Restoration of dry and wet heathland on former agricultural land

Restoration of dry and wet heathland on former agricultural land

the ground beetles (Carabidae)

Rikjan Vermeulen, Roel van Klink, Alje Woldring & Kees van der Laaken

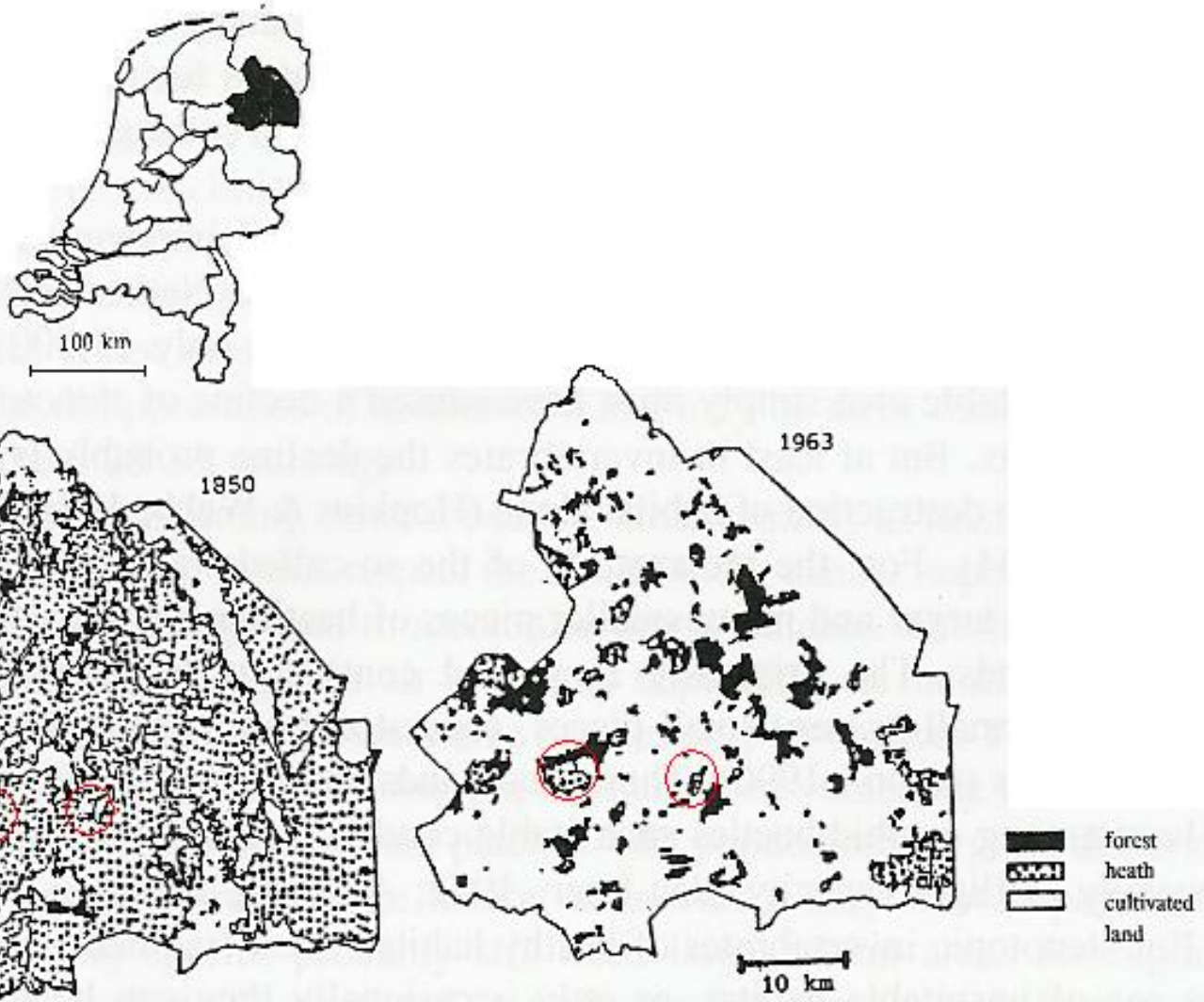
foundation

Willem Beijerinck Biological Station

Carabus nitens

Why do we want to restore heathlands?

Cicindela sylvatica
Disappeared from Drenthe



An example of the fragmentation of heathlands and dry grasslands in the Dutch province of Drenthe since 1850. The same kind of process took place in the whole North-East part of the Netherlands.

- Probably the destruction and fragmentation of heathlands resulted in the loss of heathland species:

Ground beetle species of heathlands caught in the past at Dwingelderveld and not any more during the last 25 years

Acupalpus flavicollis

Agonum krynickii

Amara infima

Carabus cancellatus

Cycindela sylvatica

Cicindela germanica

Amara praetermissa

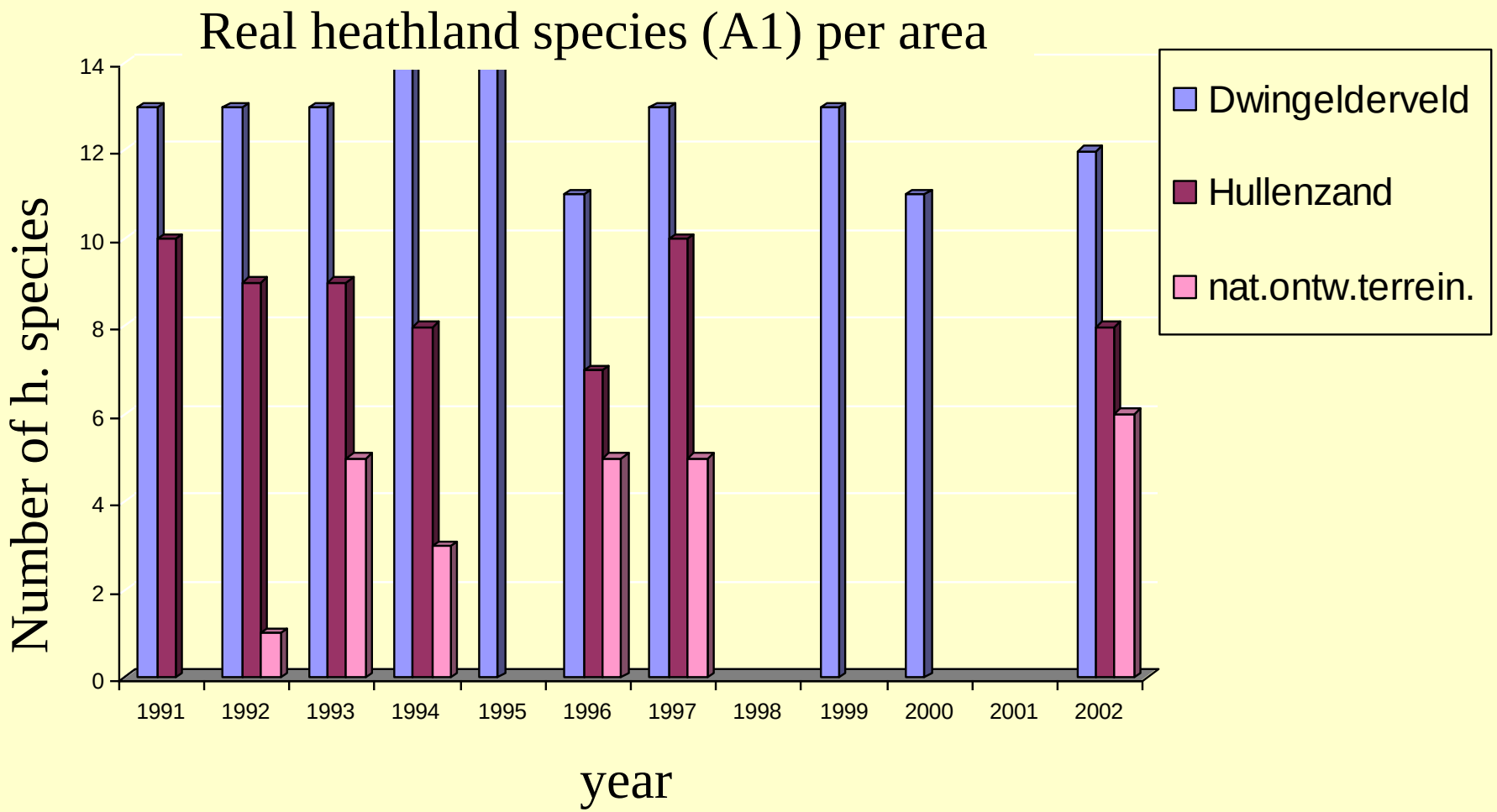
Pterostichus minor

Ca. 25 species of heathland and related habitats are now left




Nature restoration by top-soil removal

8 years after top-soil removal

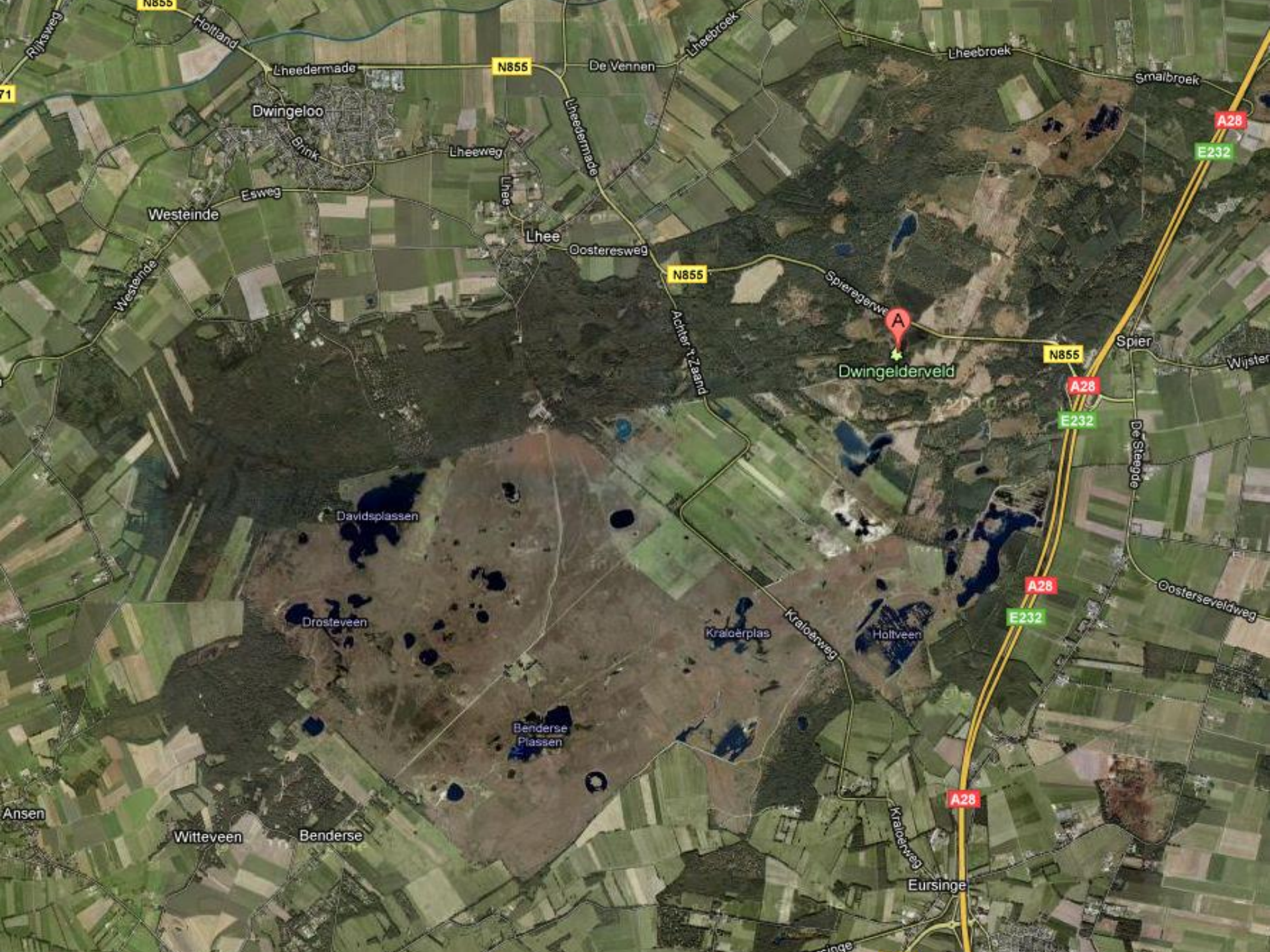

Real heathland species (A1) per area
Number of h. species
0
2
4
6
8
10
12
14
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
year
Dwingelderveld
Hullenzand
nat.ontw.terrein.

Heathland restoration is a slow process which takes at least several decades.

Is it possible to accelerate the process by different kinds of treatments in both wet and dry heathland areas?

i.e. adding acid
or adding lime

Adding plant material from other heathlands
or adding sod-cuts from other heathlands?


N855
Holland
Rijksweg
Lheedermade
N855
De Vennen
Lheebroek
Lheebroek
Smalbroek
A28
E232
Dwingeloo
Brink
Lheeweg
Lhee
Lheedermade
Esweg
Westeinde
Lhee
Oosteresweg
N855
Westeinde
Achter 't Zaand
Spiereger
A
Dwingelderveld
N855
Spier
A28
E232
De Steegde
Davidsplassen
Drosteveen
Kraloërplas
Kraloërweg
Holtveen
A28
E232
Oosterseveldweg
Benderse
Plassen
A28
Kraloërweg
Ansen
Witteveen
Benderse
Eursinge


permanent traps since 1959
Dwingeloo
Lheedermade
N855
De Vennen
Lheebroek
Smalbroek
Brink
Lheeweg
Esweg
Westeinde
Lhee
Oosteresweg
Achter 't Zaand
Dwingelderveld
Spier
A28
E232
De Steegde
Davidsplassen
Drosteveen
Kraloërweg
Holtveen
Oosterseveldweg
Benderse Plassen
Ansen
Witteveen
Benderse
Eursinge

Permanent sampling site AY weekly checked since 1959


experimental site since 2012
permanent traps since 1959
Dwingeloo
Lheedermade
N855
De Vennen
Lheebroek
Smalbroek
Brink
Lheeweg
Esweg
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Benderse Plassen
Ansen
Witteveen
Benderse
Eursinge

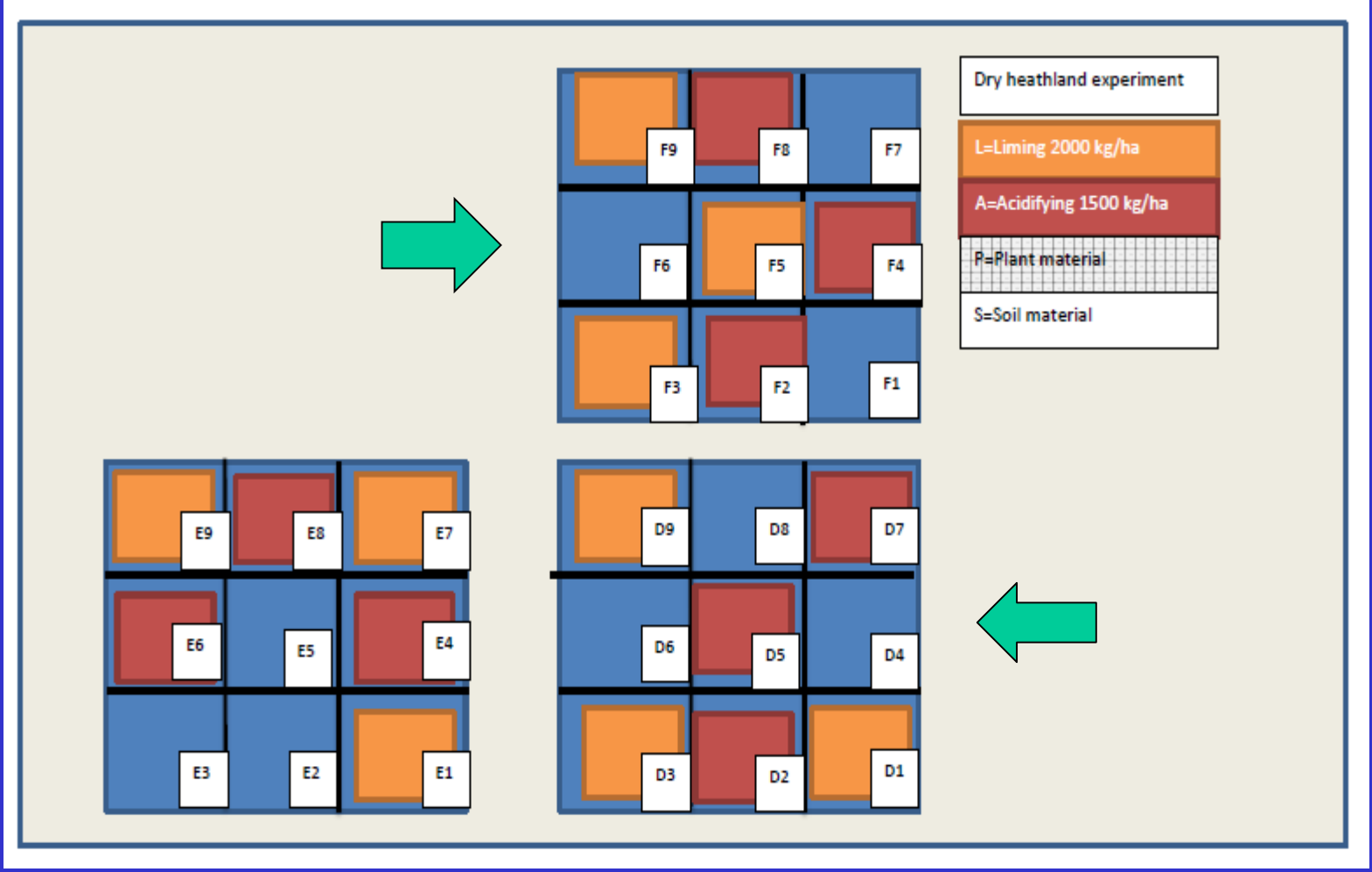
Location of Field experiment

Dry heath

Wet heath

Experimental design:
for ground beetles on the wet site only A en B were used

Experimental design:
for ground beetles on the dry site only D en F were used



Noordenveld 2012 dry site

Noordenveld 2012 dry site

Noordenveld 2017 dry site

Noordenveld 2017 trap at the wet site

Noordenveld 2016 wet site in spring

Some results of the first years and later on:

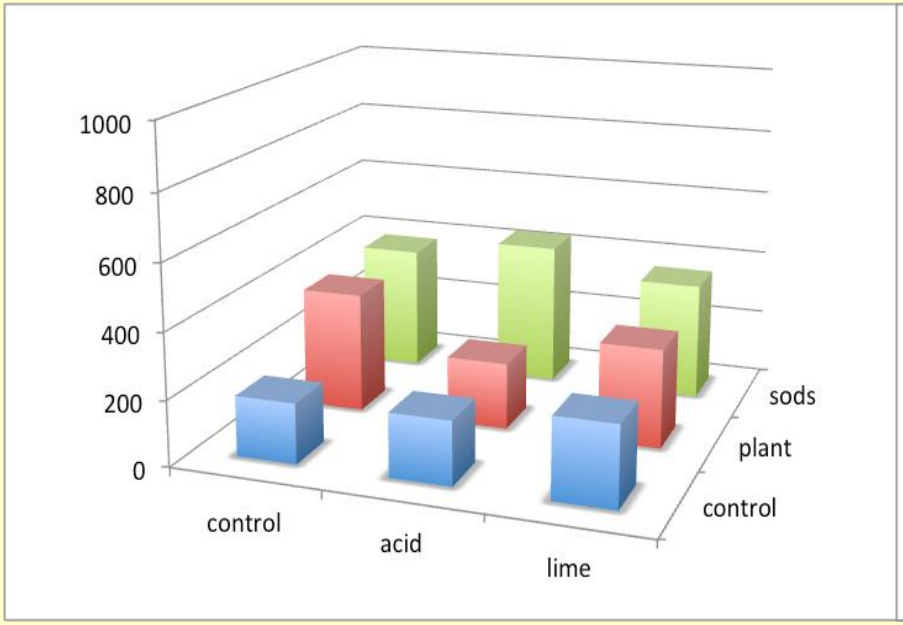
Poecilus lepidus

Carabus arvensis

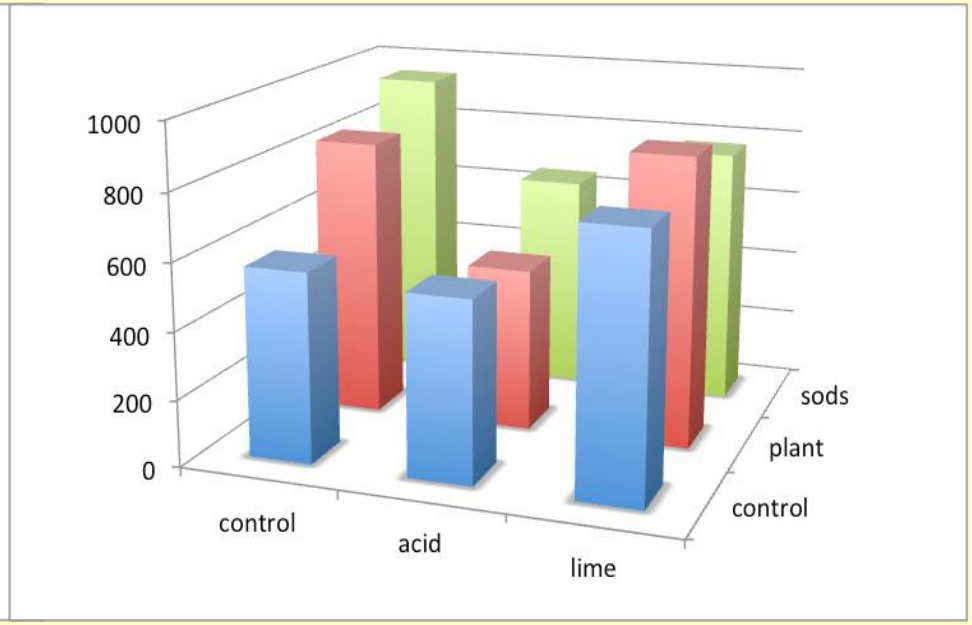
Some large species of heathland already present in 2013

Carabus nitens

Number of individuals ground beetles caught per treatment (all 4 areas summarized)

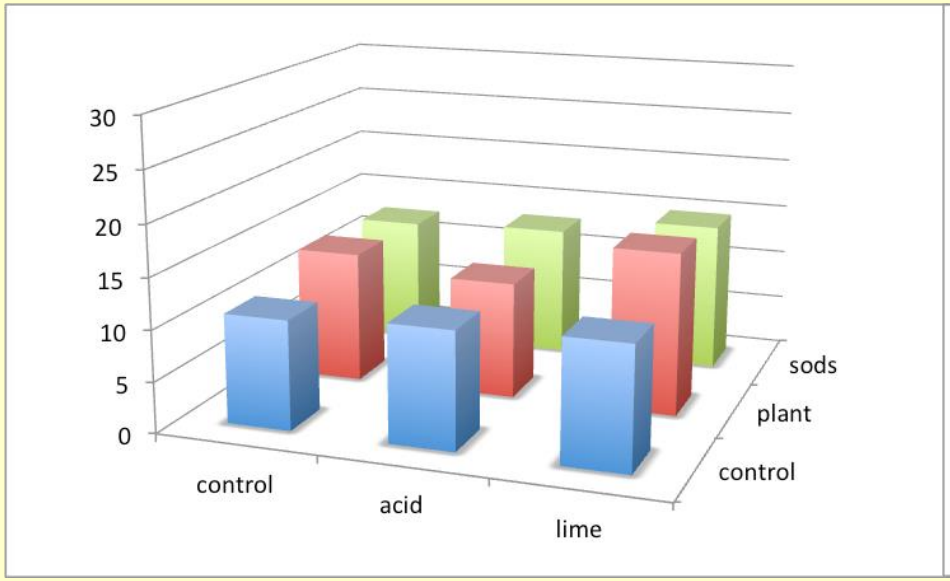


in 2012

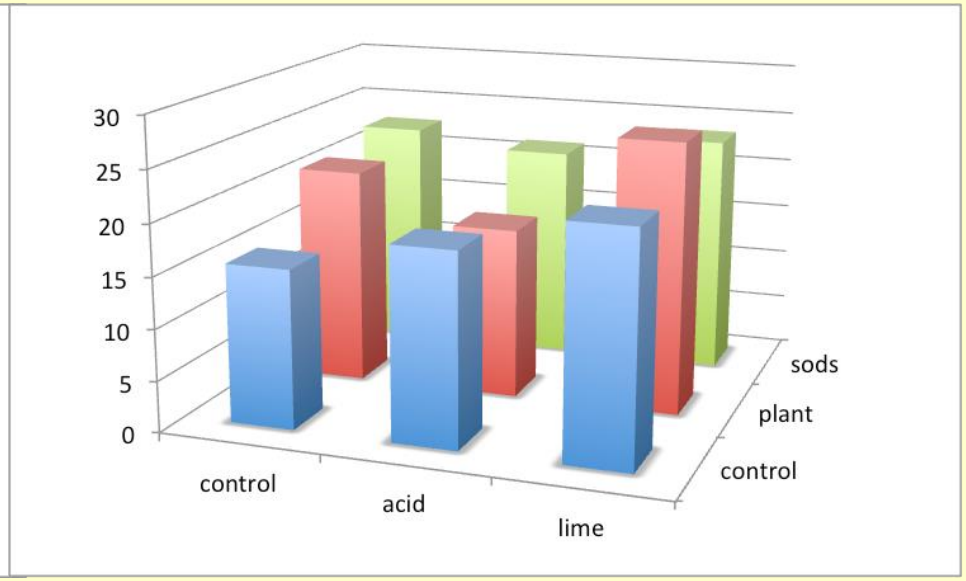


in 2013

Average number of ground beetles species caught per treatment (4 areas)

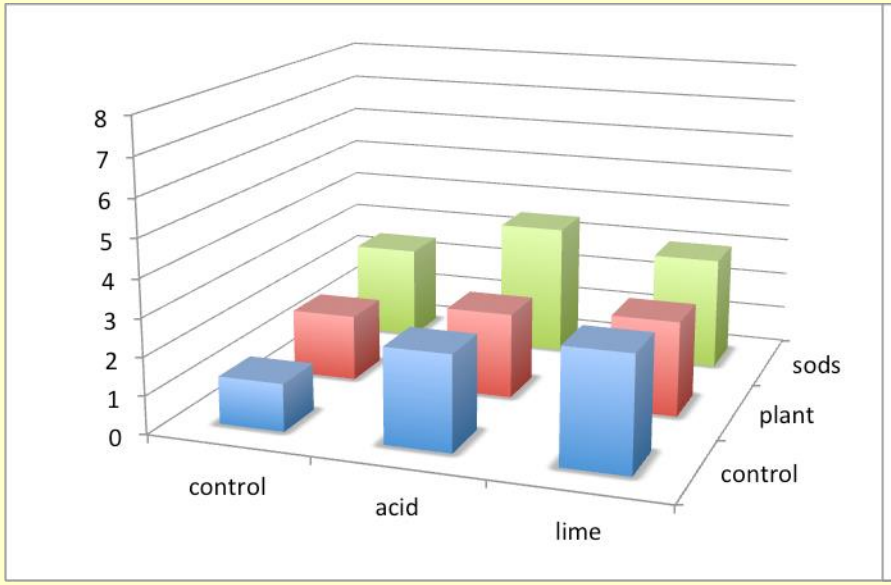


in 2012

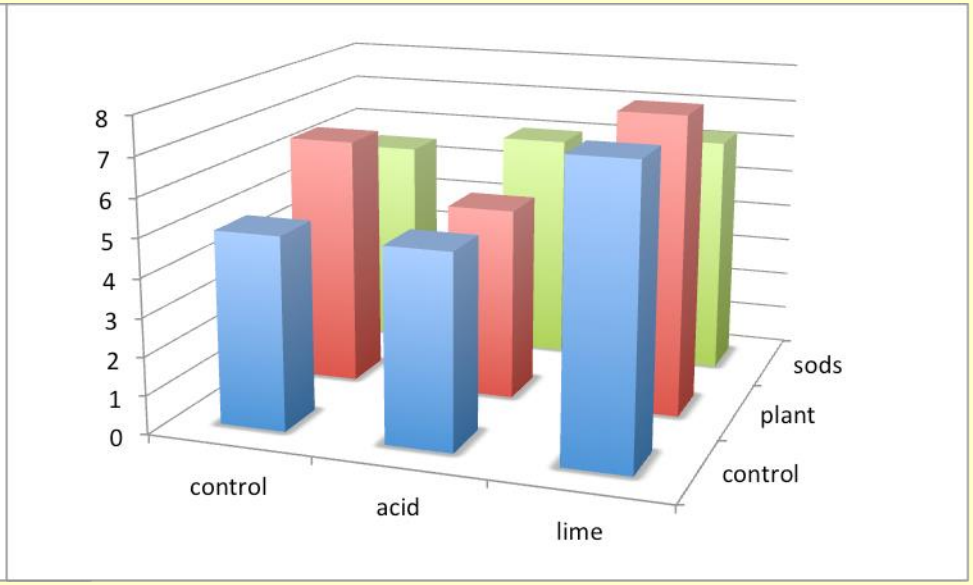


in 2013

Average number of ground beetles heathland species caught per treatment (4 areas)

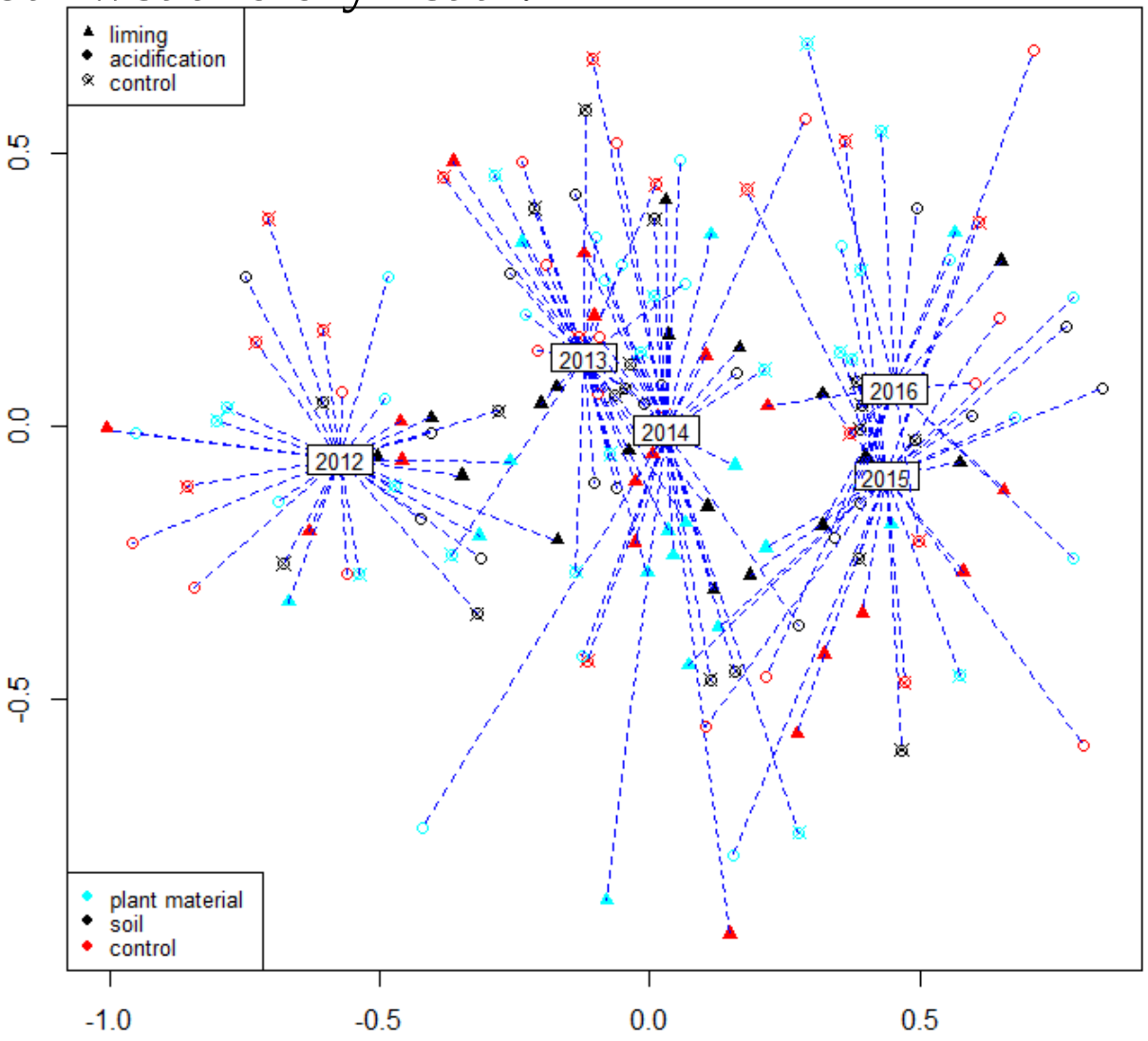


in 2012



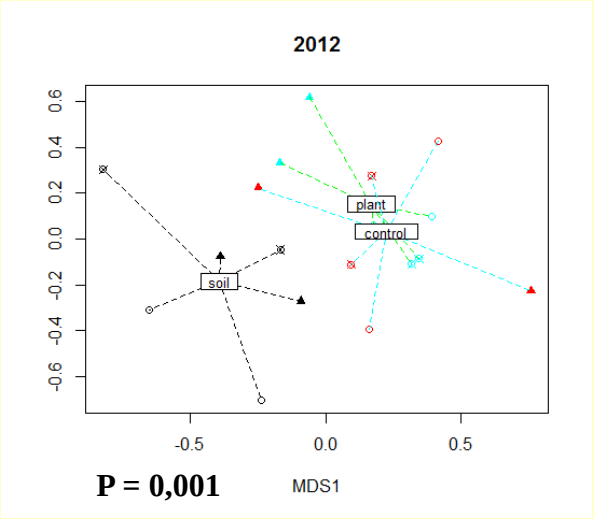
in 2013

Development of the ground beetle community
Both wet and dry heath.

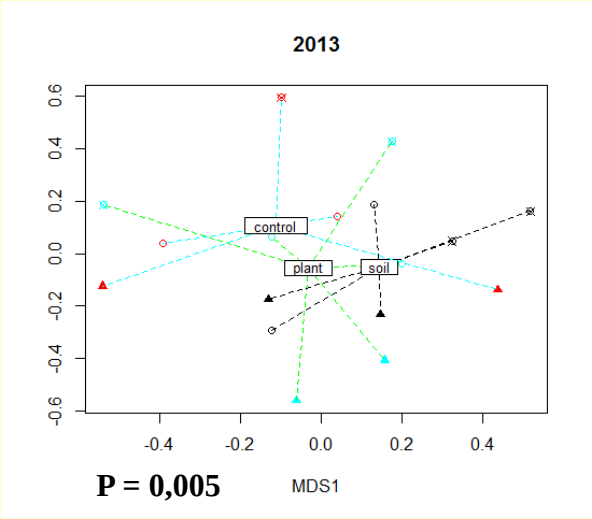


non-metric MultiDimensional Scaling

Development of the ground beetle community
Trends: biota treatment dry heath



P = 0,001



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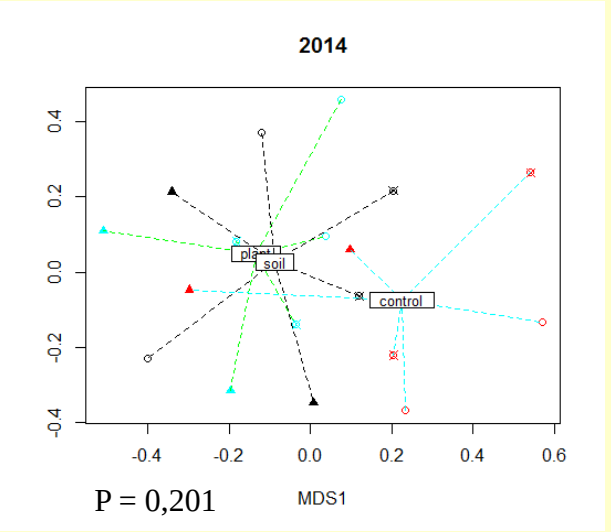
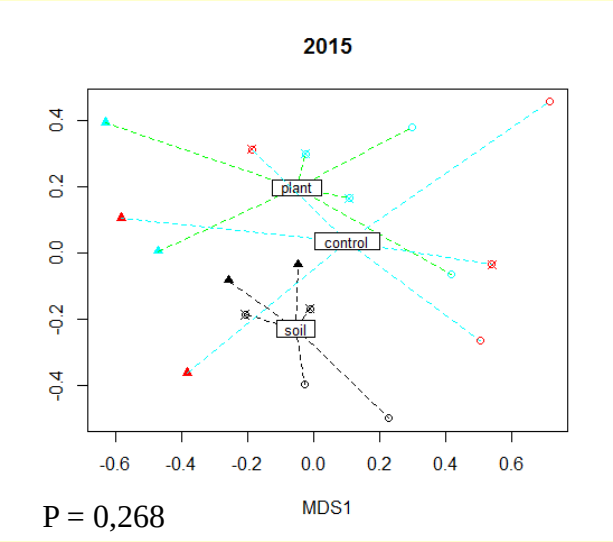
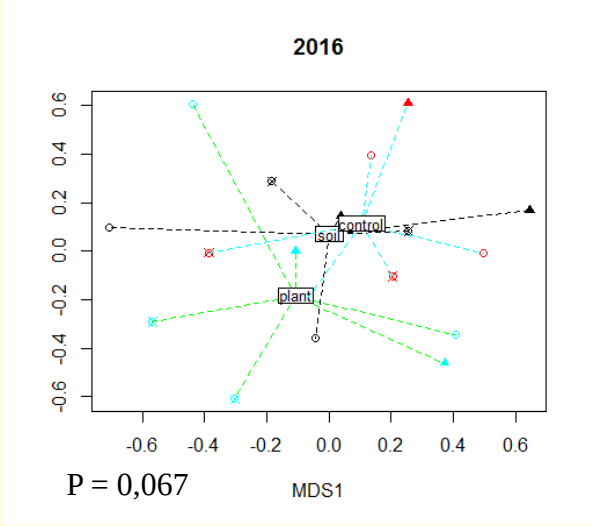


P = 0,201

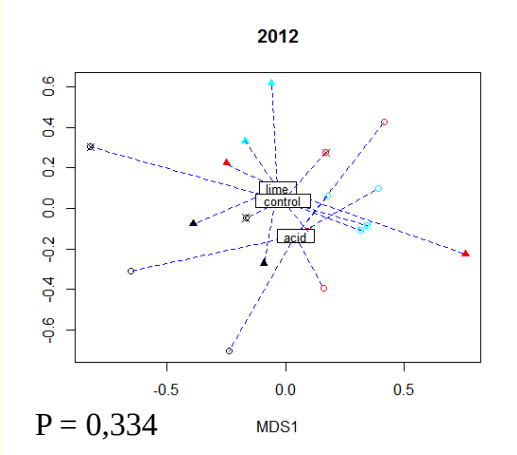


P = 0,268

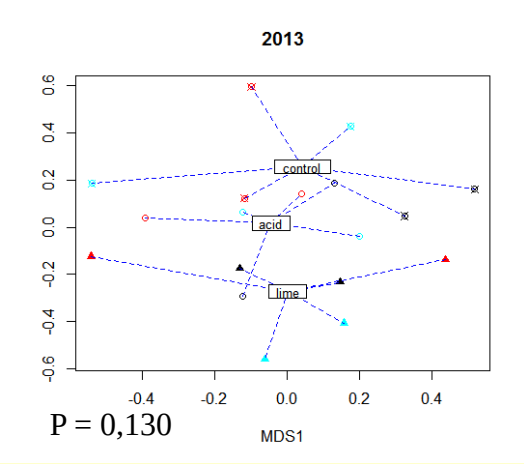


P = 0,067

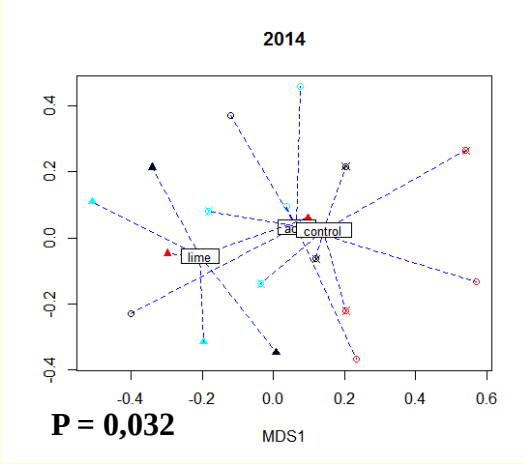
Development of the ground beetle community
Trends: acidity treatment dry heath



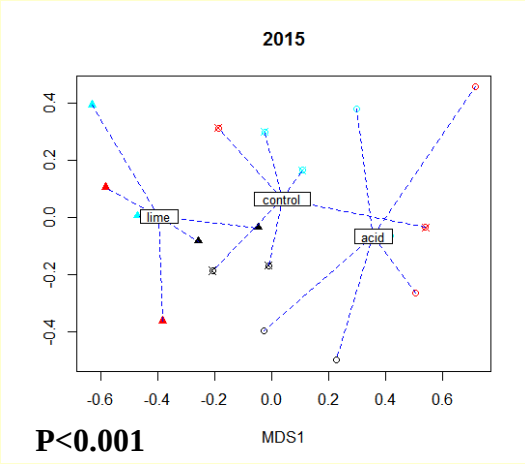
P = 0,334



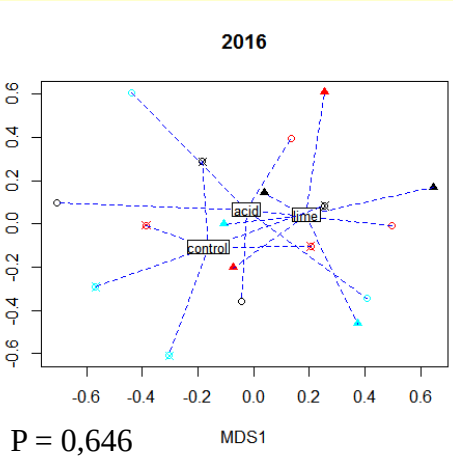
P = 0,130



P = 0,032



P<0.001



P = 0,646

Community composition over time

	Dry heath				Wet heath		
	P-pH	**P - Biota**	**Total R^2**		**P – pH**	**P-Biota**	**Total R^2**
2012	0.334	**0.001**	0.406		0.569	**0.0052**	0.399
2013	0.130	**0.005**	0.311		**0.008**	**0.039**	0.399
2014	**0.032**	0.201	0.347		0.222	**0.002**	0.322
2015	**<0.001**	0.268	0.431		0.596	0.637	0.198
2016	0.646	0.067	0.289				

1) Decreasing importance of Biota treatment

Results of multivariate permutational anova

Community composition over time

	Dry heath				Wet heath		
	P-pH	**P - Biota**	**Total R^2**		**P – pH**	**P-Biota**	**Total R^2**
2012	0.327	**0.004**	0.406		0.552	**0.005**	0.399
2013	0.114	**0.006**	0.311		**0.008**	**0.032**	0.399
2014	**0.039**	0.202	0.347		0.222	**0.002**	0.322
2015	**0.001**	0.278	0.431		0.596	0.637	0.198
2016	0.64	0.053	0.289				

2) pH is important in some years, but not consistently

Results of multivariate permutational anova

Community composition over time

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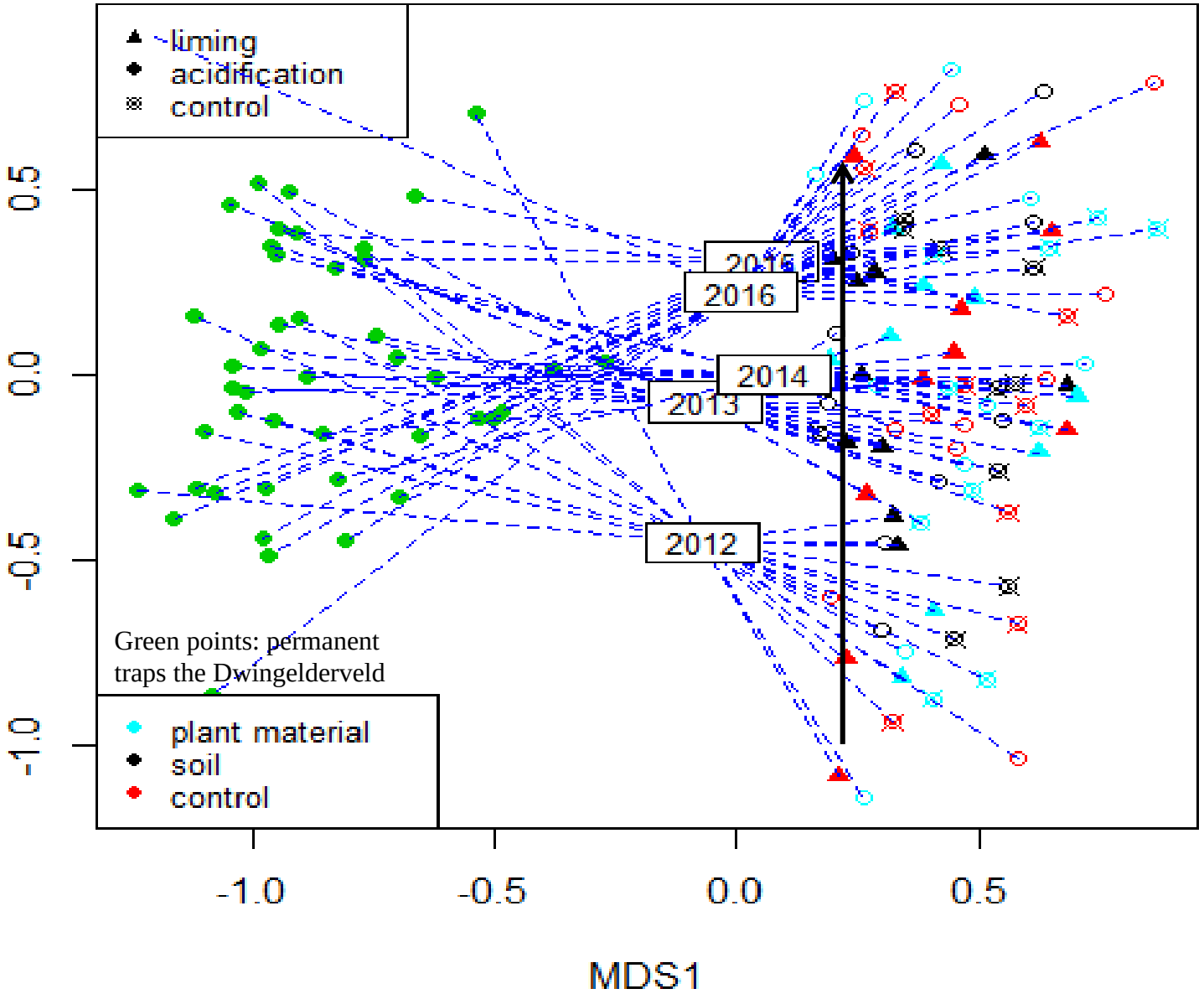
Results of multivariate permutational anova

3) Decrease in explained variation

Development of the ground beetle community
Both wet and dry heath compared to the sites at the Dwingelderveld



Some things that attract attention (provisional conclusions)

- Numbers and species caught 2013 are almost doubled in 2013 as compared to 2012

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- Treatments like liming and adding heathland sods or/and cuttings seems to affect the ground beetle fauna.

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- The effect of adding plant material or sods on the community becomes less significant after 5 years

- Numbers and species caught 2013 are almost doubled in 2013 as compared to 2012
- Treatments like liming and adding heathland sods or/and cuttings seems to affect the ground beetle fauna.
- The effect of adding plant material or sods on the community becomes less significant after 5 years
- The effect of Ph-treatments are not consistently but they are there

A general decrease of the effect of the treatments in time: the treatments become more similar and differences less obvious. The community develops however but still not in the direction of that of the old heathlands.

The monitoring will at least continue till 2018.

Cincindela campestris, a tiger beetle of heathland

Thank you for your attention

Cymindis macularis, a rare ground beetle of dry heathlands

Foundation Willem Bijerinck Biological Station, Loon the Netherlands

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