



RESEARCH CENTRE

Development of dry *Violion* grassland on former agricultural land

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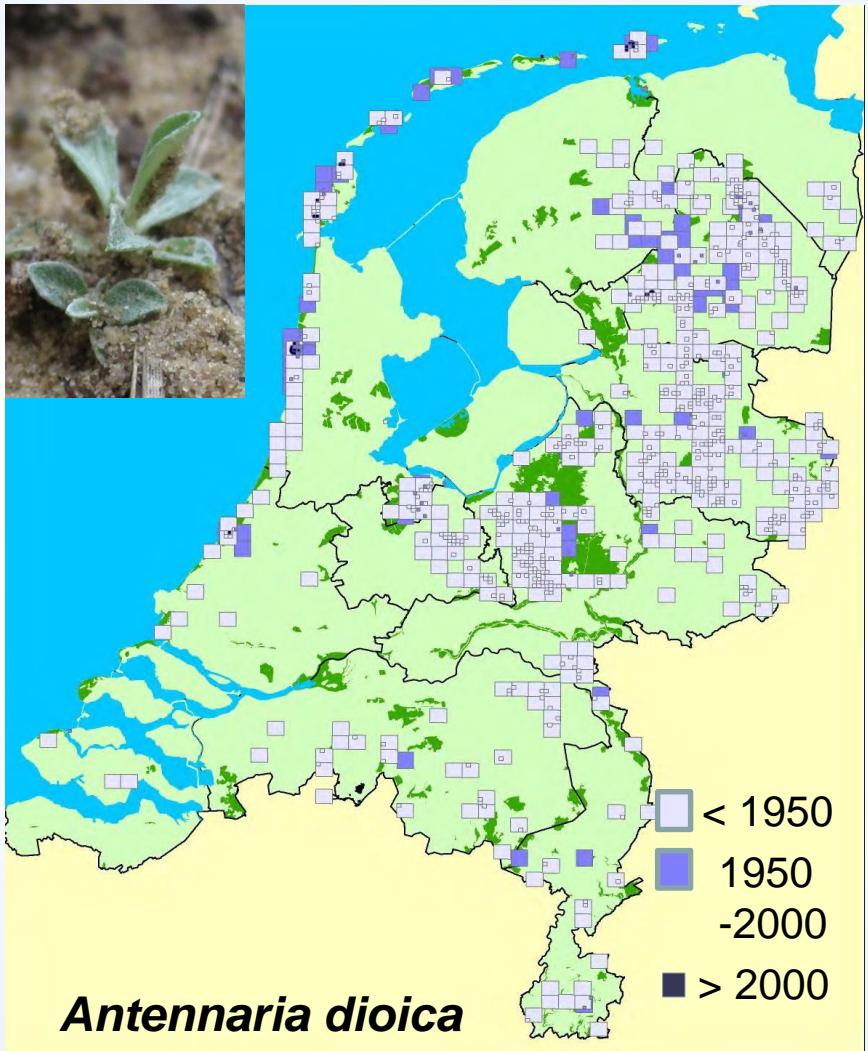
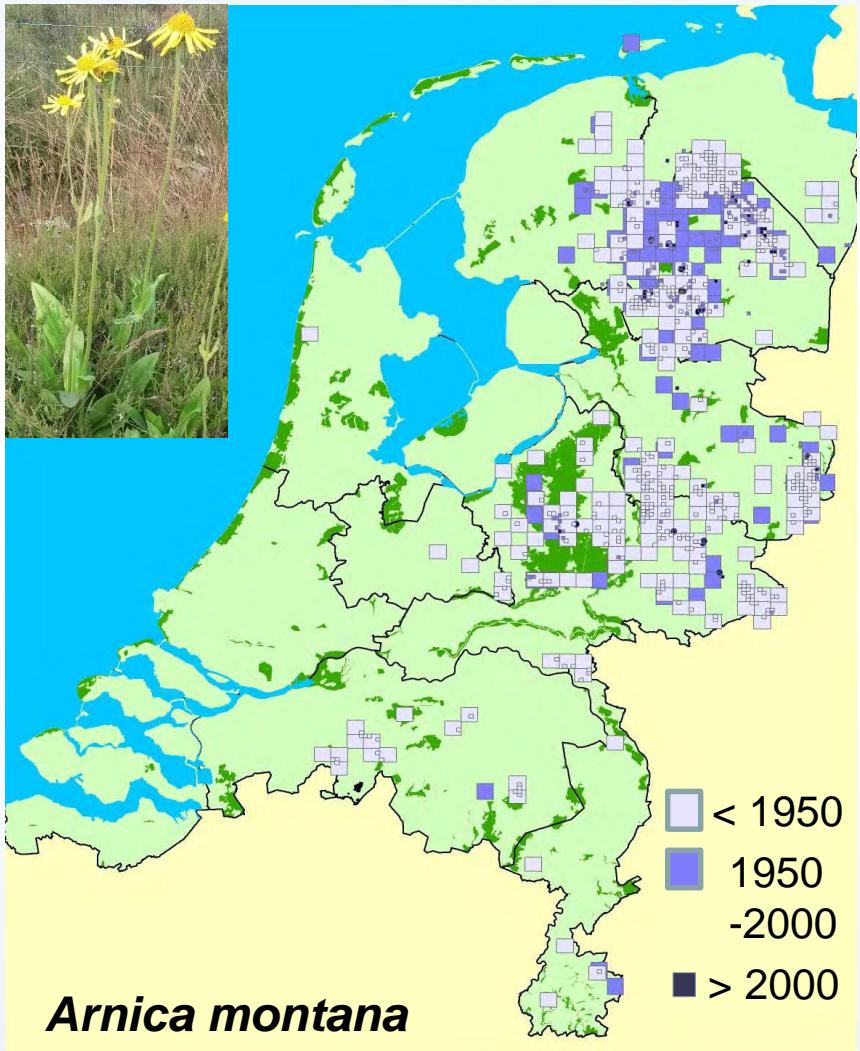


Dry *Violion* grasslands (*Nardus* grasslands)

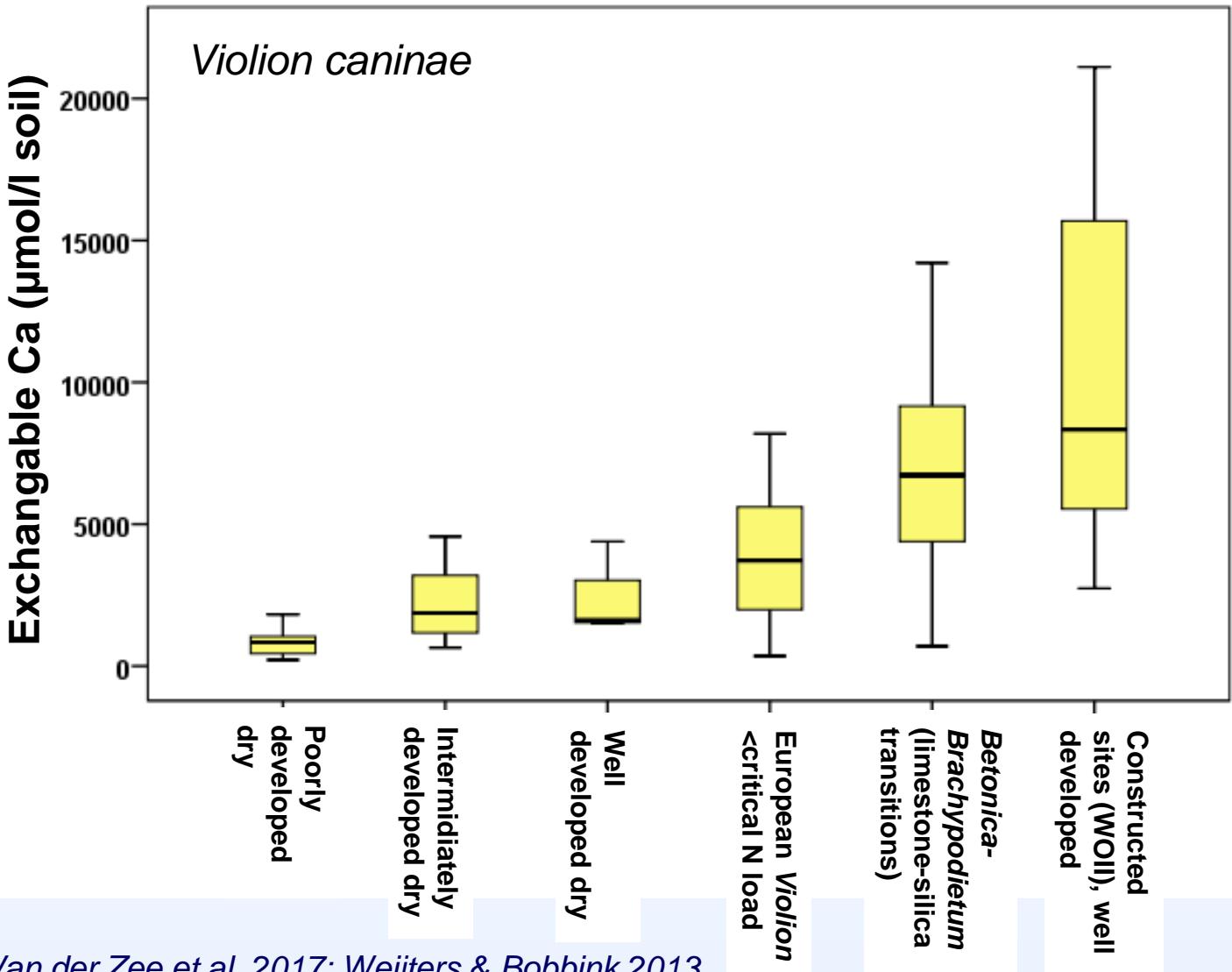


- Originally a common plant community in the heathland landscape;
- Very rich in plant species;
- H6230* (priority habitat type)
- Common species: *Festuca filiformis*, *Nardus stricta*, *Calluna vulgaris*, *Danthonia decumbens*, *Galium saxatile*, *Viola canina*, ...
- Red list species (Netherlands): *Arnica montana*, *Antennaria dioica*, *Botrychium lunaria*, *Polygala vulgaris*, ...

Decrease of species



Threats

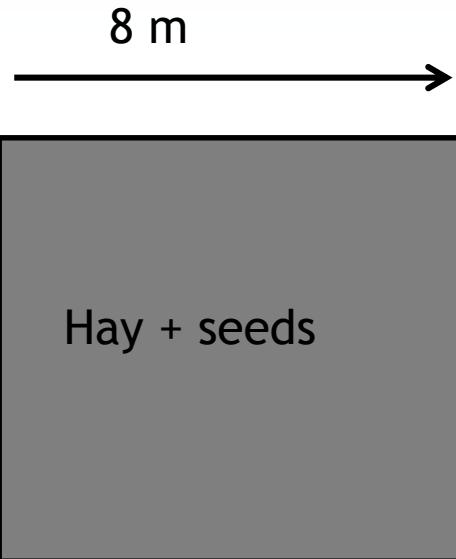
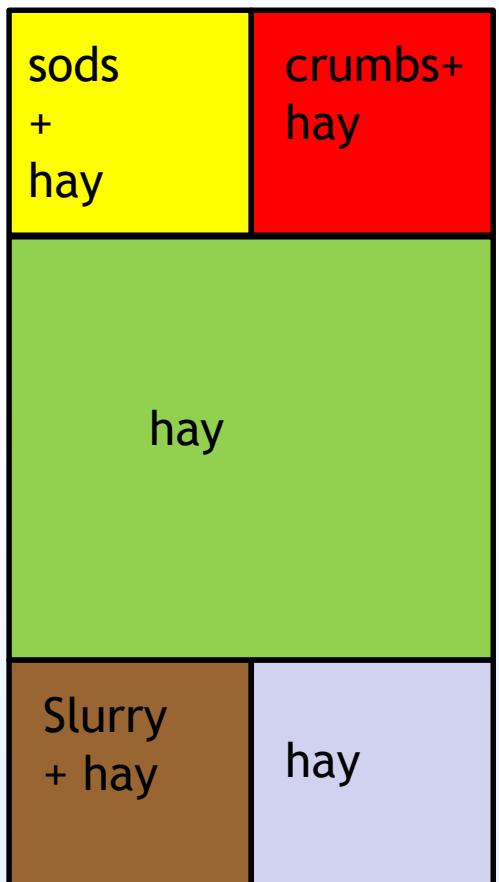


from: Van der Zee et al, 2017; Weijters & Bobbink 2013

Opportunities & constraints ex-arable land

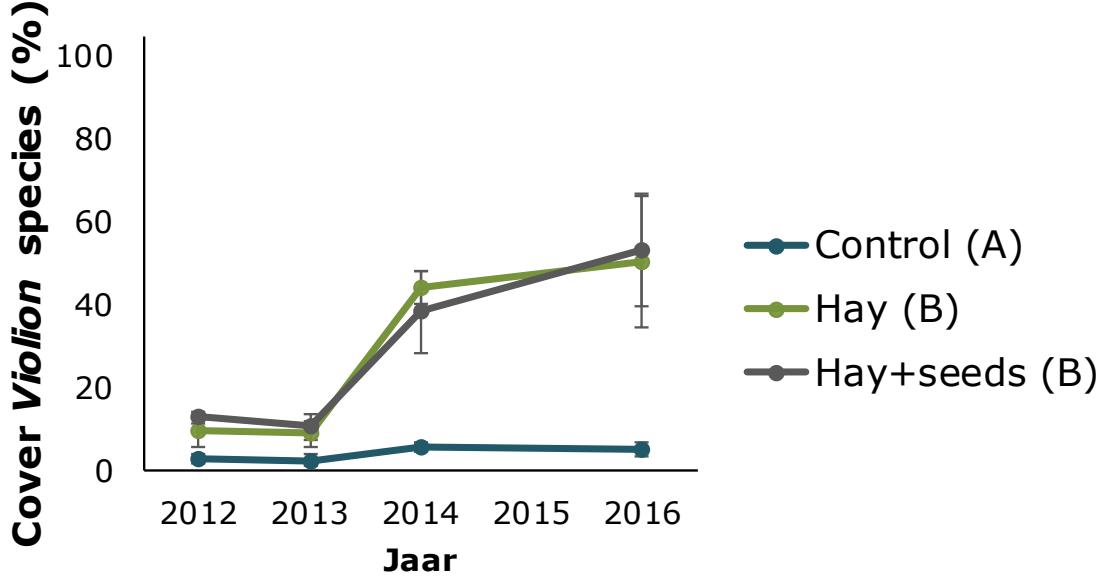
- **Opportunities**
 - buffering okay because of agricultural liming
- **Constraints**
 - too rich in nutrients (P!)
 - absence of typical plants and animal species
 - a strongly changed soil biota community
 - stagnation in development in earlier developed dry *Violion* grasslands on ex-arable land

Experiments directly after soil removal

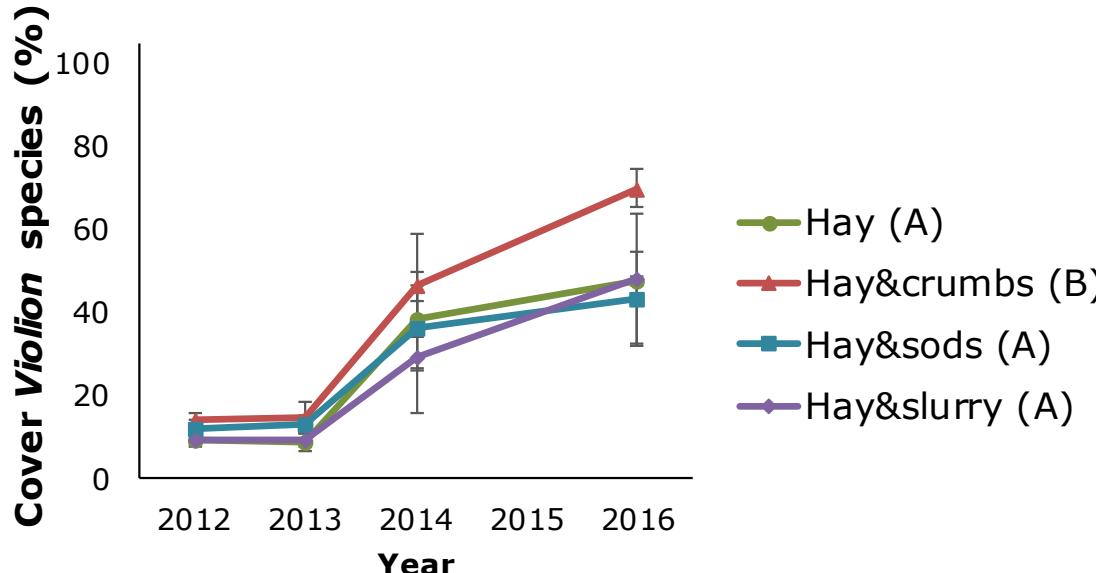


2-4 replicates
3 locations

Noordenveld



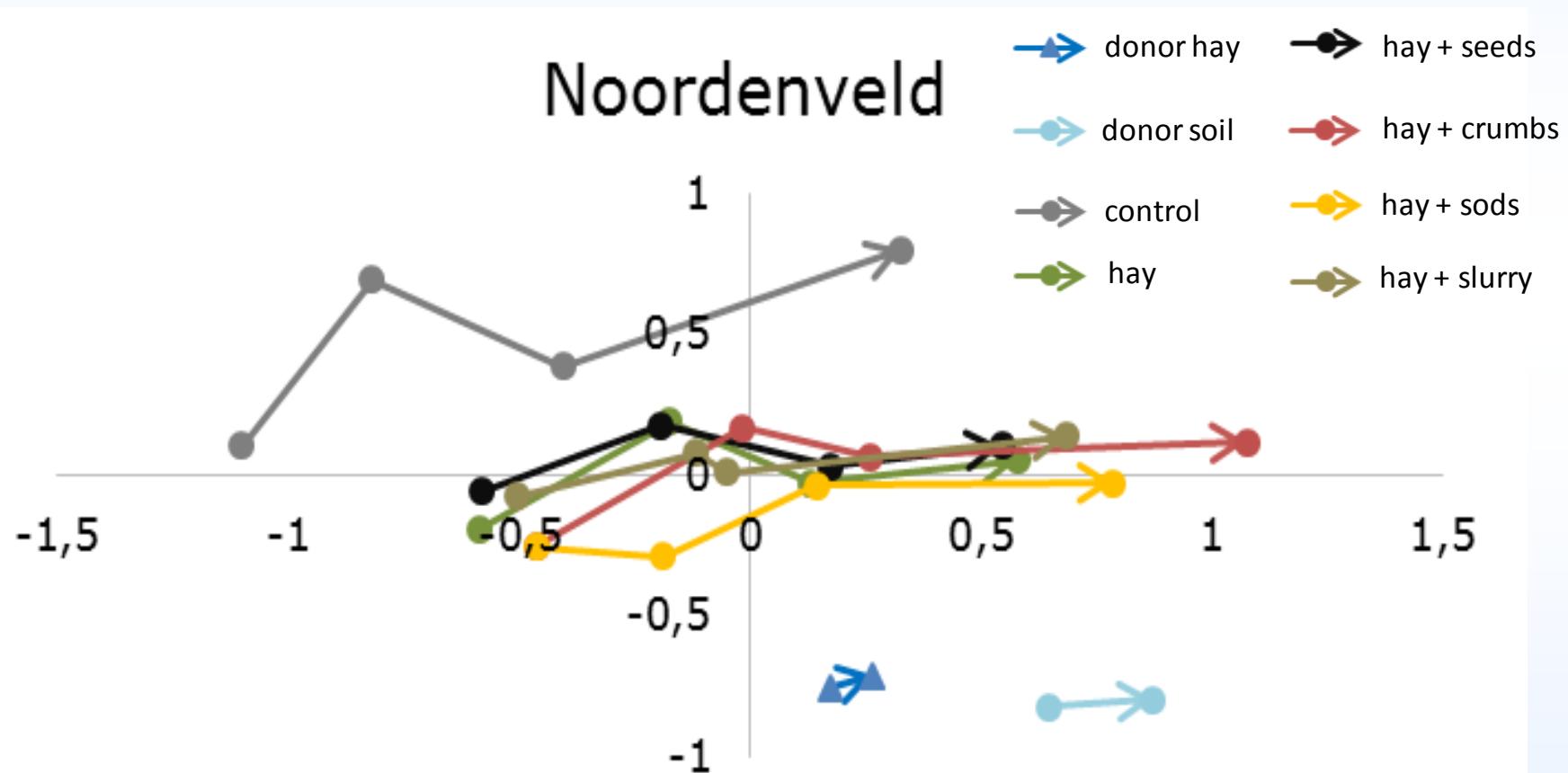
Noordenveld



- Addition of hay (+seeds) increases cover and number *Violion* species;
- Addition of soil crumbs increases cover of *Violion* species even more (especially *Festuca filiformis* & *Calluna vulgaris*)

Vegetation development

Noordenveld



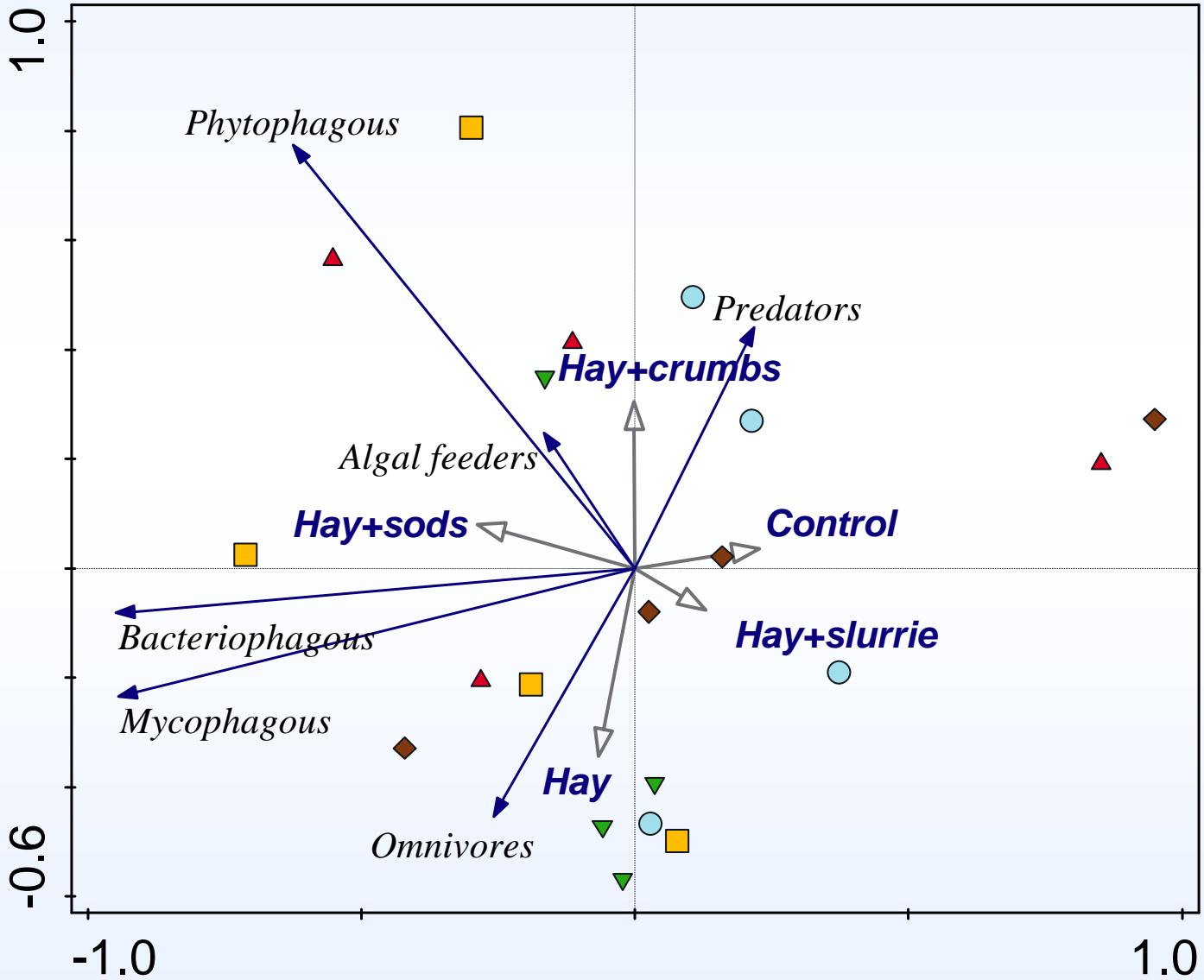
Violion species after 5 years

	control	hay	hay+seeds	hay+soil
Coverage herb layer (%)	13	60	60	59
<u>% of plots</u>				
<i>Festuca filiformis</i>	100 ^r	100³	100³	100³
<i>Lotus corniculatus</i>	100	100	100	92
<i>Euphrasia stricta</i>	100	88	100	42
<i>Rumex acetosella</i>	100	13	50	8
<i>Erica tetralix</i>	75 ^r	100^{2a}	75^{2a}	100^{2a}
<i>Carex pilulifera</i>	25	63	100	100
<i>Campanula rotundifolia</i>	25	63	100	42
<i>Potentilla erecta</i>	25	63	75	58
<i>Viola canina</i>	25	13		33
<i>Genista anglica</i>	25	13		8
<i>Succissa pratensis</i>		100	100	50
<i>Luzula spec.</i>		38	100	50
<i>Hieracium umbellatum</i>		38	13	42
<i>Luzula campestris</i>			25	8
<i>Arnica montana</i>			25	
<i>Hieracium pilosella</i>			13	17
<i>Danthonia decumbens</i>				8

Noordenveld

Italic = present at donor site
Bold = added as seeds

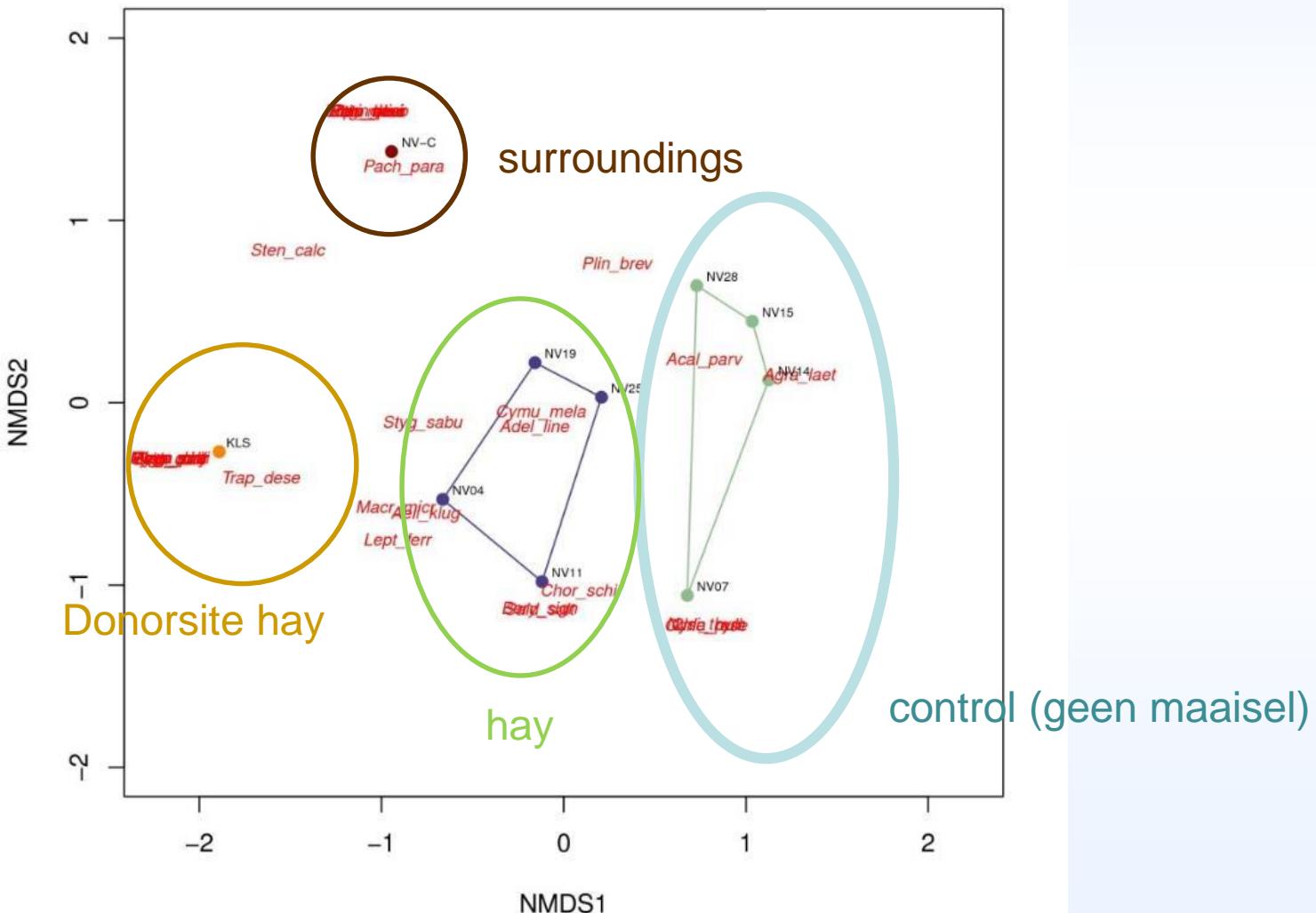
Nematods



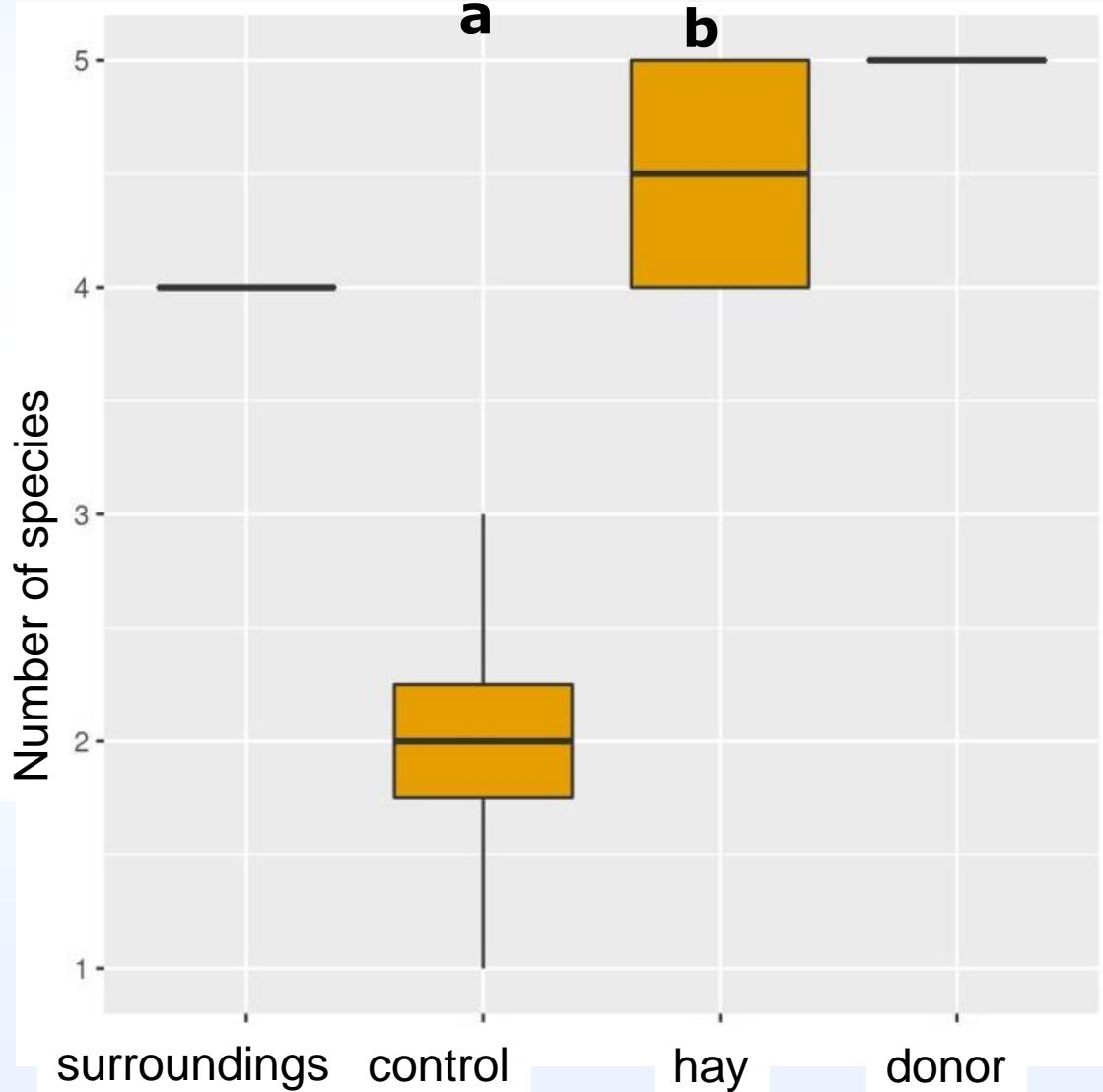
In
Noordenveld
control less
bacterio-
phagous and
myco-
phagous
nematodes

Bugs

Bug community Noordenveld



Ants



- ants: species diversity with hay addition higher than control

Conclusions

- Former agricultural sites
 - Top-soil removal necessary
 - After top soil removal: dispersion limits development towards dry *Violion* grasslands
 - Addition of fresh hay of well-developed donor sites helps in the development
 - For several species addition of seeds is necessary
 - Above-ground fauna community develops faster with hay addition

Conclusions

- Soil inoculation with crumbs or sods helps a little in the development of dry *Violion* grassland. Some species are poor seed dispersers (for instance *Nardus stricta*)
- Effect of soil inoculation with crumbs or sods on the development of a soil biota community smaller than expected. Harsh environment; role of for instance fungi in a well-maintained grassland smaller than in (more acidic) heathland;
- Not enough soil of well developed grasslands available for large-scale restoration projects

Earlier restored sites



Shallow sod-cutting,
hay + seeds

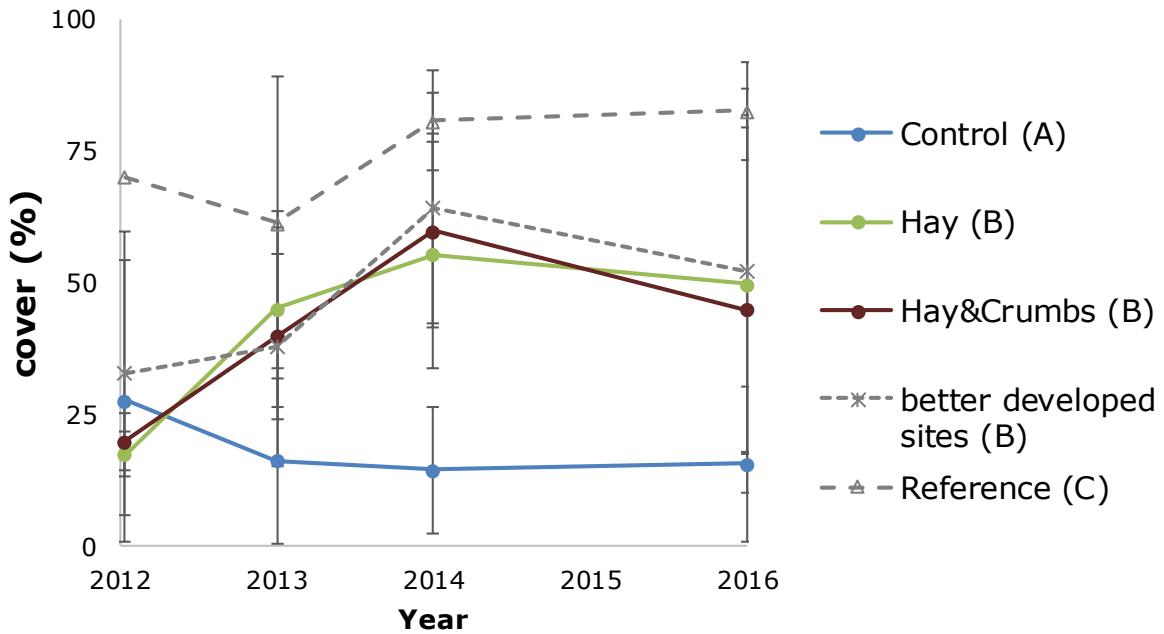
2 m
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Shallow sod-cutting,
hay + seeds +
crumbs

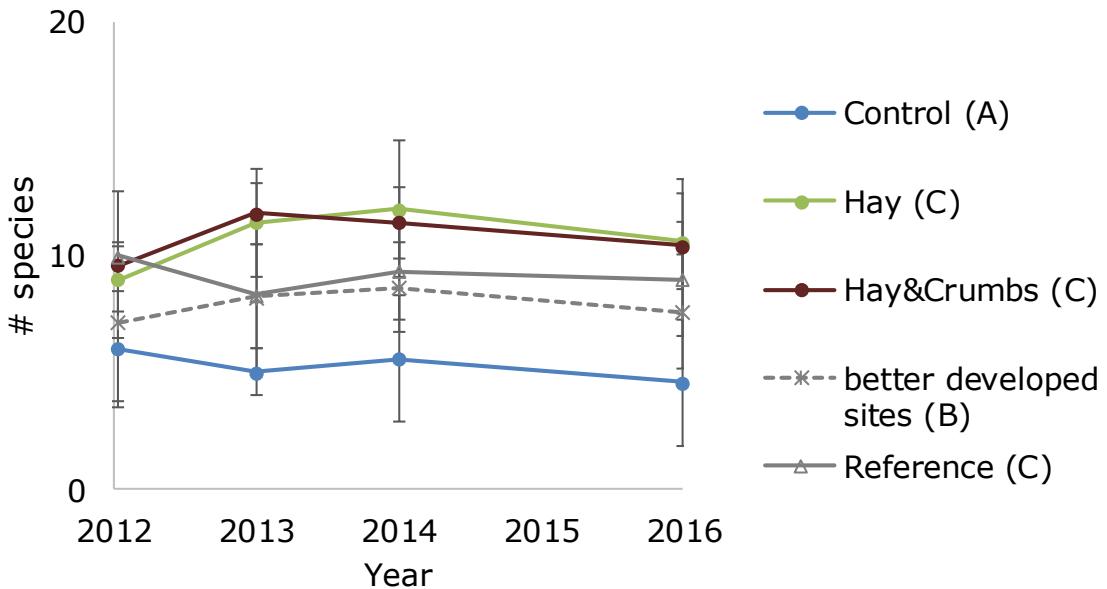
control,
original
vegetation 20
years after
restoration

5 locations

Cover *Violion* species



number of *Violion* species



Violion species after 5 years

Staverden

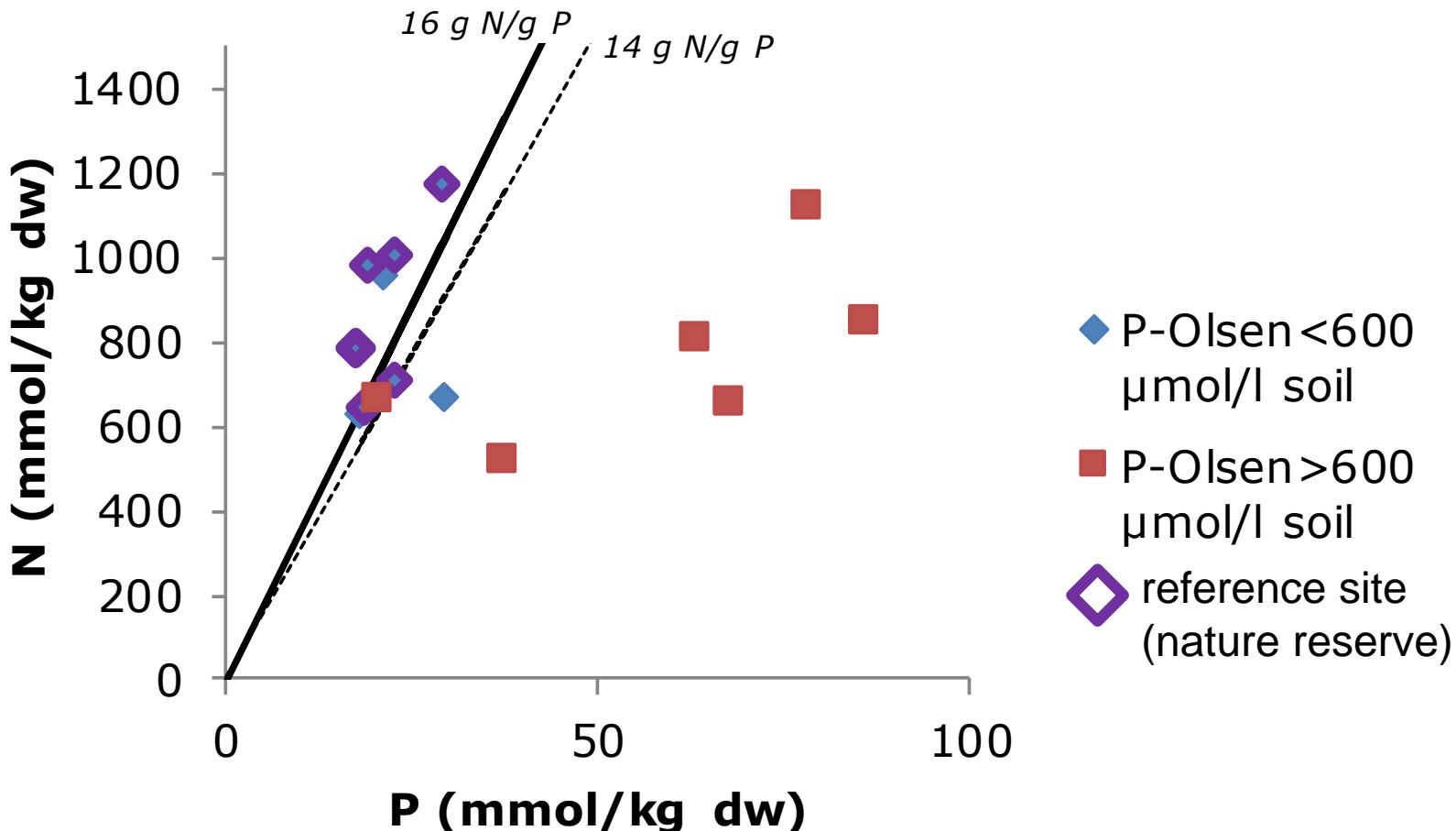
	control	hay+seeds	hay+seeds +crumbs
Total #species	14	16	22
<u>Cover Violion species</u>			
<i>Stijf havikskruid</i>	p1	m1	m1
<i>Luzula campestris</i>	r1	m1	
<i>Festuca filiformis</i>		6	6
<i>Carex pilulifera</i>		m1	m1
<i>Erica tetralix</i>		m1	
<i>Succissa pratensis</i>		p1	1+
<i>Rumex acetosella</i>		p1	p1
<i>Euphrasia stricta</i>		p1	
<i>Leontodon autumnalis</i>			r1
<i>Arnica montana</i>			r1

Italic = present at donor site

Bold = added as seeds

Hay+seeds increases number and cover *Violion* species

Nutrient concentrations above ground biomass



High P ex-arable land after top soil removal → N-limitation *Violion* grasslands; lower availability: balanced N/P-ratio around co-limitation

Conclusions

- Earlier developed sites with stagnating development
 - Addition of fresh hay and seeds after reopening vegetation helps;
 - No effects additional soil inoculation
 - Many sites still have high P after topsoil removal. On the long term accumulation of N is expected. Will quality of the developed dry *Violion* grasslands be guaranteed in future at sites with high P?