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Reintroduction of grassland species

Intensification of grassland management resulted in the disappearance of many plant species from Dutch grasslands. Nutrient removal and extensification of management alone appear inadequate to successfully restore the formerly species-rich grasslands. Viable seeds of many species are no longer present in the soil, or the chances of natural influx of seeds from the surroundings are small. Analysis of historical vegetation surveys, together with knowledge of the ecology of lost grassland plants, indicates which species have to be reintroduced.

National Ecological Infrastructure

To counteract the loss of biodiversity in the Netherlands, the Dutch government has opted for a more offensive policy, which has been formulated in the Nature Development Plan. An important and new element of this plan is the creation of the National Ecological Infrastructure (NEI). This is meant to be an ecologically coherent network of nationally and internationally important ecosystems qualifying for long-term conservation.

For the creation of the NEI 50,000 hectares of arable land will be set aside within the next 20 years. Part of this area will be converted to species-rich grasslands. Jointly with other DLO institutes and departments of WAU, AB-DLO is investigating the conditions for successful restoration of species-rich grasslands on soils which have formerly been used for intensive agriculture. Research focuses on the Veenkampen, an experimental site near Wageningen.

Disappearance of the wet meadows

As a result of drainage, fertilization, and oversowing with improved grass varieties, the originally large area of nutrient-poor wet meadows has rapidly dwindled since World War II. This has happened, for example, in the Wageningse Binnenveld, the southern part of the Gelderse Vallei. Before World War II this peaty area was well known for its vast tracts of

Blauwgraslanden ("blue grasslands"), named after the bluish leaf color of the dominant plant species. An early impression of the flora of these grasslands was given by Bijhouwer in 1931 in a publication:

"The peaty fields alongside the cycle track from De Craats (Bennekom) to Veenendaal are all very boggy. There, one finds the largest number of orchids (*Orchis latifolia*, *incarnata*, *morio*, *Platanthera bifolia*, *Gymnadenia conopsea*), and there the fields are colored white by common cotton grass and purple by *Pedicularis palustris*. Where our shoes get muddy, and the soil starts to give suspiciously, there we see between the grasses many plants of *Linum catharticum* and patches of *Gentiana pneumonanthe* in large numbers. There are also many *Sphagnum*, *Cirsium anglicum*, *Drosera* and *Pinguicula*. In early summer the Binnenveld shows a wealth of flowers as one rarely encounters elsewhere in the Netherlands".

Only a few remnants of the famous Blauwgraslanden have survived, for example, the Bennekomse Meent. In the Nature Policy Plan, the Binnenveld has been nominated as an area for nature development. Part of this area is formed by the experimental fields of the Veenkampen, a set of low-lying grasslands bordering on the Grift, a small stream.

Nutrient removal

The experimental fields of the Veenkampen cover an area of over 13 ha of grassland, which has been heavily fertilized up till 1978. The vegetation was species-poor with a dominance of perennial ryegrass (*Lolium perenne*), rough-stalked meadow grass (*Poa trivialis*), couch grass (*Elymus repens*) and dandelion (*Taraxacum officinale*). As a result of nutrient removal (termination of fertilizer application in combination with mowing and removal of biomass) the dry matter production diminished from originally about 12 tonnes per ha to about 7 tonnes per ha in 1985.

Concurrently a decrease of the proportion of perennial ryegrass (*Lolium perenne*) was observed and an increase of species such as fiorin (*Agrostis stolonifera*), lop grass (*Bromus hordeaceus*), meadow foxtail (*Alopecurus pratensis*) and sorrel



Aerial photograph of the Wageningse Binnenveld with the location of 92 vegetation relevés made between 1930-1950 (orange dots).

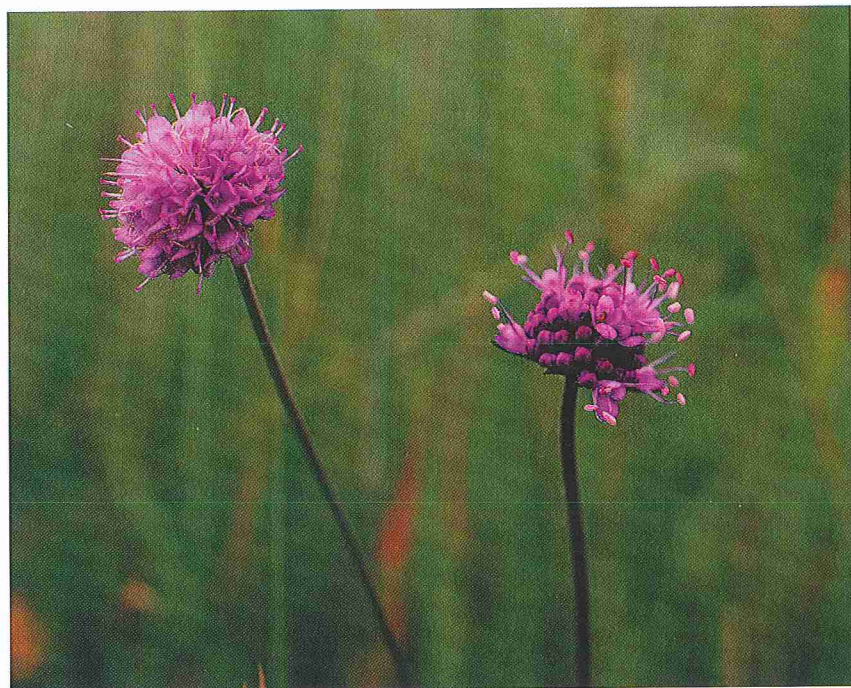
The experimental site the Veenkampen and the nature reserve the Bennekomse Meent are also indicated.

Lower left: bog gentian (*Gentiana pneumonanthe*)

Upper right: fen violet (*Viola persicifolia*): both endangered species of the Blauwgraslanden which show spontaneous, but sporadic, re-establishment from the seed bank after top soil removal in the Veenkampen

Aerial photograph, 11-3-'95,
© Topografische Dienst
Emmen.

Scale: 1: 25 000



Devil's-bit scabious (Succisa pratensis): present in 79% of the historical vegetation relevés: no spontaneous return due to lack of viable seeds in the soil

(*Rumex acetosa*). Total species numbers remained almost unchanged, and species characteristic of the Blauwgraslanden did not return. Apparently nutrient removal only was not sufficient to restore the original species diversity.

Soil re-wetting and sod removal

For this reason, it was decided in 1985 to divide the total area into several compartments with

different water regimes. Drilling two artesian boreholes made it possible to bring in nutrient-poor and base-rich water, while the construction of dikes allowed the retention of water in the compartments. In a new experimental set-up, the upper 5-10 cm of the soil was removed. The dry matter production on all experimental plots has decreased to an average of 5 tonnes per ha. On plots where the top soil was removed, the total species number increased to 98, as compared to only 55 on plots without removal of top soil. Top soil removal not only stimulates germination of annual ruderal species, but also that of species characteristic for wet, nutrient-poor meadows. The latter must have survived the period of intensive agricultural use as viable seeds in the subsoil. This group of species includes carnation grass (*Carex panicea*), pale sedge (*Carex pallescens*), *Carex oederi*, tawny sedge (*Carex hostiana*), bog gentian (*Gentiana pneumonanthe*) and fen violet (*Viola persicifolia*). Up till now they have persisted in the vegetation and some of them have even shown an increase in cover. However, other species typical of the Blauwgraslanden remain absent from the area, which became apparent after comparing the historical vegetation relevés with the present species composition.

Historical vegetation relevés

From the archives of AB-DLO, IBN-DLO and the Department TON-AUW, a total of 92 botanical relevés were selected, which were made by phytosociologists like D.M. de Vries, G. Sissingh, H. Otto, P.R. den Dulk, V. Westhoff, J. Vlieger and W.C. de Leeuw between 1930 and 1950 in the immediate surroundings of the Veenkampen on similar soils (peat or peaty clay) (see aerial photograph). In total 160 different grassland plants were recorded. In 1995, 70 species of these 160 were found in the Veenkampen: 69 on plots with top soil removal and only 39 on plots without top soil removal. Table 12.1 shows the list of species which were once common, i.e. present in more than a quarter of the historical relevés, together with their actual distribution on the experimental fields of the Veenkampen.

Missing species

Which species spontaneously reappear after top soil removal and which do not is clearly related to

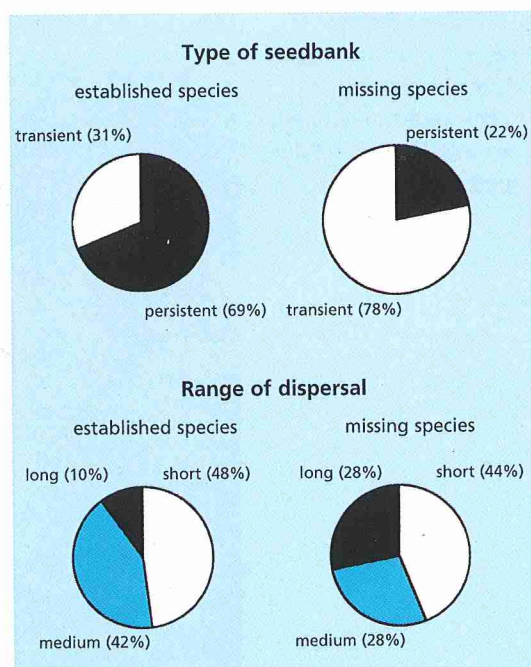


Figure 12.1
Seed characteristics (listed by species) of 47 grassland species once common in the Wageningse Binnenveld which have or have not returned spontaneously after top soil removal in the experimental site the Veenkampen

Table 12.1

List of 47 species once common in the Wageningse Binnenveld with their actual distribution on plots with or without top soil removal in the experimental site the Veenkampen.

Species selected for reintroduction experiments are underlined.

Column 1: + present in plots without top soil removal in 1995.

Column 2: + present in plots with top soil removal in 1995, (+) once present, between 1985 and 1995

their seed characteristics. Species that have a persistent seedbank are capable of successful recolonization from seeds that have survived in the soil over long periods, or even decades. A compilation of data from the literature shows that of those species (Table 12.1) with spontaneous re-establishment on plots after top soil removal, 69% has a persistent seedbank (Fig. 12.1). Of the species without spontaneous return, only 22% has this trait. The fact that absent species more often depend on dispersal by wind apparently does not increase their chances of successfully recolonizing.

Reintroduction of plant species

Ecologically, the Veenkampen is very isolated within a grassland area under intensive agricultural management. Influx of seed from the immediate vicinity is impossible because populations of the relevant species are lacking. Influx from elsewhere, for example from the nature reserve the Bennekomse Meent, is hampered by the absence of effective dispersal mechanisms. For species which profit from wind dispersal, the prevailing westerly winds are not suitable for carrying seeds from the nature reserve located in the north to the Veenkampen in the south. Hence, a rapid spontaneous increase of species richness in the Veenkampen is not to be expected. Therefore, deliberate reintroduction of seeds is a logical step to try to regenerate species-rich grasslands. Of 12 species eligible for reintroduction (Table 12.1), seeds have been collected this summer (1995) in the nearby nature reserve the Bennekomse Meent. A first sowing experiment began in the Veenkampen in autumn 1995. Whether these species will show successful colonization will become apparent during the next few years.

	1	2
<i>Agrostis stolonifera</i>	+	+
<i>Holcus lanatus</i>	+	+
<i>Juncus conglomeratus</i>	+	+
<i>Cardamine pratensis</i>	+	+
<i>Carex panicea</i>	+	+
<i>Agrostis canina</i>	+	+
<i>Ranunculus flammula</i>	+	+
<i>Thalictrum flavum</i>	+	+
<i>Anthoxanthum odoratum</i>	+	+
<i>Galium uliginosum</i>	+	+
<i>Ranunculus acris</i>	+	+
<i>Vicia cracca</i>	+	+
<i>Cirsium palustre</i>	+	+
<i>Equisetum palustre</i>	+	+
<i>Plantago lanceolata</i>	+	+
<i>Lythrum salicaria</i>	(+)	+
<i>Potentilla erecta</i>	(+)	+
<i>Festuca rubra</i>	(+)	+
<i>Leucanthemum vulgare</i>	(+)	+
<i>Carex nigra</i>		+
<i>Viola persicifolia</i>		+
<i>Galium palustre</i>		+
<u><i>Gentiana pneumonanthe</i></u>		+
<u><i>Molinia caerulea</i></u>		+
<i>Phragmites australis</i>		+
<u><i>Carex hostiana</i></u>		+
<i>Lysimachia vulgaris</i>		+
<u><i>Prunella vulgaris</i></u>		(+)
<i>Viola canina</i>		(+)
<u><i>Achillea ptarmica</i></u>		(+)
<u><i>Filipendula ulmaria</i></u>		
<u><i>Centaurea jacea</i></u>		
<u><i>Danthonia decumbens</i></u>		
<u><i>Briza media</i></u>		
<i>Festuca ovina</i>		
<i>Agrostis capillaris</i>		
<i>Eriophorum angustifolium</i>		
<i>Luzula campestris</i>		
<i>Carex pulicaris</i>		
<u><i>Cirsium dissectum</i></u>		
<u><i>Succisa pratensis</i></u>		
<u><i>Rhinanthus angustifolius</i></u>		
<i>Linum catharticum</i>		
<i>Valeriana dioica</i>		
<i>Gymnadenia conopsea</i>		
<i>Leontodon saxatilis</i>		
<i>Polygala vulgaris</i>		

Marsh plume thistle (*Cirsium dissectum*): present in 82% of the historical vegetation relevés: no spontaneous return due to lack of viable seeds in the soil

