



IG

Irish Geography

NOVEMBER 2018

ISSN: 0075-0778 (Print) 1939-4055 (Online)

<http://www.irishgeography.ie>

The future geomorphic landscape in Ireland

Eugene Farrell and Mary Bourke

How to cite: Farrell, E. and Bourke, M. (2018) 'The future geomorphic landscape in Ireland'. *Irish Geography*, 51(2), 141–154, DOI: 10.2014/igj.v51i2.1368



Geographical
Society of
Ireland

An Cumann Tíreolaíochta na hÉireann

The future geomorphic landscape in Ireland

Eugene J. Farrell¹ and Mary C. Bourke²

¹Discipline of Geography & Ryan Institute, National University Ireland Galway, Galway, Ireland

²Department of Geography, Trinity College Dublin, College Green, Dublin 2

First received: 12 December 2018

Accepted for publication: 13 March 2019

Abstract: There are multifaceted challenges in conducting geomorphology research in third level institutions in Ireland in an academic era rife with pressures to publish and expectations to conduct relevant research with high societal impact. This special issue includes a series of innovative papers that address that challenge, focused specifically on the vulnerability of Irish landscape systems to climate change and human activity. A series of recommendations are presented that promote the visibility of geomorphology research and teaching and identify opportunities where geomorphologists can contribute to national plans on broad landscape planning and building climate resilience. These include: (i) using climate change as a vehicle to foster new cross-disciplinary research programmes and to bridge the physical-human divide in the discipline of geography; (ii) monetising ecosystems goods and services as a means to obtain proportional capital investment to conserve and protect our neglected and underappreciated geomorphic features and landscapes; and (iii) advocating for appropriately resourced research funding to support essential field-based research in the wider geomorphological field across universities.

Keywords: *geomorphology; climate resilience; natural hazards; ecosystems goods and services*

Introduction

Access to knowledge of the processes, dynamics, landforms and materials of the physical landscape, i.e., the geomorphology, is vital for sustainable environmental management and in relation to development projects, risk reduction, resource use and future planning under scenarios of climate change. (Hooke and Smith, 2012, 298)

The Irish Geomorphology Group was formed by Dr Mary Bourke during the Conference of Irish Geographers hosted by National University Ireland Galway in 2013. The Irish Geomorphology Group is composed of leading scientific researchers and academics in

* eugene.farrell@nuigalway.ie (Corresponding Author)

Ireland, and members working in environment related management-research agencies such as the Environmental Protection Agency, Geological Survey of Ireland, An Teagasc, Heritage Ireland, and the Marine Institute who focus on the Irish landscape systems: oceans, coasts, rivers, catchments, peatland areas, slopes and lakes. The group is particularly focussed on ascertaining the impact of climate change and humans on the Irish landscape. The Council of Europe's European Landscape Convention (the Florence Convention) was published in 2000 and came into force in Ireland on 1 March 2004. As a party to the Convention, Ireland has agreed to '*promote landscape protection, management and planning, and to define landscape quality objectives, while fully involving the people concerned in the decisions that affect their area*' (The Heritage Council, 2010, 6).

In March 2017, the Irish Geomorphology Group executive committee proposed a special issue of *The Irish Geography Journal* to its members that would highlight the breadth and depth of geomorphology research being conducted on the Irish landscape. One of the primary objectives of initiating this project was to build awareness within the scientific community of the quality and types of interdisciplinary geomorphology research in Ireland. A second objective was to create a forum to capture and connect valuable field datasets that are critical to benchmark how Irish geomorphic systems are evolving today in order to understand how they might respond in the future with projected climate changes. The subsequent feedback from members was very positive and this special issue of *The Irish Geography Journal* titled '*The vulnerability of Irish landscape systems to climate change and human activity*' is the result of this study. This is collated as a virtual special issue online, while individual papers will be printed in this issue and issue 52-1 (May 2019). In addition, there will be some online-only papers to complete the special issue. Overall the special issue will comprise of 14 manuscripts and will have a strong international component with authorship from 32 authors located in 13 different research institutes in Ireland, the UK, Spain, Portugal, and South Africa.

The contributions focused on geomorphic research spanning a wide range of spatial and temporal scales and innovative data and methodologies, within the wider brief of climate change vulnerability and the impacts of human activity. As an initial summary, the geomorphic landforms investigated included: beaches, dunes, barriers, peatlands, paraglacial landscapes, and wetlands. The research techniques and methods reported in these landform studies included geomorphic processes (field observations and assessment), mapping (GIS; Earth Observation satellite imagery; ground penetrating radar; electrical resistivity tomography; biodiversity and habitats; UAVs; Structure-from-Motion photogrammetry), paleo-environmental reconstruction (sedimentology; dating; stratigraphy), and modelling (climate; landscape evolution; catchment dynamics; storminess). A comprehensive review of the relevant literature on marine policy and planning in Ireland identified likely impacts of climate change to Ireland and how Marine Spatial Planning might successfully address those impacts. Finally, the role of humans as geomorphic agents of change was addressed in multiple manuscripts, highlighting specifically a recent trend in geomorphology on distinctions between developed and/or modified landscapes and natural landforms.

Geomorphology publications in *Irish Geography* – patterns and trends

The publication of such a comprehensive special issue is overdue, given recent publication trends in *Irish Geography*, and better reflects the magnitude and quality of geomorphic research in Ireland. A low number of contributions from physical geographers is typical of many national geography organisations (e.g., AAG and RGS-IBG) and reflects different levels of engagement between physical geography and national geographic organisations. Those differential levels of engagement can be attributed to both specific and general influences.

Within Irish institutions generally, the composition of Irish geography departments is close to that in the UK, i.e., around 60% human geographers to 40% physical geographers. However, the total number of geographers nationally is very low and similar to a single large UK university geography department. Within the cohort of permanent academic physical geographers in Ireland, the relative number of geomorphologists is small and, in a sense that smallness allows for a shared vision and acts as an important influence on the ability to unify geography nationally as a discipline. A second contributing factor is the recent shift in academic publishing practices. Both grant assessors and academic promotion committees have placed research impact to the forefront. In geomorphology research, impact has, for better or worse, become synonymous with journal impact factor. This has led to a refocus from what one might term ‘pure’ research to an expectation that research also includes a focus on societal impacts and grand challenges. This goes hand in hand with the demonstration of value for money of publicly funded research (Brosnan, 2018). In the UK, the Research Excellence Framework (REF) is a powerful though instrumental evaluation tool to measure research quality and research impact. Modified institutional versions of performance-based research funding systems (PRFS) are now being piloted in Ireland and elsewhere. Sivertsen (2017) provides a review of the different versions (evaluation vs. indicator based) being used in European countries (Austria, Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, Italy, Norway, Poland, Slovakia, and Sweden) to allocate research funding to universities.

One possible reason for the relatively low volume of recent research on Irish geomorphology is specific constraints set in place by the above trends. However, many physical geographers in Ireland publish in high-impact journals such as: *Science*, *Nature*, *Nature Climate Change*, *Journal of Geophysical Research*, *Geomorphology*, *Earth Surface Processes and Landforms*, *Progress in Physical Geography* and *Earth Surface Dynamics* among others. Sometimes the research focus is not on the Irish landscape (with the exceptions of glacial and peatlands research), but other locations on Earth and even Mars (Bourke and Viles, 2016). This special issue of *The Irish Geography Journal* fills this lacuna very successfully and publishes substantial and very citable relevant new work on the Irish geomorphological landscape and brings with it a new local and global readership for scholarship in this *Journal*. In addition, the focus on vulnerability to climate change and human activity broadens the reach of the work and makes it multi-disciplinary in scope, content and impact. Finally, as noted above, the direct involvement of a range of statutory

and semi-state agencies in the research is, in itself, a marker of applied impact; working not in an academic silo, but directly with national funding agencies who themselves have explicit publication briefs. In this, there is a valuable and outward facing alignment of pure and applied impactful research in all of the special issue papers.

Recommendations to promote geomorphology research and teaching

The Context of Irish Geomorphological Research

This is a very opportune time for the geomorphology community in Ireland to re-engage with the *Journal* to disseminate research. This includes local scale studies, incorporating research conducted with postgraduate students which framed here in the special issue have enormous potential as comparative studies to inform international research. It will also fill a significant gap for the *Journal*, especially as physical geography papers have traditionally been among the most cited. Of the 139 manuscripts printed in *The Irish Geography Journal* in the past decade (2008 to 2018) less than 5% of the contributions can be considered as geomorphology *sensu stricto*. These contributions are dominated by peatlands studies and one related special issue in 2011 (Vol. 44, no. 1) focused entirely on climate in Ireland and how geography was best positioned to offer solutions to the multifaceted challenges of climate change risks and adaptation. This special issue is a first step for Irish geomorphologists and international geomorphologists working in Ireland to continue to expand those initiatives. More broadly, there is scope for greater visibility for geomorphological research, by more fully supporting the annual conference (Conference of Irish Geographers) which over the past decade has had relatively low numbers of physical geography themed sessions. In CIG 2018, only 8 (4%) of the 186 presentations could be themed as geomorphology; in CIG 2017, only 8 (6%) of the 135 presentations were geomorphology. Unfortunately, these numbers reflect a general trend in the disappearance of geomorphology in more generalist international geography associations.

Traditionally, geomorphology in Ireland has been hosted in Geography Departments that are located predominantly in either Social Sciences or Arts and Humanities faculties (TCD is an exception, located in a Science faculty). While there is a history of natural tension between physical and human geography and many papers have been written on this topic (e.g., Harrison *et al.*, 2004), any suggestion of a split in the discipline is robustly rejected by Irish geographers '*as the fragmentation of geography into two discrete sub-disciplines would be prejudicial to its continued existence and vitality*' (Goudie, 1986, 458). We contend that the geomorphologists intellectual world-view, which is centred on complexity, uncertainty, the importance of processes, and the particularity of local systems (Lave, 2014), belongs to and thrives in the field of geography more fully and shares many theoretical and conceptual ideas with environmental and human geographies.

There is no doubt that the unique interdisciplinary potential of geography remains largely underutilised but, perhaps now, it is becoming an imperative. The call for the

inclusion of the social sciences in physical studies is ubiquitous from European funding agencies (e.g., Horizon 2020, Interreg) to implementing environmental policies and practices (e.g., EPA) and government plans (National Planning Framework). Equally, there is a recognition in policy terms, that the kinds of robust evidence-base that science provides, helps geography as a whole to be taken seriously at different scales and levels of government. In this special issue, across all of the papers, we explicitly identify how using climate change as a vehicle can foster new cross-disciplinary research programmes and bridge the physical-human divide in the discipline of geography; the contribution that geographers can and do make to solving fundamental world problems associated with the Anthropocene and climate change are discussed in the following sections.

Climate change: the vehicle to foster new (applied) research opportunities

There is overwhelming scientific evidence that Ireland's climate is changing. A summary of potential climate change impacts was published in 2017 in a State of Knowledge report (Desmond *et al.*, 2017). Uncertainties remain in relation to the level and extent of these impacts, and how they will emerge in the coming decades. Notwithstanding these uncertainties, it is clear that Ireland will experience abrupt and, in some cases, irreversible impacts. Projected impacts include increasing average temperatures; more extreme weather conditions, including storms and rainfall events; increased likelihood of river and coastal flooding; water shortages; changes in types and distribution of species; increased slope failures, and possible extinction of vulnerable species and habitats. These all act on highly complex and dynamic geomorphic systems. To fully assess risk, we need to understand geomorphic process interactions in depth, and this is a key dimension of the papers in this special issue.

Overall there is a strong focus on climate change and its potential impacts in relation to a series of coastal environments (Loureiro and Cooper, this issue) with a specific focus in individual papers on sand dunes and machair habitats (Verandas Martins *et al.*, this issue; Gorman *et al.*, this issue; Cronin *et al.*, this issue; Farrell and Connolly; forthcoming), coastal wetlands (Gardner *et al.*, forthcoming) and barrier islands (Mathew *et al.*, forthcoming) Other papers look at wider environments including mountains, rivers and peatlands (Knight and Harrison, this issue; Connolly, this issue). One important connecting idea across the papers was the role of climate change in enacting a serious and potentially irreversible transition in all of these highly sensitive habitats and ecologies. Equally, the strongly scientific basis of many of the papers had updated older Irish research and, in particular, related that research to ongoing environmental policy directives, both Irish and European.

Developing the research in the special issue is crucial and an ongoing scientific knowledge-base of climate drivers, processes, mechanisms, feedbacks, and thresholds associated with the functioning of the Irish landscape is required. Resolving how the physical environment will respond to climate change projections in the coming century cannot be done without the requisite longitudinal monitoring programmes. This is a worrying knowledge gap in Ireland, and we need to motivate geomorphologists to link with

related disciplines to design and implement long-term research programmes that collect data to benchmark system behaviour. A smart approach to address this challenge is to continue to work closely with research agencies in Ireland who have been independently collecting environmental data. The Marine Institute, An Teagasc, Environmental Protection Agency Ireland, Geological Survey Ireland, Office of Public Works and related environmental management agencies all host research departments with experts and have lengthy histories of fruitful collaboration with academic geomorphologists.

As a topic, climate change has moved from the periphery of climatology to the centre of geography and related disciplines (sustainability; planning; energy; ecology; oceanography; hydrology; coastal and marine sciences; peatlands and wetlands). In a sense, this is a shift that this special issue both documents and accelerates. This is partly because geographers have the synthesis skills necessary to provide integrated spatial insights not available to more specialist disciplines in either the physical or social sciences (Bauer, 1996). Science practices have shifted toward a more collaborative approach, one that emphasises cross-disciplinary teamwork and geomorphologists can play an integral role in developing these new research programmes. As a socio-environmental process, climate change necessitates interdisciplinary research. Therefore, it offers especially fertile grounds for utilising the interdisciplinary potential of geography (Colven and Thomson, 2019). Indeed, *Critical Physical Geography* calls for collaboration between environmental physical and social science, where critical social theory is combined with a deep knowledge of natural science. The approach would enable a more effective and just intervention in environmental policy debates than either side alone is capable of (Lave, 2014). One interesting example is the use of local ‘ground-truthing’ of sand dune movement to triangulated scientific measurement (Cronin *et al.*, 2019).

Ireland has new statutory laws for climate change legislated by the Government for the very first time. In accordance with the Climate Action and Low Carbon Development Act 2015, a National Adaptation Framework (NAF) was published by the Department of Communications, Climate Action and Environment (DCCAE) in January 2018 and specifies the national strategy to reduce the vulnerability of the State to the negative effects of climate change and to avail of any positive effects that may occur. Specifically, our new NAF has the long-term goal of ‘building capacity’ and ‘increasing climate resilience’ of our socio-ecological and economic systems. A total of €10m has been allocated to establish four Climate Action Regional Offices (CAROs) to deliver on the local government sector’s obligations under the 2015 Climate Act and NAF. These offices (Atlantic Seaboard North: Donegal, Galway City & County, Mayo, Sligo; Atlantic Seaboard South: Clare, Cork, Kerry, Limerick; Dublin Metropolitan: Dublin City, Dun Laoghaire Rathdown, Fingal, South Dublin; Eastern and Midlands: all remaining counties) will support the implementation of the national climate policy and coordinate Sectoral Adaptation Plans for all the key sectors including: agriculture; forestry; biodiversity; transport; and flood risk management.

While the special issue papers cover some of these landscapes, there is scope to extend the science to the developing policy as well. There is potential for Centres of Excellence

to be developed within CAROs to work with experts in each geographic area and to roll out the expertise on these areas to other regions. For example, it is expected that the Atlantic Seaboard CAROs will develop expertise in storm impacts and coastal flooding, erosion, and/or accretion; the Dublin area will develop expertise in energy and built environment, and the Midlands will develop expertise in fluvial and pluvial issues. Part of the remit of these Centres of Excellence will be to leverage links to third level and other organisations for EU Interreg or LIFE funded projects in the area. This will provide opportunity for researchers to link with local government and managers. The CAROs are currently looking to establish these links and it is incumbent upon geomorphologists to identify core areas where their special skill sets can deliver to the regional plans that will be scaled down to local community-scale climate actions. Again, it is useful to note some of the articles in this special issue that might help us to move towards a more informed evidence-base for these new governance arrangements (e.g., Carr, forthcoming; Farrell and Connolly, forthcoming; Gorman *et al.*, this issue).

Increased capital investment in neglected natural resources

Some 10% of Ireland is considered to be important from the nature conservation point of view with approximately 4-5% in the coastal area (DELG, 2001) in the form of Nature Reserves (78), National Parks (5), proposed NHAs (1,000+), SPAs (109), SACs (400), Ramsar sites (47) and UNESCO Biosphere sites (2). Preventing the long-term trend of degradation of these geomorphic systems and the Ecosystem Goods and Services (EGS) they provide is critical to preserve local and regional biodiversity and the functioning of these systems. Full value auditing will justify, at least fiscally, investment in preserving biodiversity and EGS and hence promote their conservation and sustainable use (see Norton *et al.*, 2018). The lack of a formal return-on-investment framework that couples EGS and costs needs to be explored and should subsume geomorphic functioning (Murdoch *et al.*, 2007). Unfortunately, environmental decisions are often put within the framework of cost benefit-analyses which should be the signal for geographers to monetise EGS so that proportional capital investment is received. Identifying and monetising neglected EGS (e.g., see Everard *et al.*, 2010) is a Herculean challenge and requires inter-disciplinary approaches but unless major capital investment is provided, and local plans and policies are enforced, we have to expect dire consequences for our geomorphic systems in the future. Some may argue with the tenet that this capitalist approach to monetising nature is antithetical. We are in agreement (at least partly) but argue that, as a means to an end, it may be necessary to absorb contested routes and visions.

Jones *et al.* (2011) estimated EGS in UK coastal margins (dunes, machair, saltmarsh, shingle, sea cliffs, and coastal lagoons) to be £48 billion (3.46% of UK Global National Income). Applying a similar valuation method and proportional contribution to Ireland produces a crude estimate of €2.57 billion but this figure should only serve as an indicator of the potential equivalent value for Ireland's coastal margin EGS and highlights a knowledge gap that exists in Ireland to guide future research. Norton *et al.* (2018)

conducted an economic assessment of coastal, marine and estuarine ecosystems in Ireland but explicitly directed users not to use their aggregated single value (€3.58 billion) as a representation of the total economic value (TEV) as it oversimplified their approach which comprised of disparate techniques (see their Table ES.1). Again, it serves to highlight the potential value and knowledge gap. Project Ireland 2040 has earmarked €1 billion for rural development (*via* the Rural Regeneration and Development Fund). It is imperative that a significant proportion is used to build community capacities, geomorphic systems and the activities and habitats they support. To date, it is unknown and unclear what mechanisms are going to be put in place to distribute these funds. In this special issue, new tools, models and data sets linked to earth observation and geo-spatial techniques such as cumulative effects assessment (Lally and Gonzalez, forthcoming), marine spatial planning (Carr, forthcoming), or rapid assessment (Gorman *et al*, this issue) might help guide that spending.

Field-based Research and Education

Visibility matters. The term geomorphology is undoubtedly a challenge to non-specialists. In part, this is due to low visibility even within the broader field of physical geography. Tooth (2009) reenergised the discussion on the apparent disappearance of the field of geomorphology, suggesting that it is '*little known and little understood ... in relation to other academic disciplines, and especially outside university circles*' (Tooth, 2009, 752). He noted that geomorphology is absent from scientific debates on important issues. The declining use of the word geomorphology in British and American scientific literature has been quantitatively measured (Woodward, 2015). Indeed, Woodward (2015) asks if the word is going out of fashion and suggests that we [geomorphologists] are sleepwalking into oblivion. The British Society for Geomorphologists has, based on discussions about the visibility and impact of geomorphology, recently established the Communicating Geomorphology Fixed Term Working Group (Clarke *et al.*, 2017). They found that 58% of the journals containing the work of geomorphologists use the term/phrase 'earth systems science' and 'processes that affect the form and function on the Earth' rather than geomorphology.

One excellent initiative by geomorphologists to address this challenge includes the publication of the highly accessible '10 reasons why geomorphology is important' (Tooth and Viles, 2014). Indeed, following the invitation issued by Tooth during his 2015 keynote in Dublin to the Irish Geomorphology Group, a bilingual Irish/English version of this publication (*Deich gCúis do Thábhacht na Geomoirfeolaíochta*) is now in preparation. At heart, those ten reasons recognise that landscape processes are mobile, complex, multi-scalar, yet act as archives of the past to show that global change and human activities shape landscape dynamics in potentially hazardous ways. Ultimately, they identify that successful environmental management needs geomorphological knowledge, something that the papers in this special issue provide in considerable depth and detail. How that knowledge is disseminated is crucial. Tooth and Viles (2014) identify six specific target

audiences for communicating about geomorphology: academia, schools, public events, press and media, policy makers and industry.

The term 'Geography' has also arguably been slowly whittled away and replaced in the social sciences by terms such as 'people, places, and environments', 'culture', 'global studies', and 'global connections' (Marran, 2003). The natural sciences may be equally culpable as physical geography has been rebranded and repackaged within 'environmental sciences', 'natural sciences', 'environmental geography', 'natural resource management', and 'earth sciences'. Irrespective of which title is used, it is clear to practitioners that geography is the only discipline which combines the natural and social worlds and is, therefore, the best platform to combat national and global problems.

In Ireland, these semantic problems exist but can be overcome with adequate promotion, support and resourcing in schools and universities. Ironically, geomorphology research is being widely conducted in secondary schools in Ireland – but under different labels. For example, a core unit in the Leaving Certificate (the final secondary school exam in Ireland) is 'Patterns and processes in the physical environment' in which 'landform development' and 'human interactions' are two key themes along with the tectonic and rock cycles. The field component (Geographical Investigation and Skills) is another core unit and conversations with teachers and examiners suggest that physical geography studies dominate this module (70-90%). The Guidelines for Teachers document provided by the National Council for Curriculum and Assessment (NCCA) to support student learning outcomes explicitly states that the '*approach to patterns and processes in the physical environment [has an] exclusive focus on landform development ... [with an] emphasis on processes and a deeper understanding of geomorphology*'. Surprisingly, the term geomorphology is not used within the syllabus. Similarly, the main study units in the Geography Junior Cycle are: (i) Processes, patterns, systems and scale; (ii) Geographical skills; and (iii) Sustainability. Again, the term geomorphology does not appear which emphasises the wider visibility problems associated with the term.

Putting physical geography back on the map

This special issue, the first sustained and substantive contribution of physical geography research to *The Irish Geography Journal* for some time, shows the ongoing importance of geomorphology as a subject that combines a deeply evidence-based physical landscape focus alongside a long-run environmental history. More broadly, it shows the importance of geomorphology as a branch of geography. Geomorphology remains crucial in informing genuine public concerns about environmental loss and degradation, as well as human-induced climate change. This importance remains under threat outside of the academy. In 2007, Simon Jenkins presented a very coherent argument on the impact of degrading geography and history in the United Kingdom to optional status in lieu of curricular reforms that made maths and science compulsory. He articulated how the sense of space, the sense of spatial perspective, and the notion of passage of time all get lost with geography's exclusion from teaching curricula. Further, he highlighted that:

It is geography that applies common sense to the statistical hysteria (sic) of the climatologists. It is geography that brings global warming into context and applies the test of feasibility to whatever political priorities are deemed necessary. It is geography that explains why each of us is located where we are, in neighbourhood, nation, continent and planet, and how fragile might be that location. Without geography's instruction, we are in every sense lost – random robots who can only read and count. (Jenkins, 2007, 1)

On February 25, 2019, the Heads of Geography Departments at six Irish third level institutions (Mary Immaculate College, University of Limerick; Maynooth University; NUI Galway; University College Cork; University College Dublin; Trinity College Dublin) wrote a letter to the *Irish Times* titled 'Putting geography back on the map' expressing their concern at the demotion of geography from being a core subject at Junior Certificate Level. This followed on from a petition by The Association of Geography Teachers of Ireland to #SaveGeography. The rationale for removing geography and history as core subjects has never been justified other than remarks pertaining to limited staff resourcing and the fact that these subjects are not currently compulsory for all students. The response of history teachers and historians was rapid and effective. Even President Michael D. Higgins expressed 'deep and profound concern' that just three subjects (Irish, English, Maths) will be mandatory core subjects. In late 2018, the Minister for Education promised to review the decision to make history an optional subject at Junior Certificate. This has been the catalyst for geographers to mobilise and demand similar due process.

Lyndon (2013) sagely observed that the reintroduction of compulsory history and geography in the new core curriculum in the United Kingdom was, in part, a response to the negative impact on societal identity and cohesion contributed to by the absence of these subjects since their removal from the core curriculum in the 1980s. He further commented that '[I]n trying to build an education system for the 21st century, it is disturbing that Ireland would seek to replicate the failings of 1980s British education policy' (Lyndon, 2013, 1). The fate of geomorphology is closely coupled with geography and it is incumbent that geomorphologists participate in redressing this decision. One way of drawing public attention to the value of the subject is to focus on new research in geomorphology.

In 2004, in the 60th anniversary edition of *The Irish Geography Journal*, Dr Rob Kitchin wrote a short commentary on the major transitions in geography in Ireland since 2000. This opinion piece mobilised a suite of responses that are as relevant to geomorphology today as they were to geography at that time. Moore-Cherry (2014) subsequently revisited the Kitchin (2004) piece and highlighted ongoing concerns that impact geography departments. These items are highlighted to emphasise the nature of geomorphology research in Ireland and the context within which it is practised. Of particular concern was the reduction of access to field-based knowledge. Currently in Ireland, large class lectures are the primary learning experiences of undergraduate students. Fieldwork and practical classes have been reduced and/or removed. This fundamentally alters the perception of geography as a field-based discipline. Fieldwork is an integral component of geography pedagogy and, in many cases, is seen as a rite of passage. The field is 'depicted

as the locus of becoming for the real geographer' (Powell, 2002, 267) in all branches of geography. In physical geography, students are trained to observe individual landforms and/or patterns of landforms that comprise the 'uniqueness' of each landscape; students relate local landform features to their landscape context; students generate place-based understandings that can be related to theoretical principles about diversity of forms, controlling processes, and evolution (Brierley and Fryirs, 2014). There is considerable evidence that fieldtrips have a positive impact on cognitive learning through listening, watching, touching and/or experiencing (Houser *et al.*, 2011). However, despite the clear benefits to the student, organising and delivering fieldtrips comes at a significant cost for staff and universities in terms of logistics, time, costs, and delivery. These issues are becoming more prevalent as class sizes increase, e.g., the First Year programme in geography at NUI Galway has averaged 440 in the past ten years and peaked at 615 students in 2010. The onset of the Information Age has brought the field to the classroom but cannot and should not render fieldwork obsolete as fieldwork facilitates an understanding of geographic concepts in ways that the classroom cannot (Fuller *et al.*, 2000; Phillips and Johns, 2012). The papers in this issue demonstrate explicitly that a thorough grounding in field and laboratory based skills/techniques are essential to producing quality research, and these skills/techniques need to be supported more fully across all teaching levels.

Conclusions

We are at a critical juncture in time for Irish geomorphology. At a societal level, we are equally at a critical moment in wider public understanding and governmental structures that might enable future generations of geomorphological thinkers to work with those structures in the face of climate change. New climate legislation has been the catalyst to deliver a National Adaptation Framework (NAF) to make our country climate resilient and a National Mitigation Plan (NMP) to meet national targets in energy efficiency. New Regional Climate Action Offices are facilitating Local Authorities to formulate and adopt the NAF by filling knowledge gaps to identify areas and people at risk or vulnerable. The CAROs have been very vocal in advocating the important roles of researchers and communities in delivering local action plans. The geomorphology community should make a concerted effort to participate in these processes so that our scientific expertise becomes an integral part of designing sustainable solutions. Our research programmes should also be (re)designed to deliver the requisite scientific data to inform decision makers. This imposes new challenges related to multi-disciplinary approaches and, importantly, consultation with stakeholders. In other cases, it means we have to change our academic currency from publication citation counts to societal impact. Concurrently, we need to safeguard the future of geomorphology by promoting geomorphology within secondary school and university curricula. Over the past decades, there has been a healthy widening of the field of geographic inquiry which should be viewed as grounds for fostering new opportunities rather than reinforcing a divide between our two sub-

disciplines (physical and human geography). The challenges can be daunting, but are not insurmountable. The key to growing a vibrant geomorphology community is to share ideas, knowledge, resources, and responsibilities. In this way, geomorphologists will contribute to building a better environment and society.

Acknowledgements:

The Irish Geomorphology Group (IGGy) would like to thank *The Irish Geography Journal* and the Geographical Society of Ireland for facilitating and supporting this special issue. In particular, we would like to recognise the contributions and support of *The Irish Geography Journal's* editors, Dr Ronan Foley and Dr Aaron Potito. We would like to acknowledge all the reviewers who provided constructive feedback to the authors.

References

- Bauer, B.O., 1996.** Geomorphology, geography, and science. In: B.L. Rhoads and C.E. Thorn, (Eds), *The Scientific Nature of Geomorphology: Proceedings of the 27th Binghamton Symposium in Geomorphology*, 27-29 September 1996. John Wiley and Sons Ltd, 381-413.
- Bourke, M.C. and Viles, H.E.A., 2016.** Valley-floor aeolianite in an equatorial pit crater on Mars. *Geophysical Research Letters*. 43 (24), 12,356-12,362.
- Brierley, G. and Fryirs, K., 2014.** Reading the landscape in field-based fluvial geomorphology. *Developments in Earth Surface Processes*, 18, 231-257.
- Brosnan, S., 2018.** *How do we measure the impact of research?* RTÉ Brainstorm Opinion. Available from: <https://www.rte.ie/eile/brainstorm/2018/0417/955151-how-do-we-measure-the-impact-of-research/> [Accessed 23 January 2019].
- Carr, L. (2019 forthcoming)** Marine Spatial Planning in a Climate of Uncertainty – An Irish Perspective. *Irish Geography*, 10.2014/igj.v51i2.1375.
- Clarke, L., Schillereff, D. and Shuttleworth, E., 2017.** Communicating geomorphology: an empirical evaluation of the discipline's impact and visibility. *Earth Surface Processes and Landforms*, 42, 1148-1152.
- Colven, E. and Thomson, M.J., 2019.** Bridging the divide between human and physical geography: Potential avenues for collaborative research on climate modelling. *Geography Compass*, 13(2), e12418.
- Connolly, J., 2019.** Mapping land use on Irish peatlands using medium resolution satellite imagery. *Irish Geography*, 51(2), 187-204.
- Cronin, A., Devoy, R., Bartlett, D., Nuyts, S. and O'Dwyer, B., 2019.** Investigation of an Elevated Sands Unit at Tralispean Bay, South-West Ireland – Potential High Energy Marine Event? *Irish Geography*, 51(2), 229-260.
- Desmond, M., O'Brien, P. and McGovern, F., 2017.** A Summary of the State of Knowledge on Climate Change in Ireland, *EPA Report 223*. Dublin, Environmental Protection Agency.
- Dundon, H. and Farrell, E. (2019 forthcoming)** Accuracy assessment of Digital Surface Models (DSM) from UAVs for mapping coastal environments. *Irish Geography*, 10.2014/igj.v51i2.1382.
- Everard, M., Jones, L. and Watts, B., 2010.** Have we neglected the societal importance of sand dunes? An ecosystem services perspective. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 20(4), 476-487.
- Farrell, E. and Connolly, N. (2019 forthcoming)** Sand Dune Inventories of Ireland: historic and contemporary perspectives. *Irish Geography*, 10.2014/igj.v51i2.1381.
- Fuller, I.C., Rawlinson, S.R. and Bevan, J.R., 2000.** Evaluation of student learning experiences in physical geography fieldwork: paddling or pedagogy? *Journal of Geography in Higher Education*, 24, 199-215.

- Gardner, E.A., Burningham, H. and Thompson, J.R. (2019 forthcoming)** Impacts of climate change and hydrological management on a coastal lake and wetland system. *Irish Geography*, 10.2014/igj.v51i2.1376.
- Gorman, T., Kindermann, G. and Morley, T., 2019.** A Rapid Assessment Framework for Irish Habitats: A Case Study of Machair Habitat Quality. *Irish Geography*, 51(2), 205-228.
- Goudie, A.S., 1986.** The Integration of Human and Physical Geography. *Transactions of the Institute of British Geographers*, 11(4), 454-458.
- Harrison, S., Massey, D., Richards, K., Magilligan, F.J., Thrift, N. and Bender, B., 2004.** Thinking across the divide: perspectives on the conversations between physical and human geography. *Area*, 36(4), 435-442.
- Hooke, J.M. and Smith, M.J., 2012.** 'The Physical Landscape of Britain and Northern Ireland': A Project to Increase Geomorphological Awareness. *Scottish Geographical Journal*, 128(3-4), 298-303.
- Houser, C., Brannstrom, C., Quiring, S. and Lemmons, K., 2011.** Study abroad field trip improves test performance through engagement and new social networks. *Journal of Geography in Higher Education*, 35, 513-528.
- Jenkins, S., 2007.** *The assault on geography breeds ignorance and erodes nationhood.* Guardian Opinion Available from: <https://www.theguardian.com/commentisfree/2007/nov/16/comment.politics/> [Accessed 23 January 2019].
- Jones, L., Angus, S., Cooper, A., Doody, P., Everard, M., Garbutt, A. and Gilchrist, P., 2011.** Coastal Margins. In: *UK National Ecosystem Assessment Technical Report.* United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC): Cambridge, 411-457.
- Kitchin, R., 2004.** Comment: Geography in Ireland in transition. *Irish Geography*, 37(1), 15-19.
- Knight, J. and Harrison, S, 2019.** Paraglacial evolution of the Irish landscape. *Irish Geography*, 51(2), 171-186.
- Lally, A. and Gonzalez, A. (2019 forthcoming)** A comparative appraisal of four proposed GIS-based methodologies to map anthropogenic cumulative effects at a landscape level in Ireland. *Irish Geography*, 10.2014/igj.v51i2.1377.
- Lave, R., 2014.** Engaging within the academy: A call for critical physical geography. *ACME: An International E-Journal for Critical Geographies*, 13(4), 508-515.
- Loureiro, C. and Cooper, A.G., 2019.** Temporal variability in winter wave conditions and storminess in the northwest of Ireland. *Irish Geography*, 51(2), 155-170.
- Lyndon, P., 2013.** *Dropping geography and history.* *Irish Times* Opinion. Available from: <https://www.irishtimes.com/opinion/letters/dropping-geography-and-history-1.1435345> [Accessed 23 January 2019].
- Maguire, D. (2019 forthcoming)** A comprehensive roadmap to 50 years of Earth Observation (Satellite) Resources for the Island of Ireland (1972-2023). *Irish Geography*, 10.2014/igj.v51i2.1380
- Marran, J.F., 2003.** Geography: An Essential School Subject – Five Reasons Why. *Journal of Geography*, 102(1), 42-43.
- Mathew, S., Pellicer, X., Caloca, S., Monteys, S., Zarroca, M. and Jiménez-Martín, D. (2019 forthcoming)** Bull Island: characterisation and development of a modern barrier island triggered by human activity in Dublin Bay, Ireland. *Irish Geography*, 10.2014/igj.v51i2.1378.
- Moore-Cherry, N., 2014.** Geography in Ireland in transition: a retrospective. *Irish Geography*, 47(2), 3-12.
- Murdoch, W., Polasky, S., Wilson, K.A., Possingham, H.P., Kareiva, P. and Shaw, R., 2007.** Maximizing return on investment in conservation. *Biological Conservation*, 139(3-4), 375-388.
- Norton, D., Hynes, S. and Boyd, J., 2018.** *Valuing Ireland's Coastal, Marine and Estuarine Ecosystem Services.* EPA Report 239.
- Phillips, R. and Johns, J., 2012.** *Fieldwork for human geography.* Sage.
- Powell, R.C., 2002.** The Sirens' voices? Field practices and dialogue in geography. *Area*, 34(3), 261-272.
- Sivertsen, G., 2017.** Unique, but still best practice? The Research Excellence Framework (REF) from an international perspective. *Palgrave Communications*, 3, 17078.
- The Heritage Council, 2010.** *Proposals for Ireland's Landscapes 2010. Summary Document.* The Heritage Council.
- Tooth, S., 2009.** Invisible geomorphology? *Earth Surface Processes and Landforms*, 34, 752-754.

Tooth, S. and Viles, H.A., 2014. *10 reasons why geomorphology is important*. http://www.geomorphology.org.uk/sites/default/files/10_reasons_full.pdf: British Society for Geomorphology.

Varandas Martins, S., Burningham, H. and Pinto-Cruz, C., 2019. Climate variability impacts on coastal dune slack ecohydrology. *Irish Geography*, 51(2), 261-284.

Woodward, J., 2015. Is geomorphology sleepwalking into oblivion? *Earth Surface Processes and Landforms*, 40, 706-709.