

The relation between Medicagini-Avenetum and sedimentation

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Introduction

Natural river systems distinguish themselves from other ecosystems by their large temporal and spatial variation in river dynamics and related geomorphological processes. During high water erosion might take place as well as sedimentation (sand and silt). These processes can influence the natural succession of vegetation. Succession might be stopped or even put back in time, creating space for the pioneer stages of the ecosystem. This all results in a unique nature and high biodiversity. In many present day river systems, including the Dutch one, most of these geomorphological processes have been altered. This results in ecosystems disappearing and biodiversity decreasing. More over problems arise in managing the water flow in these rivers. Several ideas have been formed on how to prevent disasters, like the floods of 1993 and 1995, from happening. These ideas mainly focus on storing the increasing quantities of water transported by the Dutch rivers. Examples of these ideas are 'Komberging' (Rooij et al. 2000, Klijn et al. 2002), Living With Floods (Vis et al. 2001) and Cyclic Floodplain Rejuvenation (Duel et al. 2001). The latter one, which is discussed extensively during the NCR-days of 2002, is a larger method of lowering the floodplain flats and in this way creating bigger storage capacity. In the whole river system different floodplain flats will be lowered in different years. There is a circulation in floodplain lowering between the floodplain flats. The question is however what the consequences of all these activities are for the vegetation? Especially rare vegetation types, like the Medicagini-Avenetum that has a very specific flooding regime, might disappear. Besides the uncertainty if the Medicagini-Avenetum can spontaneously develop elsewhere (depending among others on dispersion of seeds and specific abiotic circumstances), it can be questioned how this vegetation type is related to the amount of sedimentation and composition of the sediment.

Within these plans for increasing the water storage capacity of the Dutch river system the uniqueness of the river related nature is taken into account as well. A good knowledge on the interaction between geomorphology and ecological processes is essential.

In the Nature Balance 2001 (Natuurbalans 2001; (RIVM) et al. 2001) the rarity of the Medicagini-Avenetum (Stroomdalgrasland) is stressed and the several actions in floodplain flats, for example with regard to the Note Water-Management 21st century (Nota Waterbeheer 21^{ste} eeuw; Rijkswaterstaat 2000), are seen as a threat to their subsistence. Relating the management in the river system with the Medicagini-Avenetum the following questions can be specified:

- Where can the Medicagini-Avenetum, regarding the sedimentation regime, develop within the Dutch river system?
- When is the amount of sedimentation destroying the Medicagini-Avenetum?

Method

In the winter of 2001 sediment traps were put down in three floodplain flats along the river IJssel (Vreugderijkerwaard, Cortenoever) and the river Waal-Merwede (Rijswaard) to catch sediment during flooding. During springtime vegetation relevés have been made on the locations of the sediment traps. The temporal and spatial variation of sedimentation is discussed by Maas & Makaske (NCR-days 2002 this volume). In this presentation the focus will be on the relation of the Medicagini-Avenetum, being a specific and rare river related vegetation type, with sedimentation.

Results

62 vegetation relevés, following the simplified Braun-Blanquet methodology, were made distributed over three floodplain flats (Vreugderijkerwaard, Cortenoever and Rijswaard). These were clustered by Twinspan and further ordinated by hand resulting in a classification into 6 classes.

6 classes:

- ✓ Medicagini-Avenetum pubescentis – Stroomdalgrasland
- ✓ Arrhenatheretum elatioris – Glanshavergrasland
- ✓ Alopecurion pratensis – Vossestaartgrasland
- ✓ Lolio-Potentillion anserinae with Elymus repens – Overstromingsgrasland met Kweek
- ✓ Lolio-Potentillion anserinae without Elymus repens – Overstromingsgrasland zonder Kweek
- ✓ Restgroep

Furthermore abiotic data was collected: amount of sedimentation and grain size composition, soil texture, elevation in relation to the median water level, pH-KCl and humus profiles from two depths (0-5cm, 5-25cm) were analysed for CaCO₃, organic matter, P-anorganic and P-organic, C/P.

These factors were used in the program Canoco (Braak and Smilauer 1997, 1998) to find those factors best explaining the present variation in vegetation. This resulted in two ordination diagrams (figure 1 and 2). The correlation between the abiotic factors is dependent on the vegetation.

Ordination diagram of Canoco:

- ✓ length of the arrow is a measure for the contribution of the variable to the total explained variance
- ✓ angle in between two arrows is a measure for the correlation between the two variables (small angle means high correlation)
- ✓ projection of a point on an arrow is a measure for the relative value of that point, in other words for the position of that point on the gradient described by the arrow

**Ordination diagram Canoco
Environmental data versus sites**

- Medicagini-Avenetum pubescentis
- Arrhenatheretum elationis
- ◆ Alopecurion pratensis
- ▲ Lolio-Potentillion anserinae with Elymus repens
- ▼ Lolio-Potentillion anserinae without Elymus repens

- Loam : amount of loam (0-50µm) in soil
- Elevation : elevation in relation to median water level
- Highest water level : highest water level in 2001
- Distance : distance to river
- Sedimentation : total amount of sedimentation (sand & silt) during 2001 floods

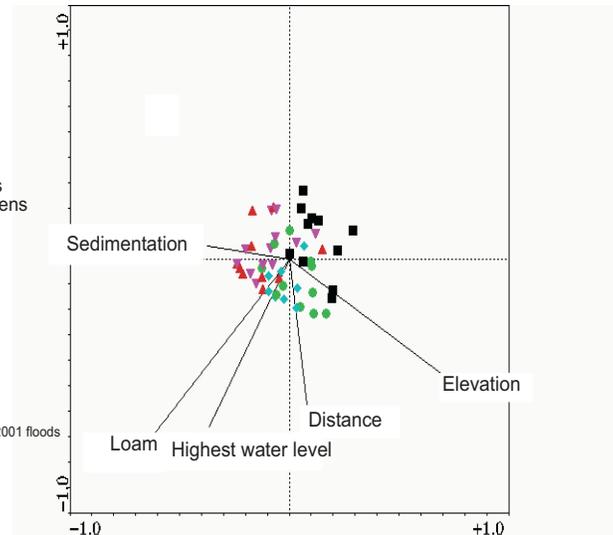


Figure 1 Canoco results: ordination diagram of environmental data versus sites.

The amount of loam (0-50µm) in the soil shows the strongest correlation followed by the elevation in relation to the median water level, highest water level in 2001, distance to the river and the total amount of sedimentation (sand and silt) during the 2001 floods. Figure 1 shows the distribution of the five vegetation types according to these factors. Plotting a selection of plant species characterising the five vegetation types (figure 2) versus these environmental factors illustrates the importance of the different factors for the separate vegetation types even better.

A clear distinction can be made between the Medicagini-Avenetum and Arrhenatheretum on the one hand the Alopecurion and Lolio-Potentillion on the other hand based on the elevation and the total amount of sedimentation (sand and silt) during the 2001 floods. The small angle between the two lines shows that these two factors are strongly correlated when explaining the variance in the vegetation. The Medicagini-Avenetum and Arrhenatheretum both occur more elevated in the floodplain and subsequently were subject to a lesser amount of sedimentation during the 2001 floods. They can be distinguished by the fact that the Medicagini-Avenetum prefers sandier locations found closer to the river. The ordination diagram shows the correlation between the amount of loam in the soil and the distance to the river when explaining the variance in the vegetation.

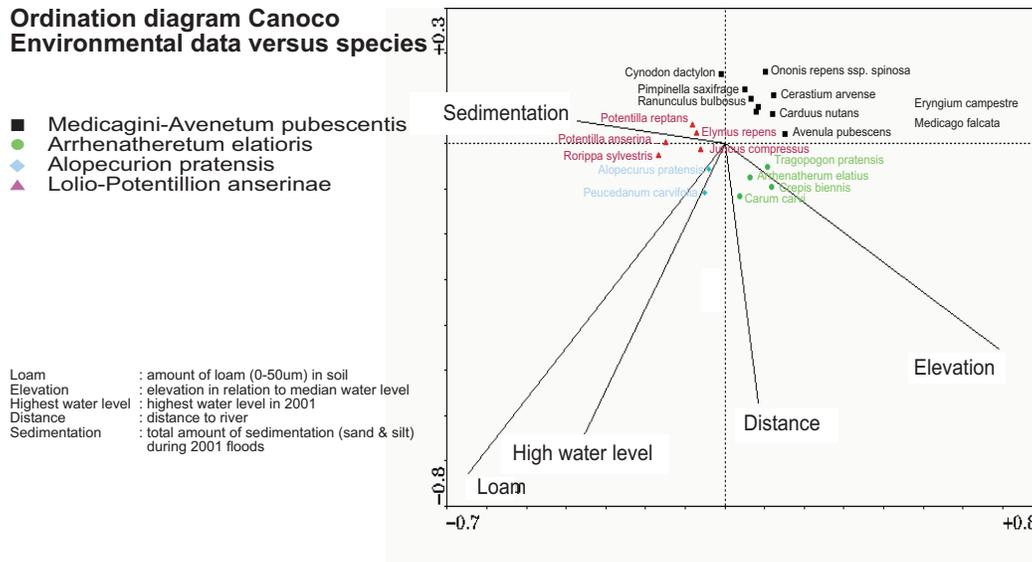


Figure 2 Canoco results: ordination diagram of environmental data versus species.

Conclusions

The Medicagini-Avenetum can be distinguished from the Arrhenatheretum because:

- ✓ Medicagini-Avenetum occurs on sandier locations
- ✓ Medicagini-Avenetum is found on more dynamic locations

Although they show some similarities as well:

- ✓ they occur on locations with the same elevation
- ✓ both do prefer locations with little sedimentation in the case of the 2001 floods

It should be taken into account that the lack of sedimentation on the locations where the Medicagini-Avenetum occurs is characteristic for the 2001 floods. Averages over several years show a different picture of more sedimentation (Maas & Makaske, NCR-days 2002 this volume).

Application within Cyclic Floodplain Rejuvenation

As an example the vegetation types occurring in the Rijswaard along the Waal-Merwede are plotted on the sedimentation of the 2001-flooding season (figure 3). The Medicagini-Avenetum is found on the locations with the least sedimentation.

Rijswaard: sedimentation flood season 2001

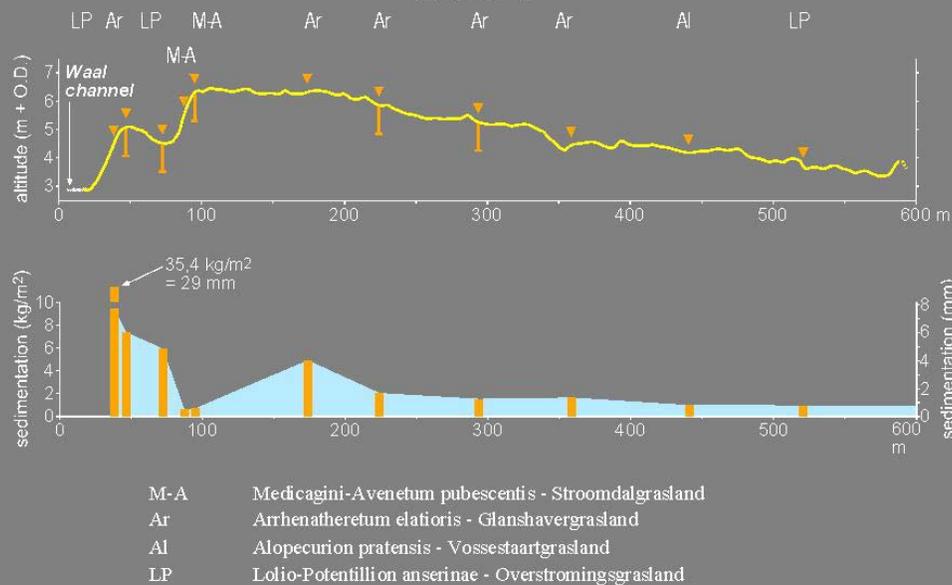


Figure 3 The amount of sedimentation in the Rijswaard of the 2001-flooding season with the locations of the different vegetation types.

The Medicagini-Avenetum occurs on a certain elevation relative to the river. When lowering the floodplain flat by one meter it takes a century to reach the altitude again where the Medicagini-Avenetum is able to develop (Maas & Makaske, NCR-days 2002 this volume). The vegetation of the Arrhenatheretum in the Rijswaard closest to the river nowadays contains some characteristic species of the Medicagini-Avenetum but is not classified as such yet. By the time it reaches the altitude of the nearby levee, where nowadays a vegetation of the Medicagini-Avenetum is present, the circumstances might enable the development of a vegetation of the Medicagini-Avenetum. The texture of the sedimented material at this location at the moment is sandy (figure 4), corresponding with the preferences of the Medicagini-Avenetum in what is the most important factor explaining the variation in the studied vegetations of the floodplain flats. The pathways of succession towards a Medicagini-Avenetum with regard to flooding are described in Nijhof (2001). This research contributes to filling in the gaps mentioned in that report.

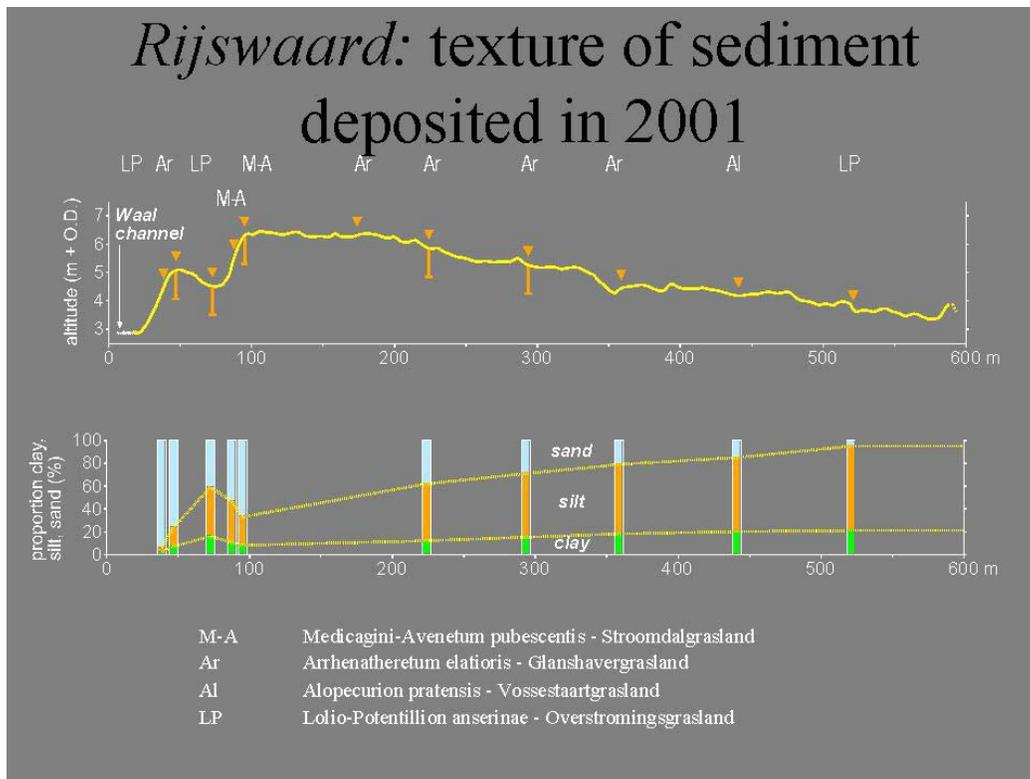


Figure 4 The texture of the sedimented material in the Rijswaard of the 2001-flooding season with the locations of the different vegetation types.

Consideration

The presented research explains part of the abiotic circumstances related to the presence of the Medicagini-Avenetum. Leaving the questions on distribution and establishment possibilities open. But knowing the preferences of the Medicagini-Avenetum, being sandy and more elevated sites at dynamic locations with little sedimentation (2001 floods), as well as the present situation in the very much regulated Dutch river system, meaning less dynamics, the question arises how the Medicagini-Avenetum can be maintained within this very tight straitjacket.

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