

<b>Institution:</b> University of Worcester
<b>Unit of Assessment:</b> 14 Geography and Environmental Studies
<p><b>1. Unit context and structure, research and impact strategy</b></p> <p><b>Context and structure</b></p> <p>The University submitted to UoA17 (Geography, Environmental Studies and Archaeology) in REF2014. At that time the subject areas for the submitting unit were grouped together strategically within the Institute of Science and the Environment (ISE). The submission reflected a dramatic improvement in the unit's performance compared to the RAE2008 submission with over 35% of outputs scored 3* or higher, compared to only 10% of outputs at 3* (and none at 4*) in RAE2008. The best quality outputs were found in the areas of hydrology, hydroecology, and rural land management. The current submission provides evidence of sustained areas of excellence from 2014, alongside a greater level of inter-disciplinary research the result of which has been: a substantial increase in successful funding applications (22 awards worth &gt;£544k), an increased number of research collaborations, and enhanced research capacity through investment in research facilities and infrastructure.</p> <p>In 2018, the University went through an academic restructure introducing Colleges and Schools (see REF5a 1.1.4-1.1.5). Staff in the submitting unit are based in the School of Science and the Environment in the College of Life, Health and Environmental Sciences, and are drawn from the Department of Geography, Archaeology and the Environment.</p> <p>The University Research Strategy 2014-2019 outlined the key role played by Research Groups in operationalising plans and ambitions for excellent research (REF5a 2.1). To support the overall delivery of the strategy, the University held a series of events focused on each of the Areas of Distinction. These events were designed to bring researchers together from across the University whose research aligned with the areas, with aim of highlighting existing areas of strength, establishing new collaborations, and developing cross- and interdisciplinary responses to problems. The events identified areas of strength and areas for development and led to development of new research groups and collaborations.</p> <p>Two of these Areas of Distinction were 'Economic, Social and Environmental Sustainability' and 'Human Health and Wellbeing', achievements against which are reflected in this submission. In 2019, to further enhance the vitality and sustainability of the research environment, research groupings within the School of Science and the Environment were reviewed. There has been a long pedigree in relation to research in the areas of river science and rural research within Geography and emerging contributions from Archaeology and Environmental studies were highlighted in REF2014. The review of research groupings provided the opportunity to link established research fields more closely than previously, to encourage contributions from a wider group of staff, to support inter-disciplinary research and to encourage new areas of across College and University research.</p> <p>Two research groups are identified within this submission, reflecting areas of expertise and strategic focus:</p> <p><i>The Pollen and Aerobiology Research Group (PARG):</i> The mission of this group is to understand the formation, release, transport, transformation and removal of bioaerosols in the atmosphere and how this affects the general environment. There are three areas of distinction evident by research underway within the group:</p> <ul style="list-style-type: none"> <li>• Human health and exposure: pollen forecasting and palynology</li> <li>• Plant health and food security: crop diseases and invasive species</li> <li>• Atmospheric processes and detection of bioaerosols</li> </ul>

*The Sustainable Environments Research Group (SERG):* This group brings together colleagues to deliver excellent research that brings benefits to people and the planet. 'Sustainable environments' encapsulate any situation where there is potential for environmental impacts to be mitigated and for environmental benefits to be achieved. Research is underway within the group in 5 thematic areas which draw on expertise from across the disciplines of geography, environmental studies and archaeology:

- Food security
- Sustainable livelihoods
- River Science
- Conservation and management of habits and species
- Sustainable places

Research across the College is overseen by a College Director of Research and Knowledge Exchange (Professor Eleanor Bradley) who works closely with the School senior leadership teams and the Research School on areas of research strategy; recruitment and staff development; chairs a College RKE committee which oversees implementation of University RKE strategy; works with Research Group leads and organises College-wide research events.

### **Research and Impact Strategy**

#### *Unit's strategic research objectives during the assessment period*

Research groupings have been utilised within the School to provide focus for research project activity, investment, and staff development. Group activity enables delivery against the central aspiration outlined within the UW Research Strategy: 'To develop excellent research with social, cultural and economic impact'.

Specific ambitions for the groups are to 1) continue to build, support and develop areas of research excellence in river science and geography and 2) to develop greater strength and depth across geography more broadly and to increase research maturity in environmental Studies and archaeology. The groups have developed their own research strategies and approaches to achieve these ambitions and work is underway to align these strategies with the newly approved UW Research Strategy 2020-2025.

University research support schemes have supported the ongoing development of research groups within this submitting unit as follows:

- The Research Outputs Facilitation Fund (ROFF) is a College fund awarded to researchers to facilitate the final stage of research projects into publication. Funding has been awarded to 2 projects in River Science Research and 1 Archaeological research project.
- The Vacation Research Assistantship Scheme (VRAS) - staff submit a proposal for research to be supported by a student working as a research assistant for up to three months over the Summer period. Ten projects from colleagues in this submission were funded, including **Lewis, Visser, Maddock (2), Dutton, Fyffe, Ashbrook, Milner (2)**
- Supporting Research Excellence Scheme – the scheme provides staff with full or partial remission from teaching and / or other duties for a period of up to two semesters (8 months) to undertake a project with a clear set of outcomes (see REF5a 3.2.3). Staff from the submitting unit have successfully applied for SRES (**Dixon, Maddock, Milner, Storey, Visser**), all producing research aligned with this submission.

The University further supported research developments over the period by creating post-doctoral research fellow (PDRF) posts for a 3-year fixed term period. Two PDRFs were appointed to support River Science research (**Hill, Woodget**), with a further PDRF appointment to support sustainable livelihoods research (**Carrie**).

University funding has been utilised to support studentships in strategic areas for research as follows: River Science (5 studentships), rural geography (1 studentship), sustainable livelihoods

(1 studentship), pollen and aerobiology (2 studentships). See Section 2 for full details of studentship support.

### *Impact Strategy*

The delivery of impactful research is a core priority within the University Research Strategy. The two case studies selected for REF2021 are a direct result of our strategy to pursue and support research that makes a difference. To achieve impacts in 'Mapping and mitigating harmful invasive species,' and 'Wetland management and Sustainable Livelihoods in Sub-Saharan Africa' we have provided targeted support including the allocation of two University funded PhD studentships, and the appointment of an early career researcher.

These case studies exemplify our approach to achieving impact by working directly with stakeholders including policy makers and relevant organisations. Pathways to dissemination and, therefore, impact are considered at project conception, and incorporate measures to frequently engage with stakeholders, culminating in enhanced outcomes. Working with stakeholders to develop research programmes also ensures research objectives will address the most pertinent issues that are of direct relevance to the end users of our research. To ensure our approach to achieving impact is current, we continue to adapt our dissemination plans as new opportunities arise. For example, during the Covid-19 Pandemic, communication with stakeholders took place via webinars rather than face to face on-farm events.

Research has been further supported through the purchase of new state-of-the-art equipment (see Section 3). This has increased research capacity and enabled a greater depth of inquiry and has led to more impactful research findings.

Workshop events to increase awareness about research impact have been held including a University wide event for all staff to consider research aligned with Areas of Distinction with potential for impact (2015); a full day workshop (2017) for academic staff to consider Research Impact; Presentation to UW Executive group to highlight ongoing areas of research with impact (2017); Half day impact workshops for UoA co-ordinators (2018). Impact Mentors were assigned to ICS authors to provide support with impact work through the REF period.

### *Open Research*

The University is committed to developing and maintaining an Open Research environment. It fundamentally recognises the value of open access publication to the HE sector, to the public, to the University and its researchers but most vitally to the integrity and value of the research.

All staff are required to upload outputs from research onto WRaP, the University's research repository. The College is provided with monthly reports on OA compliance from a central Open Access Team based in library services. Information about WRaP and OA features in staff induction, training workshops are offered through a staff development programme, 1-1 support is available on request from the Open Access and Advocacy Support officer. College events with a focus on particular databases, including Scopus, have been held over the period for all academic staff.

There is an Open Access funding application scheme available which has been accessed by staff from across the College, to support Gold Access publications. Colleagues have successfully applied for funding through this scheme over the period including **Milner, Visser, Woodget, Grundstrom, Skjoth**.

The University will look to review and revise its Open Access Policy in 2021 in light of national and international developments, in particular Plan S. The University has recently signed up to

the San Francisco Declaration on Research Assessment (DORA) and has established a working group to implement its principles.

### *Research Integrity*

At University level, the University's Research Integrity & Governance Committee has oversight of policies and procedures to support research integrity and its Chair is the University's Research Integrity Champion. The champion is expected to embed a culture of integrity across University through developing training and support for staff but also raising its profile.

At College level, Research Ethics Panels are responsible for review of all staff and research student projects to ensure they are conducted according to appropriate ethical, legal and professional frameworks, obligations and standards. Panel Chairs and Vice Chairs are experienced researchers whilst panel reviewers are drawn from across the College; lay reviewers are also recruited to the panel. Training is provided to all reviewers before they engage in the role. There is an annual audit of reviews to ensure the Panels are fulfilling their role.

The University's Research Integrity champion works closely with the Chairs of Ethics Panels at College level to ensure a culture of research integrity is embedded in the wider research culture of the College, offering support and guidance to research students and staff and maintaining a high profile for the research integrity agenda.

### *Future strategic aims*

Our aim is to nurture creativity and promote research excellence enabling full engagement with the institutional vision of being recognised through outstanding impacts for RKE. In 2020, the University produced a new Research and Knowledge Exchange strategy identifying five Areas of Challenge (see REF5a 2.3). Colleagues are already conducting impactful research in two of these areas ('Human Health and Wellbeing' and 'Sustainable Futures') but have the potential to support developments across all five. To achieve this will require ongoing support for inter-disciplinary research and across-University collaboration. Progress against this goal will utilise data drawn from research income, the volume and quality of research outputs, and the reach and rigour of research impact. These outcomes will be reviewed at College RKE Committee, with SMART objectives built into Research Group strategies and forthcoming School operational research plans.

The two research groups will be supported to sustain the excellent research already underway as well as to introduce new developments in key areas:

- The **PARG** will build on its previous successes influencing policy by maintaining and creating new research collaborations both nationally and internationally.
- The **SERG** will support members to develop research within the thematic areas of priority (food security, sustainable livelihoods, sustainable places, rivers science, conservation and management of species and habits), utilising university and College mechanisms of support for research, in addition to focusing bidding activity in these areas. New stakeholder relationships will be pursued (local, regional, national, and international) with a focus on policy makers. Clear routes for KE and research will be identified through a mapping exercise to identify new, and existing, stakeholders.
- All new research projects underway within the groups will be required to outline clear impact pathways for anticipated outcomes.

We will continue to retain and recruit excellent researchers at all career stages and will seek to increase the number of PGR students overall, but particularly as aligned with our research groups. Job descriptions will reflect research underway across the School and will be designed to attract colleagues who can contribute to work within the research groups. A review of plans to support staff on teaching, full academic and research posts will be undertaken at School level,

with a focus on aligning staff with research group activities as appropriate. This will include the provision of training for Heads of Department around setting research objectives and workload planning for all academic staff; routine evaluation of research and KE achievements at annual performance reviews; identification of staff for the research mentor scheme.

Research in new areas, not aligned with existing groups, will be identified through the regular College research update and School bidding reports. This information will enable colleagues to consider joining groups aligned to their areas of research from across the University, as well as the development of new research groupings within the School. Any new research groupings will be required to be aligned to national and international areas of research priority, notably the UKRI. Excellence in research from across the School will be celebrated through all-staff School meetings and College events.

To support and develop our Research Leaders (Professors and Research Group leads), colleagues will be encouraged to engage with a renewed Research Leadership programme designed for new research group leads and newly appointed professors. A new programme of support for existing professors will be developed for delivery across the University. College and School events will be held on a regular basis. Research outputs will continue to be rewarded through the University recruitment and promotion scheme, which includes a Professorial Mentoring scheme.

## 2. People

### ***Staffing Strategy and Staff Development***

#### *Recruitment*

The Department of Geography, Archaeology and the Environment comprises Category A staff as follows: six Lecturers, three Senior Lecturers, eight Principal Lecturers, and three Professors, whose teaching and research is supported by nine technical staff. All School staff on standard academic contracts are required to be research active; and whilst those on teaching-focused or support contracts (e.g. technical staff) do not have this contractual requirement they still contribute to the overall research and scholarly environment of the department. This promotes diversity in our research portfolio and provides the opportunity for staff to explore and pursue their research aspirations within an open research environment. The College Director of RKE is routinely involved in new standard academic appointments, providing input to the post details, outlining specific areas of research experience and expertise (to align with RKE priority areas) as well as interview and selection processes.

There have been a series of post-doctoral research appointments made to strengthen areas of research priority, to increase capacity for excellent research, but also to attract excellent researchers to the University: 6 post-doctoral research fellows (PDRFs) have been appointed, including a Marie Curie Fellow, to work in areas of aerobiology, river science and sustainable environments.

The PDRFs were aligned with talented researchers in the department, to enable their ongoing research developments, demonstrating an ongoing determination to invest in the future of research. ECRs have also been targeted to join supervisory teams for the doctoral studentships awarded over the period. The success of these initiatives can be seen through our outputs in areas of research priority (river science, aerobiology, sustainable environments), as well as the dramatic increase in research funding (see Section 3) and in our impact case studies, but also by recognising that some of these individuals have since secured senior roles either within the University or elsewhere (e.g. **Carrie**).

Through our research activities we have attracted visiting researchers. From 2016-2017, and 2017-2018 we hosted visits from two South Korean researchers based at the National Institute of Forest Science (previously the Korea Forest Research Institute) to work alongside Professor

Nick **Evans**. In 2017, a visiting researcher from Spain and another from Finland, funded by the Finnish Research Council, were hosted at the university to conduct aerobiology research with Professor Carsten **Skjoth**. In 2020, a visiting research student from India was funded by the British Council Newton Bhabha PhD placement scheme to work with Professor **Skjoth** for a 3-month period.

#### *Progression and Succession Planning*

The University runs an annual reward and promotion scheme for staff and research achievements form a central part of this scheme. Table 1 highlights that those who have reached more senior positions (Professor, Principal Lecturer) are indeed making a significant contribution to the research outputs within this unit:

**Table 1**

<b>Contract level</b>	<b>% Eligible</b>	<b>% Submitted</b>
F1 (Professor)	23	27
I0 (Principal Lecturer)	54	45
J0 (Senior Lecturer)	15	18
K0 (Lecturer/ Research Fellow or Assistant)	8	10

There have been 2 successful Professorial applications in the period (**Skjoth, Maddock**) increasing the number of Professors within the Department from 1 to 3 (**Skjoth, Maddock, Evans**). This offers the potential for additional senior leadership for the mentoring of other academic staff keen to advance their careers through research activities.

#### *Staff Development*

To support a thriving and inclusive research culture we are committed to developing and maximising the research potential of all staff on standard academic contracts, and at all stages of their careers. All academic staff are expected to engage in research, appraisals are instrumental in providing a framework to discuss research income and output writing objectives, but also staff development needs, which might include attendance at relevant courses and workshops for which there is a budget at School level.

Research aspirations are further supported through membership of one of the School's research groups, which have outlined 12 month and 3-year research objectives. There is a School budget to support staff to undertake external training.

An important resource for early career researchers and staff is the Researcher Development Programme which comprises a series of workshops over each academic year. Workshops are delivered by senior researchers and professional staff at the University but also draw on external presenters and utilise resources offered through Vitae and other professional development organisations. The programme includes a Research Leadership Programme, designed for more experienced research staff, including research group leads and newly appointed Professors. These are University-wide programmes providing colleagues with the opportunity to meet other research active staff outside their Departments / Schools, encouraging interdisciplinary research.

Staff from across the University also come together on a regular basis for the School Research Seminar Series and the College Research Seminar series. The School seminar series has run throughout this REF period and draws on a scholarly mix of internal and external staff and postgraduate speakers throughout the academic year. The series includes an annual Lovett lecture which is open to members of the public as well as staff from across the University. The COVID-19 pandemic has escalated work to make these seminars more widely available to internal and external colleagues through recordings and by hosting online. Both seminar series moved online in 2020, attracting higher average attendance numbers, whilst providing the opportunity to make them widely available to relevant external organisations.

Mentoring is an important aspect of staff development. There is a University wide mentoring and coaching scheme which brings together senior and emerging researchers, according to expertise and experience. There are a range of training and resources available for mentors and mentees engaged with this scheme. In addition to this, there is a separate professorial mentoring scheme for staff preparing for the annual call for professorial applications. This scheme aligns existing professors from across the University with those preparing applications. Overall, the Department is committed to meeting its staff development demands and aims to provide relevant opportunities enabling all to maximise their academic potential.

### **Research Students**

There has been a significant increase in research student completions within this submitting unit during the current assessment period, with 14 doctoral completions compared to 3 in REF2014. There have also been 10 MRes completions in the period.

7 PhD students (5 full-time and 2 part-time) and 3 MRes students (2 full-time and 1 part-time) are currently enrolled, with 4 of the PhD students being supported by studentships. This reflects the commitment from the University to support PGR students in areas of strategic importance. There has been a total of 12 studentships supported and an additional 3 studentships co-supervised with a Director of Studies from UoA5. Of these, 9 were fully funded and 6 were co-funded. This reflects successes in winning external funding for studentships (for example, 2 have been supported by Marie-Curie funds). The increase in numbers of MRes students has been supported by the creation of three new research degree programmes in areas of research activity (MRes River Science, MRes Ecology and Environmental Management, and MRes Archaeology).

Recruitment and selection to the PhD programmes is overseen locally by a PhD course leader. Their role is to ensure that only excellent students are accepted onto the doctoral programme and that supervisory teams meet the requirements of our Research Degree Programme regulations. The course leader also works with academic staff, Research Group leads and the College Director of RKE to advertise self-funded PhD opportunities. The course leader also monitors progress, providing advice and support to supervisory teams and students where required, as well as overseeing the School's enhancement plan for its Research Degree Programme.

The University has a well-established graduate school (branded as the Research School) that is responsible for the management of all Research Degree Programmes from recruitment to examination, in partnership with the academic schools (see REF5a 3.3.2-3.3.3).

The University has expanded the Research School team to reflect the growth in student numbers over the REF period. It provides a dedicated work and social space for students. The Research School team, co-located in the student space, provides advice and guidance for students on their programmes, and, working closely with other student-facing departments such as the Disability & Dyslexia Service, the student mental health team, careers service, also offers pastoral and wider support. A comprehensive programme of support and guidance has been developed for PGR students and supervisors around mental health and wellbeing.

All students on research degree programmes are required to undertake an associated training programme, run by the Research School (REF5a 3.3.4-3.3.5). The programme has been mapped against Vitae's Researcher Development Framework. The programme offers a suite of modules, short courses and workshops, delivered face-to-face or online, some of which are compulsory for all doctoral students, focused on the following core areas: planning and managing research; academic writing; research methods; data analysis; research integrity and ethics; dissemination, engagement and impact; careers and employability. The University also supports students to engage with external training where this is specialist and not available through the University's programmes. Students are also able to access training offered through the GuildHE Research network

Beyond the programme, the Research School offers additional development opportunities. Research Students have opportunities to teach and can access modules and workshops to develop their skills in this area, with the opportunity to gain associate or full fellowship of the Higher Education Academy. The University offers research student-specific dissemination opportunities including an annual “Images of Research” exhibition and student-led PGR Conference. The University provides funding opportunities for students to attend and speak at external conference and events and separate funds to support students to develop inter and cross-disciplinary networks, seminar series, conferences and events. The University is a member of the Brilliant Club, a charity focused on improving access to University, which provides opportunities for doctoral students to go into schools and deliver tutorials in their area of expertise. The Research School also provides ad hoc opportunities: for example, in 2019 the lead for the development programme worked with a student team to deliver a University programme for Pint of Science.

Office space for PhD students is provided at the Research School, but there is additional space available for those students who require access to specific on campus facilities (for example, laboratory space). Feedback is sought from doctoral students via the Postgraduate Research Experience Survey (PRES) every 2 years (see REF5a 3.3.6) and feedback has been utilised over this period to encourage doctoral students to feel more embedded within the culture of the College. For example:

- The School and College Research Seminar series encourage participation from doctoral students
- Students have been invited to provide posters at College Research events and work is also displayed within the School
- There is research student representation on the College RKE Subcommittee which ensures the student voice is fed into the development of research strategy at College level
- Doctoral students are provided with opportunities to work with UG students to support the development of student societies (e.g. the UW Biology Society), help with specialist teaching, serve on committees of external organisations, and make significant contributions to STEM outreach and widening participation activities

Supervision at Worcester is always by a team consisting of a DoS (who must be based at the university) and up to two other supervisors. The team must have relevant expertise and collective experience of supervision. Staff with no prior experience of supervision are supported to take on Director of Studies (DoS) roles with the support of a supervisory mentor. Supervisors are therefore selected in relation fit to the project. All supervisory teams must be approved by the University’s Research Degrees Board.

The Research School maintains a register of approved supervisors which identifies the expertise and experience of supervisors. The register is reviewed on an annual basis. There are currently 15 approved supervisors from the submitting unit, a significant increase from 8 in 2014.

The Research School provides opportunities for the professional development of experienced and new supervisors through a supervisor development programme. This programme has been in place for some 20 years but was rethought and relaunched in 2018/19. The programme offers a wide range of support for supervisors at various career stages on themes such as: introduction to supervision, supervisory styles, regulations and processes, supervising international students, PGR mental health and wellbeing, supporting student progress. New supervisors must complete the whole programme but more experienced supervisors must also engage with core elements and all supervisors are required to engage in regular refresher training (every 3 years).

Training is complemented by other development opportunities including: supervisor lunches that bring together supervisors to discuss key topics and challenges in supervision; the Share and Inspire series, and external professional development for supervisors provided through the UK Council for Graduate Education (UKCGE).



**Equality and diversity**

The University has a fundamental commitment to equality and diversity (REF5a 3.4). It seeks to consider and apply equality and diversity principles in all that it does. Its policies and processes are designed to disadvantage no-one and are subject to ongoing equality impact assessment to ensure this is the case.

The unit's approach flows from this with the Head of School ensuring that the University's principles and policies are fully enacted. Line managers are sure staff are aware of and are supported to engage with, for example, the University's flexible working policy, its parental leave policies, its policies which support carers (such as its Critical Illness Policy) and its staff wellbeing initiatives (see REF5a 3.1.8)

Several staff in the unit have benefitted from the University's flexible working policy (REF5a 3.1.8) with a move to part-time or compressed hours. There is no evidence that this has impacted on research productivity, access to funding or progression. It is notable that both at institutional (REF5a table 2) and unit level, part time staff are as well-represented in the Category A submitted as eligible category.

Staff in the unit have taken parental leave in the assessment period. They have received active support to transition back to work after the leave period, through "keeping-in-touch" days, phased return, mentoring. It is ensured that where a staff member takes parental leave this does not impact on research leadership or supervisory roles. The School has a fair and flexible approach to working, particularly during the current lockdown period in recognition of the challenges of home schooling.

Staff in the unit are committed to equality and diversity. Staff were members of the University's Athena SWAN self-assessment team; the University received its institutional Bronze Award in April 2018 and is committed to making departmental applications in the next 2 years. Staff are also engaged with various staff networks focused on protected characteristics and with the LGBTQ+ Allies scheme.

**3. Income, infrastructure and facilities****Income**

There has been a significant increase in research income across the REF period, rising from £92K in 2013/14 to £544K in 2019/2020. Key successes include securing funding from: the Natural Environmental Research Committee (NERC) in collaboration with Bangor University (lead) and the University of Exeter to explore the use of molecular genetics in understanding grass species pollen deposition (**Skjoth**); a Marie Skłodowska-Curie Fellowship (**Grundstrom**); and a Marie-Curie Career Integration Fellowship (**Skjoth**). These prestigious grant awards have led to the delivery of high-quality research and consequently the publication of several high-quality outputs of significant impact.

Colleagues have also successfully diversified income streams through strategic targeting and the engagement of relevant stakeholders, receiving funding from 20 sources over the current period. These have included:

- Government Agencies: The Forestry Commission (**Dutton**); The Environment Agency have funded 3 *river science research* studies over the period (**Maddock**)
- Charity: Funding has been awarded from the Priddy Charitable Trust for 3 archaeology research projects (**Lewis**) and the Somerset Archaeological and Natural History Society funded a further 2 archaeological studies (**Lewis**) since 2014.
- Professional Societies: The British Society for Geomorphology and Quaternary Research Association funded 2 studies over this period (**McDougall**).
- Industry: **Evans** and **Maddock** have undertaken contract research for industry partners.

**Infrastructure**

The University has invested significantly in research support infrastructure over the REF period (see REF5a section 4). The University has established robust Pre- and Post-Award processes for externally funded projects (approved in 2018/19 and subject to evaluation and review in 2020/21). These processes scaffold the Research Office support systems set out above and ensure good governance for bids and for projects.

Within the College, there is an RKE facilitator who disseminates information about new opportunities for research funding to colleagues, works closely with Research Group leads to develop a research funding profile (including fingerprinting for Research Professional), provides tailored information about specific opportunities on request and registers information about bids in preparation. Peer review for draft bids is encouraged for every submission, and mandated for larger value bids, as well as those targeting Research Council and UKRI opportunities. The peer review process is co-ordinated by the College Director of RKE, utilising expert feedback from academic colleagues across the College.

It has been recognised that the processes need to incorporate Equality Impact Assessments at various stages of both pre- and post-award. In lieu of this broader development, the University has adopted the BBSRC EIA guidance and template for reviewing research bids. It has also been agreed to undertake a review of bidding over a 5-year period from an equality perspective and this will be completed in 2021. The review will inform the development of support mechanisms for bidding.

Our strategy for generating research income is based on providing relevant support with regards to affording staff time to engage with research and providing internal funding to pump prime research leading to the development of new research programmes. This is underpinned by three support mechanisms:

- The '**Research Support Scheme**' considers applications of up to £2.5k enabling colleagues to: i) undertake small scale pilot or pump priming projects; ii) analyse research data that has already been collected to enable dissemination/publication; iii) collect impact data relating to complete or ongoing research projects, and iv) facilitate the use of existing research and the exchange of knowledge between the University and external stakeholders.
- The '**Facilitating International Research Collaboration Scheme**' supports the objectives of the Global Challenges Research Fund (GCRF) by promoting research with organisations in eligible DAC countries, and considers applications up to the value of £2.5k.
- The '**Research Outputs Facilitation Fund**' (ROFF) was established to support the University aim to build on the successes from REF2014. The fund (up to £1k per application) exists to support unfunded research which can demonstrate a high likelihood of leading to a return for submission in the REF (an output or evidence towards an impact case study), or an external funding application. Colleagues can also apply for contributions towards co-funded PhD studentships, especially when this involves engagement with industry.

To support academics with research activity, the University established a 'Researcher Pool' in 2018, enabling colleagues to readily appoint a research assistant(s) once funds have been received through our research support mechanisms. Colleagues can also apply for internal funds enabling dissemination of research findings at national and international conferences. These arrangements ensure that support is in place for colleagues to engage effectively with new and existing research collaborators, whilst increasing their capacity to publish research and disseminate accordingly.

**Facilities**

Researchers have access to a range of well-equipped laboratories for water and soil analysis, including spectrophotometers and an MP-AES. There is also a GIS suite with high specification PCs running industry standard survey and photogrammetry software. The School subscribes to ArcGIS and Digimap. Computer equipment for field use has also been invested in with 4x Panasonic Toughpads and 4x Apple iPad minis added to our existing suite of field computers.

The field survey equipment has been updated with over £100k of new survey equipment added, including a Leica laser scanner, two Trimble survey grade GPS systems (Trimble R8 and 2 Trimble R10s) with real-time RTK via an annual VRS subscription and a Noggin 500 DC/ST ground penetrating radar.

The department has consistently invested in purchasing and maintaining an up to date fleet of both rotary and fixed wing Small Unmanned Aircraft (SUAs) alongside holding a CAA approved PfCO license. The fleet of rotary SUAs includes a DJI Phantom 4 PRO, Inspire 1, Matrice 600 and three Phantom 4 RTK drones complete with Survey Grade GPS base stations. The fixed wing fleet of SUAs includes a C-Astral Bramor and three Bormatec drones. A range of different payloads has been purchased across the fleet of drones including RGB cameras and video-cameras, multispectral cameras, particle counters and a Sniffer 4D (for mapping Aerial Pollutants including VOCs, CH<sub>4</sub>, NO<sub>2</sub>, O<sub>3</sub>, CO, SO<sub>2</sub>, PM<sub>1.0</sub>, PM<sub>2.5</sub> and PM<sub>10</sub>). The School has invested in camera equipment to support research and fieldwork including GoPro's, GoPRO Max's, and an Insta PRO 2.

The School maintains two permanent river monitoring sites, the equipment in which is regularly replaced and updated including new YSI multiparameter Sondes and ISCO water samplers. Both sites have also been updated to provide telemetry accessible via an online web service and database storage. Additional river monitoring equipment has also been purchased including AquaTec Turbidity probes and Solinst conductivity, level and temperature loggers.

There has been investment in the expansion of our airborne particulate monitoring systems, including over £100K on a Rapid E real-time airborne particle identifier. We also installed weather stations and rainfall monitoring sites. A Nissan Navara 4x4 Truck has been purchased for Geography / Archaeological / Environmental fieldwork.

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

Staff in the unit have developed national and international collaborations. For example, in 2016, with a Darwin Initiative Scoping Award, **Dixon** collaborated with the University of Belize, **Maddock** and **Woodget** have worked with the University of Concepcion, Chile, to investigate the use of UAS and SfM for rapid mapping of native fish habitat prior to the construction of hydroelectric power dams, and with the University of California. **Maddock** has also collaborated with the Institute of Water for the Republic of Slovenia. **Visser** and **Woodget** have collaborated with the University of Antwerp and Ghent University to develop and test the use of hyperspatial remote sensing data for water quality and flood risk model validation. In 2018, **Visser** collaborated with a global network of scientists on a drone photogrammetry project measuring vegetation biomass in non-forest ecosystems (part of NERC-funded DRIVING-C project, NE/R00062X/1).

Colleagues have also had active involvement in EU-funded COST action networks. **Skjøth** has been part of SMARTER (2012-2016) in which he was the vice-chair and scientific co-ordinator and is currently the chair for ADOPT (2019-2023). **Maddock** was a member of SMIRES (2015-2020) and is currently a member of HARMONIOUS (2018-2023).

At the national scale, through NERC grant (NE/N002431/1) **Skjøth** has worked closely with Public Health England, Asthma UK, and the Met Office. **Evans** has actively engaged with the Malvern Hills AONB Partnership and in collaboration with Keele University on a farmers TB and vet project. **Maddock** has worked with the North Worcestershire Water Management Group (Local Authority), and the Environment Agency. **Dutton** has worked with the Forestry Commission to investigate social aspects of feral wild boars. **Lewis** has worked in collaboration with the University of Reading and Bath Spa University. Through these collaborative endeavours we have successfully contributed to national and international agenda-setting research.

### ***Contributions to the Research Base***

Since REF2014, we have increased our long-term contribution to the research base by engaging extensively in collaborations internationally and nationally with other universities, research centres, industry, and other non-government organisations. Existing collaborations have been strengthened and new relationships initiated. Research has been directed towards impact at multiple scales, to increase its reach, and to bring about change in government policy and practice. Key areas of expansion have been in the fields of aerobiology (**Skjøth & Smith**), sustainable livelihoods (**Dixon**), and river science (**Maddock, Visser & Woodget**). In addition to what is captured in the impact case studies (**Dixon**) and **Skjøth**), during the period 2014 to 2020 we have developed relationships with key research users, bringing about important changes to practice. For example, research by **Maddock, Visser & Woodget** has been instrumental in advancing the toolkit of river science practitioners for quantifying physical river habitat parameters at spatial scales relevant for the health and survival of instream biota. This contribution to the research base has benefited government agencies (e.g. Environment Agency), chartered institutions (e.g. Institute for Water Engineering and Management), wildlife trusts, charities, and commercial organisations on local to international levels.

Staff within the submitting unit have contributed to the sustainability of the discipline through engagement with professional associations and learned societies. For example, **Skjøth** has been a board member of the European Aerobiological Society (EAS), and the International Aerobiological Society (IAS) since 2008. In 2014, **Maddock** was part of the International Organising Committee for the 10<sup>th</sup> International Symposium on Ecohydraulics, Trondheim, Norway, and in 2016 was part of the International Scientific Committee for the 11<sup>th</sup> International Symposium on Ecohydraulics, Melbourne Australia. **Smith** was on the Scientific Committee for the 11<sup>th</sup> International Congress of Aerobiology, Parma, Italy (2018).

We have organised and hosted several important conferences specifically aligned to our research expertise to maximise our contribution to the discipline. For example, in 2016 we hosted the 4<sup>th</sup> annual Small Unmanned Aerial Systems for Environmental Research (UAS4Enviro) international conference, led by **Maddock** and **Visser**. Since 2014, **Dixon** has been a member of the organising committee for the Beacons Development Education Centre Annual Conference.

Colleagues have attended international conferences and delivered keynote talks. For example, in 2018 **Dixon** presented his research as a keynote speaker at the United Nations World Water Week in Stockholm, Sweden, and at the European Geosciences Union General Assembly in Vienna 2015. **Skjøth** delivered a keynote lecture at the 10<sup>th</sup> International Congress on Aerobiology, Sydney, Australia 2014, and the 11<sup>th</sup> International Congress on Aerobiology, Parma, Italy 2018. The university will also be hosting the 12<sup>th</sup> International Congress on Aerobiology in 2022, chaired by **Skjøth**. In 2017, **Skjøth** gave a presentation at the Palynology, Aerobiology and Allergy Science (PAAS) symposium, Vienna, Austria, and in 2020 **Skjøth** gave a keynote lecture at the 7<sup>th</sup> European Symposium on Aerobiology, Cordoba, Spain. In 2017, **Woodget** gave an invited talk at the EnviroDrones Conference (Hanover, USA). **Storey** delivered a presentation at the 47<sup>th</sup> Conference of Irish Geographers (Belfast, 2015), whilst **Evans** gave an invited presentation at the 2<sup>nd</sup> Irish Rare Breeds Conference in 2018. In 2014 **Dutton** delivered an invited presentation on managing wild boar at the joint British Ecological Society-Field Studies Council Symposium on Conservation Evidence. **Lewis** has given keynote

presentations at the Mendip Hills Heritage Conference (2013, 2015), and Somerset Archaeological and Natural History Society Annual Symposium (2016). **Lewis** has also delivered talks as an invited speaker at the Theoretical Archaeology Group Conference (University of Chester, 2018), and the Prehistoric Society Conference (Woking, 2015), and at the Bronze Age Forum (Queens University, Belfast, 2013).

During the census period, colleagues have made valued and important contributions through peer-review for a wide range of journals and publishers across the disciplines captured by this unit including Journal of environmental studies and sciences; Geojournal; International Journal of Sustainable Development and World Ecology; Journal of Environmental Management; Applied Geography; Geomorphology; Hydrological Sciences Journal; River Research and Management; Journal of Rural Studies; Landscape Research; Social and Cultural Geography; Progress in Human Geography.

Staff also hold membership of editorial boards including **Dixon** (*Wetlands*), **Skjøth**, (*Aerobiologia*), **Smith** (*International Journal of Biometeorology; Aerobiologia; Grana*), and **Visser** (*Journal of Maps*).

A further indicator of our contribution to the discipline is through our external examination of 15 national and three international doctorate students. During the census period colleagues have examined at the University of Gothenburg, Sweden (**Skjøth**, 2015), University of Antwerp, Belgium (**Visser**, 2016), University of New England, Australia (**Maddock**, 2016), University of Aberdeen (**Evans**, 2014), University of Manchester (**Skjøth**, 2014; **Lewis**, 2014), Queen Mary University of London (**Maddock**, 2014, 2017), University of Birmingham (**Lewis**, 2013, 2014; **Dutton**, 2015), University of Huddersfield (**Dixon**, 2016), University of Leicester (**Evans**, 2017), Newcastle University (**Visser**, 2018), Royal Holloway University of London (**Maddock**, 2018), University of Wolverhampton (**Dutton**, 2018), Cranfield University (**Maddock**, 2019), and Loughborough University (**Maddock**, 2019).

Colleagues have influenced international research priorities through panel membership of the Newton Fund (British Council) (**Skjøth** 2015+). We have also made on-going and significant contributions as reviewers for UK and international Research Councils, and other grant awarding bodies. This includes the Belgian Federal Science Policy Office (**Skjøth**), Science Fund of the Republic of Serbia (**Skjøth**), Swiss National Science Foundation (**Skjøth**, **Storey**), Estonian Research Council (**Maddock**), German Research Foundation (**Smith & Visser**), National Science Centre Poland (**Visser**), Paris Institute for Advanced Study (**Storey**), UKRI Future Leaders Fellowships (**Maddock**), BBSRC-GCRF (**Dixon**), ESRC (**Evans**), NERC (**Evans & Smith**), Social Sciences and Humanities Research Council of Canada (**Evans**), Czech Science Foundation (**Evans**), Defra (**Evans**), Riksbankens Jubileumsfond, Sweden (**Evans**), and the British Council Newton Links, and Research Links programmes (**Skjøth**). **Visser** is also a Council Member for the Remote Sensing and Photogrammetry Society (RSPSoc), and is chair of their Education & Training committee which oversees the development, co-ordination and execution of the Society's policies in promoting awareness of remote sensing and photogrammetry among teachers and students at all levels (2017+). In 2019, **Evans** participated in the Defra review of the Action with Communities in Rural England (ACRE) funding scheme which influences national and local policies. Since 2014 **Lewis** has been a member of the Somerset Archaeological & Natural History Society Heritage Grants Committee.

Colleagues have delivered numerous talks at other universities and organisations. For example, **Dixon** gave a research seminar at the University of Canterbury, New Zealand in 2017, and the University of Huddersfield in 2018, whilst in 2019 **Skjøth** delivered an invited presentation to the Royal Meteorological Society (Reading). **Maddock** delivered a seminar at the University of Leeds (2019). **Lewis** has given research seminars at the University of Bristol (2016) and University of Chester (2019).

***Contribution to Economy and Society***

Colleagues also frequently engage with the public through an active programme of public talks and lectures including the 'Pint of Science' programme of public events, Professorial inaugural lectures and Professorial talks delivered at The Hive. Our research is also disseminated via online media including Twitter. **Dutton** has delivered multiple talks at Mammal Society workshops. **Woodget** has given invited talks on UAVs at several workshops, including those run by the British Geological Survey (2014), Environmental Agency (2015), and Natural England (2017). **Woodget** has also presented research findings on the use of drones for river habitat assessment at an event organised by the Chartered Institute for Water Engineering and Management (2016), and the Institution of Environmental Sciences (2015). **Dutton** has also given a series of talks to local wildlife trusts.

**Dixon** is a member and co-founder of Wetland Action, an international network of researchers and practitioners that aim to disseminate good practice in sustainable wetland management primarily in Africa. **Dixon** also provides pro bono technical advice for Self Help Africa, an organisation dedicated to ending hunger and poverty in rural Africa.

Colleagues have obtained fellowships. For example, in 2017 **Dixon** was a visiting Erskine Fellow at the University of Canterbury, New Zealand. **Dixon** was also a Trustee of Tiyeni (Malawian NGO) from 2014 - 2017 and is now a member of their Technical Advisory Team (2017 +). From 2017-2018 **Smith** was a Scientific Advisor for an allergen project at Uludağ University, Turkey, and from 2014-2020 **Smith** was a Scientific Advisor for a project on pollen monitoring and modelling, at the Technological University, Dublin, Republic of Ireland, funded by the Irish Environmental Protection Agency. **Maddock** is a Trustee for the Severn Rivers Trust, which was established to secure the preservation, protection, development and improvement of the rivers, streams, watercourses and water bodies in the Severn catchment (2019+). From 2014-2015 **Dutton** was on the Mammal Society Scientific Committee providing advice on feral wild boar and their re-emergence in the UK. Since 2007, **Lewis** has been on the Advisory Committee for the Clwyd-Powys Archaeological Trust and is a Council Member and Grants Administrator for the Prehistoric Society (2018+). In 2014, **Smith** was a Visiting Professor at the Adam Mickiewicz University, Poland.