Effect of mono- and mixed grazing of cattle and sheep on grassland diversity patterns

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Background

Plant diversity ⇨ Ecosystem functions

- ⇨resource use (Hooper & Vitousek, 1998)
- ⇨productivity (Tilman et al., 2006; van Ruijven & Berendse, 2007)
- ⇨stability (Dodd, Barker & Wedderburn, 2004)

Grassland maintenance ⇨ management

Grazing ⇨ sward heterogeneity ⇨ plant diversity ↑


- ⇨control of dominant species: coexistence of subordinates
- ⇨gaps: seedling establishment

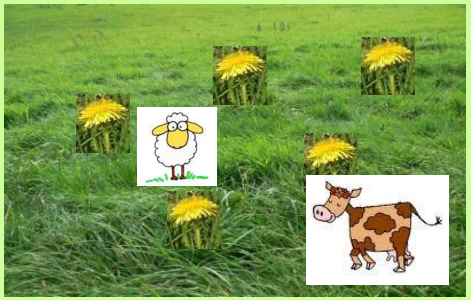
Hypotheses

1. Vegetation composition differs after grazing with cattle or sheep.

⇨ Differences in forage selectivity, treading, excretion pattern

http://www.beautys.de/v/wiese+gruene+wiese+rasen+gras+grasflaeche+2.html
http://www.schafis.com/

2. The homogeneity of the vegetation is higher in co-grazed compared to mono-grazed pastures.



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http://www.onlinekunst.de/bauernregeln/mai.htmlhttp://www.rund-um-schulmilch.at/kuhgeheimnis/wiekueheaussehen/

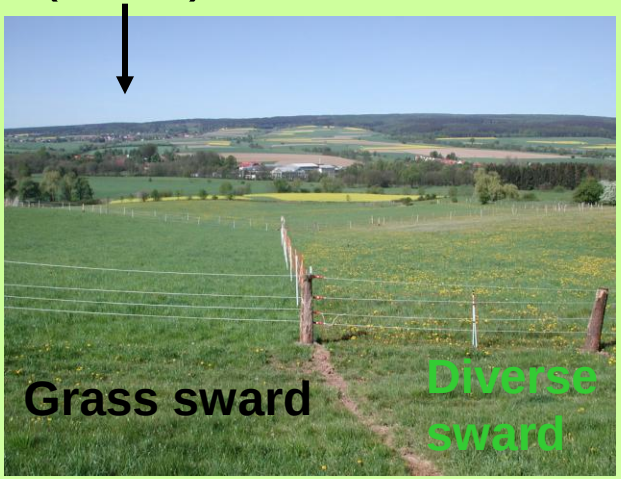
⇨ Complementary forage use
⇨ Homogeneous utilisation & disturbance

Experimental site

> 16 years: pastures
Soil: Pelosol (texture: clayey/silty loam)

Lolio- Cynosuretum

Herbicide (2006)



9.2 ± 2.5 13.8 ± 3.7

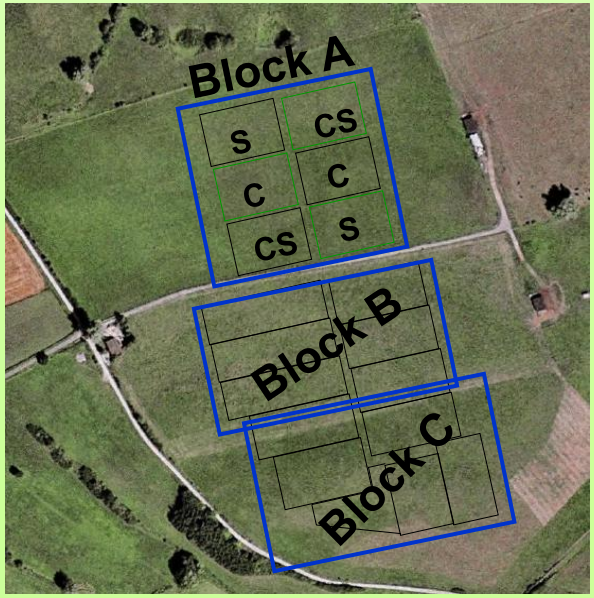
Plant species (mean ±s.d.), 2007
basis: 5 x 9 m² per paddock

Experimental site

Solling Uplands, Germany
(51°46’47.85” N, 9°42’11. 71” E ;
184-209 above sea level)

Precipitation: 879 mm
Mean annual temperature: 8.2 °C

Design



Factor	Level
Sward type	Grass sward
	Diverse sward
Grazing variant	Cattle (C)
	Sheep (S)
	Co-grazed (CS)
Replications	3 Blocks

- paddock: 0.5 ha
- rotational grazing: 12 to 8 LU ha^{-1} (1 LU = 500 kg)
  - ⇨ 3 times/ year
  - ⇨ 7- 14 days
  - ⇨ May–September

Experimental animals

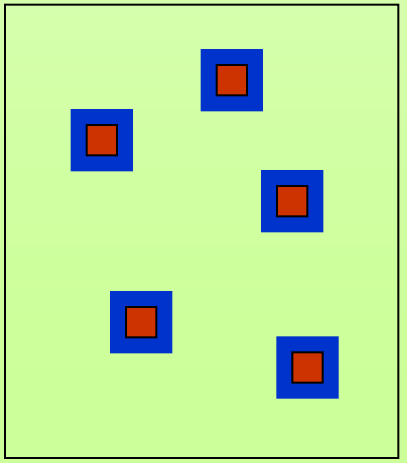
Blackheaded & Leine
(ewes & lambs)

German Simmental
(cows & calves)

Measurements of diversity patterns (2007-2009)

(May/June):

- plant species number & yield proportion (Klapp & Stählin, 1936)
- plant species

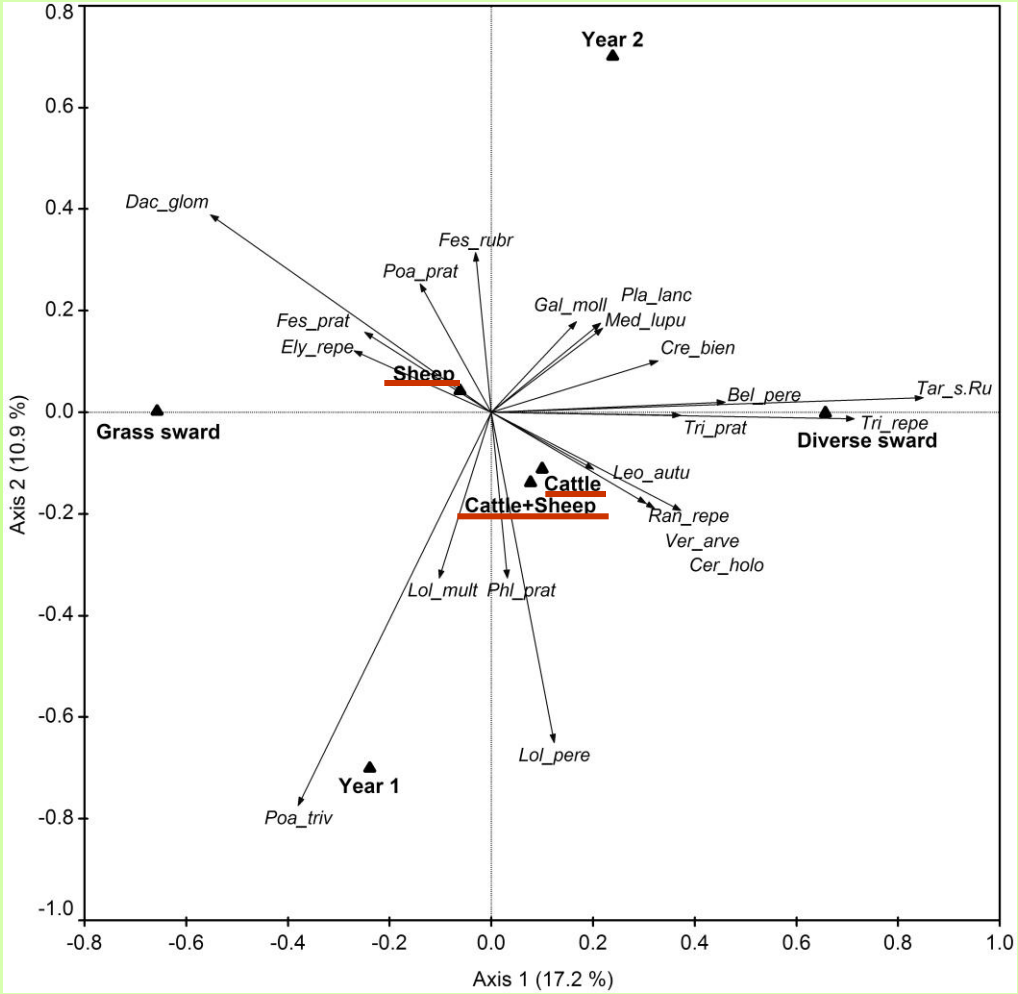


after grazing

- Sward height: 50 measurements/ paddock (Castle, 1976)

⇨ Multivariate & univariate analyses

Effects of grazing on vegetation composition



Principal component analysis (PCA)

Variables:

year, sward type, grazing variant

Covariables:

spatial factors (slope, blocks)

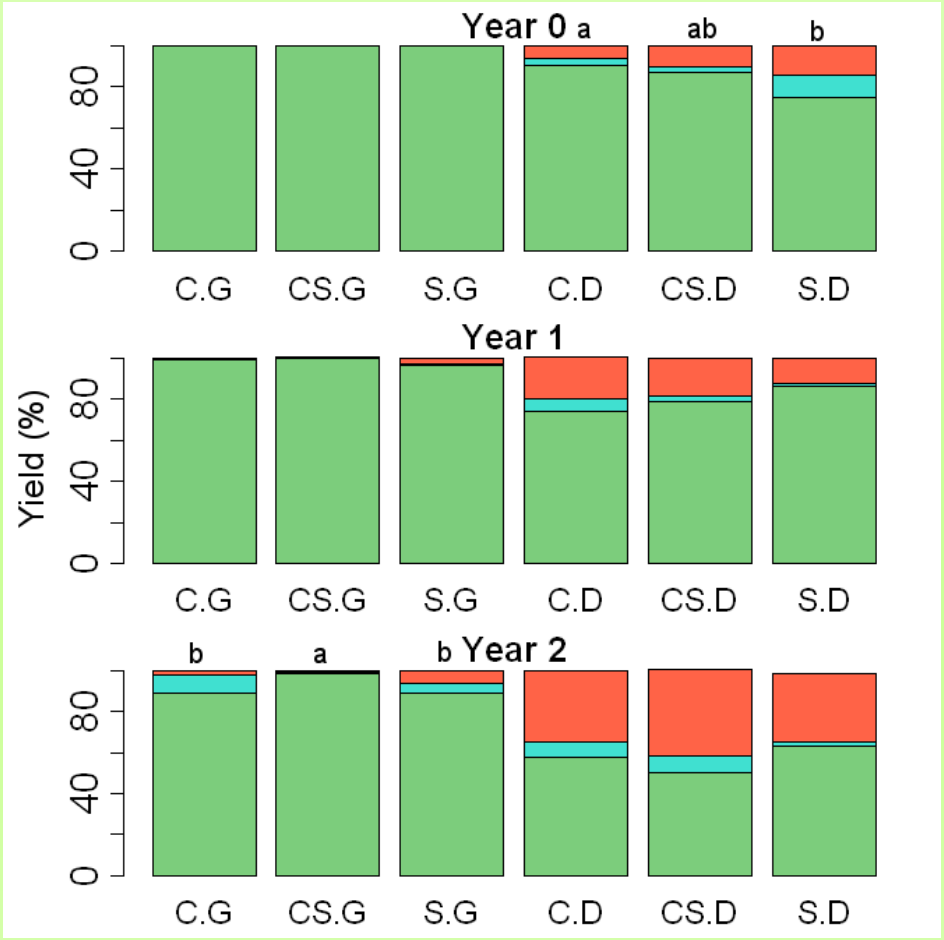
Species fit range: 5-100 %

Species names: 3+4 first letters.

1. Year, Sward & grazing effects (RDA: Monte Carlo permutation test)

2. Cattle & co-grazing: similar vegetation composition (PCA)

Grazing effects on functional groups (% Yield)



Year effect ☑ 👎 ☑ ☑ ☑ ☑

C: cattle
S: sheep
CS: C+S

forbs
legumes
grass

G/D: grass/ diverse sward

Year 0: before start of grazing

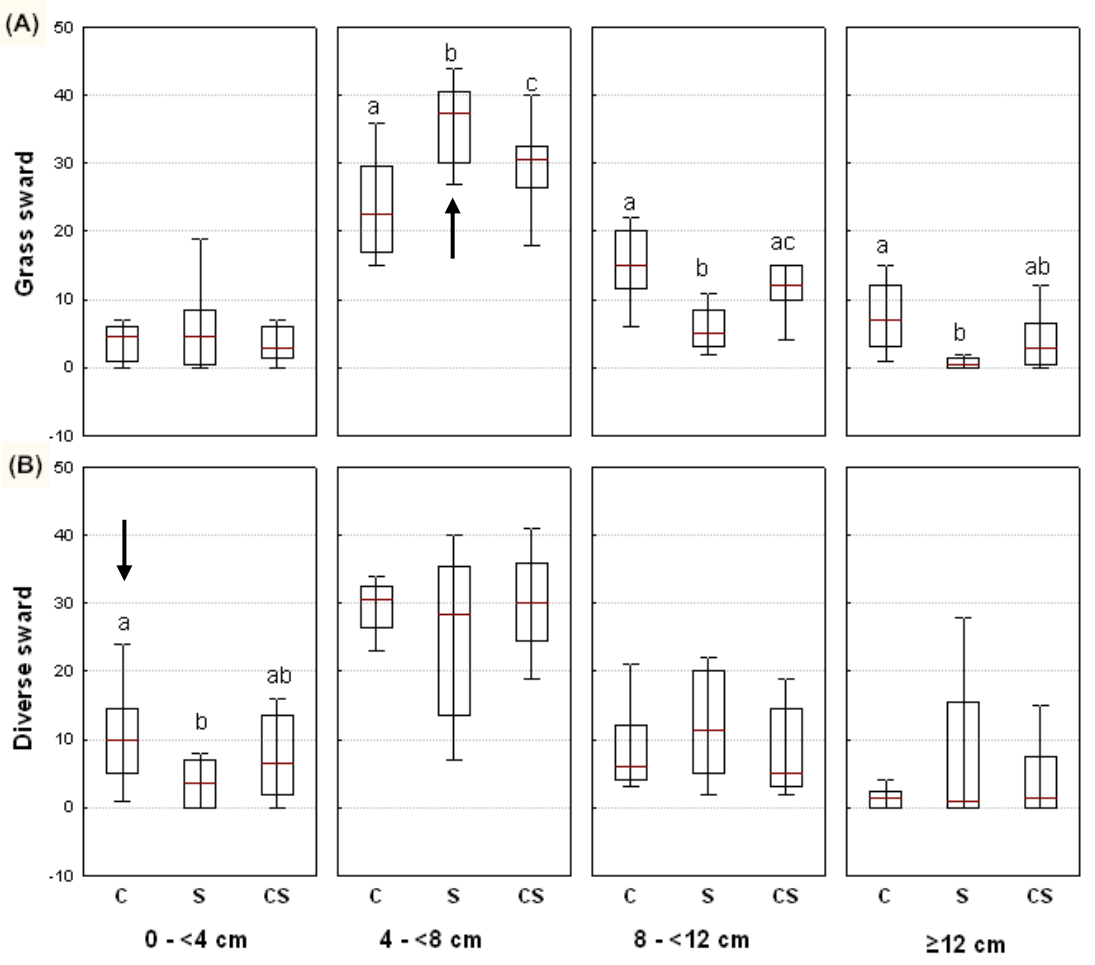
Year 1/ 2: after 1/ 2 years of grazing

Small letters: grazing variants differ within one sward ($p < 0.05$).

Statistics: Chi^2 or Fisher test.

1. **Dicots ↑**
2. **Sheep: Legumes ↓(diverse sward)**

Grazing effects on sward height structure



C: cattle
S: sheep
CS: Cattle + Sheep
Small letters: grazing variants differ within one sward ($p < 0.05$).
Statistics: repeated measurement ANOVA (Data: 2009).

1. Sheep: low quality (grass sward)

⇨ grazing in short sward areas ↑

2. Cattle: low crude fibre content (diverse sward) ⇨ higher forage intake.

Conclusions

1. Vegetation composition differs after grazing with cattle or sheep. ✓

- ✓ Significant effects on vegetation composition
- ✓ Sward height distributions differed in cattle & sheep pastures
- ✓ legume yield sheep pastures ↓

2. The homogeneity of the vegetation is higher in co-grazed compared to mono-grazed pastures. ☝

- 👎 No effect on vegetation evenness (data not shown)
- ✓ Sward height distributions: intermediate between cattle and sheep plots
- ☞ Vegetation composition of cattle/ co-grazed pastures similar

Conclusions:
Evidence of grazing effects on

✓ Sward structure

✓ Vegetation composition

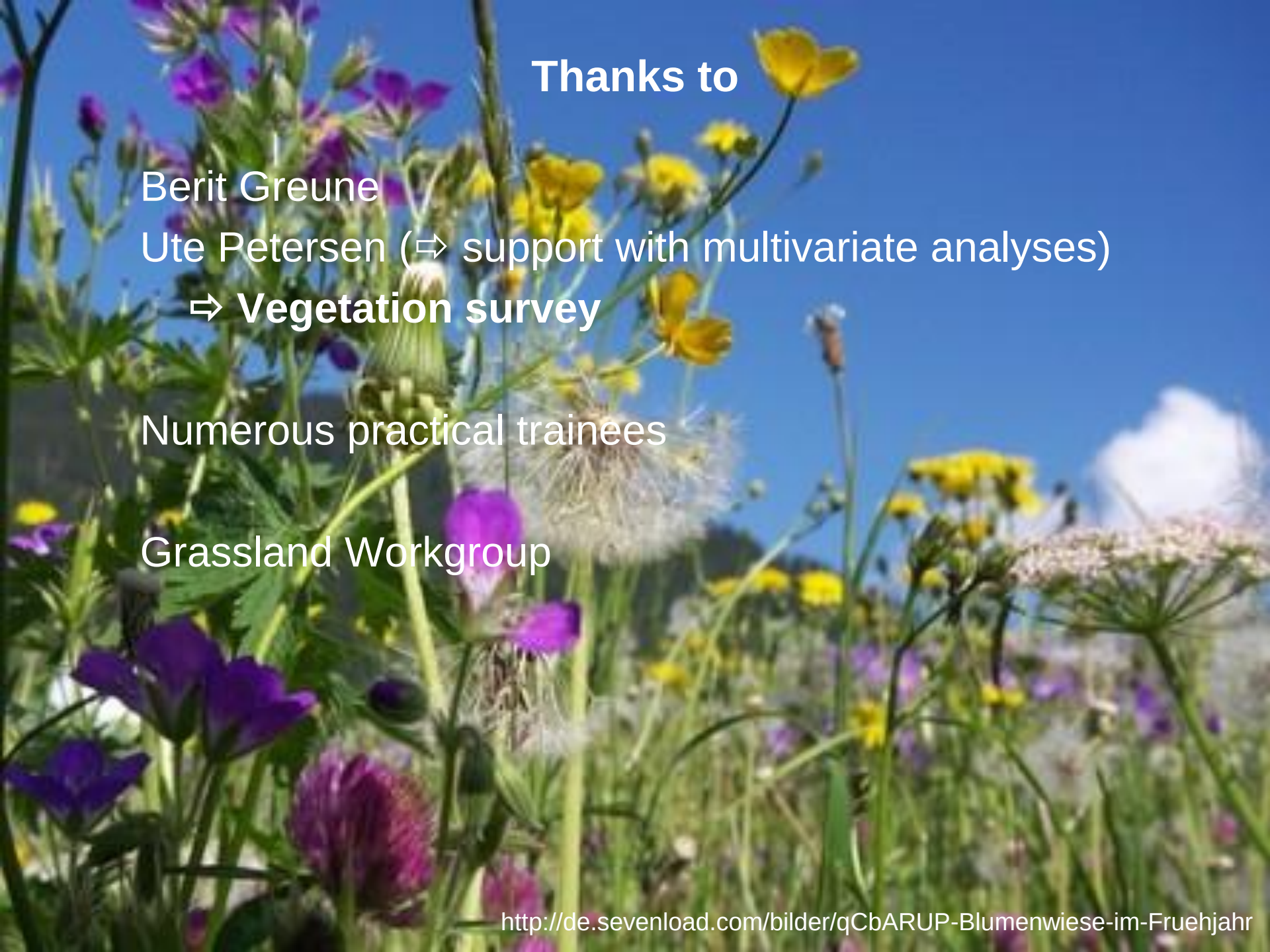
⇨ Grazing effects of cattle & sheep on vegetation

⇨ Co-grazing might be

beneficial to diversity in the long-term

a management option for diversity-targeted grassland

Picture:
http://www.kuh-online.de/



Thanks to

Berit Greune

Ute Petersen (⇨ support with multivariate analyses)

⇨ **Vegetation survey**

Numerous practical trainees

Grassland Workgroup

http://de.sevenload.com/bilder/qCbARUP-Blumenwiese-im-Fruehjahr


Thank you
for your attention!

Conclusions:
Evidence for grazing effects on

- ✓ Sward structure
  - ☞Frequency of different sward height classes differs in cattle & sheep grazed pastures
  - ☞variance coefficients of sward height: cattle > sheep pastures
- ✓ Treading & Forage selectivity
  - ☞dicot yield ↑
    - ⇨ seedling establishment ↑
      coexistence of subordinate species
  - ☞legume yield ↓ in sheep pastures (diverse sward)
    - ⇔Homogeneity of nutrient excretion
  - ☞ trampling tolerance Year 2 > Year 1

Pictures:
http://www.kuh-online.de/

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