Fine-scale Monitoring of climate change Effects on the high-MountaIn gRassland Ecosystem in the Romanian Carpathians (MEMOIRE)

Report on TASK 3 (2020)

Summary of TASK 3

The third task of the project had to accomplish two main activities: Act. 3.1. Conducting exploratory analyses to link biodiversity and ecosystem properties to bioclimate variables; and Act. 3.2. Developing predictive models of the response of biodiversity and ecosystem properties to climate change in the Romanian Carpathians. **All these activities have been successfully accomplished**. We carried out all statistical analyses, as well as the predictive models, to make use of the existing MEMOIRE dataset.

Introduction

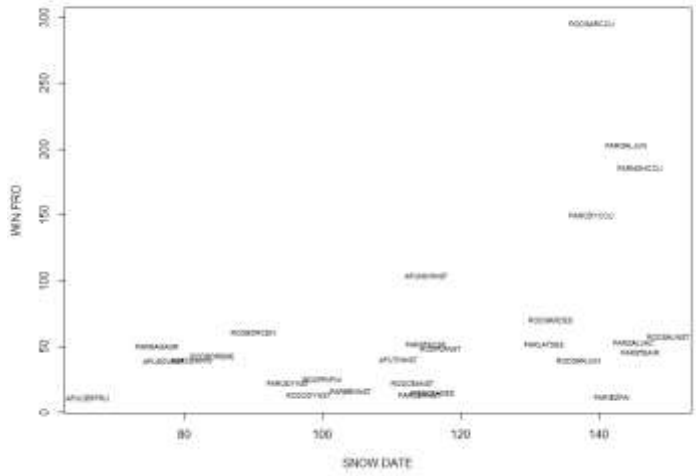
At this stage, we were in full capacity to investigate what are the potential effects of climate change scenarios on mountain grassland ecosystems in the Carpathians. This has not been possible without a comprehensive dataset of local factors measured in the field during 2018 and 2019. To better understand the functioning of the grassland ecosystems, we relied on ground data at a fine-scale. In the context of alpine environment, which are characterized by a high topographical heterogeneity, local variables are the most meaningful. Therefore, the hypotheses addressed in this study were related to the key role played by small scale parameters, such as bioclimate and nutrient content, on ecosystem functioning.

Act. 3.1. Conducting exploratory analyses to link biodiversity and ecosystem properties to bioclimate variables

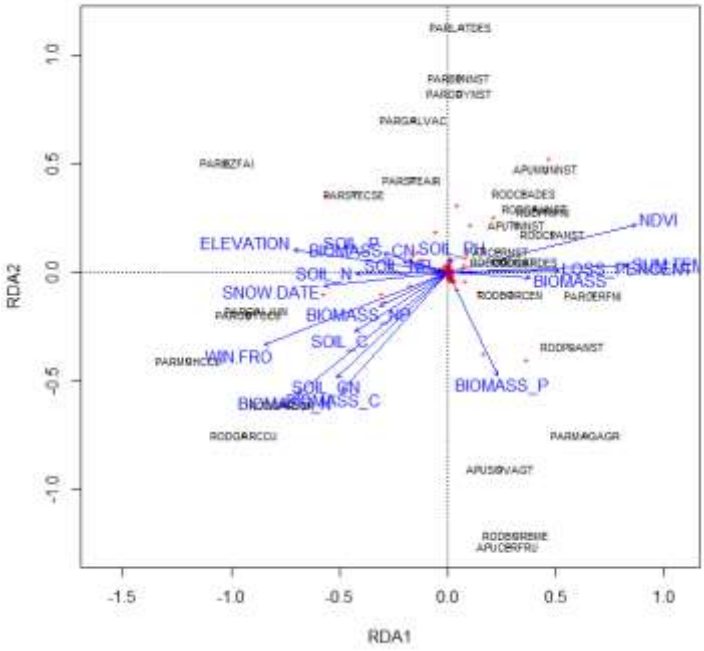
This activity consisted on building R codes to explore the relationships among different parameters characterizing grassland ecosystems. We first structured the database in folders, imported in R, running the scripts and export the results.

Some of the main conclusions derived from the analyses are as follows. The long-term monitoring sites were located optimally across and elevational gradient, from 1200 to 2300m a.s.l. Vascular plant species richness decreases with altitude, while local bioclimate indices derived from data loggers (cumulated summer temperatures and freezing intensity) were of higher explanatory power. We also found a complementary contribution of these two bioclimate

indices to the description of the thermal-based template of grassland conditions. The significant relationships found between the concentration of nutrients in soil and live biomass suggested a limitation imposed by their content in the substrate.



The bi-dimensional thermal-based habitat template of MEMOIRE sites. Winter conditions (intensity of frost events - axis Y) form a complementary dimension compared to the length of the growing season (snowmelt date – axis X).



The multivariate space (RDA) defined by floristic composition and local factors. The first dimension is characterised by a gradient of temperature and productivity.

Act. 3.2. Developing predictive models of the response of biodiversity and ecosystem properties to climate change in the Romanian Carpathians

In order to develop predictions of biodiversity and ecosystem functioning changes under a warming climate, we followed several steps. First, we fit models between species richness and above-ground biomass as dependent variables and summer temperatures (growing degree days) and the snowmelt date, as recorded in the field. This model was fit using a multivariate linear regression. We then used this model and predicted the changes of species richness and productivity based a scenario with higher summer degree days and earlier snowmelt date. The results showed that both species richness and productivity increased as a result of these climate changes.

Conclusions

All the activities of the MEMOIRE project were successfully conducted. Our principal aim was to develop a network of long-term monitoring sites across the Romanian Carpathians. We managed to install 28 sites in grasslands, which included measurements of key ecosystem properties, and lately we increased the number of sites with several points equipped with data loggers and floristic releves.

Our network is in full capacity to provide permanent information, with high accuracy, of critical bioclimate measurements, which are really meaningful for alpine plant life. We are confident that the network will be enriched with new sites, particularly in the Parâng and Rodna master sites.

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