ON THE IMPORTANCE OF ADEQUATE RESTORATION REFERENCE: THE EXAMPLE OF PANNONIC ROCKY GRASSLANDS

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Abstract: The use of reference is fundamental to monitor and evaluate the success of restoration interventions. As global changes influence ecosystem composition, reference targets also change in time. Therefore the use of historical data provides deeper insights into long-term trends of ecosystem changes and helps determine realistic restoration goals. Large European data sets gathered from the early 20th century on may be used for assessing changes in the natural state of vegetation in search for restoration potentials. Pannonic rocky grasslands under the "Rupicolous pannonic grasslands" 6190 habitat are among the most important Natura 2000 habitats because of their unique species composition and high frequency of Annex II species of the Habitat Directive. The aim of our study was to detect long-term plant composition changes in order to estimate redtoration potentials of these associations. Phytosociological relevés sampled between 1931 and 1961 served as historical reference to re-sampling between 1991-94. Historical and recent states were compared using typical species occurrences and social behaviour characteristics of species. We detected a decrease in typical species' frequencies. Specialist species richness decreased significantly, while natural pioneers, disturbance tolerant and weedy species increased their number. Our results showed a slight, but general degradation of Pannonic rocky grasslands. Realistic reference species composition target for the Rupicolous pannonic grassland habitat type has less typical species and more disturbance indicators compared to historical phytosociological descriptions.

Keywords: 6190 Rupicolous pannonic grasslands (Stipo-Festucetalia pallentis), pollution, climate change, identifying appropriate conservation and restoration objectives

Introduction

The use of reference is fundamental to monitor and evaluate the success of restoration interventions. As global changes influence ecosystem composition, reference targets also change in time. Therefore a single time reference inadequately expresses the potential states and the historic range of variation expressed by the ecosystem (SERI 2004). The use of historical data may provide deeper insights into long-term trends of ecosystem changes and helps define realistic restoration goals.

In Europe, large datasets were gathered to describe plant communities from the early 20th century on. The difficulty in using historical data is that these were not gathered with the intention to serve as state references. Their use is often criticised because of inconsistency of sampling methods due to different goals, taxonomic and sampling skills of experts (Wild, Neuhäuslová & Sofron 2004), and imprecise localization of the relevés (Pyšek et al. 2004).

Pannonic rocky grasslands (under the 'Rupicolous pannonic grasslands' 6190 habitat) are among the most important Natura 2000 habitats because of their unique species composition and high frequency of Annex II. species of the Habitat Directive. The aim of our study was to detect long-term plant composition changes in order to estimate restoration potentials of these associations.

Materials and methods

151 phytosociological relevés of seven rocky grassland communities were sampled between 1931 and 1961 at 71 sites in Hungary (Simon 1977, Szujkó-Lacza 1961, Török et al. 1994, Török & Zólyomi 1998). These relevés served as historical reference to re-sampling between 1991-94. Information on the studied sites, communities and relevés is summarised in Table 1.

Table 1. Historical phytosociological relevé data: association type, abbreviation, number of plots, time and place of sampling, and substrate type of historic samples used in the study.

Association	Abbrev.	No of plots	Time	Mountains	Base rock
Minuartio-Festucetum pseudodalmaticae (Klika 1938)	MF	29	1958-61	Zempléni Mts.	silicate (S)
Potentillo-Festucetum pseudodalmaticae (Majovsky 1955)	PF	30	1953-56	Visegrádi Mts.	silicate (S)
Poëtum pannonicae (Zólyomi 1936)	PP	12	1954-60	Börzsöny Mts.	silicate (S)
Campanulo divergentiformis-Festucetum pallentis (Zólyomi 1958)	CF	29	1931-32	Bükk Mts.	limestone (L)
Festuco pallentis-Brometum pannonici (Zólyomi 1958)	FB	16	1932-41	Budai, Keszthelyi and Bakony Mts.	dolomite (D)
Seselio leucospermi-Festucetum pallentis (Zólyomi /1936/ 1958)	SF	25	1933-41	Budai, Keszthelyi and Bakony Mts.	dolomite (D)
Seslerietum sadlerianae (Soó ex Zólyomi 1936)	SS	10	1933-35	Budai Mts.	dolomite (D)

No permanent plots were marked at the first sampling period, so the re-study was carried out based on the historical description of sites (locality, aspect, slope, elevation, quadrat size and earlier species list) in the same month of the vegetation period as for the first time ('corresponding quadrat' concept, Persson 1980). Presence-absence data of vascular plant species were used for the analyses. Because of imperfect localization of the relevés, plots from the two time periods were not paired but were treated as repeated samples for each association type.

Eight taxa out of the 40 Habitat Directive Annex II plants occurring in Hungary can be found in this habitat type. Annex II species and characteristic species of the Annex I habitat type 6190 description (23 species altogether) were used to test the change in the abundance of species typical to rock grasslands (EUNIS database 2006).

The Social Behaviour Types (hereafter SBT) of Borhidi (1995) were used to estimate the naturalness of communities. Categories of competitors and stress tolerants show low habitat disturbance (good natural state). Competitors (C) indicate low stress, while stress tolerants thrive in high stress intensity, with two subtypes: specialists (S) with a narrow niche and generalists (G) with broad niches. Ruderals prefer low stress intensity and high disturbance levels. Natural pioneers (NP) show disturbances caused by natural factors, disturbance tolerants (DT) indicate human disturbances, whereas presence of

weeds and alien species (W) implies degradation processes. The significance of temporal changes in average occurrences of *typical species* and SBTs per plot was tested by independent t-test.

Results and discussion

The average occurrences of 23 *typical species* decreased in each association type but two (CF and MF associations; Fig. 1). Dolomite communities support many *typical species* (including many endemic and relict species due to special characteristics of dolomite base rock; Rédei et al. 2003), however, their occurrences decreased significantly in time. Since other base rock (e.g. silicate) communities have very few *typical species*, their use is limited in studying the natural state of vegetation and should be completed by using other indicators.

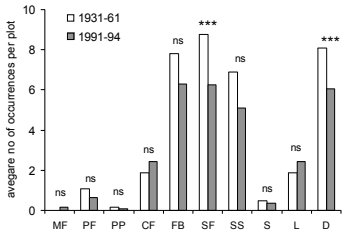

Fig. 1. Average occurrences of *typical species* of 'Rupicolous pannonic grassland' Natura 2000 habitat type within different communities and substrate types in 1931-61 and in 1991-94. Significant differences between historical/recent data are indicated by *** ($p<0.001$) and ns = non significant. For abbreviations see Table 1.

The changes in the distribution of SBTs for the total sample are demonstrated in Fig. 2. The decrease of the abundance of specialists is significant, whereas species indicating higher disturbance levels (e.g. natural pioneers, disturbance tolerants and weedy species) increased their number. However, the amount of weeds was still relatively low at the time of the resampling, which is a sign of the good natural state of the vegetation.

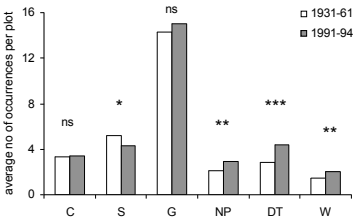

Fig. 2. Change in the average occurrences of the social behaviour types (SBT) of Borhidi (1995) for the total sample between 1931-61 and 1991-94. Significant differences based on t-tests between historical/recent data are indicated by * ($p<0.05$), ** ($0.001<p<0.05$) and *** ($p<0.001$), ns = non significant.

Our results showed a slight but general degradation of Pannonic rocky grasslands. Presumed factors responsible for the observed changes are local (tourism and overpopulated wildlife) and larger scale factors (e.g. atmospheric nitrogen deposition; Bozó 2003/2004). These pressures may constrain future prospects of restoration trials. For example, alien *Pinus nigra* has been planted at rocky habitats in large scale from the mid 20th century that degraded these grasslands. Such sites have been restored by clear-cutting of *P. nigra* plantations (Tamás & Csontos 1998). When restoring these rock grasslands, realistic reference targets should have less typical species and more disturbance indicators compared to historical phytosociological descriptions.

Conclusions

The case study has shown that available historical data can be used for assessing changes in the natural state of rock grasslands. Data on long-term trends helped identify environmental factors influencing regeneration potential and to select a more realistic target in restoration trials.

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