

Report

BEE-STEWARD agri-environment schemes

User instructions & Documentation

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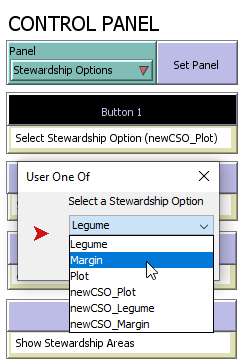
# Introduction

This document provides the user instructions how new agri-environment schemes can be defined in BEE-STEWARD via the habitat input file. It also describes how wildcards can be applied in the bumblebee species input file to simplify the entry for nesting habitat and how a new option to set random-seeds in BehaviorSpace experiments can be applied. All changes to the code are described in the second part of the document.

# User instructions

## Defining new agri-environment schemes in the habitat input file

New agri-environment schemes (AES) can now easily be defined in the habitat input file by adding a new line to the file. It is important that the entry in the first column (*habitatColourID*) starts with “FlowerSpeciesList\_” and that the *habitatType* identifies the type of AES, i.e. contains either “Plot”, “Legume” or “Margin” (starting with a capital letter). Colour range specification should be -1. Flower densities need to be defined behind the column “ONLY FLOWER DATA BEYOND THIS COLUMN”. Once all adjustments have been made, save the file. The AES can then be applied in the model in the usual way (Panel: “Stewardship Options”, Button: “Select Stewardship Option”):



## Use of wildcards in the *BeespeciesFile*

A wildcard (\*) can now be used in the *BeespeciesFile*, to define a range of habitat types as suitable for nesting (column *nestHabitatsList*). Simply add an asterisk behind the habitat name. All subhabitat, starting with the same string, will then be defined as nesting habitats.

Examples:

List in Habitat file: Resulting new list:

“Grassland” “Grassland”

“Grassland\_neutral\*” e.g. “Grassland\_neutral1” “Grassland\_neutral2” ”Grassland\_neutral3”

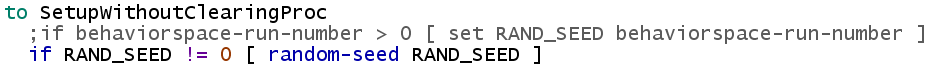
“Grassland\*” e.g. “Grassland” “Grassland\_neutral1” “Grassland\_neutral2”

“Grassland\_neutral3” “Grassland\_improved”

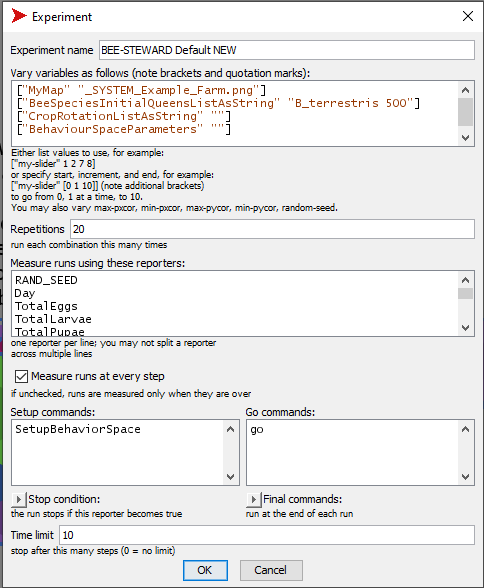
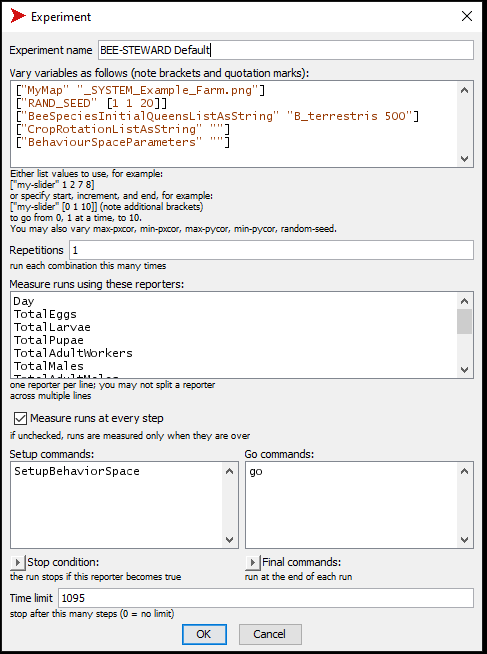
## Option to define unique random-seeds during BehaviorSpace experiments

The current practice of defining *random-seed* has the disadvantage that runs with the same *RAND\_SEED* value are identical, until changes due to different parameter values kick in. A new feature overcomes this issue by setting *RAND\_SEED* in BehaviorSpace experiments to the unique *behaviorspace-run-number*.

This feature is currently out-commented and needs to be activated by deleting the semicolon in *SetupWithoutClearingProc*:



If it is activated, BehaviorSpace experiments should be set up slightly differently: *RAND\_SEED* should no longer be listed under the “Vary variables..” section, instead “Repetions” should be used to define the number of replicates. It is recommended to have *RAND\_SEED* as an ouptput (“Measure runs..”).



Example: Defining a BehaviorSpace following the previous (left) or the optional new version (right)

# Changes made to the BEESTEWARD BBCT model

## Overview of Changes

*Major changes:*

1.) Asterisk as nesting habitat wildcard in habitat input file

2.) Definition of agri-environment schemes solely via habitat input file

*Additional, minor changes:*

3.) fixing a file path issue

4.) fixing a bee “shape” related issue when defining a new bee species

5.) option to leave out exclamation mark in header of habitat input file

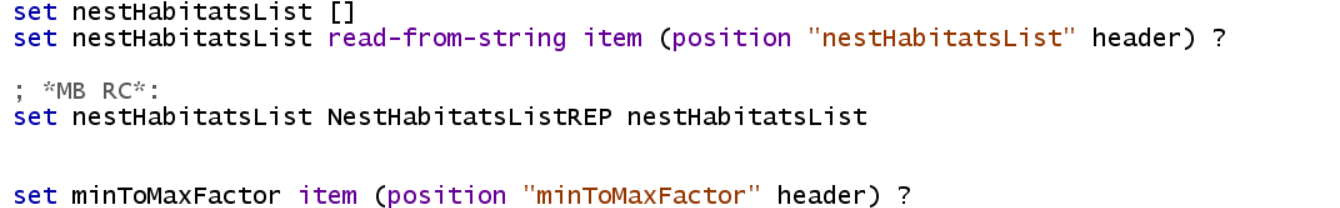
6.) alternative option for setting random seed in BehaviorSpace experiments

## 1.) Asterisk as nesting habitat wildcard in habitat input file

In order to keep the habitat input file short, an asterisk can now be used as wildcard to define a range of similar habitats as suitable for nesting. E.g. “Grassland\*” would then result in any habitat of the Grassland type to be suitable for nesting.

Changes to *CreateSpeciesProc*:

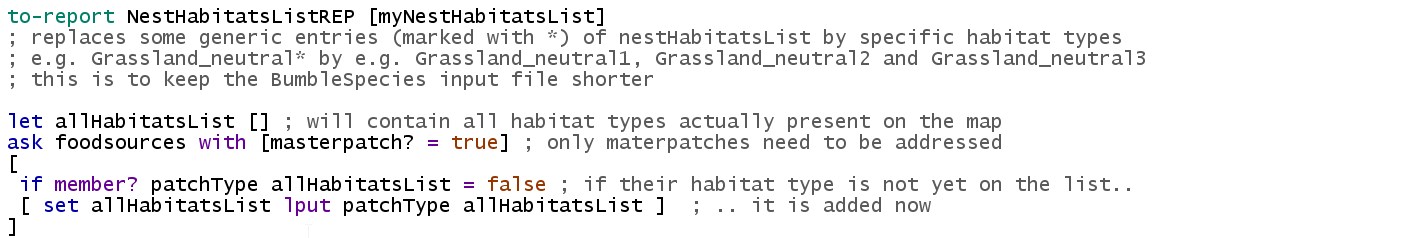
A new line was added to define *nestHabitatsList* via a reporter-procedure:



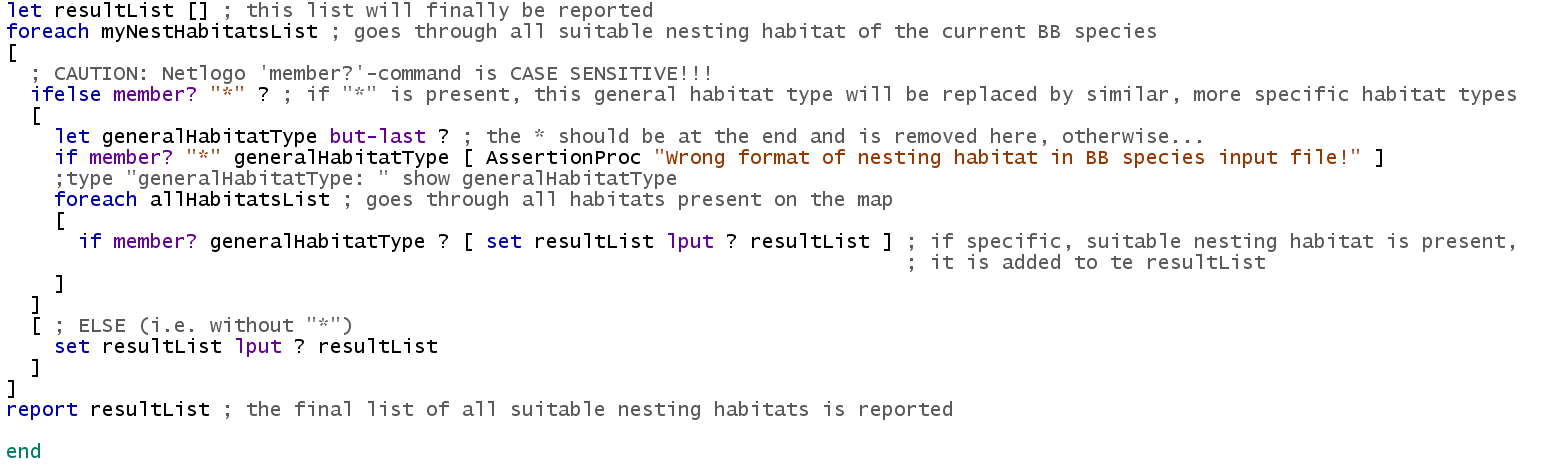
New reporter-procedure *NestHabitatsListREP* [myNestHabitatsList]

*NestHabitatsListREP* takes the original *nestHabitatsList* as input and adjusts (or extends) it, if necessary: Nesting habitats marked with “\*” are replaced by all habitats belonging to the defined category and present on the map.

First, a list of all habitats present on the map is created (*allHabitatsList*):



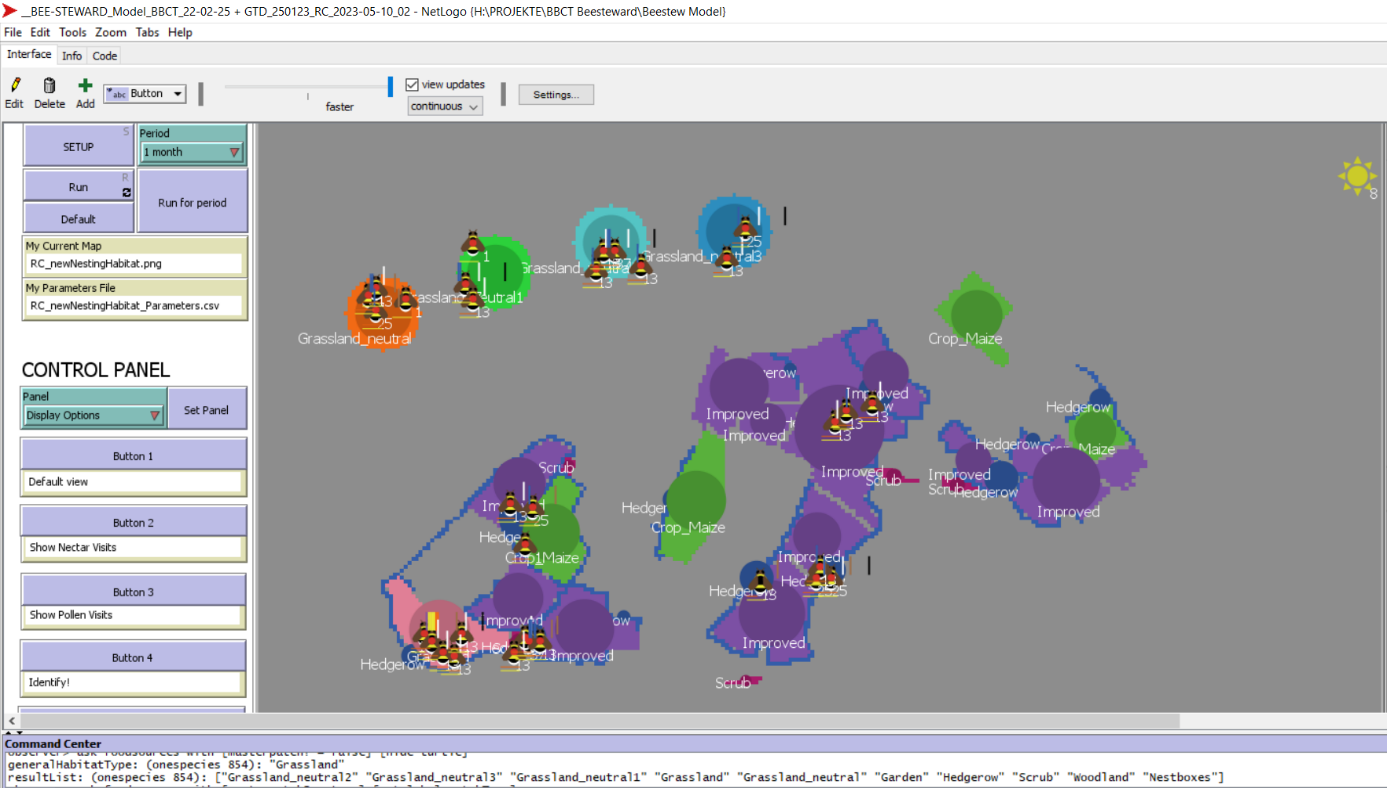
Then for all items in *myNestHabitatsList*, the list with all nesting habitats of the currently created bumblebee species, it is checked whether they contain an asterisk. If they don’t, they are added to the new list (*resultList*) without changes. If they do, however, then all sub-habitats present on the map are added to the species’ nesting habitat list. Finally. the updated list is reported:



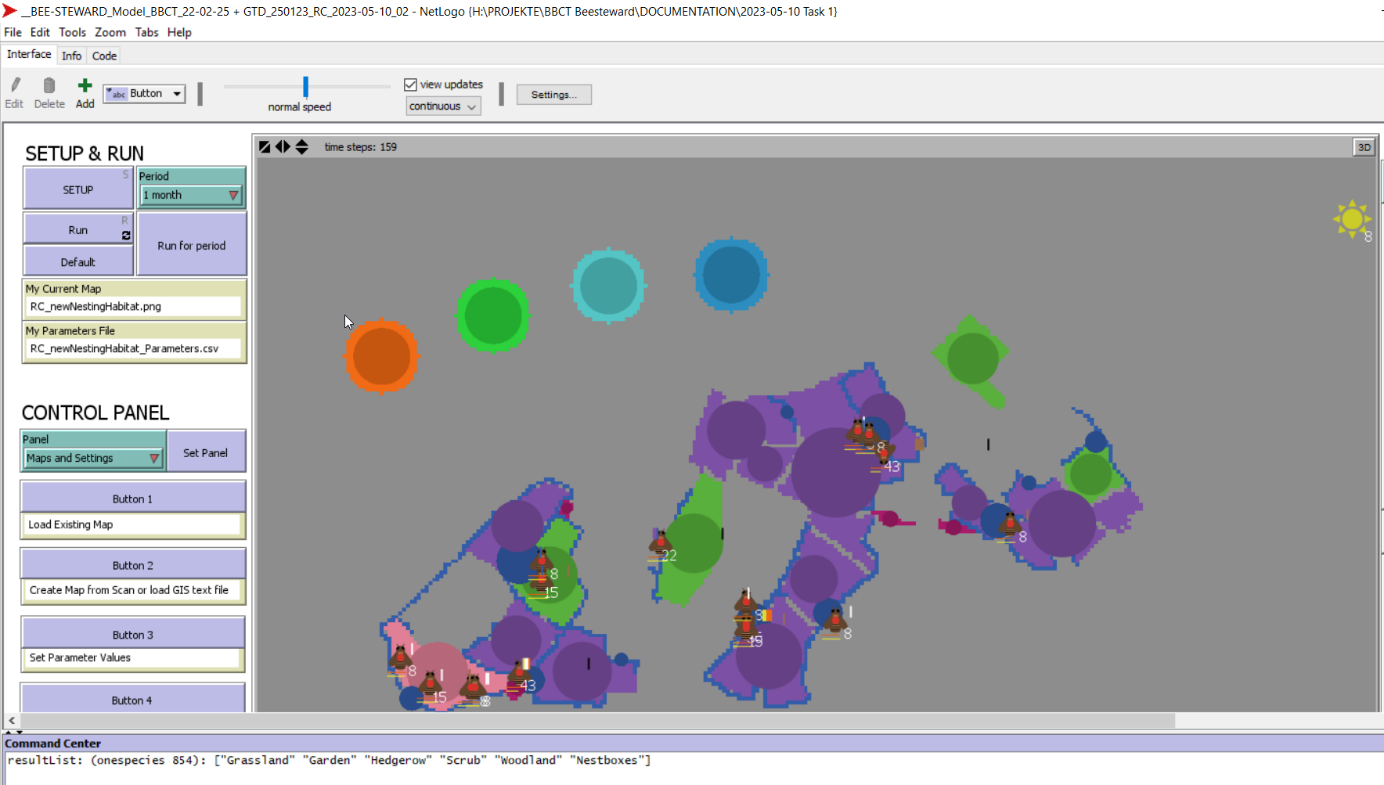
Test:

The four patches of different Grassland types have been added to the Beesteward default map. The nesting habitat definitions in the bee species input file have been modified for *B. terrestris* from [..”Grassland”..] to [...Grassland\*...], but not for B. pascuorum.

Result test run B. terrestris: colonies are created in the new habitat types:



Result test run B. pascuorum: no colonies are created in the new habitat types:



## 2.) Definition of AESs solely via habitat input file

Agri-Environment Schemes (AES or CSO, Countryside Stewardship Options) are now defined via the habitat input file instead of being hard-coded into the program.

### Changes to *Globals*:

*-* ***FlowerSpeciesList\_AllCSOsList***

*FlowerSpeciesList\_Legume, FlowerSpeciesList\_Margin* and *FlowerSpeciesList\_Plot* have been replaced by a single list (*FlowerSpeciesList\_AllCSOsList*), which contains the flower information for each AES (i.e. it is composed of *FlowerSpeciesList\_Legume, FlowerSpeciesList\_Margin* etc., plus the flower definitions of any new AES)

Format of *FlowerSpeciesList\_AllCSOsList*: e.g.

[["[\"Alsike\_clover\" 10]" "[\"Common\_knapweed\" 14]" ... ] [...(flower species list of AES 2)...] ...[...]]

**- *Patchtype\_CSOsList***

*Patchtype\_Legume, Patchtype\_Margin* and *Patchtype\_Plot* have been replaced by a single list (*Patchtype\_CSOsList*). It lists all AESs defined in the habitat input file.

Format of *Patchtype\_CSOsList*: e.g.

["\"Legume\"" "\"Margin\"" "\"Plot\"" "\"newCSO\_Plot\"" "\"newCSO\_Legume\"" etc.]

**- *AllCSOList***

A new list, *AllCSOList*, has been defined. It contains the same information as *Patchtype\_CSOsList* but in a slightly different format

Format of *AllCSOList*: e.g.

["Legume" "Margin" "Plot" "newCSO\_Plot" "newCSO\_Legume" etc.]

### *Editing*

Stewardship options do now start with a capital letter (“Margin”, “Plot” etc.)

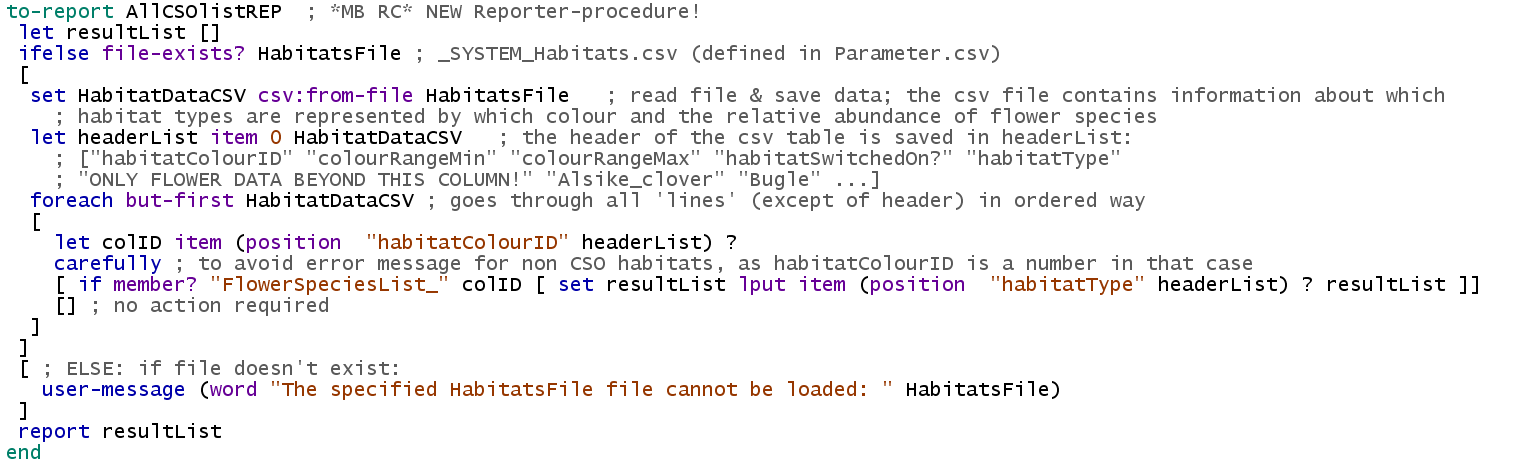
### Changes to ParametersProc

*CSS\_OptionsList* is now defined via a reporter-procedure:

set CSS\_OptionsList AllCSOListREP

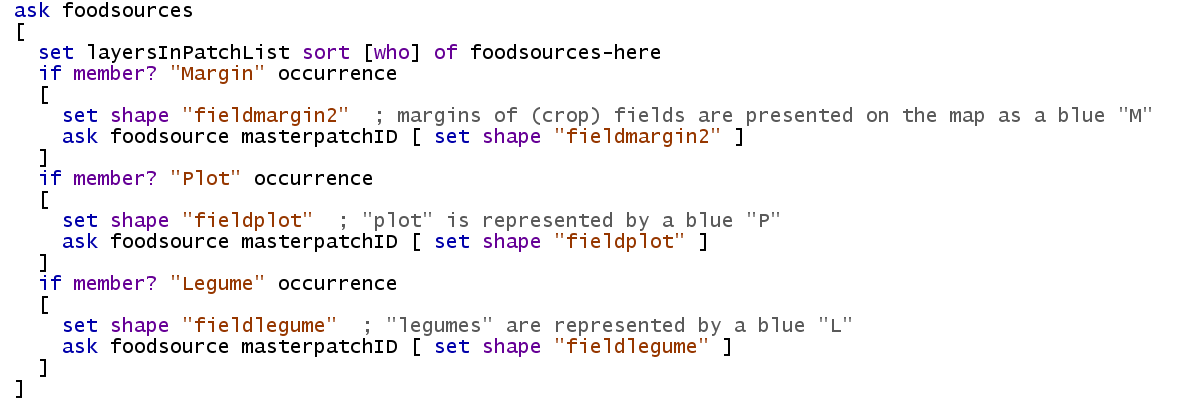
### New reporter-*procedure* AllCSOlistREP

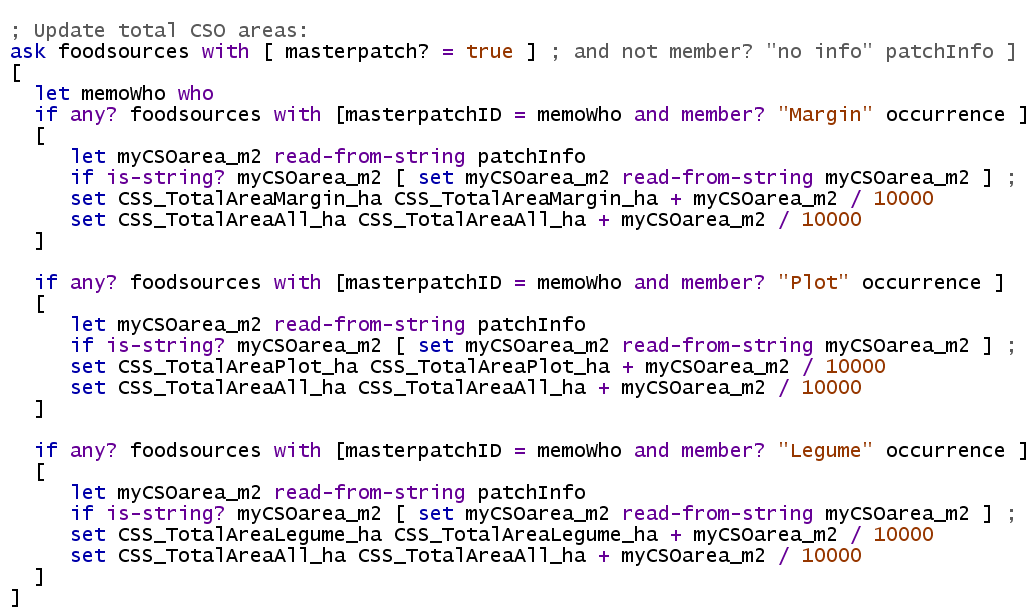
As AES are defined via the habitat input file, this file must be loaded first. AES can be distinguished from normal habitats, as they contain “FlowerSpeciesList\_” in their *habitatColourID*. The *habitatType* of each AES is then added to the *resultList*, which is finally reported (e.g. ["Legume" "Margin" "Plot" "newCSO\_Plot" "newCSO\_Legume" etc.]). Please note that AES *habitatTypes* must contain either “\_Legume” or “\_Plot” or “\_Margin” (starting with capitals). This specifies which type of AES it is and affects the information the user is asked for.



### Changes to *CreateLayersProc*

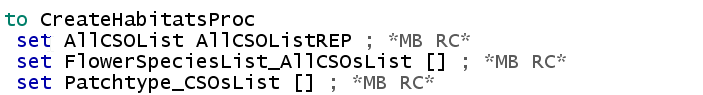
*if occurrence = "margin"* etc. has been replaced by *if member? "Margin" occurrence* etc. to ensure all margin-like (etc.) AES are addressed.





### *Changes* to CreateHabitatsProc

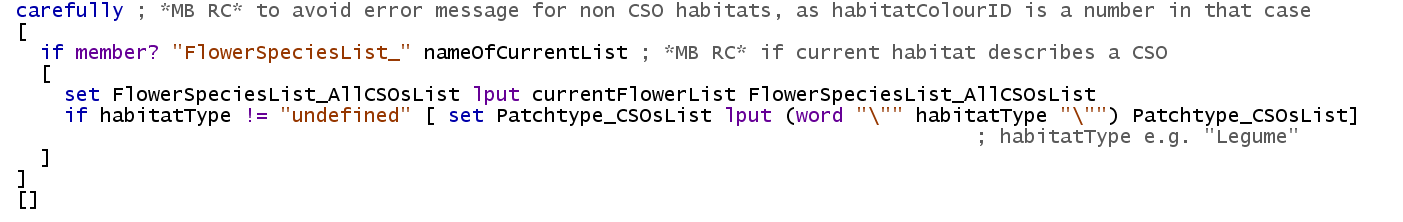
The new global variables are set up as lists:



if nameOfCurrentList = "FlowerSpeciesList\_Margin" etc. has been replaced by

if member? "FlowerSpeciesList\_" nameOfCurrentList

*FlowerSpeciesList\_AllCSOsList* and *Patchtype\_CSOsList* are then defined. As *habitatColourID* ordinary habitats is a number, not a string, the *carefully* command must be used to avoid an error message:



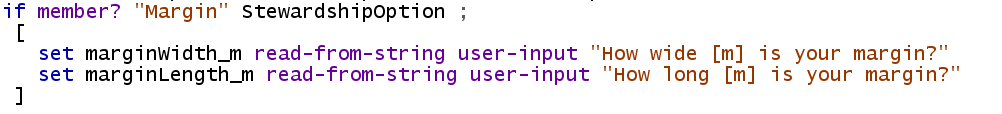
*Patchtype\_CSOsList* lists the AES and *FlowerSpeciesList\_AllCSOsList* lists the flower densities in those AES. As the order of AES is the same in both lists, flower density data can be accessed for each AES.

### *Changes* to ButtonStewardshipOptionsProc

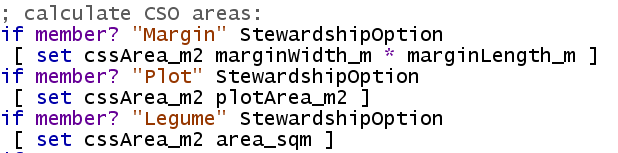
The flower resources are saved for all defined AES as nested lists in the new global variable *FlowerSpeciesList\_AllCSOsList* and all defined AES are listed in the same order in *AllCSOList*. To access the data for the current AES, its position needs to be determined and is saved in the new local variable *positionCSO*. The new local variable *cssFlowerspeciesList* then saves the flower species list needed to apply the currently chosen AES (*StewardshipOption*):



As there is no longer just one “Margin” AES but potentially a variety of margin schemes, it is checked whether or not the name of the chosen stewardship option contains the string “Margin” to start the corresponding user dialogue (similar for “Plot”-like AES):

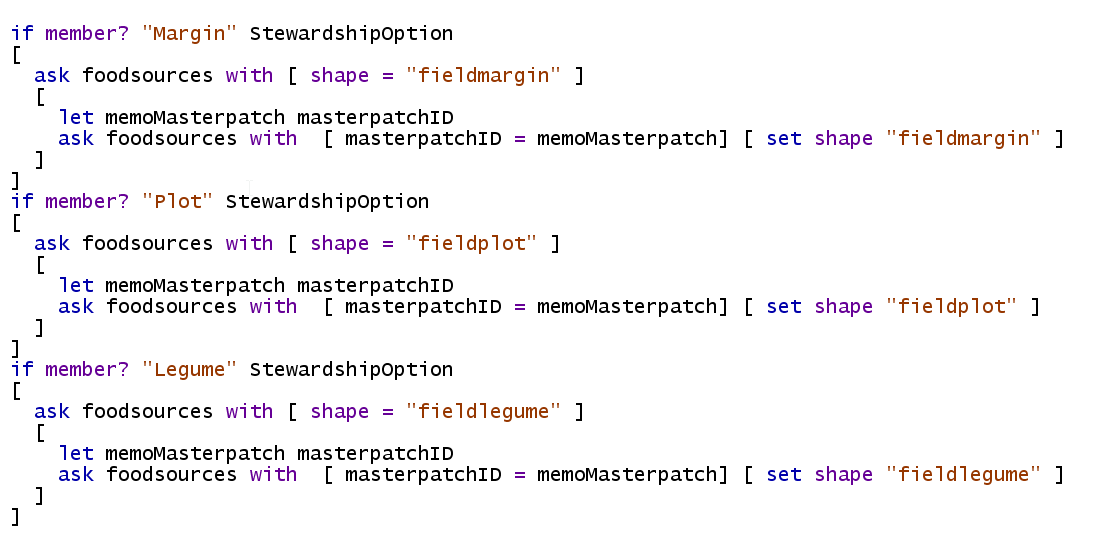


This applies also when the area used for AES (*cssArea\_m2*) is determined:



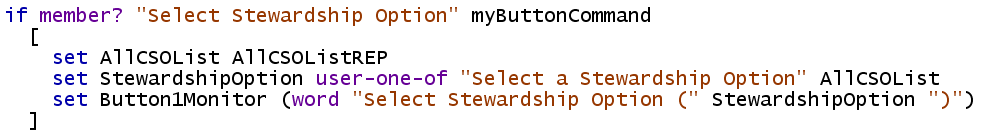
### *Changes* to StewardshipOptionsUpdateFoodsourcesProc

Like in *ButtonStewardshipOptionsProc*, a potential set of AES needs to addressed, using the *member?* command:



### Changes to PanelButtonProc

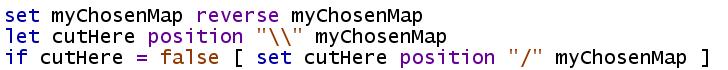
When the user clicks the “Select Stewarship Option” button on the “Stewardship Options” panel, the dialogue now shows a variable list with all AES defined:



## 3.) Fixing a file path issue

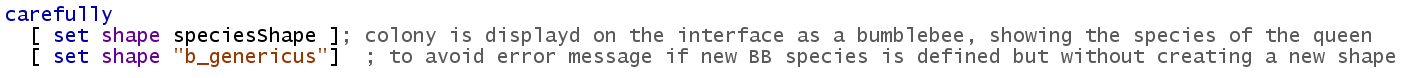
The previous code was only supporting Microsoft style of file paths, using backslashs. Unix-like system however use slashes. Now both systems are supported.

E.g. in *ButtonLoadExistingMapProc* (similar in *SaveLoadSettingsProc* and *FilenameREP*):



## 4.) Fixing a bee “shape” related issue

By default, the shape of a *colony* is to *speciesName*. If the user defines a new bee species without creating a new shape with Netlogo’s turtle shape editor, this may cause an error. In this case, the *colony*’s shape is now set to the generic shape "b\_genericus":



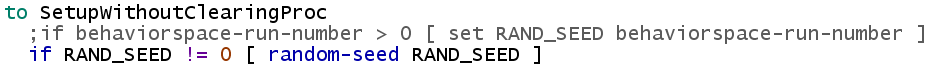
## 5.) Option to leave out exclamation mark

An exclamation mark in the header of the habitat input file was causing problems in combination with other applications. The exclamation mark can now be removed (*CreateHabitatsProc*):



## 6.) Alternative option for setting random seed

In order to have a unique and well defined random seed, a new option is provided when running BehaviorSpace experiments (to activate, the semicolon needs to be removed):



## 7.) Additional changes to code to enable advanced use

We have created 2 new procedures to enable the adanced use of BEE-STEWARD to run large lanadscapes and create nectar and pollen ‘heat’ maps that are compatable with gepgraphical InformtionSystems. See Adavanced user guide - Twiston-Davies, G. (2023) Advanced BEE-STEWARD Guide: Using BEE-STEWARD with large landscapes and Geographical Information Systems (GIS). Report for the Bumblebee Conservation Trust, Stirling.

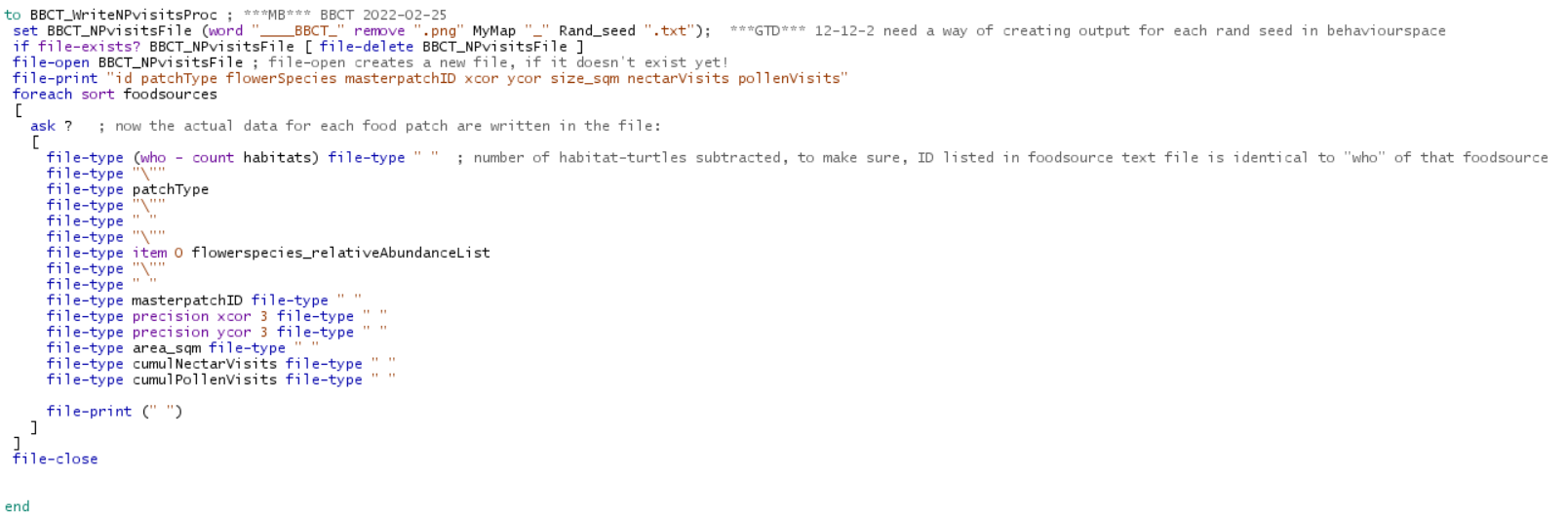
Changes to *patches-own*:

We have added *pcolorSave* for use in 2 new procedures:



Additional procedures:

*BBCT\_WriteNPvisitsProc*



*BBCT\_WriteGriccellsToPatchesProc*

