

Evaluating stream habitat using a 2D hydraulic model

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Atlantic Salmon



The freshwater pearl mussel (photo by Sue Scott).

The freshwater pearl mussel *Margaritifera margaritifera* has been identified as an 'indicator', 'flagship', 'umbrella' and 'keystone' species, indicative of a healthy river ecosystem. It has, however, been classified as an endangered species due to its unprecedented, worldwide decline during the latter part of the 20th Century, primarily as a result of human activities, and some consider *M. margaritifera* to be one of the most endangered freshwater mussels in the world. The freshwater pearl mussel and its habitat are fully protected by the Wildlife and Countryside Act 1981.

Scotland is a global stronghold for the mussel, having up to half the world's known recruiting populations, but numbers have declined substantially in the last 100 years. The pearl mussel is now extinct, or no evidence exists of recent juvenile recruitment, in approximately two thirds of Scottish rivers in which it was originally found.

Many factors have contributed to its decline including pearl fishing, industrial and agricultural pollution, siltation, physical riverbed habitat degradation, flow alteration and declines in salmonid host stocks (the mussel's complex life cycle involves a parasitic larval phase on either Atlantic salmon or brown trout). The potential impacts of climate change on both the mussel and its host fish, particularly changes in rainfall affecting flow regimes and temperature, remain uncertain.

This research project will focus on the impact of flow alterations, both due to climate change and hydroelectric schemes, and on the impact of habitat restorations, such as the construction of habitat enhancement measures and the removal of past in-channel engineering works (e.g. weirs, dams, fishery works). Through the use of a two-dimensional hydraulic model (River2D) the potential value of stream habitat for Atlantic salmon, brown trout and the freshwater pearl mussel *Margaritifera margaritifera* at different development stages will be investigated using Weighted Usable Area (WUA). These habitat evaluations will be carried out for present conditions in a number of freshwater pearl mussel rivers. The model will then be used to simulate a range of scenarios for each river, to investigate for example the impact on WUA that higher winter flows and lower summer flows may have for the three species, the effect of flow alterations in regulated rivers, e.g. what impact a reduced compensation flow may have, the impact of removal of past-in-channel engineering works, and the installation of habitat enhancement measures. Comparison of the habitat evaluations for each species will allow an assessment to be made of the impact of each modelled scenario. A modelling approach before field implementation of the same scenario clearly has its advantages in case of any detrimental impacts, especially considering the protected conservation status of the mussel.

Research methods will include an initial desktop study to identify a number of suitable rivers and associated reaches that will allow the full range of scenarios to be modelled. Familiarisation with the hydraulic model River2D will be vital. Fieldwork will include collection of detailed topographic data using GPS equipment, velocity data using Valeport current meters, depth and substrate data, and the construction of habitat suitability curves for Atlantic salmon, brown trout and the freshwater pearl mussel at different development stages (e.g. adult, parr and fry for salmon and trout, adult and juvenile for the mussel).

The outcomes from this research will be of direct benefit to conservation managers, river engineers and hydroelectric operators. It will add to the growing body of work focussed on improving the knowledge of the habitat requirements of these important species, thereby assisting in their conservation by identifying optimal approaches to habitat restoration.

Application procedure and deadlines

To be considered for PhD studentships to be held in the School of Geographical and Earth Sciences (GES), suitably qualified candidates should apply via the website of the College of Science and Engineering (<http://www.gla.ac.uk/colleges/scienceengineering/graduateschool/prospectivestudents/essentialinformation/>). Closing dates for University and research council funded studentships will be in early in the new year, as stated on the GES studentships page: <http://www.gla.ac.uk/schools/ges/research/postgraduate/>.

Non- English speakers must meet the University's English language requirements. Candidates for NERC studentships should also meet the NERC's requirements for both academic qualifications and residential eligibility. For more information go to <http://www.nerc.ac.uk/funding/application/studentships> and please note that *non-UK European Union citizens will be awarded fees only by NERC.*

For informal enquiries about the research projects please contact the relevant supervisors. Information on the GES graduate school and the application process can be obtained from Mrs Jean McPartland, the assistant to head of the School (Jean.McPartland@glasgow.ac.uk).