Enhanced nitrogen supply leads to changed plant chemistry and vegetation shift in boreal mire

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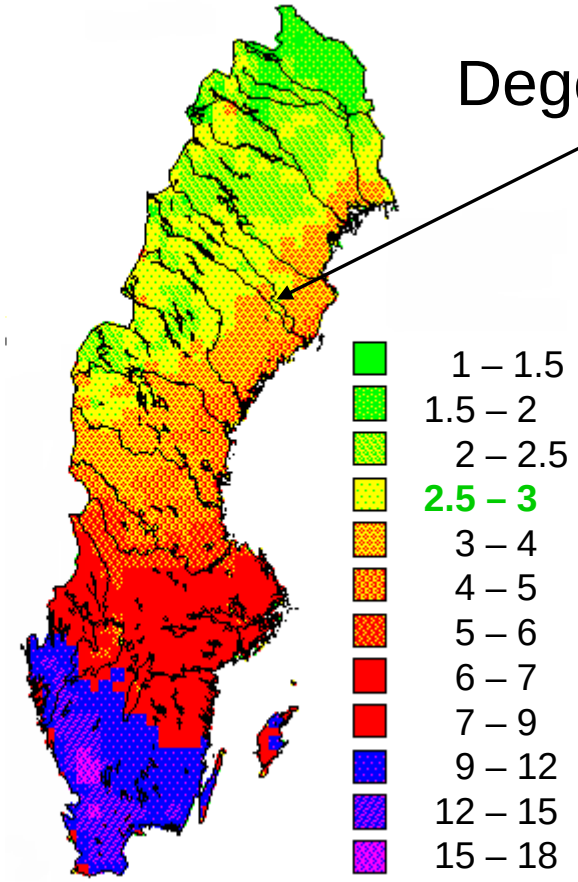
Total N deposition in (kg ha^{-1} yr^{-1}) Sweden



Swedish Meteorological and Hydrological Institute (SMHI; 26 November 2001)

Degerö Stormyr Kulbäcksliden

full factorial design with N, S and T treatment

treatments were applied since 1995:

- ammonium nitrate (30kg N ha^{-1} yr^{-1})
- sodium sulphate (20kg S ha^{-1} yr^{-1})
- greenhouses enhance air temp 3.6°C above ambient

fieldwork

Study species (clockwise from upper left): *Andromeda polifolia, Eriophorum vaginatum, Sphagnum balticum, S. lindbergii, S.majus, Vaccinium oxycoccos, S. papillosum*

treatment responses

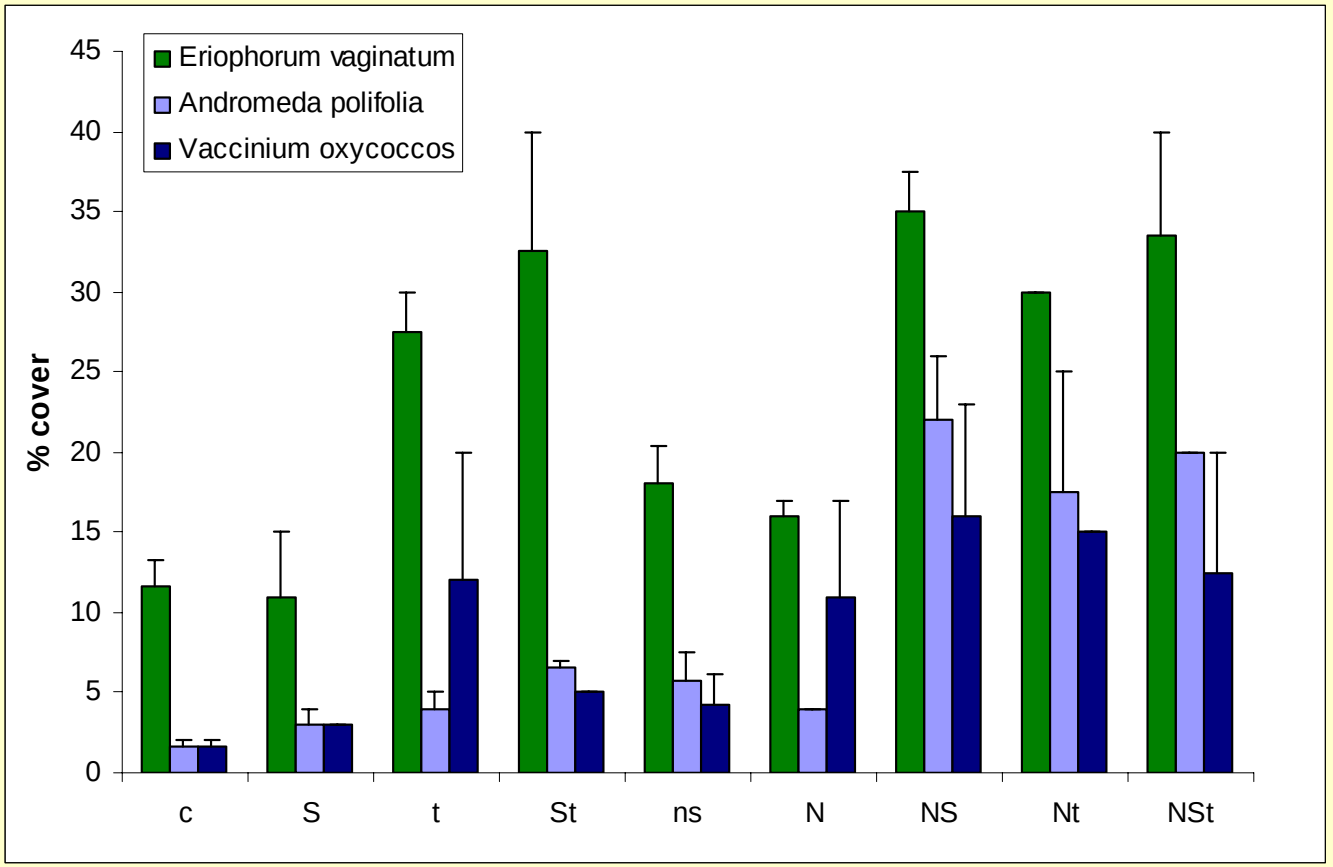
control

sulfur

high nitrogen

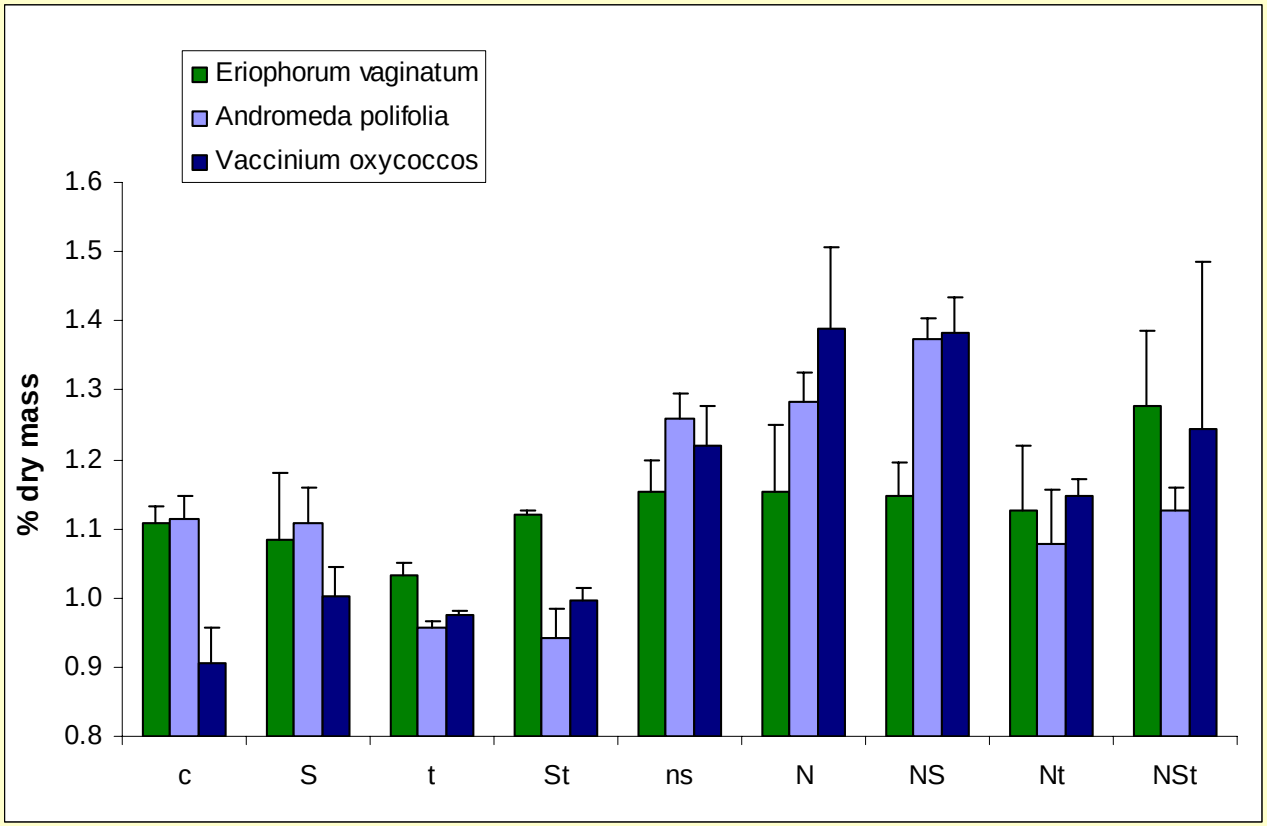
nitrogen & temperature

Vegetation cover of the three vascular plants in %

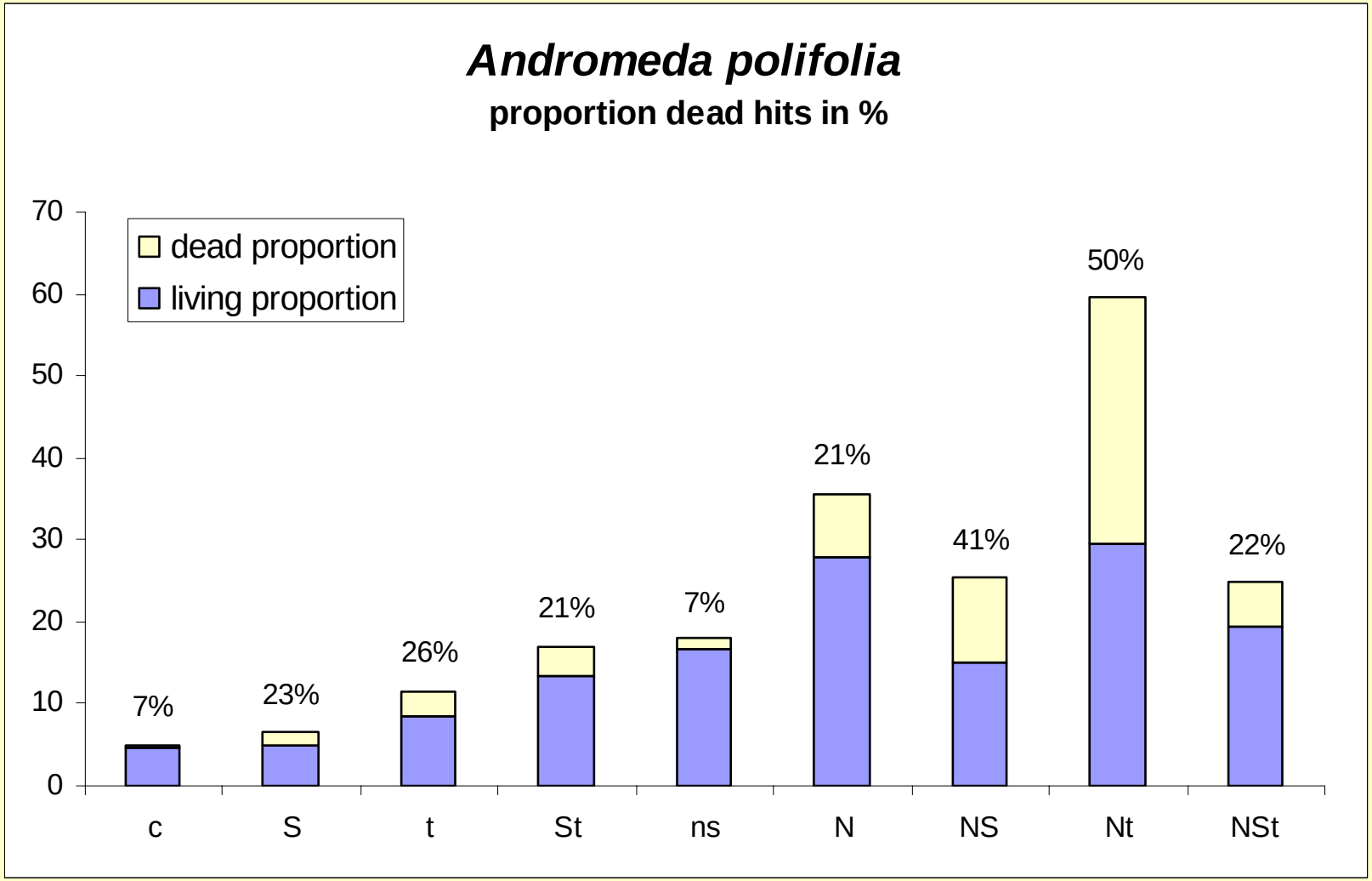


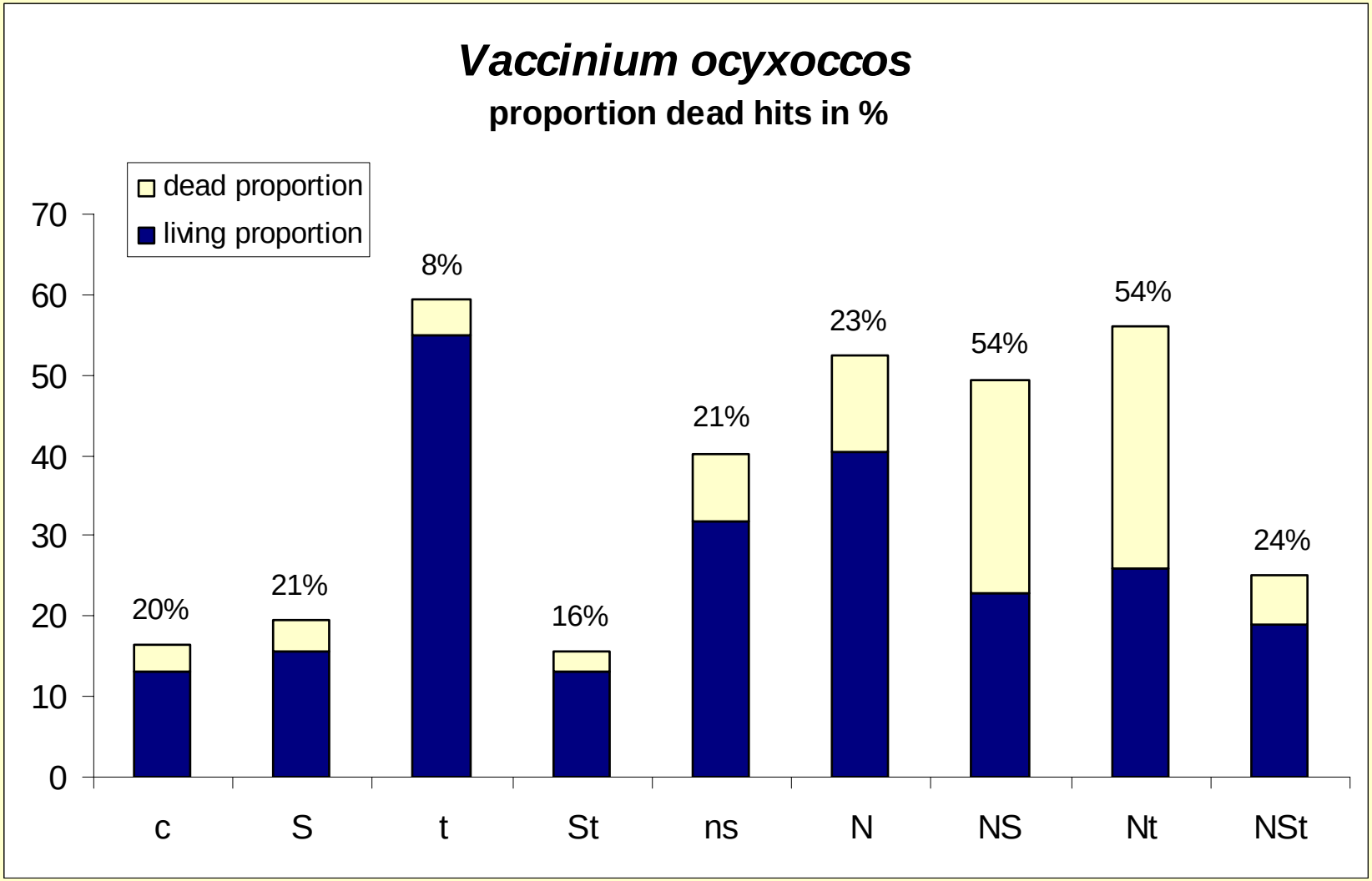
factors	d.f.	F	model sig.	R^2	Sig. model factors	
E. vaginatum	F1,15	48.7	***	0.76		+T***
A. polifolia	F2,14	14.6	***	0.68	+N***	+T**
V. oxycoccos	F1,15	4.6	*	0.24	+N*	

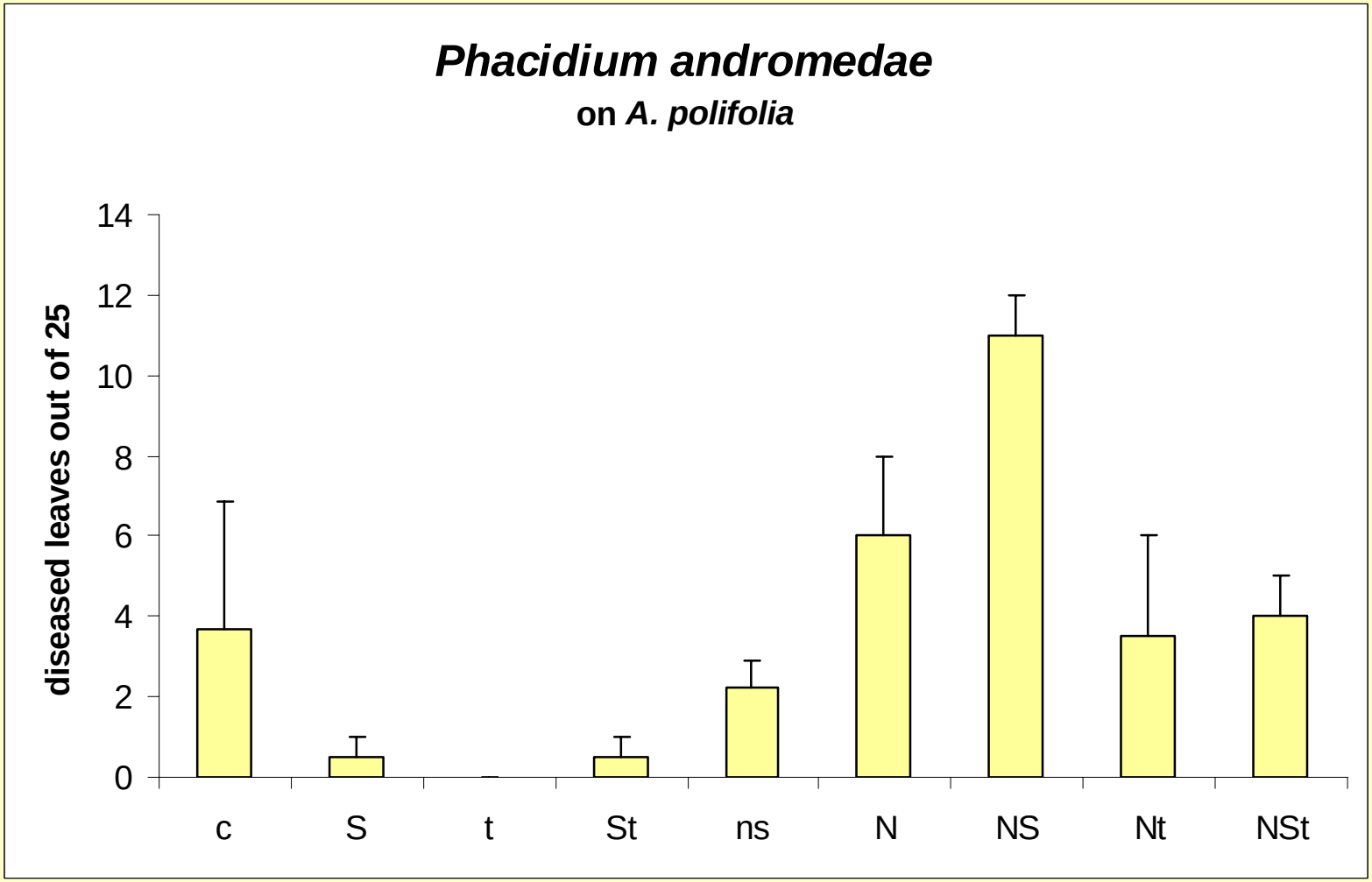
Leave nitrogen content of the three vascular plants in % dry weight

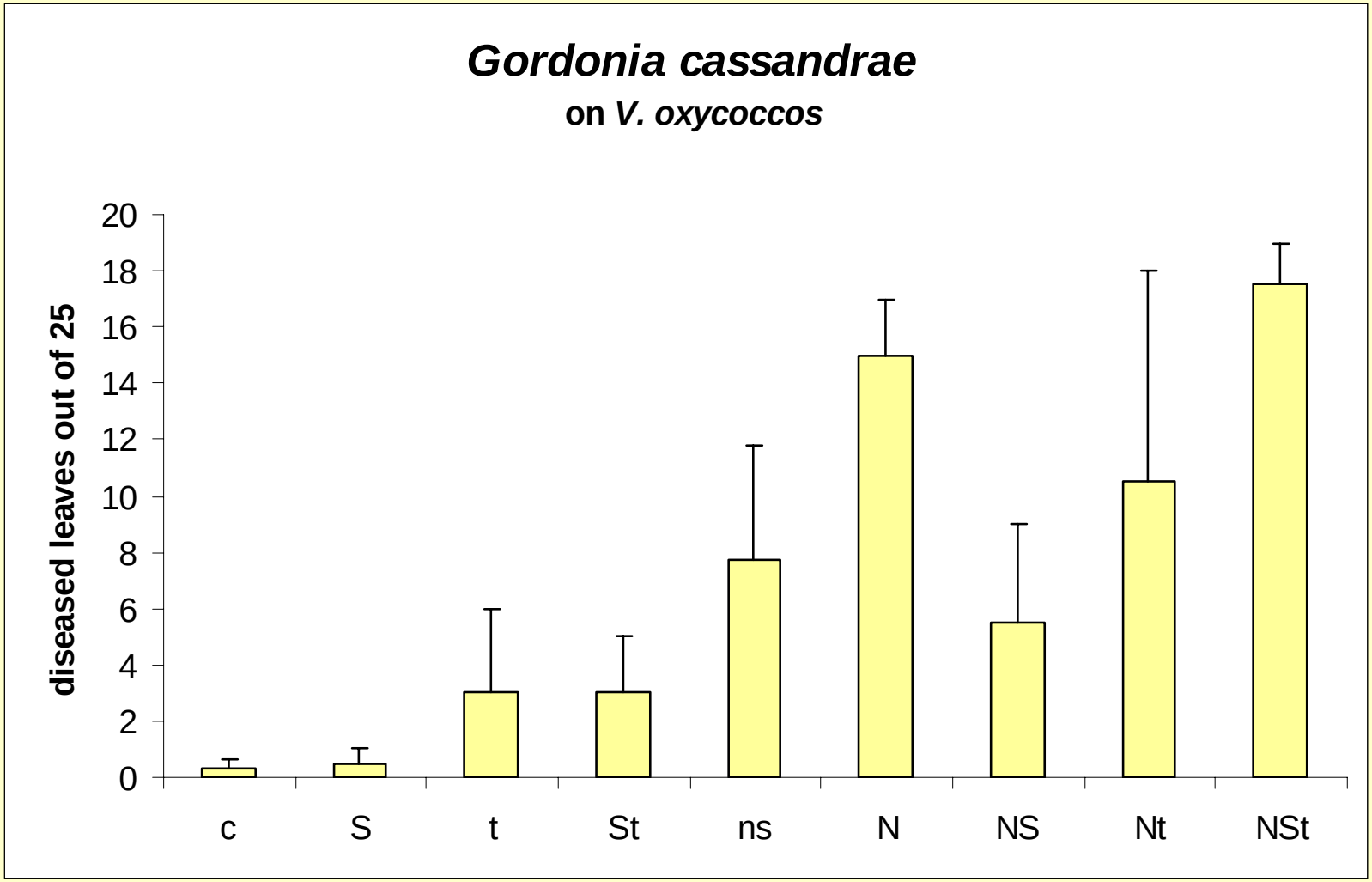


factors	d.f	F	model sig.	R^2	Sig. model factors	
E. vaginatum			n.s.			
A. polifolia	$F_{2,14}$	38.8	***	0.85	+N***	-T***
V. oxycoccos	F1,15	25.5	***	0.63	+N***	

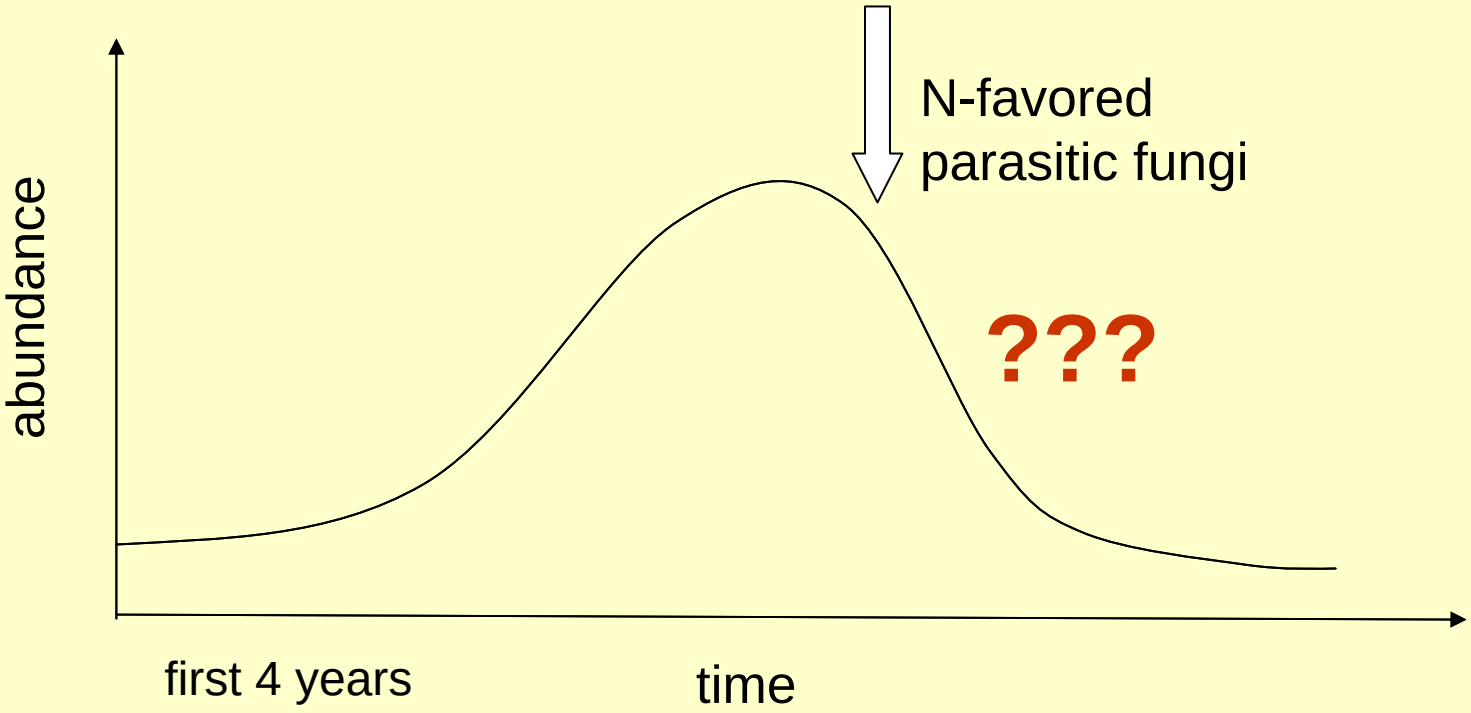

Andromeda polifolia
proportion dead hits in %
dead proportion
living proportion
70
60
50
40
30
20
10
0
7%
23%
26%
21%
7%
21%
41%
50%
22%
c
S
t
St
ns
N
NS
Nt
NSt


Vaccinium ocyxoccos
proportion dead hits in %
dead proportion
living proportion
70
60
50
40
30
20
10
0
20%
21%
8%
16%
21%
23%
54%
54%
24%
c
S
t
St
ns
N
NS
Nt
NSt


Phacidium andromedae
on A. polifolia
diseased leaves out of 25
14
12
10
8
6
4
2
0
c
S
t
St
ns
N
NS
Nt
NSt

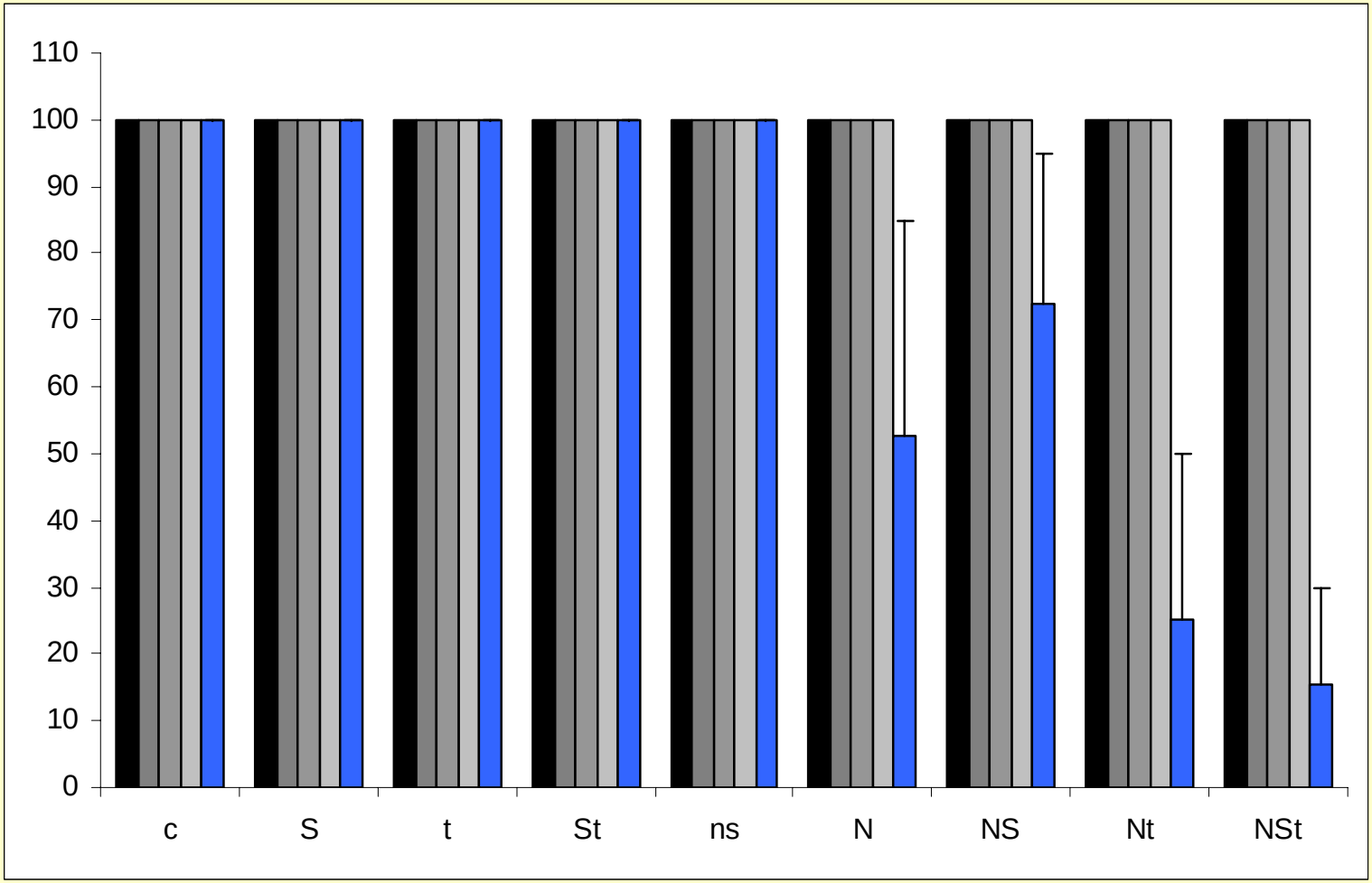

Gordonia cassandrae
on V. oxycoccos
diseased leaves out of 25
20
18
16
14
12
10
8
6
4
2
0
c
S
t
St
ns
N
NS
Nt
NSt

Hypothetical reaction of vascular plants to enhanced nitrogen supply



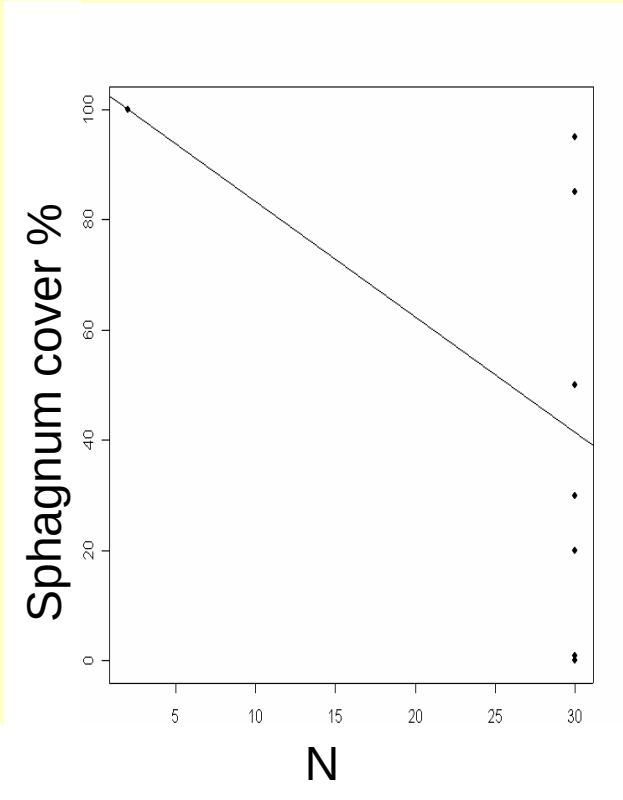
Time lag!!

Sphagnum ssp. cover in %



Time series 1995 - 96 - 97 - 98 - 2003

sphagnum ~ nitrogen



	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	104.1875	8.6995	11.976	0.000 ***
N	-2.0938	0.4217	-4.965	0.000 ***

Residual standard error: 24.3 on 15 degrees of freedom

Multiple R-Squared: 0.6217

F-statistic: 24.66 on 1 and 15 DF, p-value: 0.0001694

Chemical analyses of the three *Sphagnum* species

- C/N ratio
- Chlorophyll content
- Amino acid concentrations
- Soluble carbohydrates +
- Sphagnan
- C/P ratio

The vegetation response and the reaction of parasitic fungi will soon be available in: “**Global change shifts vegetation and plant-parasite interactions in a boreal mire”** (Ecology; in press)

Data on Sphagnum tissue chemistry remains to be published - hopefully soon

..... so far

it remains an open question whether nitrogen has a direct toxic effect on *Sphagnum* ssp., or microorganisms such as bacteria and fungi are favoured and in turn degrade Sphagnum tissue.

However, Sphagnum death might have direct impacts on

Climate change

Sphagna are key species

ecosystem change

reduced C - sequestration

enhanced methane emission

Scenarios of ecosystem change

Temperature

drier conditions – **bogs**

Sphagnum fuscum

Eriophorum vaginatum

dwarf shrubs

Nitrogen

wetter conditions – more **nutrient rich minerotrophic mire**

sedges and brown mosses

no Sphagna

Nitrogen & Temperature

drier conditions

no Sphagna

graminoid dominance

(dwarf shrubs)

deciduous shrubs and trees

succession to forest community

Where are we heading???


Thank you for your attention!!