SNF project No. 197641 (01.01.2021–31.12.2024)

Patterns and drivers of epochal changes in grassland biodiversity in Switzerland: The Square Foot Project

Summary

Over the last century, biodiversity on Earth has declined dramatically across taxa, ecosystems and regions, which has prompted various scientists to coin it the sixth mass extinction. While the fact as such is beyond doubt, it is unclear which facets of biodiversity (e.g. fine vs. coarse scale; alpha/beta/gamma; taxonomic/phylogenetic/functional) are affected and how, and which drivers (e.g. land use change, climate change, habitat change/loss, eutrophication, landscape simplification, biotic invasions) are the most relevant ones. As most quantitative studies on biodiversity change are local to regional, cover a few decades at best and address only one or a few drivers, it is not surprising that their results are idiosyncratic and often contradictory. The understanding of patterns and processes of anthropogenic biodiversity change/loss is strongly impeded by the lack of long-term monitoring datasets of species assemblages that have been sampled in a consistent way across larger geographic and ecological extent.

For natural and semi-natural grasslands, which host a big part of Europe's biodiversity and are among the most threatened habitat types, such a dataset has recently been discovered: Between 1883 and 1931, three botanists have sampled 590 vegetation plots of grasslands of any type across the whole of Switzerland with a highly standardised and precise method – they determined all vascular plant species on areas of 0.3 m × 0.3 m ("square foot") and measured the above-ground dry weight of each species. With the Square Foot Project, we aim to resurvey the plots of this globally unique dataset and combine it with the wealth of spatially resolved historical and current environmental and land use data that are available in Switzerland to address the following objectives:

Objective 1: Diversity change across Switzerland. Quantify the multiple facets of biodiversity change of grassland vegetation over more than a century at the national extent of Switzerland and attribute it to the wide set of drivers under discussion.

Objective 2: Compositional change across Switzerland. Partition the observed biodiversity change of grassland biodiversity into responses of individual species to drivers and how they translate into changes in community assembly.

Objective 3: In-depth comprehension of mechanisms of change. Relate the grassland diversity and composition change to aspects of land use, fertilisation, climate change and other drivers, account for potential indirect effects such as via increases in mean plant size or altered type of nutrient limitation.

Objective 4: Applications and scenarios. Project drivers into the future and infer on the expected impact on grassland composition as well as promising conservation strategies.

Our approach will allow us to quantify how different facets of plant biodiversity changed over such a long period, how this change varied geographically and how these patterns aggregate at larger grain sizes. Moreover, given the size of the dataset, the availability of data on environmental drivers and their significant variation across Switzerland, to our knowledge, this will be the first data-based, comprehensive evaluation of the effects of all commonly discussed drivers and their interactions. This will allow quantifying their relative importance. In-depth comparisons of the current average with the historic average and the currently most biodiverse grasslands in Switzerland will further allow us to develop scenarios for the future and identify key measures for maintaining grassland plant biodiversity.