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Impact of wicker deflectors on the ecological restoration of regulated lowland watercourses. A case study of the Flinta River

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IMPACT OF WICKER DEFLECTORS ON THE ECOLOGICAL RESTORATION OF REGULATED LOWLAND WATERCOURSES. A CASE STUDY OF THE FLINTA RIVER

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Introduction

Over the past century, many watercourses have been straightened as a result of measures to improve the hydraulic capacity of river channels and regulatory measures related to various socio-economic needs. At present, ecological restoration measures are being carried out wherever possible to improve the ecological status of rivers, thereby restoring the semi-natural state of these watercourses. One of the hydraulic structures used in river channels for this purpose are river channel deflectors. They are environmentally friendly low head hydraulic structures built up with wood wicker and stones. The reason for them is to protect river banks against erosion, to change the direction of river flow making river course naturally meandrous instead of artificially straight fig. 1), to make the natural refugia's for fish and invertebrates and finally to improve hydraulic discharge conditions. Since most of that kind of channel deflectors are low head, they are very likely to be used by river managers and designers in lowland creeks and small lowland rivers. However, the extent and magnitude of hydromorphological changes including accumulation, erosion and sediment transport features is so important that a thorough understanding is required.

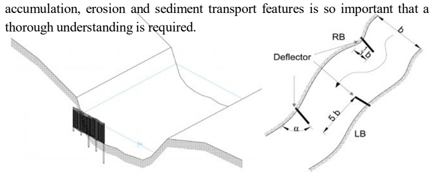


Fig. 2. . The deflector layout scheme and placement along the studied section of the Flinta River: (a) completed deflector in the river; (b) scheme of the layout of deflectors in the river

Fig. 3. Installed wicker deflector in river.

Results

Based on field studies and field data, analyses were carried out and the locations and timing of accumulation and composition of sediment deposited in the riverbed were determined (fig. 4). Sites of bed and bank erosion were also identified and the average volume of sediment carried in the river was determined. In addition, the changes in sediment composition over time (fig. 5) and the change in velocity distribution in the cross-section were determined (fig. 6). The introduction of deflectors has managed to effectively improve both the hydromorphological and hydrological status and increase the dynamics of the changes taking place in the riverbed.

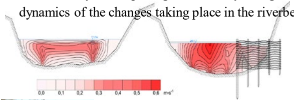


Fig. 6. Change in velocity distribution for deflector section.

Fig. 7. Changes in the bed layout of the river Flint in the period 2013-2022.

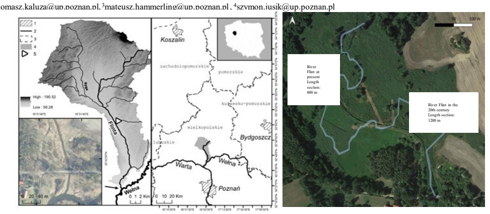


Fig. 1. Locaton of Flinta river section (a) and changes of river lenght on centuries (b).

Methodology

The poster presents an analysis of the impact of the influence of wicker deflectors on changes occurring in the small lowland river. Field studies were carried out over 5 years on the Flinta river located in Greater Poland. Deflectors were positioned alternately in order to initiate renaturalisation processes (fig. 2b). The structure was made of wicker interwoven on wooden pegs (fig. 2a and 3). Regular measurements of geometry, distribution of water velocity in the river and shear stresses were carried out and sedimentts changes. Hydrodimensional analyses and modelling were conducted for the measurements obtained, which made it possible to determine the scale and speed of changes in river and to determine the influence of deflectors on changes in river bed and phenomenon of restauration. In addition, the study has been supplemented by an assessment of the ecological and hydrological aspect using HIR and MMOR methods.

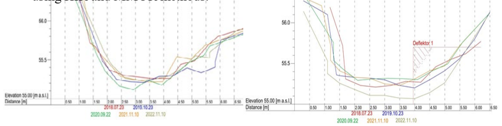


Fig. 4. Changes in cross-sections between 2018 and 2022, for cross-sections (a) no. 4 with out deflector, (b) no. 8 with deflector.

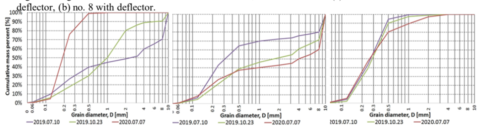


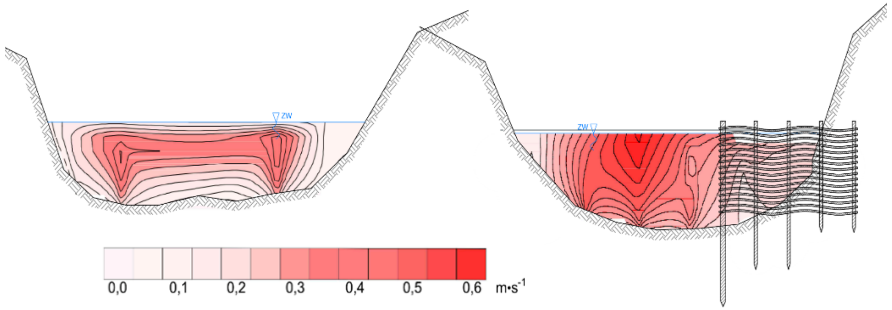
Fig. 5. Changes in sediment size: (a) point no. S2—downstream of the deflector cross-section (cross-section no. 6—2 m downstream of the deflector in the water current); (b) point no. S3—cross-section downstream of the deflector (cross-section no. 7—1 m downstream of deflector "in shadow" of deflector); (c) reference point no. S15—in cross-section no. 27.

Conclusion

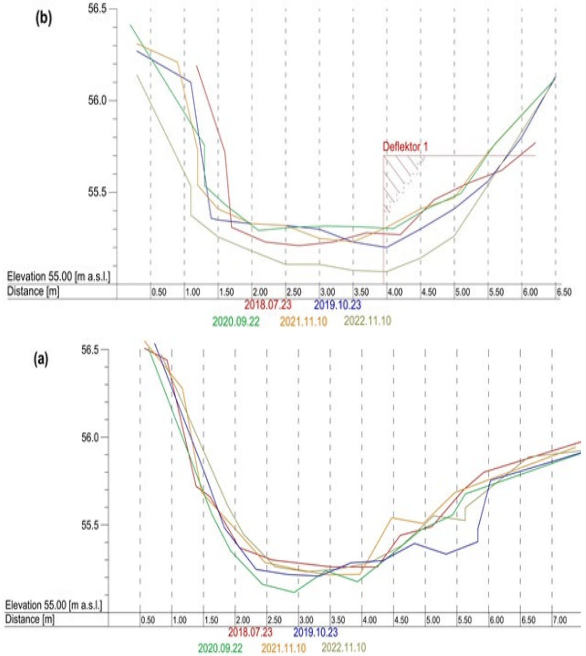
The introduction of wicker deflectors into a small lowland river had a positive effect on the conditions in the river. The deformation of the current has influenced the initiation and decisive acceleration of meandering processes (Fig. 4). The changes in the channel system contributed to an increase in the length of the watercourse and thus began to reduce the gradient of the channel and has a positive effect on channel retention. Deflectors have also had a positive effect on the variability of velocity distribution (Fig. 6). This has a huge impact on the diversity of habitat conditions for various forms of living organisms. The sediment movement phenomena in combination with the deflectors are also starting to gain in intensity. Previously unobserved bottom forms such as accumulation zones and paved bottoms with coarse gravel have appeared in the channel.

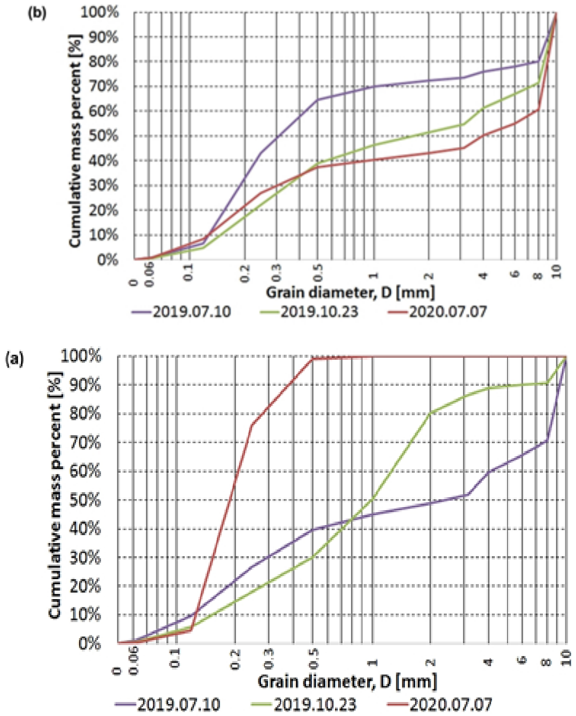
The introduction of deflectors into small and modified streams is able to effectively improve both the hydromorphological and hydrological status and increase the dynamics of the changes taking place in the channel.

Scope of research



Velocity measurment and distribution

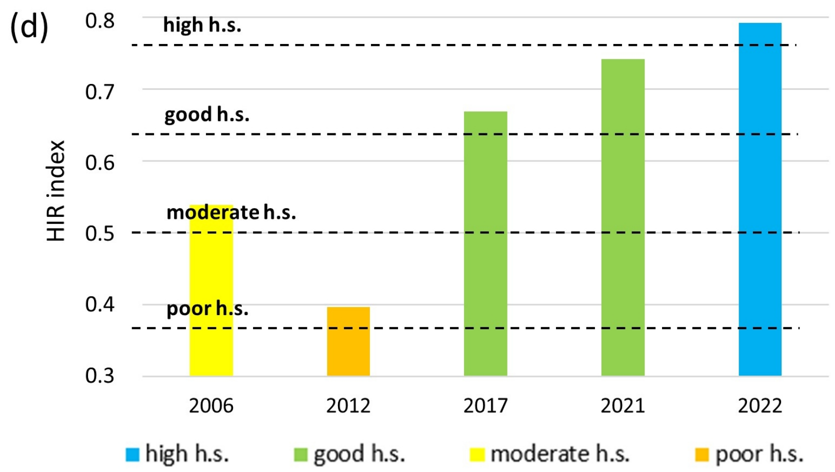




Geometry mesurment

Sediment measurment and distribution

Most interesting conclusions



March 2013

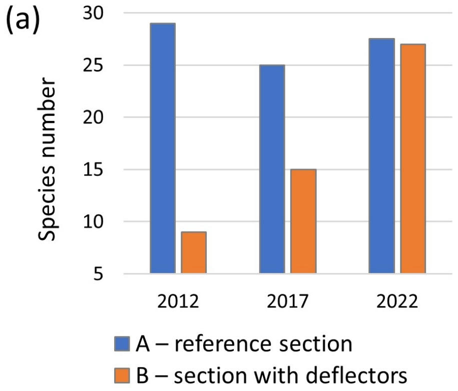
before construction of deflectors

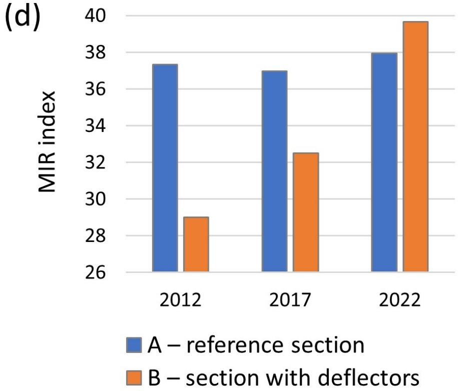
March 2019

October 2019

Jun 2021

Jun 2022





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Thank you for your attention

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