Herb vegetation diversity and meadow flora under protection regime (based on the study of Central-Forest and Polistovsky nature reserves)

[1] Valentina Borodulina, [1] Oxana Cherednichenko, [1] Veronika Gorik

[1] Lomonosov Moscow State University, Biological faculty, Dept. of Geobotany

Introduction

Mainland meadows of the forest zone are formed and maintained by human activities. After the exclusion of agricultural use meadows degrade and become overgrown with forest. Objects of our research were mainland meadows existing in a protection regime in the Central-Forest (Tver` region) and Polistovsky (Pskov region) nature reserves (Fig. 1).

Figure 1. Map of reserves location

We compared partial floras on abandoned meadows and on used meadows (in the protection zone) of these reserves. Our goal was to check the hypothesis of a reduction in species richness, species saturation, species diversity and disappearance of rare species in meadows under protection regime.

Materials and methods

Collecting of field data was conducted by plots of size 100 m2. The work is based on 209 relevés of herb vegetation from Central-Forest reserve and on 208 ones from Polistovsky reserve. We made relevés of abandoned meadows located in nuclei of reserves and used meadows outside the reserves. This allows to identify specific features of meadow flora under protected regime.

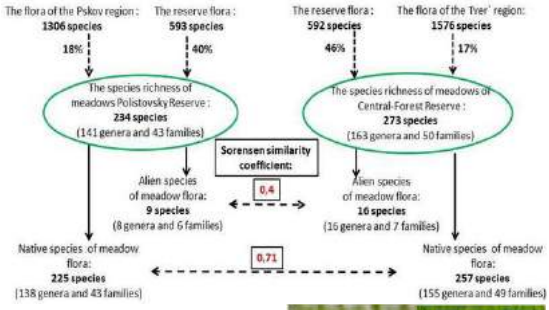
For the data processing we used the following methods(Tab. 1).

Table 1. List of methods and programs used in data processing

Analyzed data	Methods and programs
The degree of similarity in species composition of meadow partial floras of two reserves	Sorensen similarity coefficient
Recognition of herb communities types	Cluster analysis (flexible beta method, β=-0.25, PC-ORD 6.0)
Ordination	DCA, PC-ORD 6.0
Interpretation of ordination axis	Landolt`s and Ramensky`s scales (EcoScaleWin software, PC-ORD 6.0)
The degree of similarity between partial meadow floras of recognized types	Cluster analysis based on the matrix of quantitative Sorensen – Czekanowski similarity coefficient realized in GRAPHS program
Species diversity	Shannon index; PAST program
The estimation of species saturation and Shannon index	Statistica 7.0
Significance of the differences in species saturation and Shannon index	Kruskal-Wallis test ANOVA; Statistica 10

Results and discussion

Species richness of meadows



Four rare species were found on the meadows of Central-Forest Reserve and five rare species were found on the meadows of Polistovsky Reserve. The only species, *Dactylorhiza baltica*, which is registered in the Red Book of the Russian Federation, was found on the meadows of both reserves.

Table 2. Different types of herb communities in the reserves

Types of herb communities	Code name	Presence of anthropogenic factor
Polistovsky Reserve		
Used mesic meadows	Pol_1	used
Abandoned semi-wet meadows	Pol_2	abandoned
Ruderal tall-herb mesic communities	Pol_3	abandoned
Mesic tall-herb communities with Filipendula ulmaria	Pol_4	abandoned
Mesic herb communities with Calamagrostis epigejos	Pol_5	abandoned
Wet herb communities with Calamagrostis canescens	Pol_6	abandoned
Central-Forest Reserve		
Used mesic meadows	Cen_For_1	used
Abandoned mesic meadows	Cen_For_2	abandoned
Wet and mesic tall-herb communities with Filipendula ulmaria	Cen_For_3	abandoned
Ruderal tall-herb mesic communities	Cen_For_4	abandoned

We have recognized 4 types of herb communities in the Central-Forest and 6 ones in Polistovsky (Tab. 2).

Dividing the partial meadow floras by types of herbal communities, we see that species richness is the highest on used mesic meadows of both reserves and on abandoned mesic meadows of Central-Forest Reserve (Fig. 2).

Except for this one case (Cen_For_2), the hypothesis of reduction of species richness on abandoned meadows (under protected regime) is confirmed. The case of abandoned mesic meadows requires a special study.

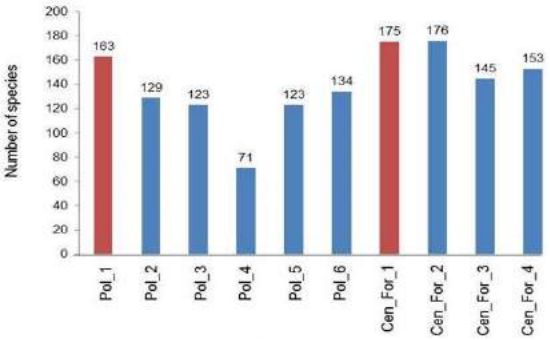


Figure 2. Species richness in different types of herb communities (red – used; blue – abandoned)

Alien species are more frequent on abandoned meadows, mainly due to cultivated species, which remain in places of settlements (Fig. 3).

Rare species usually occur on abandoned meadows too. Apparently, they remain on meadows which were hand-mown, however they extinct on tractor-mown meadows (Fig. 4).

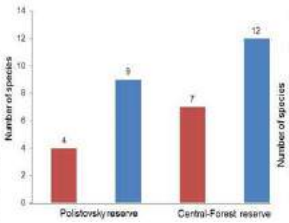


Figure 3. Alien species in partial meadow floras (red – used; blue – abandoned)

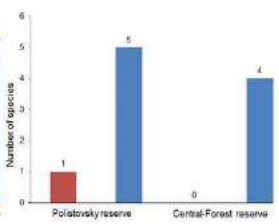


Figure 4. Rare species in partial meadow floras (red – used; blue – abandoned)

Polistovsky reserve

Central-Forest reserve

According to the hypothesis species saturation and diversity should decline after abandonment. We have found that species saturation decreases not in all types of abandoned meadows (Fig. 5).

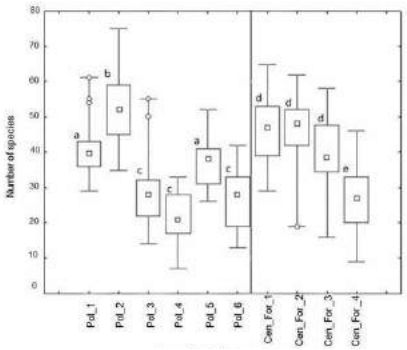


Figure 5. Species saturation in different types of herb communities

Species saturation on recently abandoned meadows of Polistovsky reserve (Pol_2) is significantly higher than on used meadows ($p < 0,05$). In other communities (except for Pol_5) there is a decrease of species richness ($p < 0,05$). In Pol_5 significant changes in the number of species were not observed in comparison with Pol_1 (Fig. 5). We expect that the presence of the supporting factors such as mowing and grazing in Pol_1 and spring burns in Pol_5 explains this observation.

We have found a decrease in species saturation in ruderal communities on the meadows of Central-Forest reserve (Cen_For_4) ($p < 0,05$) (Fig. 1). Significant reduction in species saturation was not observed in other herb communities of the reserve.

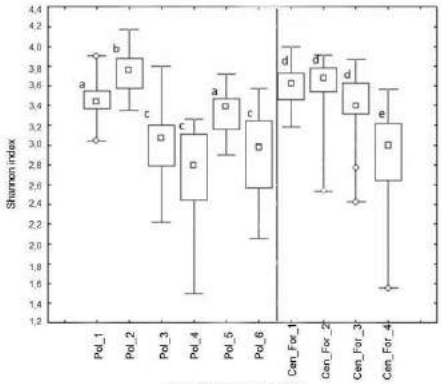


Figure 6. Species diversity in different types of herb communities

Similarly for changes in species diversity (Fig. 6). Note that species diversity reduces not in all types of abandoned meadows.

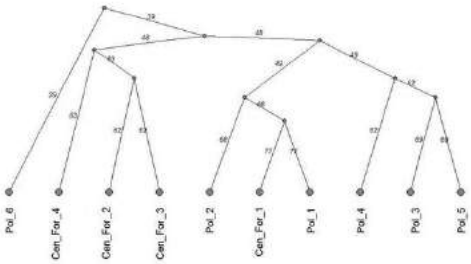


Figure 7. Dendrogram of similarity of different types of herb communities

Used and recently abandoned meadows are most similar in species composition (Fig. 7). We have established that the similarity of the species composition in partial meadow floras is primarily determined by the presence of the anthropogenic factor while local features of the areas play a minor role only. Wet meadows of Polistovsky Reserve have the lowest similarity to others and we suppose that soil moisture is the important factor (Fig. 7).

Conclusions

- Species richness of used meadows is higher compared to abandoned ones. However saturation and diversity of species does not decrease in all types of abandoned meadows (e.g. increase was observed in Polistovsky reserve).
- The similarity of species composition of herb community types is determined primarily by the presence of anthropogenic factor. Local peculiarities of these territories play a secondary role.
- Alien species are more frequent on abandoned meadows. This is mainly due to cultivated species which remain on former settlements.
- The hypothesis of disappearance of rare species on abandoned meadows was not confirmed. Rare species usually occur on abandoned meadows. Apparently, they remain on meadows which were hand-mown, however they extinct on tractor-mown meadows.