



# The impact of acute and chronic hydrochemical disturbances on stream ecology

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## Introduction

River regulation, alteration of stream habitats and degradation of water quality have had significant impacts on aquatic ecosystems worldwide. In Ireland, the two main threats to water quality are municipal (point source) and agriculture (diffuse sources). The Water Framework Directive was established as an overarching approach to protect waterbodies in Europe. It requires Member States to achieve or maintain at least 'Good' ecological and chemical status in all waters by 2021.

The Teagasc Agricultural Catchments Programme is identifying links between land managed according to the National Action Programme (Good Agricultural Practice, GAP) measures and water chemical and ecological quality. However, the degree to which stream ecological status will improve in response to implementation of the GAP measures requires further investigation. Hypotheses emerging from the ACP are that a high frequency of storm events that cause overland flow (acute disturbance) increases the likelihood of poor in-stream ecological status.

The study will identify how stream ecological communities respond to agricultural and non-agricultural acute and chronic stressors throughout the year. Identifying the impact of these stressors will help inform how

agriculture can be sustainable with regard to water quality in agricultural catchments.

## Objectives

- Investigate the impact of acute versus chronic inputs (sediment and nutrients) on stream ecology (abundance, diversity and functioning) across a range of land uses and intensities.
- Assess how the timing of storm events (i.e. at periods of high ecological activity and low base flow) affects different taxa in riverine habitats.
- Through controlled mesocosm experiments, examine how nutrients and sediment interact to effect stream communities.
- Inform policy expectations regarding the potential for Good Agricultural Practice and other measures to enable stream waters in Ireland to reach Good Ecological Status as per WFD requirements.



**Figure 1. Freshwater aquatic habitats play an important role in providing ecosystem services.**

## Materials and Methods

The study is examining the ecological response to acute and chronic stress to streams. Furthermore, the temporal impact of stress (including at periods of high ecosystem activity) on stream ecological community structure and the implications for the WFD is being examined.

The study is a combination of literature review, catchment scale field studies and controlled environment experiments. We are analysing existing high temporal resolution hydrochemical monitoring infrastructure and seasonal stream biology and habitat data (Figure 1) from the ACP. New, higher temporal resolution stream ecological datasets have also been generated.

The study is also examining how nutrients and sediment interact and influence stream communities through the use of an ex-stream mesocosm (Figure 2).

## Expected benefits

This research will provide information to policy-makers in relation to the impact of agricultural and non-agricultural nutrient stresses on the ecological status of watercourses. By having this knowledge, mitigation measures and schemes can be better targeted such that Ireland fulfils its obligation in relation to the Water Framework Directive.

The proposed study addresses some of the priorities under the Strategy for science, Technology and Innovation which aims to provide a scientific foundation and support for a sustainable, competitive, market-oriented and innovative agriculture, food and forestry sector.

Furthermore, the study will help policy-makers target suitable and cost-effective mitigation measures which will help alleviate some of the

pressures associated with nutrient and sediment input to watercourses and help Ireland attain its targets under the Water Framework Directive and the Habitats Directive.

This project will directly address one of the goals of Pillar 3 (Agri-environmental Products and Services) of the Teagasc Foresight 2030 Report to provide evidence-based knowledge to support policymakers in designing, implementing and evaluating programmes for agri-environment products and services.



**Figure 2. Ex-stream mesocosm system in Johnstown Castle.**

A greater understanding of the major stressors and processes of stress that impact aquatic ecosystems will help address some of the key objectives of Food Harvest 2020 and FoodWise 2025 i.e. protect water resources and protect biodiversity. Furthermore if agriculture is to achieve its production targets in a sustainable manner, greater knowledge in relation to the impact of episodic and sustained events on the ecological status of aquatic systems is required.

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