



## Paths of nitrogen transfer from white clover to non-legume plants in unfertilized pastures

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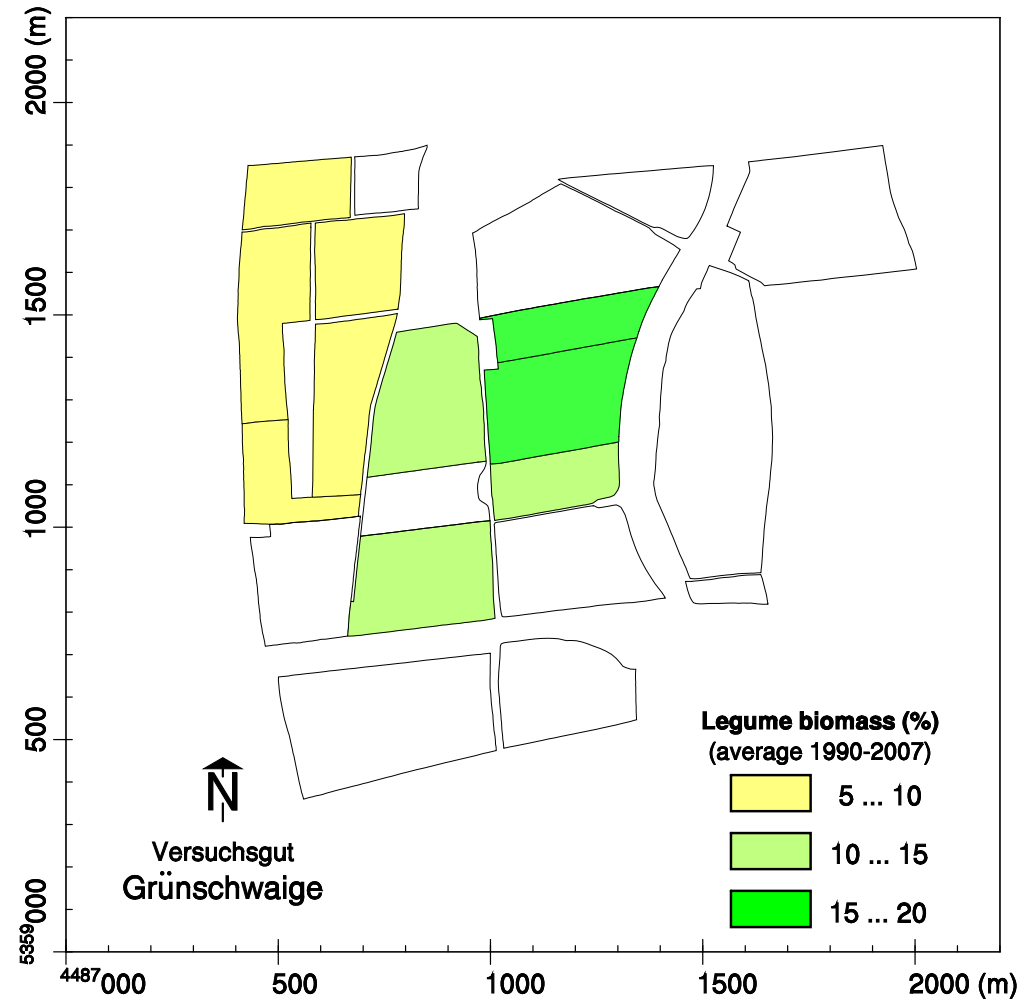


## Putative mechanisms of BNF-N transfer:

1. a **direct transfer** between living plants (e.g. by mycorrhiza, leaching/interception),
2. a local but **delayed transfer** when non-legumes colonize a patch with decaying legume biomass,
3. a **spatially diffuse transfer** via the excreta of grazing animals.

## Site:

- Grünschwaige Grassland Experimental station
- 5 pastures old grassland (5 ... 10% clover)
- 5 pastures on former arable land (initially high clover)
- All pastures were grazed to constant height by cattle



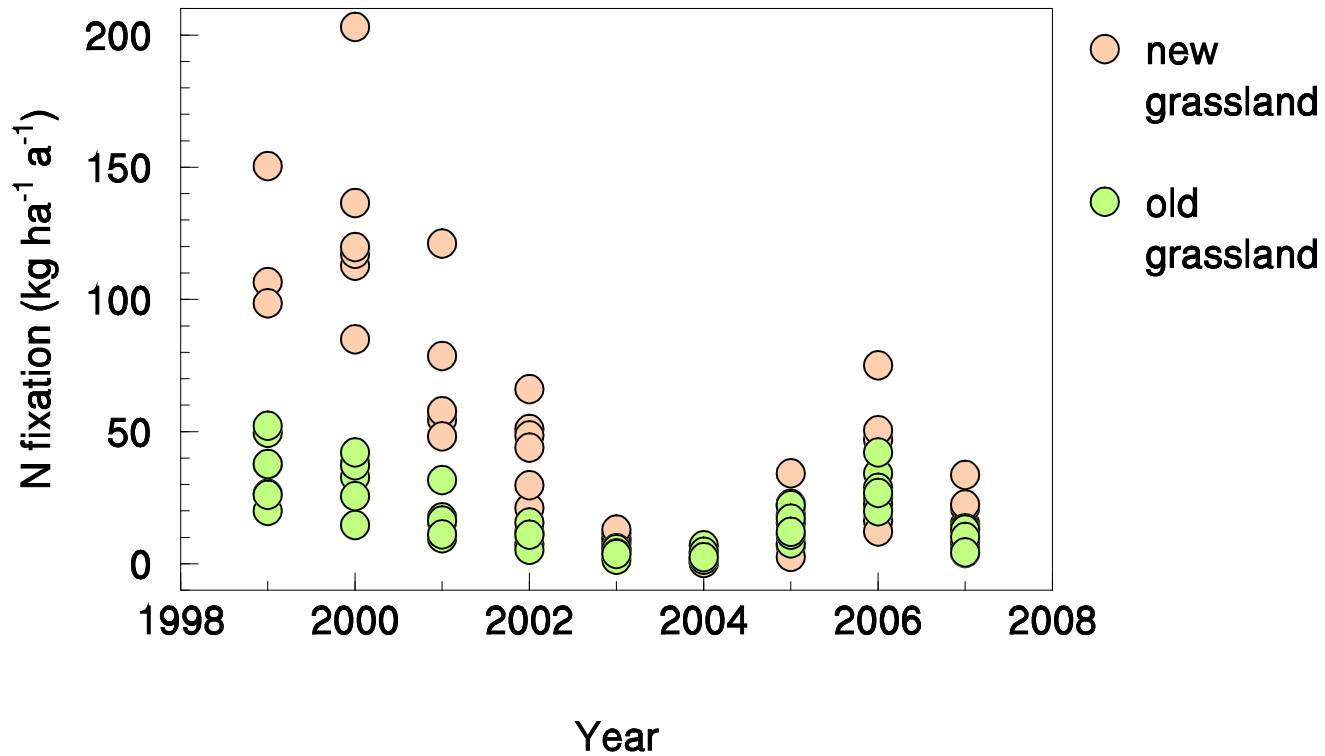
## Data:

- Total biomass production estimated from the feed intake of the cattle
- Relative mass of legumes on 10 pastures during 9 years  
(40 permanent 1 m<sup>2</sup> quadrats resolved in 100 squares,  
3 dates per year)
- BNF calculated according to Høgh-Jensen *et al.*, 2004
- Isotope measurements of soil, clover, grass and cattle hair  
(Soil N: approx. 4‰  
BNF N: approx. - 2‰  
Feed-hair shift: 3.2‰ according to Männel *et al.*, 2007)

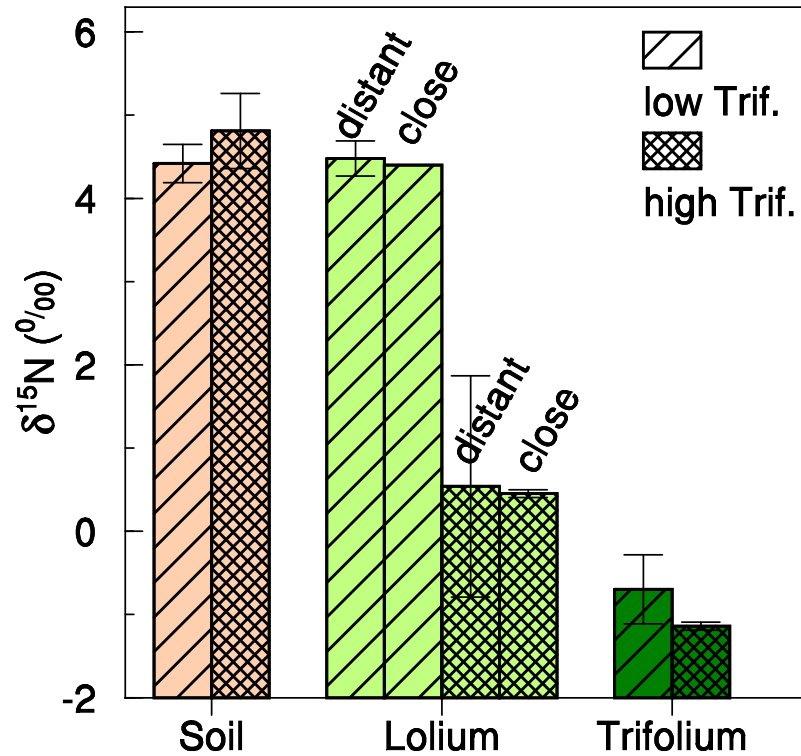
Høgh-Jensen *et al.* (2004) *Agricultural Systems* 82, 181–194

Männel *et al.* (2007) *Global Ecology and Biogeography* 16, 583-592

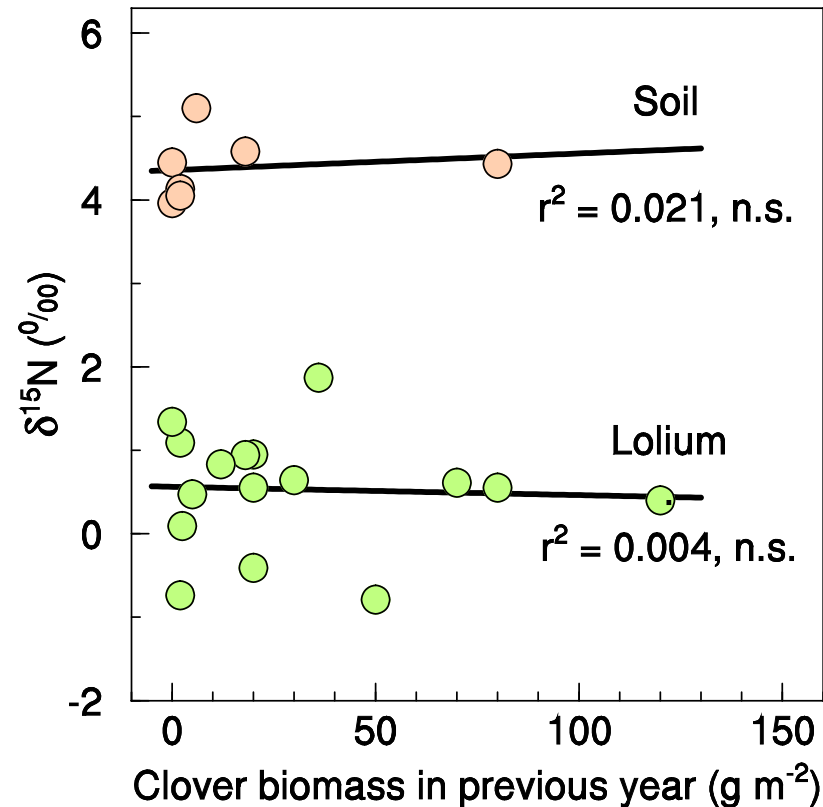
## Nitrogen fixation:



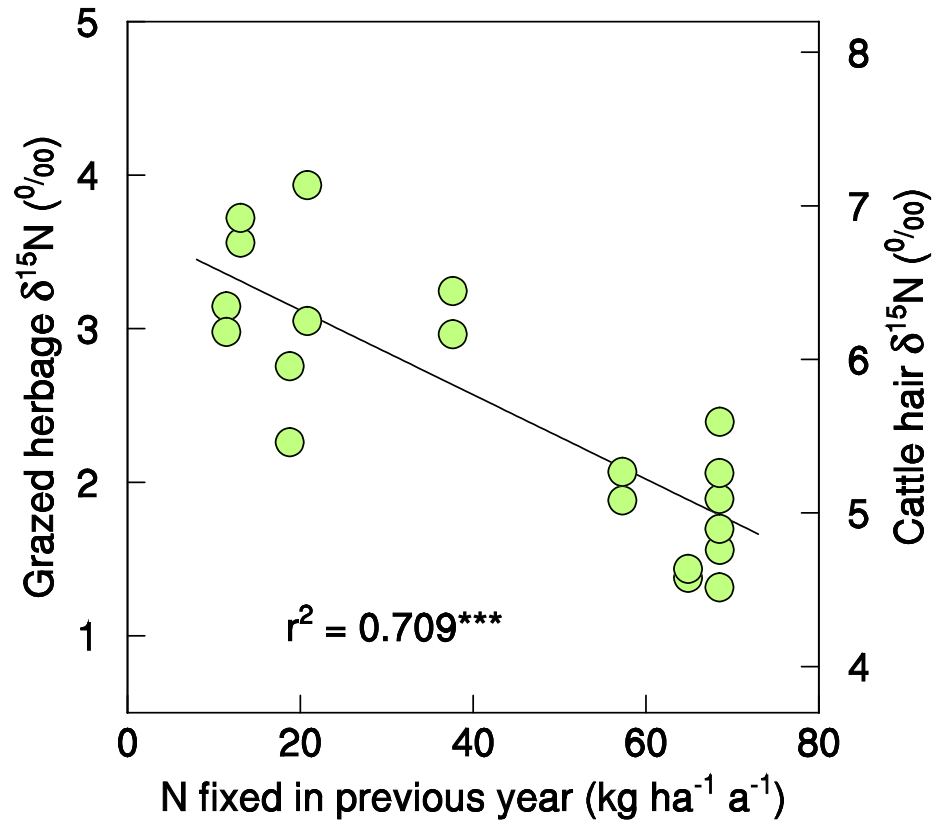
## Nitrogen transfer between living plants:



## Nitrogen transfer from decaying clover residues:



## Nitrogen transfer *via* the grazer:





The transfer *via* the grazing animal dominates since:

- N concentration in green clover leaves is high
- Leaf biomass and leaf N of clover are efficiently grazed
- N is allocated to re-growing clover leaves
- N concentration in senescing clover biomass is low



## Conclusions

- *Grass* benefited from clover (up to 70% BNF-N)
- This high contribution indicates a repeated cycling of the BNF-N
- Transfer of BNF-N occurred mainly *via* the excreta of the grazers.
  - Grazing enhances the redistribution and cycling of BNF-N
  - Thus transfer is independent of the spatial distribution of legumes inside the paddock