IAPETUS

doctoral training partnership

NERC SCIENCE OF THE ENVIRONMENT

Upland river management and sustainability under changing environment: thinking outside the reach-scale box

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In partnership with Lake District National Park Authority

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Overview

The aim of this research is to develop a robust research methodology that provides a regional geomorphological assessment of patterns of river erosion and sedimentation so that appropriate 'targeted' management strategies can be implement to address current engineering problems and mitigate against future flood risks. The methodology is developed for the Lake District National Park but will be appropriate for any upland area.

Flooding of St John's in the Vale 2007.

Background: The underlying rationale of this project is that only by developing a regional assessment of patterns of river erosion and sedimentation can the longer-term dynamic response of river systems be determined and appropriate

'targeted' management strategies developed to address current engineering problems and mitigate against future flood risks. The stated vision for the Lake District National Park (LDNP) 2006-2030 is *to provide an inspirational example of sustainable development in action; where its prosperous economy, world class visitor experiences and vibrant communities come together to sustain the spectacular landscape, its wildlife and cultural heritage (LDNP Partnership, 2006).* In an upland environment like the Lake District, freshwater systems provide the fundamental template and resource around which the community and economy are structured.

There are 139 WFD-designated water bodies in the Lake District, including 95 rivers and 38 lakes of which 40 rivers and 11 lakes are in good ecological status (2009/2010 data). However this does not tell the whole story as recent floods (2005, 2008, 2009) have significantly affected upland communities and subsequent river readjustments continue to pose major problems for environmental management . Although the LDNP aims to address these issues by protecting and restoring natural water features through whole catchment management and mitigating

against climate change through adaptation strategies, the necessary knowledge to underpin such actions is often piecemeal. For example, river restoration schemes in Lake District valleys are usually based on short reaches of the river where 'the problem' exits and aim to deliver an immediate (short-term) fix.

The problem with this approach is that such actions can be quickly undone or, worse, exascerbate existing problems if the sediment dynamics of the wider river system are not adequately considered at appropriate spatial and temporal scales .A pressing scientific gap is a holistic geomorphological assessment of the state of river systems within the wider LDNP.

The approach required to address this problem is novel in the sense that the assessment is a river reach, or even a single river, but of the region as a whole. For some time geomorphologists have favoured the reach as a suitable scale for study and quantification; the downside is that such spatially-restricted thinking has resulted in schemes that fail to appreciate whole-system behaviour. The latter is the only logical way to examine this problem as it allows large scale patterns to be established which are both diagnostic of key environmental drivers and longer term trends and importantly at a scale which fits the regional management unit of the National Park.

Methodology

The project design and methodology provide an original framework which utilises existing resources and expert knowledge and is structured around four key components:

1) A regional geomorphological assessment of erosion and sedimentation patterns and trends of all the major upland river valleys in the LDNP using a combined desktop and field-based approach; underpinned by the LDNPA GIS resource base.

2) Incorporation of this new database on system vulnerability and resilience into risk register. This will include areas of the river corridor susceptible to the impacts of continued erosion / deposition which may be accentuated by changing rainfall and river flow patterns and will be compiled from expert knowledge within the LDNP partnership and stakeholders.

3) Tools that can be used by the NP, local land managers and stakeholders to provide assessments of river channel management issues and facilitate evaluation of the feasibility of key restoration strategies.

4) Knowledge Production: dissemination of (a) this 'new' knowledge of Lake District river systems to both residents and visitors; and (b) sharing of original methodologies (components 1-3) with other NPs, AONBs and regional management partnerships.

A major strength of the project is the novel integration of region-wide data on river erosion trends and patterns. This involves a challenging project combining data from a variety of sources held within the LDNP partnership and associated bodies. Basic data is already available through existing NP management systems and Stillwaters project partners (EA, UU) which will facilitate efficient access to supplementary sources. The project also has the advantage of using existing frameworks to channel expert knowledge from NP staff and associates directly at the problem at hand.

To ensure 'engagement' of end-users and stakeholders we will exploit existing structures of LDNP partnership which provides a 'hub' to these users and a means of two-way engagement between the science community and river users/ local communities. The will involve participation in the annual 'Stillwaters Workshop' working with the LDNP Education Service to deliver key facts about the project. In addition we intend to develop four bespoke activities:

1) A series of GIS products and maps that provide a clear picture of the regional pattern of river behaviour in space and over time which provides a powerful tool for 'providing local context' and uniting interests.

2) Easily accessible web-based analysis and modelling tools allowing end-users to ask simple 'what if?' question about environmental change in both hindcast and forecast modes.

3) River valley workshops to engage with local people to evaluate views on river behaviour and problems. At each event a 7m river course 'wallpaper' will be laid down and visitors can sketch on notes and make annotations.

4) A weekly Lake District river blog where end-user and public can submit comments and photographs of current river-sediment problems. At the end of each month three will be 'selected' and the science behind each explained; building a compendium of examples.

Timeline

YEAR 1

- Establish contacts with user groups and develop project community
- Complete regional assessment of river stability – desk and field study

YEAR 2

- Refine regional river stability assessment and develop the geomorphic risk register critical sites

- Engage community through river workshops focussing on areas at risk

YEAR 3

- Develop and trial simple web-based tools to facilitate end-user analysis of river management issues.
- Disseminate 'new' knowledge to regional and National bodies.

Training & Skills

Training is fundamental to the development of postgraduate research students and, together with the DTP, University and Department we provide a substantial training programme. Priorities for training are determined from the 'Training Needs Analysis' carried out in the initial supervisory meeting with the student.

Departmental training in (a) research skills and techniques and (b) research environment are provided through four mechanisms: (i)a programme of taught modules; (ii) internal training 'workshops' that focus on key geographical research skills and techniques; (iii) input from supervisors; and (iv) physical geography research postgraduates normally take the taught departmental module 'Implementing Research Design' during their first year. The aim of this module is to help students put University training in research design into practice specifically in relation to physical geography research both generally and with regard to the student's own project work. Students receive instruction in data collection and the scientific method, contextualizing and problematizing research in physical geography, planning for field- and laboratory work, and team and group working in physical geography. Assessment of students in this module is formative. In addition to generic training offered by Durham University, the Geography Department also at Durham provides training through a series of in-house 'workshops'. These workshops offer the opportunity to gain both experience and knowledge with a number of tools in a specifically geographical disciplinary context and to gain an understanding of some of the wider structures and practices which make up academic life. This programme has been developed in response to postgraduate requests and is open to ALL postgraduate students irrespective of degree or year of study.

Research training continues through the second and third years, and is based around a number of themes: Recognition and validation of problems; Demonstration of the original, independent and critical thinking, and the ability to develop theoretical concepts; Knowledge of recent advances within research field and in related areas; Understanding relevant research methodologies and techniques and their appropriate application within research field; Ability to analyse and critically evaluate findings and those of others; and Summarising, documenting, reporting and reflecting on progress.

References & Further Reading

Hopkins, J. and Warburton, J. (In Press) Local perception of infrequent, extreme upland flash flooding – prisoners of experience? Disasters

Lake District National Park Authority (2014) Caring for … http://www.lakedistrict.gov.uk/caringfor [accessed October, 2014]

Lane, SN. Tayefi, V., Reid, S.C., Yu, D. and Hardy, R.J. (2007). Interactions between sediment delivery, channel change, climate change and flood risk in a temperate upland environment, Earth Surface Processes and Landforms, 32, 429-446.

Large, ARG, Gilvear, D.J. 2014. Using Google earth, a virtual-globe imaging platform, for ecosystem services-based river assessment. River Research and Applications.

Newson M, Large ARG. 2006. 'Natural' rivers, 'hydromorphological quality' and river restoration: A challenging new agenda for applied fluvial geomorphology. Earth Surface Processes and Landforms 31: 1606-1624.

Warburton, J (2010) Sediment transfer in steep upland catchments (Northern England, UK): landform and sediment source coupling. In Otto, J.C. and Dikau, R. (eds): Landform - structure, evolution, process control. Lecture Notes in Earth Sciences, Vol. 115. Springer. Heidelberg,165-184.

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