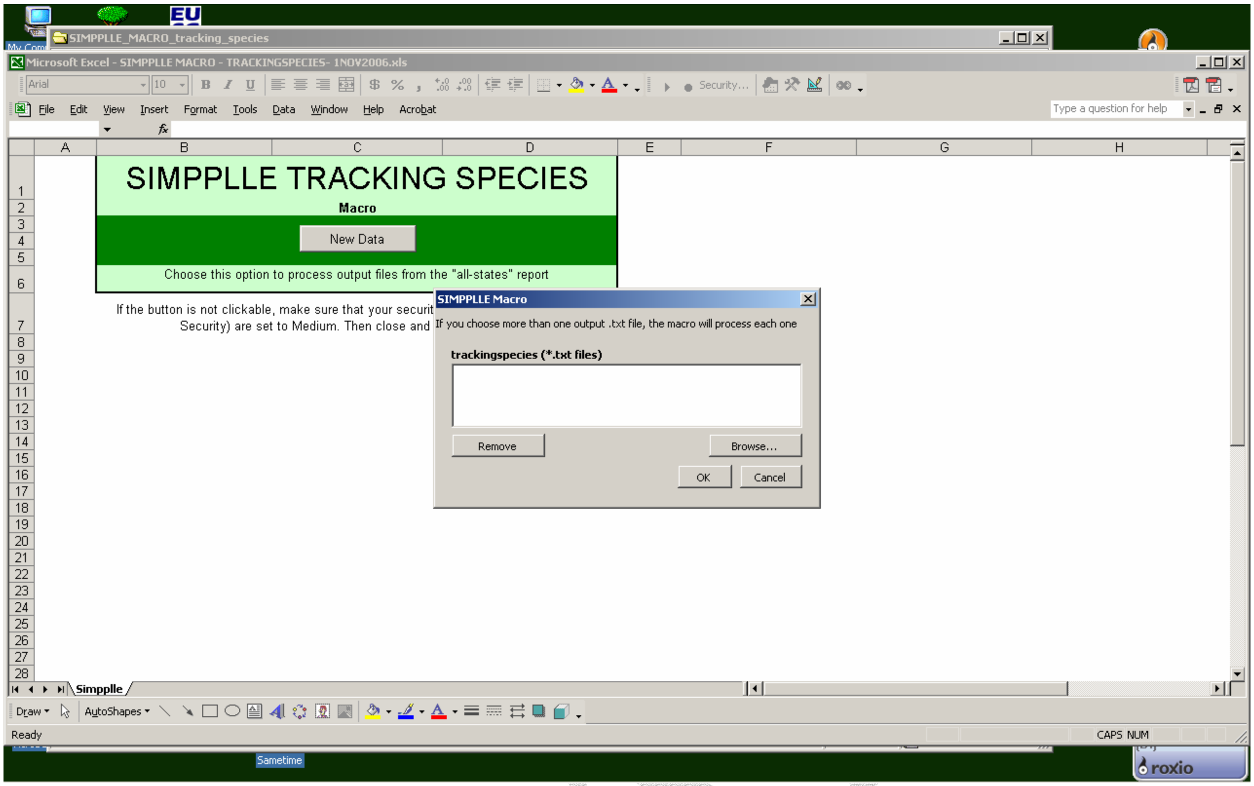
SIMPPLLE_MACRO_tracking_species
Microsoft Excel - SIMPPLLE MACRO - TRACKINGSPECIES- 1NOV2006.xls
File Edit View Insert Format Tools Data Window Help Acrobat
SIMPPLLE TRACKING SPECIES
Macro
New Data
Choose this option to process output files from the "all-states" report
If the button is not clickable, make sure that your securit
Security) are set to Medium. Then close and
SIMPPLLE Macro
If you choose more than one output .txt file, the macro will process each one
trackingspecies (*.txt files)
Remove
Browse...
OK
Cancel
Simpplle
Ready
CAPS NUM

Figure L-3

APPENDIX M – MRPP

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 (MRPP) provide techniques which allow the use of multi-response data that are at least 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). Because the size of landscapes, the number of polygons representing the landscapes, and the associated terrain of individual landscapes is highly variable 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.