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RE-ASSEMBLAGE OF PLANT COMMUNITIES: A SURVEY OF FLOODPLAIN MEADOW RESTORATION PROJECTS IN THE UK

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Summary
Re-assemblage of plant communities on the restoration sites is a slow process, largely dependent on historic use of the sites prior to restoration, the amount of applied propagules, site management during early restoration stages, and speed of ontogenesis of the target species. Use of the MAVIS calculator of similarity scores between existing vegetation and standard plant communities as described in British NVC, showed the potential of measuring restoration progress. Most of the restoration sites and most of forming plant communities scored 50-60%, which is slightly indicative towards a good progress in community re-assemblage.
Key words: Floodplain meadows, restoration methods, herbs, grasses, vegetation types, MAVIS.

ОРГАНИЗАЦИЯ РАСТИТЕЛЬНЫХ СООБЩЕСТВ: ОБЗОР ПРОЕКТОВ ПО ВОССТАНОВЛЕНИЮ ПОЙМЕННЫХ ЛУГОВ В ВЕЛИКОБРИТАНИИ

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Аннотация:
Организация растительных сообществ на восстановленных пойменных лугах – медленный процесс, зависящий от ряда условий. MAVIS калькулятор был использован для оценки сходства растительности на восстановленных лугах со стандартными типами Британской национальной классификации растительности. Большинство лугов показали 50-60% сходства. Этот уровень считается индикационным в направлении успешности реорганизации растений в определенные сообщества.
Ключевые слова: пойменные луга, методы восстановления растительности, травы, злаки, типы растительных сообществ, MAVIS.

Community re-assembly in areas severely disturbed or cleared from the previous vegetation has been well-discussed in plant ecology literature (e.g., Sykes et al., 1994; Wilson et al., 2000). Out of four major models of the re-assembly processes, the 'pre-adaptation' model (Johnson, Mayeux, 1992) is the most applicable to the floodplain meadow restoration sites, where both biotic and physical filtering shape newly establishing plant communities. In the UK, numerous projects aiming to restore species-rich mesotrophic grasslands which were severely damaged or destroyed by intensive agriculture from 1930 to 1980s, have been carried out in recent years (Lawson and Rothero, 2016). How well have communities of fast growing perennial herbs re-established themselves on the restoration sites? What is the time scale of the restored vegetation to get similarity to the target communities? The answers to these questions came out of a nationwide survey of restoration projects carried out on floodplains in England and Wales in 2016-2018.

Botanical data were collected from 115 restoration fields in 28 river valleys; the survey sites varied in size, pre-restoration conditions, flooding regimes, restoration techniques, and age (from newly restored to the 40-year old sites). Botanical surveys were carried out on five 1x1 m quadrats, randomly scattered across the field to capture a range of plant associations formed on the site by the time of survey. Almost all of them belonged to the neutral lowland mesotrophic grasslands (MG) by British National Vegetation Classification (NVC) (British…, 1992; Wallace, Prosser, 2016). Restoration efforts mainly targeted re-creation of three species-rich meadows: MG4, MG5 and MG8 types (Table 1), for which specific seed mixtures and green hay were used.

The MAVIS calculator (https://www.ceh.ac.uk/services/modular-analysis-vegetation-information-system-mavis) based on Czekanowski coefficient, was used to measure the degree of similarity between vegetation on the restoration sites and standard NVC types. For each restoration field, the output of the calculation gave the top ten possible types and subtypes of NVC communities arranged according to their similarity scores. Those ten options reflect multiple assembly pathways. Despite the same species propagules distributed on most of the restoration sites, their germination rate, population establishment and spread across the sites varied greatly. Instead of one of three target communities, expected to be found on the restoration site, 22 types (Table 1) and 46 sub-types of NVC plants communities were suggested for 115 restoration sites included in the survey.

Similarity scores for NVC types were grouped in five categories: (1) below 40% - a random set of species; (2) 40-50% - very few species recorded together as in standard communities; (3) 50-60% - indicative scores pointing at a low level of re-assemblage of the species into the community; (4) 60-70% - strongly indicative score of well assembled community; (5) over 70% - conclusive score which is found in well-established plant communities.

Table 1. NVC types of plant communities most presented on restoration sites.

MG1	*Arrhenatherum elatius* grassland
MG3	*Anthoxanthum odoratum-Geranium sylvaticum* grassland
MG4	*Alopecurus pratensis -Sanguisorba officinalis* grassland
MG5	*Cynosurus cristatus-Centaurea nigra* grassland
MG6	*Lolium perenne-Cynosurus cristatus* grassland
MG7	*Lolium perenne* leys and related grasslands
MG8	*Cynosurus cristatus-Carex panicea-Caltha palustris* grassland
MG9	*Holcus lanatus-Deschampsia cespitosa* grassland
MG10	*Holcus lanatus-Juncus effusus* rush-pasture
MG11	*Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland
MG12	*Festuca arundinacea* grassland
MG13	*Agrostis stolonifera-Alopecurus geniculatus* grassland
MG14	*Carex nigra-Agrostis stolonifera-Senecio aquaticus*
MG15	*Alopecurus pratensis-Poa trivialis-Cardamine pratensis* grassland

Distribution of the similarity scores across restoration sites and meadow communities revealed a relatively low level and speed of species re-assembly into communities. The majority of sites demonstrated some indicative (50-60%) similarity scores with one or another type of vegetation (Fig. 1). The number of sites where plants present a random selection of species (score <50%), was slightly higher than sites with few communities in a good assemblage state (Fig.1, 2). Target plant communities MG4 and MG8 as well as MG15 (a very close type to MG4) showed some good progress in 20-30% of the sites (Fig. 2). Those were either restoration sites of more than 20 years old, or sites which received large and repeated application of propagules sown in several instalments. The latter significantly supports such general assemblage goals as commonality, species composition, persistence, distribution, and relative abundance (Drake, 1990). Another way of speeding up re-assemblage of meadow plant communities was in keeping open ground

on sites for several years from the start of restoration, allowing the seedlings of weak competitors to spread across the site and establish themselves.

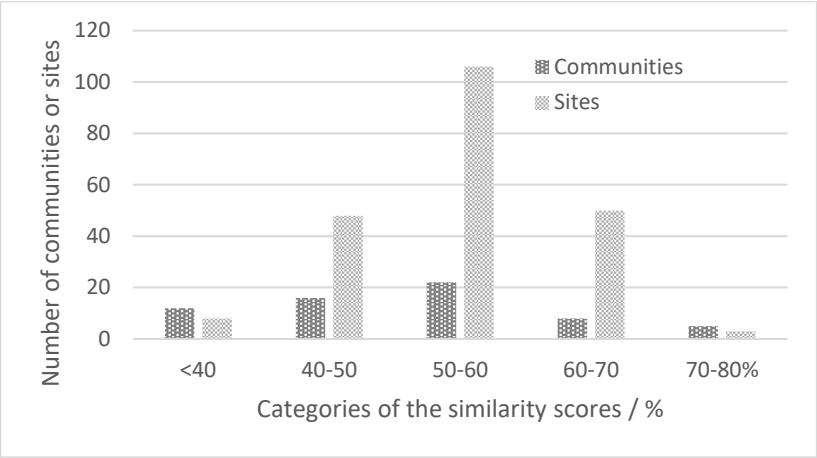

Fig. 1. Distribution of the vegetation similarity scores across the restoration sites

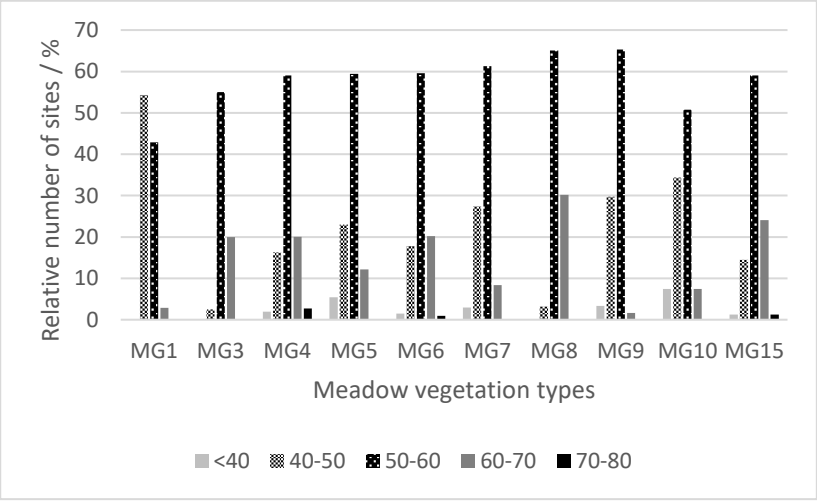

Fig. 2. Distribution of the vegetation similarity scores for ten vegetation types, which were most represented in the restoration sites.

The tendency of restoration sites to develop grassy communities, such as MG6, MG7, MG9 and MG10 (Table 1), is explained by fast growth and intensive spread of grasses, able to outcompete seedlings of herbs. Fast-growing species were present in 60-90% of quadrats, frequently dominating the communities. The speed of ontogenesis of the species seems to play a key role at the early stages of vegetation re-assemblage. Assembly rules also have a strong historical component (Drake, 1990). The pre-restoration condition of the site often played a critical role in filtering species' ability to germinate and establish there. Slightly indicative (50-60%) similarity scores dominated across all plant communities (Fig. 2) demonstrating a large degree of uncertainty in community re-assemblage on restoration fields.

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