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Removal of riverbank protection along the River Rhine (the Netherlands)

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ABSTRACT: The normalisation since the 1970s of the river IJssel, one of the three branches of the Lower River Rhine, has resulted in riprap riverbank revetments along nearly its entire length. In 1995 a pilot project started to restore the transition zone from water to land, with shallow water and frequently flooded and morphologically dynamic biotopes. In this project the riprap on the banks was removed and replaced by groynes, and the intensive grazing of the riverbank was changed to grazing by horses in low densities. A post-project monitoring plan of 6 years was set up which included hydrological, morphological and ecological parameters.

After removal of the riprap gradual riverbank erosion took place. Any sedimentation of the main channel as a result of bank erosion could not be observed, due to the large yearly fluctuations of the bed level. Until now the erosion of the riverbank has led to more gradual slopes with new habitats like shallow water, small sandy beaches with pioneer vegetation and temporary steep clay banks. The grazing by horses in low densities has created rough grasslands and richly structured herbaceous vegetation with an abundance of seeds and insects. The number of breeding as well as non-breeding birds increased. Thus formerly lost characteristic riverine habitats are present again, while this rehabilitation presented no constraints for the navigability of the river.

KEYWORDS: riverbanks, river rehabilitation, river morphology, morphological processes, ecology, riverine vegetation, riverine birds.

Introduction

The river Rhine rises in the Swiss Alps and flows through France, Germany and the Netherlands towards the North Sea. Its basis covers 185.000 km² and the average discharge in the Netherlands at Lobith is 2300 m³/s, with maximum-recorded peaks during the winter/spring season of 12.600 m³/s (1926). In the Netherlands the Rhine divides into three branches, rivers Waal, Nederrijn and IJssel (Figure 1) In the Netherlands the river Rhine is a heavily modified river. Most parts of the three branches have been fixed with groynes and riprap revetments on the banks. They protect the riverbanks from erosion and by that they keep the channel for shipping deep and wide enough.

Along the IJssel during the 1960s and 1970s, bank erosion was rapidly proceeding and dikes, constructions and shipping were in danger (figure 2). The banks were protected with riprap river revetments, to prevent further erosion. Due to these constructions the gradual zonation between the channel and the floodplains disappeared. Shallow waters, frequently flooded parts of the riverbanks and steep clay banks disappeared. Because of this the morphological dynamics on the riverbanks decreased and through this the possibilities for accommodation of birds, fish and plants decreased sharply.



Figure 1: The Rhine branches in the Netherlands; with an arrow the project area is indicated.



Figure 2: Bank erosion along the IJssel in the 1960s and 1970s (RWS/Directorate Eastern Netherlands)

The Engelsche werk

In the 1990s more attention was focussed on nature development on riverbanks. A plan for 700 m of riverbank on the right side of the IJssel near Zwolle ('The Engelsche Werk') was developed ([1]; figure 1). In 1995 the riprap revetments where replaced by groynes with unprotected banks in between. Current, waves, sedimentation and erosion processes on the banks could take place again.

The soil at the Engelsche werk area consists of sand with clay banks in it. After the relandscaping cows and horses are allowed to graze in the project area.

In figure 3 the situation before and after the riprap revetments and the situation after the re-landscaping of the area is presented.

Methods

To monitor the development of the processes along the riverbanks a monitoring programme has been set up. Morphological as well as ecological (birds and vegetation) parameters have been monitored during the period 1995-2001.

In the shipping channel bed level soundings have been made; frequently just after the re-landscaping and at a lower frequency (once per year) in a later stadium. On the riverbanks and the floodplain bed levelling was applied. This data was combined to create an altitude map of the complete area. With these data changes in morphological processes where easily tracked.

The vegetation development was monitored by recording the vegetation -types, -cover, -structure and the edges of the vegetation types. Four vegetation recordings were made during the monitoring period, one before the re-landscaping.

Bird monitoring is performed in two periods: before (1992-1995) and after (1996-2001) the re-landscaping. Breeding as well as non-breeding birds were monitored.

Water levels were recorded automatically at a nearby gauging station. Field visits were frequently made.

Results, Discussion and Conclusions

The detailed presentation of the results, discussion and conclusions are describe in Simons et al. (in prep.) [2]. Here is a short overview of it presented.

On the river bank ecological recovery has occurred. By removing the riprap revetments and replacing them by groynes, the riverbank has been exposed again to water and water level changes and erosion processes took place. This caused a retreat of the riverbank. The hydraulic and morphologic processes reshaped the riverbank. Plants and birds immediately responded to the created variety of the riverbank. Whenever the conditions changes again, so did the composition of vegetation and birds.

After six years, a more gradual transition between land and water, with shallow water zones and sandy beaches, and occasionally small steep clay banks had been formed. This is characteristic for the other Dutch Rhine branches, but exceptional for the IJssel. Grazing in low densities created, higher up the banks, a rich structured herbaceous vegetation. In relatively wet years, even marshy herbaceous vegetation was recorded on the banks.

The bed level of the shipping channel is after the change in type of riverbank protection not structural raised. Sedimentation and erosion processes do take place in the shipping channel bed level, but these are mainly caused by natural fluctuation of the river than by erosion of the banks.



Figure 3: Aerial photos of the bank and part of the floodplain of the 'Engelsche werk'. A: the situation in 1970, preceding the fixation of the banks;
B: The situation in 1991 preceding the re-landscaping of the banks; C: The situation in 1996 after re-landscaping;
D: The situation in 1999 (RWS/Directorate Eastern Netherlands).

List of references

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