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Colonization and succession in restored wet grasslands: lessons from long-term experiments

Norbert Hölzel

Institute of Landscape Ecology, University of Münster

Case study I:

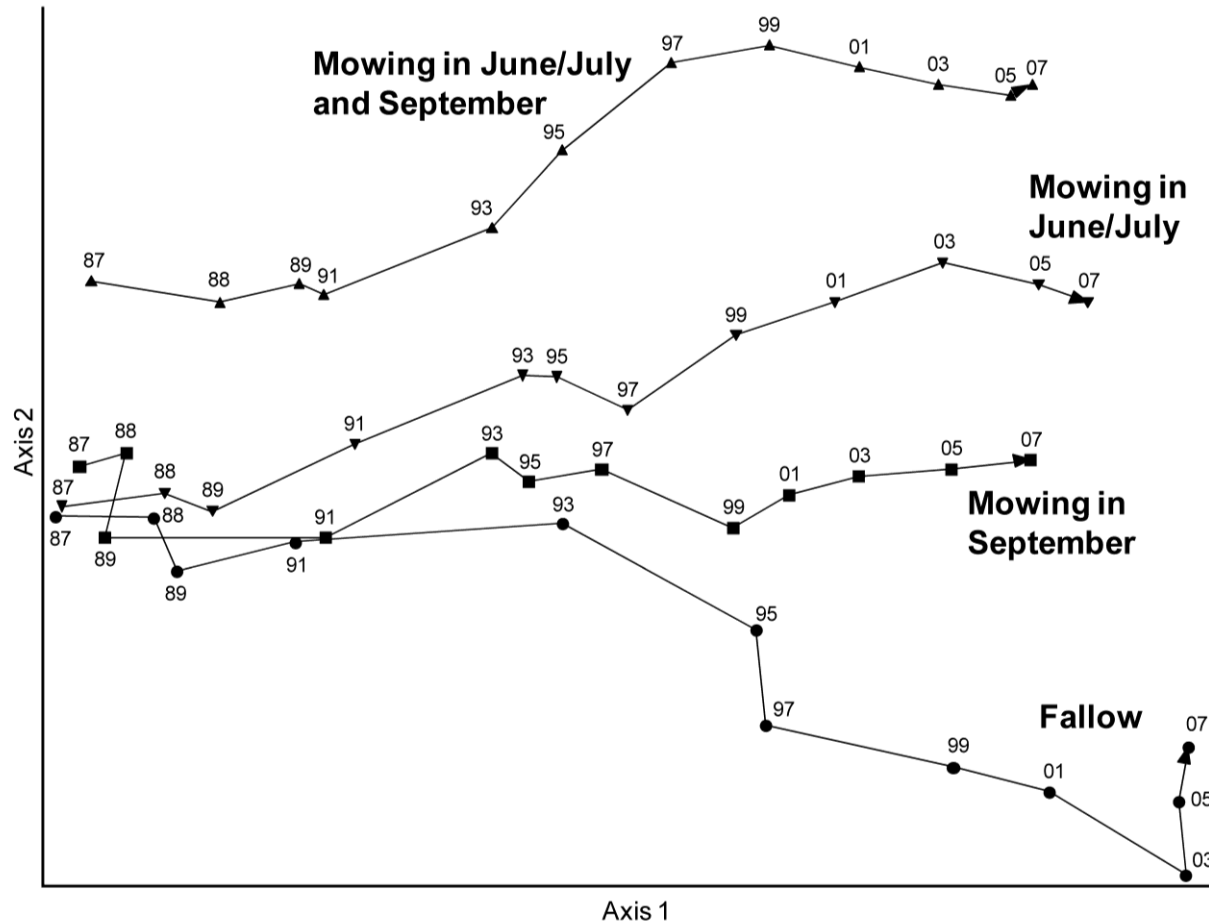
Monitoring of restoration management in wet meadows in NW-Germany over 20 years



Peter Schwartz

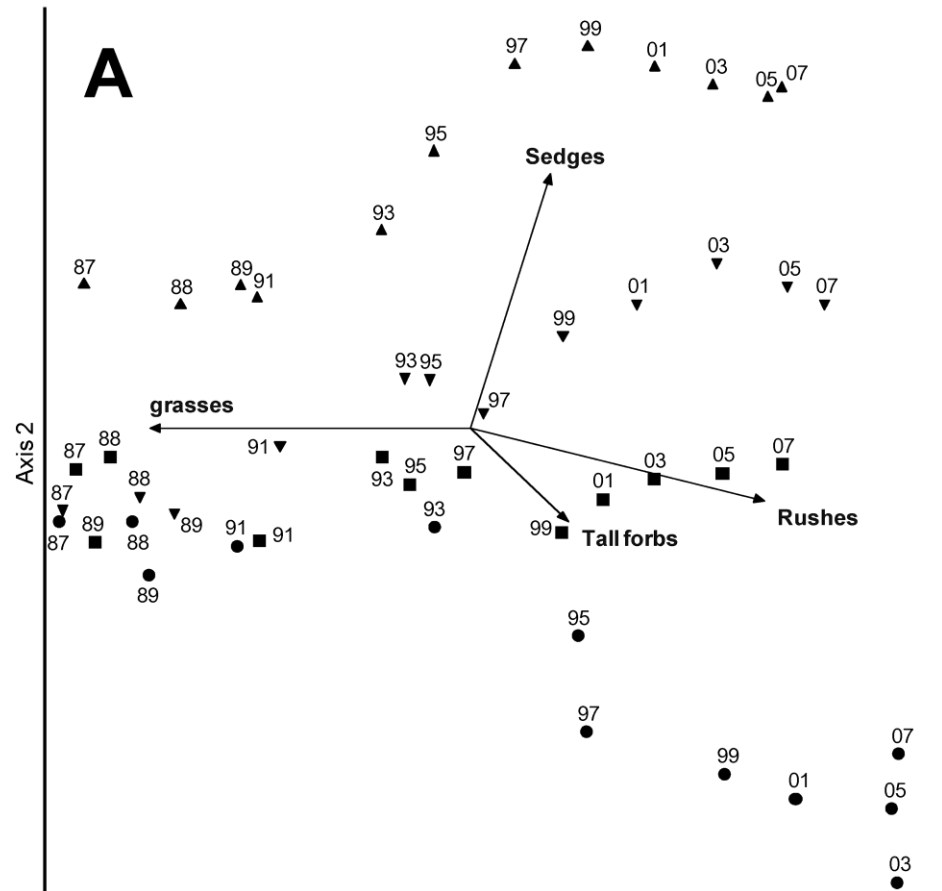


Long-term trends over 20 years (floristic composition)



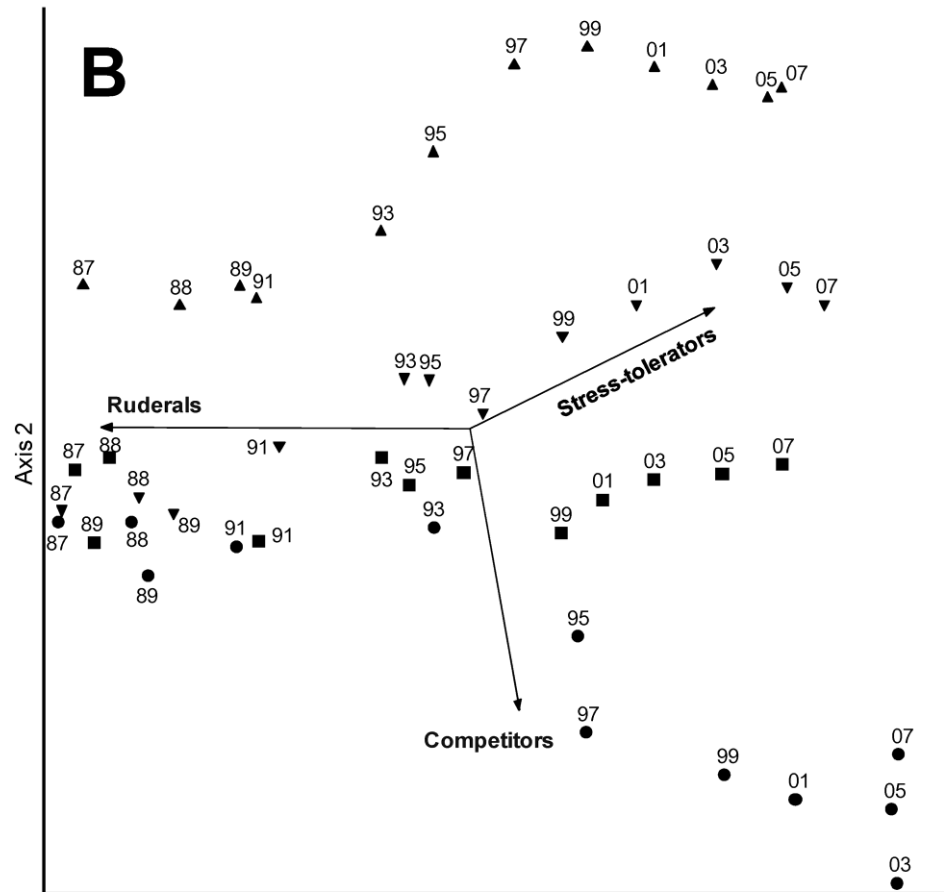
Poptcheva K, Schwartze P, Vogel A, Kleinebecker T & Hölzel N (2009) Changes in wet meadow vegetation after 20 years of different management in a field experiment (North-West Germany). *Agriculture, Ecosystems and Environment* 134: 108-114.

Long-term trends over 20 years (Functional types)



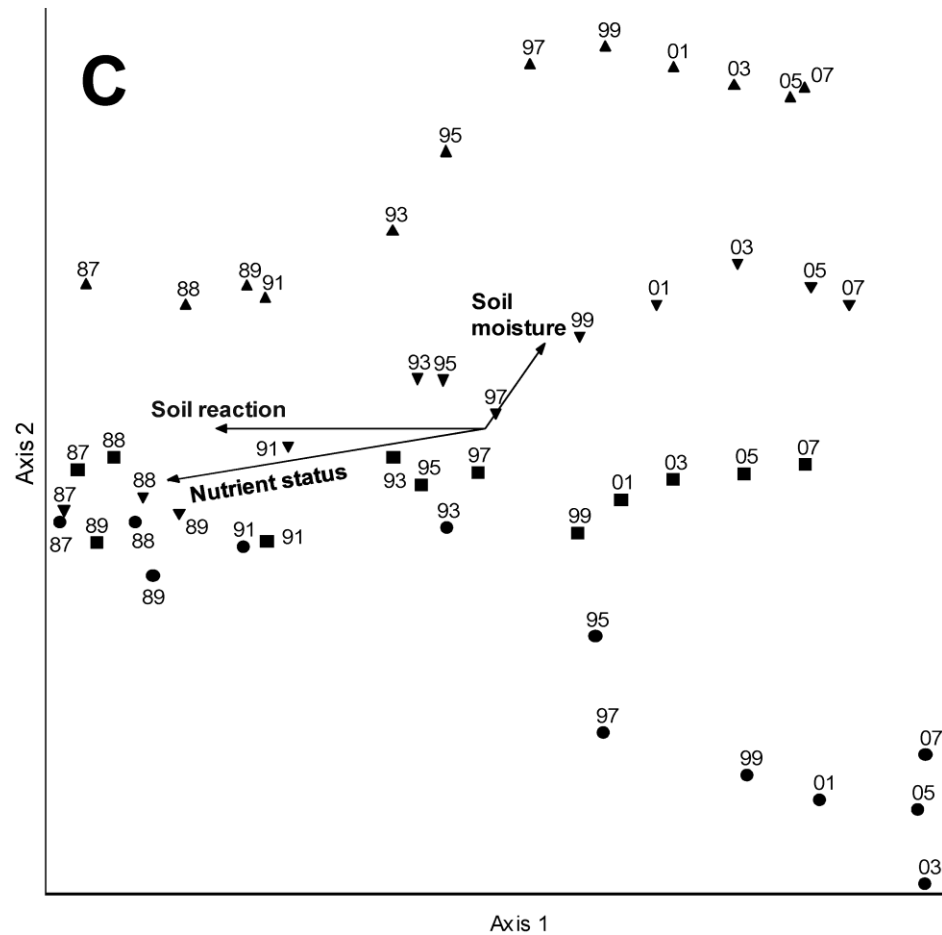
Poptcheva K, Schwartz P, Vogel A, Kleinebecker T & Hölzel N (2009) Changes in wet meadow vegetation after 20 years of different management in a field experiment (North-West Germany). *Agriculture, Ecosystems and Environment* 134: 108-114.

Long-term trends over 20 years (Strategy types)



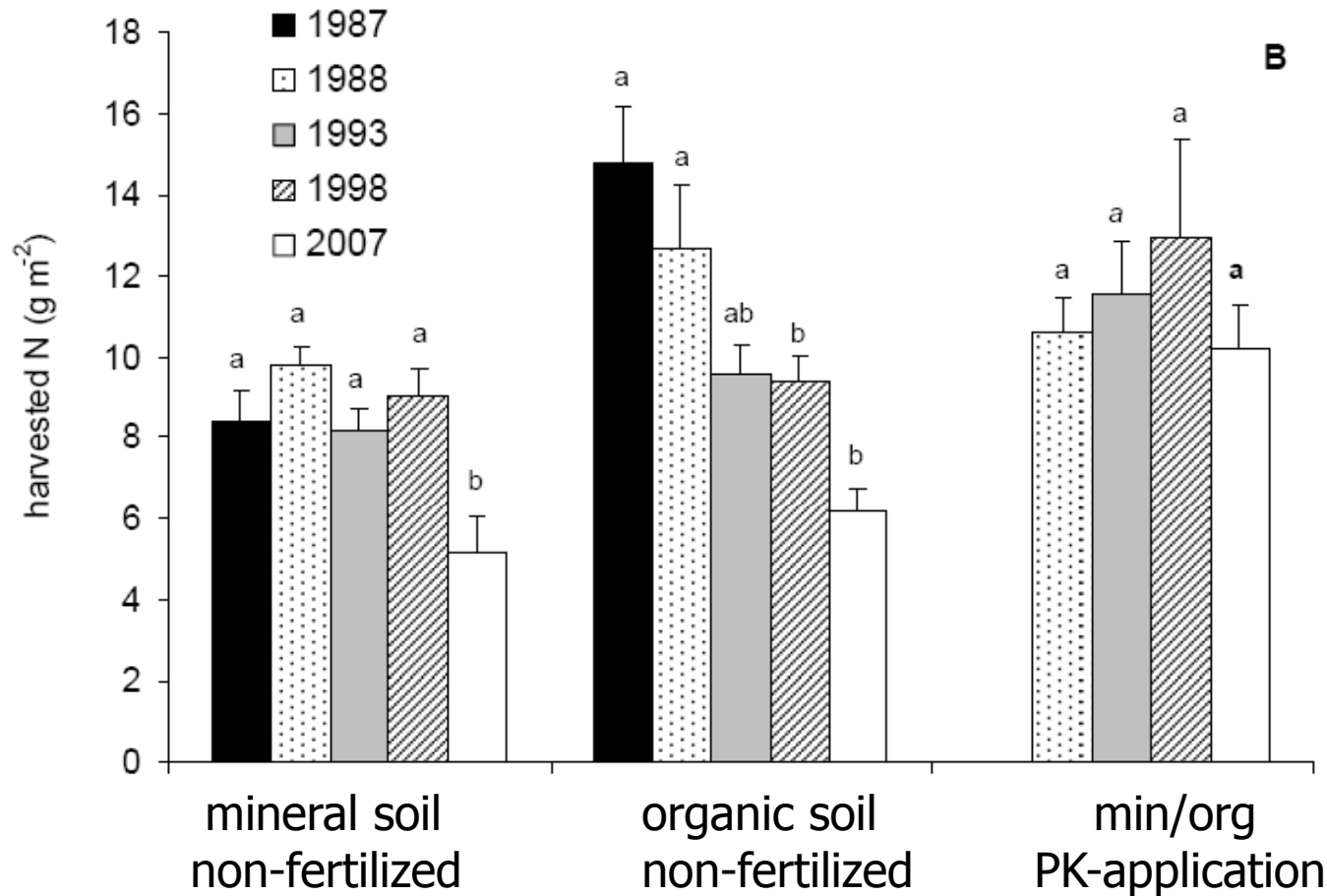
Poptcheva K, Schwartze P, Vogel A, Kleinebecker T & Hölzel N (2009) Changes in wet meadow vegetation after 20 years of different management in a field experiment (North-West Germany). *Agriculture, Ecosystems and Environment* 134: 108-114.

Long-term trends over 20 years (Ellenberg indicator values)



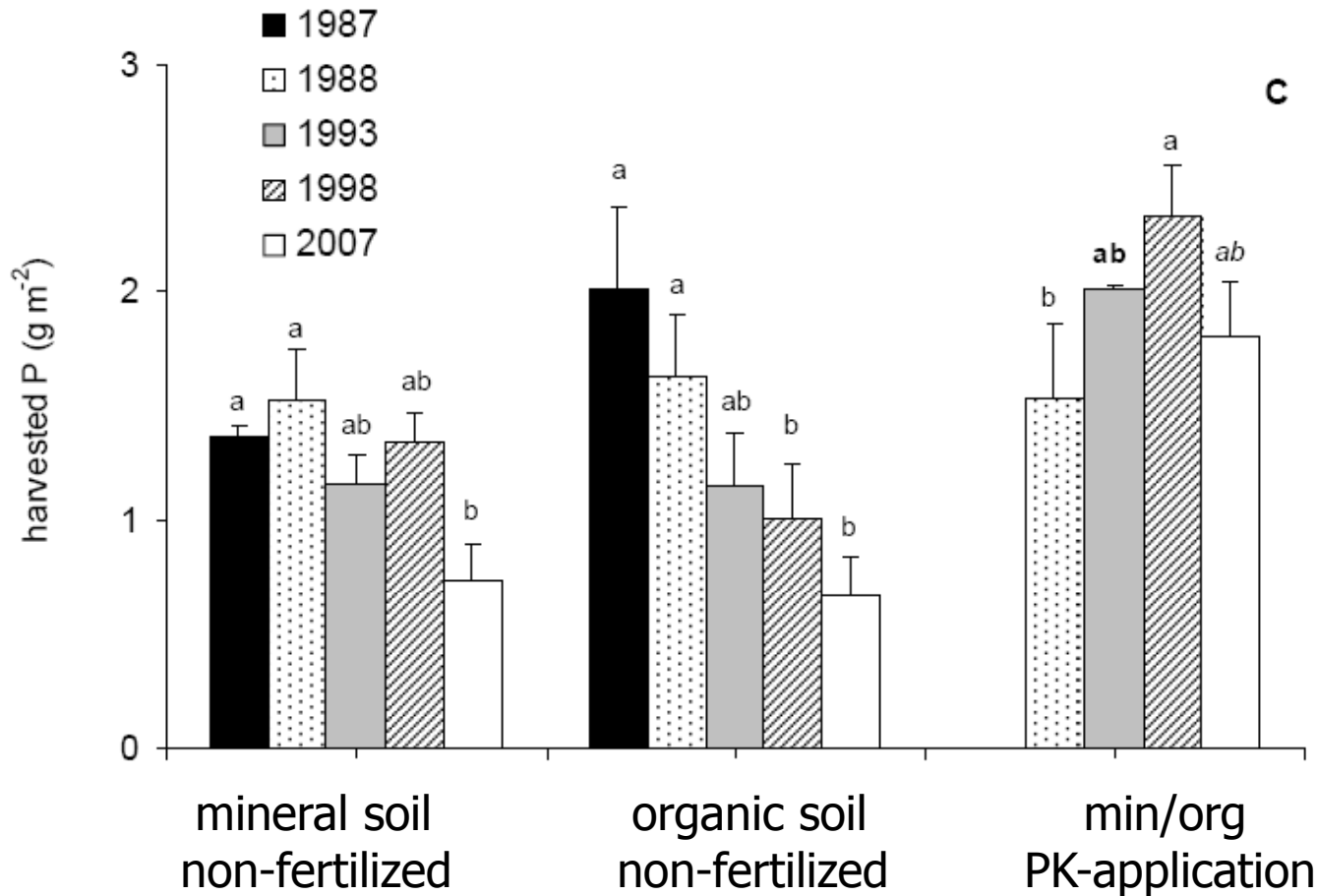
Poptcheva K, Schwartze P, Vogel A, Kleinebecker T & Hölzel N (2009) Changes in wet meadow vegetation after 20 years of different management in a field experiment (North-West Germany). *Agriculture, Ecosystems and Environment* 134: 108-114.

Change in harvested N (mowing twice a year)



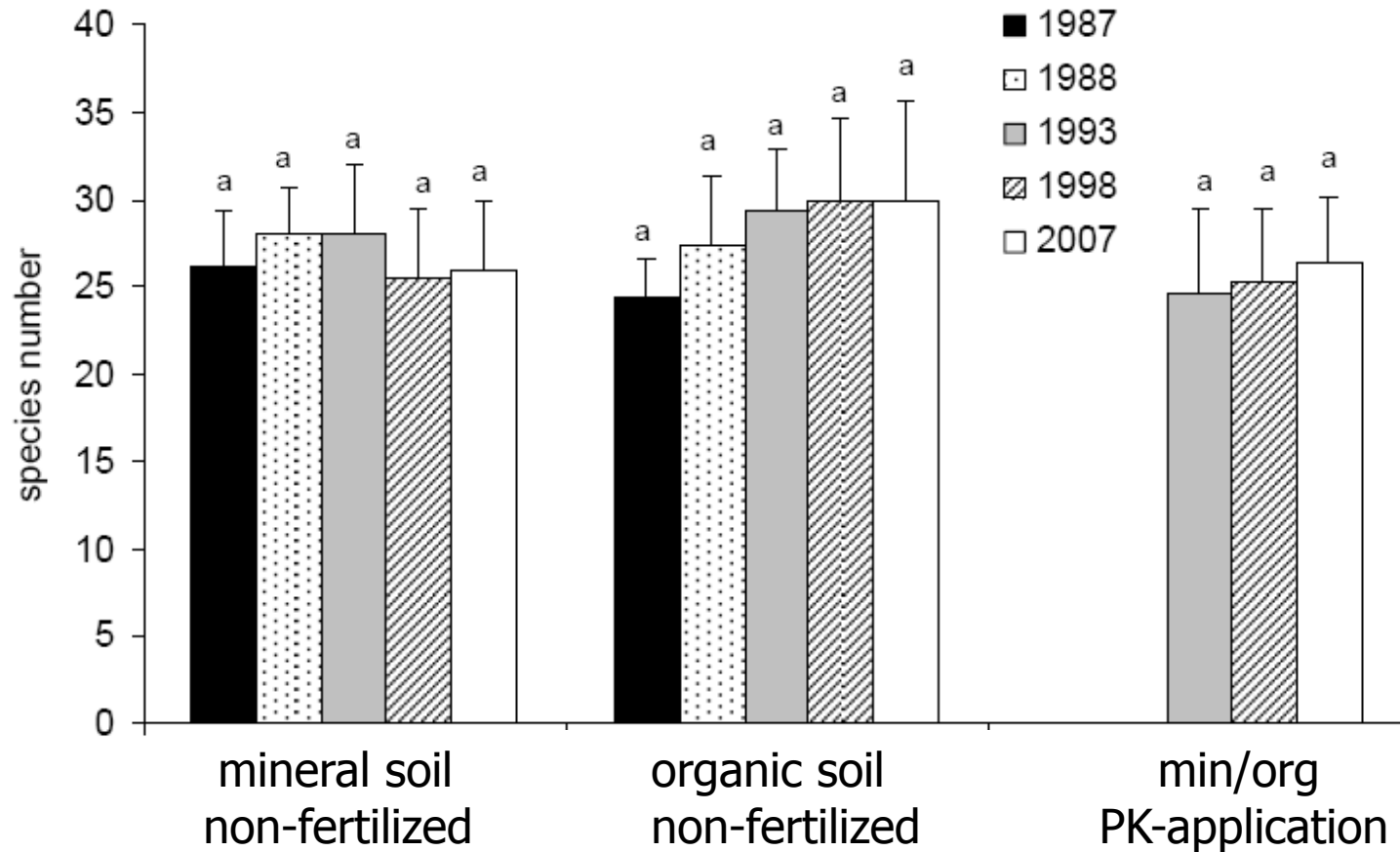
Oelmann, Y., Broll, G., Hölzel, N., Kleinebecker, T., Vogel, A. & Schwartze, P. (2011) Nutrient impoverishment and limitation of productivity after 20 years of conservation management in wet grasslands of north-western Germany. *Biological Conservation* 142: 2941-2948

Change in harvested P (mowing twice a year)



Oelmann, Y., Broll, G., Hölzel, N., Kleinebecker, T., Vogel, A. & Schwartze, P. (2011) Nutrient impoverishment and limitation of productivity after 20 years of conservation management in wet grasslands of north-western Germany. *Biological Conservation* 142: 2941-2948

Changes in species-richness (mowing twice a year)



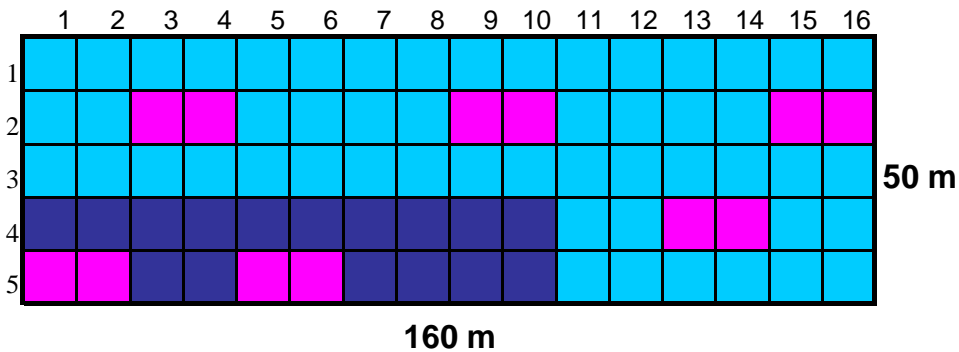
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Summary I:

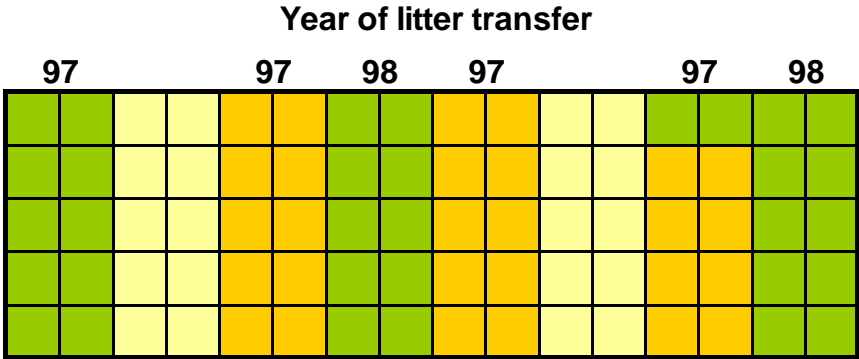
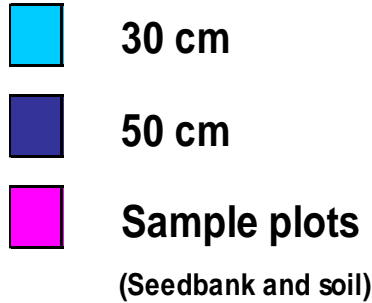
- successful depletion of nutrient pools by hay making twice
- mesotrophic condition can be achieved within 20 years
- significant impact of mowing regimes on floristic composition
- decline in ruderals and competitors
- spread of stress-tolerant species
- slight increase of plot species-richness
- almost no immigration of new target species
- ongoing changes even after 20 years

Case study II: Topsoil removal and hay transfer

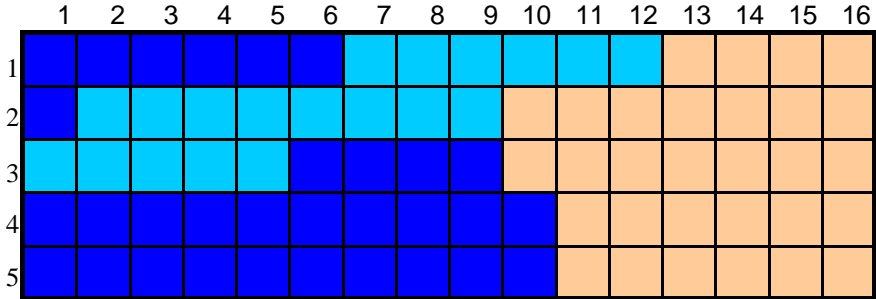
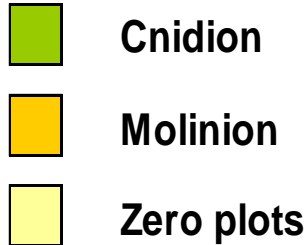




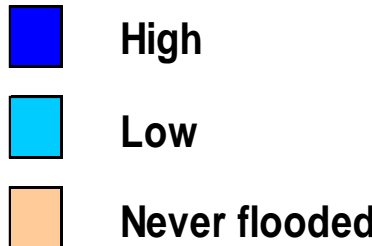
Topsoil removal

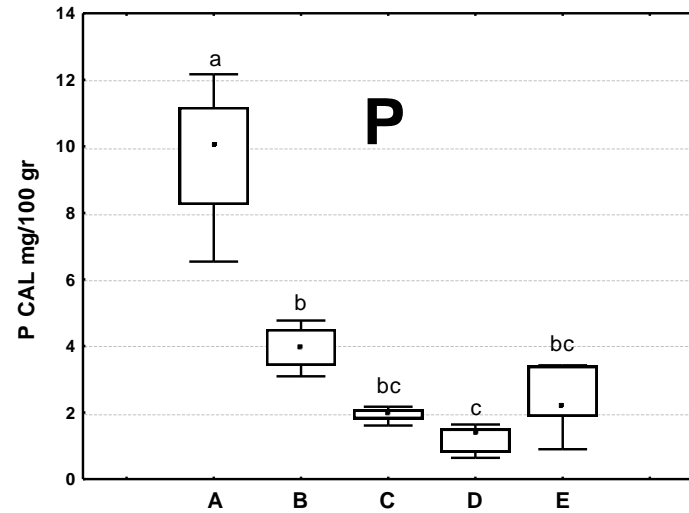
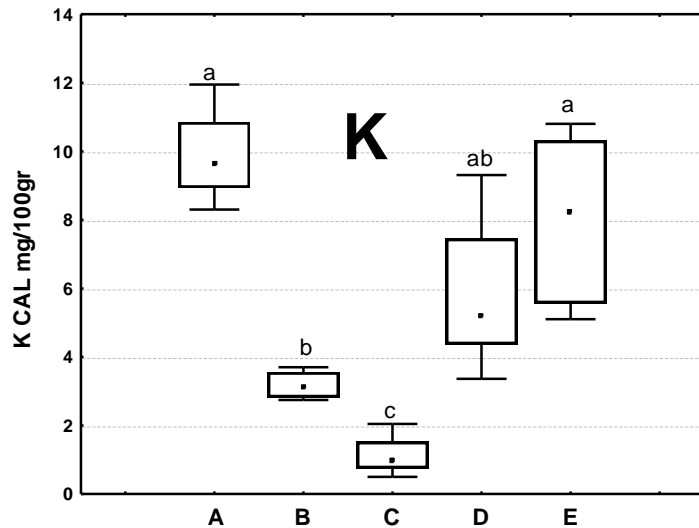
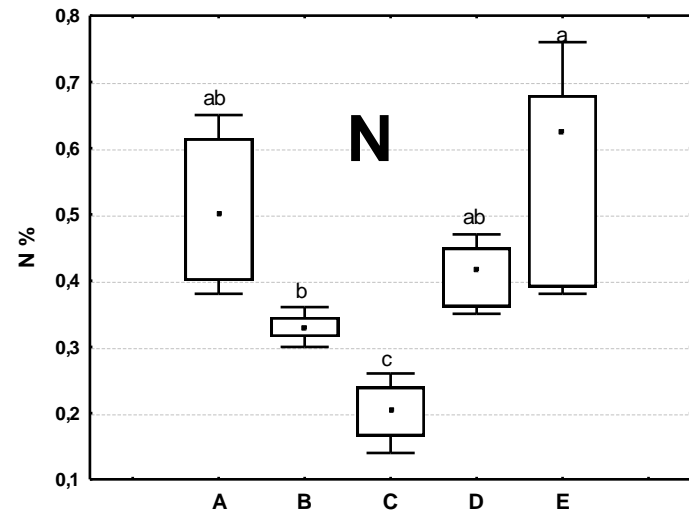
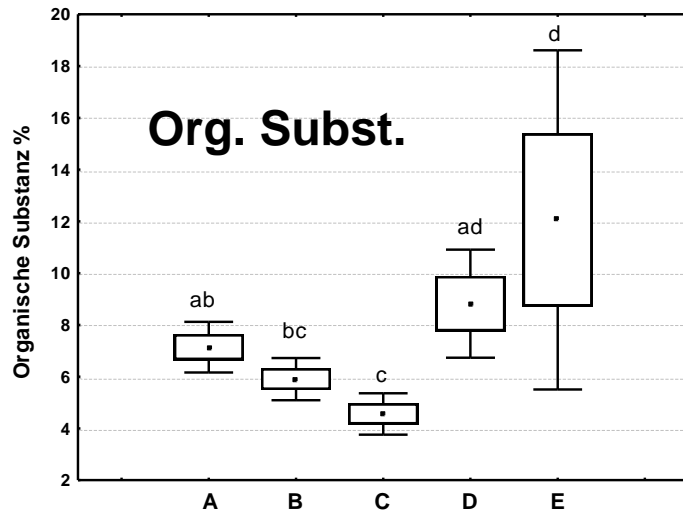


Origin of hay



Flooding frequency





A = former arable field

B = 30 cm topsoil removal

C = 50 cm topsoil removal

D = Molinion donar sites

E = Cnidion donar sites

Cnidion donar site



Molinion donar site



Hay transfer after topsoil removal



Restoration site in 1997

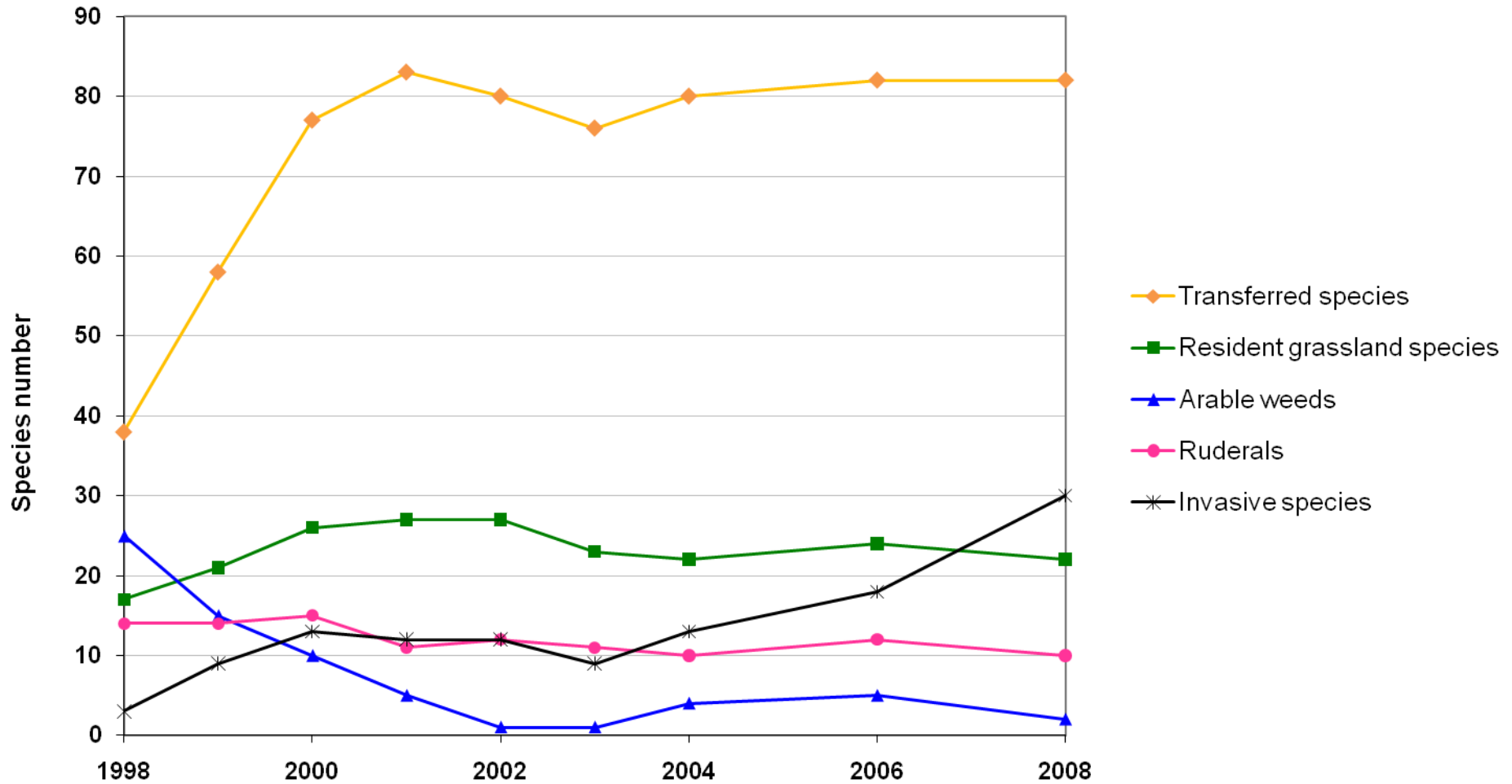


Same site in 2004



Species number 1998-2008

(Strips I-III)



Transferred target species:



Gentiana pneumonanthe



Arabis nemorensis



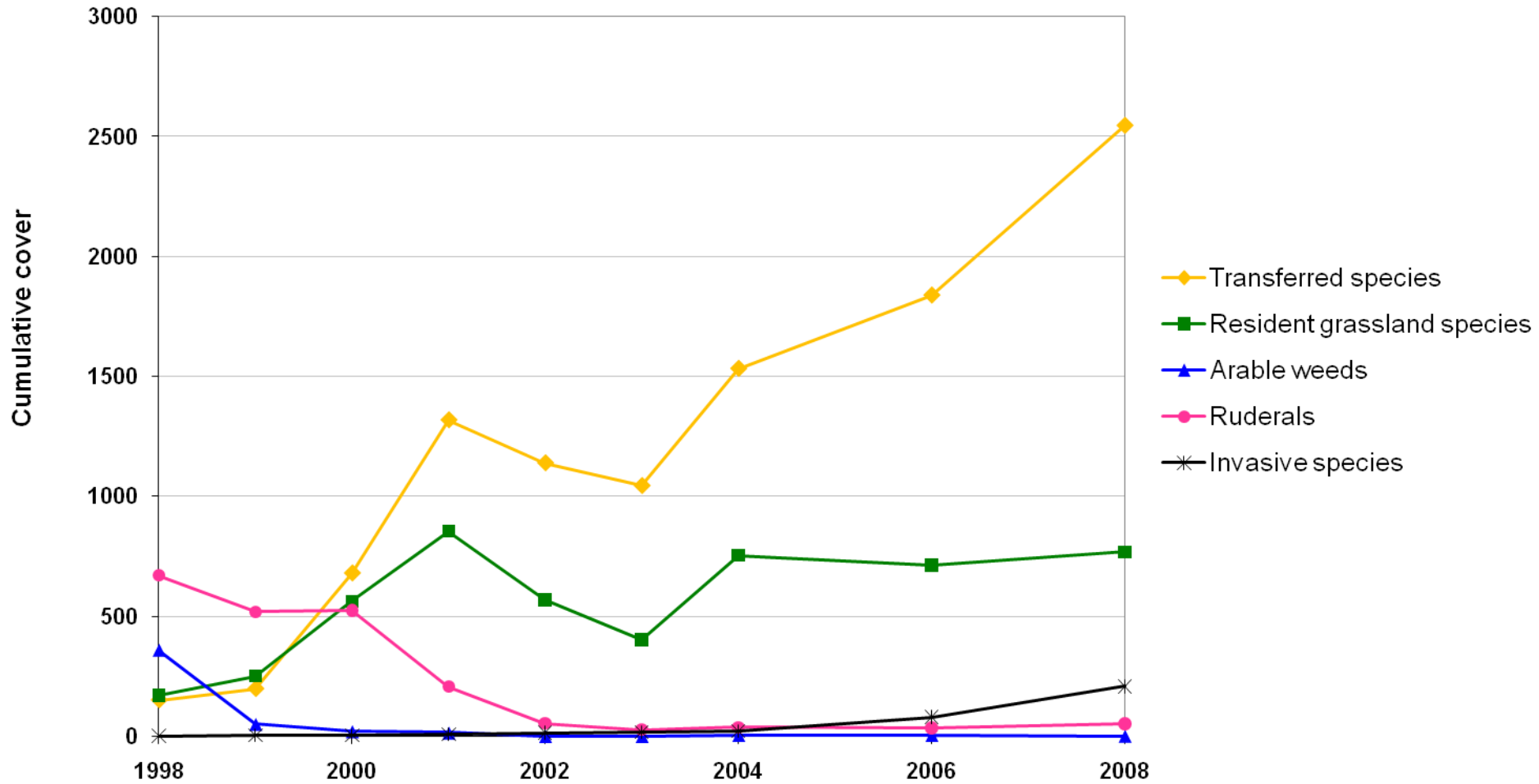
Viola elatior



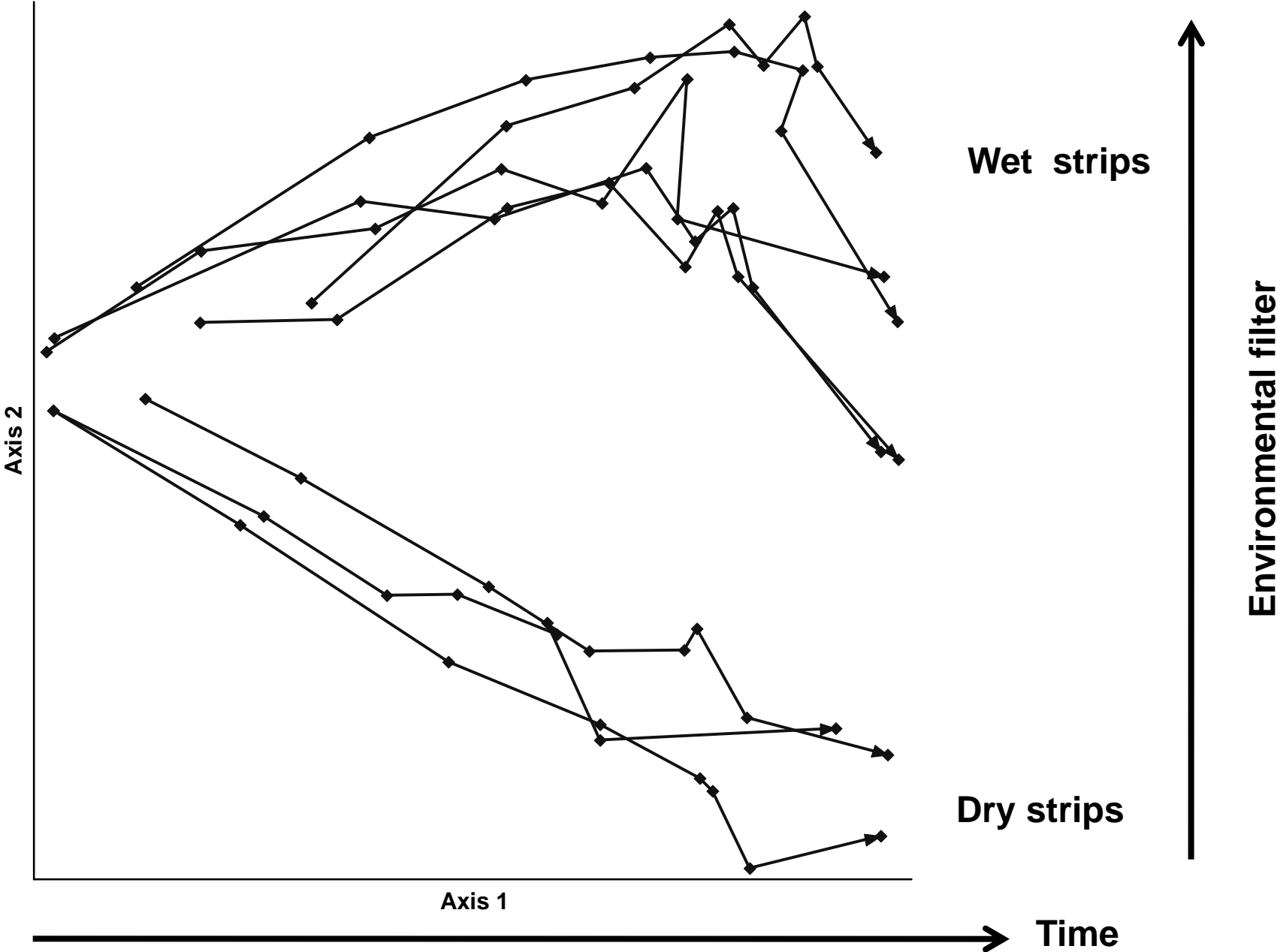
Iris spuria

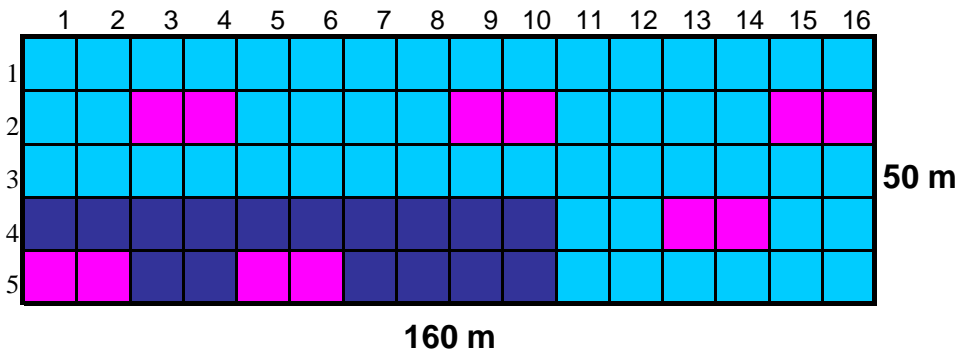
Cumulative cover 1998-2008

(Strips I-III)

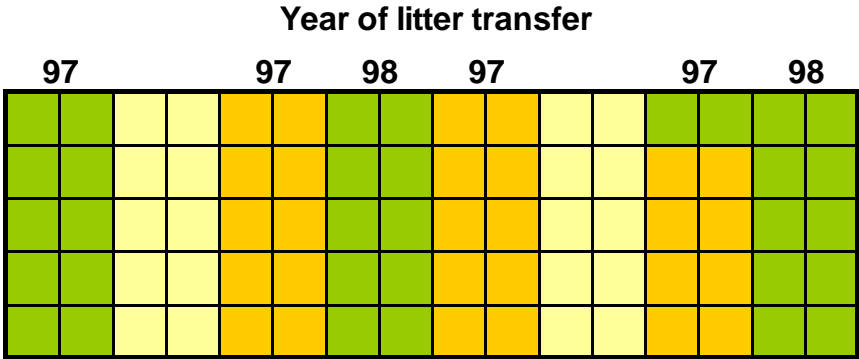
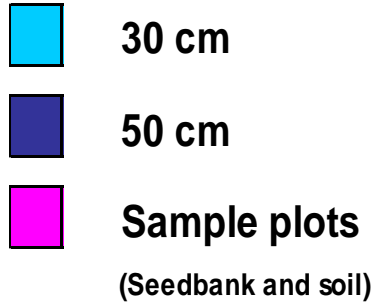


Trajectories in DCA-ordination (all strips)

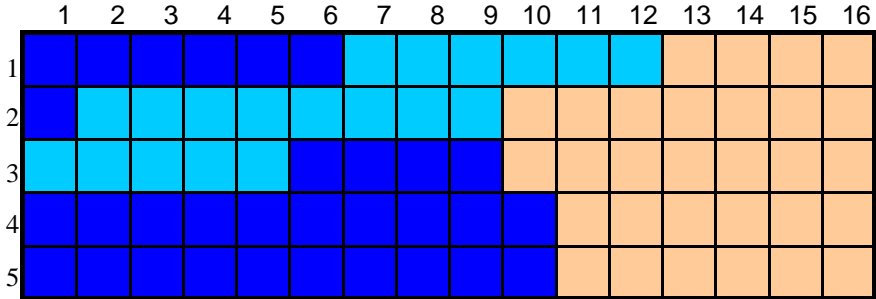




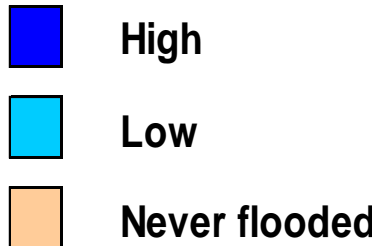
Topsoil removal



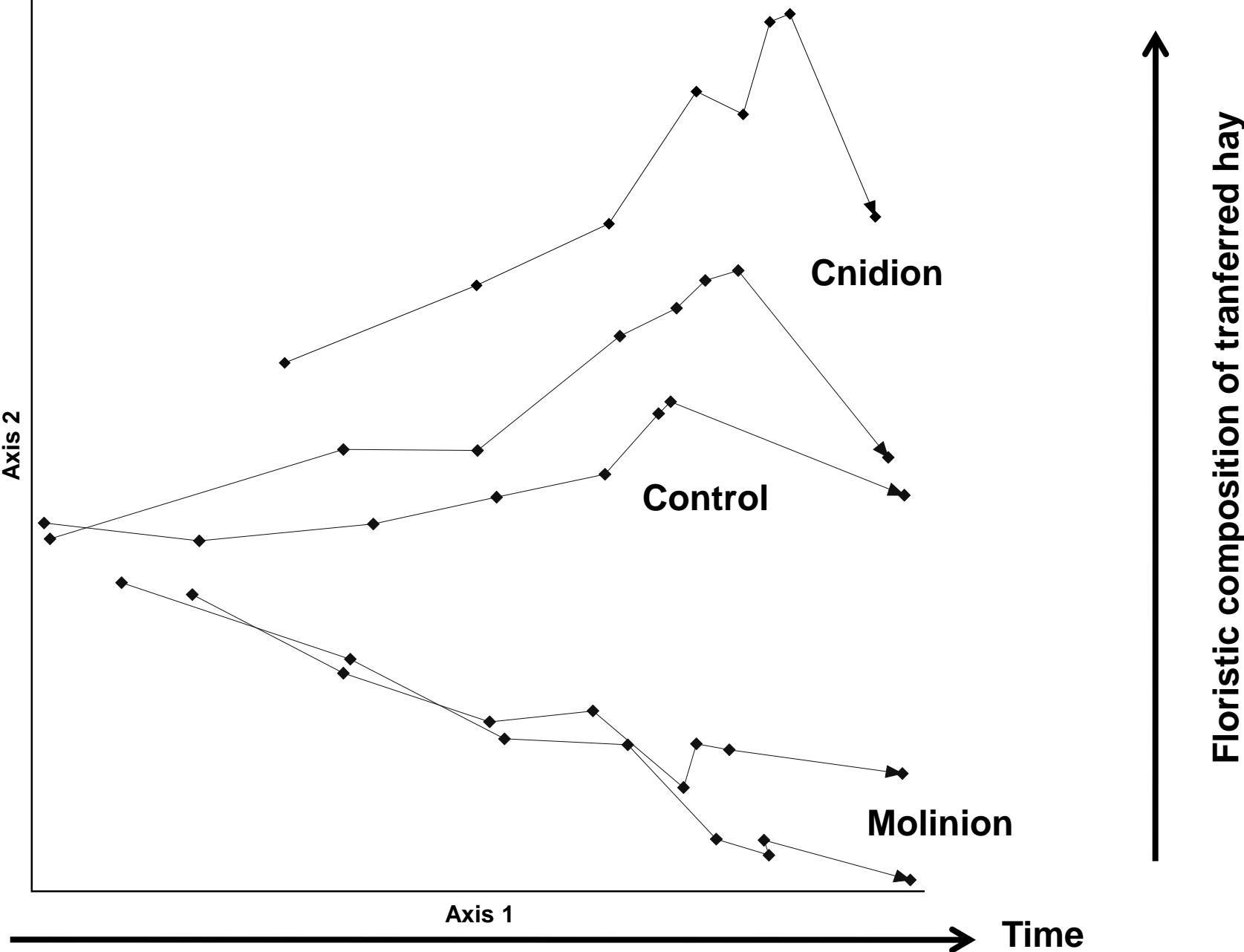
Origin of hay



Flooding frequency

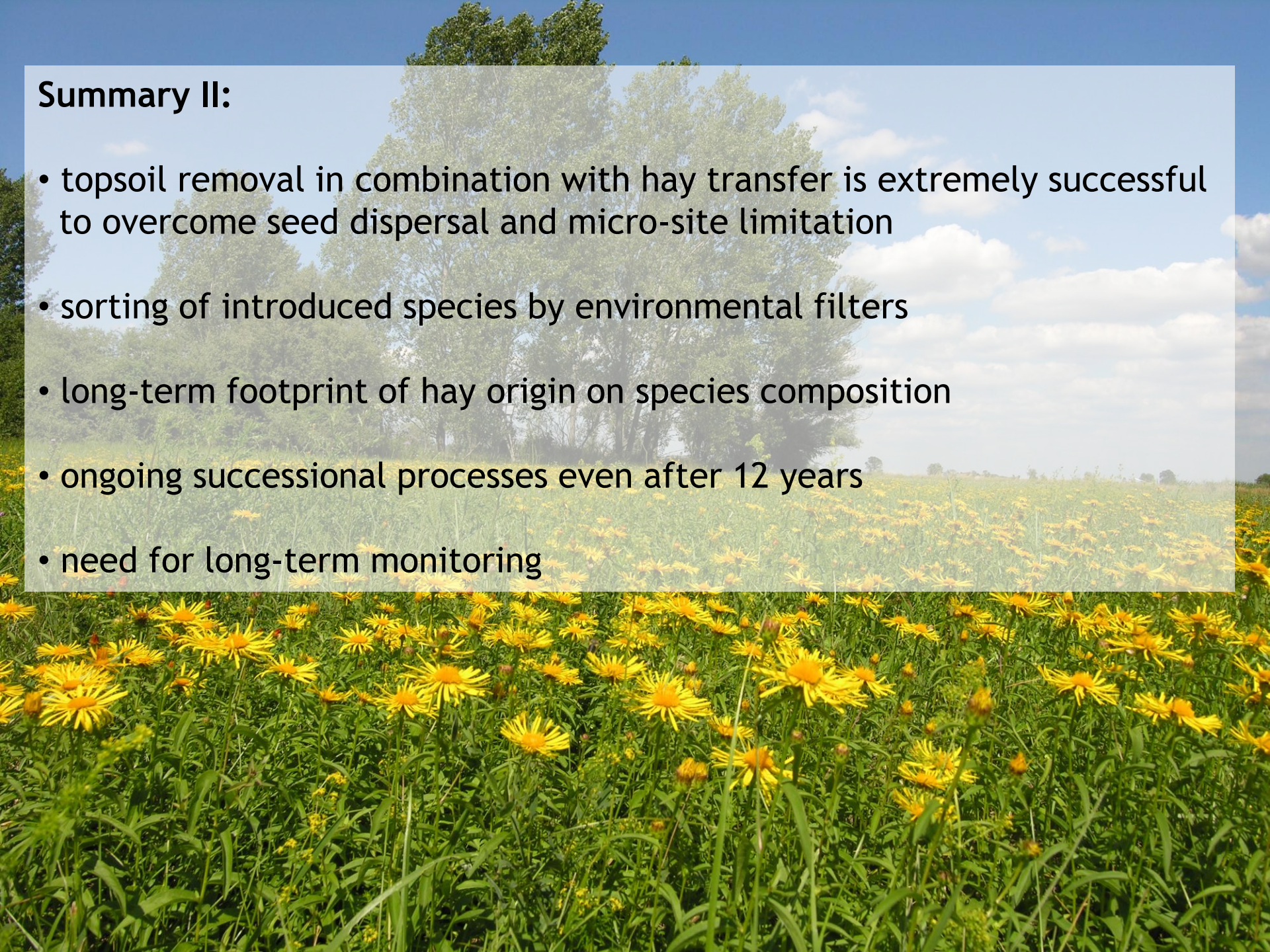


Trajectories in DCA-ordination (wet strips only)



Summary II:

- topsoil removal in combination with hay transfer is extremely successful to overcome seed dispersal and micro-site limitation
- sorting of introduced species by environmental filters
- long-term footprint of hay origin on species composition
- ongoing successional processes even after 12 years
- need for long-term monitoring



Thanks to:

Forstamt Groß-Gerau: *Henner Gonnermann, Dietrich Kulsch, Paul Hedderich*

University of Gießen: *Annette Otte, Jupp Scholz-vom Hofe*

Municipality Riedstadt: *Barbara Stowasser, Matthias Harnisch*

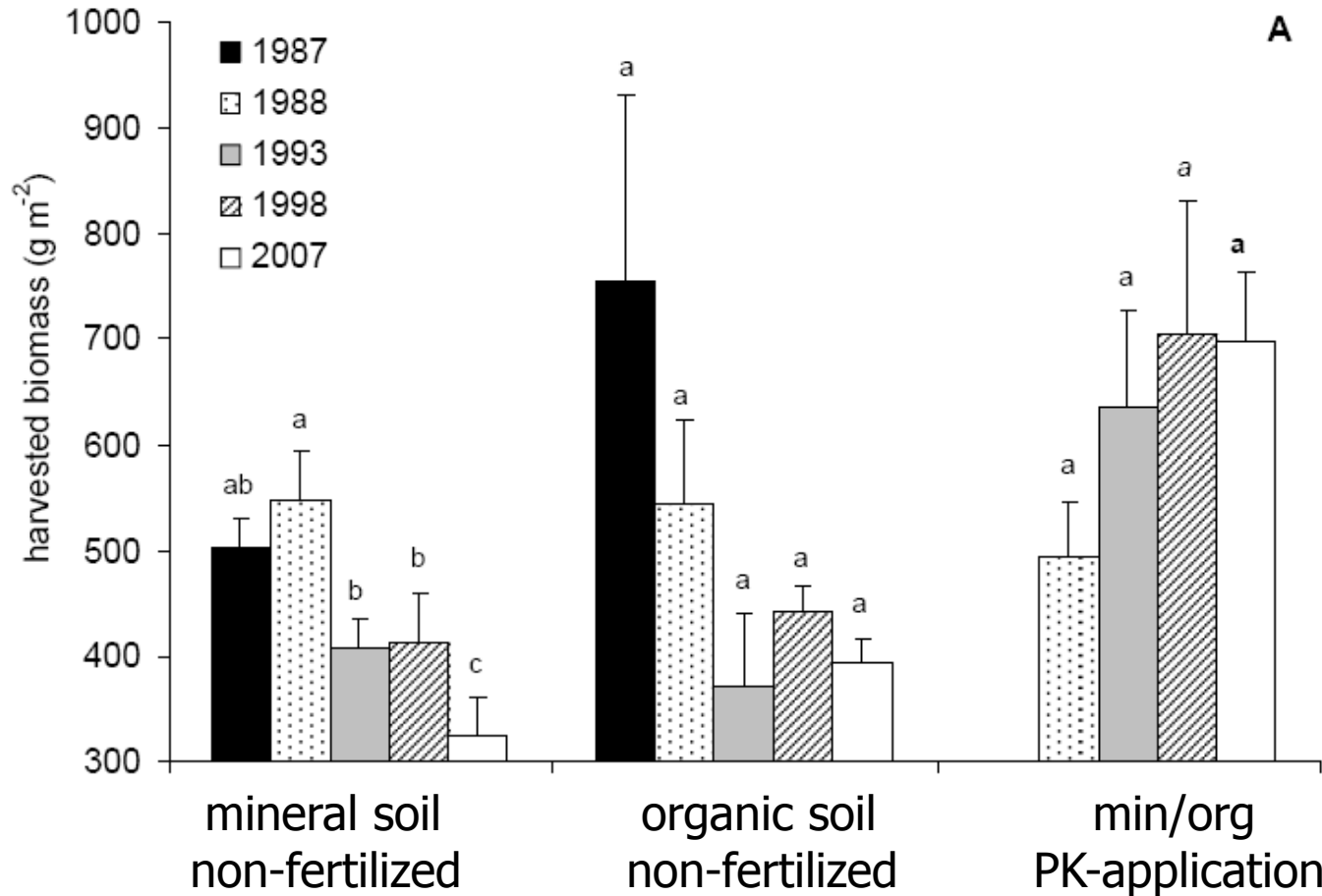
Student helpers: *Lorenz Geissler, Tobias Donath, Petra Göbel, Ines Klingshirn, Valter Mayrink*

Univeristy of Münster: *Gaby Broll, Yvonne Oelmann, Andreas Vogel, Kathrin Poptcheva
Eva Rosinski, Kristin Fleischer (graphs) and many other students*

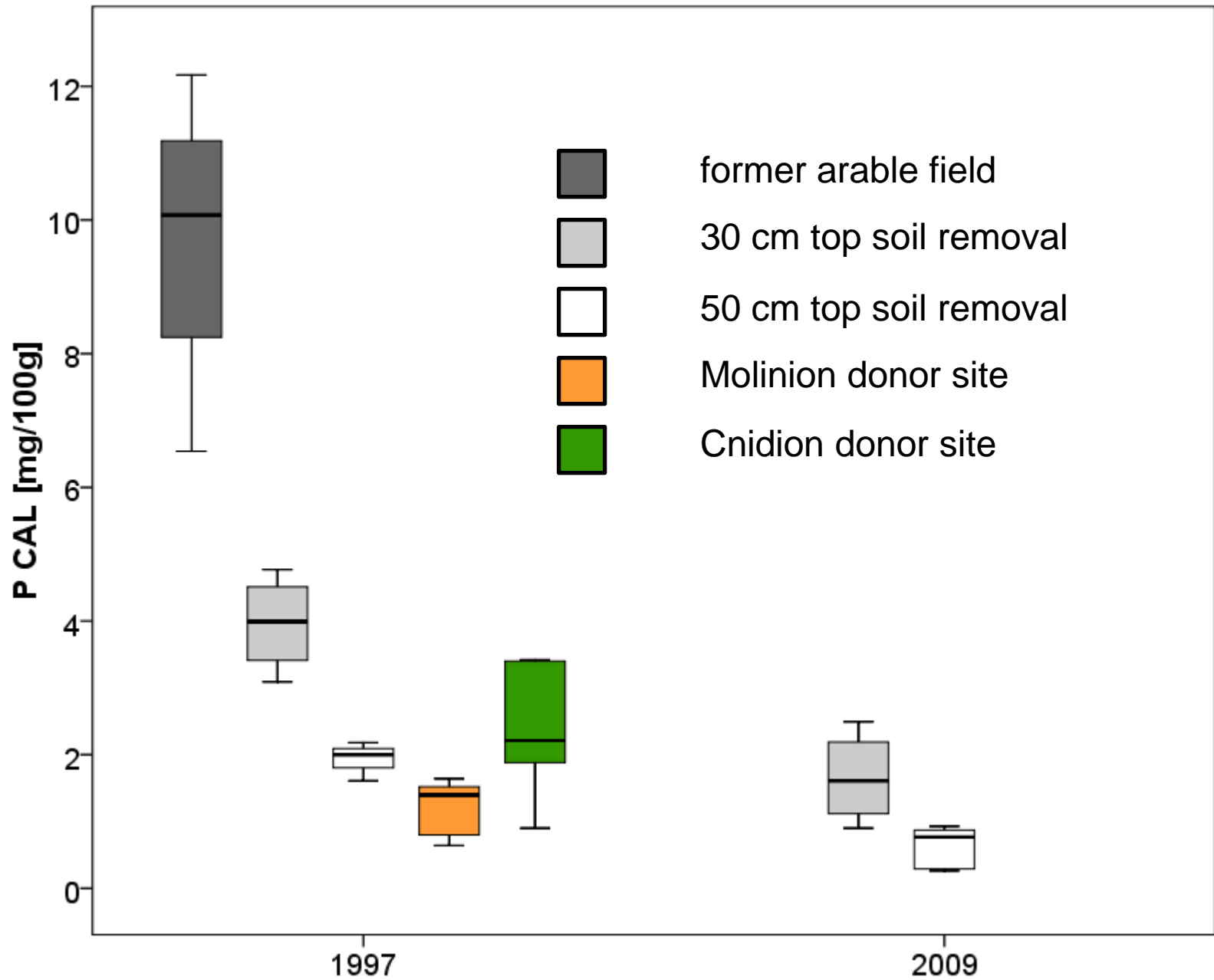


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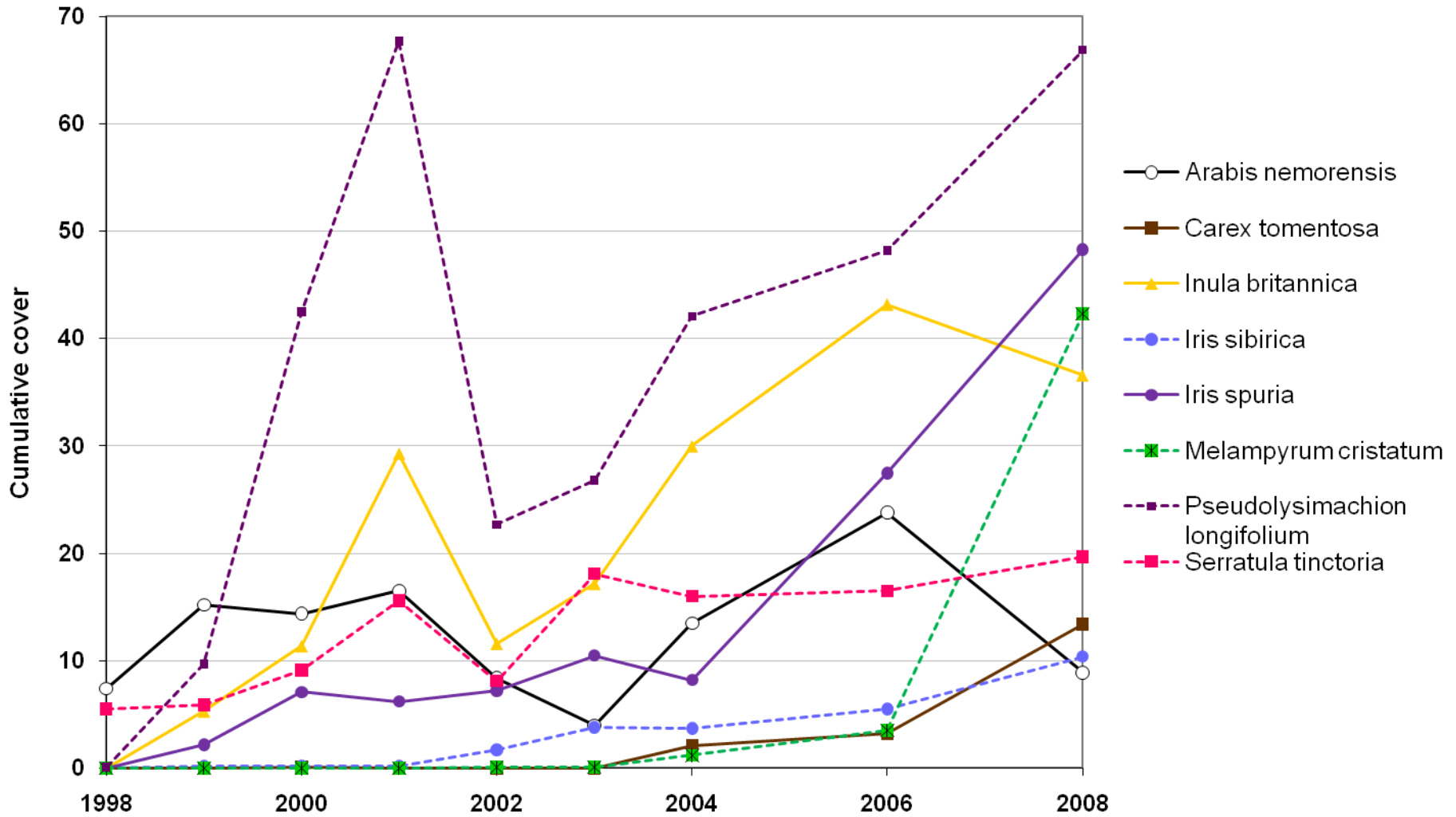
Change in harvested biomass (mowing twice a year)



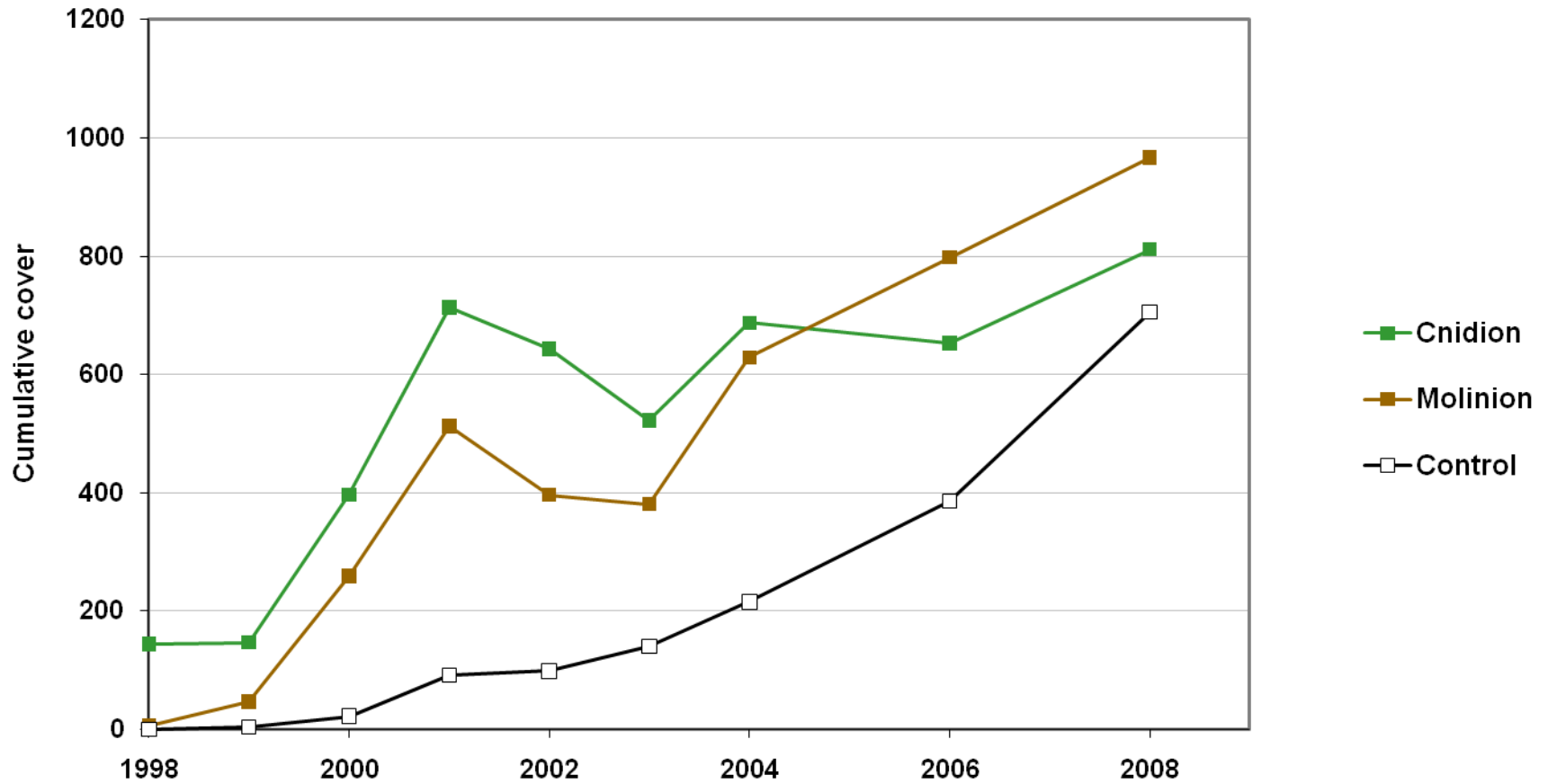
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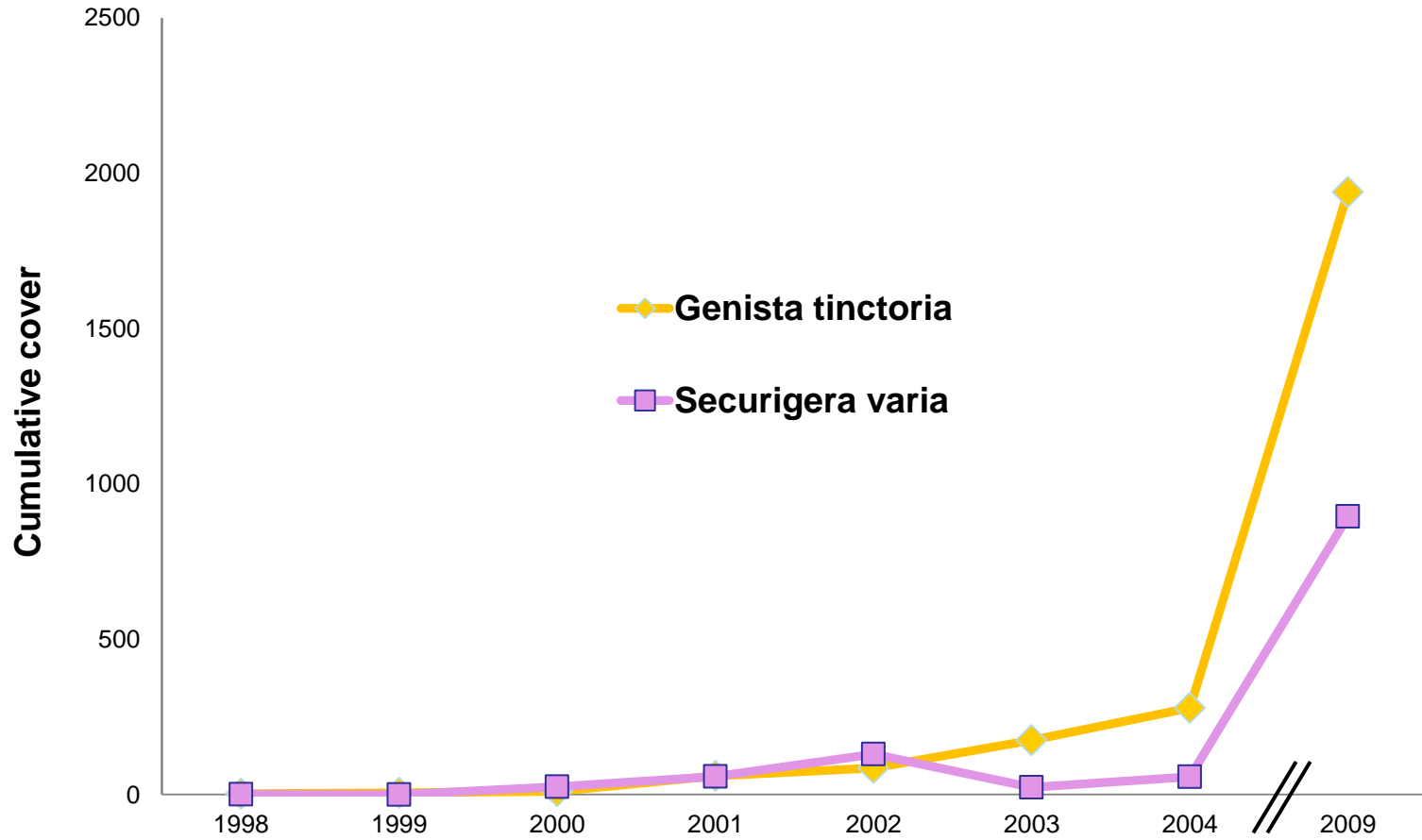
Cover development of different target species



Cover of transferred species



Development of legumes



Cover of invasive species

