

**BioVeL – Biodiversity Virtual e-Laboratory**

## **Workflow Documentation**

# **Life Table Response Experiments (LTRE) Fixed design year effect for multiple places Workflow for local execution**

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Mr Alex Hardisty  
<http://www.biovel.eu>  
36 months



## LTRE fixed design year effect for multiple places Workflow

# 1 Description

The Life Table Response Experiments Year Effect for Multiple Places workflow provides an environment to analyse two or more stage matrices (e.g., two or more matrices of different years from one place) at two or more different locations. The objective of this workflow is to determine the effects of the research years (2 or more) on  $\lambda$ . This workflow performs a fixed LTRE, one way design (Caswell 2001).

LTRE is a retrospective analysis (Caswell 1989), beginning with data on the vital rates and on  $\lambda$  under two or more sets of environmental conditions (in this case 2 or more years from different places) (Horvitz, Schemske and Caswell 1997). The goal of the analysis is to quantify the contribution of each of the vital rates to the variability in  $\lambda$ . (Caswell 1989, 1996, 2001 in Horvitz, Schemske and Caswell 1997).

## Fixed Treatments: Decomposing Years Treatment Effects for multiple places

A fixed-effect analysis treats the matrices as representative of particular conditions, either experimental or natural (*high vs. low nutrients* in a one-way model, for example, or *year and spatial location* in a two-way model). The goal is to determine how much a treatment level (in this case year) on  $\lambda$  is contributed by each of the vital rates. The analysis uses a linear approximation in which the sensitivities appear as slopes. The effect of a treatment on  $\lambda$  depends on its effect on each matrix entry and on the sensitivity of  $\lambda$  to that entry. (Horvitz, Schemske and Caswell 1997).

For more details of the analysis see: Retrospective Analyses: Fixed Treatments (page 262 in Horvitz, Schemske and Caswell 1997) and Chapter 10 Life Table Response Experiments (page 258 in Caswell 2001).

# 2 General

## 2.1 Name of the workflow in myExperiment.

Name: Life Table Response Experiments fixed design year effect for multiple places workflow

Download: The workflow pack can be downloaded at myExperiment under the following address:  
<http://www.myexperiment.org/packs/582.html> or only the workflow:  
<http://www.myexperiment.org/workflows/4437.html>

## 2.2 Date, version and licensing

Last updated: 20<sup>th</sup> Augustus 2014

Version: 1

Licensing: CC-BY-SA

### 2.3 How to cite this workflow

To report work that has made use of this workflow, please add the following credit acknowledgement to your research publication:

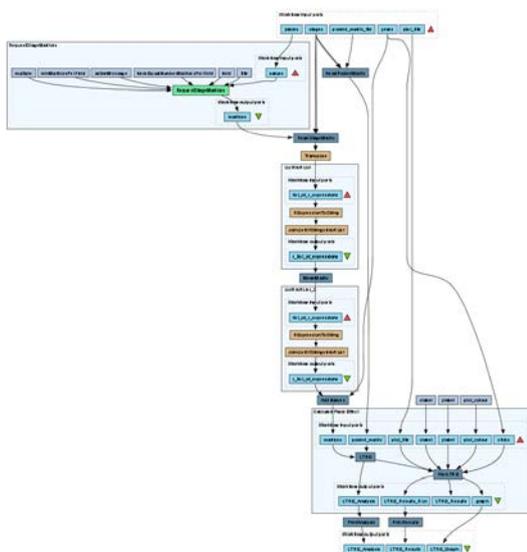
The input data and results reported in this publication (tutorial) come from data (Dr. Gerard Oostermeijer unpublished results and publication: Oostermeijer, J.G.B. M.L. Brugman, E.R. de Boer; H.C.M. Den Nijs. 1996. Temporal and Spatial Variation in the Demography of *Gentiana pneumonanthe*, a Rare Perennial Herb. *The Journal of Ecology*, 84: 153-166.) using BioVeL workflows and services ([www.biovel.eu](http://www.biovel.eu)). The Life Table Response Experiments Year Effect for Multiple Places workflow was run on *<date of the workflow run>*. BioVeL is funded by the EU's Seventh Framework Program, grant no. 283359.

## 3. Scientific specifications

### 3.1 Keywords

Life Table Response Experiments, fixed design, year effect for multiple places, Population Models, Retrospective analysis.

### 3.2 Scientific workflow description



The aim of the LTRE - year effect for multiple places workflow is to provide a connected environment for perform LTRE analysis of two or more matrices representing two or more years at two or more different places. The workflow accepts input data (matrices) in a .txt format (decimal numbers indicated by dots e.g.: 0.578). The output is provided as a set of R results and graphic plots.

**Figure 1. A)** Graph of the LTRE – year effect for multiple places in Taverna workbench.

*For more detailed description of the functions, please visit the Tutorial section.*

## 4 Technical specifications

### 4.1 Execution environment and installation requirements

The Workflow requires a Taverna Engine including the Interaction Service plugin. The simplest way to install a Taverna Engine is to install Taverna Workbench, and then install the Interaction Service plugin.

The workflow also requires an Rserve installation with the *popbio* package installed. It is possible to setup the workflow to use a remote Rserve. However, instructions for installing a local Rserve are provided below.

### 4.2 Taverna installation, including updates and plugins

#### 4.2.1 Taverna installations

- Taverna Workbench: Version 2.4 or 2.5. For installation files and instructions, please go to <http://www.taverna.org.uk/download/workbench>

#### 4.2.2 Taverna Plug-ins

- Please install the [Interaction](#) plugin: version 1.0.2+

#### 4.2.3 Taverna Dependencies

- Install R software in your computer. See: <http://www.r-project.org/>
- Start R, and install package Rserve:
  - `install.packages("Rserve")`
- Install package popbio
  - `install.packages("popbio")`
- Local R Server: (Rserve) running at port 6311. See <https://wiki.biodel.eu/x/3ICD> for additional information.

#### 4.2.4 How it works

- First, open R, once R is opened, type `library(Rserve)` and press enter; then type `Rserve()` and press enter again. You will see then the following message: Starting Rserve...

```
"C:\PROGRA~1\R\R-30~1.1\library\Rserve\libs\x64\Rserve.exe"
```

After this operation you can open Taverna and run the workflow.

# 5 Tutorial

## 5.1 Introduction

This tutorial requires 11 input files; 10 matrices, 2 per place for two consecutive years (88-89 and 89-90) and a pooled matrix (or a weighted main matrix).

## 5.2 Input data.

### 5.2.1 Data preparation/format

The workflow accepts input data (matrices) in a .txt format, all decimal numbers in each matrix must be indicated by dots e.g.: 0.578. All examples matrices for the tutorial are available in the PACK: <http://www.myexperiment.org/packs/582.html> or here below. All the files must be saved in the same directory.

### 5.2.2 Input data

The input files are in a .txt format: to download click here in each file:

#### Dwingeloo 1

- [MDwin1\\_88\\_89.txt](#)
- [MDwin1\\_89\\_90.txt](#)

#### Dwingeloo 2

- [MDwin2\\_88\\_89.txt](#)
- [MDwin2\\_89\\_90.txt](#)

#### Dwingeloo 3

- [MDwin3\\_88\\_89.txt](#)
- [MDwin3\\_89\\_90.txt](#)

#### Lochem

- [MLochem88\\_89.txt](#)
- [MLochem89\\_90.txt](#)

#### Terschelling

- [MTers88\\_89.txt](#)
- [MTers89\\_90.txt](#)

#### Pooled matrix

- [Pooled\\_matrix\\_Gentiana.txt](#)

To understand how to calculate a pooled matrix or a weighted main Matrix, please see: *Choice of a reference matrix* (pag: 253, in Horvitz, Schemske and Caswell 1997). This list of matrices will be used to perform a fixed Life Table Response Experiments year effect for multiple places analysis. Finally you will be able to export your results to different formats.

Please note that the workflow as well as the tutorial is a beta version, and may contain errors. We hope you will still find it interesting to work with this workflow, and look forward to your feedback.

## 5.2 Select input data dialogue boxes.

The first step is to fill out the input ports:

### 5.3.1 INPUTPORTS

1) **Places:** The list of places (two or more) where the research has being carried out. The respective name places must be filled one by one. First, click Add Value (see arrow in Fig. 2), fill a place name (not longer than 12 characters) and press Enter; then click Add Value and fill once again the next place name, repeat the action until you have filled all the place names.

e.g. [Dwingeloo 1, Dwingeloo 2, Dwingeloo 3, Lochem, Terschelling]

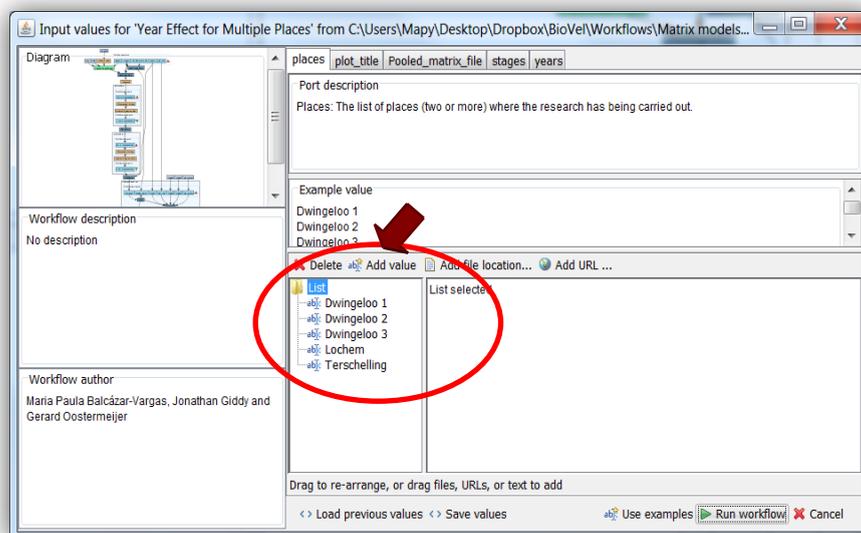


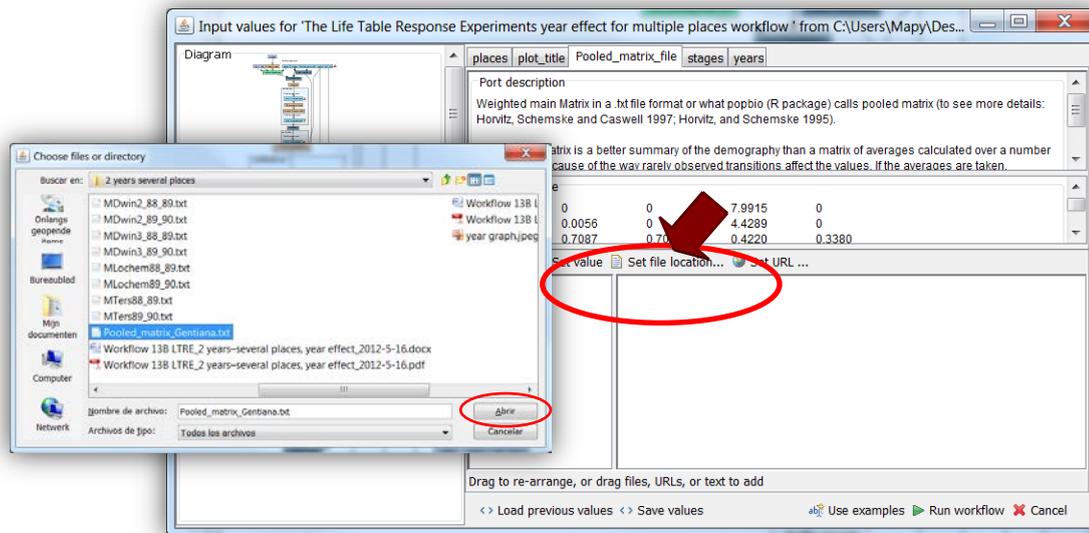
Figure 2. Inputs name of the places to be filled in (example).

2) **Plot Title:** Descriptive main title for labelling generated outputs (graphs). Click Add Value, fill a title and press Enter.

e.g: LTRE, *Gentiana pneumonanthe* (name of the analysis, *species taxonomic name*)

3) **Pooled matrix file:** Weighted main Matrix in a .txt file format or what *popbio* (R package) calls pooled matrix (to see more details: Horvitz, Schemske and Caswell 1997; Horvitz, and Schemske 1995). Click in Set file location (red arrow in Fig 3), a window dialog appears and the user selects the file (e.g. Pooled\_matrix\_Gentiana.txt) and then clicks the Open button. Then the link to the file will appear on the Taverna window.

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**Figure 3.** Input Pooled matrix to be filled in. Click in Set file location (red arrow), a window dialog appears and the user selects the file (e.g. Pooled\_matrix\_Gentiana.txt) and then clicks the Open button.

4) **Stages:** the names of the stages or categories of the input matrix. In the following example, the matrix has 5 stages or categories. The respective name stages must be filled one by one. First click Add Value (see arrow in Fig 4), fill a stage name (not longer than 8 characters) and press Enter; then click Add Value and fill once again the next stage name, repeat the action until you have fill all the stages names.

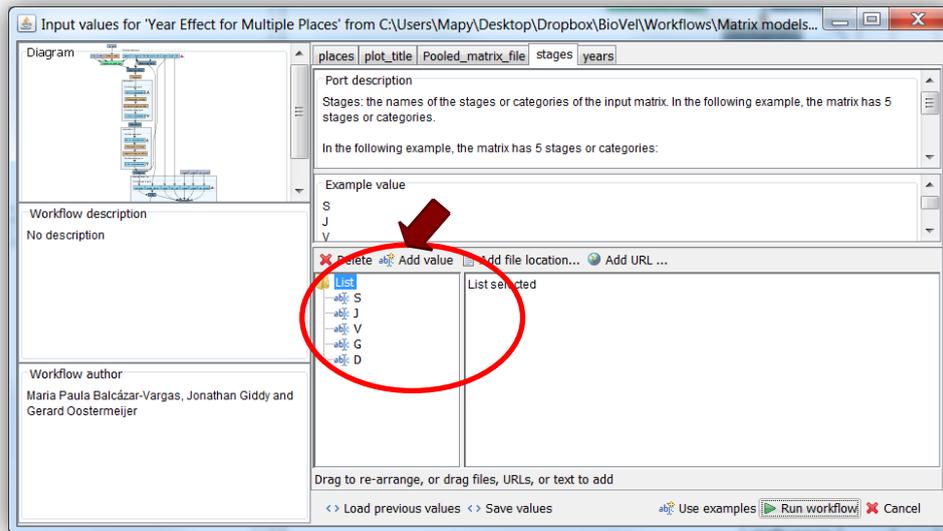
In the following example, the matrix has 5 stages or categories:

The stages of this matrix are called:

- |                             |   |
|-----------------------------|---|
| 1) Seedlings                | S |
| 2) Juveniles                | J |
| 3) Vegetative               | V |
| 4) Reproductive individuals | G |
| 5) Dormant plants           | D |

e.g. [S, J, V, G, D]

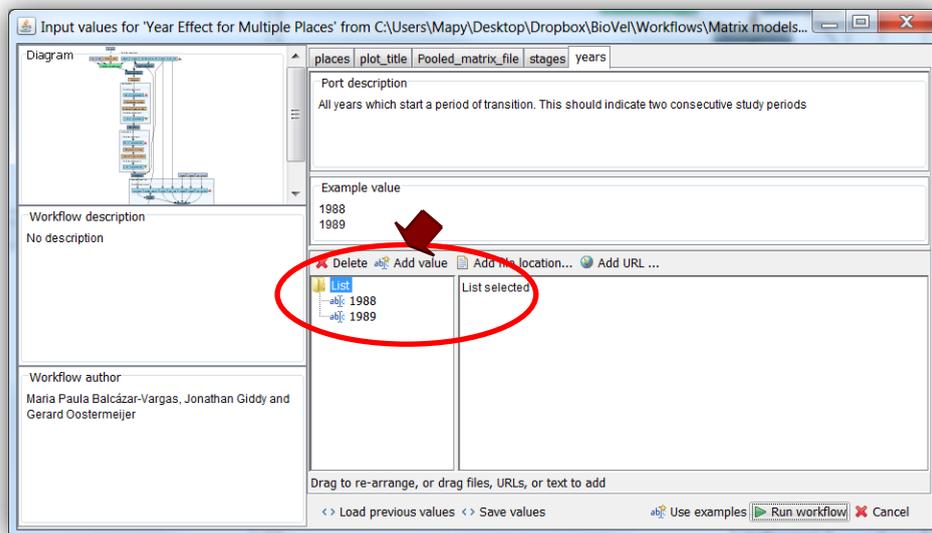
## LTRE fixed design year effect for multiple places Workflow



**Figure 4.** Inputs stages names to be filled in (example).

5) **Years:** All years which start a period of transition. This should indicate two consecutive study periods (Fig. 5). In the following example, we have two years (1988 =data interval between 1988 and 1989 and 1989= data interval between 1989 and 1990):

e.g [1988, 1999]



**Figure 5.** Inputs years to be filled in (example).

After the user has filled out the input ports and has clicked the **Run Workflow button**, a dialogue pages appear in the user's internet browser. See the next section:

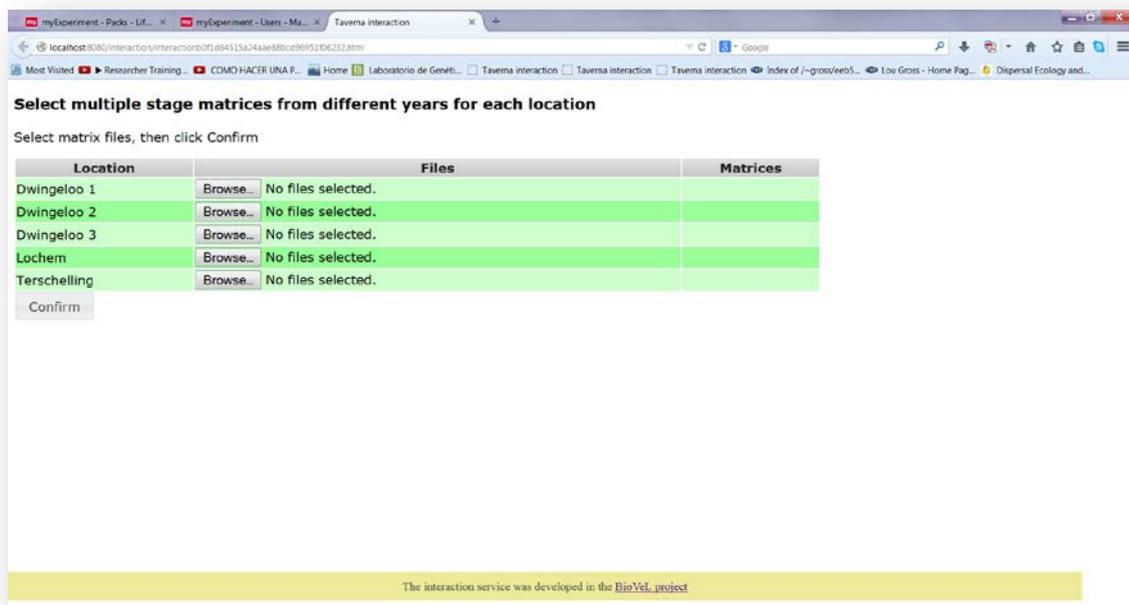
## LTRE fixed design year effect for multiple places Workflow

### 5.3.2 DIALOGUE

1) **Places:** Inside this dialogue appears the names of the places. When the dialogue appears (Fig 6), the author clicks Browse for the first place (Dwingeloo 1), a window dialog appears and the user selects all the files (two or more matrices that belong to that place, years 87-88 and 88-89) and clicks Open (Fig 7). Then the selected matrices appear in the browser. Repeat the procedure for each place (Fig 8). Once all the matrices are submitted, click in Confirm (Fig 9). After clicking Confirm, the confirmation “Matrices submitted” appears (Fig 10). When the analyses are completed, they appear on different windows under results in Taverna, the user can save each output separately. The workflow controls whether each location has 2 or more stage matrices from consecutive years intervals.

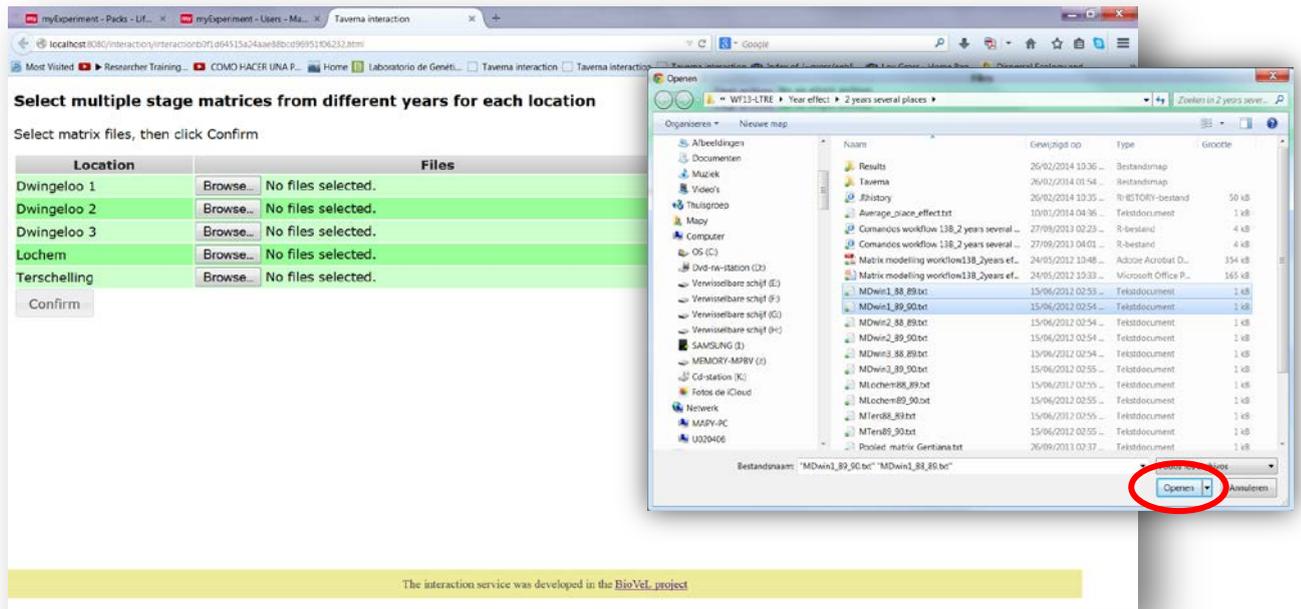
In the following example, there are 5 places:

- 1) Dwingeloo 1
- 2) Dwingeloo 2
- 3) Dwingeloo 3
- 4) Lochem
- 5) Terschelling

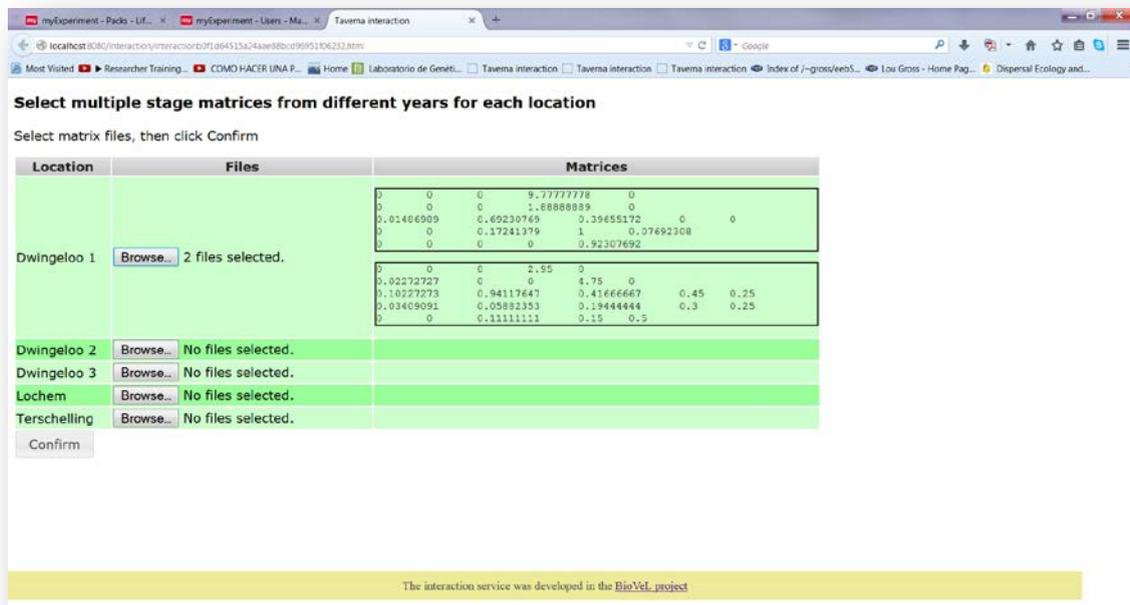


**Figure 6.** Places dialogue appears.

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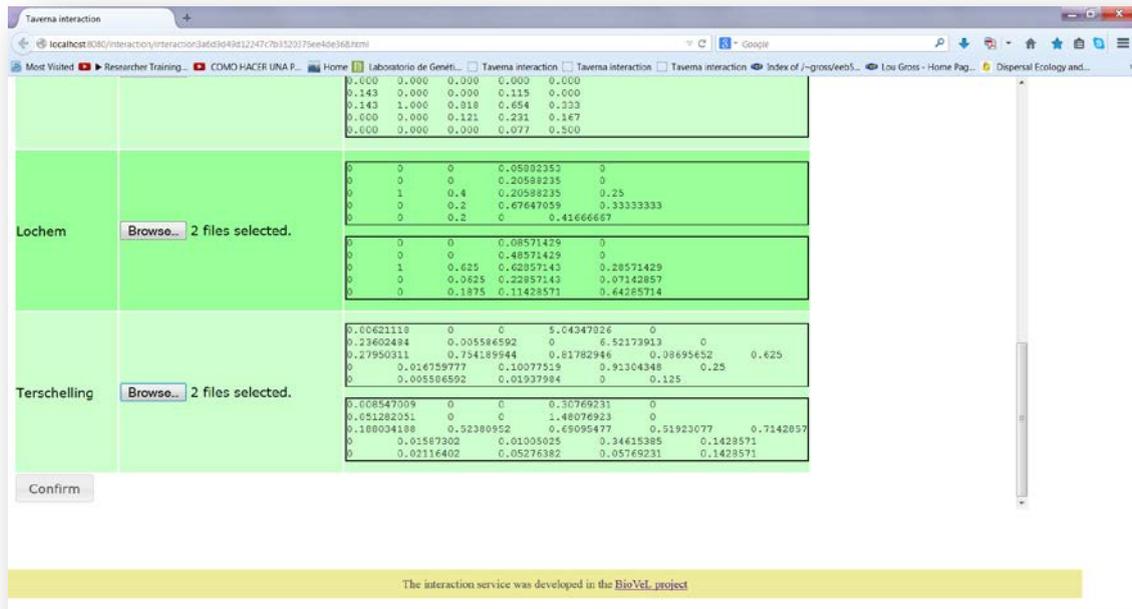


**Figure 7.** Places dialogue browse. Click in browse (Dwingeloo 1), a window dialog appears and the user selects the files (two or more) and then clicks the Open button.

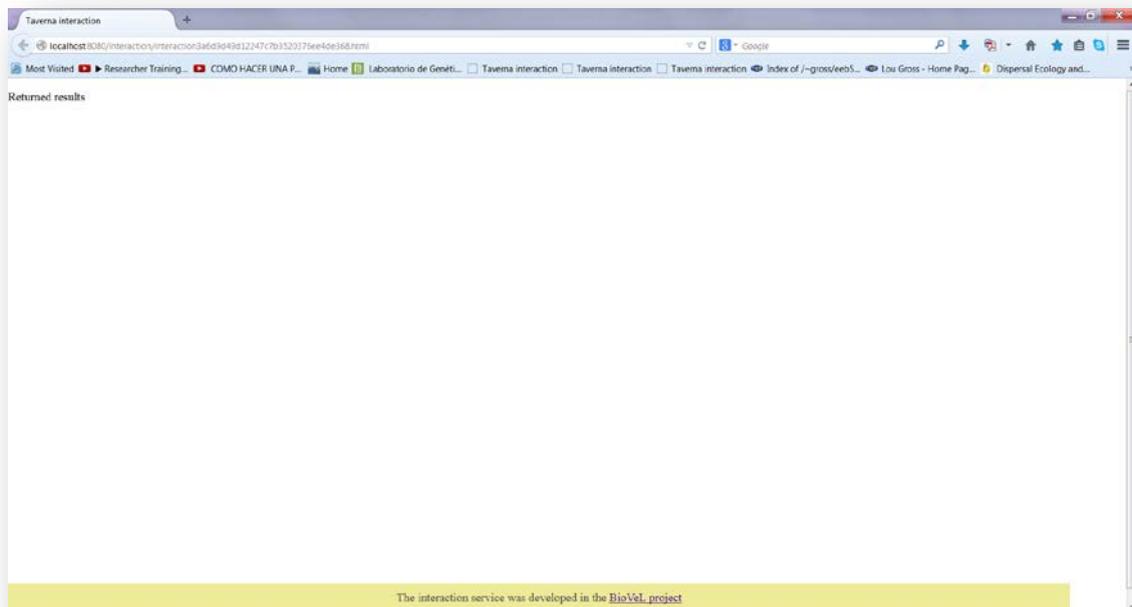


**Figure 8.** Places dialogue. The selected matrices appear. Repeat the procedure for each place.

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**Figure 9.** Places dialogue. Once all the matrices are submitted, click in Confirm.

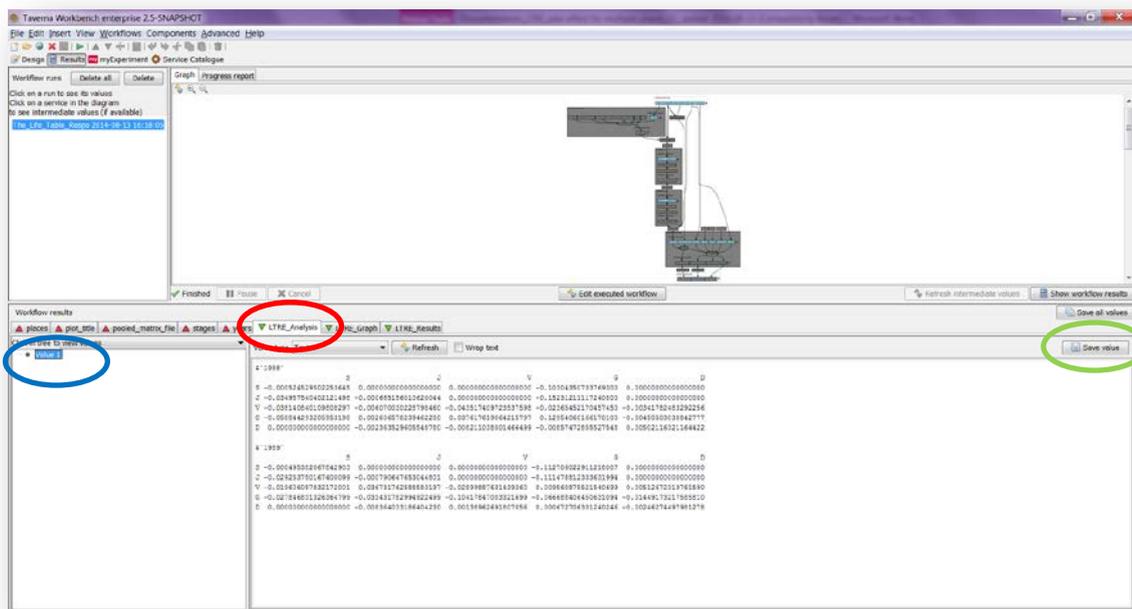


**Figure 10.** Places dialogue. After the user clicks Confirm, the confirmation “Matrices submitted” appears. Refer back to Taverna workbench.

## 5.4 Save data/results

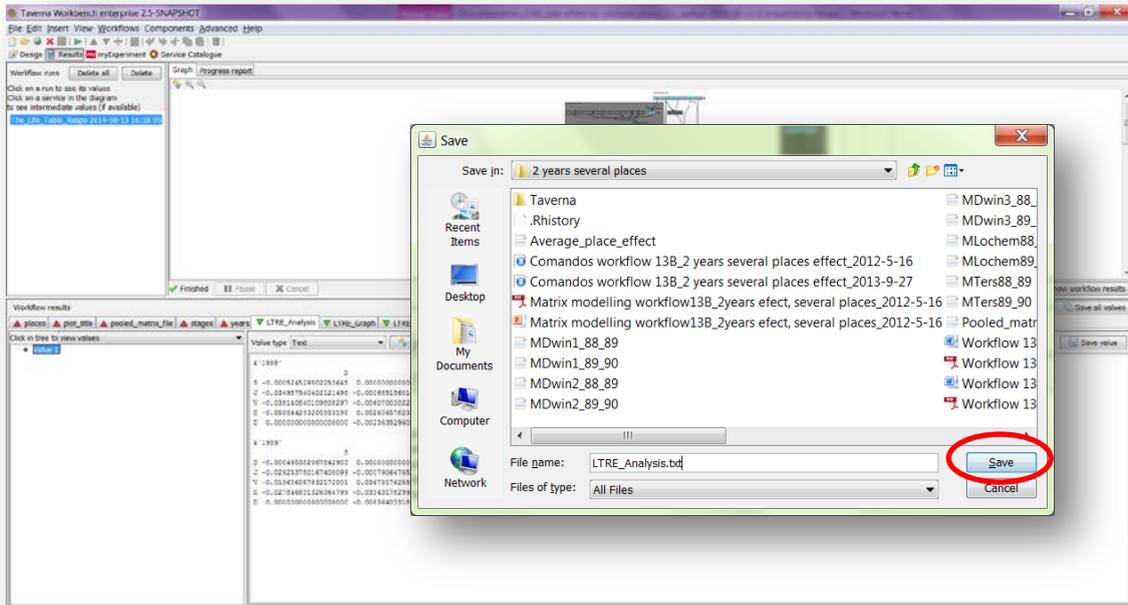
### 5.4.1 OUTPUTS

First, click in the selected result window e.g. **LTRE\_Analysis**. Second, click in the left window on value 1 and you will see the LTRE\_Analysis results in the right window. Third, on the right window click on save value (Fig 11). Fourth, name the file and determinate the extension file. For a text file: e.g. .csv or .txt. For images: .jpg or .png (Fig 11 and 12). Finally, save the file in the chosen map (Fig 12).



**Figure 11.** Taverna workbench results. When the analyses are completed, they appear on different windows under results in Taverna. **LTRE\_Analysis** window (red circle). Value 1 on the left window of the **LTRE\_Analysis** output results (blue circle). Save value on the right window of the **LTRE\_Analysis** output results (green circle).

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**Figure 12.** Name the file, adding the extension for the file. For a text file: e.g. .csv or .txt. For images: e.g.: .jpg or .png.

### ***LTRE fixed design year effect for multiple places***

1) ***LTRE\_Analysis***: Intermediary results showing the matrices calculated on the LTRE analysis per year. After this step the workflow sums up all the values per matrix giving us the final result: LTRE\_Results The csv file after apply text to columns (Fig 13).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	S '1988'																		
2		S	J	V	G	D													
3	S	-0,00052	0	0	-0,10304	0													
4	J	-0,03496	-0,00067	0	-0,15231	0													
5	V	-0,03814	-0,00607	-0,04352	-0,02365	-0,00342													
6	G	-0,05884	0,002607	0,037618	0,129541	-0,00451													
7	D	0	-0,00236	-0,00821	-0,00857	0,005021													
8																			
9	S '1989'																		
10		S	J	V	G	D													
11	S	-0,0005	0	0	-0,11271	0													
12	J	-0,02925	-0,00079	0	-0,11148	0													
13	V	-0,01961	0,036732	-0,026	0,009561	0,005127													
14	G	-0,02785	-0,03343	-0,10418	-0,06669	-0,01449													
15	D	0	-0,00836	0,00139	0,000673	-0,00246													
16																			
17																			
18																			
19																			
20																			
21																			
22																			
23																			
24																			
25																			
26																			

**Figure 13.** ***LTRE\_Analysis*** output file open in excel (.csv).

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2) **LTRE\_Graph**: Creates a histogram to display the LTRE\_Results (Fig 14). The year effect is shown in the Figure. In this example: The year 1989 had the largest negative effect on  $\lambda$ , and no year had a positive effect.

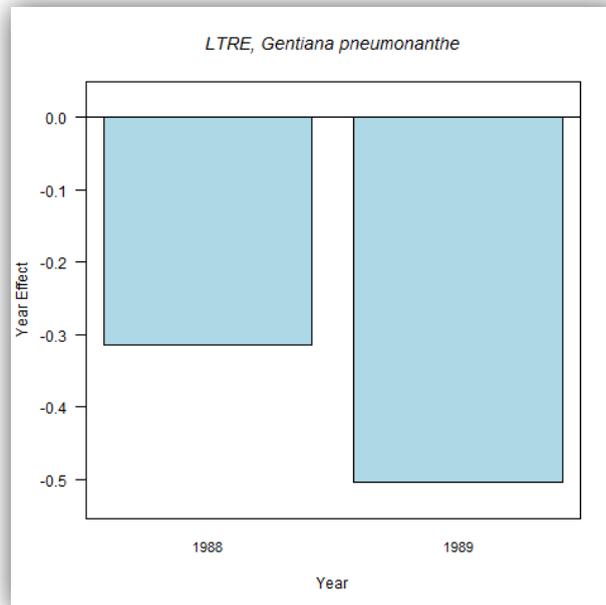


Figure 14. **LTRE\_Graph** opens as a coloured graph.

3) **LTRE\_Results**: The results of the LTRE per year. These are the generated values of the plotted LTRE graph. The csv file after apply text to columns (Fig 15).

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	1988	1989											
2	-0,31402	-0,50431											
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													

Figure 15. **LTRE\_Results** output file open in excel (.csv).

## 6 Support

For questions with using the workflow, please write [support @biovel.eu](mailto:support@biovel.eu)

For definitions of technical and biological terms, please visit the BioVeL glossary page:  
<https://wiki.biovel.eu/display/BioVeL/Glossary>

## 7 References

This workflow was created using and based on Package '*popbio*' in R. (Stubben & Milligan 2007; Stubben, Milligan & Nantel 2011).

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**Caswell, H.** 1996. Demography meets ecotoxicology: Untangling the population level effects of toxic substances. Pp. 255-292 in M. C. Newman and C. H. Jago, eds., *Ecotoxicology: A Hierarchical Treatment*. Lewis, Boca Raton, Fla.

**Caswell, H.** 2001. *Matrix population models: Construction, analysis and interpretation*, 2<sup>nd</sup> Edition. Sinauer Associates, Sunderland, Massachusetts.

**Horvitz, C.C. and D.W. Schemske.** 1995. Spatiotemporal Variation in Demographic Transitions of a Tropical Understory Herb: Projection Matrix Analysis. *Ecological Monographs*, 65:155-192

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**Oostermeijer J.G.B., M.L. Brugman, E.R. de Boer; H.C.M. Den Nijs.** 1996. Temporal and Spatial Variation in the Demography of *Gentiana pneumonanthe*, a Rare Perennial Herb. *The Journal of Ecology*, Vol. 84(2): 153-166.

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**Stubben, C., B. Milligan, P. Nantel.** 2011. Package '*popbio*'. Construction and analysis of matrix population models. Version 2.3.1

## 7.1 Acknowledgements

### 7.1.1 Authors

1. **Maria Paula Balcázar-Vargas** Instituut voor Biodiversiteit en Ecosysteem Dynamica (IBED), Universiteit van Amsterdam.
2. **Jonathan Giddy** Cardiff School of Computer Science and Informatics, Cardiff University, Cardiff CF24 3AA, United Kingdom.
3. **Francisco Quevedo** Cardiff School of Computer Science and Informatics, Cardiff University, Cardiff CF24 3AA, United Kingdom.
4. **J. Gerard B. Oostermeijer** Instituut voor Biodiversiteit en Ecosysteem Dynamica (IBED), Universiteit van Amsterdam.

### 7.1.2 Project funding

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## 7.2 Publications