**Diagnosing the reasons for biodiversity decline in rural rivers**

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**Full Project Description**

Rivers are biodiversity hotspots, but are subject to manifold pressures such as abstraction, pollution and impoundment, and have some of the highest extinction rates of any ecosystem [1]. The mix of pressures to which they are exposed changes through time, and whilst some have been decreasing in the UK (e.g. urban point-source pollution), others have become more prominent (e.g. diffuse pollution, fine sediment, climate change). Past research has shown major improvement and large-scale ecological recovery in urban rivers across England and Wales, but hinted at emerging problems in rural areas [2], with recent work identifying local extinctions and declines amongst more specialist taxa [3]. These signals could presage major conservation and management issues at a national scale, and so there is a need for a large-scale investigation into rural rivers to examine their current status, recent trends and reveal underlying mechanisms. This project plans to address this gap by tapping into the power of ‘big data’ to reveal the changing fortunes of rural rivers over nearly 30 years. The first part will use national-scale biological monitoring data to quantify how river invertebrate communities have changed across England and Wales, and how this varies according to factors such as land cover and altitude. This will reveal the fortunes of different stream types and their apparent resilience to pressures such as droughts. Secondly, the role of potential drivers of community change (e.g. climate, nutrient concentrations) will be tested to start unpicking the underlying causes of change. The third part, informed by Parts 1 & 2, will use fieldwork to gain greater insight into the proximal mechanisms contributing to national changes, either comparing subsets of streams with contrasting fortunes or manipulating the experimental stream channels at the Llyn Brianne Stream Observatory. The project is a collaboration between Cardiff University, the Centre for Ecology and Hydrology (CEH), the Environment Agency and Natural Resources Wales. The multi-disciplinary programme of work combines the power of ‘big data’ and modern statistical modelling, with GIS and a range of environmental data sets, all allied to extensive fieldwork. The close working relationship with two key stakeholders in the area will maximise the impact of the research, as well as providing a rich training environment and opportunities to build professional networks within and beyond academia. This will be enhanced by training modules within the Fresh CDT and the extensive range of skills training courses provided by Cardiff University. References: 1. Strayer, D.L. & Dudgeon, D. (2010) J N Am. Benthol. Soc. 29, 344–358. 2. Vaughan, I.P. & Ormerod, S.J. (2012, 2014) Glob. Change Biol., 18, 2184–2194 & 20, 2725–2740. 3. Durance, I. & Ormerod, S.J. (2010) J N Am. Benthol. Soc. 29, 1367–1378; Larsen, S. et al. (2018) Ecology, 99, 1316–1326.

**Real Life challenges this project will address**

Rural rivers comprise the majority of the river network and evidence shows that biodiversity is declining in many of them, often in subtle ways. The causes are not fully understood and the range of potential drivers is changing through time (e.g. climate, diffuse pollution). Sustainable river management needs clear evidence of how and why rural rivers are changing to inform policy and practice.

**What you should know about this project**

Biodiversity is declining in many rural rivers, but the extent of this decline and the underlying drivers are poorly known. Combining big data sets and fieldwork, this project aims to fill the gap. The supervisory team brings together the necessary research expertise (e.g. freshwater ecology, environmental modelling), with direct beneficiaries of the research - the statutory monitoring agencies for England and Wales - ensuring maximum impact on river management.

**What expertise you will develop**

The PhD will train the student in the skills needed for modern environmental research, including: • Data analysis and modelling of community and water quality data in R software • GIS and analysis of remote sensing data • Freshwater fieldwork, including sampling techniques and taxonomy • The broader policy context around the conservation and management of rivers • Transferable skills (e.g. oral presentation, science communication)

**Why this project is novel**

Previous research has focused on the recovery of urban rivers or studied rural rivers within limited geographic areas. For the first time, this project will cover the diverse range of rural rivers across England and Wales, taking in a near 30-year timespan, to assess status and diagnose causes of change. Globally, there are few opportunities to study ecological systems at such spatial resolution and temporal extent.

**Rest of Supervisory Team:**

**Stakeholder Organisation** Environment Agency

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