

Institution: Queen's University Belfast

Unit of Assessment: 14

1. Unit context and structure, research and impact strategy

a. Overview

Geography at Queen's (QUB) is a well-established and influential unit. Though comparatively small (19.5 FTE), Queen's geographers have shaped key research agendas across the discipline spanning the human and physical worlds, both past and present. In Human Geography (HG) we have led debates on the role of space and place in the global geographies of knowledge, politics, power and religion, and provided critical understanding of ethnic and residential population change. In Physical Geography (PG) our work is providing new insights into climate change impacts on peatlands, soil erosion and Quaternary ice-ocean interactions, while our innovative work in geoforensics is having wide application in criminal investigations. In GI Science we apply novel analytical approaches to interrogate health and the environment and longitudinal population trends, amongst other themes. *We are an outward-facing unit with a strong tradition of forging transnational, regional and local connections with external partners, giving geographical research at Queen's a critical role in contemporary debates about social and environmental futures.*

The **vitality of our research environment** is illustrated by our achievements since REF 2014, which include: (i) a large body of work in leading geography and geoscience journals and influential book contributions; (ii) our success in increasing our research income from **£5.25m** to **£7.14m** and our PhD completions from **14** to **33** between REF 2014 and REF 2021; (iii) strategic investment in a new Centre for *GI Science and Geomatics*; (iii) the award of a NERC-funded DTP (QUADRAT) co-led by staff in the Unit which is delivering leading PGR training; and (iv) major cross-disciplinary projects and partnerships which have strengthened impact and public engagement, including an AHRC-funded national public engagement centre.

b. Unit Context and Structure

Geography is one of five disciplinary units in QUB **School of Natural and Built Environment** (SNBE), established following the merger of the former School of Geography, Archaeology and Palaeoecology (SGAP) and the School of Planning, Architecture and Civil Engineering (SPACE)

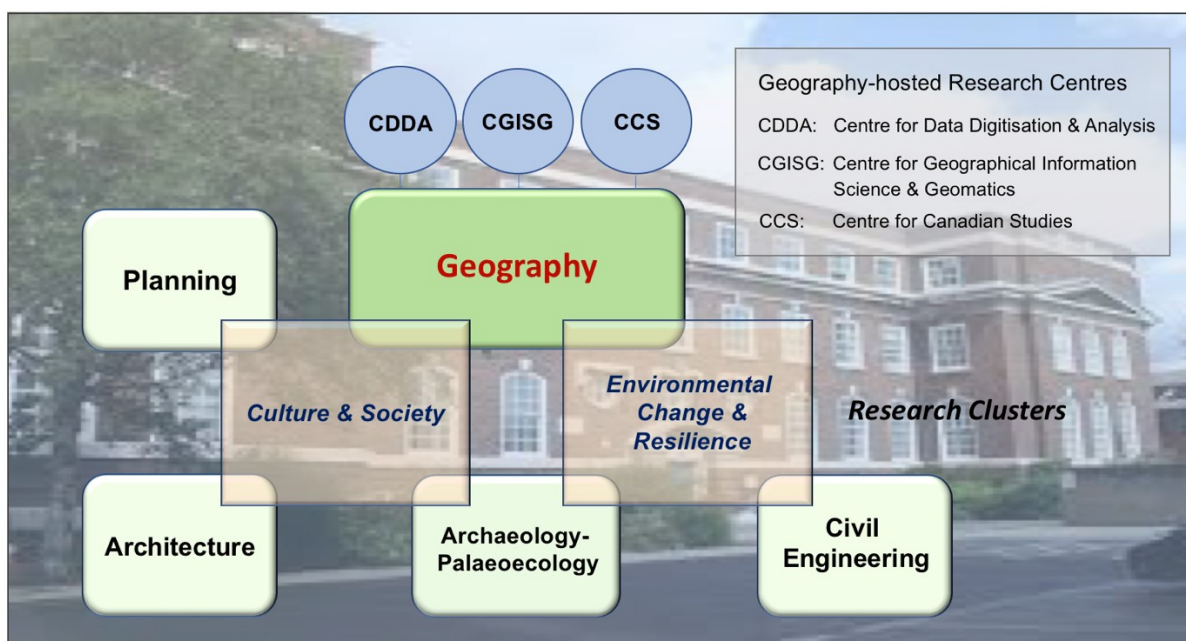


Fig. 1: Discipline and relevant research cluster relationships in SNBE.

in August 2016 (Fig. 1). In REF 2014 SGAP was returned as a single unit to UoA17. In July 2020 QUB Geography comprised 18.5 FTE permanent academic staff, (including one permanent research fellow and a lecturer who has taken up a NERC fellowship), and one fixed term lecturer. Research in the Unit is promoted through two large cross-disciplinary SNBE research clusters, both led by Geographers; **Culture and Society (C&S)** (Lilley) and **Environmental Change and Resilience (EC&R)** (McKinley) (Fig. 1). These have enabled us promote our disciplinary strengths, whilst nurturing productive new research directions.

Geography also hosts three QUB research centres, the **Centre for Data Digitisation and Analysis (CDDA)**, which works with public bodies to create digital content and infrastructures, the QUB **Centre of Canadian Studies (CCS)**, which connects interdisciplinary research in Canada to international policy agendas, and the recently formed **Centre for GIS and Geomatics (CGISG)**, which reflects a strategic commitment to expanding GI Science research and impact in QUB. Strong links exist with the **QUB Centre for Climate, the Environment and Chronology (¹⁴CHRONO)**, the School of Biological Sciences, and members of our HG group are active within the University's **Senator George J. Mitchell Institute for Global Peace, Security and Justice (SGMI)**.

c. Research Strategy: 2014-2020

Our research strategy has evolved since 2016 with the creation of the School of Natural and Built Environment and as a result of new strategic investments. Our research foci in Geography are informed by key questions within and between our School disciplines, by research council funding priorities and opportunities, and University-level strategic themes.

The **key aims** of our REF 2014 research strategy for **Geography** were to:

1. lead and contribute measurably to critical and scientific enquiry in human and physical geography;
2. develop and disseminate new techniques of data analysis, visualisation and interpretation;
3. inspire and facilitate new researchers through a proactive strategy of attracting and supporting PGR students and embedding early career researchers in our grant-funded projects;
4. develop the impact and outreach of our research;

In addition to the above, since 2016 our priorities have included:

5. building on our strengths in GI science and the newly formed **CGISG**, to address multi-disciplinary themes in HG and PG;
6. further develop interdisciplinary research, harnessing opportunities across SNBE, QUB and beyond.

In all areas of activity, we have delivered against our priority aims [**bold italics A1-6 below**].

Our strategy was **implemented** as follows:

➤ **Contributions to intellectual enquiry and scholarship in Geography: [A1,2]**

- In **Historical-cultural geography** a long-standing area of strength in QUB Geography, our publications have defined historical geographies of knowledge and knowledge-making practices. Major outputs have examined geographies of reading and speaking about science, especially Darwinism, explicated urban histories of scientific and cartographic enterprise, and explored inter-connected spaces of gender, empire and natural history. Conceptual innovation in this area includes the elucidation of 'speech spaces', relations between science and civic and colonial geographies, and distinctive contributions to medieval studies. Novel applications of historical GIS have challenged understanding of mapping histories. **[A2]** Noteworthy also, are the **scholarly contributions from our PhD students**. For example, the monograph, 9 articles and 2 book chapters produced by our PhD students in historical and cultural geography have added substantially to understanding the places and spaces of scientific knowledge.
- In **Political geography** our work has made a compelling contribution to critical geopolitics, post-colonialism and the securitization of borders. Key outputs have addressed the literary

geopolitics of twentieth-century space exploration, apocalyptic and conspiratorial geo-political imaginaries, the fundamental reconfiguration of social 'abnormality' through border surveillance technology, and an 'indigenous studies' approach to post-colonial identity. This work has probed and expanded a lexicon of theoretical categories including bio-power, gender, identities, imaginaries, imperialism, (in)security, nationalism, performances, post-colonialism, technology and more. Other key outputs offer a cogent analysis of the **geographies of religion**, including rigorous empirical research on Evangelical apocalypticism, Zionism, Christian millennialism and conspiracism, amongst other themes.

- In **Population geography**, our research excellence is demonstrated via leading and novel analyses of socio-spatial inequalities and longitudinal population trends. These have had international scholarly impact, generating robust and significant new empirical, theoretical and methodological contributions to the literatures on ethnic diversity and segregation, the geographies of long-term deprivation, population structure and change, and internal migration propensities. Our outputs reflect our reputation for the application of advanced spatial analysis of Census and other population data, at a range of scales [A2,5]; these have been influential in shaping academic debates and policy agendas (see Section 4c).
- In **Physical geography** we have continued to build on our established profile of expertise in the area of long-term environmental change from REF 2014, with the support of the ¹⁴**CHRONO Centre**. Major outputs have analysed the response of European peatlands to recent climate change, the role of Holocene climate in modulating volcanic eruptions, and the interactions of global climate, polar ice sheets and palaeoceanographic processes around sensitive glaciated margins. Other contributions have developed new methodological tools and analytical approaches, including innovative geophysical approaches to examine the influence of subglacial lakes on ice dynamics, novel geoforensic and geostatistical approaches to interrogate soil geochemistry datasets and estuarine lithofacies, and the relationships between soil geochemistry and kidney disease [A2,5]. We have made a leading contribution to applied research with testate amoebae (e.g., as a new tool for tracking Arsenic pollution in lakes and in quantitative palaeohydrology [A2]).
- In total, our 20 (19.5 FTE) staff members published 250 journal articles, 10 edited books, 66 book chapters, and two monographs, and delivered 468 conference presentations, seminars and research talks in 35 countries. Of our peer-reviewed journal articles, 188 (75%) were published in Q1/Q2¹ journals, including seven papers in *Nature* journals (-*Geoscience*; *Climate Change*; -*Communications*), and five in *Transactions of the Institute of British Geographers*.
- The recognition of our scholarly work is evidenced by **distinguished honours and awards** conferred upon our staff during the REF period, notably a CBE to *Livingstone* for his contributions to scholarship in Geography, History of Science and Intellectual History, and other prestigious *RGS* and *Geological Society of London* and *RIA* awards (see Section 4e).

➤ **Research awards which enhanced PGR & ECRs: [A3]**

A significant increase in research income during the REF period (from £5.25m in 2014 to £7.14m in 2021), has enhanced vitality by supporting post-doctoral researchers and PhD students, advanced our disciplinary research agendas (see Section 3a), and our impact and interdisciplinary activity.

- Examples of projects which supported **postdoctoral researchers** include the 'Northern Ireland Longitudinal Study' (*NILS*) (ESRC; *Shuttleworth* PI; >£2.2m), 'Mapping Lineages' (Leverhulme; *Lloyd* PI) and a Templeton Foundation award to *Finnegan* (each supporting 1 PDRF). Through these and other awards, we supported **10** fixed-contract PDRFs in REF 2021. We also significantly increased our PhD awards and our PGR community increased from **34** to **50** between REF 2014 and 2021 (see Section 2).
- Our success in delivering **outstanding PGR training** has been strengthened by the £5m [QUADRAT NERC DTP](#) award in 2018 (co-led by *McKinley*; £2.46m to QUB), which is run jointly with Aberdeen and QUB Biological Sciences and a broad network of collaborative partners. Our emphasis on *Biodiversity*, *Earth Systems* and *Environmental Management*

¹ Journal Citation Reports 2019

research themes is enabling us to address significant environmental and societal challenges in line with the NERC remit. [A1,3,6]

➤ ***Maximising research impact and outreach: [A4]***

Our strategy was underpinned by the following objectives:

- Targeting opportunities for impact via our research centres, QUB networks and major grants
- Expanding links with external partners
- Embedding an impact culture across the discipline

The strategy was advanced as follows:

- A **Geography impact lead (Ruffell)** acts as a key link for connecting academic and non-academic partners by working closely with QUB Impact champions and co-ordinating impact training, seminars and workshops.
 - A **School Impacts Fund** and cluster funds support projects with impact (e.g., *Mullan's* work assessing soil erosion risk with stakeholders in Belgium).
 - Impact objectives and achievements are also embedded in our mentoring and appraisal processes. Events run with partners (e.g. *Ulster Museum*) have helped to generate awareness of outreach amongst our postgraduates.
 - Our **Research Centres** are a major vector for achieving impact, enabling us to strengthen relationships especially with non-HEI partners and increase public awareness of our research:-
 - Through **CGISG**, for example, we are leading outreach in spatial science, geomatics/geodetics, geostatistical analysis, geo-programming and digital mapping. Notable hosted resources include *Lloyd's* ESRC-funded '*PopChange*', a novel Britain-wide population data resource and analytical tools which allow researchers to explore neighbourhood changes [A1,2,5]. This and associated policy briefings have been used widely by local government (with >40 local authorities registered to use the resource), charities and academics.
 - Through **CDDA**, one of the leading Digital Humanities centres in the UK, we used e-resources and innovative digitisation, visualisation and web technologies in >30 projects, benefitting government, NGOs and community groups (e.g. *NI Executive, National Museums of NI (NMNI)*). [A2] Notable examples include GCRF projects in Assam, India, focusing on sustaining heritage at risk, and the '*Digitising Scotland*' project (*DSP*), which is enabling online provision of Vital Registration Data forms for Scotland via *National Records Scotland*.
 - Major awards which **strengthened links with external partners** include the ESRC-funded '*NI Longitudinal Study*', undertaken in partnership with *NI Statistics and Research Agency (NISRA)*. The resulting co-produced resource embeds social science and public health research within NI labour market mobility frameworks (see Section 4).
 - Strong cross-sector partnerships have also been forged through the **QUB Heritage Hub (HH)**. Led by Geography, with scholars from QUB History, HH bridges cross-disciplinary expertise and capacity in heritage (built, cultural and natural) at QUB, developing heritage networks, projects and initiatives locally and globally, in line with *QUB's Engaged Research Action Plan*. [A6]
 - In total, our staff delivered **109** outreach or public engagement talks (from *KESS* talks at Stormont, to *NI Science Festival* talks), and were involved in the organisation of **78** outreach events (from a large public event to raise public awareness of research on *Irish Peatlands* involving >25 NGOs and government agencies (lead: *Roe*), and many events for the LL-PEC, amongst others). We published **52** journal articles with **industry or non-HEI partners** (e.g. public health; geological survey collaborators).
- Our impact case studies illustrate key aspects of our approach to impact and outreach:-*
- '*Innovative Aquatic Geoforensics*' (*Ruffell; McKinley*) developed and applied new analytical approaches for forensic search in water, integrating GIS with GPR-based geophysics [A2], and building on our significant networks in geoforensics to achieve

impact. The work was undertaken with police and other agencies; beneficiaries included the *National Crime Agency* and the *Home Office* amongst others (see *ICS-219632057*).

- The AHRC-funded '**Living Legacies 1914-18 - Sharing contested heritage through digital and spatial humanities**' (Lilley with Ell, Director CDDA) embedded digital and spatial geohumanities approaches in community coproduction during the Centenary of WW1 (2014-19), with a wide range of partners and beneficiaries. LL is profiled by the RGS-IBG as an exemplar case study (see *ICS-219632062*).

➤ **Interdisciplinarity: [A6]**

- Geography staff play a leading role directing our **two cross-disciplinary research clusters** (Fig. 1) which have led to significant new collaborations reaching beyond QUB:
 - In **Culture & Society**, examples of Geography-led projects include GCRF-supported projects framed around the *UN's Sustainable Development Goals*, including human-environment interactions in Bangladesh and the economic and cultural value of intangible and dissonant heritage in South Asia, connecting architects, planners, archaeologists and geographers.
 - In **Environmental Change & Resilience**, geographers have played a leading role in the ERC-funded [FRAGSUS](#) project with QUB archaeologists, which examined human-environment interactions and heritage conservation in Malta, with *Ruffell* leading project geophysics, and the EPSRC-GCRF '**VERTICES GeoEnergy**' project (*McKinley* PI), which integrated geochemistry data in the development of versatile energy solutions with Civil Engineers (CE), Geological Survey NI (GSNI), UNESCO Centre for Global Geochemistry, Chinese Academy of Geological Science and other partners, resulting in a student workshop (15 Chinese UG students) and collaborative journal outputs.
- Our **Centres** further support our interdisciplinary research. *CDDA* supports diverse projects with Archaeology, History, Languages, Creative Arts; and *CGISG* with QUB Biology, Engineering, Computer Science, Archaeology and Public Health. The **Centre for Canadian Studies** connects multi-disciplinary research in Canada to international and policy agendas. The high-profile annual *CCS Eaton Lecture* attracts diverse academic and public audiences.
- In addition to the **Heritage Hub**, projects led by *Finnegan* (AHRC; *Templeton Foundation*) have partnered historical geographers with prominent researchers in history, history and philosophy of science and theology, generating several highly inter-disciplinary outputs.
- Geographers also played a major role in the GSNI-led €4.5m EU INTERREG IVA-funded '*Tellus Border*' ground-based and airborne data acquisition project (*McKinley; Ruffell*). Inter-disciplinary research stemming from [Tellus](#) on the links between health and the environment with *CGISG [A5]* has included the QUB Nephrology Research group, *Belfast Health Trust* and the *UK Renal Registry*.
- Our strong **DTP links** have enabled us to foster numerous cross-disciplinary **PgR projects**. In HG, projects funded by ESRC NINE and AHRC *Northern Bridge* DTPs have developed through collaborations with QUB Archaeology and History especially. In PG, the NERC QUADRAT-DTP reflects our ability to deliver interdisciplinary PGR training across SNBE disciplines with Biology.
- Our commitment to fostering interdisciplinarity is also evidenced by **major hosted conferences** where geographers play a leading role. The 2018 [GeoEnv](#) conference, for example, saw geographers interact with international scholars from mathematics and engineering; and the 2019 '*Dignity and Respect*' conference co-run with *QUB Senator George Mitchell Institute, British Council* and *SGI-UK*, with scholars from law, anthropology and environmental governance, amongst others.

d. Future Research Strategy: 2021-2026

To ensure the continued vitality of our research environment in the next REF period we will continue to pursue our key strategic objectives **A1-6** as above, with additional priorities identified as follows:

- increase and diversify our funding base by targeting strategic calls which harness our disciplinary strengths and cross-disciplinary networks (e.g. in the heritage, conflict, socio-economic change, wetlands and climate change, and environment and health areas);
- to build capacity, enabling us to lead and contribute to world-leading cross-disciplinary research that addresses global challenges in our core research areas;
- further expand and sustain impactful co-produced research through strengthened partnerships, with integration of our research centres *CDDA*, *CGISG*, and *¹⁴Chrono*.

e. Open Research Environment

We comply with the University's arrangements for Open Access, making outputs and data from grant-funded projects publicly available via QUB repositories. Between April 2016-Dec 2020 we achieved 89% compliance in uploading journals and conference outputs to the repository; an increase of 30% from 2014-16. We make our major datasets freely-available through our centres (e.g., weather data from our monitoring station, hosted by *CGISG*), or through national facilities such as the UK Data Service (e.g., *PopChange* resources), along with an array of public outputs including interactive mapping tools (e.g., *HSC 'Dementia'* project; Leverhulme *'Mapping Lineages'*), and policy briefings (e.g., *PopChange*). Our staff engage widely in public dissemination (see above) and national media engagement (e.g. *The Conversation*) and coproduced research is shared with government (e.g. NISRA) and NGOs.

f. Research integrity and ethics

We have a well-developed framework for ensuring that our research meets high ethical standards in line with the *UK Concordat for Research Integrity*. Grant proposals are assessed via a Faculty Ethics Committee, while School and Geography (*Shuttleworth*) Ethics leads oversee PGR and UG research related ethics. Major projects involving co-produced database resources follow professional codes of practice (e.g. *NILS* has approval from *ORECNI*). *Catney* has taken a lead role in developing a major new initiative supporting postdoctoral staff in the Faculty of Engineering and Physical Sciences (EPS), which includes research integrity and ethics. This is providing a model of best practice for other areas.

2. People

a. Staffing strategy and recruitment

Our staffing strategy aims to recruit, motivate and retain high quality staff to implement our research priorities [A1-6]. Since the formation of SNBE in 2016, we have increased the geography academic staff contingent to **re-energise research capacity in existing and new research areas**, and capitalise on the **interdisciplinary focus** of the new School:

- **Developing emerging research strengths:** The strategic appointment of *Lloyd* and *Catney* in 2018 has strengthened our expertise in population geography and helped to develop the impact of *CGISG* in line with **A5**. Their influential work in ethnic and residential change, labour market mobility, and important policy and resource contributions make the QUB population geography group a leading international centre. Lecturer appointments have also added expertise in climate change and soil erosion modelling (*Mullan*) and in palaeoceanography and ice-ocean interactions (*Newton*), complimenting existing strengths in the environmental change research area. Since appointment, *Newton* has been awarded a NERC Industrial and Innovation Fellowship (IIF) and *Flood* has joined the PG staff on a fixed-term contract, adding expertise in coastal processes and geostatistics. *Sturm's* appointment in 2015 augmented existing strengths in cultural geography. A new permanent GI senior research scientist further strengthened *CGISG*.
- **Developing interdisciplinary research capacity:** The appointment of *Lloyd* and *Swindles* (both at Chair), who both address the environment via strongly interdisciplinary frames, have helped to forge cluster connections. *Lloyd's* research integrates strengths across the S&C and EC&R cluster groups *Environment and Health*, *Spatial-temporal modelling*, and the emerging area of *GIScience and Cities [A5]*, whilst *Swindles'* work on peatland-climate interactions, a core focus of expertise in the EC&R cluster (with CE and archaeologists),

enhances our ability to tackle pressing issues in climate change and anthropogenic impacts on peatlands. [A1]

In total, six permanent academic staff have joined the Unit since 2014; three in PG and three in HG. Overall, our permanent academic staff body increased by 2.5 FTE (from 16 to 18.5) during the REF period, the recent appointments partly balancing earlier retirements and two staff who left. Our current academic staff profile includes research-active staff at all career stages including 7 Professors (4 HG; 3 PG), 1 Reader (PG); 8 SL (6 HG; 2 PG); 3 L (1 HG; 2 PG) and 1 permanent PDRF (*Ell*). We have supported a further **10** post-doctoral researchers during the REF period, including a Marie Skłodowska-Curie Actions Fellow (MSCA).

Future Staffing Plans: To achieve our strategic goals over the next 5 years (*Section 1d*), we aim to increase our staff base in HG and PG, particularly in the geopolitics and climate change modelling/impacts areas, augmenting our existing strengths. Appointments at the lecturer level will help us to balance our demographic profile and allow succession planning, covering anticipated retirements in the next REF period.

b. Staff Development and Career Progression

We provide an intellectually stimulating and supportive research environment for our staff at all career-stages and recognise the primacy of staff development for promoting research:

- We are committed to supporting **early-career researchers** (including postdoctoral researchers) alongside established staff. Probationary and ECR lecturers are allocated a senior mentor to advise on career development, have full access to training courses (e.g., PGCHET; 'Supervising Research Students'). They also have an initially light teaching load and priority access to ring-fenced PhD (DfE) studentships.
- A streamlined appraisal process, introduced by QUB in 2019, supports staff development and career progression. During this REF period we have also prioritised support for **mid-career staff** by providing internal review of grant applications (see *Section 3b*) and encouraging staff to undertake leadership roles (e.g. *Johnson, Lilley, Roe* and *McKinley* were SNBE cluster directors). The success of our support strategy is evidenced by **10 staff promotions** in the unit during the REF period.
- A **Geography Work Load Model** developed since the last REF guides managerial decisions on work balance. A rotating **sabbatical policy** further increases staff research time. Staff can request sabbatical leave at the rate of one semester per three years' work (or 1yr/6yr). During the REF period, 13 staff (6 female, 7 male) had sabbatical leave. Recent achievements during sabbaticals include development of successful international collaborations in India (*Lilley, 'Surveying Empires' project; Kumar, DfE-GCRF awards*) and the development of an MOU in China (*McKinley*) (see *Section 3a*).
- Since the last REF staff have played a leading role in setting up new **mentoring initiatives** in SNBE for **post-doctoral researchers** (*Roe*) and the development of a Faculty-led Mentoring Programme for contract researchers (*Catney*). These provide guidance, for example, with research writing, ethics, time-management and employability skills.
- To further support our **post-doctoral researchers** we have prioritised delivery of an informal peer-review system to support grant and lectureship applications. During the REF period four of our PDRFS (*Wright, Doebler, Porter, Leidenhag*) and two PGRs (*Song, Flood*) have successfully gone on to secure lectureships or other HEI posts.
- We supplement training offered through the University's Learning and Development Programme with **in-house training** (e.g. R in biogeography; fossil chironomid analysis). Cluster fund awards (up to £1000/staff member) support external training, conference attendance, career development as well as active research.
- We adhere to the principles of the **Researcher Development Concordat**, as evidenced by our commitment to staff development, our recruitment strategies, recognition procedures, reflective review of staff progress, and our Equality and Diversity strategy (see *below*).

c. Training and Supervision of PGR Students

The Unit provides an excellent and supportive environment for PGR students, and all of our submitted staff are, or have been involved in supervising students during the REF period.

- **Growth in numbers:** The success of our strategy to expand our PGR research community through increased external funding [A3] is further evidenced by **a significant increase in our PhD completions**, which rose from **14** for geography FTE in REF 2014 to **33** PhDs (plus one MPhil) in REF 2021. Our total PhD students increased from **34** students to **50** between the two REF periods. This rise occurred in spite of a large reduction in core studentship awards from NI Department of Employment and Learning (DEL) (pre-2017) and NI Department for Economy (DfE) (post-2017). Faculty re-structuring of taught Masters programmes has also impacted the pool of well-qualified students available to undertake PhDs.
- The NERC QUADRAT DTP further underlines our commitment to outstanding PGR training. This will bring **25 ring-fenced awards to the School between 2019-2023**. The DTP also includes an accredited strategic management and leadership qualification, promoting career development. Other awards have come from the AHRC *Northern Bridge* and ESRC NINE DTPs, EPSRC, regional government agencies (e.g. DAERA), third-sector stakeholders (e.g. *Historic Scotland*) and private funding. We regularly review strategies to increase PGR recruitment and widen the funding base. For example, a newly approved (June 2020) MA in *Geopolitics* to be run jointly with QUB Politics and International Studies (commencing 2021) has been developed to expand the number of qualified students available for our PhD programmes.
- **Training and management:** PGR education and training are co-ordinated by a SNBE Postgraduate Research Co-ordinator, supported by a postgraduate research committee, which manages the selection of PhD projects and offers of core (DfE) awards. DTP awards are administered by separate committees involving staff from the Unit and partner centres. PhD students receive at least 30 days of training over their three or 3.5 years of study. Students avail of a wide range of generic courses in the QUB Graduate School. **In-house training** is also facilitated (e.g. geophysical survey techniques; R courses). Students may apply to clusters for additional funding (average: £500/student) for costs which cannot be covered from other sources (e.g. external training). Three fieldwork prizes are awarded annually to geography PGRs for innovative projects.
- **Supervision and progression:** Each student has at least two supervisors and supervision proceeds in line with the University's *Postgraduate Code of Practice*, supported by a dedicated progress committee. Students have regular supervisory meetings with agreed plans of actions and undergo a rigorous performance review after the first nine months. Supervisors receive training in the University's *Research Student Lifecycle System*, which provides supervisory teams with visibility of students' progress and reporting. Policies are in place to monitor completion rates, temporary withdrawals, and other support needs. During the Covid-19 pandemic all final year students were granted no-fee extensions, and all students supported via regular online meetings.
- **Research environment and employability:** Postgraduate students are an intrinsic part of our research community and are actively involved in cluster activities, the Geography seminar series and other School events, e.g. the School's annual **Research Day**, a lively event which promotes interdisciplinarity and fosters engagement. Geography PGRs also participate in a student-led seminar series co-run with Archaeology-Palaeoecology (Arc-Pal) students and Faculty events (e.g. poster competitions). Students are encouraged to engage in research-related outreach events and enhance career development via teaching support.
- Employer-focussed and skills development days led by PGRs and developed through our strong NI employer networks (e.g. linked to our '*Geography at Work*' UG module) have further helped students to develop employability skills and secure employment outside academia. Examples of recent students who have benefitted include: *Gerrow*, Heritage

Projects Officer, [Ulster Architectural Heritage](#); *Bell*, [ESRI](#), UK; *Quail*, Refugee resettlement manager [Bryson Intercultural](#)).

- **PRES scores increased for the Unit between 2015-2019 showing increasing levels of PGR satisfaction, taking them above the sector average (86% versus 81%).**
- **Wider contribution of submitted staff to doctoral programmes and training:** Geographers play a central role in strategic PGR development and management; *McKinley* co-led the successful QUADRAT DTP bid, *Roe* was QUADRAT co-lead in 2019-20 and *Johnson* and *Dunnett* are members of the *Northern Bridge DTP* panel.

d. Promotion of Equality and Diversity

- We are committed to creating a research environment in which staff and students can reach their true potential and with equal opportunities for male and females. We have **14** (70%) male and **6** (30%) female academic staff in our REF 2021 return (with a small (4%) increase in females since REF 2014), and 3 international staff (from S. Asia, N. America and the Middle East). Our contract research staff (PDRAs plus RAs) for the REF period comprised **8** males; **9** females and our PGR students **31** males; **19** females.
- School-wide policies offer support for flexible, family-friendly working arrangements, and follow QUB policies on maternity and adoption leave. Wherever possible, all meetings and seminars are scheduled for school-friendly times. All staff receive training for interview panel membership, with a focus on equality and diversity. Review of our staff equality and diversity policies is assured at School meetings as a fixed agenda item.
- Members of the Unit form an active part of the **School's Athena SWAN Action Team (SAT)**, co-led by *Warke*, and previously led by *Sturm* and *McKinley*. Encouraging more **female staff to train and apply for leadership roles** has been one of the team's priorities. The appointment of three of the Unit's six female staff to DR roles, one to Head of Discipline, and DTP appointments during the REF period highlights success here. All six staff also achieved promotion success (3 to Chair; 3 to SL).
- The former School of GAP was awarded Athena **SWAN Silver** in 2010 and 2015. Whilst significant work has been undertaken to bind together the different Athena SWAN cultures within the significantly enlarged School, SNBE has yet to achieve SWAN accreditation, although a submission for SWAN Bronze (November 2020) is pending, and a clear set of SAT priorities have been formulated. Amongst these are measures to promote gender balance in future PGR and staff applications (e.g. through increased visibility of female staff role models). We are aware of the significance of EDI (Equality-Diversity-Inclusion) and have embedded EDI principles in grant applications. We are working with RGS and QUB to inform future practice in this area.

3. Income, infrastructure and facilities

a. Income

Our commitment to increasing our research funding base has been successful; total income spend increased from £5.25m in REF 2014 (for Geography FTE in our submission to UoA17) to £7.14m (=£**366K/FTE**) in REF 2021. Our income from BEIS Research Councils, Royal Society and British Academy notably **increased by a factor of six per FTE since REF 2014**, rising from £43K/FTE in REF 2014 (=UoA17 mean) to £250K/FTE in REF 2021, and forming 68% of our total. We added new income streams from the European Union (H2020) and UK Government and Health Authorities (e.g. [PHA](#)) and diversified our charity awards.

Examples of awards that have been driven by our strategic priorities (**A1-6; Section 1c**) and which underline the reach of our research include:

- In the **impacts** area, the **AHRC**-funded '*Living Legacies 1914-18*' Public Engagement Centre (*Lilley*, PI; £1.7m), shaped stakeholder practices around the 2014-19 Centenary of WW1; and the **ESRC**-funded NILS-RSU (*Shuttleworth*, PI, >£2.2m), is providing key social and economic data analyses to policy and research bodies in N. Ireland and beyond (see *Section 4 for details*). [**A4**]

- Capitalising on our **interdisciplinarity [A6]**, GCRF-funding has supported research on climate change and heritage in SE Asia, an international workshop for enhancing UK-South Asia networks, and a study of the spatial analysis of human development in India, amongst other projects. Two tripartite **DfE US-Ireland** awards have addressed the repurposing of wind turbine blades (Re-Wind *McKinley* PI) and future coastal flood risk in Belfast (UrbanARK; *McKinley* CI with SNBE collaborators). [A4,6]
- Grants from the **Leverhulme Trust** ('*Mapping Lineages*'; *Lloyd*, PI), and the **British Academy** ('*Surveying Empires*'; *Lilley*, PI) are challenging orthodoxies in the histories of maps and map-making. [A1]
- The **NERC QUADRAT** DTP (£2.4m to QUB), is delivering leading PGR training across three thematic NERC areas [A3,6]; *Newton's* NERC IIF is testing the efficacy of Carbon capture and storage in the North Sea region, and the NERC-funded '*InSAR for Geotechnical Infrastructure*' project, has enabled stakeholders to remotely assess environmental risk and resilience in relation to geotechnical infrastructure (*McKinley*, with SNBE collaborators). [A4]
- The EU INTERREG-IVA *Tellus Border* project has had significant application for understanding the sustainable development of natural resources in the Irish border region; this and other *Tellus* resources have led to several projects (e.g. with the UK renal registry; *Section 1c*) and an **international MOU** with the *Chinese Academy of Geological Sciences* and other international partners, signed on behalf of the QUB EPS Faculty in 2017. [A4,5,6]
- Programmes of work funded by HSC R&D (*Catney*, PI) and Belfast City Council (BCC) (*Lloyd*, PI) are providing **novel new perspectives on the geographies of age and ageing** and deprivation in NI, and the incorporation of spatial data analysis into resource allocation. This ongoing research is already changing the ways in which spatial data are consumed and used to shape policy interventions within NI. Project outputs have generated significant interest among government agencies and charities aimed at supporting people with dementia and those in disadvantaged neighbourhoods. [A4,6]
- **ESRC**-funded research (*Lloyd*, PI) is exploring spatial inequalities in South Africa, with an innovative exploration of the lived experience of inequalities through linked-in attitudinal data from surveys. Building on scholarly outputs and a web-resource, the work is creating a major tool for policy-makers aimed at guiding future schemes to reduce economic disparities between communities. [A2,4]

b. Organisational infrastructure and support for research and impact

Effective interplay between support structures at University, Faculty, School, and at the discipline level is crucial in the management of research and in the generation of research income. Measures undertaken by the Unit to support research include:

- The SNBE **Research Committee** (chair: *Lilley*), overseas research strategy development, strategic PGR matters (e.g. DTP applications) and communicates funding opportunities to staff.
- The **Directors of Research** lead cluster-based activities, and direct staff to University teams and resources for research support. Our staff benefitted from: QUB Research Grant Incentivisation Scheme; REF-support fund, Faculty Impact and Internationalisation funds, amongst other awards.
- We made effective use of **international QUB-networking awards**: e.g., *Amir* ran two major workshops and developed outputs on spatialising political thought with a QUB International Engagement award; *Roe* collaborated with biologists in USP, São Paulo, to develop a successful EU H2020-MSCA application (application of microfossil traits for water quality monitoring) with a QUB-FAPESP award.
- A SNBE **Director of Internationalisation** (*Kumar*) provides further support with international funding applications (e.g. GCRF), partnerships and MOU development.
- **SNBE clusters** fund primary research, including proof-of-concept work to promote applications, fieldwork and conference attendance.

- Our **Work Load Allocation** model guide decisions on research time allocation; staff are given increased time both to prepare applications and also manage active projects.
- **Research expertise** (e.g. new project development, grant applications and pathways to impact), is shared through workshops, School Research days and Geography Staff Away Days, and through peer-review of grant applications. A strategy to support mid-career staff applications has resulted in several successes.
- Staff liaise with **Research and Enterprise (R&E) Directorate** and a Faculty Research team to identify funding and impact opportunities, avail of tailored grant writing courses and develop applications. Peer review of research applications by R&E staff has significantly increased the success rate of our research applications.
- To **diversify our engagement with the wider RCUK and UKRI research agendas**, we are working with QUB Biological Sciences to develop a new interdisciplinary '**Sustainability and Environmental Solutions Centre**'. This will provide a hub for strategic research planning and development in NI, bringing together national and international working groups, industry, government and NGOs, and a forum to review ideas for future UKRI funding.

c. Operational infrastructure and facilities

The School has dedicated laboratories to support PG research, with one full-time technician. The extensive facilities include **¹⁴CHRONO Centre**, which provides support for ¹⁴C dating (palaeolimnological/peatlands research), with discounted AMS-dates for SNBE staff. In Spring 2020, QUB committed to upgrading this facility with a new state-of-the-art £1.7m MiCADAS-AMS, which will be operational by mid-2021. Other resources include well-appointed microscopy and microfossil preparation laboratories, a mass spectrometer (C:N isotopes); X-ray diffractometer, Infra-Red spectroscopy, Atomic-Absorption Spectrophotometry, Laser particle-size analyser, Magnetic Susceptibility (for sediment/geochemistry and water property analyses), coring and geophysical survey equipment, including ground-penetrating radar (for geoforensics and lake/peatlands research), laser scanners and equipment for airborne pollen surveys.

CGISG has several data-servers and a large suite of dedicated PCs with commercial, open-source GIS and remote sensing software, and Small Unmanned Aerial Vehicles for geospatial data collection and web-enabled digital mapping. The facilities support a large array of projects, from cluster-based research to public engagement activities. CGISG also hosts a dedicated weather station with live data-streaming. We have recently **expanded server resources to extend the impact of Lloyd and Catney's research** in population geography, facilitating the hosting of databases (e.g. *PopChange*) and interactive models and supporting ongoing ESRC and Leverhulme projects.

CDDA occupies a dedicated wing of the Geography (Elmwood) Building (**Fig. 1**), and has a large digitisation laboratory, a laboratory to showcase the centre's work (e.g., through public engagement events), and specialist machine rooms.

The Elmwood building also has a large map library and a refurbished staff common room, which has been instrumental in supporting research meetings, student-led initiatives and is important space for informal discussions and society events.

Collaborative access to infrastructure: SNBE share a Scanning Electron Microscope with QUB School of Mathematics and Physics, supporting our research with microfossils, volcanic ash and stone weathering research.

d. Benefits in kind

Land and Property Services (LPS) provide access to spatial data through the **NI Mapping agreement** (worth £250K/year in in kind support). In collaboration with LPS, a Continuously Operating Reference Station is installed in the Elmwood building. This provides the National Active GNSS Network (Island of Ireland) and serves the Greater Belfast Area. The high accuracy geodetic information is key for field research and research in Geomatics.

4. Collaboration and contribution to the research base, economy and society

Geography at Queen's has a strong tradition of forging transnational, regional and local connections, collaborations, partnerships and engagements both within Northern Ireland and across the island of Ireland. **In addition, QUB Geographers all, without exception, have** extensive and far-reaching collaborations and networks that span the globe, and through research initiatives and collaborations have yielded deep and meaningful relationships world-wide, with research communities, policy makers, NGOs, third sector organisations, including community groups and grassroots bodies. Through both individual and collective enterprise, the geographical reach of QUB Geography since 2014 has been further consolidated, especially in South-East Asia, South Africa, China, North America and in Europe and the Middle East. Much of this collaborative engagement has **involved cross-disciplinary research partnerships**, built up particularly through continued **strengths in transdisciplinary research areas**, including cultural and natural heritage, geoforensics, GISCi, environmental change, palaeoecology, peatlands research, and social policy.

a. Research collaborations

In Human Geography, collaborations are particularly fostered through our expertise in **digital and big data**. **CDDA** and **CGISG** have played a pivotal role in creating new collaborative research projects and initiatives that have enabled external organisations to undertake major research using spatial big data. The **NILS Support Unit (NILS-RSU)** has strong external relationships with a number of ESRC investments – *Administrative Data Research (ADR) NI* and the other UK LS support units – and non-ESRC/UKRI partners – *NISRA, Business Services Organisation, LPS*, and the *Public Health Agency (PHS)*.

A second area of strong research collaboration is fostered through expertise on **natural and cultural heritage**. In India, *Kumar* has led a team of international collaborators in a GCRF project on climate change and hidden heritage in Majuli (Assam), with collaborators from *Indira Gandhi National Centre for Arts India, (IGNCA)*, three *Indian HEIs* and NGOs in Assam. QUB Geography also played a key role in the delivery of the ERC-funded **FRAGSUS** project 'Fragility and Sustainability in small island environments' in Malta (led by QUB Arc-Pal), involving *Ggantija Visitor Centre (World Heritage Site)*, and the *National Museum of Archaeology Valletta*.

In other areas of PG, strong collaborations have developed through our expertise in **wetlands palaeoscience and climate change reconstruction**. *Swindles* led large teams of European researchers to examine climate change impacts on peatlands resulting in major multi-authored outputs (e.g. *Nature Geoscience*); *Newton* is a proponent on the successful *International Ocean Discovery Program Proposal 909*, a multi-million-pound project to drill a 40 Myr climate record from NW Greenland; with the support of **CCS**, *Roe*, an Adjunct Research Professor at Carleton University, Ottawa, has collaborated widely with Canadian HEI researchers and NGOs (e.g. lake associations) to develop biomonitoring approaches in lakes.

b. Networks, partnerships and beneficiaries

We are involved in **multi-scalar partnerships** with non-HEI organisations and bodies in NI, RoI and GB (e.g. *RSPB, National Trust, NIEA, Public Health Agency, GSNI, LPS, Met Office, Armagh Observatory, An Garda Síochána, GSI*), and internationally (e.g. *Southern African Social Policy Research Institute; Columbian Forensic Laboratory*), amongst many others. Our partnerships are strong and meaningful and include, since REF 2014, new and strengthening partnerships with *NMNI, Department for Communities (NI)* and **NHLF**, forged through particular projects, including *Landscape Partnership Schemes* in NI, (e.g. *Mournes LPS*), and via public engagement and engaged research initiatives such as CDDA's *WW1 Community Platform*, an online resource for NHLF Centenary community digital data, funded through **Living Legacies** PEC. In partnership with the Met Office, we provide seasonal pollen counts that are used in national daily weather bulletins.

Partnerships are also evidenced by our **MOUs**. In addition to a MOU organised by *McKinley* on behalf of EPS Faculty with the *Chinese Academy of Geological Sciences* (knowledge transfer,

UG/PGR exchange), **CDDA** has MOUs with the *Polis Center, Indiana University, Purdue University Indianapolis*, and the *Electronic Cultural Atlas Initiative* based at *UC Berkeley*.

c. Wider contributions to research base, economy and society

QUB Geography makes a significant contribution to culture, economy and society in the UK and beyond. This is evidenced especially by the key roles played by two major funded programmes housed in the Unit.

- First, on **economic and social contributions**, ***NILS*** is part of a wider programme of UK longitudinal studies. The strategic contribution of census and administrative LSs is their temporal span, which permits analyses of intra- and inter-generational demographic and social change, their facility in collecting data on household and family relationships, and the breadth of consistent socio-demographic profile information that they can hold. *NILS* is an integral part of N. Ireland's data infrastructure, and is important in the delivery of *Public Housing Association* strategies to facilitate and maximise the use of health and other data routinely collected by the public sector for the benefit of regional service users and the public. It has helped to ensure successful delivery of the current R&D Strategy by HSC R&D Division on behalf of the *Department of Health*.
- Second, **public engagement and outreach** delivered through the ***Living Legacies*** PEC has contributed to a programme of cross-community cohesion during the *Decade of Centenaries* in NI. This has been achieved through grassroots engagement with hard-to-reach communities in NI, including ex-offenders' support groups, women's groups, and diverse community networks (e.g. *NW Migrant's Forum*), groups from deprived areas (e.g. *Shankill Area Social History group*), and through partnership with HEIs and non-HEIs, including *Public Record Office of NI*, amongst many others. The results of these community-based engaged research programmes led by LL were published by the *NI Community Relations Council in 2018* (see **ICS-219632062**).
- Third, on **public and social policy**, research by *Catney* on ***ethnic residential segregation*** informed the 2016 *Casey Review into Opportunity and Integration*, a national review by *Department for Communities and Local Government* (now **MHCLG**). The research provided evidence to the review team and was used to inform policy interventions for local communities. Also, *Department for Work and Pensions*, used *Catney's* research on ***ethnic inequalities in employment*** in 2017 to inform their response to the Prime Minister's 2017 pledge to increase ethnic minority participation in labour markets, as well as the *Government's Race Disparity Audit* and the *McGregor-Smith Review of Race in the Workplace, 2017*.

End-user collaboration is also fundamental in our research in Physical Geography, where we also provide the **academic evidence-base to inform policy and practice** and co-create projects with stakeholders to ensure research is of wider value beyond academia.

- For example, in **geoforensics**, *Ruffell's* significant contributions to developing search methodologies have been widely employed in humanitarian search casework by rescue and law enforcement agencies, including the *Department of Science & Technology, UK Home Office/MI5*. Inputs from beneficiaries (e.g. *National Crime Agency*) have enabled search protocols to be refined, permitting enhanced decision making (see **ICS-219632057**).
- *Swindles'* research on ***ash particle size and dispersal patterns of Icelandic volcanic tephra***s derived from European peatlands has been used by the aviation industry (including *NASA's Vehicle Integrated Propulsion Research group* and jet engine manufacturer *Rolls Royce*) to model ash-cloud conditions and better understand the threat to aviation safety from volcanic eruptions. This work is being submitted as an ICS for REF2021 by Leeds University, where *Swindles* was formerly employed.

d. Contributions to sustainability of discipline

Our staff are active in promoting geographical thinking and Geography as a discipline. In addition to our scholarly works (*Section 1c*), our contributions range from professional service roles that provide leadership and guide strategic developments, to outreach and PGR/PDRA

training which seek to promote inter-generational renewal. Examples of our varied and significant contributions **during the REF period** include:

- *Royal Geographical Society-Institute of British Geographers'* (RGS-IBG) committee and strategy group involvement, including leadership roles (e.g., *Lloyd*, Chair, *Quantitative Methods Research Group*; *Shuttleworth*, Chair, *Population Geography Research Group*); our leading role in Northern Ireland RGS-IBG (including a hosted seminar series overseen by *Dunnett*); our participation in the 2015 RGS-led *Review of UK Physical Geography*; RGS accreditation for our UG degrees;
- our record of service **on external policy and allied disciplinary committees**: e.g., *Catney* serves on the [ONS](#) Ethnic Group Assurance Panel, informing policy feedback on ethnicity statistics and census output use by policy-makers; *McKinley*: President, *International Association of Mathematical Geosciences* and [IUGS](#) Executive member; *Roe*: QRA Honorary Secretary; *Warke*: Director, *Ulster Architectural Heritage Society*; *Lilley*: Chair, *British Historic Towns Atlas*. Our staff served on **7 Royal Irish Academy** committees, including the *Geosciences & Geographical Sciences* and *Climate Change & Environmental Sciences* committees;
- our **strategic investments to RCUK and other funding bodies**. Eight staff have served on major grant review panels, including ESRC, AHRC and NERC Peer Review Colleges, NERC Radiocarbon Facility Steering Committee, NERC Global Challenge Fund Panel, and the Carnegie Fund Panel, amongst others;
- our **commitment to developing capacity and ideas** in the discipline and beyond through our QUB Centres and research and engagement centres (NIL-RSU and LL);
- our **service through major editing roles**; e.g. *Ell* is Founding Editor of the *International Journal of Humanities and Arts Computing*; *Lloyd*, Associate Editor, *Journal of the Royal Statistical Society*. Our staff served on **15** journal editorial boards (including *Scientific Reports*; *Population, Space & Place*) and edited **4** major monograph series;
- our **conference organisational activities**; including *Irish Geographers' Conference 2015* (with GSI); [GeoENV 2018](#); *European Forensics, 2018*; *9th International Symposium on Testate Amoebae 2018 (ISTA9)*, amongst others. In total we organised >40 conferences and workshops and convened 33 conference sessions;
- our **Geography seminar programmes**, which lie at the heart of scholarship in Geography, ranging from high-profile public lectures (e.g. **CCS** annual Eaton Lecture), RGS-IBG NI lectures, Geography and cluster seminars, 'reading groups' to 'lunch & learn' seminars run by ECRs;
- over 35 **international visitors** and **formal visiting scholars** (>3 week visits) (e.g. John Agnew, Geography UCLA; Les Cwynar, University of New Brunswick) who have inspired staff and PGR researchers and extended the reach of geographical research at QUB;
- our **media activities**, including contributions to [The Conversation](#) (4 staff) press coverage (e.g., *Newton's* 2018 *Nature Geoscience* paper) and radio and TV appearances (e.g., *McKinley*, BBC's '*Great Irish Journeys*');
- our broad array of **geography-themed outreach events** (see *Section 1c*); *Geography Employer Panel* events; lectures for schools (5/year);
- our textbook contributions, which are influencing **UG/PG Geography teaching** e.g. *Lloyd's* co-authored '*Principles of Geographical Information Systems*' (OUP);
- the use of our research in the **A-Level Geography Curriculum**, e.g. *Catney's* work on ethnic diversity and segregation is detailed extensively in the Edexcel A-Level textbook.

e. Indicators of wider influence

The wider reach and influence of QUB Geography are further evidenced by numerous prizes, prestigious fellowships and awards conferred on staff during the REF period. In addition to the award of **CBE to Livingstone**, *Johnson* was elected as a **MRIA** for her contributions to historical geography. We also received major **RGS** awards (*Lilley*: Cuthbert Peek award; *Catney*: *Gill Memorial award*); **Geological Society of London** awards (*Ruffell*: William Smith Medal; *Newton*: Wollaston Fund); and distinguished fellowships (e.g., *Roe*: *Ireland-Canada Foundation's James Flaherty Professorship 2018*). We delivered **3** named lectures (e.g.,

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Livingstone: Dupleian Lecture, Harvard University, 2015); **27** plenary talks and keynotes (e.g., *Lilley*: Medieval Congress, Leeds 2015) and **79** invited conference/workshop contributions. *The Wiley-Blackwell Companion to Cultural Geography* edited by Johnson *et al.* was a *Choice* 'Outstanding Academic Title' in 2014. A festschrift volume (John Hopkins University Press) was published in 2020 to celebrate the work of David Livingstone, with contributions from internationally recognised geographers.