Differential impact of climate change on seed characteristics of poor and good colonizing forest herbs?

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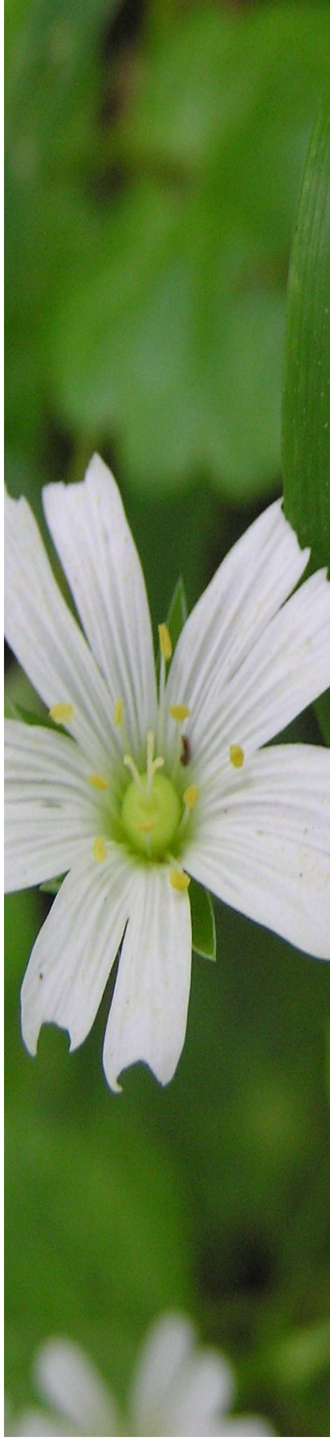
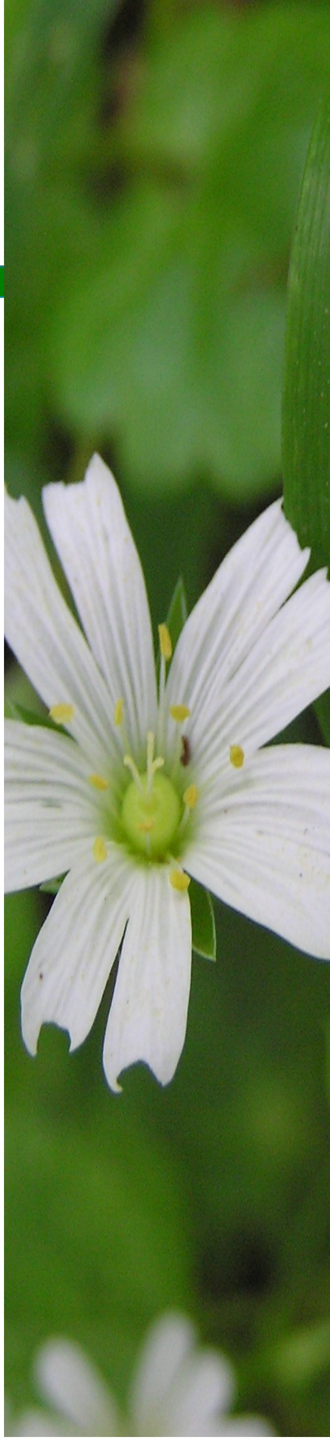
Approx. 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global temp. exceed 1.5-2.5°C (IPCC 2007)

What about forest plants?



Introduction

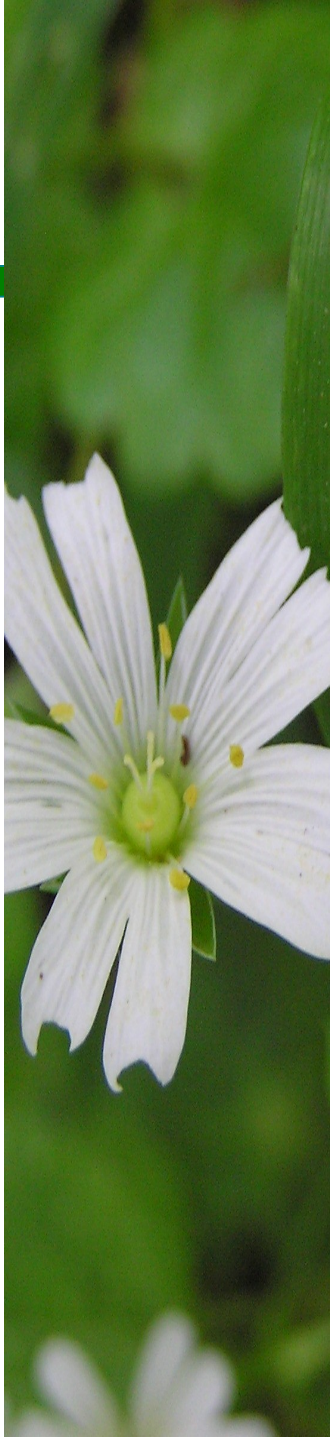
- Hermy *et al*. (1999) estimated that ~30 % of the European forest flora can be considered as ‘ancient forest species’.
- Due to their very low capacity of colonizing newly available habitats, ancient forest species are probably very vulnerable to climate change.



Introduction

- However, vulnerability assessments are complicated by the fact that ***colonisation rates may change*** in response to climate change as well.
- For ancient forest species, it has been shown that low colonisation rates are, among other factors, caused by:
  - Dispersal limitation
  - Long generation times*
  - Low recruitment rates*

*: likely to be affected by climate change



Overarching Objective

To determine if and to what extent the demography and colonisation rates of (ancient) forest plants will be affected by climate change

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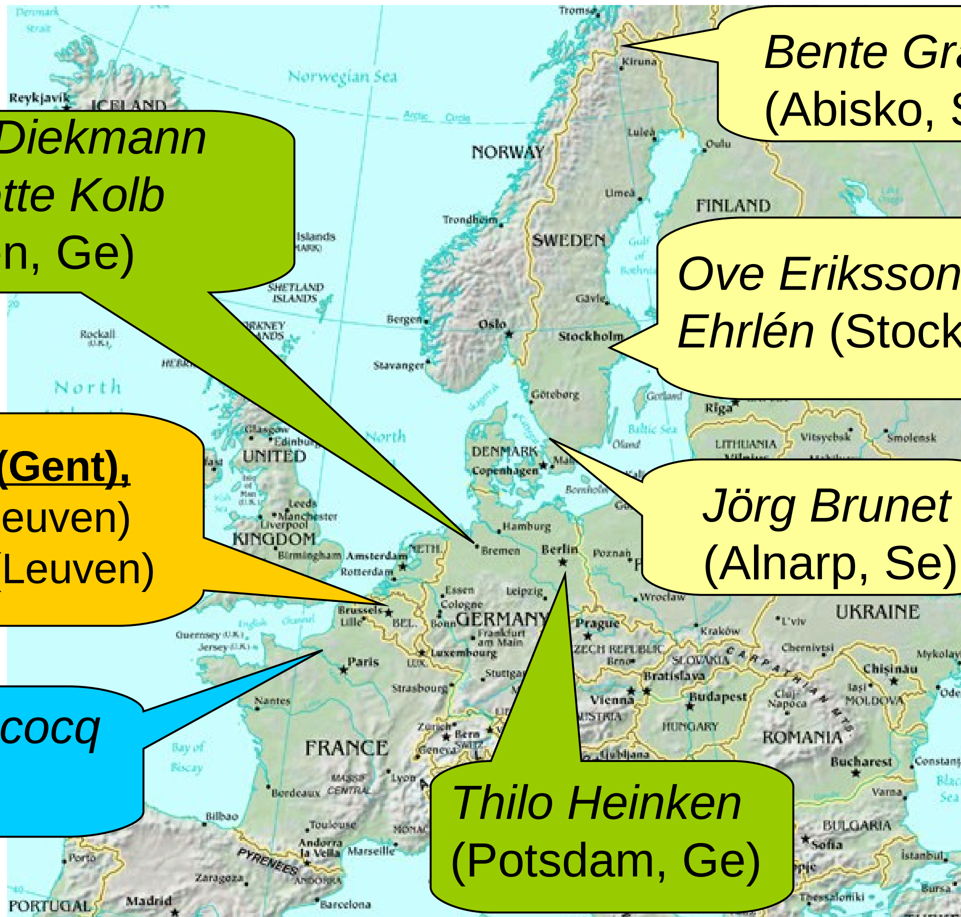
FWO Scientific Research Community (2007-2011)

‘Dynamics of forest plant populations in a changing environment’



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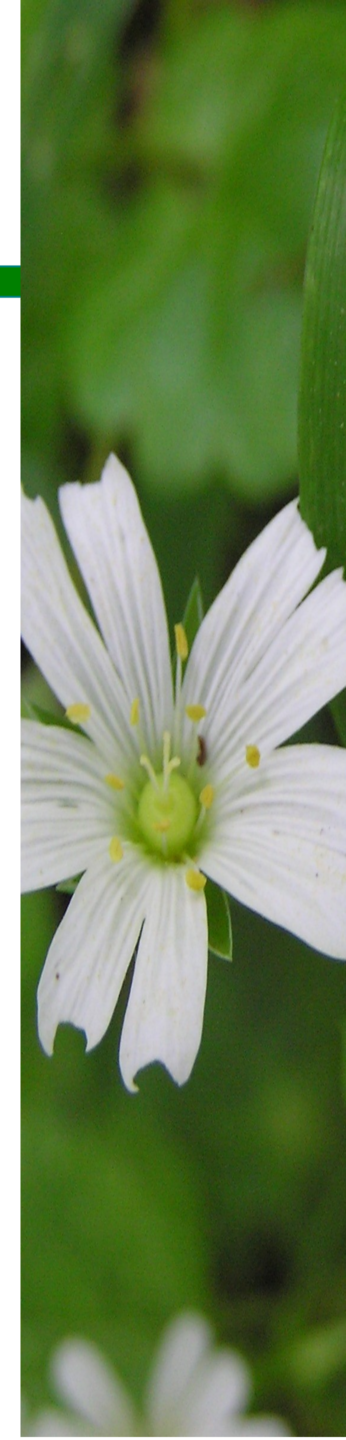
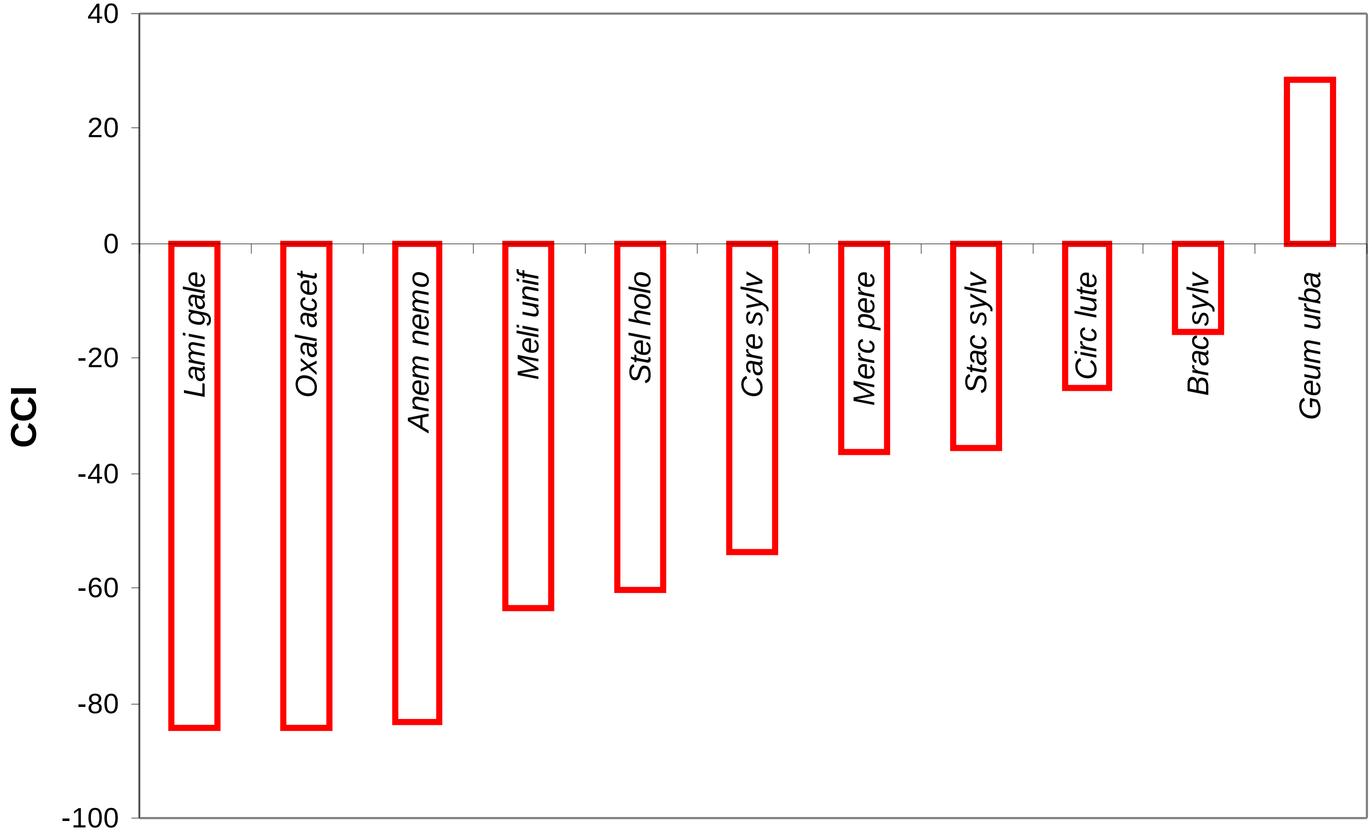


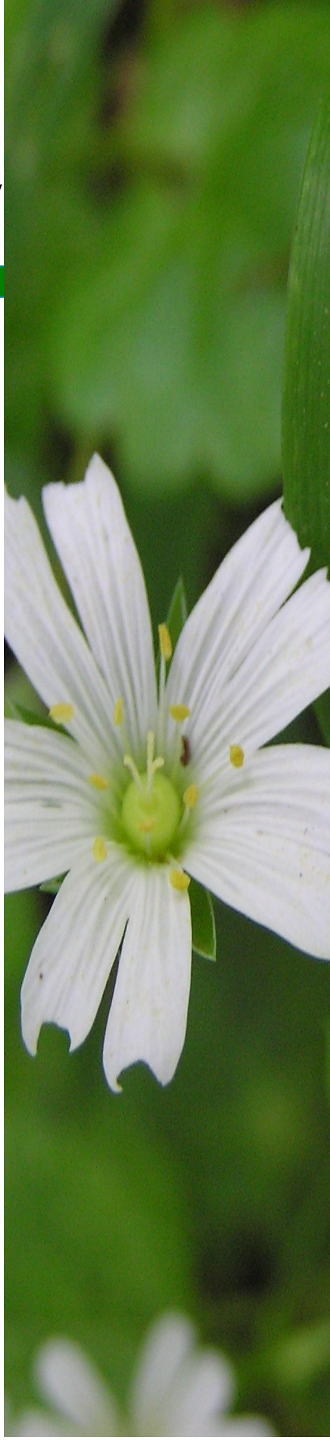
Objectives of this study

- In 2005, a preliminar study was set-up to explore how seed characteristics and germination rates change along a 1500 km latitudinal gradient from northern France to mid Sweden.
- Specific research questions were:
  - Does seed quality, measured as seed mass and germinability, increase with warmer climate?
  - Will we expect climate change to affect species with different colonisation abilities differently?

Selection of 11 typical forest herbs differing in their colonisation capacity



Updated 'Colonization Capacity Index' according to Verheyen et al. *J. Ecol* 91: 563-577



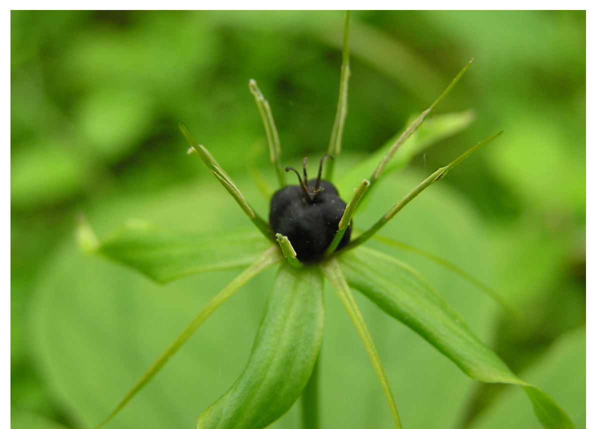
Anemone nemorosa

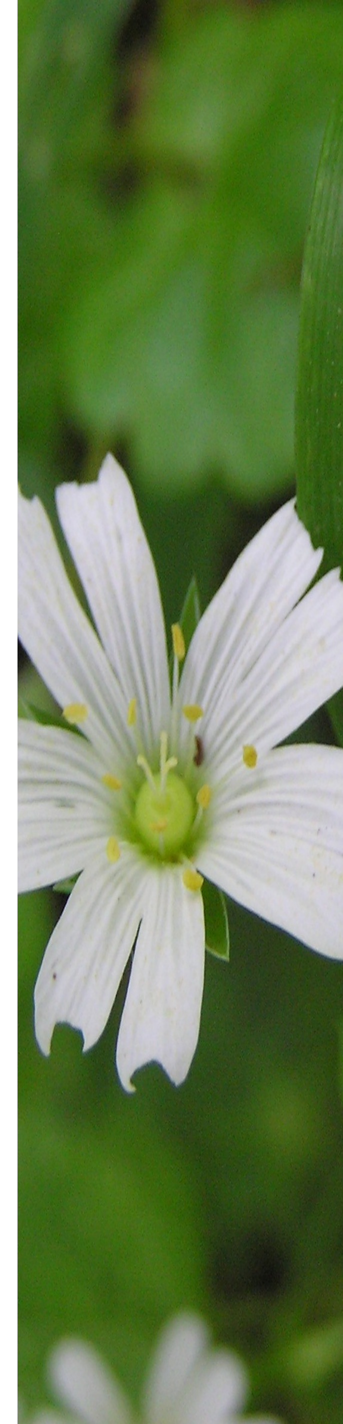
Stellaria holostea

Carex sylvatica

Lamium galeobdolon

Paris quadrifolia





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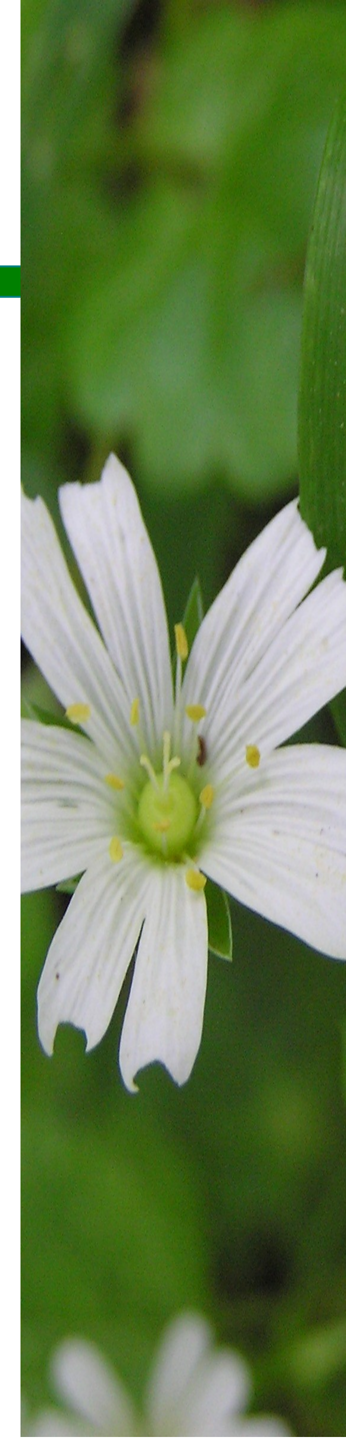
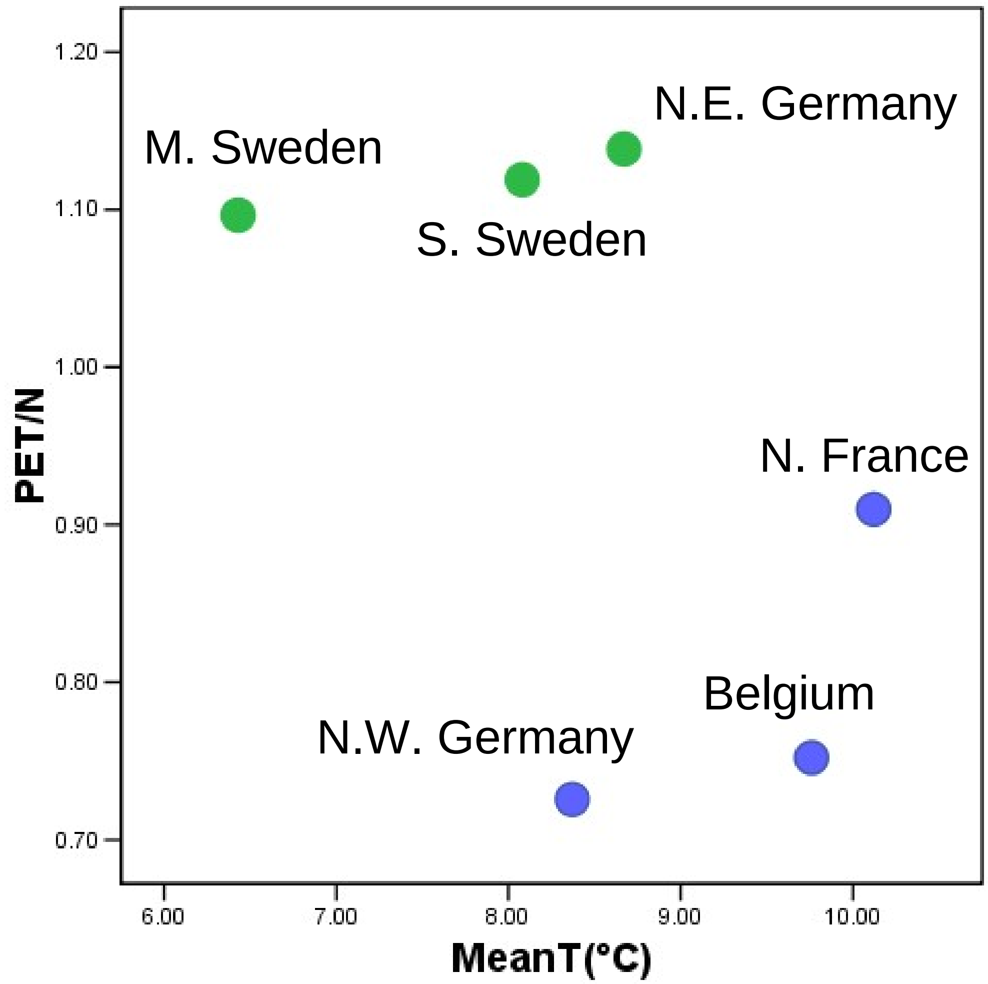
Seed collection at six locations



Climate types



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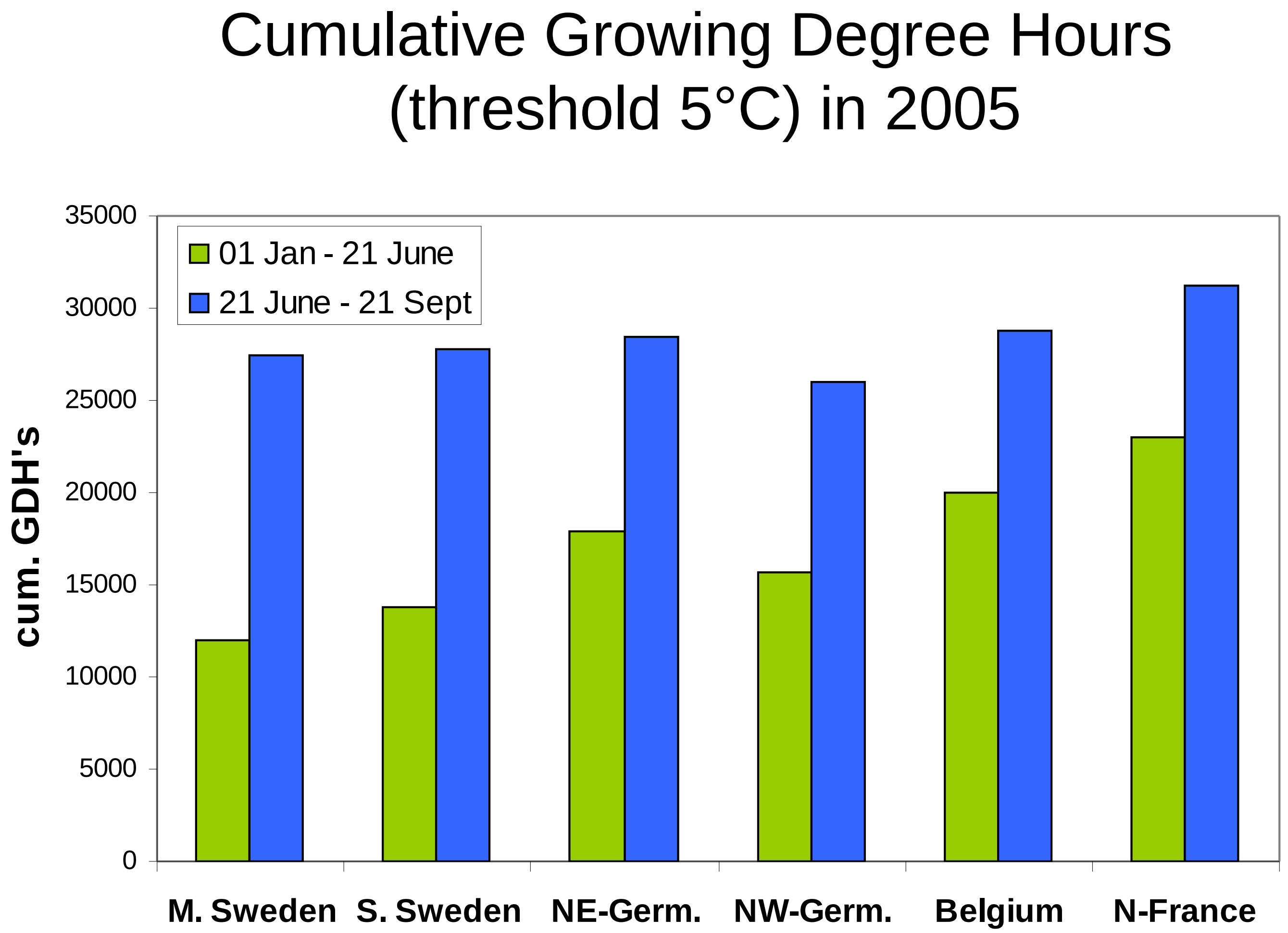
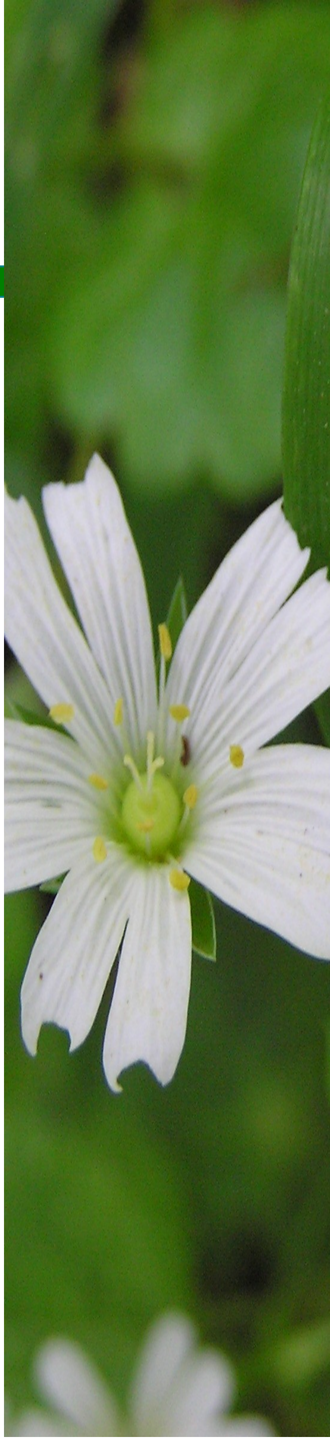
Growing Degree Hours





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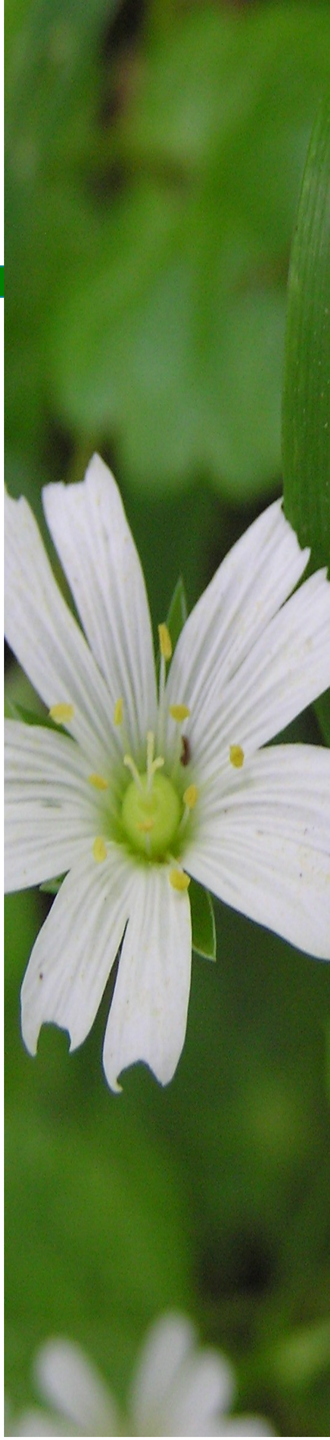
Response variables

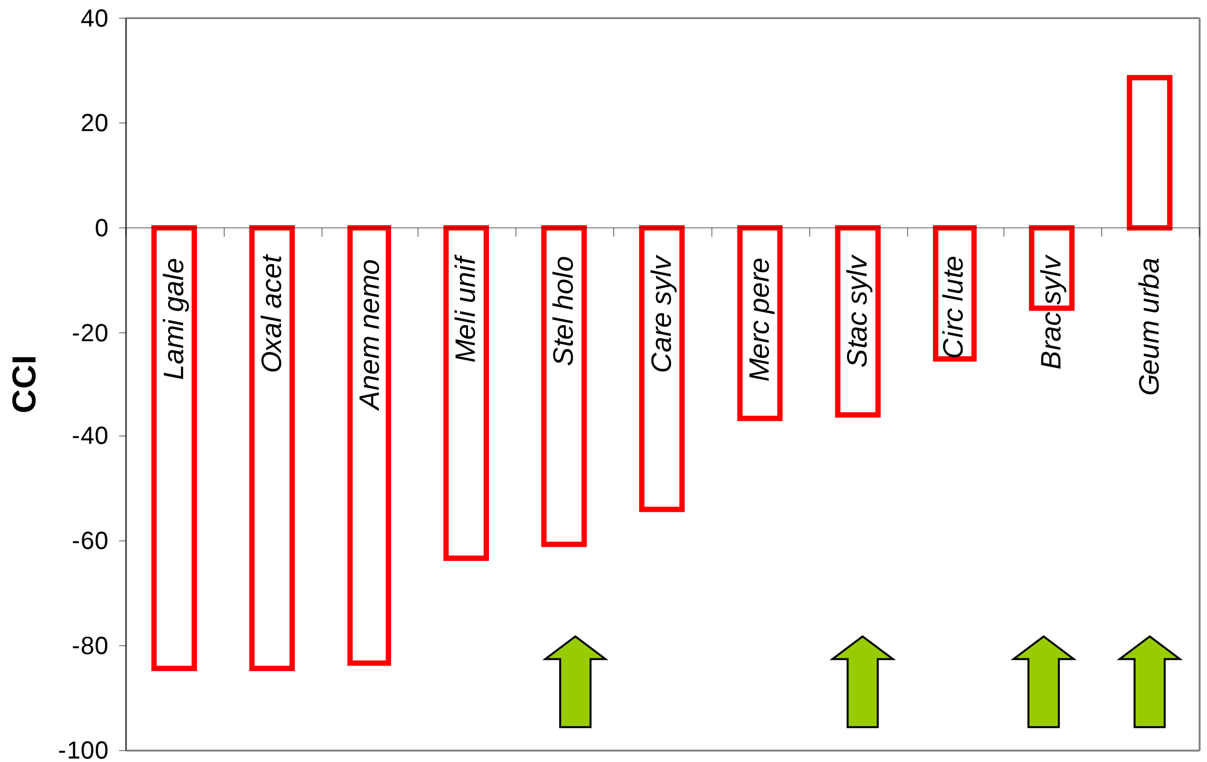
- Seed weights

- Germination % under two treatments:
  - Warm$_{(20°C/10°C)}$ + Cold$_{(2°C)}$ + Warm$_{(20°C/10°C)}$
  - Cold$_{(2°C)}$ + Warm$_{(20°C/10°C)}$

Differentiation between non-dormant (i.e. immediately germinating) and dormant species

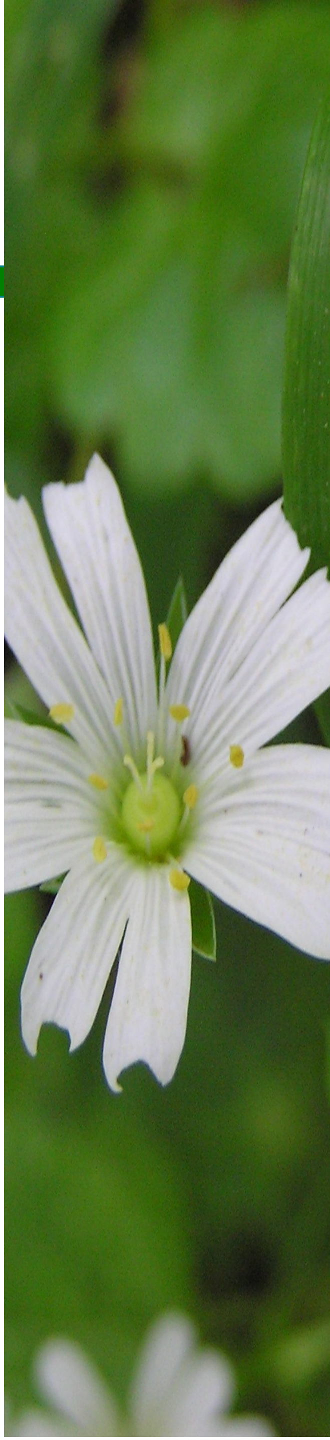


Dormancy?



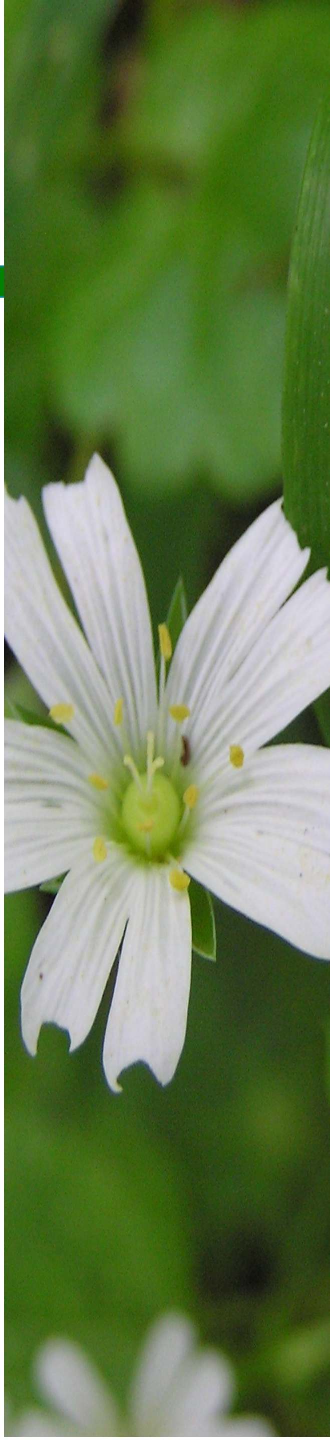
Seven dormant species and ***four***, mostly good colonizing species, which more or less germinate immediately

(cf. Verheyen et al. *J. Ecol* 91: 563-577)

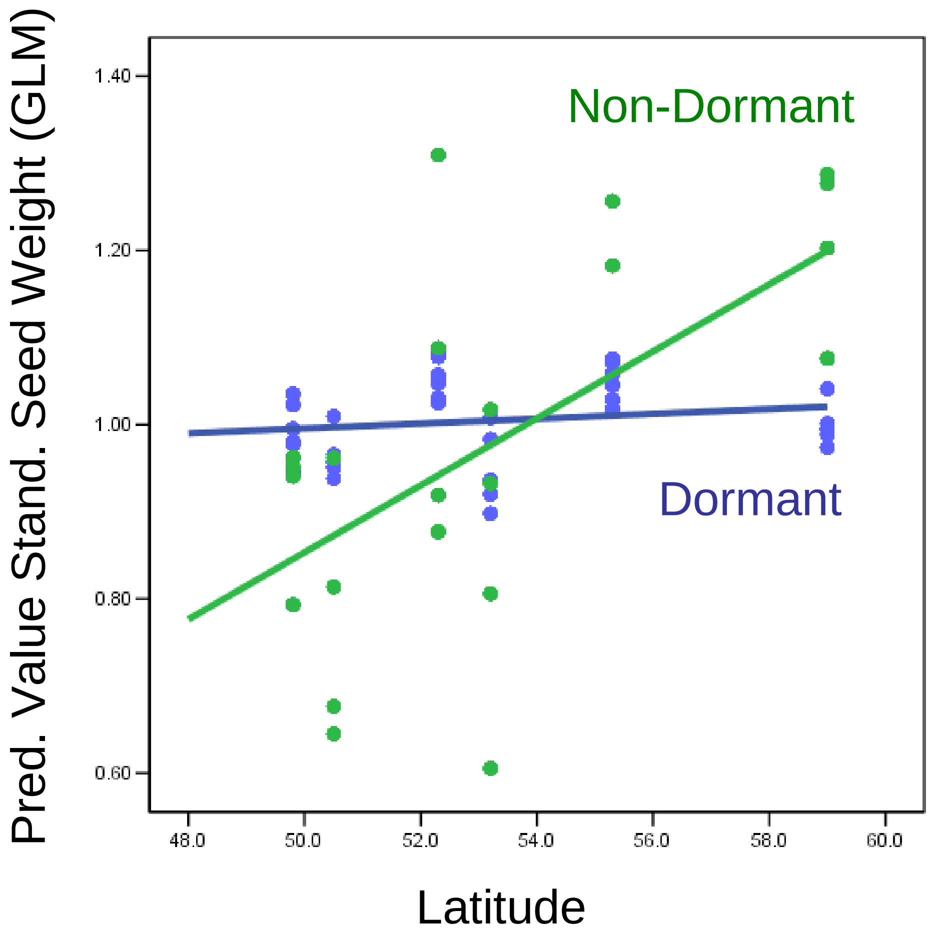


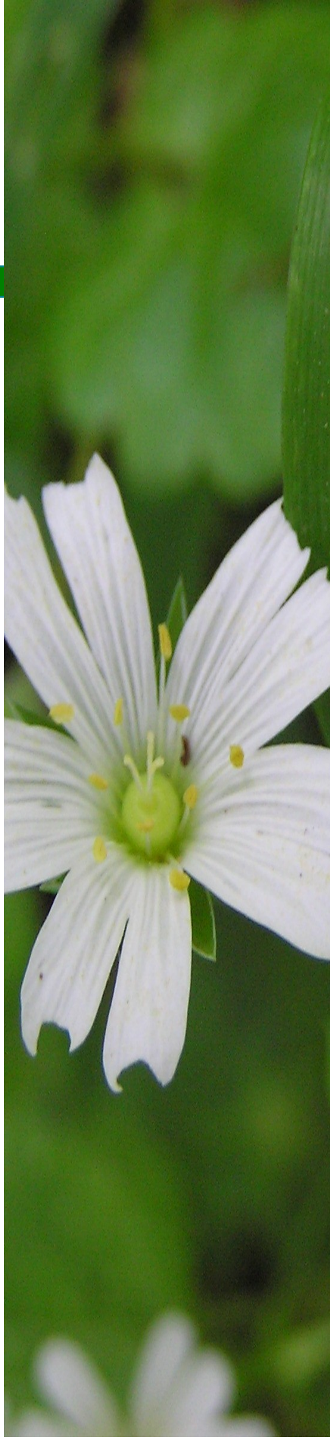
Effects on Seed Weight (GLM)

Variable	**Significance**
Latitude (covariate)	$p < 0.001$
Stand. GDH (covariate)	$p < 0.001$
Climate (random factor, 2 levels)	ns
Dormancy type (random factor, 2 levels)	$p < 0.001$
Dormancy type x Latitude	$p < 0.001$
Dormancy type x GDH	$p < 0.001$
Dormancy type x Climate	$p = 0.077$



Dormancy type x Latitude





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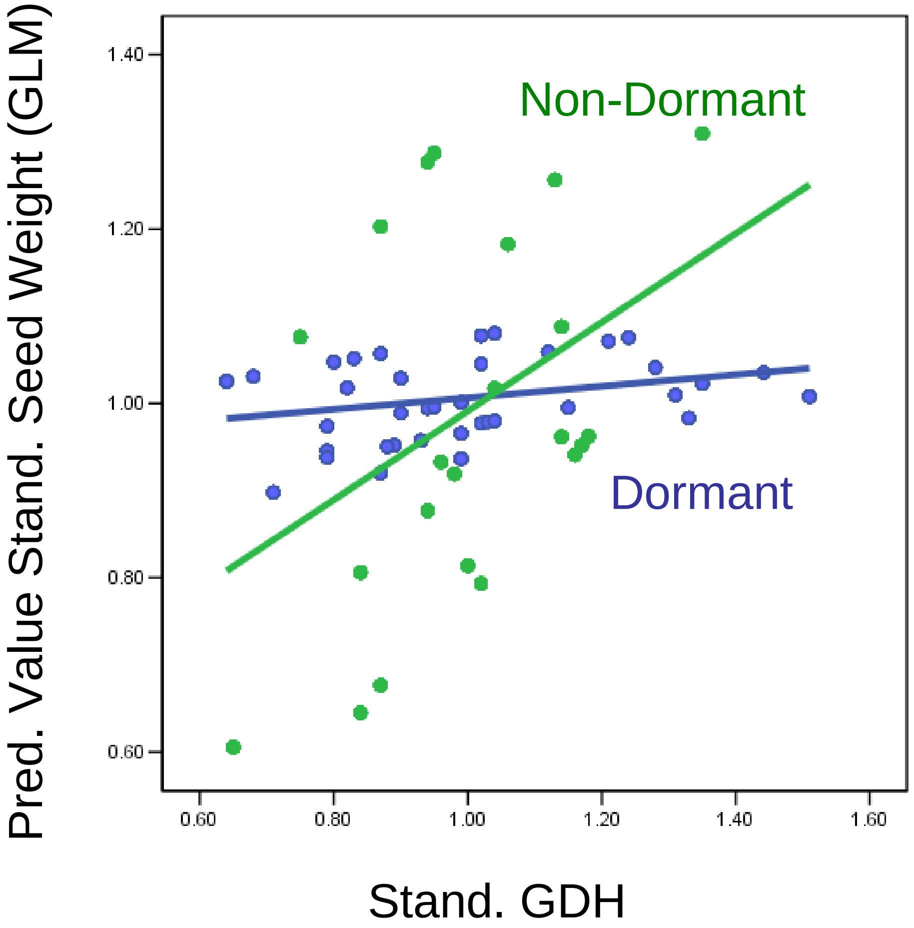
Dormancy type x Growing Degree Hours



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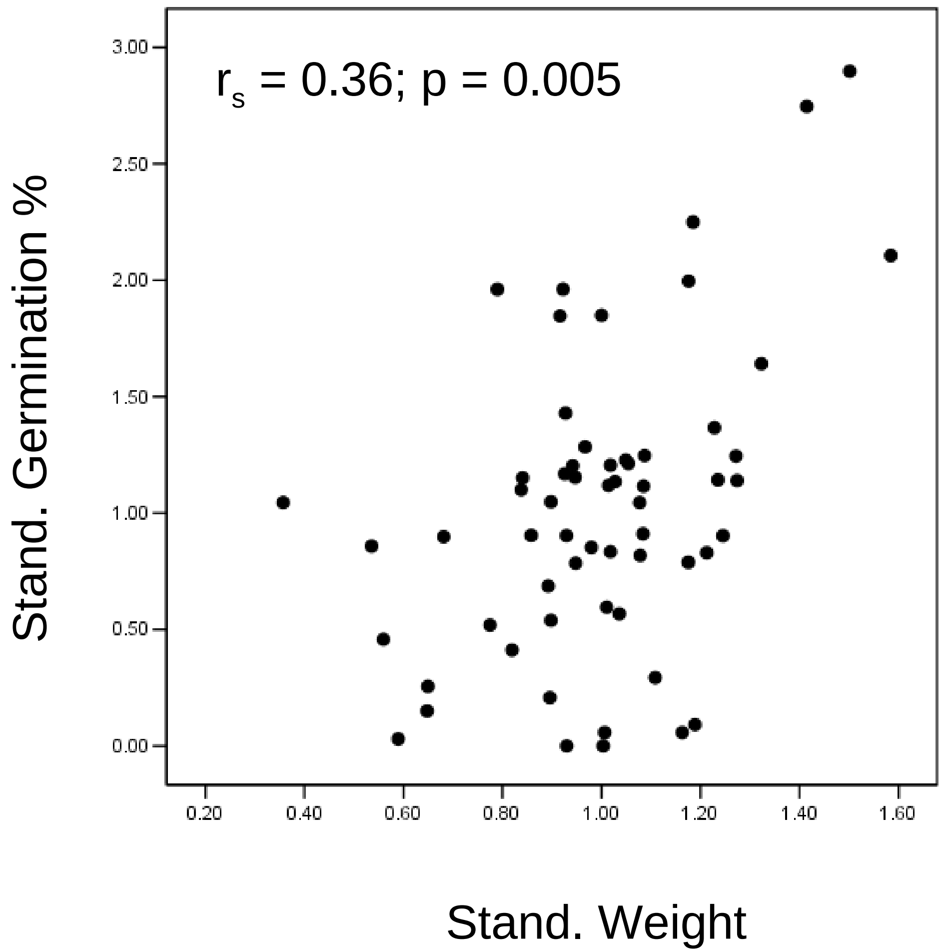
Effects on Germination %



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Effects on Germination % (GLM)

Variable	Significance
Latitude (covariate)	ns
Stand. GDH (covariate)	ns
Stand. Weight (covariate)	p=0.005
Germination Treatment (fixed factor, 2 levels)	p<0.001
Climate (random factor, 2 levels)	ns
Dormancy type (random factor, 2 levels)	ns
Dormancy type x Latitude	ns
Dormancy type x GDH	ns
Dormancy type x Climate	ns
Dormancy type x Stand. Weight	ns

Conclusions

- Does seed quality, measured as seed mass and germinability, increase with warmer climate?

  Yes, but only non-dormant species appear to be sensitive to climate (and latitude), whereas dormant species are not. Furthermore, it appeared that seed weight was directly affected, while germinability only indirectly (via seed weight).

- Will we expect climate change to affect species with different colonisation abilities differently?

  Since non-dormant species are often good colonising species and *vice versa*, climate change could indeed increase the difference in colonisation capacities between good and slow colonising forest species. However, it is obvious that more research will be needed to validate these findings.