

Project title: The effect of river flow variability and extremes on biota of temperate floodplain rivers under multiple pressures

Description for the general public

Spatial and temporal variability of flow has been for a long time appraised as the fundamental factor affecting riverine biota, which has led to the concept of environmental flows, i.e. “the flow regimes required in a river to meet its ecological objectives”. The natural flow regime plays the key role in maintaining river ecosystems in good health, whereas any departures from the natural state, referred to as ‘flow alterations’, result in negative responses of these ecosystems. The objective of the proposed project is to increase the understanding about the effects of river flow variability, with a particular focus on extreme low and high discharges, on biota of temperate floodplain rivers under multiple, environmental and human pressures. Geographically, the project will operate in three spatial scales: (1) rivers of ‘Central and Western Europe’ freshwater eco-region; (2) Polish rivers and (3) the Jeziorka river located in central Poland, south of Warsaw. Two most important groups of biota from the point of view of ecology of running waters will be analysed: macroinvertebrates and fish. Both are key and complementary indicators of river water quality.

The project will explore three different pathways of studying flow-ecology relationships: (1) systematic review and meta-analysis, i.e. well-established methods of evidence synthesis; (2) statistical modelling carried out at national scale; (3) ecohydrological modelling consisting of a cascade of inter-related mathematical models describing different environmental processes (water balance, water resources management, hydrodynamics of river flow, aquatic species distribution), supported by extensive monitoring and carried out for the Jeziorka catchment.

A systematic review of scientific and non-scientific literature on relationships between flow regime and biota in temperate floodplain rivers of Central and Western Europe will be conducted. Knowledge about both quantitative and qualitative flow-ecology relationships is crucial for setting environmental flows at the regional scale. A particular focus will be put on one specific case, i.e. the effects of floods on macroinvertebrates. The project will for the first time systematically analyse the time that is needed for macroinvertebrates to recover after floods and which of the human or environmental factors affect this time.

In Poland, there exists large amounts of data from different disciplines – in this case hydrology (river flows measured at 1000+ gauges) and freshwater ecology (bio-monitoring data sampled at 1000+ points) that have never been put together and jointly analysed using appropriate data-driven, statistical methods. The project will for the first time do this work with the purpose of deriving regionally-valid, empirical relationships explaining which river flow components affect macroinvertebrate and fish indices most.

Through a case study in the Jeziorka catchment, the project will also tackle the issue of climate change impacts on temperate floodplain river ecosystems as well as the influence of land use change and water resources management. It will explore which of these three factors (climate, land use, water management) is likely to affect riverine biota most in the time horizon reaching the year 2050. In the view of ongoing climate warming and increasing sub-urbanisation pressure, surface water resources may become insufficient to meet the demand of competing users. At the same time, the project will investigate whether sustainable water management policies may help to mitigate the problem of potentially increasing water deficit for biota. All this will be done using the model cascade developed for the Jeziorka catchment.

In summary, it is strongly believed that this project will have a tangible impact on the development of the inter-disciplinary science of hydro-ecology.