GRASSLAND RESTORATION IN PRACTICE – DO WE ACHIEVE THE TARGETS?

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Abstract: The restoration of mesophile grasslands is area-wise one of the most frequently implemented measures used to counteract environmental impacts in the course of infrastructural projects in Germany.
A comprehensive evaluation of all grassland restoration measures that were implemented between 1992 and 2003 in Saxony-Anhalt offers a valuable insight into the current practice. On most of the 135 sites standardized, not site-adapted, herb-poor seed mixtures of allochthonous origin were used. These established mainly monotone, species-poor, grass-rich grasslands, that do not correspond to grasslands that are typical for the region. Long-term investigations of these species-poor grasslands show little or no development towards the restoration target. Especially varieties of small Festuca species impede the colonization of typical species due to their competition characteristics. They are causing a thick litter layer with no niches for establishment. Reaching the restoration target requires extensive and expensive corrective measures (e.g. re-sowing with typical species, more frequent mowing). Establishment methods using site-adapted, autochthonous materials (e.g. hay flower seeding, hay mulch seeding, transplanting sods) were expectantly more successful, but highly underrepresented. Only one of these methods was applied onto merely three sites.
Overall, the study has shown, that a) the current practice results in numerous monotone grasslands with a similar species stock, that do not reflect the variability of site conditions, b) grasslands established by standardized seed-mixtures remain species-poor for several years. To restore species-rich mesophile grasslands, it is urgent to change the current practice by using site-adapted, autochthonous species for their restoration.

Keywords: mesophile grasslands, invasive species, identifying appropriate conservation and restoration methods

Introduction

Species-rich mesophile grasslands have a high nature conservation value. Consequently they are identified as priority habitat types in corresponding guidelines (lowland and highland hay meadows in Natura 2000, EU 2078/92, ESAs guidelines for agri-environmental programs in UK, etc.). Numerous research, nature conservation and restoration projects aimed at the creation or restoration of species-rich mesophile grasslands (e.g. Walker et al. 2004, Jongepierova et al. 2007). Like in other countries, the restoration of species-rich mesophile grasslands on arable land is of particular importance in Germany. There it is area-wise the second most important measure implemented to counteract environmental impacts in the course of infrastructural projects.
Many experimental studies examined the degree of success of different approaches to restoration on arable land such as natural regeneration, seeding with different seed mixtures, hay mulch seeding etc. (e.g. Pywell et al. 2002). But little is known about the ecological effectiveness of grassland restoration measures beyond research projects. To research the success of the current practice in Germany, we evaluated exemplarily all grassland creation measures on arable land that were implemented between 1992 and 2003 in the federal state Saxony-Anhalt. In addition we analyzed data from permanent plots that are located on different newly established grasslands belonging to compensation sites for the autobahn A14 in Saxony-Anhalt (Tischew et al. in press).

The investigations were intended to answer the following questions: (1) What approaches were used to establish species-rich grasslands? (2) Did they achieve their conservation targets (with respect to occurrence of typical/target species, typical habitat structure) and what influenced the development of species-rich mesophile grasslands? (3) Does the similarity of the newly established grasslands with the target community increase over time? (4) What are recommondations for future restoration projects?

Materials and methods

We used a target-performance comparison for determining the level of target achievement. The target state is considered to be identical with the restoration goal. The actual performance on the 135 sites in Saxony-Anhalt was investigated on 100x100m plots in 2003 and 2004. The comparison is based on three criteria: (1) the floral similarity with the target biotope (defined by number and frequency of typical species), (2) the structural similarity with the target biotope (defined by the degree of correspondence), and (3) the degree of interference (defined by the number and frequency of degeneration indicators, invasive plants, and the cover value of the litter layer). We standardised the values for every single criteria to the value scale from 0 to 100 points. Finally we aggregated these values into a value for target achievement and standardised this to a scale from 0 to 100 points as well.
To determine age effects, we used data from permanent plots that were investigated within research projects dealing with evaluations of compensation measures. The plots represent newly established grasslands that are equal in terms of target biotope and site conditions but differ in greening approaches used. The development of grasslands established by sowing herb-poor seed mixtures, herb-rich seed mixtures, and natural regeneration were observed over a period of eight years on 5x5m using the Barkman-scale (Dierschke 2004) and were analyzed with ordination methods.

Results and discussion

Whithin the last ten years mostly “conventional” greening approaches were used to establish grasslands on medium moist to medium dry sites. At 65% of the evaluated sites in Saxony-Anhalt standardised seed mixtures of allochthonous origin, that were not adapted to the site conditions, were used. These herb-less or herb-poor mixtures mostly consist of 2-5 grasses, 1-2 legumes and 0-13 herbs. In all mixtures the sum of herbs never exceeded 3% by weight. 11% of the sites were seeded by using seed mixtures that are better adapted to the site and consist more herbs (number of herbs 9-12 with overall 5-20% by weight). Approximately 25% of the sites were left to natural regeneration. Alternative approaches, such as mulch seeding, were highly underrepresented (Figure 1).
The current practice results in mainly monotone, (target-) species-poor grasslands, that predominantly do not correspond to the target grassland communities. Instead of communites of high conservation value that reflect the natural differences in nutrient and hydrological balance, uniform grasslands with similar species stock dominate on the investigation sites. So compared to the restoration targets, communites that are typical for the corresponding region are currently highly underrepresented (Figure 2).

The worst results in terms of target achievement were caused by sowing standardized herb-less / -poor seed-mixtures (SSM 7.1.1, 7.1.2, 7.2.2, and Country) which founded uniform, dense, and species-poor crops (Figure 3). All these mixtures include high amounts of varieties used in intensive farming as well as non-native or non-local provenances. Some of these can be considered to be invasive plants because of their competition characteristics (e.g. varieties of small *Festuca* species, *Leucanthemum vulgare*, and *Plantago lanceolata* as well as *Onobrychis viciifolia* and *Sanguisorba muricata*). These plants may replace typical species and impede their immigration and dispersal. Especially the varieties of small *Festuca* species reach up to 50% coverage, form a thick litter layer and cause difficulties for the immigration and dispersal of typical, especially small plants. Overall this impedes the development of the target community considerably.
Sowing the more herb-rich seed-mixtures (SSM 7.1.4, 7.3, and SM dry/moist/wet) showed better results. However, for the success of these mixtures it is decisive to take the site conditions into account when the seed mixtures are composed. In practice, not all of them were optimally suited to the site or the share of herbs was still too low, which led to grasslands which were poor in target species and structure. Moreover, even the herb-rich mixtures contained non-native or non-local provenances. The corresponing plants dominated at some sites and effectively hampered further development.
The approach „natural regeneration" showed better results than the ones mentioned before (exception: on medium moist soil). Still, the development towards the target community proceeds slowly, as species have to move in first. Because of their richness in structure, an abundance of open patches and the lack of species hampering development, the immigration conditions on the examined areas are very good.
The only approach in Saxony-Anhalt that led quickly to the development of species-rich grasslands was hay flower seed. Site-adapted plant material of local provenance that was used on the corresponding sites was optimally suited to establish the target community.

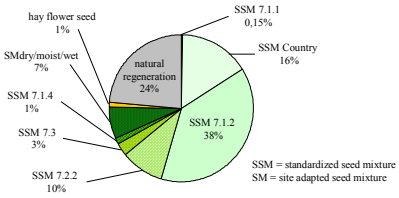

Figure 1. Percentage of approaches to establish mesophile grasslands in Saxony-Anhalt

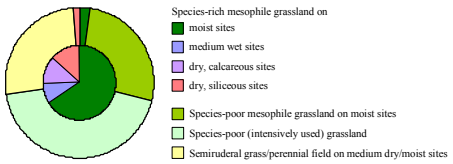

Figure 2. Percentage of target biotopes (inner circle) and actual performance (outer circle),

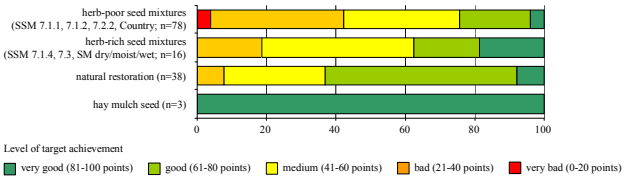

Figure 3. Level of target achievement for approaches to establish mesophile grasslands in Saxony-Anhalt

The analysis of the permanent plots showed a) no or little development to the target community on sites sown with species-poor seed mixtures, b) slow (especially on nutrient-rich sites), but significant development on sites sown with species-rich mixtures or left to natural restoration. In a), the target community can only be achieved by means of extensive corrective measures (complete or partial re-sowing with target species). In b), the development may result in species-rich grasslands if the distance to donor populations is not too far. Otherwise the development must be supported by reseeding of supplemental typical species (Bischoff 2002).

Conclusions

The study shows that the current practice results in monotone grasslands that remain species-poor for several years and do not correspond with their target biotopes. This points out the importance to integrate state-of-the-art ecological restoration practices in grassland restoration. Despite many experimental studies about grassland restoration on arable land, their findings are seldom implemented. The frequent use of standardized seed-mixtures is often due to the focus on cost minimization (standardized seed-mixtures are less cost intensive than autochthonous seed material).
Besides the usage of autochthonous material, the composition of the seed mixtures is especially important. In species-poor areas, the mixture must contain the target species. On nutrient-rich sites the percentage of herbs in the seed mixtures should be increased or supplemental herbs should be reseeded after an impoverishment period.
If longer periods of development of the target biotope are acceptable, sites with nearby donor populations can be left to natural regeneration (best on nutrient-poor soil). If not enough autochthonous material is available, natural regeneration is usually a better option than using non-autochthonous material (exception: moist and nutrient-rich sites).

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