Institution: Queen's University Belfast

Unit of Assessment: 17

a. Overview

Staff submitted in UoA17 are all in the School of Geography, Archaeology & Palaeoecology (GAP), returned as a single unit for consistency and coherence following HEFCE guidelines. No staff from GAP are being returned in any other UoA. Research is structured into three research clusters: Environmental Change (EC), Past Cultural Change (PCC) and Society, Space & Culture (SSC). Research management is the responsibility of the Head of School (HoS), a Director of Research (DR) for each cluster, and the School Management Board (SMB). GAP hosts three multidisciplinary research centres, managed within clusters, but working across GAP: Centre for Climate, the Environment and Chronology (^{14}CHRONO) for radiocarbon-dating and chronology; Centre for Archaeological Fieldwork (CAF) for archaeological investigations; and Centre for Data Digitisation and Analysis (CDDA) for engagement with the digital humanities.

b. Research strategy

The main challenges we are seeking to address are key, sustainable, research agendas in (i) chronology, nature and rate of change in environments (past and present, natural and anthropogenic); (ii) mechanisms for cultural change through time and space; and (iii) exploring the constitutive role of space and place in the global geographies of knowledge, politics and power. These priority areas are promoted within three research clusters (Environmental Change, Past Cultural Change and Society, Space & Culture, respectively), established to (i) strengthen collaborative work across GAP; and (ii) create critical masses of researchers using common research resources. Our research draws on expertise in science and humanities, involving strong elements of laboratory and field-based research which has led to high-quality publications of global scope and interest, from monographs arising from detailed archival work, to collaborative scientific articles, to prizes and to major research grants (e.g. ERC).

GAP staff investigate and advance knowledge about the physical and cultural world, past and present, focusing upon contemporary relevancy. Our research in the geographies of the history of science, colonialism and landscapes provides challenging intellectual frameworks. We proactively combine cutting edge research in environmental change with archaeological exploration to develop chronologies, understand the response of organisms to climate change, and to contextualise human-environmental relations from the Palaeolithic to the present. We are outward looking and work to bring our research into the global arena through strategies of civic engagement, consultation, and international collaboration. Our strategic aims are to: (i) set research agendas in key areas of natural science, archaeology and human geography; (ii) influence contemporary debates (climate change to conflict resolution, the management of memory, the geographies of science, geopolitics, globalisation, population dynamics and public policy); (iii) develop and disseminate new techniques of data analysis and interpretation; (iv) inform and influence heritage management practices and public engagement with the past; (v) inspire and facilitate new researchers through a proactive strategy of attracting and supporting high quality research postgraduate students and embedding early career researchers into our grant-funded projects. Our approach to realising these strategic aims is robust and agile, demonstrated by achievements since RAE 2008 and our goals for the next five years.

Strategy over the period since RAE2008 has achieved an increase in the strength and significance of research in the School, as assessed by QS World University Rankings, where **Geography at QUB is now (2012-13) included in the world's top 100 (51-100)**, having risen from 151-200 in 2010-11, and 101-150 in 2011-12. This improvement reflects continuing development of the subject's reputation at QUB, seen also in comparisons of citations and H-indices. **We aim to reach the top 50.** Archaeology (not a QS subject) at QUB is now ranked 8th out of 34 UK institutions by the *Guardian*'s subject league tables for university entrants in 2014.

School research strategy: aims and plan

1 **Lead and contribute measurably to global scientific and critical human geography enquiry**. Research clusters should develop projects at the cutting edge of their respective fields. **The amount of UK and EU Research Council funding should increase to expand the work of**

academic staff and improve the School's research profile and strength. There will be continuing development of a strong, vital and sustainable research culture in everything the School does. Regular research cluster seminars (>20 per year, mostly supported by School funds) are attended by all research cluster academic staff and postgraduates, typically with speakers from outside the School (13 out of 15 in the most recent semester, visiting from Canada, Germany, Ireland, Russia and USA). An evening seminar series organised by postgraduates offers speaking opportunities to early career staff and PhD students. Informal reading groups meet regularly to discuss topics in human geography and palaeoecology, with staff attending from other Schools. An annual research day since 2010, to further improve research culture in the School, particular for its younger members, includes a forum for all 2nd year PhD students to gain experience in making presentations, and receive feedback, alongside themed presentations by academic staff.

2 **Influence contemporary debates.** Development of the international visiting scholars program to bring key collaborators to the School for 1-2 weeks, strengthening research links and helping PhD students and postdocs develop external contacts. Recent visitors on this program include Nick Blomley (Simon Fraser 2008), Harriet Ritvo (MIT 2013), Jim Kennett (UCSB 2008), Vyacheslav Moiseyev (Russian Academy of Sciences 2013), Wiebke Kirleis (Kiel 2011). We have retained established leaders on fractional appointments to assist in this development (Agnew, Campbell, Orford).

3 **Develop, employ and disseminate new techniques of data analysis.** We place emphasis across GAP on collection of new data from field, laboratory and archival research, and on the development of new techniques for analysing these data and combining with existing archives. We build on the strengths in this area demonstrated over many years by e.g. ^{14}CHRONO and CDDA.

4 **Develop collaborative international research agendas.** Encouragement of GAP staff to be enthusiastic participants in projects, conferences, and fieldwork, globally. Much current international collaboration is concentrated in India (three PhD student projects and two staff research projects [Kumar, Orford]), Northern America (three PhD studentships and five staff projects [Blaauw, Donnelly, Horning, Johnson, Roe]), and the Mediterranean and Near East (staff and PhD projects in Israel, Italy, Spain, Portugal and Malta [Amir, Brandherm, Hunt, Malone]). These collaborations will continue to increase, and others will be developed. GAP staff (Reimer) will continue to lead the major international radiocarbon calibration project (INTCAL) that co-ordinates all palaeoecological and archaeological dating of the past 50,000 years, crucial for understanding the background to modern environmental and climatic change (e.g. IPCC). Recent appointments (e.g. Blaauw) are a commitment to continuing this approach.

5 **Inspire and facilitate new researchers**. GAP will maintain its strong research tradition of individual scholarship, particularly in human geography. ECRs will be integrated into the research cultures of different traditions in the School through the research cluster system, as investment for the future. Current interdisciplinary projects include jointly supervised PhD projects with the QUB Schools of Biological Sciences, History, Law, Pharmacy, Planning, Architecture & Civil Engineering (SPACE), and Sociology. GAP collaborates fully with the Faculty of Arts, Humanities and Social Sciences (AHSS), including the recent establishment of the Institutes for Collaborative Research in the Humanities and Study of Conflict Transformation and Social Justice. New research opportunities will be developed, including Antarctica (Barr), Africa (Basell, Blaauw, Reimer) and South America (Bennett). **The recent appointment of Agnew (UCLA), is part of the School's continuing initiative to increase global networking and collaborations, which we will extend.**

School strategy is implemented through the activities of the three research clusters. These contribute to overall strategy and are responsible for putting it into place in each of the three areas:

Environmental Change investigates how the Earth's environments have changed through natural and anthropogenic processes over different time scales, ranging from a span of 50,000 years to the near instantaneous. We develop the techniques and tools to solve problems in areas such as heritage management and geoforensics, and we seek to address fundamental issues in palaeoecology about how organisms respond to environmental changes on longer timescales, and

how they evolve. The cluster continues to focus on chronology and rate of change of past environments developing the strategic areas identified for RAE 2008, building on the major infra-structural investment in the radiocarbon-dating facility. Deepening research on radiocarbon calibration (Reimer, Blaauw) has led to a series of major publications, and is the basis, globally, of the timescale for the last 50,000 years, used in archaeology, geology and palaeoecology. Other strategic areas in the cluster are: mathematical geology and remote sensing, including involvement in the EU INTERREG Tellus regional mapping project (McKinley and Ruffell), palaeoecology (Bennett, Hunt, Plunkett, Roe), tephrochronology (Plunkett), the development of stone weathering studies (Warke), geomorphology (Barr [deglaciations], Orford [gravel shorelines], Reyes [Quaternary geology], Warke [weathering]) and geoforensics (Ruffell).

Past Cultural Change explores the material manifestation of cultural change through time and space, combining innovative scientific methods with theoretically-informed analyses to bridge the humanities and sciences. Our archaeological research is strategically linked through a shared, key intellectual concern: understanding processes, mechanisms, and expressions of cultural change. Our strategy is to focus upon exploring mechanisms for cultural change through time and space developing the priority areas outlined in RAE 2008 (Eurasian palaeopathology, Mediterranean prehistory, Northwest European structural space and Irish archaeology) together into a more coherent whole, enhanced by expansion into early prehistory and later historical archaeology through strategic new staff (Basell, Horning). Key research areas are early hominid development and the emergence of symbolic behaviour (Basell); the emergence of agriculture in Ireland (McCormick) and of complex society in the Mediterranean (Malone); palaeopathological markers of cultural interaction in Eurasia (McKenzie, Murphy), social significance of metallurgy in Bronze Age Europe (Brandherm); introduction of Christianity in Europe (McCormick); expansion of medieval North Atlantic trading economies (Gardiner); impacts of early modern colonial encounters throughout the Atlantic world (Horning); and material and cultural legacies of 19th-century Irish Diaspora (Donnelly). A core feature of all PCC research is scientific archaeology, utilising the ^{14}CHRONO radiocarbon-dating and palaeoenvironmental facilities. Strengths in historical archaeology (McCormick, Gardiner, Horning, Donnelly) have facilitated collaborations with human geographers, anthropologists and historians. Staff have developed active programmes of public engagement, with the aim of contributing measurably not only to public education, but to policy debates and heritage management. PCC has successfully attracted and mentored high quality postdoctoral researchers, contributing to the development of the next generation of scholars.

Society, Space & Culture. A major question on the SSC research agenda is ascertaining the role of space in knowledge enterprises and socio-political processes. Since 2008 SSC's strategy has been to address this problem in several distinct but related ways. **First**, making sense of the spatiality of scientific culture has been expanded through projects on the comparative geographies of botanical gardens in Britain and Ireland, the place of science in Victorian civic culture, the cultural politics of the sciences of human origins, and post-war British outer space research (Dunnett, Finnegan, Johnson, Livingstone). **Second**, critical cartographic/GIS techniques have been deployed to interrogate the veracity of the knowledge universe of the map, while digitally-translated documentary data have been used to re-configure understanding of medieval urbanism and agrarian economies, as well as the spatial dynamics of religion and the politics of cartographic rhetoric (Amir, Campbell, Ell, Lilley, Livingstone). **Third**, the troubled material geographies of divided societies have animated investigations of Northern Irish labour market mobility and welfare reform, Belfast's industrial past, and the capacity of memory spaces to foster or challenge reconciliation in Ireland and the Middle East (Amir, Johnson, Royle, Shuttleworth). **Fourth**, attention to the critical significance of space in the constitution of political life has challenged conventional understandings of ideas of sovereignty and globalisation, the development of island-based Company Colonies, and the use of camouflage techniques as political resistance (Agnew, Robinson, Royle). Since SSC seeks to shape research agendas across the humanities, the production of monographs is central to our research strategy and the cluster has published 9 with major academic presses since 2008. Two monographs have won prizes. The strategic appointment of Professor John Agnew as Distinguished International Professor is designed to consolidate our leadership in political geography and intellectual history. With an eye to the next generation, SSC has appointed three ECRs in historical and political geography.

c. People, including: Staffing strategy and staff development

The School upholds the seven principles of the Concordat to support the Career Development of Researchers (CCDR), as identified below.

Strategy and development
The School's strategy is based on direct planning and response to natural evolution. Integration of early-career staff into School structure and ethos is critical, and individual staff development has been continuous throughout the REF period. Research strategy emphasizing grant income, output quality and international presentation is conducted through DRs: fostering individual research, mentoring, undertaking appraisal and conducting annual research reviews. The research agenda and School aims are discussed at School and cluster meetings, involving all staff (CCDR 4, 5). SMB regularly reviews research progress in general, and the School underwent an external review of its activities in 2008 (CCDR 7).

Priority areas are identified for new appointments to ensure that the School attracts high quality applicants and maintains subject diversity. An increasing focus on research quality (double-weighted in appointment committees: CCDR 1) has led to shifts in research strength within strategic areas through appointments. For example, during the current REF period, the **EC staff balance has shifted from predominantly geomorphology to a greater proportion of staff in Quaternary science, aligned towards the radiocarbon-dating facility**, and remote sensing, while maintaining geomorphology as a distinctive element.

Eight new permanent academic staff have been appointed during the REF period, in identified priority areas, specifically for their research strength (CCDR 1). Three have successfully passed through probation periods and become established members of the School, and five are within their normal probation periods. These appointments are (i) Chair in Archaeology (Horning) to maintain leadership in a core discipline and bring new expertise in historical archaeology; (ii) Lecturer in chronology (Blaauw) to forge a link between technical radiocarbon dating and palaeoecology; (iii) two Lecturers in archaeology (Brandherm, to strengthen Mediterranean and Bronze Age archaeology, and Basell to bring expertise in early prehistory and Africa); (iv) two Lecturers in environmental change (Barr, Reyes) to strengthen expertise in physical geography, geomophology and remote sensing; and (v) two Lecturers in human geography (Amir, Dunnett) to reinforce strengths in political, cultural and population geography.

Newly appointed academic staff are allocated a mentor and complete a three-year probation period before confirmation in post using criteria that include publication of international research outputs and grant award activity appropriate for the field and career stage. During the probation period, teaching levels are held lower than for non-probationary staff, and administrative roles are minimal. Incoming academic staff are supported through start-up packages for equipment and networking, and prioritisation of School funds in support of their research and co-supervision of PhD students (CCDR 3). All new staff must complete PGCHET and 'Supervising Research Students' courses.

Non-probationary staff can request sabbatical leave at the rate of one teaching semester per three years work (or one calendar year per six years work), which is usually granted (by SMB) if a suitable research plan, in accord with School strategy, is provided. During the REF period, 11 academic staff (five female, six male) have had sabbatical leave. Over the next four years, 10 periods (five female, five male) of sabbatical leave are planned. QUB, School, and research cluster funds are available for conference attendance and proof-of-concept meetings as support for career development and active research (CCDR 4).

DRs are line managers for academic staff, responsible for leading, encouraging and facilitating the research of their clusters and appraising individual performance, potential and promotion prospects at twice yearly meetings. HoS appraises DRs on the same basis, and meets individually with academic staff to discuss research outputs (CCDR 2, 4).

Equality and diversity: There are currently 28 permanent, full-time, academic staff in GAP,

comprising (female number in brackets): lecturer 10 (4); senior lecturer 8 (3); reader 5 (2); professor 5 (2). In addition, there are 3 (0) academic-related research staff, 3 (0) professorial staff on 20% contracts, and 2 (1) fixed-term lecturer. There is one academic staff vacancy (permanent post in SSC), which will be filled during 2014. Periods on the academic staff range from new to more than 30 years.

There are currently 11 (4 female) PDRAs in GAP. One (McCabe) is being returned in REF. **Personal awards to Campbell (from Wissenschaftskolleg zu Berlin) and Livingstone (from Leverhulme) have funded temporary lectureships in SSC** bringing new blood to the cluster and cultivating the next generation of critical human geographers. There are seven (6 female) staff visiting Fellows in the School.

The School strives for equality in all its activities, receiving a SWAN Silver Award in 2010 and an application for a gold award will be made in late 2013 (CCDR 6). QUB in the only UK university with an Institutional SWAN Silver Award. A key part of this process is recognising that fair policies – what is fair to women is fair to all staff – will be fully implemented. In 2010, GAP set itself the target of ensuring that at least 50% of School and research cluster seminars highlight innovative research being carried out by top female scholars, and is close to reaching that target (42% in 2012/13, from 15% in 2009/10). All PhD viva examinations have both male and female staff present as external or internal examiner, or as independent chair. Two of the three DRs are female, and the School Manager is female. Early appointments are made to temporary posts to cover maternity leave, providing support for female staff on leave, and career opportunities for junior staff. Paternity leave is guaranteed, and more staff are taking this.

SMB is the School research ethics committee, ensuring a co-ordinated, cross-School approach to upholding the best possible ethical practice.

Research students

Postgraduate students are a significant component of the School. New, research-oriented, taught Masters courses have been developed, and there are now five across all areas of the School. We actively seek external funds to support research studentships, which has led to a recent rise in PhD students, funded from public sources (NI Department of Employment and Learning), research grants, and private sources. The number of completed PhDs has risen steadily during the REF period, from 3 in 2008, to 12 in 2012, and 6 in 2013 (Jan - Jul). There are currently 48 PhD full and part-time PhD students registered in GAP evenly distributed through years 1-3. There is a strong conversion rate from GAP Masters courses to PhD (13 of GAP's current 48 PhD students). Two recent PhD students have been appointed directly to academic posts.

Postgraduate research education and training is co-ordinated across the School by a single postgraduate research co-ordinator, who is supported by the postgraduate research committee (PGRC) comprising HoS, DRs and one other staff member from each research cluster. PGRC manages the selection of new PhD projects, interviews applicants, and makes recommendations for offers of awards. It ensures that all incoming PhD students meet requirements for the degree, and allocates awards competitively. PGRC also manages the annual performance review of research students, including acceptance to the PhD program after the first nine months of study, recommends examiners and chairs for PhD vivas and discusses the cases of students who are facing difficulties. PhD students undertake 30 days training over their three years. A record of training activity is kept and logged as part of the students' annual progress monitoring. QUB Postgraduate courses provide generic training (eg presentation skills, software use) and more specific training is provided by GAP as well as through external programmes (eg *GIS in the Digital Humanities* seminar at Lancaster). GAP also runs courses covering specific topics requested by students (e.g. radiocarbon dating, chronology building, shallow geophysics). All PhD students have available a minimum of £700/year for research expenses regardless of funding. Students may apply to HoS for funding above that to cover costs necessary for their project and which cannot be covered from other sources. Two fieldwork prizes (£1000 each) are awarded annually, competitively, for innovative projects. **Results of the 2013 Postgraduate Research Experience**

Survey show 86.1% of GAP PhD students are satisfied overall with their research degree programme (sector average 81.6%).

The School is a full participant in current QUB applications to AHRC for a Block Grant Partnership (in a consortium with Durham and Newcastle) and to NERC for a Doctoral Training Partnership (in a consortium with six other UK universities).

d. Income, infrastructure and facilities

The QUB Research and Enterprise Directorate has been reorganised to focus on delivery of outcomes and outputs from the research base at QUB, and to guide effectively the translation of research into social, economic and cultural impact. This extensive programme of change has enabled the Directorate to provide strategic support for researchers in GAP to changing research funding environments (CCDR 3). The reorganisation has refocused the Directorate into a clear structure encompassing QUB strategic priorities. This investment has involved the recruitment of over 30 new staff in faculty-facing roles from QUB and external sources.

Research funding to the School through the REF period has averaged ca £1.5M per year (total £9.2M 2008-2013). Of this, 54% (£5M) came from UK government bodies, and 16% (£1.4M) from UK Research Councils and similar. 33 staff received more than £10k during the REF period, two staff more than £1M. Research clusters actively discuss how to prepare competitive applications, and how to assist staff in preparing collaborative bids. Staff are required to be active in grant applications, but the School recognises that the need for research income to address particular research questions is variable across the disciplinary traditions. Smaller, targeted grants can facilitate projects in some aspects of human geography and archaeology. The following indicate the range of grant funded projects involving GAP staff during the REF period:

A new £2.1M Malta scientific archaeological project funded by European Research Council for 2013-2018 has been awarded to Malone with a team of GAP staff in both PCC and EC, working with researchers at Cambridge and institutions in Malta. This is a major collaborative project for the School, anticipated to feature strongly among research outputs for the next REF period.

2010-2013, a £4 million EU-funded Tellus Border INTERREG (Inter-Regional Co-operation Programme IVA project in collaboration with Geological Survey NI, Geological Survey Ireland, Dundalk Institute and SPACE (QUB) (McKinley, Ruffell). This provides input to both governments in Ireland on changes in soil carbon stocks for their adherence to the Kyoto Protocol on Climate Change. A second project is being used by Northern Ireland Environment Agency (NIEA) to monitor the spread of pollution in groundwater from buried waste.

2006 – present, the £1.8M Northern Ireland Longitudinal Study (NILS) a large-scale record linkage study of approximately 500,000 people created by linking statistical and administrative data sources within Northern Ireland, funded by ESRC, the Health and Social Care Research and Development Division of the Public Health Agency (HSC R&D Division) and NISRA. Shuttleworth is Director of NILS.

A number of collaborative projects in the humanities have been influential in driving research in the area. Examples are: (i) a £172k AHRC Knowledge Transfer Fellowship *Discover medieval Chester: place, heritage and identity* (Lilley [CI] 2012-13, with co-applicants at Southampton and KCL); (ii) a £137k AHRC 'Beyond Text' grants *Linguistic geographies: the Gough Map of Great Britain and its making* (Lilley [PI] 2010-11, with co-applicants at Oxford, CCH and KCL); (iii) a £123k AHRC award *Mapping medieval Chester: place and identity in an English borderland city, c.1200-1500* (Lilley [CI] 2008-09 with co-applicants at Swansea and KCL; and (iv) a £152k Leverhulme Major Research Fellowship to Livingstone to research and produce a monograph *The empire of climate*.

Considerable importance is placed on the physical environment of academic staff, through ensuring provision of high-quality, welcoming workspace and modern equipment (CCDR 3). GAP is housed in two adjacent buildings, one purpose-built and the other extensively re-fitted (2006), shared across disciplines within the School, providing space for all the School's laboratory, office, and classroom activities. Dedicated laboratories support physical geography (with two full-time technicians), palaeoecology and archaeology. Building infrastructure has been enhanced during

the REF period, including widespread laboratory refurbishments of the ^{14}CHRONO lab, and palaeoecology and archaeology laboratories. General refurbishments include a new central School Office and a staff common room, which has been instrumental in supporting research meetings within the School buildings, including student-led initiatives. Recent examples include the Irish Quaternary Association spring meeting (2012), *Interpreting Identity. Our construct or theirs?* (**a two-day student-led initiative, 2012**) and the British Rock Art Group (2013). The next meeting of the Bronze Age Forum (Nov 2013) will be hosted in the School. **Total investment in building infrastructure over the REF period has been ca £600k, and ongoing through late 2013.**

GAP is well equipped with state of the art analytical instrumentation. Decisions on major equipment purchases are taken by SMB, which places considerable value on ensuring that staff are well-supported with up to date equipment (CCDR 3). **The School's largest facility is an accelerator mass spectrometer (AMS) for radiocarbon dating, as part of the ^{14}CHRONO research centre (a £6.2M investment from SPUR2).** This significant piece of research infrastructure is the only such facility on the island of Ireland, and one of only three in the UK. Its existence is a crucial research facility for members of GAP providing academic staff with rapid, high quality chronological support for research projects at all levels, access to research networks and is a major source of income, bringing in up to £300k per annum from research and commercial activity. Other major items include: an elemental analysis - isotope ratio mass spectrometer (EA-IMS) (stable isotopes of C and N), an X-ray diffractometer (mineralogy of materials); a portable X-ray fluorescence instrument (elemental concentrations in field and lab); laser scanners (for surfaces of buildings and outcrops down to individual archaeological artefacts); geophysical equipment for gamma-ray (low-level radioactivity), resistivity and magnetometry (buried features); ground-penetrating radar (locating buried objects); laser particle size analyser (for fine-grained inorganic sediments); simulated weathering equipment (to test effects of controlled climates on natural stone and building materials); and UV-fluorescence microscopy (taphonomic patterns in pollen). The School shares an SEM-microprobe with the School of Maths & Physics, and uses it for elemental analysis of volcanic ash. All equipment is used across the School for a wide range of applications in physical geography, geoforensics, archaeology and palaeoecology.

^{14}CHRONO, led by Reimer, houses equipment and facilities for radiocarbon and other stable isotope measurements. The Centre currently employs, from its trading income, technicians (4 FTE), research fellows (3 FTE) and a clerical assistant (0.33 FTE). Income comes primarily from services to commercial archaeology, and heritage institutions, plus projects funded by NERC, ERC and other research bodies. It has enhanced the School's research capability by providing informed dating consultations, small sample analyses (e.g. single cereal grains and small macrofossils), and low cost or free analyses in support of postgraduate, postdoctoral and academic staff research.

CAF, led by Donnelly, undertakes the archaeological fieldwork requirements of the NIEA, leads a range of other projects, engages with local authorities, Heritage Lottery Fund, National Trust, and charitable organisations (eg Foyle Civic Trust) as well as the commercial sector. CAF comprises 14 professional archaeologists who conduct archaeological excavations, topographical and geophysical surveys. Its published outputs during the REF period include four popular books, two monographs and over 30 excavation reports. CAF works with community and charitable groups across Northern Ireland and on a joint excavation programme with the University of Massachusetts in Lowell. CAF is managed within PCC but also works closely with staff from EC, most notably in 3D laser scanning and on forensic projects with the Police Service of Northern Ireland (PSNI).

CDDA, led by Ell, develops digital resources for government and higher education users, providing the new methodologies needed to use these resources effectively. It has received more than 20 grants totalling £1.5M during the REF period for projects including a digital gazetteer of place names worldwide, digitising UK-wide parliamentary records, and a digital archive of old maps. It employs 4-12 FTEs depending on activity, has modern equipment, and provides support and supervision to GAP PhD students. It currently works on medieval English socio-economic data, the Great War, augmented reality, and links built environment and documentary sources for Belfast.

e. Collaboration or contribution to the discipline or research base

Active collaboration and international leadership are core to GAP and key to implementing our

research strategy and attaining our strategic aims. We collaborate not only in the academic world, but with the public and private sector, allowing us to meet our five strategic aims:

1 Evidenced by honours: **Livingstone was awarded the Royal Irish Academy Gold Medal in Social Sciences (2008)**, the **Founder's Medal of the Royal Geographical Society (2011)** and Hon. D. Litt at Aberdeen (2013). **Bennett received a Royal Society Wolfson Award (2007-2012)**. **Four staff (Bennett [2011], Campbell, Livingstone and Royle [2008]) are Members of the Royal Irish Academy (RIA)**, in addition to two emeriti (Baillie, Mallory). **Campbell and Livingstone are Fellows of the British Academy**. **Reimer was awarded the Lyell Medal by the Geological Society of London (2013)**. **Campbell was elected member of Academia Europaea (2013)**. Royle was elected Fellow of the Royal Historical Society (2009). Agnew was Visiting Professor of Political Science, Siena (2010), Phi Beta Kappa (US National Honor Society) Visiting Scholar 2012-13 and Professor of Italian at UCLA (2011). Six staff are Fellows of the Society of Antiquaries of London. Bennett was Guest Professor in Palaeobiology at Uppsala University, Sweden (2008-2012). Horning is Honorary Professor of Anthropology at College of William and Mary (USA) and Distinguished Visiting Professor at Notre Dame (USA). Roe is Adjunct Research Professor, Carleton University, Ottawa (2003-2015). Hall (Professor emerita) was elected Honorary Life Member, Quaternary Research Association (2010) and Parnell Visiting Professorial Fellow, Magdalene College, Cambridge (2009-10). **Recent prizes: Outstanding Academic Title (Choice) awarded to Agnew for his monograph *Globalization and Sovereignty* (2009). Prix du Québec, Association of Canadian Studies in Ireland to Royle (2010), and the Frank Watson Book Prize for Scottish History to Finnegan (2011) for his monograph *Natural History Societies and Civic Culture in Victorian Scotland***. Livingstone gave the Gunning Lecture (Edinburgh 2009), the Gregory Lecture (Southampton 2010), and is Gifford Lecturer-designate (Aberdeen 2014). Campbell gave the Ellen McArthur Lectures at Cambridge (2013). Reimer gave a plenary lecture for the Quaternary Research Association Discussion Meeting (London 2013). Royle gave the Eccles Lecture, British Association for Canadian Studies (Birmingham 2011).

2 GAP staff lead international organisations, serve on RCUK panels, organise conference sessions, edit key journals and are active in the media. **Agnew was President of the American Association of Geographers (2008-9), and Livingstone was Vice-President (Research), Royal Geographical Society (2007-2010).** McKinley is Executive Vice-President of the International Association for Mathematical Geosciences (2012-16). Gardiner is President of the Society for Medieval Archaeology. Royle is Treasurer, International Small Island Studies Association (2010). Finnegan, McKinley, Murphy and Royle sit on RIA subject committees. Ruffell is Chair of the Geological Society of London Specialist Group 'Forensic Geoscience' and Training Officer for the UNESCO-funded IUGS priority funded Initiative on Forensic Geology. Shuttleworth is Director of the NI Longitudinal Survey and Chair of the Population Geography Research Group of IBG-RGS Finnegan has served on the Committee of the Historical Geography Research Group IBG-RGS. Livingstone was Council Member of the British Society for the History of Science (2009-2011). Horning is Monographs Editor (former Secretary) of the Society for Post-Medieval Archaeology, and Committee Member and founder, Irish Post-Medieval Archaeology group. Hunt is a Council Member of the Libyan Studies Society. Royle is Member, Council of British Geography (representative for Ireland). Staff serving on UKRC Peer Review Colleges are Gardiner (AHRC 2007-), Horning (AHRC 2010-), Shuttleworth (ESRC 2010-), Bennett (NERC 2008-11), Blaauw (NERC 2012-). Roe is a member of the NERC Radiocarbon Facility Steering Committee (2012-). Livingstone has carried out research reviews for Plymouth (2010), Queen Mary London (2011), Glasgow (2012), and was Chair of the Research Programmes Review, Royal Geographical Society (2009-2010). GAP staff are involved with the activities of the Royal Society, British Academy and Royal Irish Academy through grants, publications, committees and fellow/memberships. Academic staff have served as editors for six academic journals (*Childhood in the Past*; *Historical Archaeology*; *Journal of Archaeological Science*; *Island Studies Journal*; *Journal of Indo-European Studies*; *Territory, Politics, Governance*), are guest editors and on editorial boards of >40 journals.

3 We develop and disseminate new techniques of data analysis. Software for radiocarbon calibration CALIB (Reimer), age-depth modelling CLAM and BACON (Blaauw), and data analysis

and plotting *psimpoll* (Bennett) have been produced, maintained and distributed freely. All are in use by the Quaternary community, and contribute towards GAP's standing (CALIB has 3600 citations, Bacon 60, CLAM 180, and *psimpoll* 210). The development of CLAM and BACON during the REF period has attracted high-profile users including the European Pollen Database and the US palaeoecological meta-database, Neotoma, and is facilitated through collaborations. Blaauw collaborates with CIMAT (Guanajuato, Mexico) over software development (Bacon, Clam) and 7 joint outputs, Bennett with Willis (Geography and Biodiversity, Oxford), with 6 joint outputs in biogeography and palaeoecology, and with Parducci (EBC, Uppsala), with 4 joint outputs. GIS techniques pioneered by Lilley, in collaboration with Lloyd (Liverpool) led to collaborative projects with RIA on the digital mapping of Derry and Chester and joint publications.

4 Strategic partnerships ensure that GAP research develops areas of economic relevance. We collaborate with (i) NIEA on built heritage and public engagement; (ii) Historic Scotland on stone weathering analysis; (iii) National Museums Northern Ireland (NMNI) on collections research and presentation. The research of CAF, CDDA and NILS is strongly linked to relevant public bodies. A British Universities Funding Initiative (NERC-funded) PhD award to McKinley demonstrated links between epidemiological data and toxic elements in soils, informing future health and well-being public policy, and allocation of public resources. Warke is member of the Historic Buildings Council (2010-), advising the NI Minister for the Environment. Hunt and Malone collaborate with Cambridge Archaeology (8 and 10 joint outputs respectively) on grant-funded projects in Libya, Malta and Italy that engage closely with local heritage community; an AHRC Connected Communities project (Horning) is addressing sustainability in the Western Isles. Finnegan has co-curated an exhibition on the Belfast Naturalist's Club and hosted a series of public lectures in collaboration with the Ulster Museum as part of his AHRC-funded project on Science in Belfast. GAP further contributes to the wider community through consultancy, e.g. to Plexus Energy and Rockhopper Exploration for a project on the potential impact of oil production on the economy and society of the Falkland Islands (Royle); and Knowledge Transfer Partnerships from Queens/Collins Engineering (£86k) for underwater mapping for engineering purposes and Queens/ConSarc (£150k) for assessment of Historic Stone Structures (Ruffell).

5 Our collaborative partnerships and professional leadership provide training and support for new researchers. Collaboration with NMNI led to a successful AHRC collaborative doctoral award (Horning), and with Scottish Natural Heritage to another doctoral award (Warke). Training for an ECR has been obtained through an AHRC research grant (Finnegan). NIEA provide support in kind to research students (McCormick, Horning, Donnelly, Gardiner). Murphy collaborates with Schulting (Oxford), on joint PhD supervision and 4 joint outputs, and with Chistov (St Petersburg, Russia) with 2 PhDs and 4 joint outputs. Lilley and Shuttleworth collaborate with Lloyd (Liverpool) with joint PhD supervision and 7 joint outputs. Reimer collaborates wtih CEREGE & University of Cape Town on hyrax midden palaeoproxies (5 joint outputs). Over 100 students and ECRs participated in the Society for Historical Archaeology Conference at Leicester (chaired by Horning 2013), with 700 delegates from 33 countries. Chairs of international conference sessions include Bennett at Southern Connection (Bariloche, Argentina, 2010); and International Palynological Congress (Tokyo, Japan, 2012); Blaauw, Hunt and Reimer at INQUA (Bern, Switzerland, 2011); Hunt, Plunkett and Reimer at World Archaeological Congresses (Dublin 2008 and Jordan 2013); Murphy at the Annual Conference of the Society for the Study of Childhood in the Past (Miami 2009; Granada 2012); Horning at the Society for Post-Medieval Archaeology / Irish Post-Medieval Archaeology Group (Derry 2013) and a collaborative conference with NUI Galway (Enniskillen 2013); Brandherm and Plunkett at the Bronze Age Forum (Belfast 2013); Brandherm organised GEA – Material Culture and Social Identity in the Later Prehistory of Southern Iberia. McKinley chaired the Geostatistics session of Accuracy (Leicester 2010). Murphy organised a session at the Annual Meeting of the European Association of Archaeology (Helsinki 2012). Reimer was on the organisation committee of the 18th, 19th and 21st International Radiocarbon Conferences, and organised sessions at C14 & Archaeology (2008 and 2011) and European Geophysical Union (Vienna 2009). Roe was session convenor at International Paleolimnology Symposium (Glasgow 2012) and CANQUA (2013). Ruffell organized the 2010 Environmental Forensics conference (Geological Society of London 2010).