



Biological Tools to Measure the Impact of Flow on Ecology in Irish Rivers

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What did this research aim to address?

Flow is an important determinant of the biological community in a river, as different species are adapted to different flow velocities. Because human-driven factors, such as climate change, water abstraction and the construction of instream barriers, can alter river flows, thereby having negative impacts on river biota, it is important to be able to monitor and mitigate such impacts. There is an increasing number of biomonitoring tools available for measuring the effects of changes in flow on river biota. The main aim of this project was to investigate whether data gathered during biological monitoring programmes in Irish rivers could be used to measure impacts of changes in flow on ecology, and to determine whether hydroecological monitoring tools could provide useful additional information for assessing the ecological status of Irish rivers. In this project, the responses of macroinvertebrates, fish and macrophytes to changing river flows was investigated using biological survey data matched with river flow data from nearby hydrometric stations, and biotic indices for monitoring the impacts of changes in flow on Irish river biota were developed.

What did this research find?

Three macroinvertebrate hydroecological indices that were designed to measure the effects of changes in flow, drought and sedimentation in British rivers were tested, and two were adapted for Irish rivers. Scores calculated with the indices were correlated with river flows, and these indices could therefore provide useful information about flow, and some other hydromorphological conditions, in Irish rivers. No suitable fish-based flow index could be adapted to an Irish context using the available data, and no strong relationships were found between fish data and flow, although this may have been due to limitations with available data. A new macrophyte hydroecological index was developed, and was found to be suitable for characterising a combination of prevailing hydromorphological conditions, including flow, and could potentially be used for monitoring the effects of flow and assessing the lotic environment in Irish rivers. An appropriate method for generating a flow-based multi-metric index was identified and used in this project, and, with further work on larger and overlapping datasets for macroinvertebrates, macrophytes and fish, could lead to the development of a multi-metric index for Irish rivers.

How can the research findings be used?

Hydroecological monitoring tools should be incorporated into Irish river monitoring programmes to address national plans and legislation, such as the Water Action Plan 2024 and the Water Environment (Abstractions and Associated Impoundments) Act 2022. Macroinvertebrate hydroecological indices are likely to be most useful, while macrophyte indices also have potential. Further work should be carried out to test the overall performance of the macrophyte index, and to test the performance of the macroinvertebrate indices in different river types and different water quality. An online dashboard that can be used to calculate the macroinvertebrate indices was also developed as part of this project, and is available at https://mgammell.shinyapps.io/biotic_index_dashboard/. To improve data quality for future investigations of flow–ecology relationships, hydrological reference sites, with hydrometric gauges continuously measuring flow, should be maintained at appropriate locations that represent the full range of Irish river typologies without significant hydromorphological, water quality or abstraction pressures. Biological monitoring sites should be established as close as possible to all hydrological reference sites, and surveys for macroinvertebrates, macrophytes and fish should be carried out at all sites annually.

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