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Invasion of *Calamagrostis epigejos* in sandy dry grasslands: effects on biodiversity and effectiveness of restoration measures

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The study species

- *Calamagrostis epigejos* (Wood Small-reed) is a native, rhizomatous tall grass of temperate Europe
- In central Europe, it was formerly mostly restricted to clear-cuttings in forests
- In recent decades, it is massively spreading in various habitats, such as:
 - sandy dry grasslands
 - calcareous dry grasslands
 - coastal dunes
 - alluvial grasslands
 - pine forests



The problem

- After invasion, *Calamagrostis* forms extensive, species-poor stands (polycormons) with a thick litter layer that prevents germination of other species
- The reason(s) for the recent spread of *Calamagrostis* are not well understood. They could include:
 - land-use abandonment
 - air-borne nitrogen input
 - “continentalisation” of the climate
- Despite the big conservation problems caused by *Calamagrostis* and various studies dealing with the issue, so far no effective measures have been found to “fight” this invader (partly due to the short duration of studies).



Questions

- How fast is *Calamagrostis* expanding into the dry grasslands?
- Which effect does *Calamagrostis* invasions have on vegetation (and grasshopper communities)?
- How is *Calamagrostis* affected by different restoration measures?

Study area

- Wendland (district Lüchow-Dannenberg, Lower Saxony) in the Biosphere Reserve “River Landscape Elbe”
- 4 test sites within 1 km. All are subject to low-intensity grazing by sheep once in spring and once in autumn.
- Alliances *Corynephorion canescentis* and *Armerion elongatae*



Methods

Descriptive part:

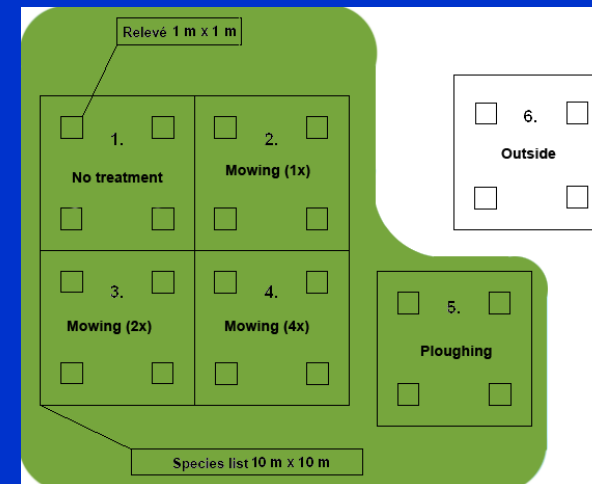
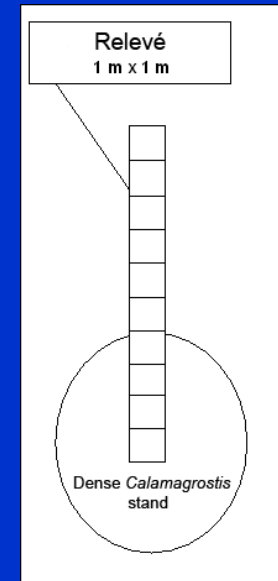
Transects of 10 m length and 1 m width to analyse the speed of the expansion of *Calamagrostis* without specific treatment. The transects are arranged at the perimeter of six differently sized *Calamagrostis* polycormons in two of the study sites.

Experimental part:

* 5 different treatments (ploughing once, intensive grazing once a year, mowing 1x, 2x, and 4x a year) + controls with (no treatment) and without *Calamagrostis* (outside).

* These treatments are applied to 100-m² plots in each of the four study sites. Within each large plot, we further analysed four 1-m² plots in detail.

6 years, i.e. long-term (compared to previous studies).



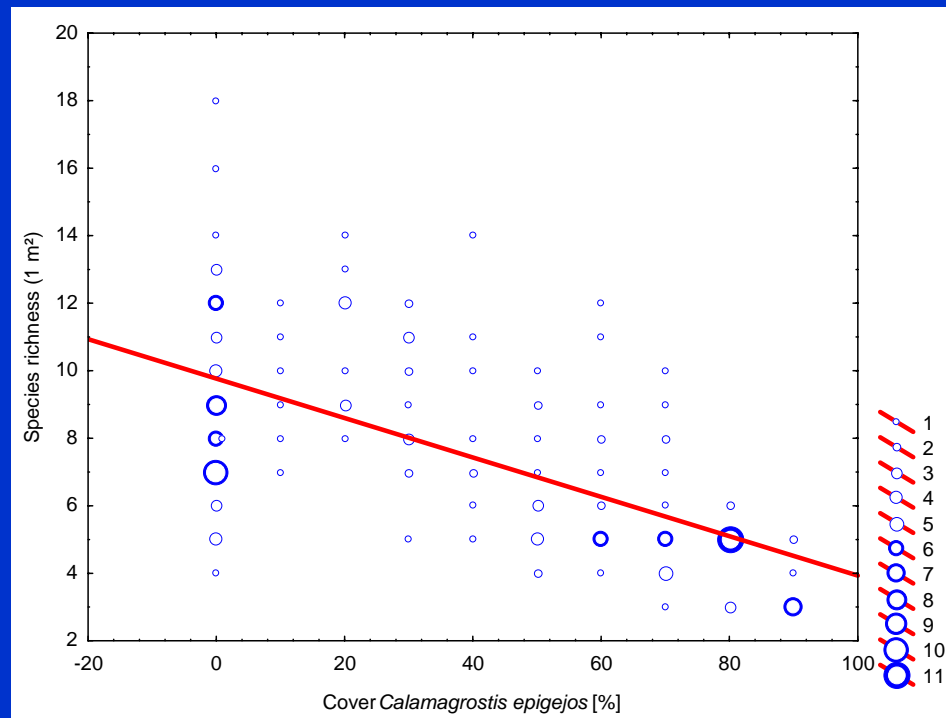
Expansion of *Calamagrostis*

- Untreated *Calamagrostis* polycormons ($n = 6$) expanded by 1.11 ± 0.50 m (mean \pm SD) in the first year and by 0.73 ± 0.76 m in the second year.
- The detected maximum radial expansion of a polycormon was 1.95 m in one year.
- The variation in expansion speed was higher among different polycormons than between years.
- Non-significant tendency that intermediately-sized (c. 100 m²) polycormons spread faster than both smaller and larger ones.



Effects of *Calamagrostis*

- Cover of *Calamagrostis* had strong negative effects on plant diversity, explaining 37% of the variance in species richness ($p < 0.001$).

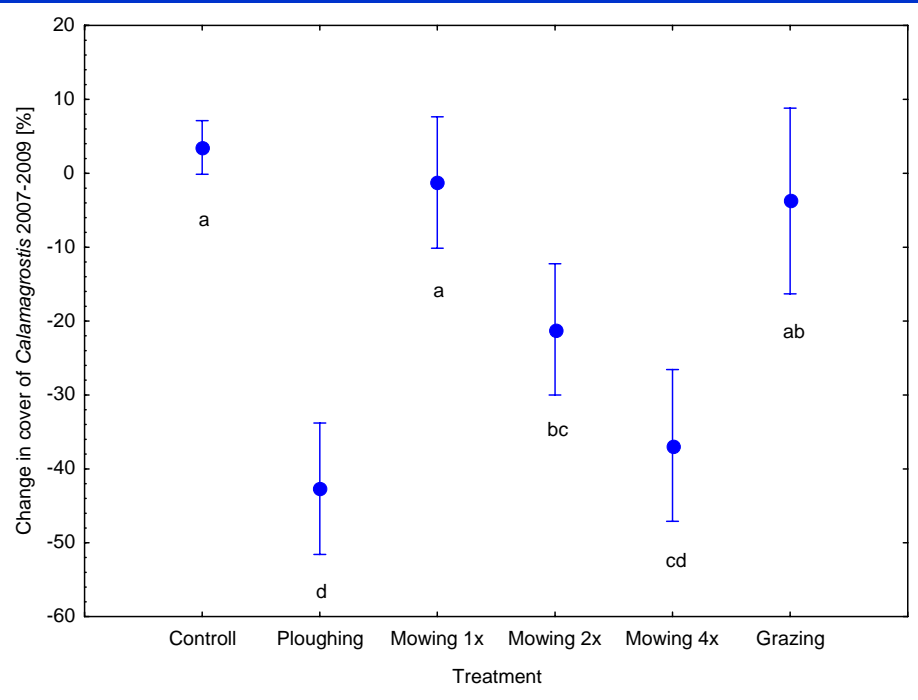


- The effects of culm density of *Calamagrostis* ($p < 0.001$; $R^2 = 29\%$) and of litter cover (n.s.) on species richness were less pronounced.

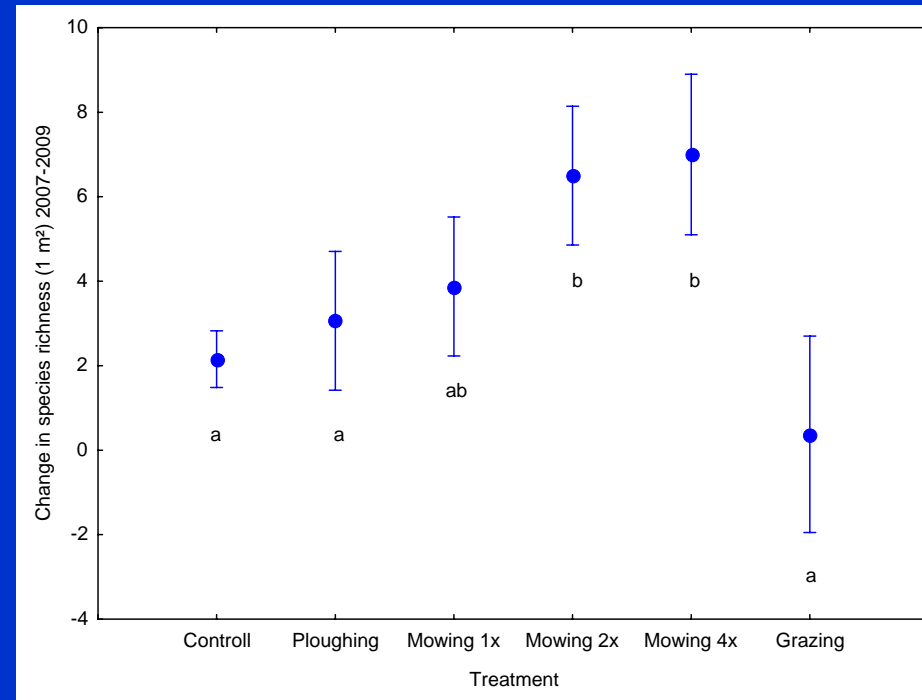


Restoration measures (after 2 years)

Calamagrostis cover



Species richness





Conclusions

- *Calamagrostis* is spreading fast and has strong negative effects on the plant diversity of dry grasslands.
- After 2 years, only high-intensity management techniques, such as ploughing and mowing at least twice a year, had significant effects, while grazing and mowing once a year had not.
- A continuation of the experiment is necessary to assess the overall benefits of the different treatments (e.g. after two years ploughing was most effective in reducing *Calamagrostis* cover but least effective in increasing species richness).
- In future studies also other measures such as cattle grazing (especially in winter) and top-soil removal should be considered



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