Institution: University of Ulster

Unit of Assessment: 7 Earth Systems and Environmental Sciences

a. Context

The main beneficiaries of our research are organizations and individuals concerned with policy development relating to agriculture and freshwater, coastal zone management, heritage management, and disaster risk reduction. We also engage frequently with the media and with primary and secondary schools.

Much of the research in the Environmental Sciences Research Institute (ESRI) relates to societal influences on ecosystems and water resources; a major driver of the latter is the need for compliance with European legislation. In this context, scientists in the freshwater sciences and ecology research groups have strong links with government bodies such the Northern Ireland Environment Agency (NIEA); the Department of Agriculture and Rural Development; and the Department of Rural Development; as well as with the non-departmental public body Agri-Food and Bioscience Institute (AFBI) in NI. In the Republic of Ireland, they work with Teagasc (the Agriculture and Food Development Authority); the department of Agriculture, Food, and the Marine (DAFM); the Department of the Environment, Community, and Local Government (DoECLG); and the Environmental Protection Agency (EPA).

The NIEA funds the Centre for Maritime Archaeology (CMA) in ESRI which employs 3 members of contract research staff. Academics affiliated with the CMA serve on Department of Culture, Media and Sport committees in England, work with heritage management agencies such as Historic Scotland and the National Trust for Scotland and with community groups in NI and Scotland, and are involved in a UNESCO initiative on international heritage preservation.

The coastal systems group provides advice to local councils in Northern Ireland and the Republic of Ireland on beach management and has worked with Donegal County and Limavady Borough Councils to develop management plans for soft beach defences. The head of the group (JAG Cooper) chaired the NI Marine and Coastal Forum from 2006 – 2013 and engages with end users through European conferences on integrated coastal zone management.

Researchers in the geophysics group are actively involved in disaster risk reduction in the context of earthquake and tsunami hazard and have strong links with humanitarian NGOs and governmental and non-governmental bodies concerned with seismic hazard.

b. Approach to impact

Development of relationships

The majority of our interaction and engagement with end users and beneficiaries result from collaborative research projects involving governmental or non-governmental agencies or other interested stake-holders whereas others grow out of relationships and contacts developed during the course of research, particularly in areas such as geophysics. We also conduct research specifically commissioned by end users, for example in the Centre for Maritime Archaeology and as part of the NI Countryside Survey.

Current large scale projects involving ESRI members and end users include: DOLMANT for lake management (Interreg IVa funded: Rippey), CIRB on invasive plants and native biodiversity (Interreg IVa: Fornara), GLANAM on glaciated ice sheet margins (FP7: Benetti, Dunlop), Britice-Chrono on ice sheet forecasting (NERC: Benetti), one on climate change and landslide/tsunami risk in the UK (NERC: McCloskey, Dunlop, Nalbant), and REAKT on earthquake risk reduction (FP7: Steacy).

Nature of relationships and follow through

Research on earthquake/tsunami hazard in Sumatra led McCloskey to involvement with the Padang tsunami educational charity Kogami. He has worked with closely with its head, Patra Reni Dewi, to develop an educational campaign to help residents, and particularly school children, understand exactly what to do in and immediately following an earthquake. He also works regularly with Concern Worldwide and Christian Aid and, for example, during the Haiti earthquake crisis provided real time advice to Dominic Crowley of Concern. McCloskey leads a project funded by the

NERC PURE (Probability, Uncertainty, and Risk in the Environment) scheme to work with Concern on a real-time tool for assessing developing seismic hazard during relief efforts. He is a member of the steering group of the HEFCE funded ELRHA (Enhancing Learning and Research for Humanitarian Assistance) initiative, and he has recently served as an earthquake expert for the UK government Foresight committee on increasing society's ability to deal with natural hazards.

A NERC funded project on earthquake forecasting involving Steacy and Matt Gerstenberger at GNS Science in Lower Hutt, New Zealand, led to research on the Canterbury earthquake sequence and consideration of their – at that time – embryonic forecasting model at an expert elicitation panel (Nov. 2011) on future seismic hazard in the Christchurch region. Steacy was a member of that panel and modelling based on its results has been used to inform the revision of design standards for the rebuild of Christchurch. She has since been appointed as a visiting scientist at GNS Science which advises the government on all aspects of seismic hazard in NZ.

In the Quaternary environmental change group, Clark was one of the two Coordinating Lead Authors of the Intergovernmental Panel on Climate Change chapter on "Sea Level Change" which provided projections for regional and global levels in the 21st century, as well as for global sea level beyond the 21st century.

In freshwater science, Rippey has long established relationships with all the environment agencies in the UK and Ireland and hence has been involved in almost all the consortia they funded to develop bioassessment methods for rivers and lakes. These include DARES, DALES, LEAFPACS, and Phytoplankton Classification for Lakes in the UK, RIVTYPE in Ireland, and NS Share across the two countries. One of the main outcomes was a generic bioassessment methodology, CBAS (Canonical Correspondence Analysis Based Assessment System), which now forms the basis of the method used for phytoplankton assessment in lakes in the UK, Ireland, Germany, Sweden, Finland, Norway, Spain, and Italy.

Also in freshwater science, Jordan's research on catchment hydrology and pollution from both diffuse and point sources has led to changes in water policy and management practice. In particular, the Republic of Ireland has changed its policy and expectations with respect to compliance with the Water Framework and Waste Directives; much of this occurred as a result of his 3 year secondment to Teagasc. Additionally, his development of a high temporal resolution monitoring system for nutrient flows in rivers and his research demonstrating the 'spikiness' of such flows has led to the adoption of this practice by several other high profile UK and Irish research projects related to water policy. Jordan currently has a service level agreement with Teagasc to provide expert services on the scientific evaluation of the Nitrates Directive Programme.

The CMA has conducted major projects for NIEA such as archaeological surveys of Strangford Lough and Rathlin Island, and an assessment of the impact of climate change on Northern Ireland's archaeological heritage. It acts as a consultant on behalf of NIEA on legislative issues affecting the coastal and marine zones (e.g. UK Marine & Coastal Access Act (2009) and Northern Ireland Marine Bill). The CMA is consulted by NIEA on planning and development in the offshore and coastal zone to mitigate adverse impacts on archaeological remains. Over 200 such consultations have been addressed since the partnership was initiated in 1999. It also provides advice to NIEA on the protection, management and conservation of maritime sites and recommends significant sites or monuments for protection. Additionally, Breen and Forsythe were invited by UNESCO to participate in the development of the Unitwin Network for Underwater Archaeology.

The coastal systems group regularly advises the Donegal County Council in Ireland on issues such as pier developments, links golf course maintenance/development, and sand dune restoration and management. As a result, the council has generally opted for environmentally sensitive approaches to these ventures. This soft approach to coastal management has been advocated by JAG Cooper at workshops across Europe and his influence has led to a working group on shoreline management being set up within the NI Department of the Environment.

The majority of our staff interact frequently with the media, both in terms of responding to breaking news or events (e.g. large earthquakes) and also to inform the public about interesting research findings. Additionally, a number of staff have been featured in high profile television programs such

as *Horizon* (McCloskey), *Coast* (Benetti, Breen, JAG Cooper, Dunlop), and *Secrets of the Irish Landscape* (Benetti, Dunlop).

ESRI members also engage in significant outreach activity, some recent events include a Royal Irish Academy hosted lecture on geoscience and society (McCloskey), the Belfast Tall Ships exhibition (Breen, Forsythe), the Belfast Titanic centenary event (JAG Cooper, Forsythe, Jackson), and a debate on fracking held in the NI parliament buildings (Stormont) and organized by the MLA Basil McCrea (Steacy). Additionally, they bring science into schools via events such as geography conferences (JAG Cooper, Steacy), the 'Big Dig' (Breen) and a GIS initiative (McKenzie).

Supporting impact

The importance of impact is recognized at all levels in the University, including in promotion criteria. At Ulster, there are three routes to promotion – research, teaching and learning, and academic enterprise – which are equally valued. While traditionally academic enterprise has been seen as engagement with industry or other activities with a monetary reward, it's recently been broadened to include impacts such as influencing policy. Additionally, impact is a criterion for internal distinguished researcher awards and applicants for promotion or professorial progression on the research track are invited to provide evidence of impact.

ESRI supports impact in a number of ways. The most significant is through allowing colleagues to work at outside agencies, for instance during the current REF period Jordan had a 3 year secondment to Teagasc whereas Nalbant is currently on a one year leave of absence to act as Director of the Earth and Marine Sciences Institute, a government organization under the umbrella of the Scientific and Technical Research Council of Turkey.

Additionally, impact is supported through the ESRI budget, for example by funding workshops, publications, and other types of engagements with outside beneficiaries. Recent examples include funding for the Irish Sea Marine Forum and support for travel to conferences and workshops involving end users. We also work flexibly with staff to enable them to take advantages of unexpected opportunities, for instance by re-arranging teaching on short notice.

c. Strategy and plans

At present, individual members of ESRI have relationships with individuals in various governmental or quasi-government agencies as well as parliamentarians and government ministers. Although these relations are sustained and substantive, we are currently in the process of formalising and promoting these links through a Faculty wide strategy led by the Head of School in Environmental Sciences (also Director of Academic Enterprise).

More generally, we recognise that research programs on global problems such as environmental change and natural hazards require the co-design and co-production of knowledge between natural and social scientists. This greatly increases the impact, which increases even more if policy makers are involved from the outset. The NERC PURE project led by McCloskey is an excellent example of this idea, in it a PhD student and a postdoctoral researcher will be seconded to work with Concern on developing a tool to help them understand changing seismic hazard following a large earthquake in a region where the humanitarian organisation is working.

In ESRI, we are encouraging these types of interactions by holding a series of workshops in which the approach, and outcomes, of such collaborations are discussed, as are practical tips for developing similar engagements. We also expect to make new appointments at the natural/social science interface in the next year or two.

d. Relationship to case studies

The 3 case studies exemplify our approach to impact. The main impacts from Jordan's work on nutrient transport were realized as a result of his secondment to Teagasc, A Cooper's impact resulted from his long standing relationship with NIEA, and Breen's from his relationship with NIEA and his strong desire for research to make tangible changes in the community.