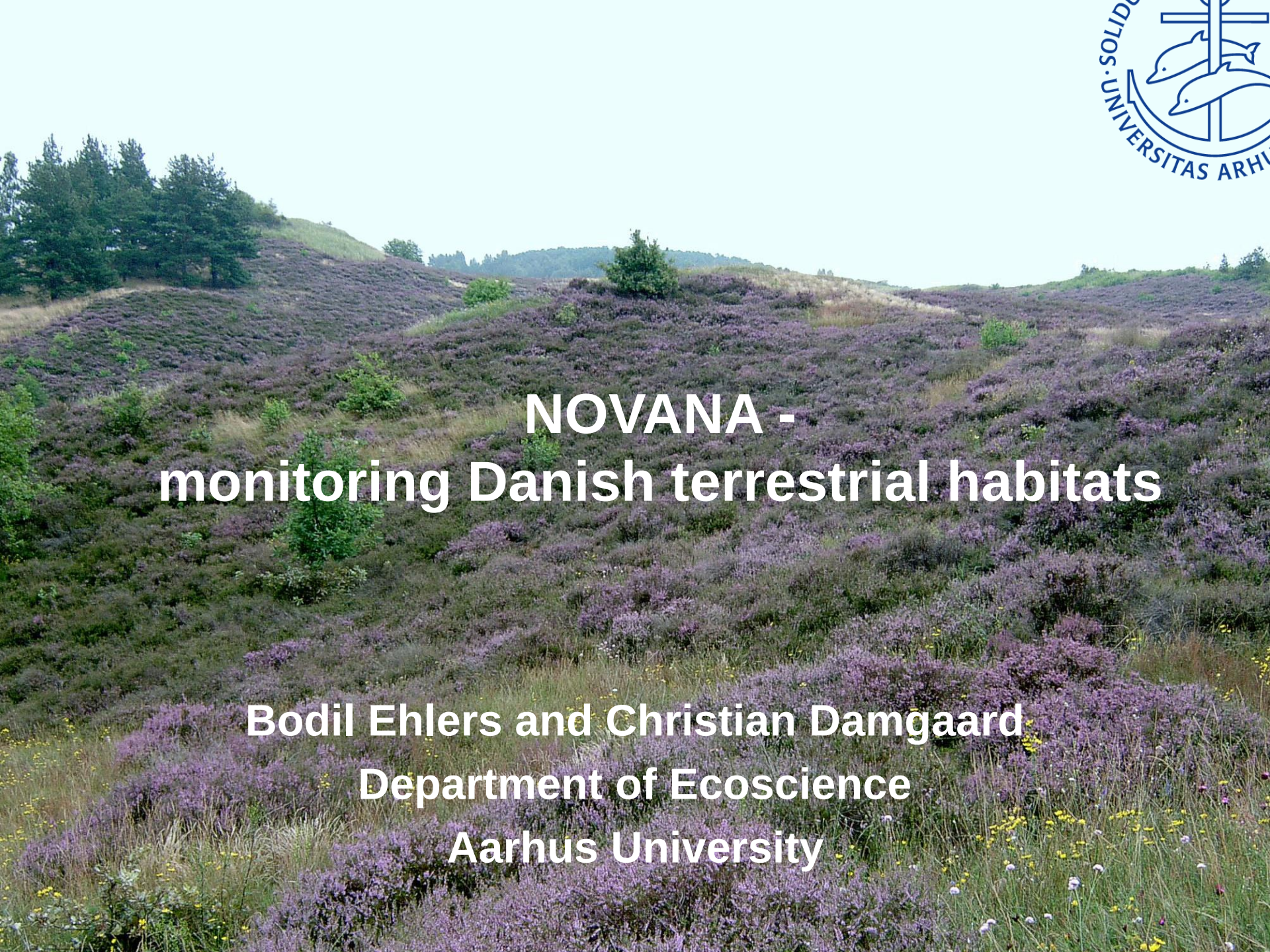


NOVANA - monitoring Danish terrestrial habitats

Bodil Ehlers and Christian Damgaard
Department of Ecoscience
Aarhus University

Monitoring habitat types since 2004

- Habitat types
  - 32 open habitat types (dunes, heathlands, grasslands, bogs)
  - 10 forest habitat types
- 2 bioregions (Atlantic, Continental)
- 2722 sites
- 26606 plots
- 70481 plots*year

- https://novana.au.dk/

Monitoring habitat types since 2004

Plot 0.5x0.5 m:
Cover of plant species (pin-point)
Vegetation height
Leaves: N, P
Soil sample: pH, C, N, P

5 m circle:
Presence - plant species
Cover of selected species
Cover of plants affected by herbivory
Grazing or moving
Gaps in vegetation/bare soil/sand
Other structures

Resampled with GPS uncertainty since 2004

Plot data - higher plants

- Absence – presence data
  - Circle - 5m radius
- Plant cover data using the pin-point method
  - 16 pins per plot
  - Single species: beta-binomial distribution
  - More species: multinomial-Dirichlet distribution
  - Possible to compare with e.g. Braun-Blanquet cover data

Are ongoing trends in plant species richness associated with the decline in insect abundance and diversity?

ECOLOGY

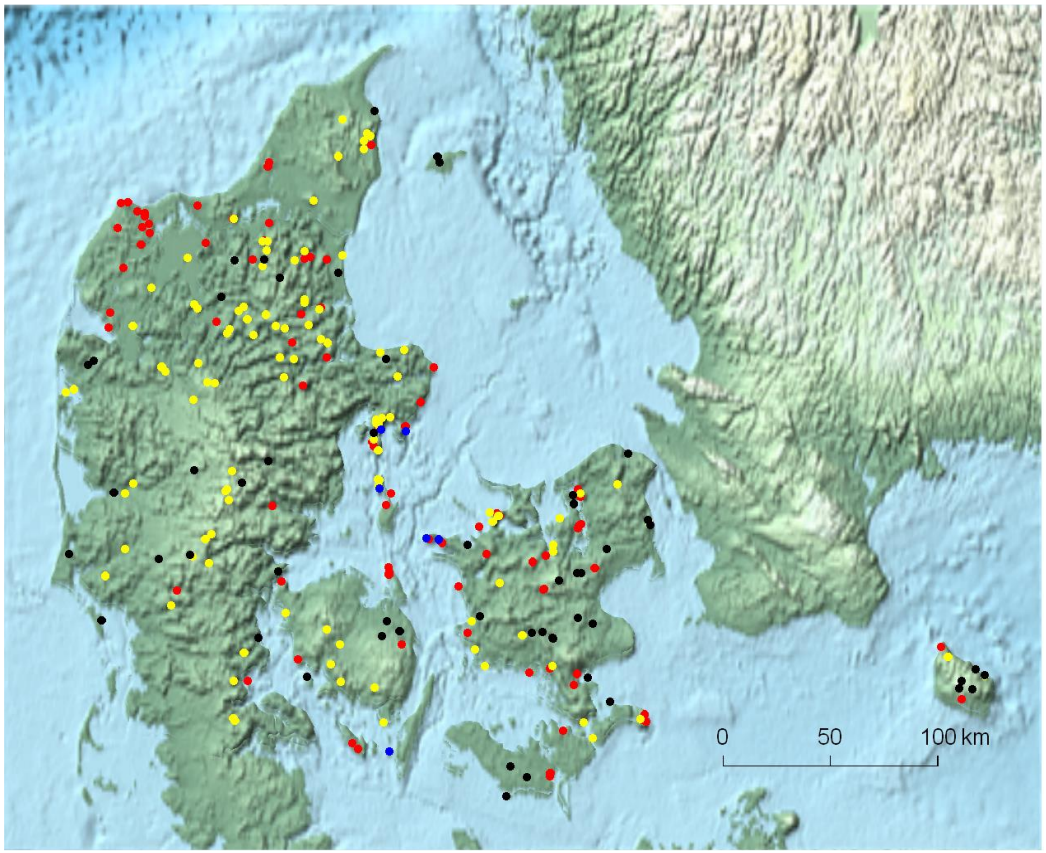
Plant extinctions take time

Many plant species may already be functionally extinct

By **Quentin Cronk**

Parallel Declines in Pollinators and Insect-Pollinated Plants in Britain and the Netherlands

J. C. Biesmeijer,[1*] S. P. M. Roberts,[2] M. Reemer,[3] R. Ohlemüller,[4] M. Edwards,[5] T. Peeters,[3,6] A. P. Schaffers,[7] S. G. Potts,[2] R. Kleukers,[3] C. D. Thomas,[4] J. Settele,[8] W. E. Kunin[1]



- 6120: Sand calcareous (6)
- 6210: Dry calcareous (98)
- 6230: *Nardus* grassland (111)
- 6410: *Molina* meadow (53)

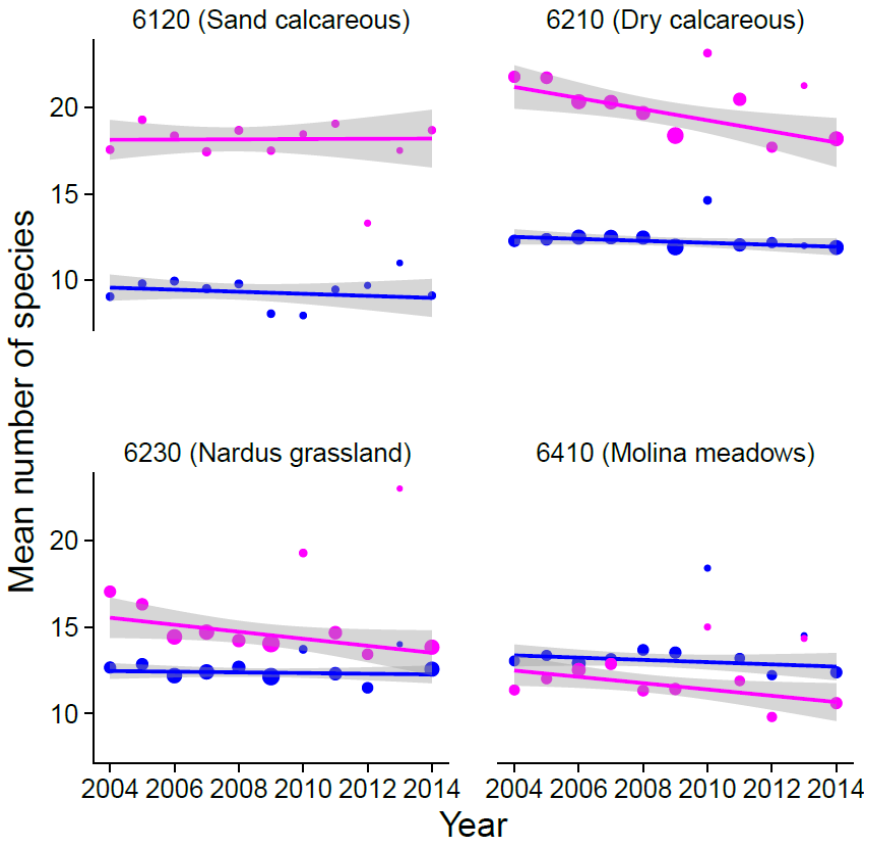
244 Sites/6242 plots

Each site monitored at least 3 times from 2004-14 (average 4.25)

Wind pollinated (245 species) **Insect pollinated (518 species)**

Extracted records of all flowering plant species recorded found in the plots, and used Floras & literature to determine main pollination mode of each species



A significant decline in number of insect pollinated plant species in all grassland types (except 6120 (only represented by 6 sites))

Pink: Insect pollinated species
Blue: wind pollinated species

Decline in insect pollinated plants higher in poorly grazed grasslands.

Grazing index:
Number of years a site was grazed divided by number of years that it was monitored

High/low: >/< 0.5.

Habitat	6120 (6 sites)			6210 (98 sites)			6230 (111 sites)			6410 (53 sites)		
	Slope	Chisq	P	Slope	Chisq	P	Slope	Chisq	P	Slope	Chisq	P
Insect	0.099	1.78	0.18	-0.13	25.9	<0.001	-0.04	4.43	0.035	-0.15	32.4	<0.001
Wind	-0.03	0.80	0.37	0.026	3.55	0.59	0.076	30.99	<0.0001	-0.0055	0.06	0.80
Grazing intensity												
	High	Insect		-0.08	6.79	0.009	-0.01	0.24	0.62	-0.14	12.29	0.00046
	Low	Insect		-0.24	32.76	<0.0001	-0.23	19.23	<0.0001	-0.16	20.5	<0.0001
	High	Wind		0.04	5.32	0.02	0.06	17.32	<0.0001	-0.049	1.95	0.16
	Low	Wind		-0.003	0.02	0.66	0.15	16.45	<0.0001	0.037	1.77	0.18

“Specialized”: e.g. Boraginaceae, Caryophyllaceae, Fabaceae





“Generalized”: e.g. Asteraceae, Apiaceae, Ranunculaceae



Plants with specialized pollination decline the most

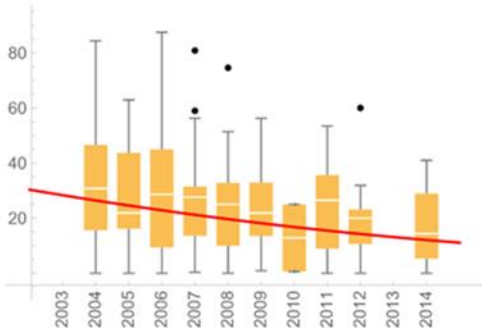
Habitat	6120 (6 sites)			6210 (98 sites)			6230 (111 sites)			6410 (53 sites)		
	Slope	Chisq	P	Slope	Chisq	P	Slope	Chisq	P	Slope	Chisq	P
Specialized	0.06	3.6	0.06	-0.06	31.8	<0.0001	-0.03	9.17	0.002	-0.12	14.41	0.0002
Generalized	0.03	0.62	0.43	-0.03	4.6	0.03	0.02	2.26	0.13	-0.15	48.4	<0.0001

Conclusions

- Ongoing decline in insect pollinated plants across grasslands
- Wind pollinated plants either stable or increasing
- Higher loss of insect pollinated plants when sites are not grazed (varied with grassland type)
- Higher loss of insect pollinated plants with more “specialized” pollination

Changes in species cover

- **Wet heathlands - *Erica tetralix***

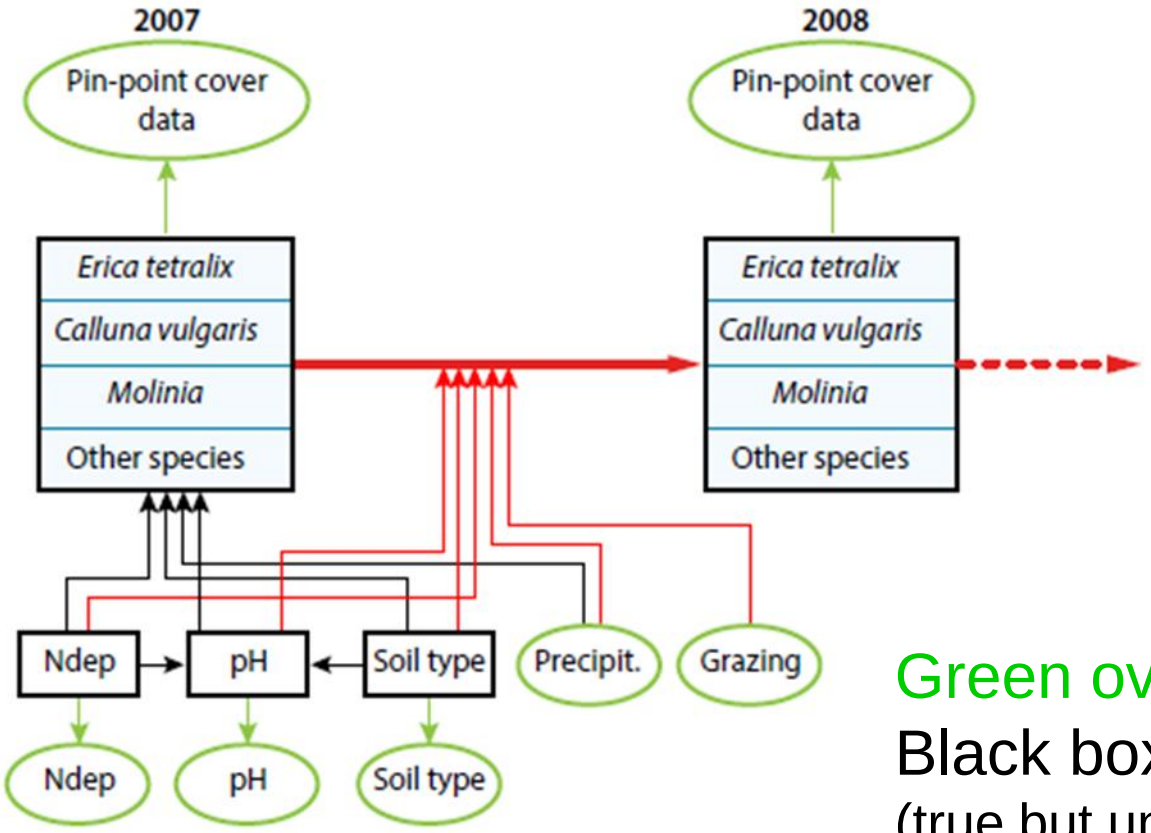


- **Dry heathlands - *Molinia caerulea* – increase in cover**

- **Grasslands:**
  - **Decline in the cover of species with large seeds**
  - **Decline in the cover of species with thin leaves**
  - **Decline in the cover of species with Grime R strategy**

Can we use the monitoring data to generate local prediction that may be used in adaptive management?

Spatial and temporal model



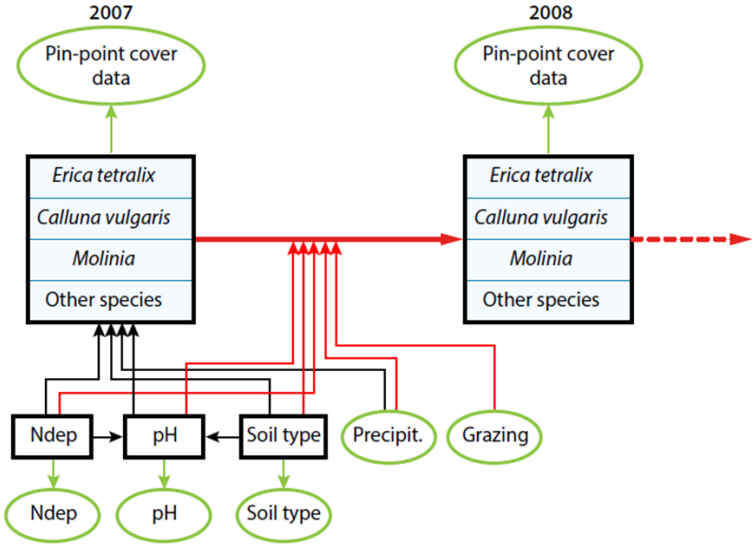
Green oval: data

Black box: latent variables
(true but unknown values)

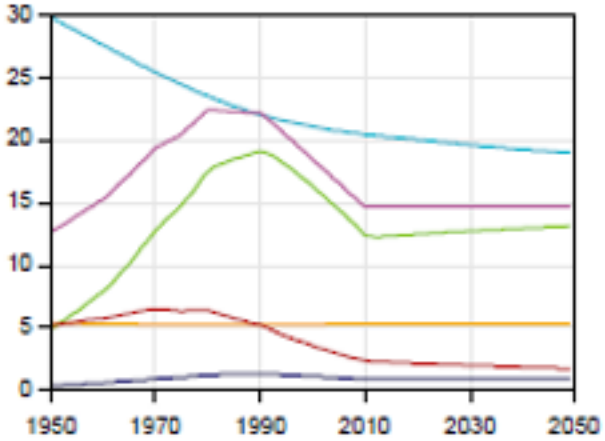
Black arrow: spatial proc.

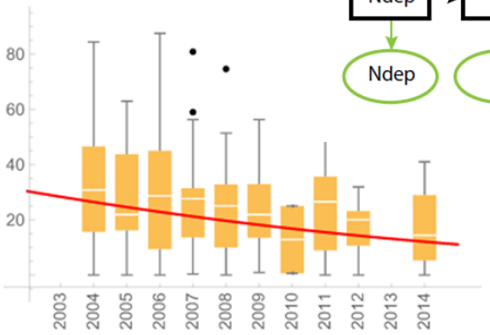
Red arrow: temporal proc.

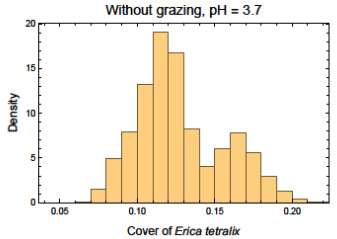
Local ecological predictions

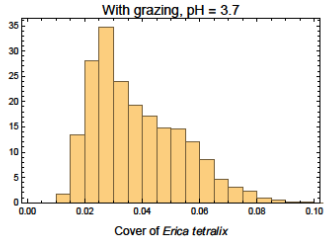


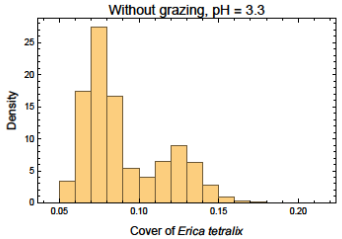
Long term N balance

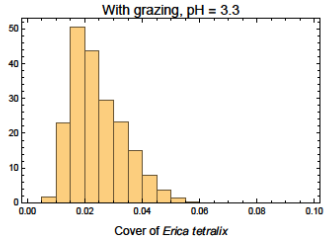












Initial cover: 5%

Use ecological predictions as input to local adaptive management plan

- Workshop with local stakeholders
  - Quantitative local predictions
    - Site specific soil conditions, pH, climate, …
    - Uncertainties
  - Involve local stakeholders
    - Management objectives
    - Historic management
    - Other local knowledge and constraints
    - Local interests – e.g. fencing and animal welfare