LANDIS-II Stress Mortality v1.0 Extension User Guide

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1 Introduction

This document describes the **Stress Mortality Extension** for use with the LANDIS-II model. This extension must be run with a Biomass Succession. For information about the model and its core concepts, see the *LANDIS-II Conceptual Model Description.*

1.1 Version 1.0

Version 1.0 is compatible with LANDIS-II v6.0.

1.2 Extension Description

1.2.1 Overview

This extension models biomass removal, mortality, and reduced establishment due to stress conditions. Stress conditions can be triggered by many different exogenous factors (e.g,, heat stress, introduced species that are pervasive.). The extension was initially developed to simulate stress due to drought although the logic is general enough to be used for multiple purposes.

The stress extension does not include any spatial processes. It determines whether stress is occurring, determines the effect on individual cohorts, and modifies or kills the cohorts. Stress can occur at different time and for different species in each ecoregion.

There is no stress intensity. A stress is either occurring or not occurring. If a stress occurs for an ecoregion and species, a biomass reduction is applied dependent upon age. If the cumulative stress exceeds a designated threshold within the current year plus three prior years, the cohort is killed.

1.2.2 Time Step

The extension has a fixed annual time step. Therefore, the user does not need to indicate the time step.

1.2.3 Onset of Stress

Stress can begin at any year and for any species and ecoregion. These years do not need to be consecutive nor do they need to follow the time step of any other extension, including succession. The duration of stress is similarly flexible with a minimum duration of one year.

1.2.4 Partial Biomass Removal

The removal of biomass from cohorts depends on the species and age of each cohort. The fraction of biomass to be removed (e.g., a portion of the total cohort) for a species and age is determined by an input table.

1.2.5 Cumulative Mortality

A cohort may be killed if the cumulative fraction of biomass removed (above) exceeds a threshold determined by the user. Only the current year and the three previous years are taken into consideration when calculating cumulative stress. Stress need not be consecutive within this four year window to be cumulative, i.e., one good year will not necessarily 'rescue' a cohort.

1.3 References

1.4 Acknowledgments

This research was funded the US Geological Survey program:

2 Parameter Input File

The input parameters for this extension are specified in one input file. This text file must comply with the general format requirements described in section 3.1 *Text Input Files* in the *LANDIS-II Model User Guide*.

2.1 LandisData

This parameter's value must be `"Stress Mortality"`.

2.2 Stress Onset Table

This table contains the year, ecoregion, and species during which stress occurs. The first column is year beginning from simulation year 1. The second column is the ecoregion name and must match one of the ecoregion names defined for the scenario. The third column is species and must match one of the species defined for the scenario.

2.3 Partial Mortality Table

The partial mortality table contains a list of the species for which stress will apply. The species name is followed by a **fraction cohort removal** and the corresponding cohort ages. The fraction cohort removal must be between 0.0 and 1.0. The cohort ages are in parentheses and can be given as a range (50-75) or given a less than or greater than comparative (>150) (<25). They need not be mutually exclusive. Only the greater than (>) and less than (<) inequality comparatives are allowed within the input file (e.g., greater than or equal to, >=, will causes errors). Greater than (>) is implemented as greater than or equal to, whereas less than (<) is always less than. Ranges are treated as greater than or equal to the lower value of the range, and less than the upper value of the range.

Note: There CANNOT be any spaces between the fraction cohort removal and the open parentheses.

2.4 MapName

Note: This is not currently functioning.

This file parameter is the template for the names of the stress induced biomass removal output map. The parameter value must include the variable "**timestep**" to ensure that the maps have unique names (see section 3.1.8.1 *Variables* in the *LANDIS-II Model User Guide*). The

user must indicate the file extension. The user must also include sub-directory name(s) as needed.

2.5 LogFile

The file parameter is the name of the extension's log file. The log file contains biomass removed by species and total and the number of cohorts killed by species and total. These data are arranged by time step.

3 Example File

```
LandisData "Stress Mortality"

StressOnsetTable
>>year landtype  species
>> -------- -------------
2      eco1       abiebals
2      eco1       poputrem
20     eco1       abiebals
20     eco1       poputrem
21     eco1       poputrem
22     eco1       poputrem
23     eco1       abiebals
23     eco1       poputrem
2      eco2       poputrem
3      eco2       poputrem
4      eco2       poputrem
5      eco2       poputrem
20     eco2       poputrem
23     eco2       poputrem


PartialMortalityTable
>> species MortalityRate(Agegroup)
abiebals  0.37(1-50) 0.2(>50)
poputrem  0.37(1-40) 0.5(40-80)  0.63(>80)

CompleteMortalityTable
```

```
        >> species CummulativeBiomassReduction(%) to
        trigger complete mortality
        abiebals   90
        poputrem   90


        MapName  stress/stress-map-{timestep}.img  <<
        Currently no maps are being produced; a
        placeholder
LogFile  "stress-mortality-log.csv"
```