

# Biomass Harvest v4.6 LANDIS-II Extension User Guide

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Last Revised: April 5, 2024

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# 1 Introduction

This document describes the Biomass Harvest Extension for the LANDIS-II model. Users should read the LANDIS-II Model User's Guide prior to reading this document.

The Biomass Harvest Extension for LANDIS-II is derived from the Base Harvest extension and therefore generally behaves the same as Base Harvest. The largest change is that Biomass Harvest supports partial thinning of cohorts; other changes are listed below. Consult the user guide for Base Harvest for further information.

**Note:** The Biomass Harvest Extension is compatible with succession extensions that use the same cohort type, in this case cohorts with species, age, and aboveground biomass data. Currently, the Biomass Succession, NECN, Forest Carbon Succession, and PnET-Succession extensions meet this criterion. Therefore, Biomass Harvest is *not compatible* with the Age-only Succession or BFOLDS Forest Succession extensions.

## 1.1 Major Releases

### 1.1.1 Version 4.4 (January 2021)

Numerous bugs and other fixes were resolved:

- Fixed a bug in repeat harvest where sites would be queued up for a repeat harvest even if nothing was harvested.
- Fixed a double counting bug in repeat harvest logging.
- Fixed an issue where sometimes the log would double count when cohorts were killed by age only disturbances.
- Users can now specify 100% or omit the percentage to indicate a complete harvest.
- Increased the decimal precision in the event log.
- Fixed an issue with partial stand spreading where sometimes ineligible sites would be queued up to harvest.

### 1.1.2 Version 4.2 and 4.3 (October 2019)

Corrected many various bugs in the underlying libraries. See the Base Harvest User Guide for complete details (v4.2). Updated to Succession Library v8 (v4.3).

### 1.1.3 Version 4.1 (March 2019)

Updated with Succession Library v7.

### 1.1.4 Version 4.0 (August 2018)

Updated to be compatible with Core v7.

### 1.1.5 Version 3.2 (June 2017)

Added compatibility with succession extensions that support the cohort interfaces from Biomass Cohorts through the new dependency on the Biomass Library. Any succession extension that uses a cohort structure that supports the interfaces from Biomass Cohorts should be able to be compatible with this extension.

Various issues were addressed (see GitHub repository).

PartialCohortMortality functions added to improve allocation of dead material post-harvest.

### 1.1.6 Version 3.1 (November 2015)

All version 3.1 enhancements recorded in the Base Harvest user guide also apply to Biomass Harvest

### 1.1.7 Version 3.0 (September 2015)

Added biomass harvested (Mg) for each species to Event Log

All version 3.0 enhancements recorded in the Base Harvest user guide also apply to Biomass Harvest.

The extension was updated to include restructured versions of the harvest libraries. Biomass Harvest version 3.0 is compatible with Land Use version 1.0.

### 1.1.8 Version 2.2 (March 2014)

The metadata library was incorporated. All outputs are now recorded in designated xml files with units, etc.

### 1.1.9 Version 2.1 (March 2013)

Fixed a bug with partial harvesting when percentages < 100% were specified (issue #23).

### 1.1.10 Version 2.0

Biomass Harvest version 2.0 is compatible with Core v6.0.

### 1.1.11 Version 1.3

Version 1.3 incorporated the numerous fixes that were applied to the Base Harvest version 1.3.

## 1.2 Minor Releases

### 1.2.1 Version 4.6 (April 2024)

Fixed a bug with stand spreading repeat harvests where the wrong sites would be queued up for the repeat harvest.

Multiple Repeat Harvests will now harvest the exact same sites again in the repeat steps.

### 1.2.2 Version 3.2.4 (May 2018)

Update to biomass cohort library.

### 1.2.3 Version 3.2.3 (March 2018)

Update to Library-Harvest-Mgmt.

### 1.2.4 Version 3.2.1 (February 2018)

Updated to be compatible with the Succession Library v5.

### 1.2.5 Version 2.0.4

Bug fixed regarding ages, age ranges, and partial removal percentages in the species list for cohort removals. In some cases the first or last species listed was not properly assigned to the prescription.

### 1.2.6 Version 2.0.3

Compatible with Base Harvest 2.1.2, which added capability for selecting a percentage of stands as the harvest target, and add potential for interaction with the Base BDA extension to allow presalvage prescriptions.

### 1.2.7 Version 2.0.2

Bug fixed that caused improper simulation of repeat harvests.

### 1.2.8 Version 1.3.1

The log files were changed to be more explicit about the biomass removed units, both in the output maps and the event log file. Output

maps units are now **kg ha<sup>-1</sup>**. Event log units are now **Mg biomass removed** and **Mg ha<sup>-1</sup> biomass removed** per damaged site.

### 1.3 Acknowledgements

Funding for the development of LANDIS-II has been provided by the Northern Research Station (Rhinelander, Wisconsin) of the U.S. Forest Service.

## 2 Input Files

The inputs for this extension are identical to those listed in the Base Harvest User Guide with the exceptions listed below. The 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 "Biomass Harvest".

### 2.2 PreventEstablishment

The user can use the PreventEstablishment keyword after the SiteSelection choice to indicate that no new cohorts can establish after this prescription has been applied to a site.

Example:

```
Prescription SmallDevelopments
  StandRanking      Random
  MinimumTimeSinceLastHarvest 0
  SiteSelection     PartialStandSpread 1 1
  PreventEstablishment
```

### 2.3 Species List for Cohort Removal

When SpeciesList is specified for the CohortsRemoved parameter in a prescription, the user may specify a percentage after any individual age or range of ages. The percentage indicates what proportion of the biomass of a cohort(s) will be removed. For example:

```
CohortsRemoved SpeciesList
acersacc 1-40(50%) 50(65%) 65-70 71-107(15%)
```

The default percentage is 100%. If no parenthetical biomass removal values are given, the Biomass Harvest extension will behave identically to the Base Harvest extension and remove 100% of the cohort. Age ranges not listed are not removed.

## 2.4 Biomass Maps

The new `BiomassMaps` parameter comes after the `PrescriptionMaps` parameter.

The parameter specifies the template for the names of output maps of biomass removed from harvested sites. Like the `PrescriptionMaps` parameter, the `BiomassMaps` parameter requires that the timestep variable be used in its value:

```
BiomassMaps harvest/biomass-removed-{timestep}.img
```

This parameter is optional. If it is not present, then no output maps are created.



## 3 Output Files

The outputs for this extension are identical to those listed in the Base Harvest User Guide with the exceptions listed below.

### 3.1 Biomass Maps

The biomass maps indicate the amount of biomass removed from each site in  $\text{g/m}^2$ . A map is produced for each harvest timestep.

### 3.2 Event Log

The columns in the Biomass Harvest event log are: year, management area, prescription used, stand affected, event ID, that stand's current age, that stand's current rank, total event size (number of sites), number of sites where cohorts were removed, number of sites where cohorts were damaged, Mg biomass removed,  $\text{Mg ha}^{-1}$  biomass removed per damaged site, total number of cohorts partially removed (damaged), total number of cohorts removed (killed), number of cohorts affected (damaged or killed) for each species, and Mg biomass removed for each species.

### 3.3 Summary Log

The columns in the Biomass Harvest summary log are: year, management area, prescription used, total number of sites where cohorts were damaged, total Mg biomass removed, total number of cohorts partially removed (damaged), total number of cohorts removed (killed), total number of cohorts affected (damaged or killed) for each species, and total Mg biomass removed for each species.