

# Old Field Meadow Plant Community Resilience to, and Recovery from Five Years of Simulated Severe Drought

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## Introduction

- ❖ Grasslands provide numerous ecological and economic benefits including habitats for multiple rare species, agricultural land, and carbon sequestration.
- ❖ Climate change in Southern Ontario is expected to cause increases in the severity and frequency of summer droughts, which can severely impact grasslands.
- ❖ Grassland plant community species richness (number of different species) is known to promote stability against non-native plant invasions and extreme weather events.
- ❖ Drought is well known to cause a decline in species richness: Our goal is to investigate whether initial richness is indicative of community resilience to drought, and to understand its potential recovery from drought.



**Figure 1:** Old field meadow in Newboro, Southeastern Ontario (Left) with an active rainout shelter simulating summer drought (Centre), and an inactive one terminated in 2015 (Right).

## Methods

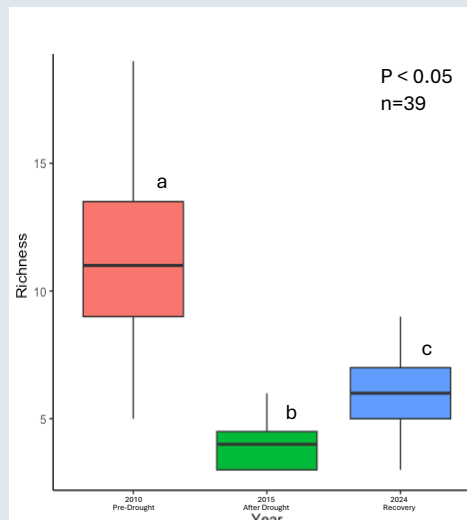
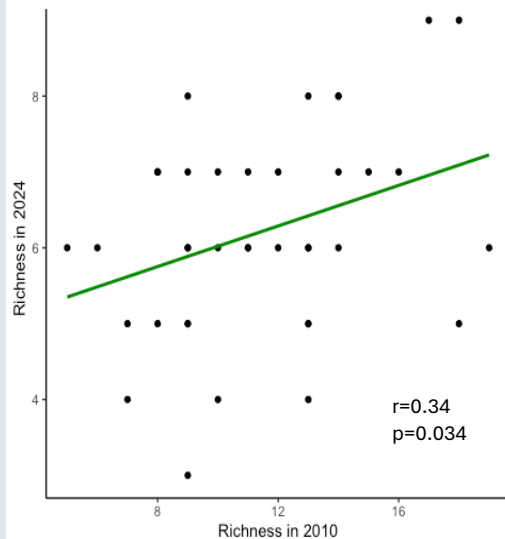
- ❖ Species richness data were collected in 39 (1m<sup>2</sup>) plots prior to experiment set-up (2010), after five years of simulated drought (2015), and after nine years of recovery (2024).

## Questions

1. Does the initial plant community species richness influence its resilience to drought?
2. Does species richness recover to ambient (control) levels within nine years after release from severe drought?

## Results

1. Plots with relatively high species richness in 2010 gained more species by 2024.



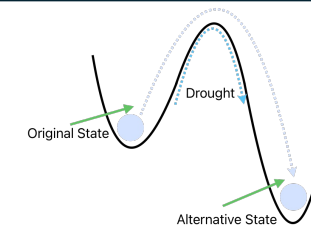
2. Community richness after nine years (2024) only partly recovered from the severe drought-induced decline in 2015.



**Figure 2:** Images of *Bromus inermis* (Left), *Vicia cracca* (Middle), and *Galium spp.* (Right).

## Discussion

- ❖ Plant communities can recover from prolonged drought events; however, recovery is very slow, with our results suggesting maybe 20 years required for full restoration.
- ❖ Initial species richness influences a community's capacity to restore its richness after severe drought, however, other unmeasured factors must also be important.
- ❖ Prolonged exposure to drought seems to push plant community richness into an alternative stable state. Therefore, severe multiyear drought in Ontario meadow grassland is likely to greatly diminish their biodiversity conservation value.



**Figure 3:** Graphic showing the alternative stable state that is suggested by our findings.

## Sources

1. Alho, J.R. (2008). The value of biodiversity. *Brazilian Journal of Biology*, 68(4), 1115-1118. <https://doi.org/10.1590/s1519-69842008000500018>
2. Beisner, B., Haydon, D., & Cuddington, K. (2003). Alternative stable states in ecology. *Frontiers in Ecology and the Environment*, 1(7), 376-382. [https://doi.org/10.1890/1540-0902\(2003\)001\[0376:assie\]2.0.co2](https://doi.org/10.1890/1540-0902(2003)001[0376:assie]2.0.co2)
3. Keyring, J., Dengler, J., Walker, J., Vitev, N., Ugur, E., Sopotlieva, D., Ranjini, J., Picon-Cochard, C., Nijis, L., Hernandez, P., Güler, B., von Gilhaussen, P., De Boeck, H. J., Bloor, J. M. G., Berwaers, S., Beerkuhnien, C., Arin Khan, M. A. S., Apostolova, I., Altan, Y., ... Jentsch, A. (2017). Species richness effects on grassland recovery from drought depend on community productivity in a multiple experiment. *Ecology Letters*, 20(11), 1406-1413. <https://doi.org/10.1111/ecl.12348>
4. Tilman, D., & El Haddad, A. (1992). Drought and biodiversity in Grasslands. *Oecologia*, 89(2), 257-264. <https://doi.org/10.1007/bf00317226>
5. Van Ruijven, J., & Berendse, F. (2009). Diversity enhances community recovery, but not resistance, after drought. *Journal of Ecology*, 98(1), 81-86. <https://doi.org/10.1111/j.1365-2745-2008.01503.x>