The effects of climate change, extreme droughts, and fine-scale disturbances in the Pannonian sand grasslands, Hungary

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The study area – a heterogeneous and changing landscape

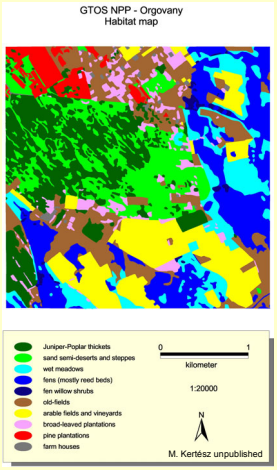
Geographic setting

Kiskunság: central part of the Carpathian Basin, alluvial plain of the Danube, calcareous sand

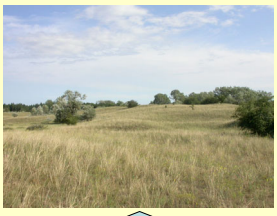
The high habitat diversity results from three major factors

- Transitional climate and vegetation (forest-steppe),
- Heterogeneity of water supply (water table depth),
- Diversity of current and past land use.

Mosaic landscape and high habitat diversity



Pannonian sand grasslands



- On high sand dunes, poorest soils, semidesert-like vegetation;
- extensive areas, relatively undisturbed;
- high conservation value (endemic species).

Land abandonment

Afforestation by non-natives

Ongoing changes in the region:

- Increased aridity and 2-3 m decrase in the water table since the 1970s;
- Socio-economic changes (farming is not profitable, end of the communist area, increasing wellfare, accession to the EU);
- Countryside is gradually abandoned: people move to towns, farming and number of grazing animals are declining;
- Consequences of changes: spread of invasives, increased fire risk;
- New land use types: afforestation (by non-natives), energy plantations, eco-tourism, nature conservation.

Climate change experiment – VULCAN

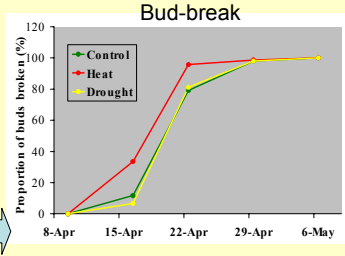
The experimental site

As a partner in the EU PF5 VULCAN project we experimentally simulate warming by covering plots by night and simulate drought by partially excluding the precipitation in other plots.

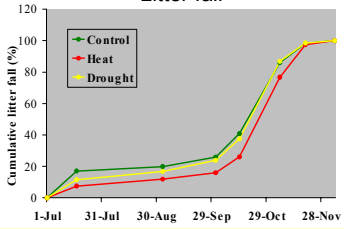
We found earlier bud-break and later litter fall for *Populus alba* due to warming, which means an extended growing season. *Festuca vaginata* (not shown) responded negatively to drought by declining cover and lower regeneration rate.

Warming – extended growing season

Bud-break

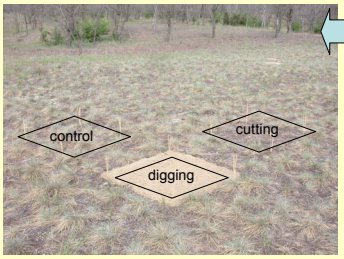


Litter fall



Fine-scale disturbance experiment

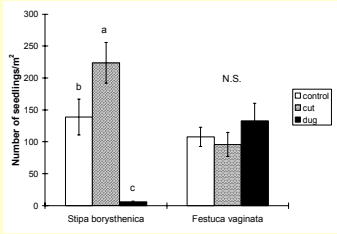
Experimental disturbances



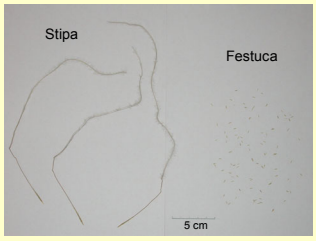
We investigated the response of dominant sand grassland species to experimental disturbances with soil disturbances (digging) and without soil disturbances (cutting).

Stipa borysthenica recovered rapidly if soil was not disturbed (cutting), but very slowly on bare sand (digging); *Festuca vaginata* recovery was similar across treatments.
Insufficiant *Stipa* recovery on bare soil is related to its seeds morphology. Its seeds with large feathers are blown away by wind, which indirectly promotes *Festuca* on bare sand.

Differential recovery by the two dominant species

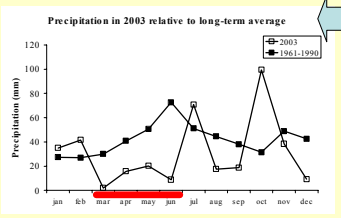


The role of seed morphology



Extreme drought events

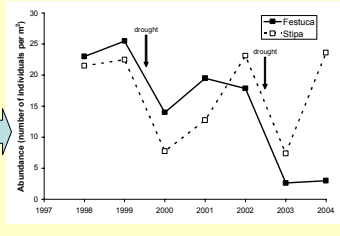
Drought in 2003



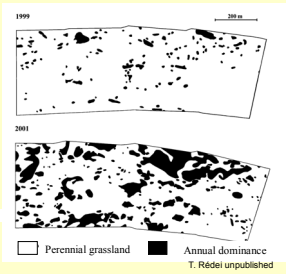
In years 2000 and 2003 extreme drought events occurred in the region.

Based on repeated surveys in permanent plots, we found that stands previously co-dominated by *Festuca* and *Stipa* turned into *Stipa* dominated stand due to the fast recovery of *Stipa*. Repeated vegetation mapping highlighted the dieback of perennial grassland and expansion of annuals, which can be interpreted as „desertification".

Shift in species dominance



The expansion of annuals – desertification?



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