Plant ecology and biodiversity

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Objectives

to discuss:

- one aspect of biodiversity: species richness

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- three mechanisms influencing species richness

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- one aspect of biodiversity: species richness

- three mechanisms influencing species richness

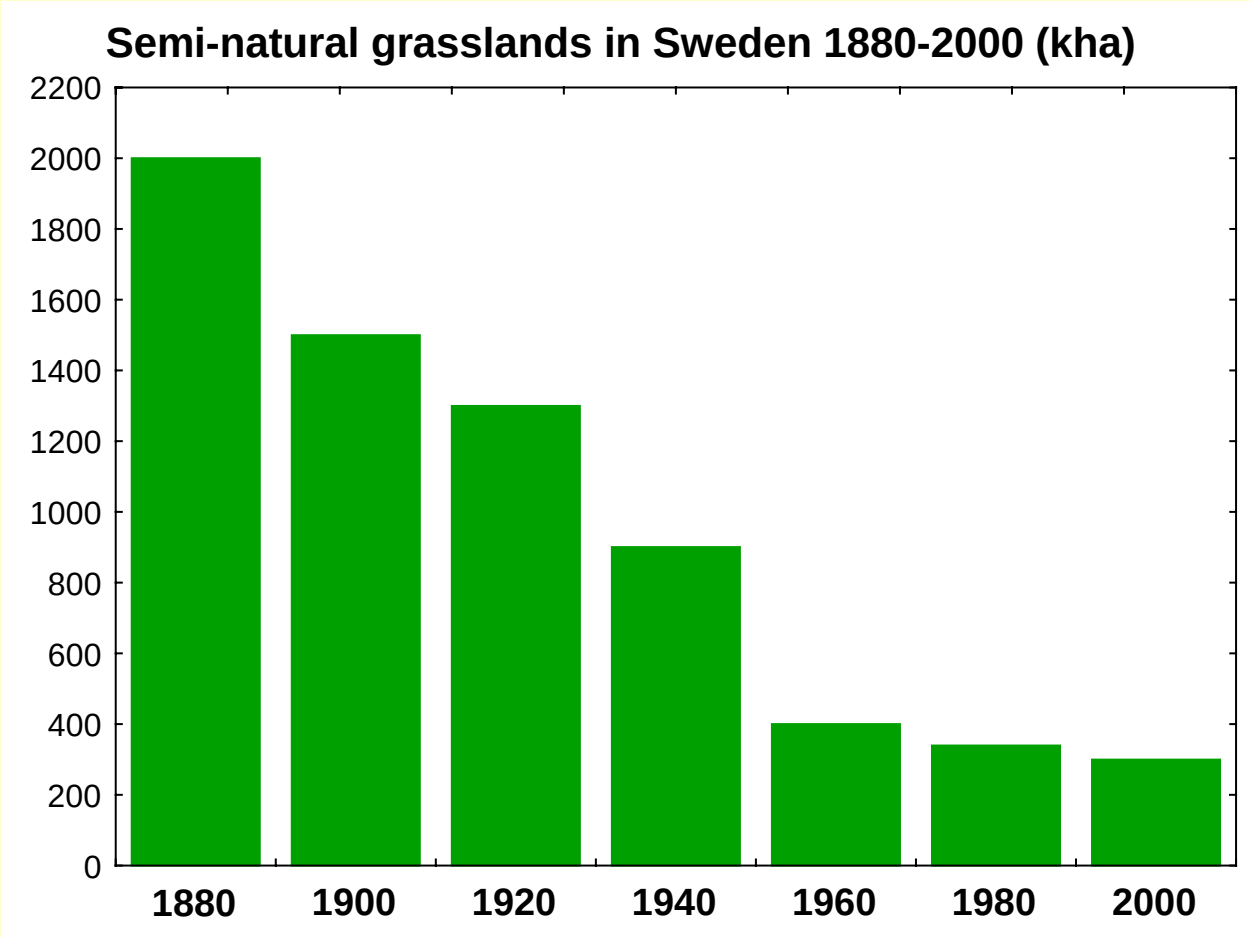
- Scandinavian semi-natural grasslands

Scandinavian semi-natural grasslands

- long management history
- grazing or mowing
- not fertilized

The decline of semi-natural grasslands

(c. 250 000 ha remain today)

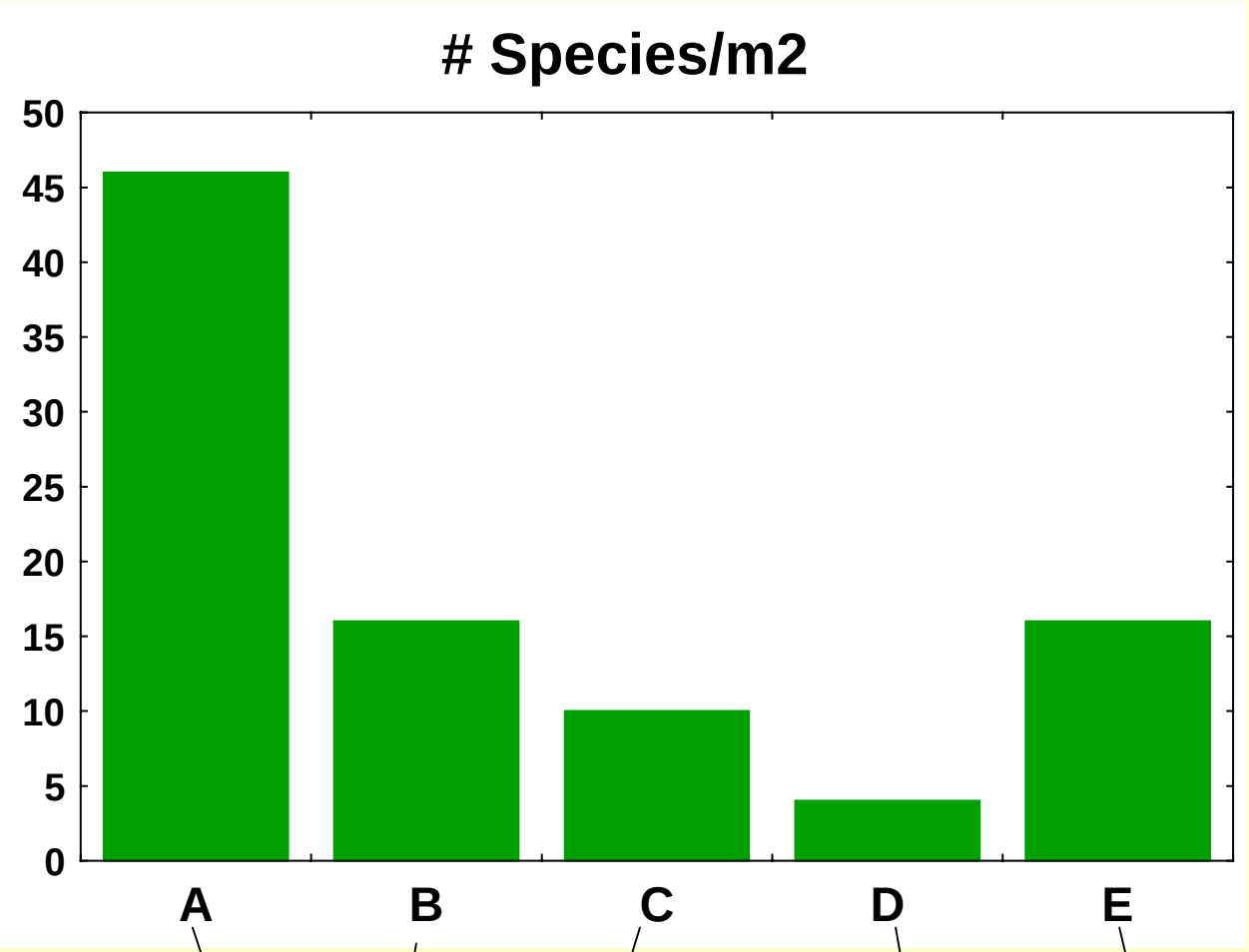


low grazing pressure

forest grazing

abandoned forest grazing

Species richness (density)



semi-natural grasslands

abandoned 10-15 years

abandoned > 15 years

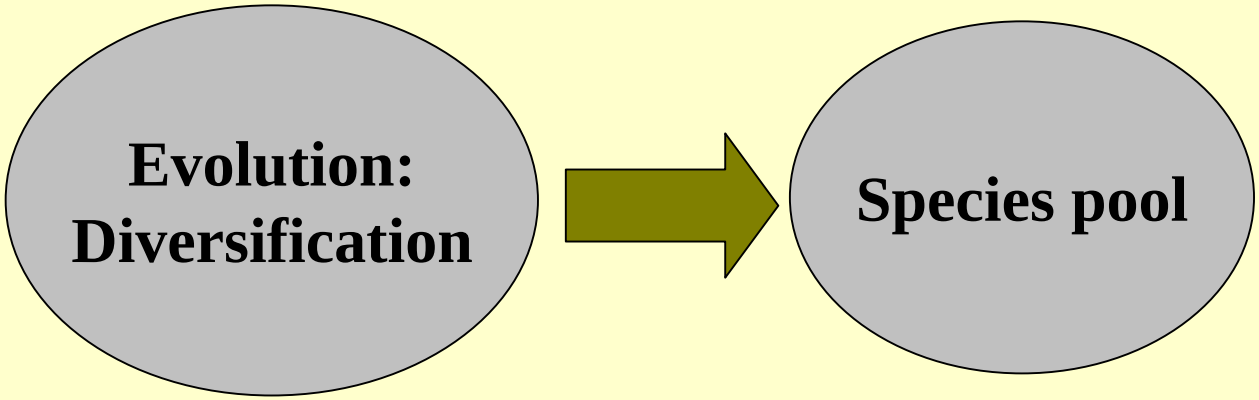
former field, pasture < 5 years

former field, pasture 10-15 years

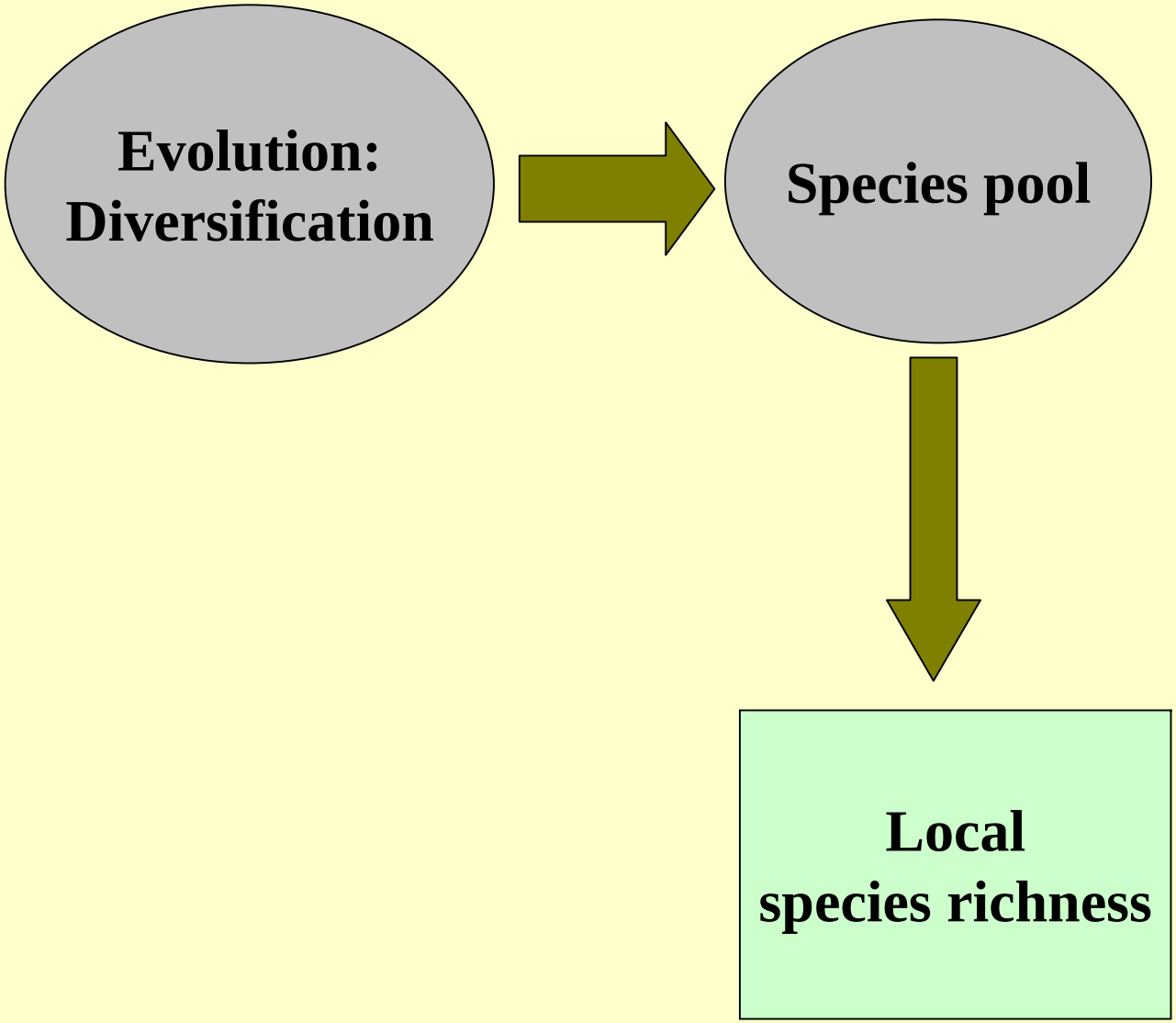
Processes affecting species richness

Evolution: Diversification

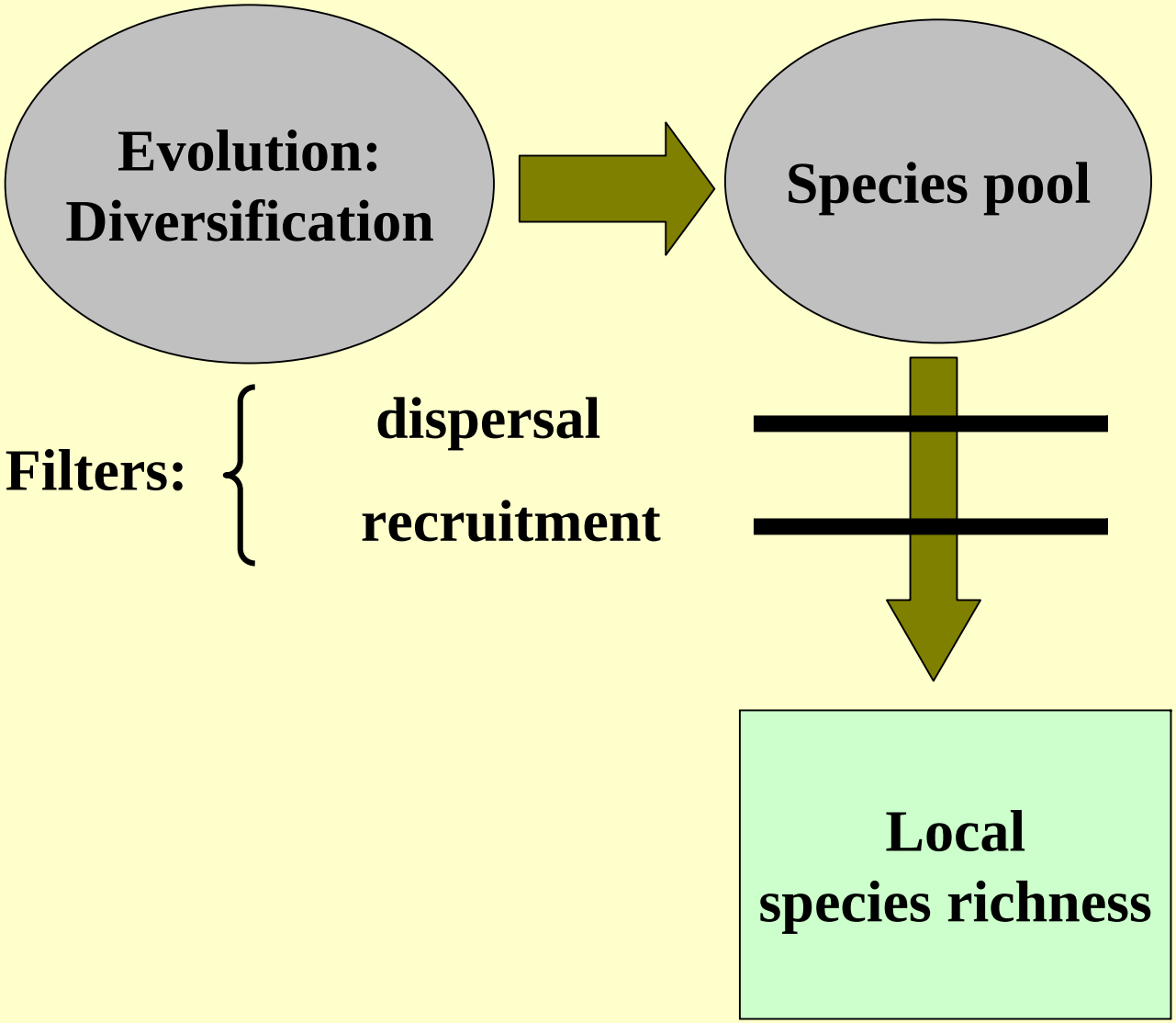
Processes affecting species richness



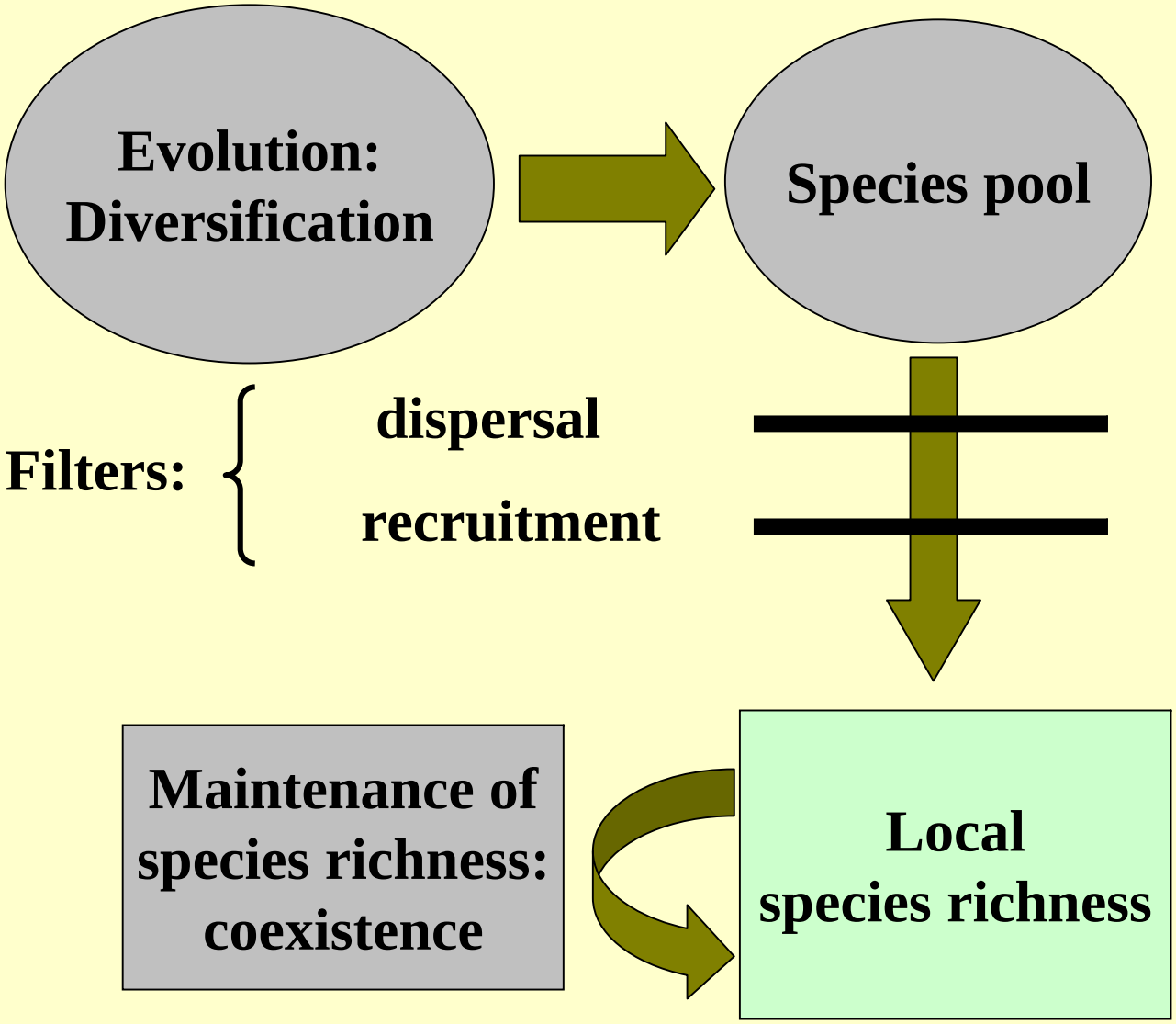
Processes affecting species richness



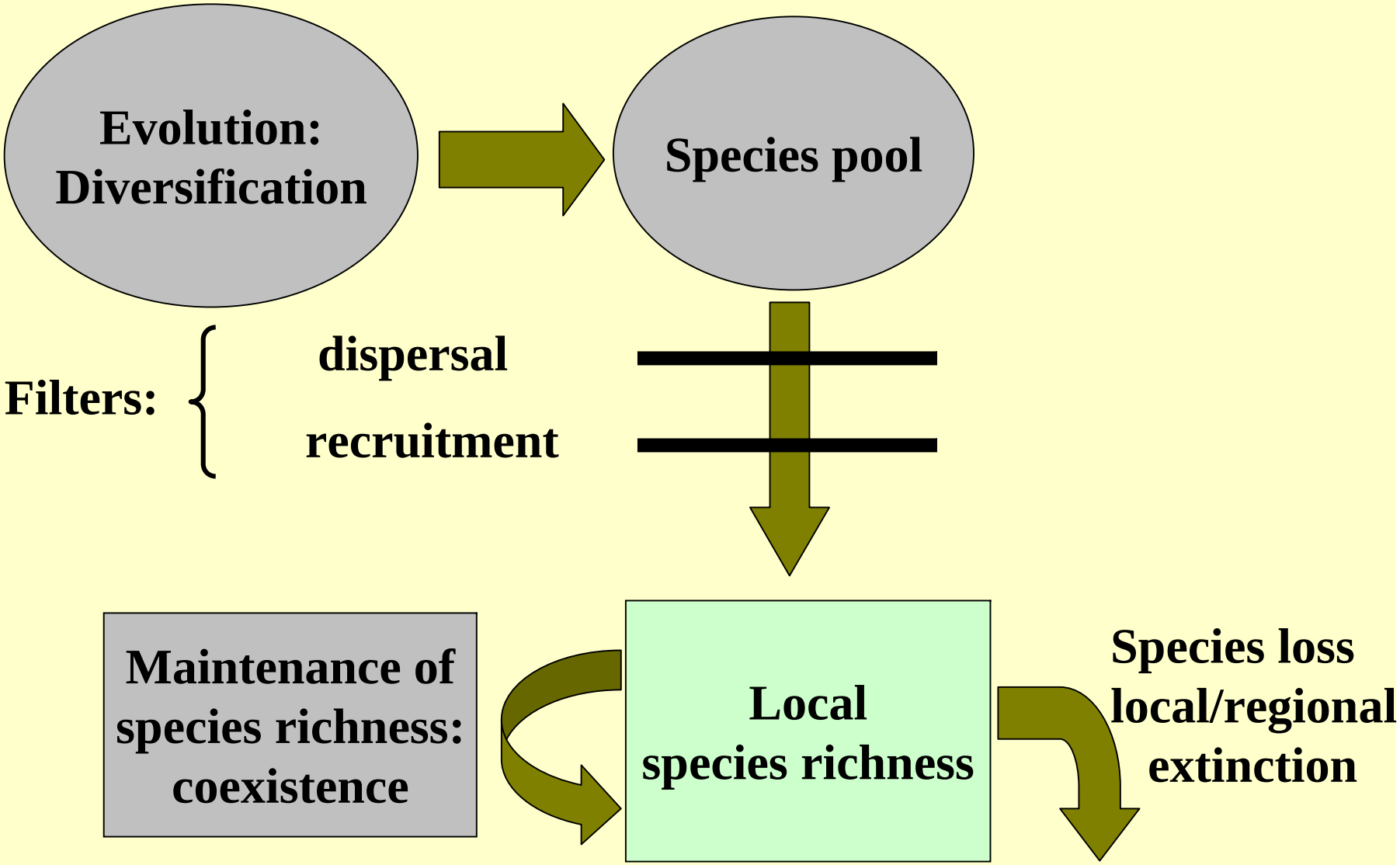
Processes affecting species richness



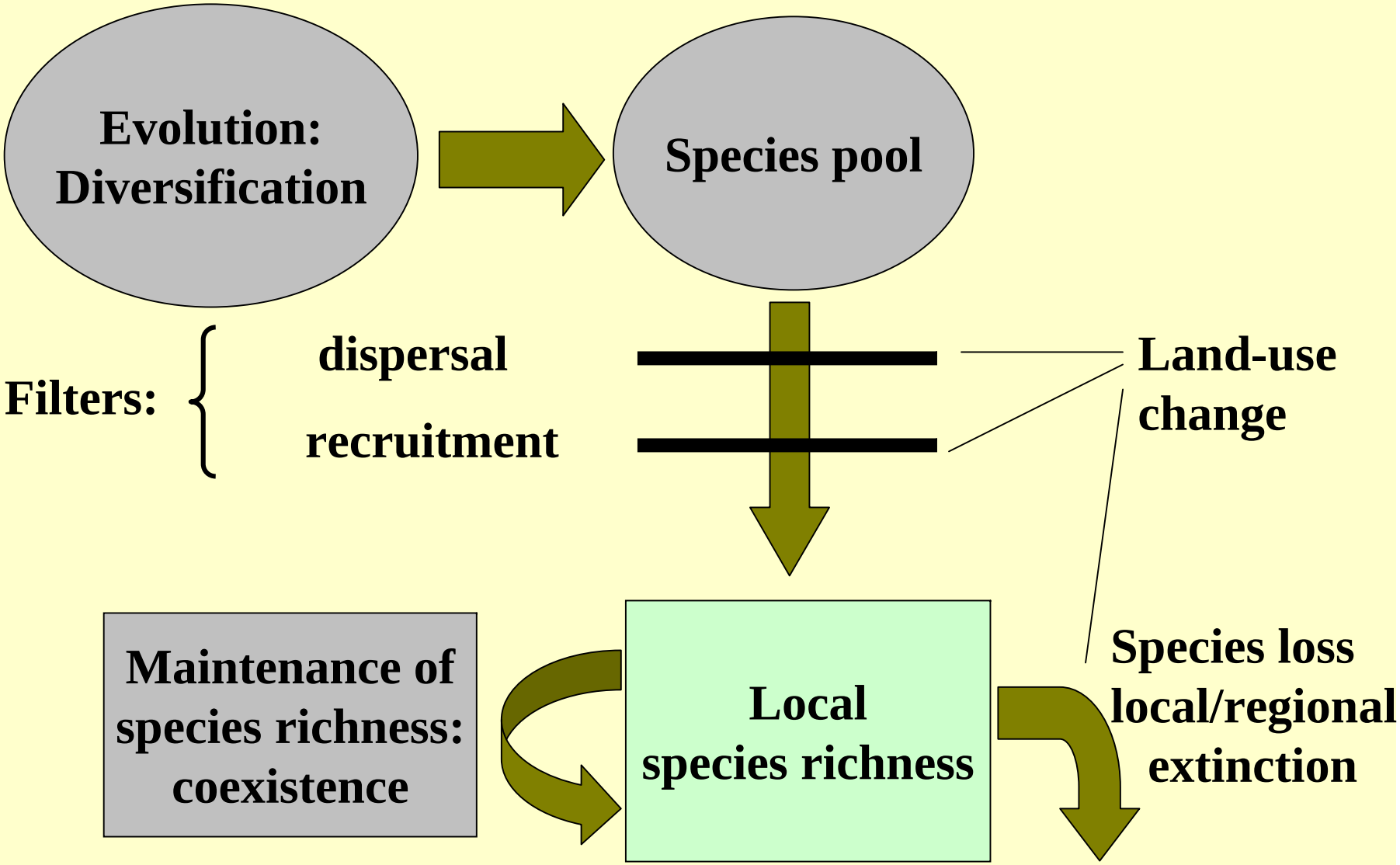
Processes affecting species richness



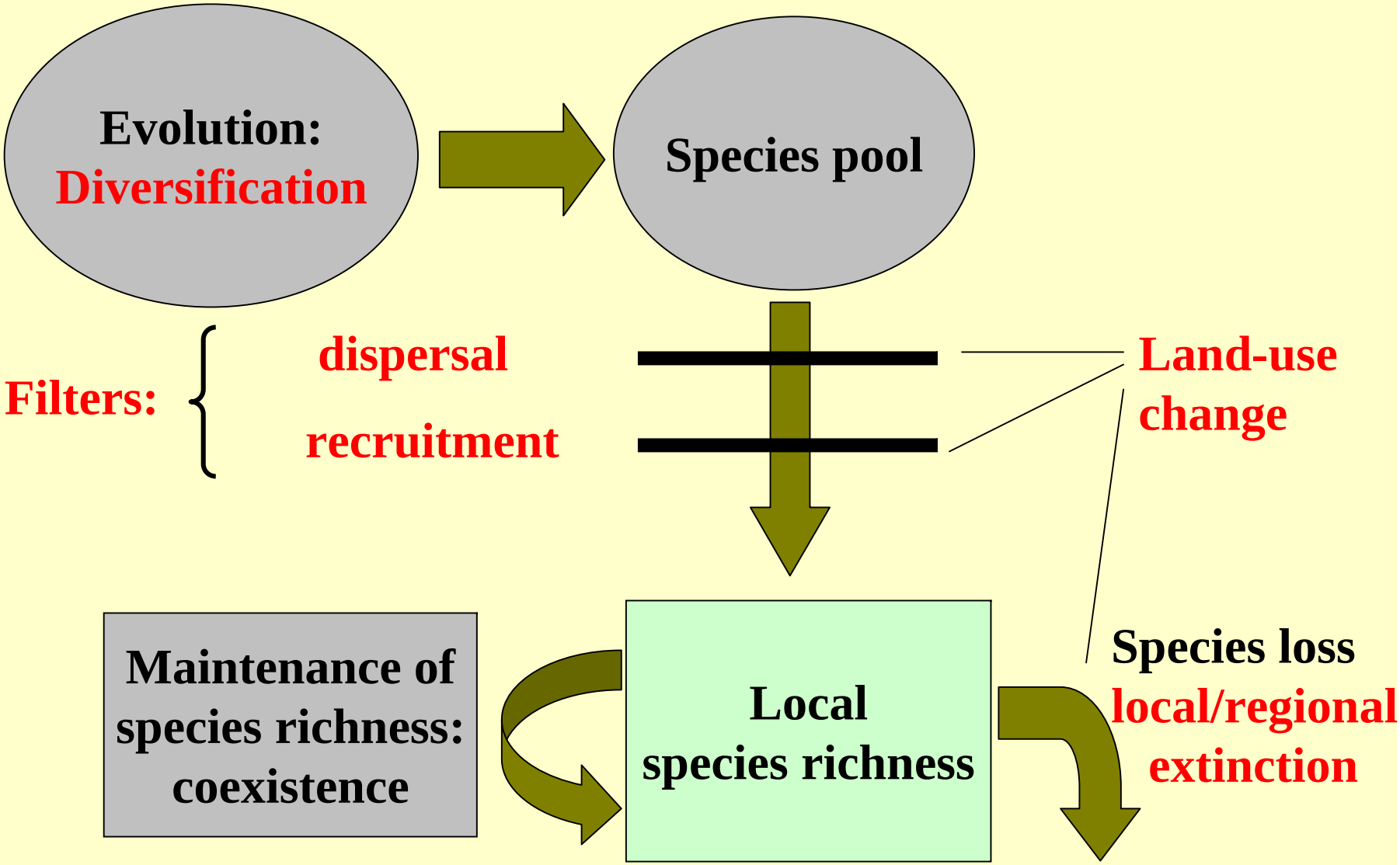
Processes affecting species richness



Processes affecting species richness



Processes affecting species richness



1. Species diversification

Do plant-animal interactions promote plant species richness?

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pollination? Yes

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Do plant-animal interactions promote plant species richness?

pollination? Yes

frugivory? Yes?

1. Species diversification

Do plant-animal interactions promote plant species richness?

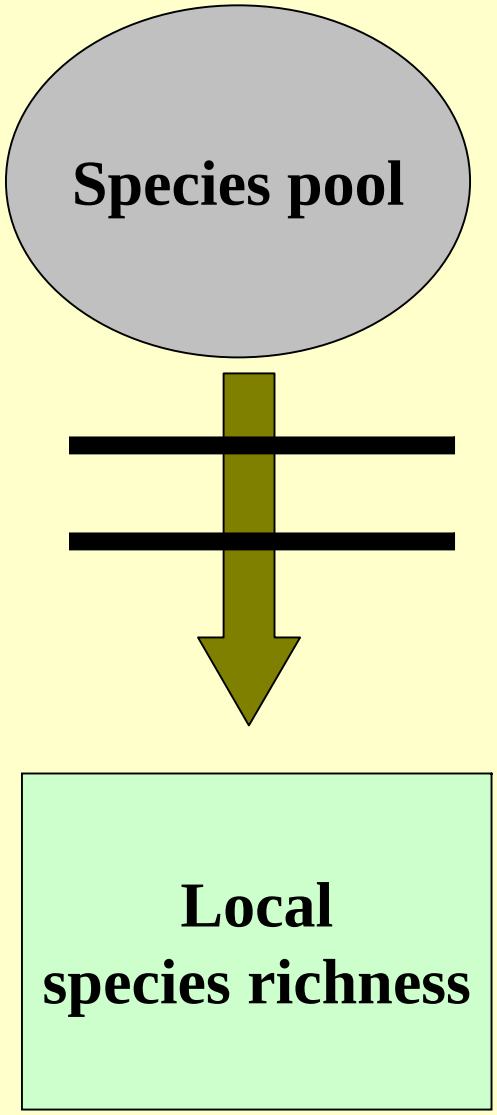
pollination? **Yes**

frugivory? **Yes?**

grazing? **Yes?**

2. ”Filters”from the species pool to local species richness

– dispersal and recruitment



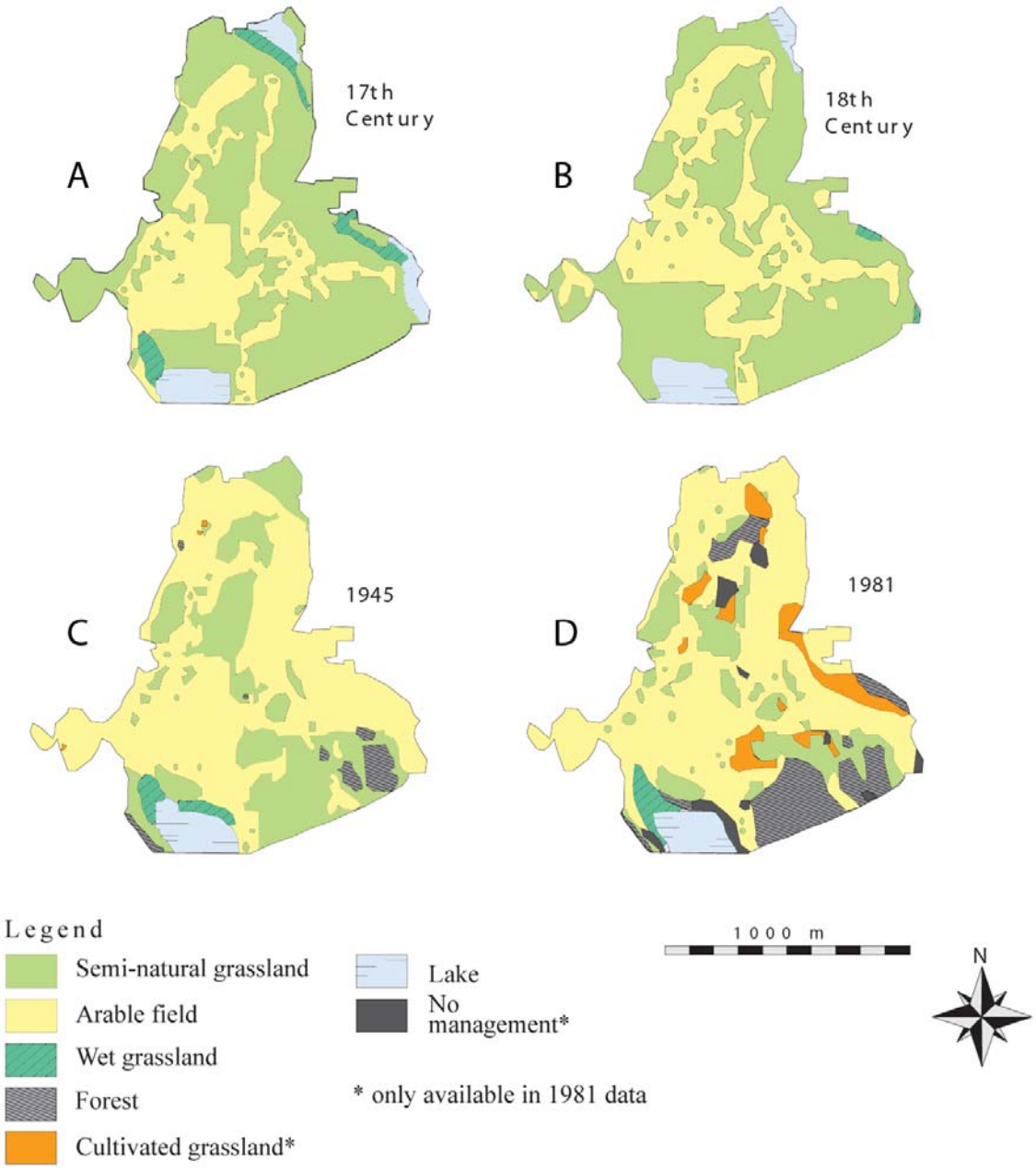

Nynäs nature reserve
c. 100 km south of Stockholm

Land use history

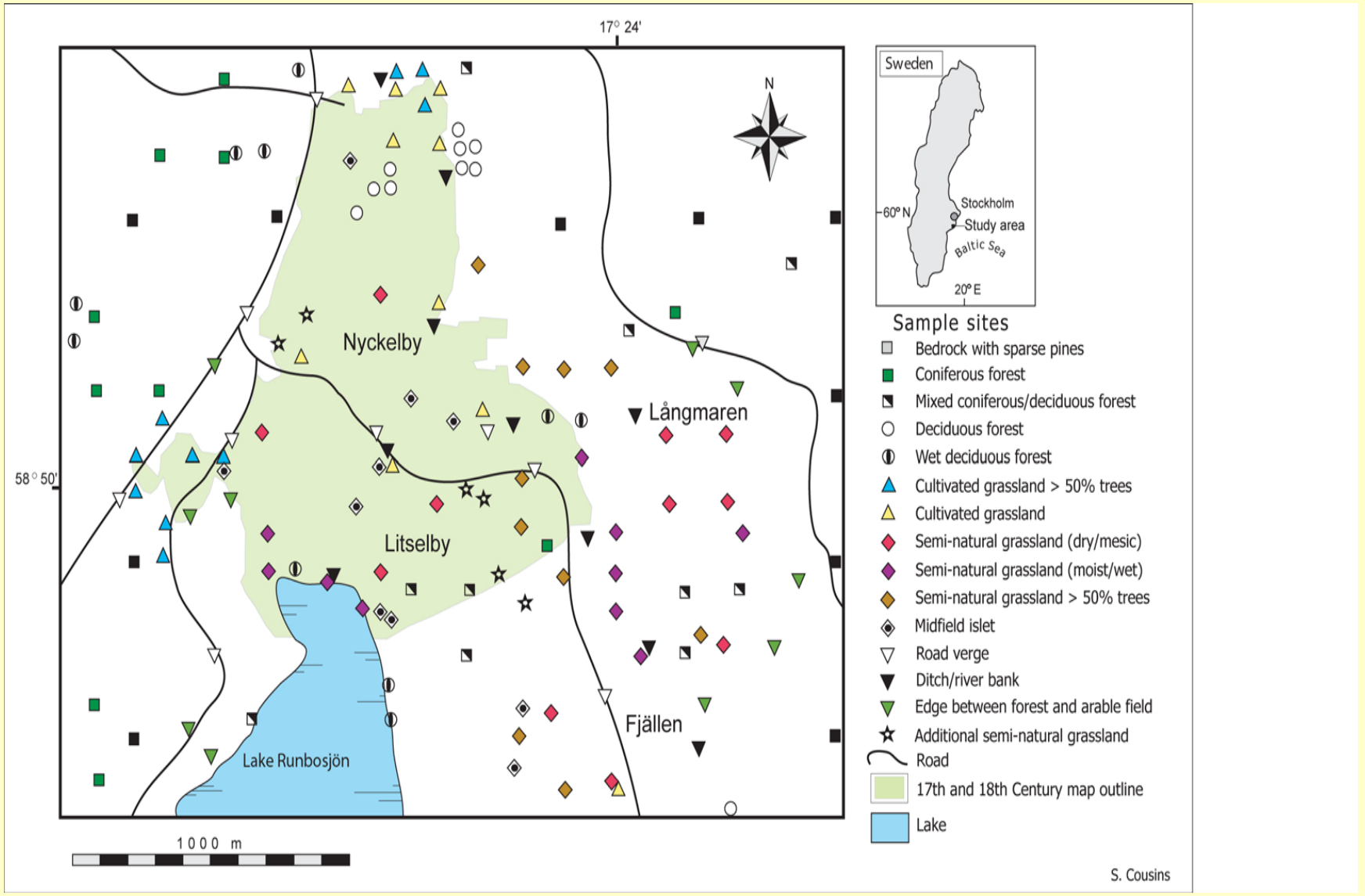
based on

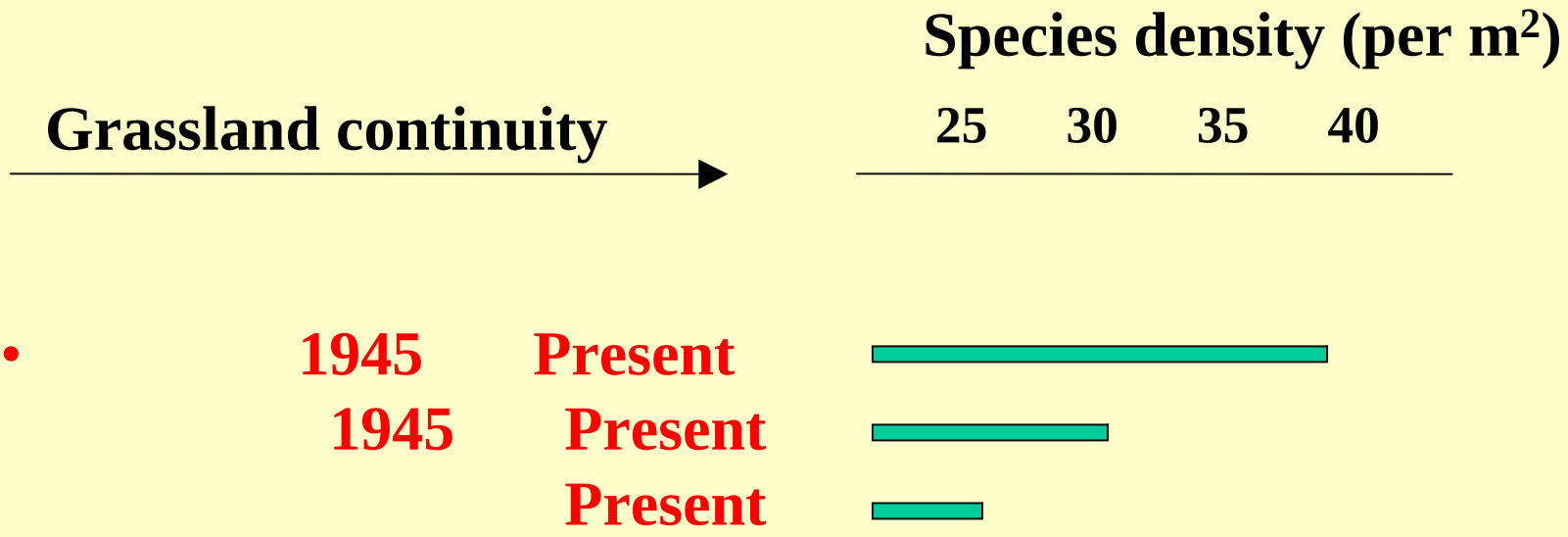
-cadastral maps

-aerial photos



Sampling: Inventories at 146 sites in 14 vegetation types





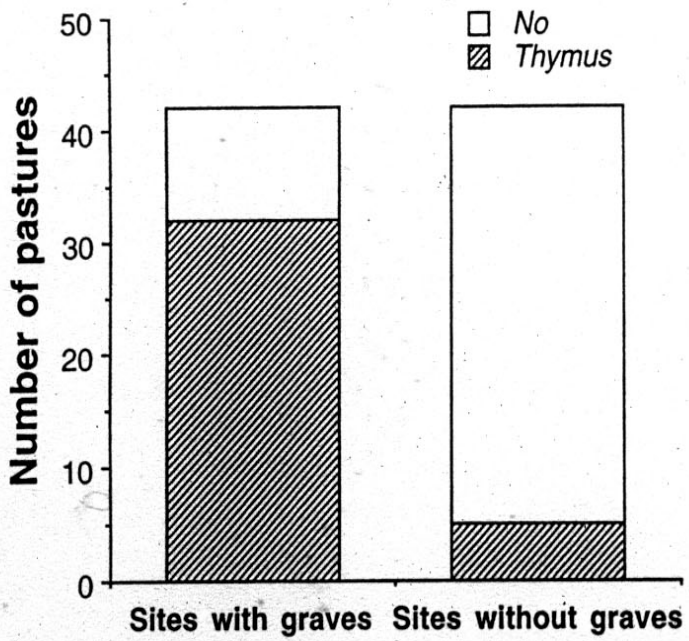
- 1945 Present
  1945 Present
  Present

Of 52 species analysed, 17 were positively associated with grassland continuity

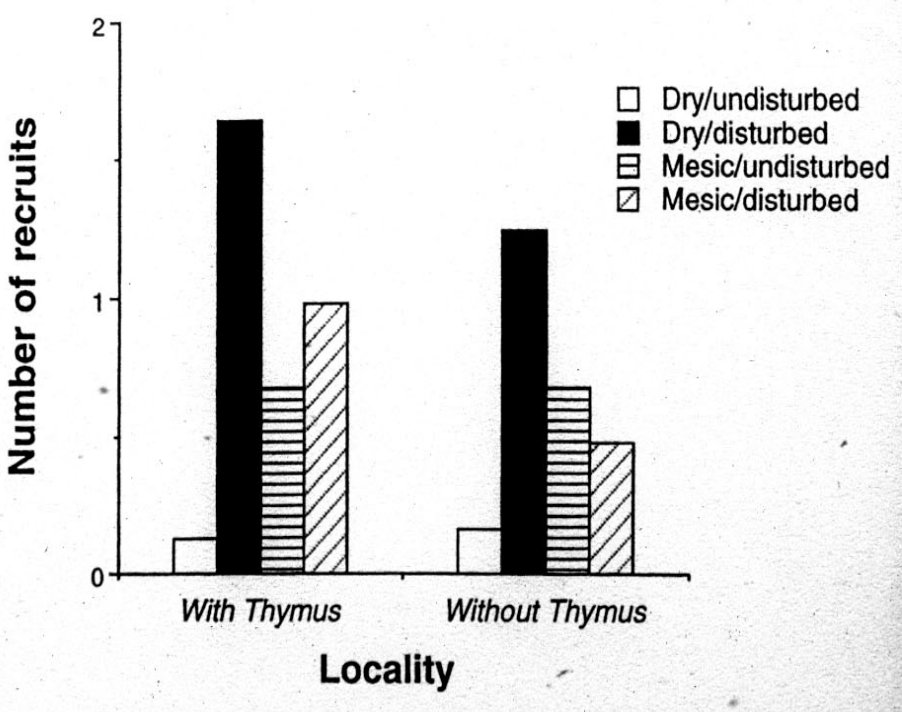
Regional.....

Dispersal limitation in *Thymus serpyllum* in seminatural grasslands

Patterns of occurrence



Results of sowing



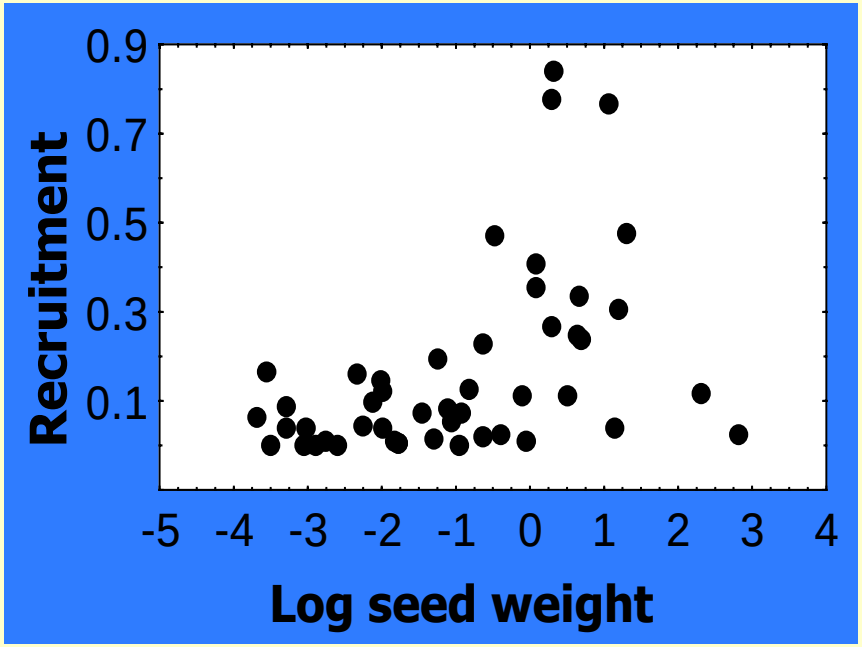
Dispersal limitation

..ubiquitous in grassland species

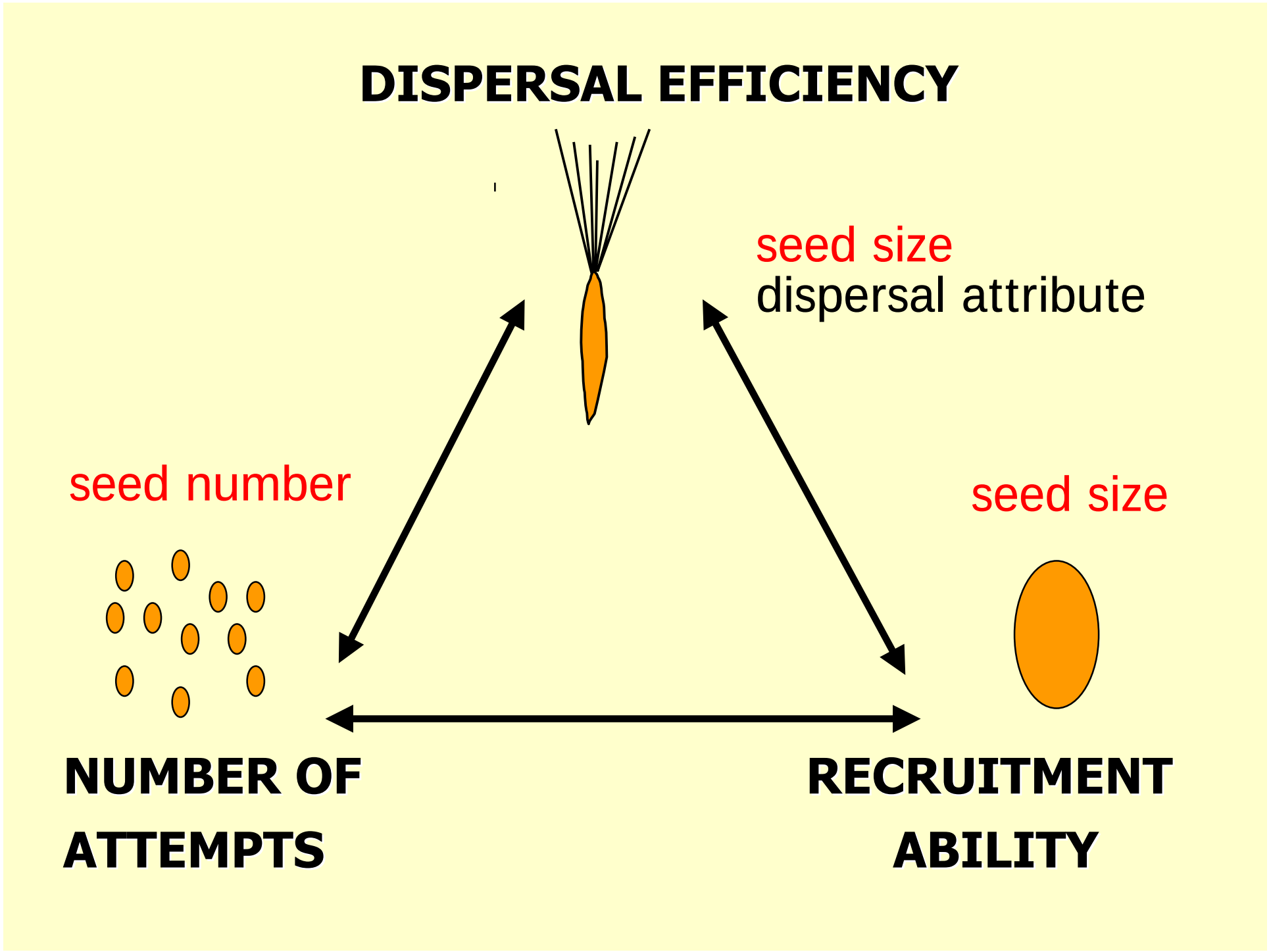
..also at a local scale

Experiment with
50 species

seed size effects

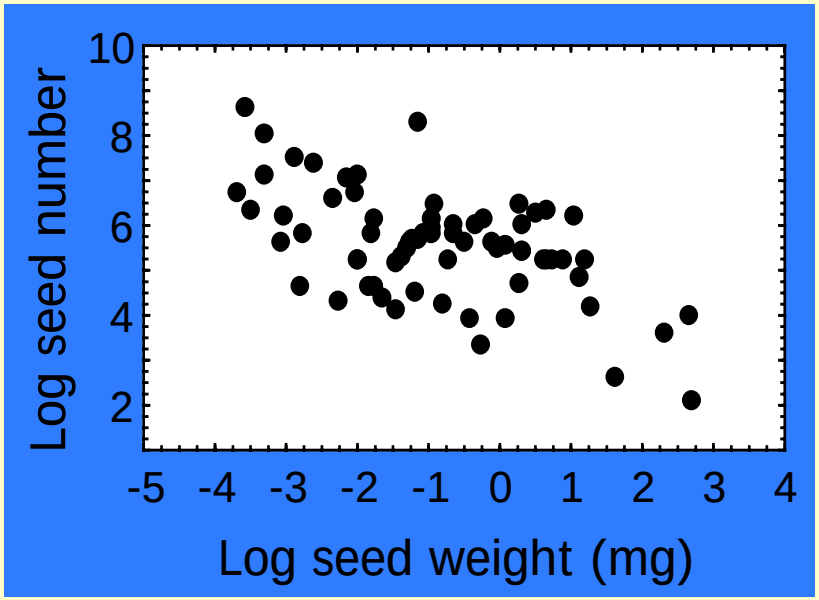


r^2=0.21, p < 0.001


DISPERSAL EFFICIENCY
seed size
dispersal attribute
seed number
seed size
NUMBER OF ATTEMPTS
RECRUITMENT ABILITY

SEED SIZE AND NUMBER TRADE-OFF

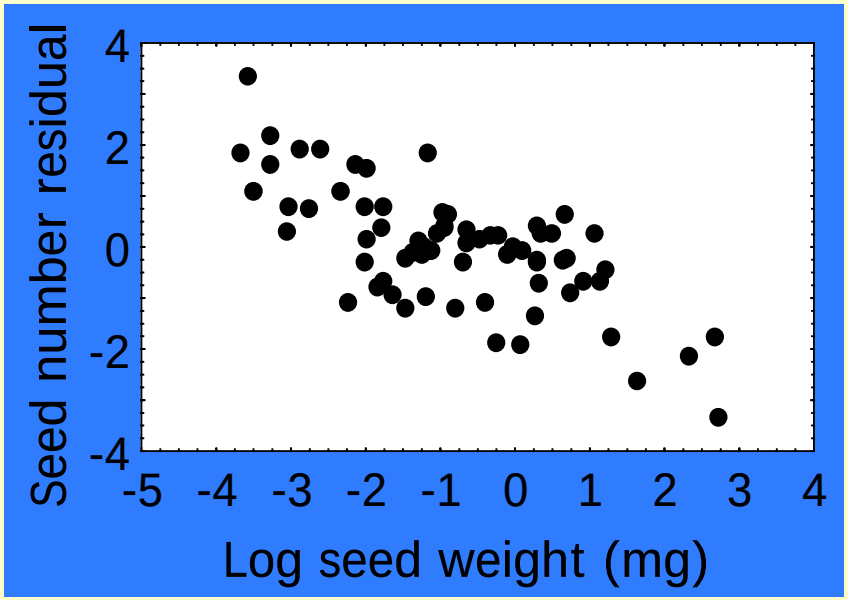
CROSS-SPECIES ANALYSIS



72 grassland species

r^2=0.31 p<0.05

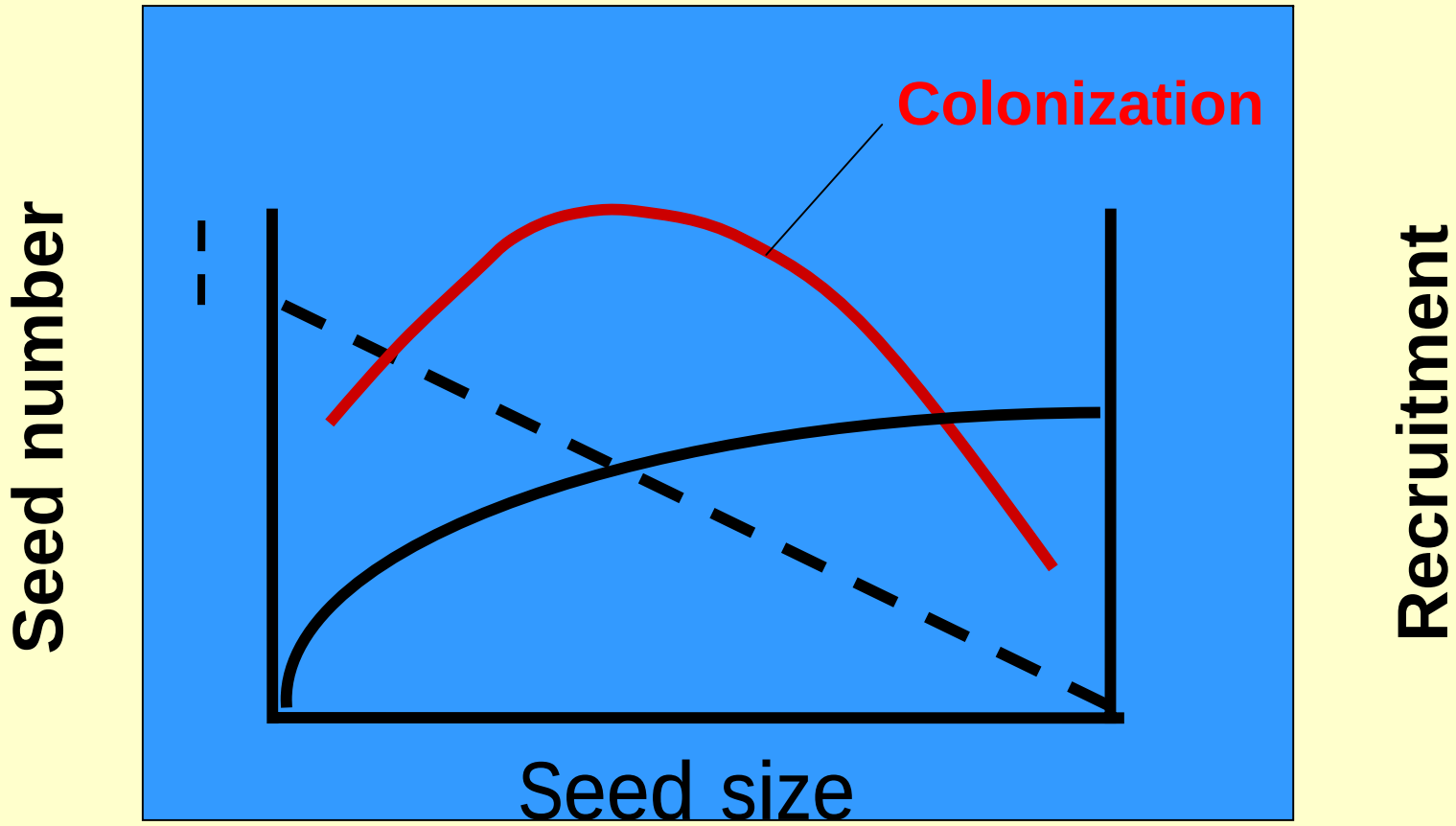
PHYLOGENY AND PLANT SIZE ACCOUNTED FOR



35 species pairs,

r^2= 0.49 p<0.05

Seed size/seed number trade-off and colonization

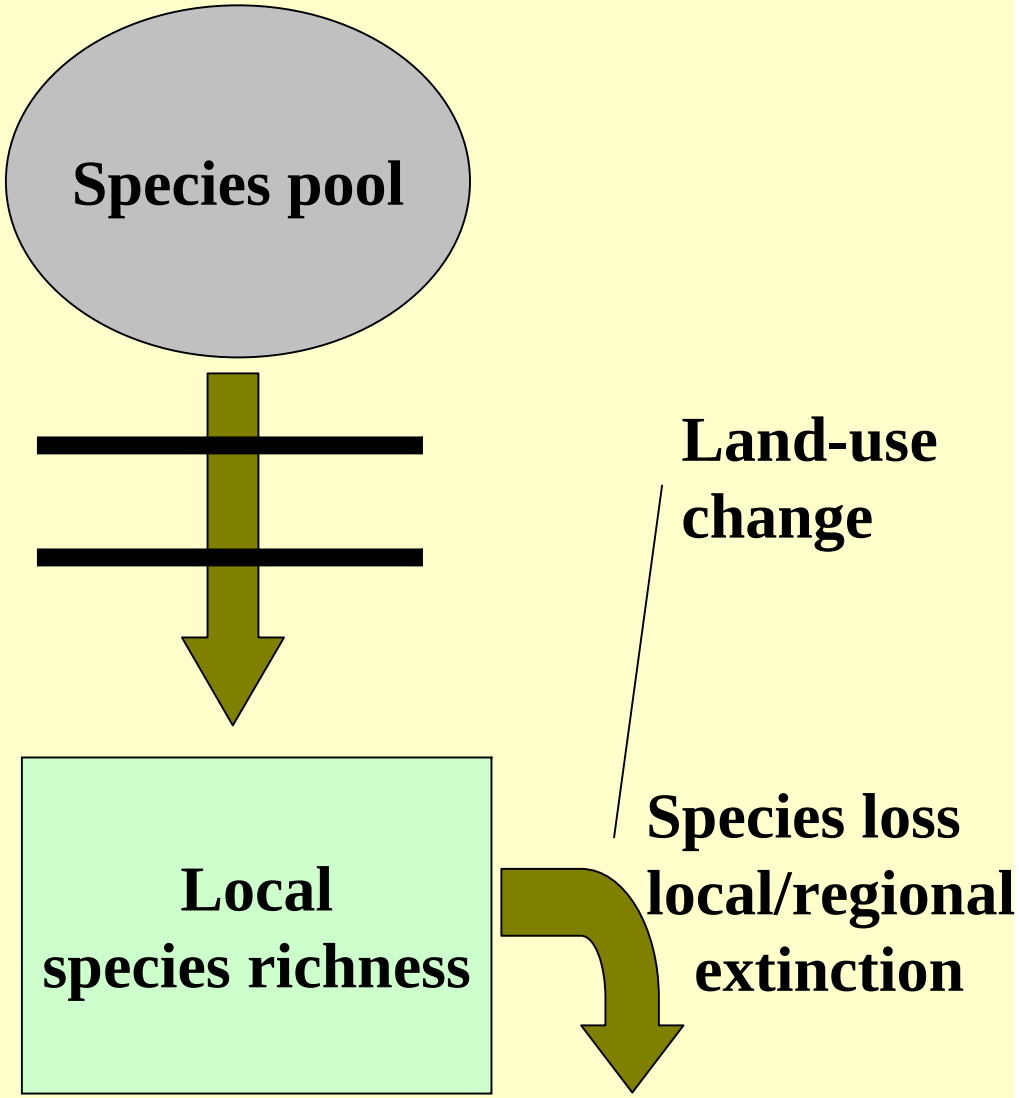


Filters from the species pool to local species richness – dispersal and recruiment

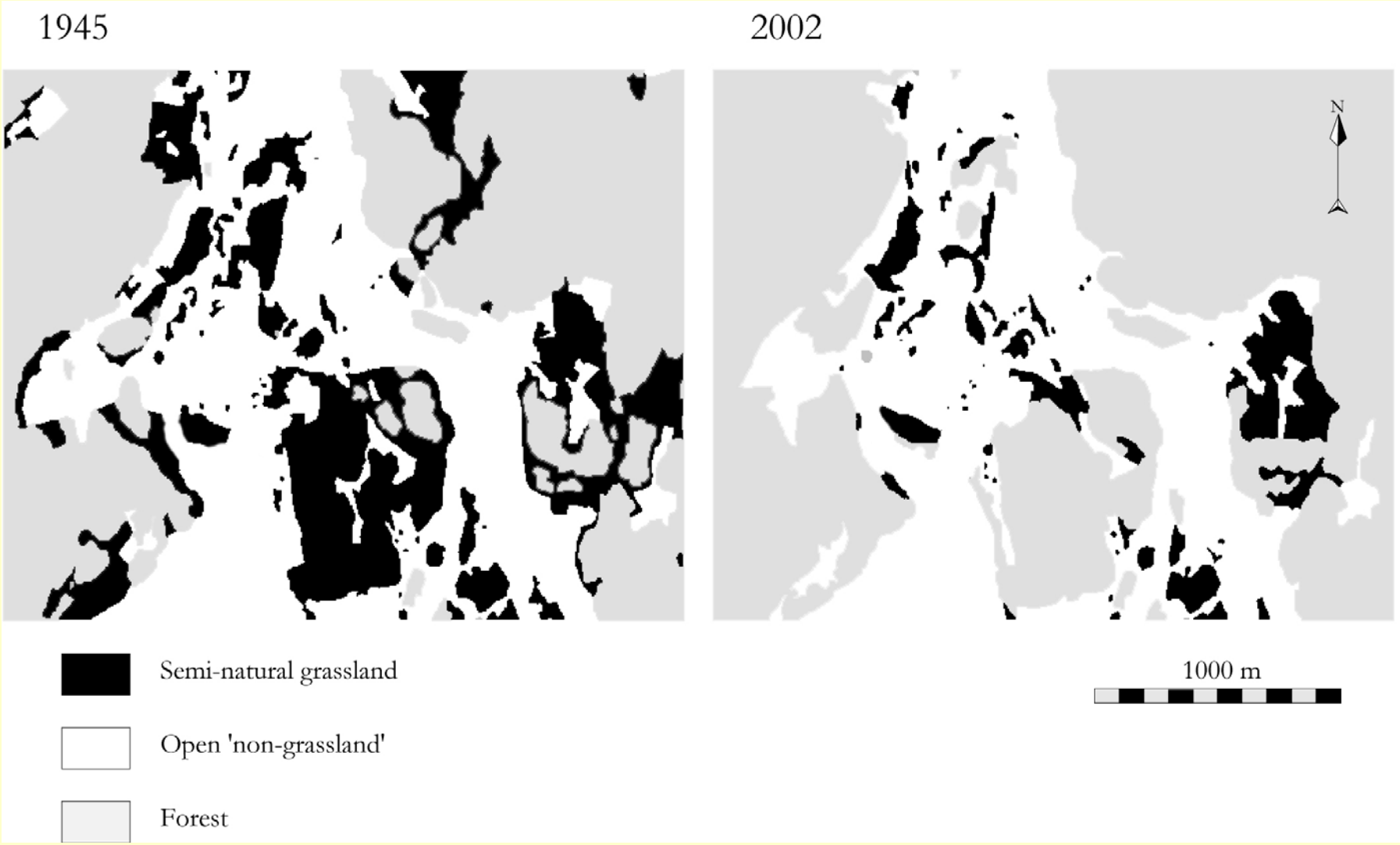
- determined by seed size/seed number trade-off?

- does this trade-off determine colonization ability?

3. Land-use change and species loss

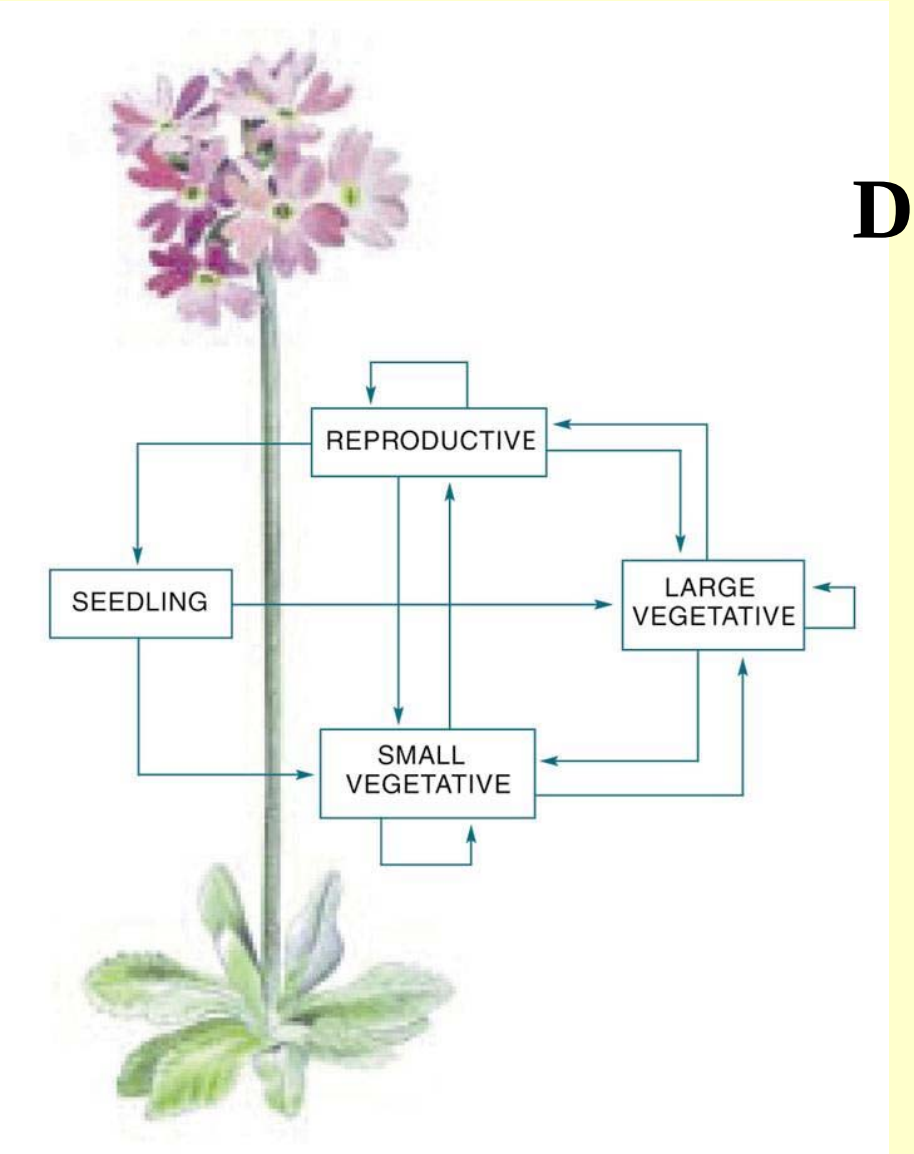


Grassland fragmentation during c. 50 years



Primula farinosa

- Long-lived perennial
- Declining



Demography 1996-1999

at sites with different management regimes

Matrix models

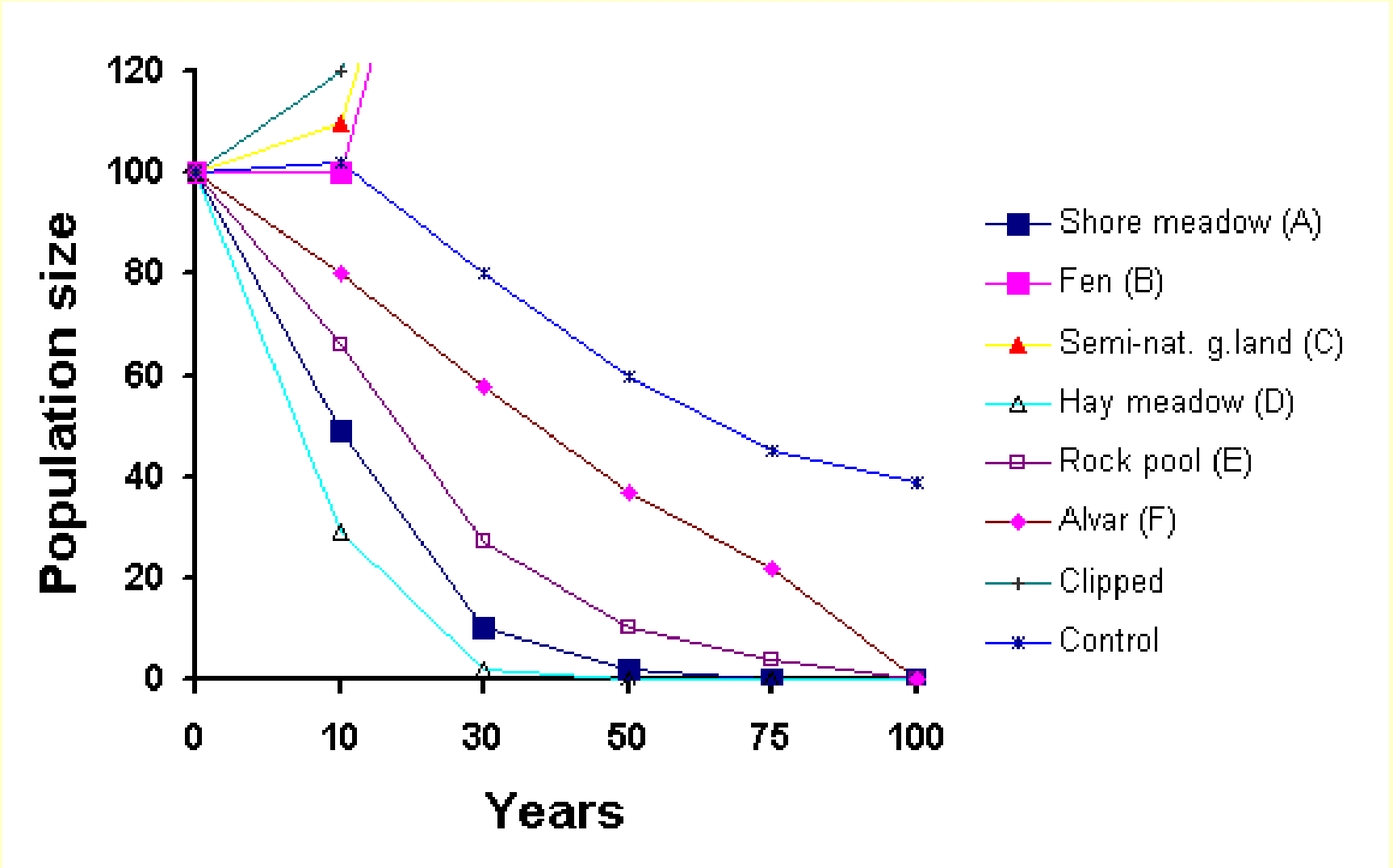
(Caswell 2001)

$$\boldsymbol{n}(t+1) = A * \boldsymbol{n}(t)$$

		seedling	small veg.	large veg.	reproductive	
Population A	seedling	0.000	0.000	0.000	0.500	
	small veg.	0.522	0.421	0.078	0.000	
	large veg.	0.000	0.395	0.766	0.500	
	reproductive	0.000	0.026	0.060	0.500	

----- objective: project extinction risks

Projected population development based on demographic data



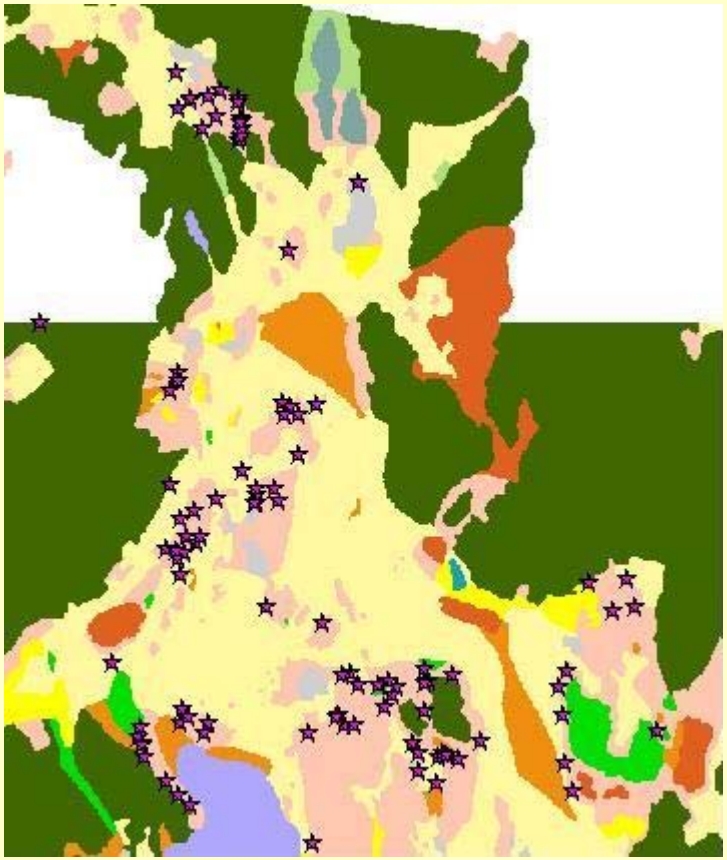
Other examples:

E_{50} = extinction risk during 50 years

	N (pop)	
perennials		
Plantago media	**50-400**	**0**
Agrimonia eupatoria	**50-400**	**0**
biennials		
Carlina vulgaris	**60-400**	**0.4 - 0.7**
Gentianella campestris	**200-500**	**0.4 - 0.6**

Succisa pratensis

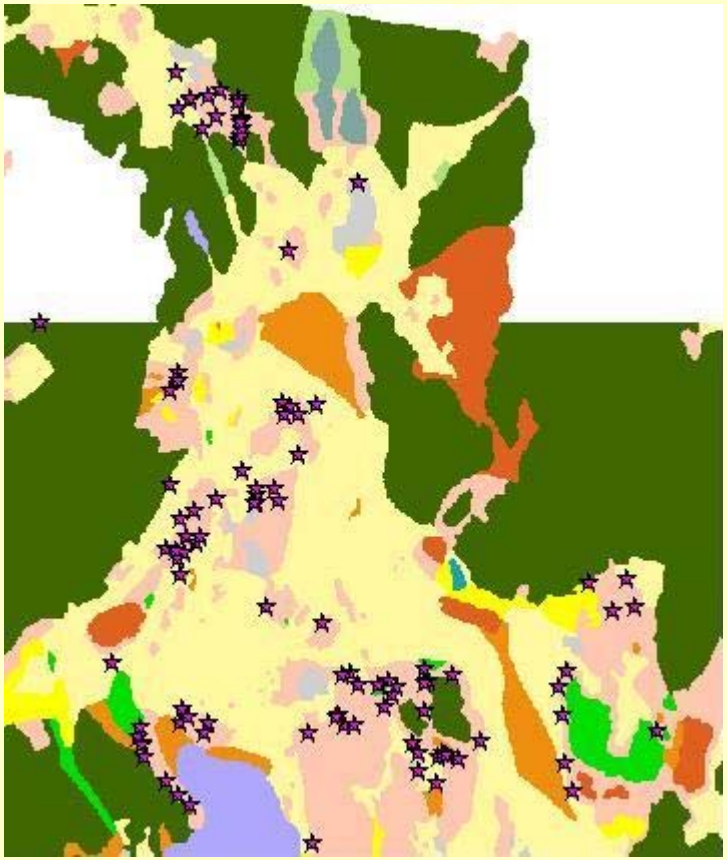
Patches mapped on habitats
1945



1 km

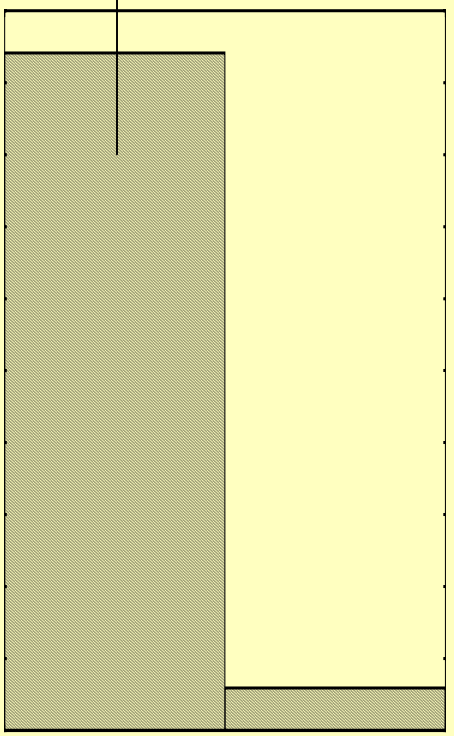
Succisa pratensis

Patches mapped on habitats 1945



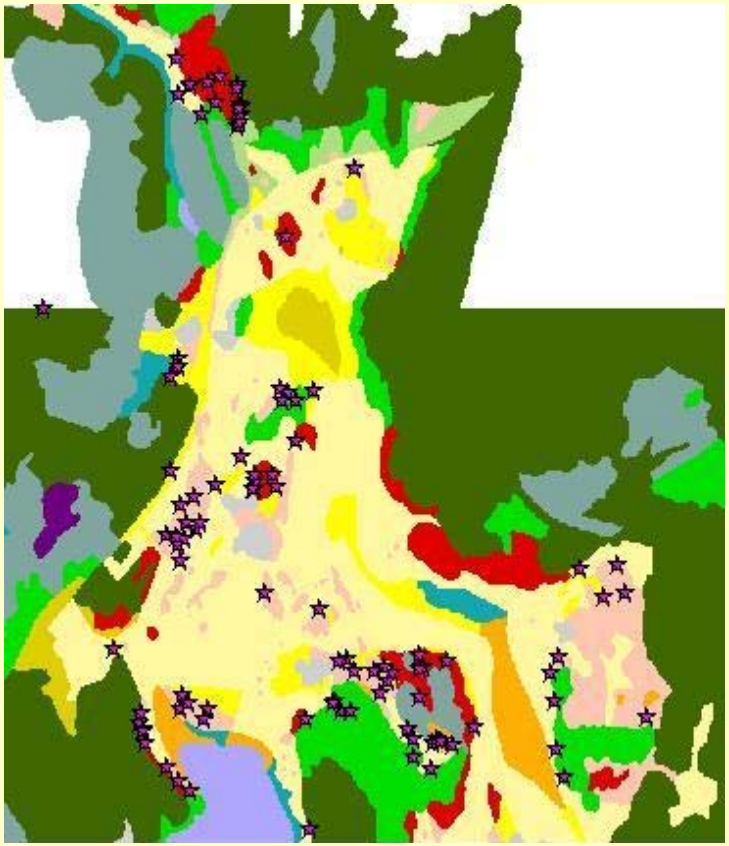
100%

Semi-natural grasslands



Succisa pratensis

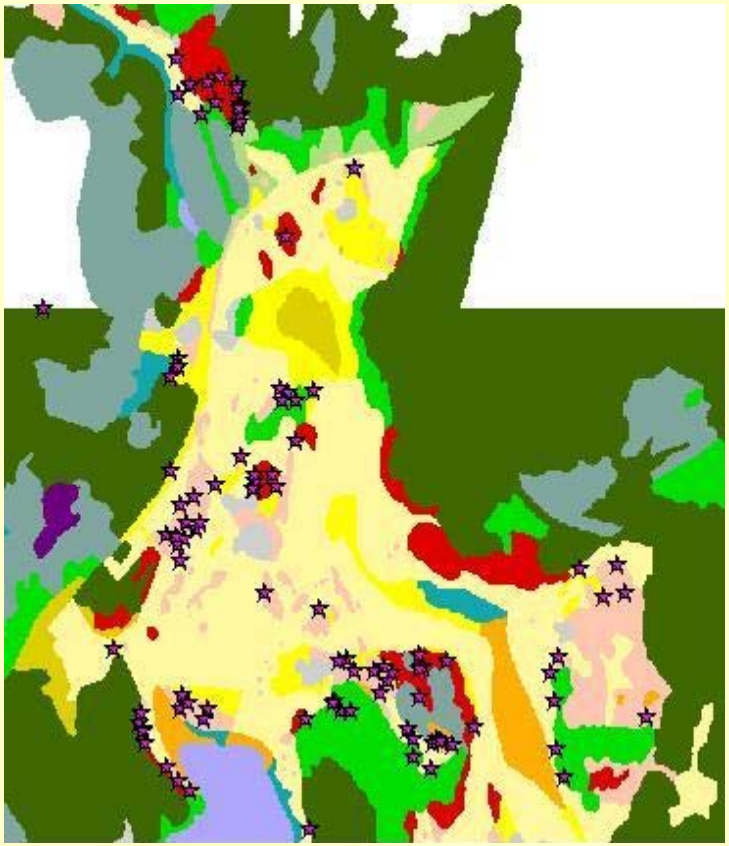
Patches mapped on habitats 2001



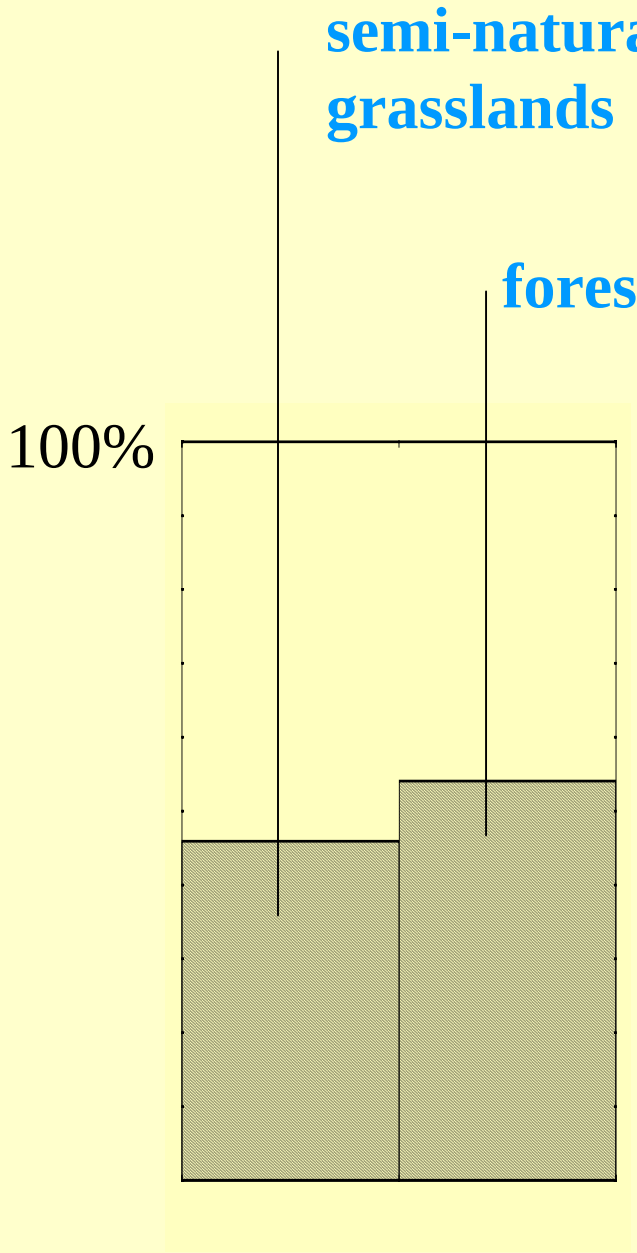
1 km

Succisa pratensis

Patches mapped on habitats 2001



1 km



Effects of the landscape habitat configuration?

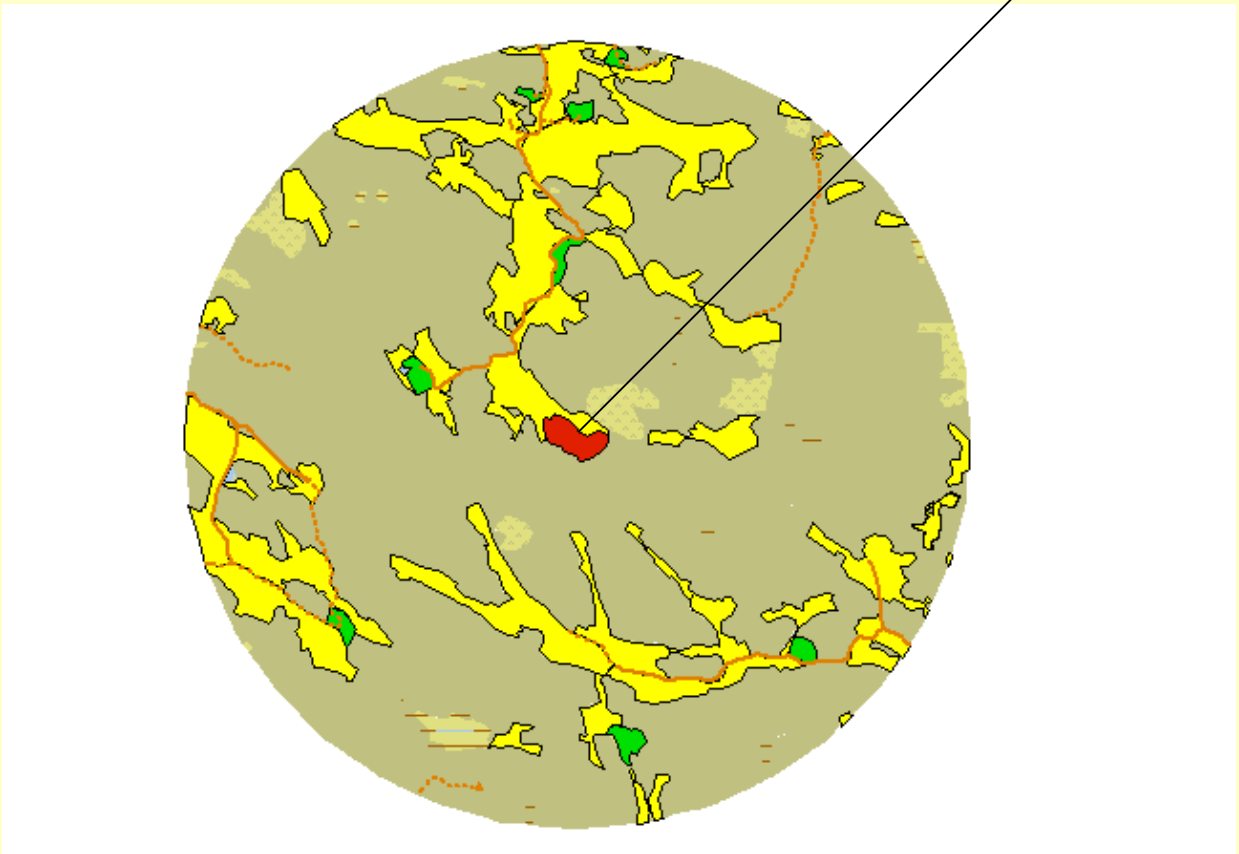
30 semi-natural grassland sites selected

- **total species richness**
- **species density**
- **presence of selected target species**

Landscape effects on restoration

grassland connectivity

Target site



Spatial scale

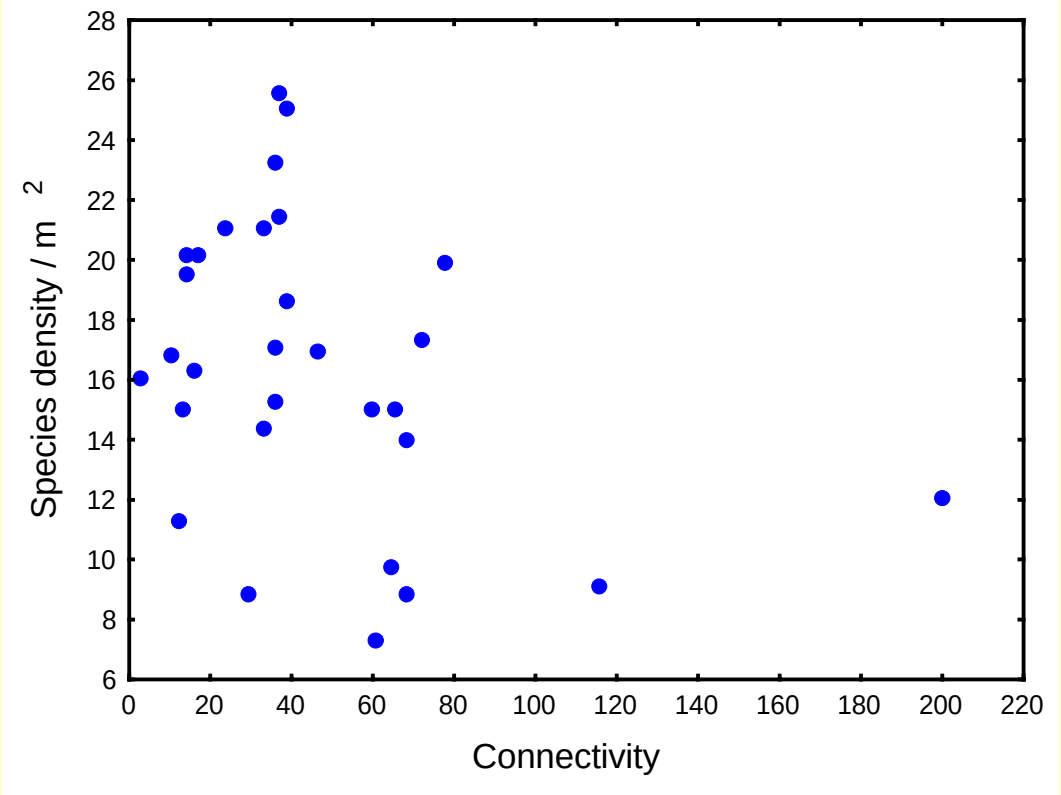
1 km radius

2 km radius

Species density

Present-day landscape

- **no relationship!**



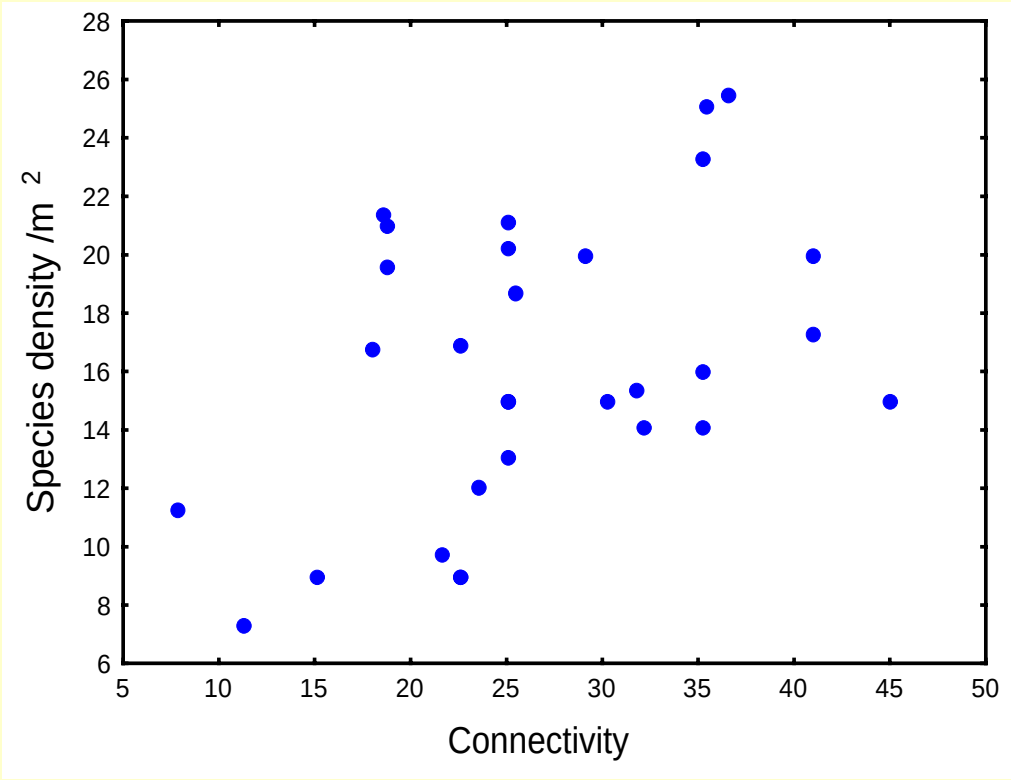
Species density

Connectivity

Species density

Historical landscape (c 1900)

p = 0.008



Species density

Connectivity

Land-use change and species loss

- long-lived species respond slowly

- remnant populations are probably common

- regional risk of extinction under-estimated

- effects of landscape structure may be overlooked if landscape history is not considered

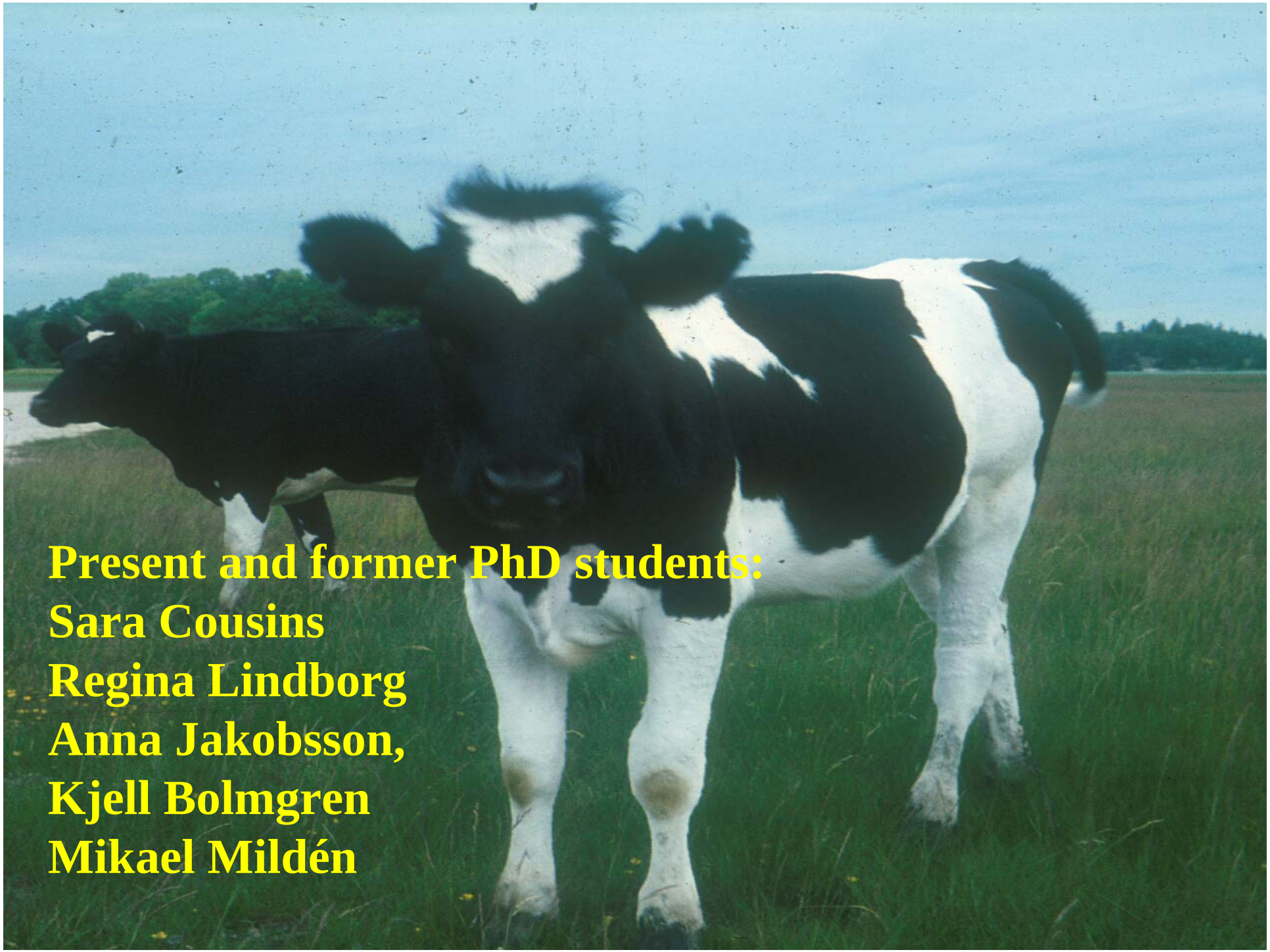
Plant ecology and biodiversity of grasslands
- some important research topics:

- mechanisms for species diversification

- size of species pool

- the role of trade-offs for local species richness

- the role of landscape history for spatial distribution of species


Present and former PhD students:
Sara Cousins
Regina Lindborg
Anna Jakobsson,
Kjell Bolmgren
Mikael Mildén