Plant reintroduction: a glimmer of hope for the conservation of critically endangered species

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Botanic Garden Meise, Belgium

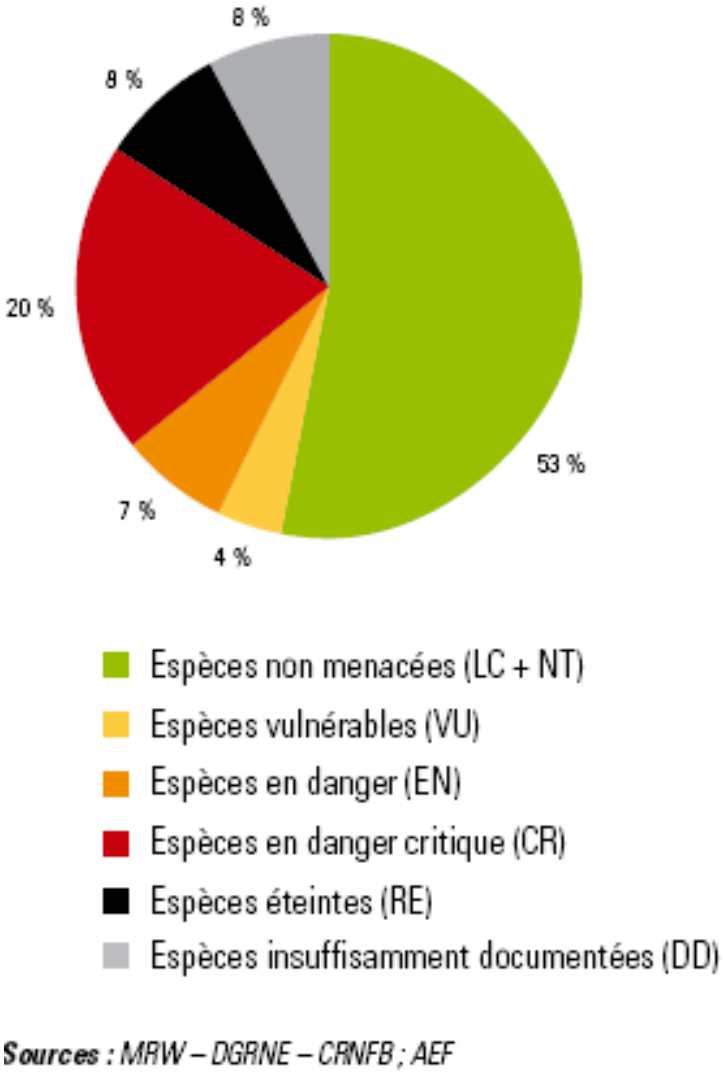
Introduction

Biodiversity policies contribute to the conservation of species and habitats

However ...

Species are still disappearing!

In the last 30-40 years, 56 and 115 plant species have disappeared from Flanders and Wallonia, respectively



***Sources** : MRW – DGRNE – CRNFB ; AEF*

In situ conservation alone is not 100% effective!

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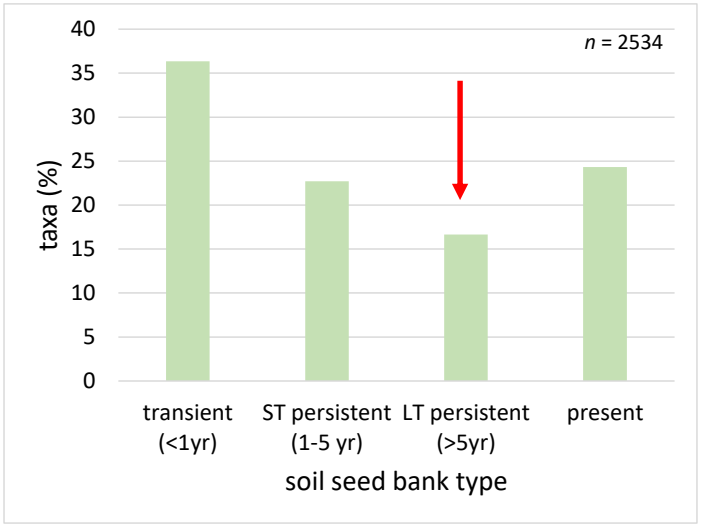
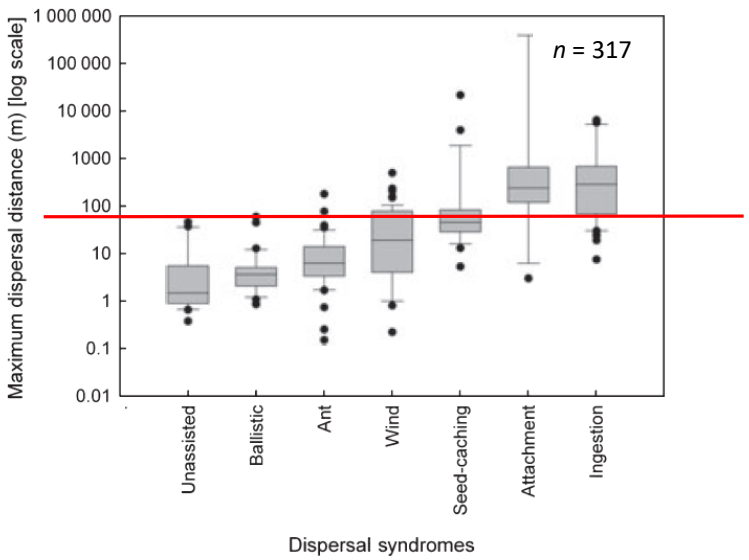
Introduction

Even if the habitats are restored:

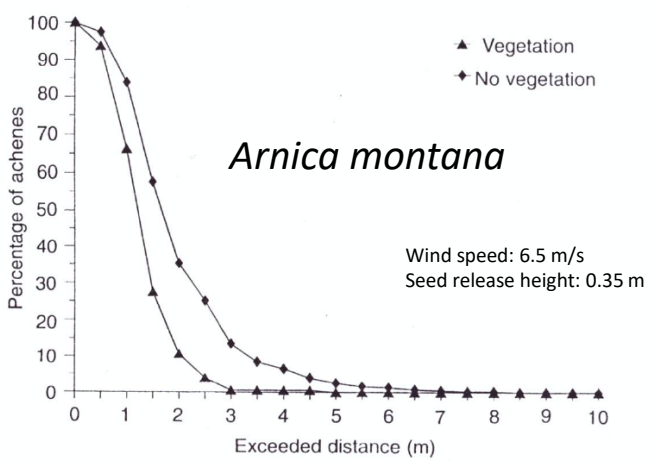
- Most targeted species will not spontaneously return in areas where they used to occur (transient seed bank, limited dispersal capacity)



Thompson et al. (1997) *The soil seed banks of North West Europe*



Thompson et al. (2011) *J. Ecol.*



Strykstra et al. (1998) *Acta Bot. Neerl.*

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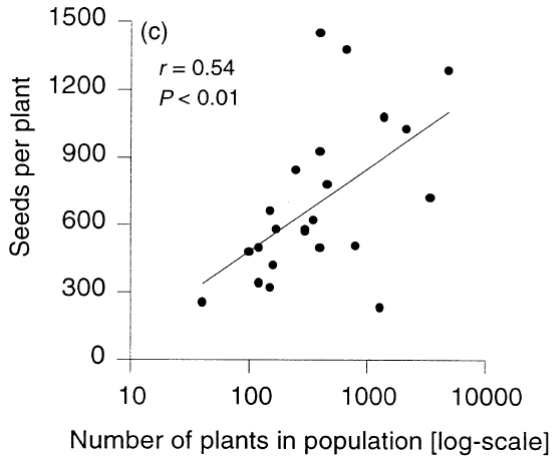
Introduction

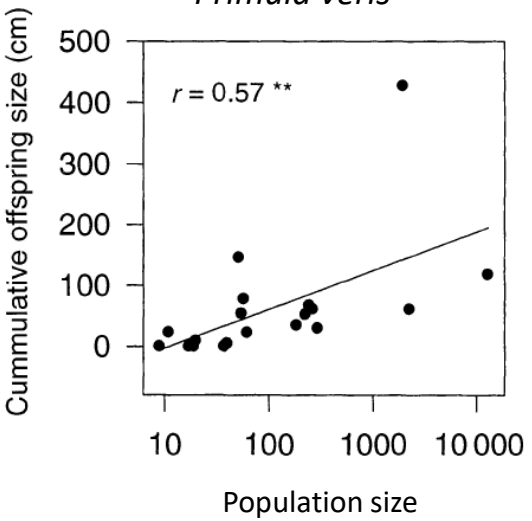
- Several species will not persist in the long run if their populations do not have a minimum viable size

Gentianella germanica



Fischer & Matthies (1998) *J. Ecol.*

Primula veris



Kéry et al. (2000) *J. Ecol.*

For these species, it may be necessary to:

- Increase the size of the remaining populations (reinforcement)
- Restore the extinct populations (reintroduction)

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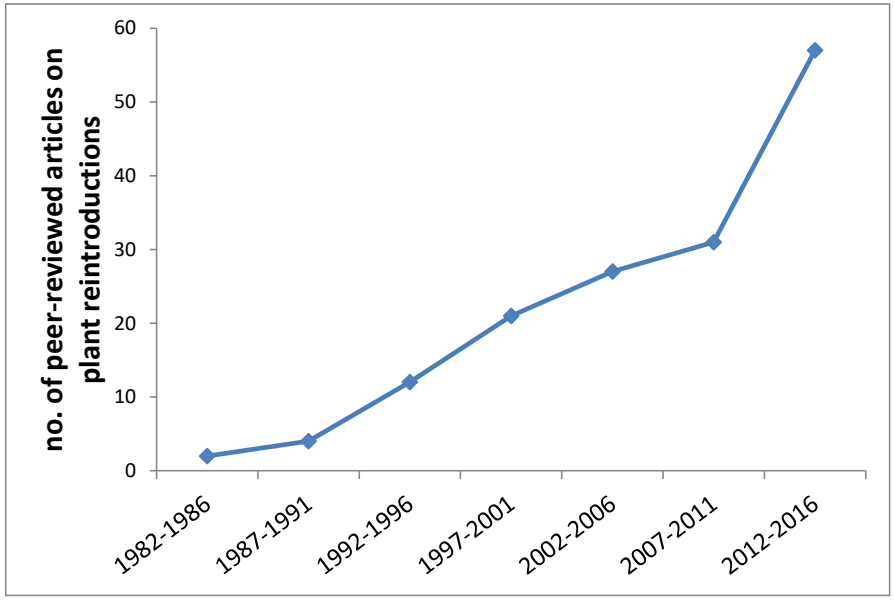
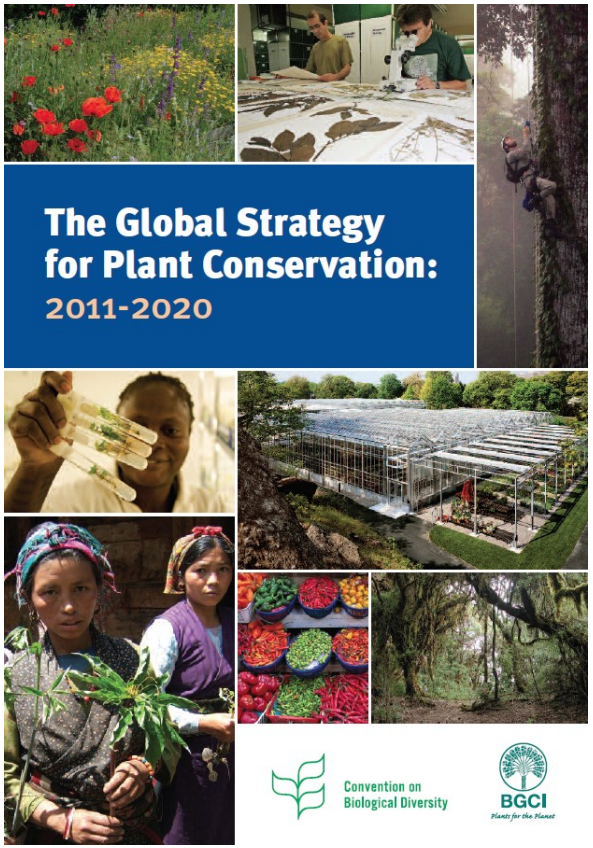
Introduction

- Species reintroduction has been more and more acknowledged in international treaties and legislations
- Consequently, it has become an increasingly used conservation approach worldwide



Source: Web of Science database, using the following query: (reintroduc* OR translocat* OR outplant* OR re-establish* OR transplant* OR reinforce*) AND plant



With grey literature included: at least 949 plant reintroductions (849 taxa) in 39 countries

Godefroid & Vanderborght (2011) *Biodivers. Conserv.*

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LIFE Project « Herbages » (LIFE+11NAT/BE/001060)

"Priority actions for grasslands and meadows in Lorraine and the Southern Ardenne"

- 7 yr project (2013 – 2019)
- 400 ha to be restored
- 11 habitats
- 3 partners: NGO, regional environmental administration, Botanic Garden Meise
- Funding: European Union LIFE programme (75%)

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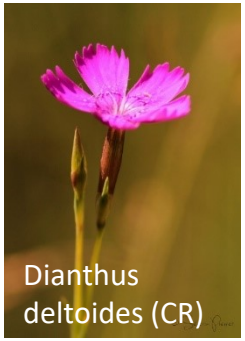
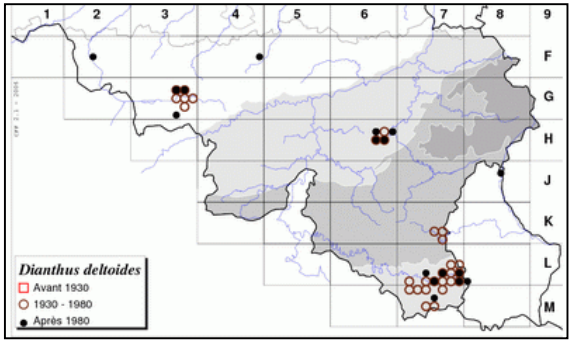
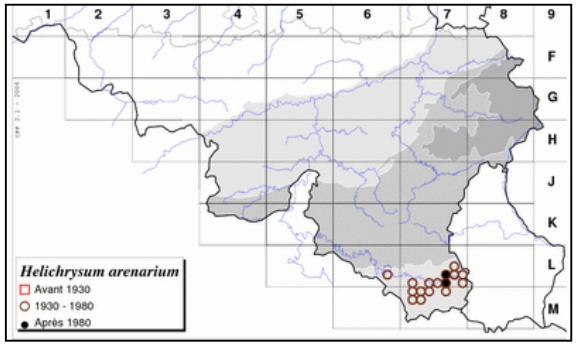
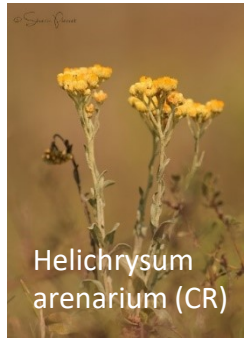
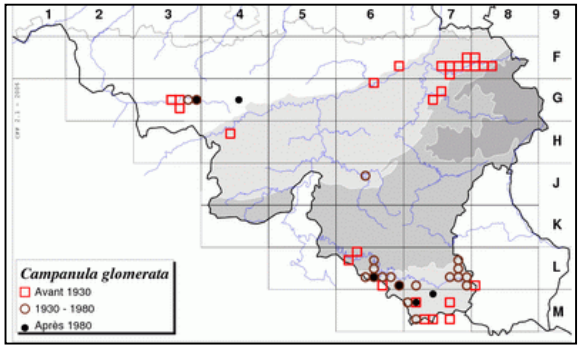
Target species for reintroductions/reinforcements

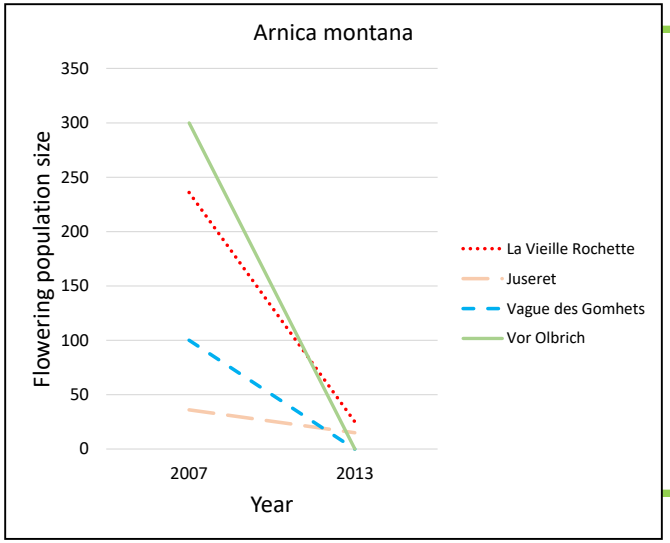


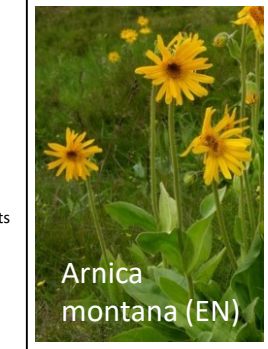












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Methods

1. Seed collection in source populations

- in similar habitats (geographically close to the target sites)
- 2-7 source populations/species
- 50-200 individuals and >5000 seeds/source population

2. Leaf sampling in source/target populations for estimating genetic diversity

- 1 young leaf / individual
- min. 30 individuals / source population

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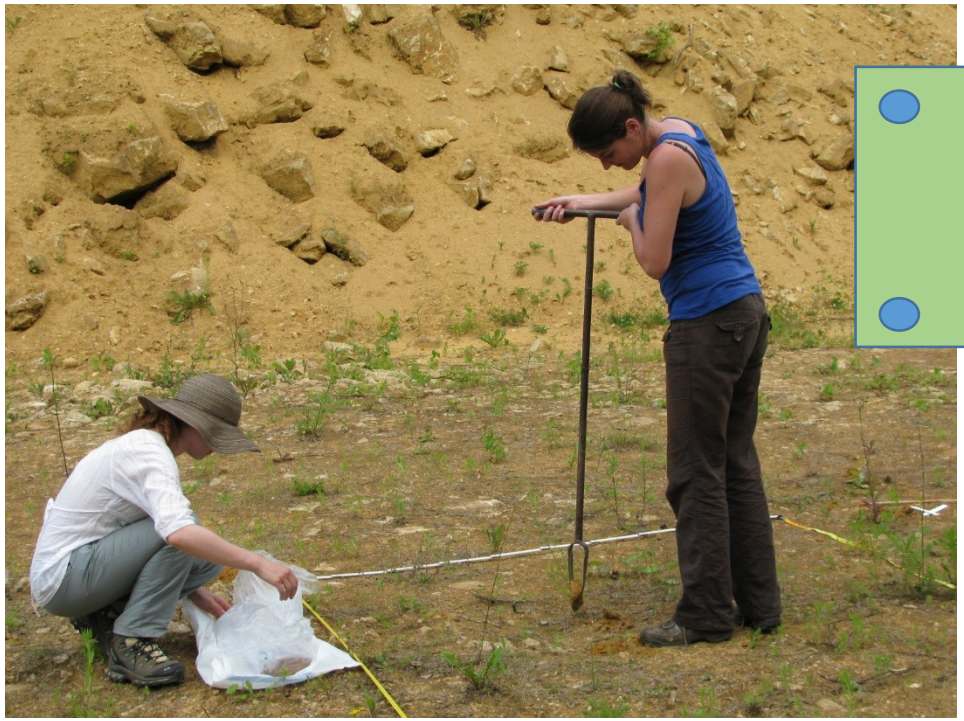
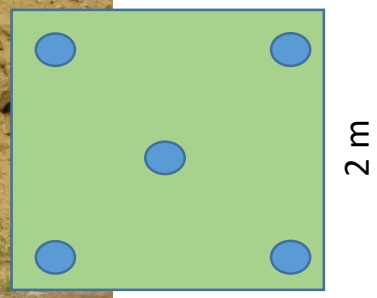
Methods

3. Study of the soil seed bank: soil sampling in target sites

- 5 soil cores in 2 plots (4m²) per site (2 depths: 0-5cm and 5-10cm)
- soils samples put in seed trays for direct germination in the greenhouse





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Methods

4. Plant propagation in the nursery

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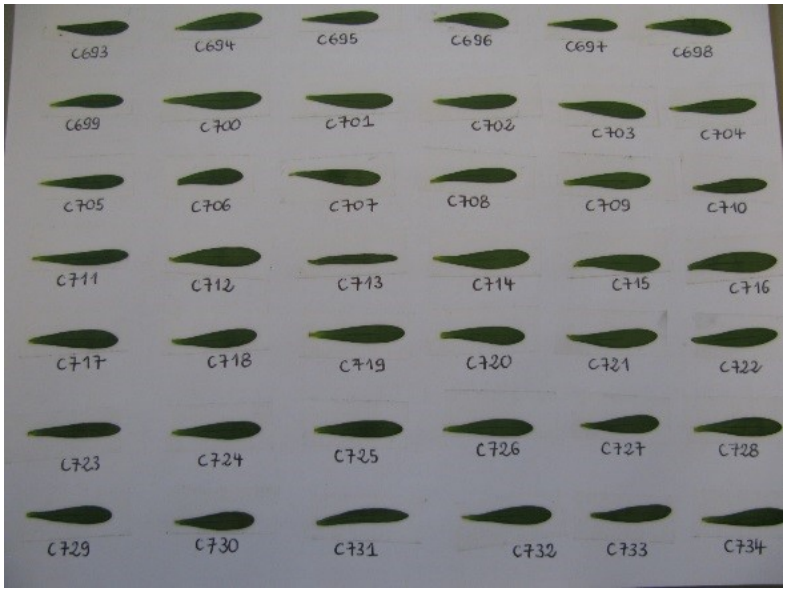
Methods

4. Plant propagation in the nursery

Monitoring of the vegetative growth (rosette diameter or length/width of the longest leaf, leaf area and shape): all individuals (2000 per target species)



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Methods

5. Transplantation into the target sites

- 3-6 target populations / species
- 500 to 700 individuals / target population

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Methods

5. Transplantation into the target sites

Mapping of each individual simultaneously with planting

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	V104		W229		M123		C281		V42		F176		M275	
2		M61		L63		V155		W20		M19		V230		V150
3	C176		V215		E16		M214		V212		V275		W172	
4		F99		M42		L16		V207		C92		M200		L51
5	V131		L221		M172		W216		V210		E126		M120	
6		M92		W28		V54		F52		M209		W199		V233
7	L200		V251		F130		M15		C279		V106		M184	
8		W82		M31		V7		V128		F143		M104		E173
9	V114		C204		M241		W51		V80		C241		M203	
10		M16		E105		V26		L76		M220		W224		V92
11	W102		V142		F160		M278		V252		V148		C197	
12		C64		M288		W17		V187		F44		M215		L151

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Methods

6. Monitoring of the transplanted populations

Floral display (number of flowering stalks and flower heads per stalk)

Vegetative growth (rosette diameter)

Reproductive success: Sampling of closed ripe fruits or fruiting heads for estimating seed production and quality (aborted and viable seeds)

Methods

7. Monitoring of the transplanted populations: recruitment

Estimating population extension by clonal propagation and/or seedling recruitment:

- Counting total number of recruits or
- 80 permanent quadrats of 20 x 20 cm / population (*Helichrysum arenarium*)
- Pictures are imported into ImageJ to count the number of ramets (rosettes)
- Population extent (area) is also measured

Results

9100 transplants
17 populations

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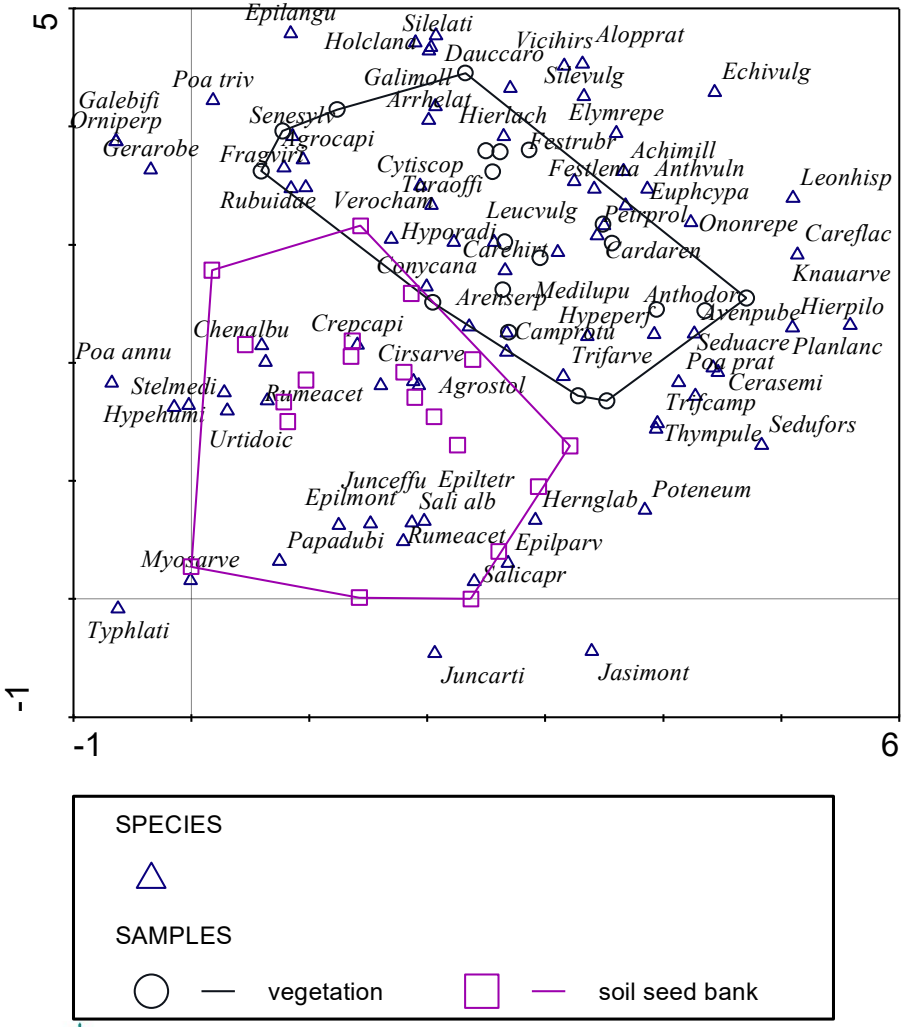
Results

1. Soil seed bank



Most frequent species	%
Arenaria serpyllifolia	60
Epilobium montanum	55
Betula pendula	50
Salix alba	45
Urtica doica	40
Agrostis stolonifera	35
Conyza canadensis	35
Juncus effusus	35
Rumex acetosella	35

Godefroid et al. (2018) *Rest. Ecol.*

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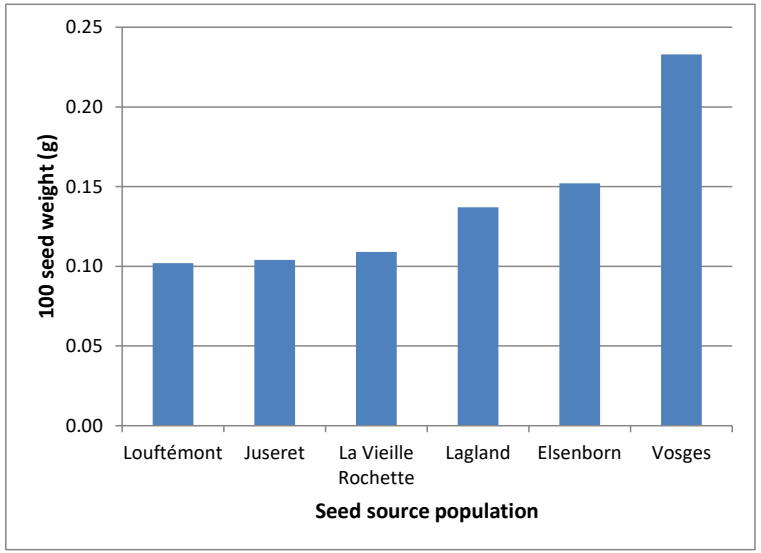
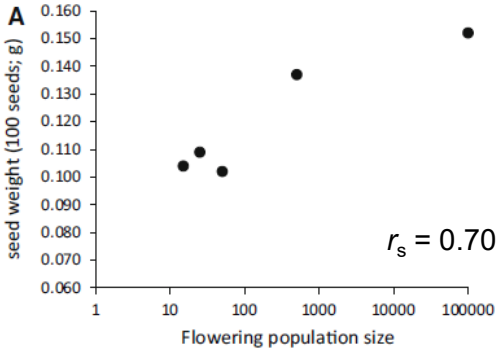
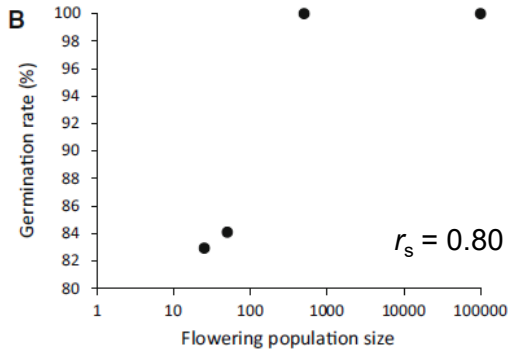
Results

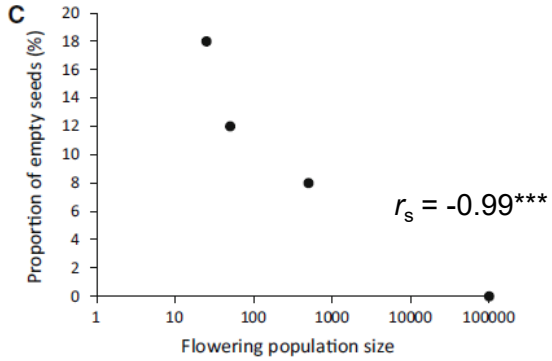
2. Seed quality

Arnica montana









Godefroid et al. (2016) *Plant Ecol.*

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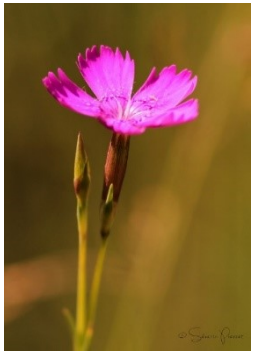
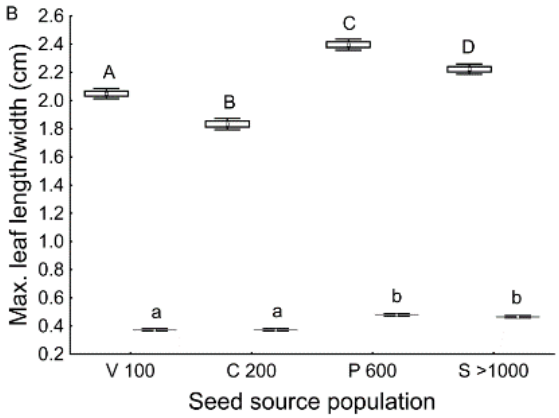
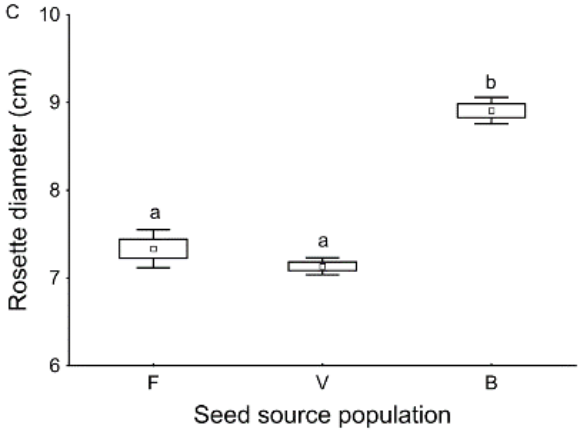
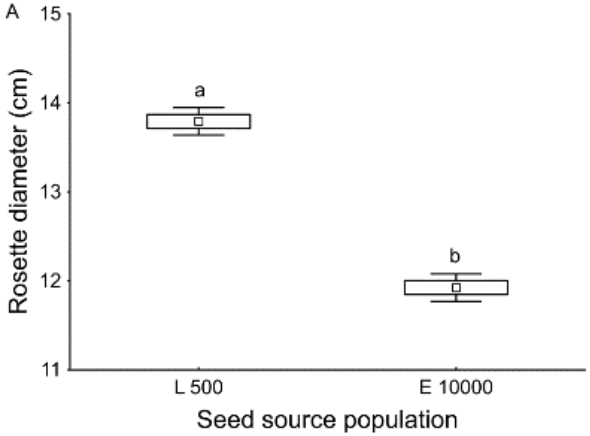
Results

3. Vegetative growth BEFORE transplantation









Godefroid et al. (2016) *Plant Ecol.*

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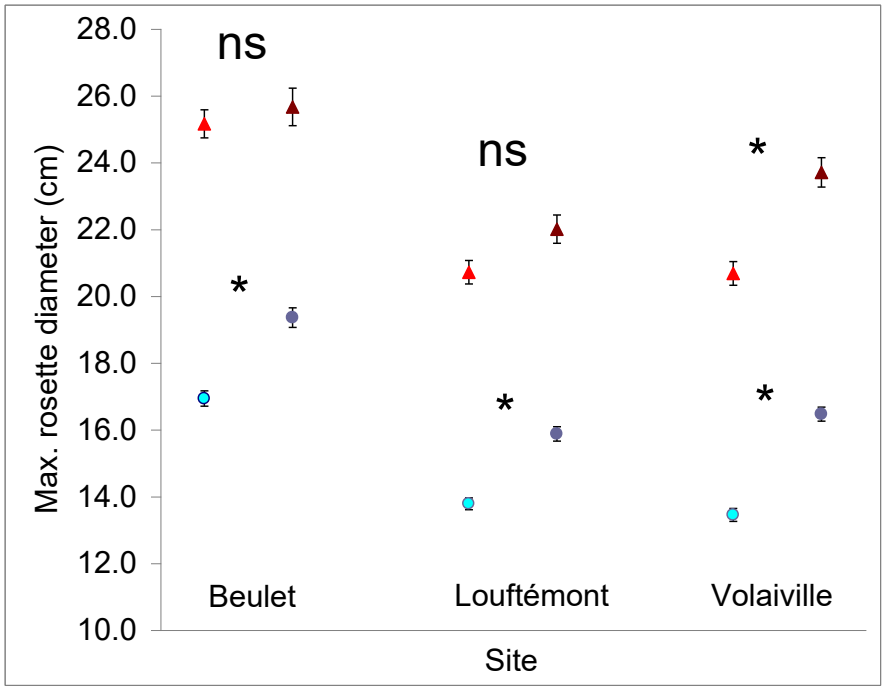
Results

3. Vegetative growth AFTER transplantation



2016
- L
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2015
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Arnica montana

Outplanting date:
October 2014

June 2015

June 2016

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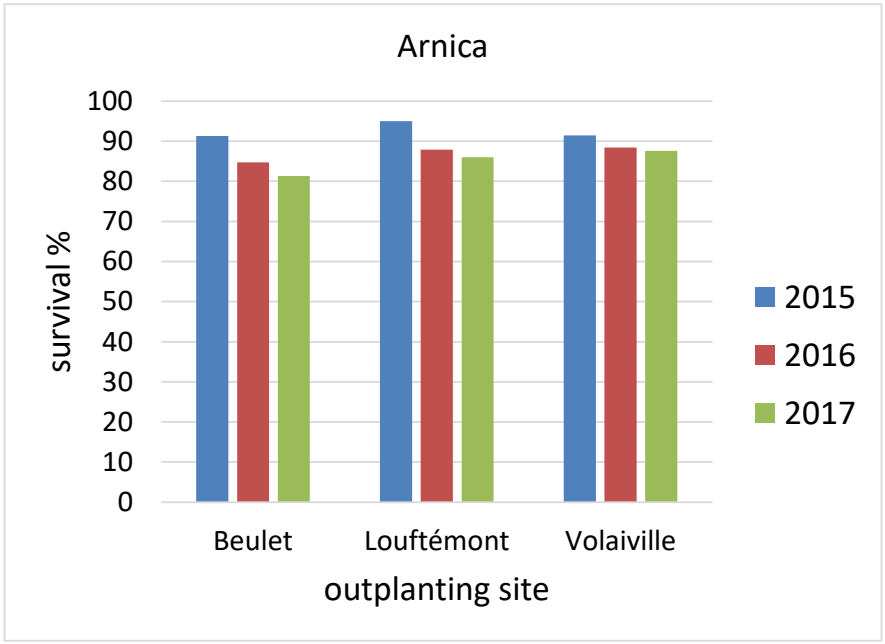
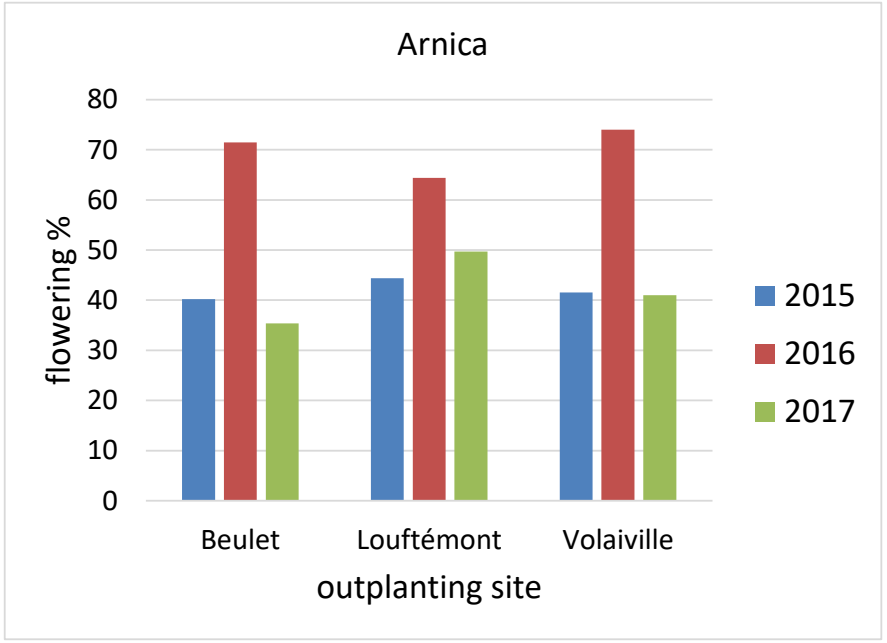
Results

4. Survival and flowering

Arnica montana

Outplanting date: October 2014





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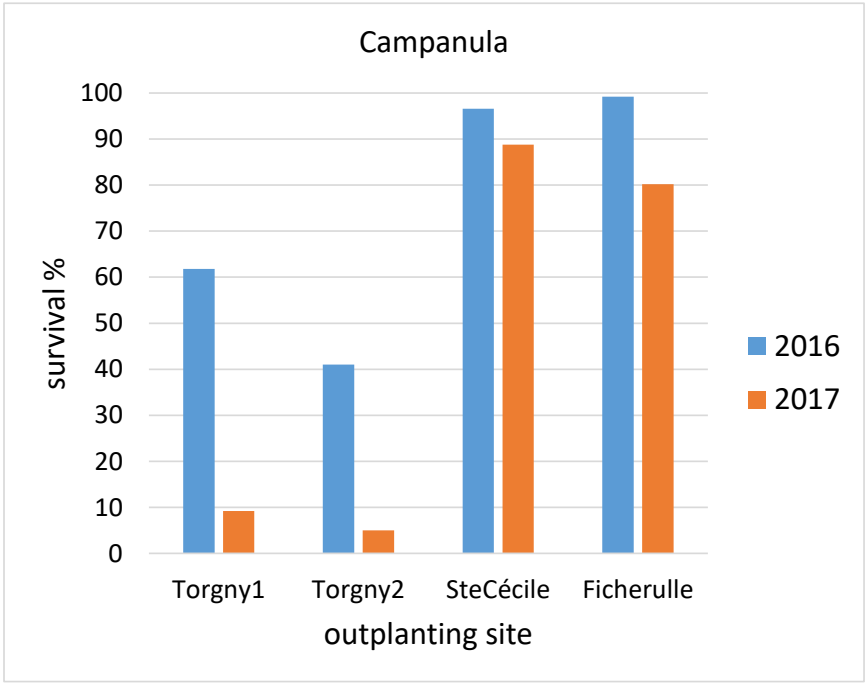
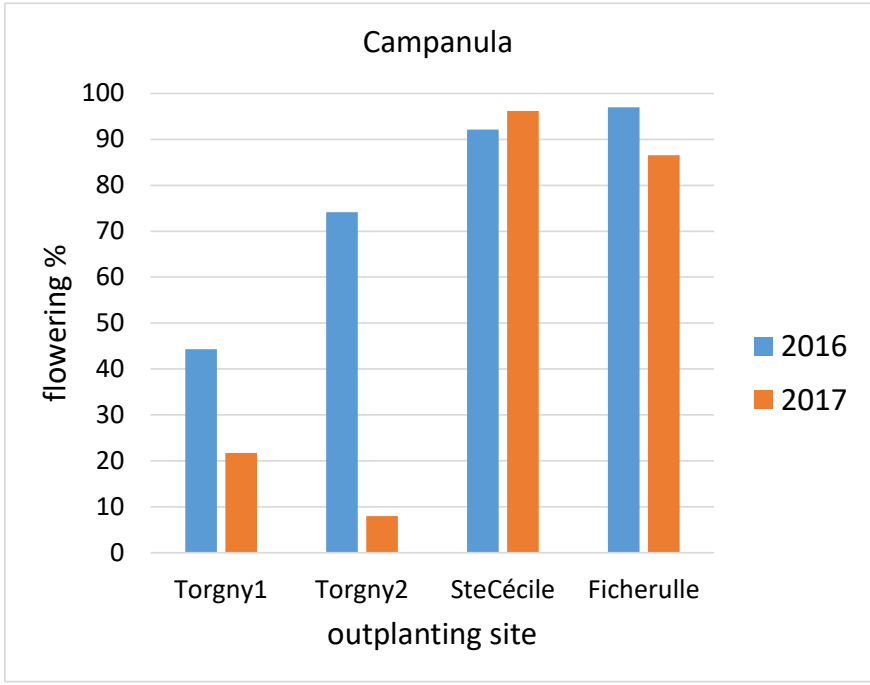
Results

4. Survival and flowering

Campanula glomerata

Outplanting date: September 2015





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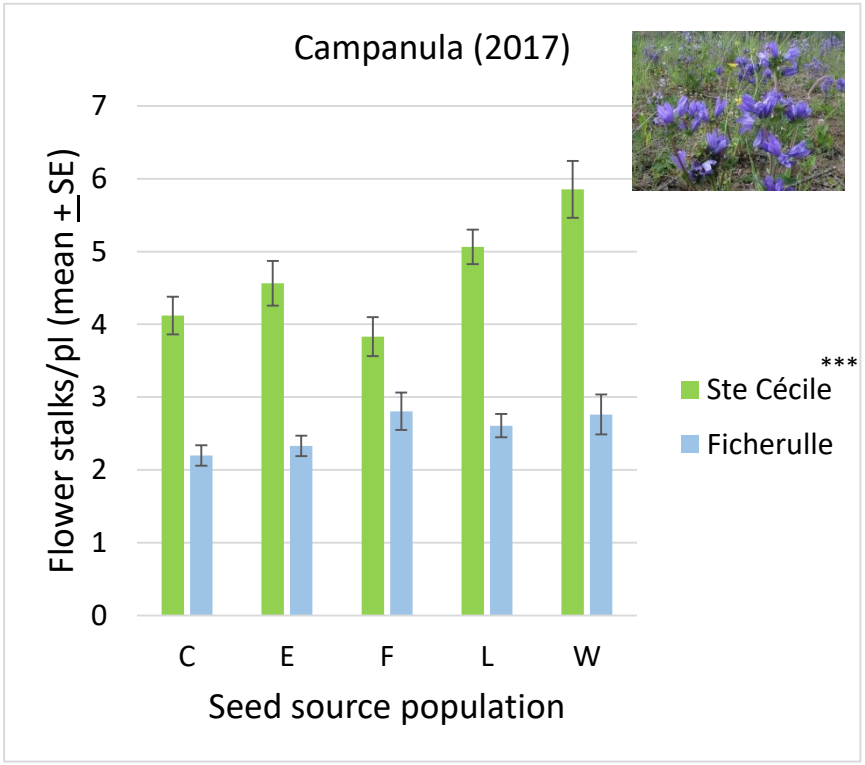
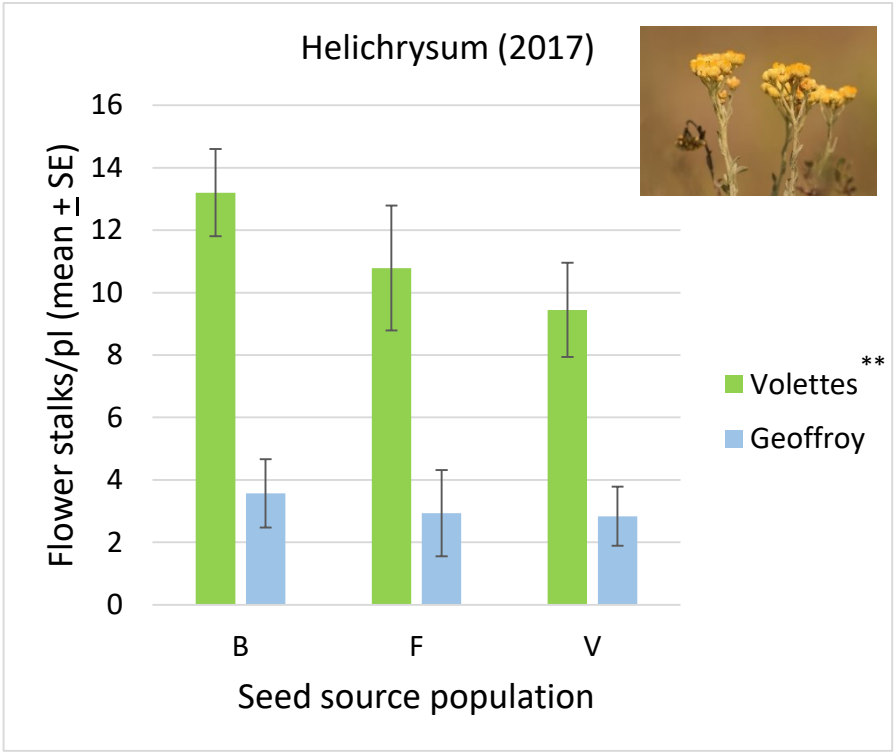
Results

5. Floral production





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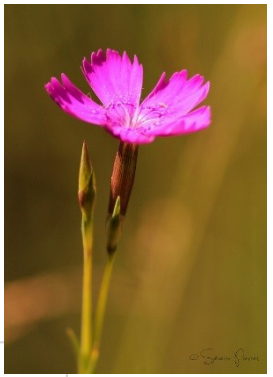
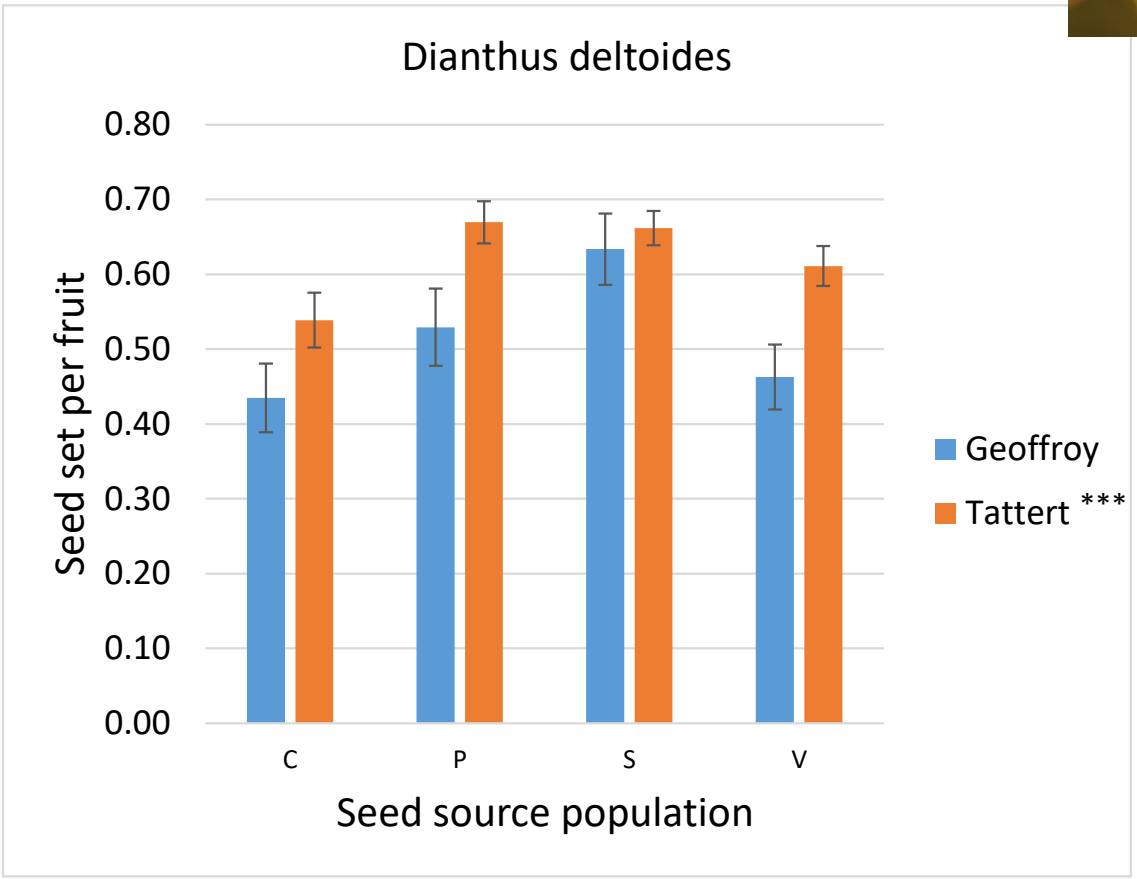
Results

6. Reproductive success



At the end of the first vegetation season



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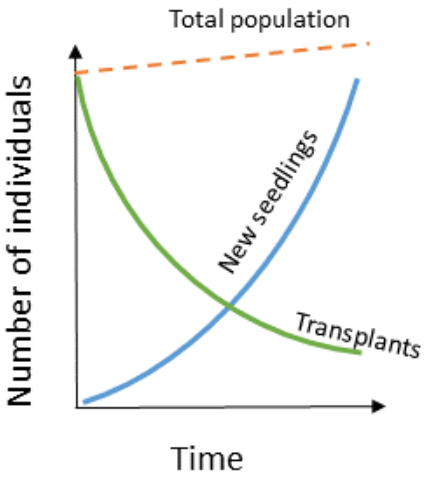
Results

7. Recruitment

Species	total number of new individuals
Dianthus deltoides	316
Campanula glomerata	734
Arnica montana	1782
Helichrysum arenarium	1803



- Seedlings are produced (+ clonal propagation for *Helichrysum*)
- New seedlings also start to colonize the surrounding area with new plants up to 18 m from the planting area (*Helichrysum)*
- A demographic dynamics is ongoing
- The transplanted individuals that will die in the future can be replaced by new plants

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Conclusions

- Soil seed bank: the typical grassland specialists are missing from the seed bank → a successful grassland restoration requires to artificially introduce seeds of target specialist species

- Seed quality may be reduced in small populations: important factor to consider for optimizing the selection of seed source populations

- Differences in plant size have been detected according to the origin of the seeds (but the differences decreased after 2 years) , suggesting maternal effects, some local adaptation and/or local genetic drift effects

- Differences in reproductive performances between sites and seed origin: important to verify in the future how the choice of the source populations and target sites might impact transplanted population dynamics

Acknowledgements

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