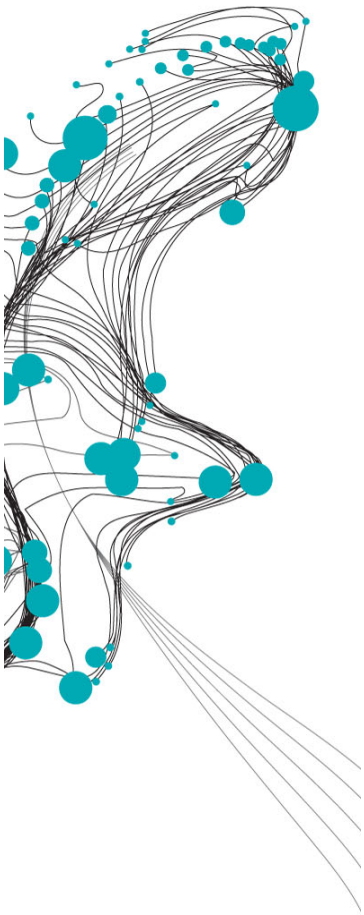
FLOW-VEGETATION FEEDBACK OF EMERGENT AND SUBMERGED RIGID VEGETATION IN STAGGERED FORMATIONS



Macrophytes are part of ecosystems within rivers and estuaries. The presence of macrophytes provides a habitat for aquatic life. To be able to provide sufficient management and conservation of these macrophytes, it is crucial to understand the flow-vegetation-sediment feedback. This feedback can influence the evolution of macrophytes within ecosystems and is therefore important in conservation and management. The flow interaction is an important factor in the spatial development of patches. This study explores the flow-vegetation feedback of submerged staggered rigid patch configurations in uni-directional flow and aims to show the difference in flow behaviour compared to rigid emergent patches. Additionally, it aims to show the difference between submerged rigid isolated patches and submerged rigid patches in a staggered configuration.

Experiments were conducted at the Royal Netherlands Institute for Sea Research (NIOZ) in Yerseke, employing a racetrack flume. Two configurations were examined: emergent and fully submerged staggered patches with rigid stems. Interpatch spacings relative to patch diameter (D) were set at 2D and 0.25D longitudinally and transversally. Comparative reference data from previous studies were utilized for isolated patch experiments and staggered emergent patch configurations.

An acoustic Doppler velocimeter (ADV) was employed to measure flow velocities, necessitating data filtering to eliminate signal contamination. Various filters based on correlation and signal-to-noise ratio (SNR) were explored, with the -5/3 law of turbulent energy cascade in the inertial subrange guiding filter selection. Optimal results were obtained with a 15% correlation filter combined with 4dB SNR.

The water flow behaviour analysis was done using longitudinal and transversal profiles for both emergent and submerged patch configurations. The main difference between emergent and submerged staggered configurations shown in the longitudinal profiles was the greater turbulence and recirculation behind the submerged patches compared to the emergent patches. Additionally, the transverse profiles showed the same trends. This greater turbulence however is counterintuitive as greater amount of water is displaced with an emergent patch configuration. Overall, the study suggests that submerged patches cause greater mixing due to the vertical vortex behind submerged patches. The vertical vortex of the upstream submerged patch induces turbulence, and when this turbulence is combined with the downstream vertical vortex, turbulence increases even more.

Understanding the water flow behaviour behind submerged staggered patch configurations contributes to the development and management of ecosystem-based solutions. By elucidating these dynamics, this research aids in the implementation of effective conservation and management strategies for macrophyte-rich ecosystems within rivers and estuaries

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