Summary

Freshwater fish populations face a significant threat due to the fragmentation of river systems, leading to a decline in their numbers. Despite the construction of fish passages aimed at mitigating these impacts, their relatively low efficiency remains a challenge. Existing research primarily focuses on understanding fish behaviour individually, often overlooking collective behaviour dynamics, particularly in relation to flow dynamics. This thesis addresses this gap by analysing fish collective behaviour across varying flow velocities. An experimental campaign conducted from May to June 2021 with wild *Telestes muticellus* provided the groundwork for the study. An artificial intelligence-based approach is developed to extract trajectory data of individual fish from videos taken during the experimental campaign. The study investigates the social facilitation effect across different group sizes and flow velocities while also examining pairwise interactions using linear approaches. Furthermore, a novel transfer entropy-based method is introduced to quantify information transfer, considering non-linear dynamics. This research contributes to a deeper understanding of fish collective behaviour and its interaction with flow dynamics, offering insights for enhancing fish passage design and conservation efforts in freshwater ecosystems.