Institution: University of Salford

Unit of Assessment: 7

1. Unit context and structure, research and impact strategy

Unit context and structure

Researchers in the **Ecosystems and Environment Research Centre (EERC)** work in close partnership with conservation experts, academics and policymakers across the globe. We undertake research centred around biodiversity and sustainability that leads to preservation of the environment through changes to policy and practice. We have significant international reach, working across all seven continents, with key partnerships in: *Ukraine*, developing new methods in radioecology; *India*, improving environmental and public health; *Brazil*, studying mammal behaviour and conservation; and in *Europe* and the *USA* contributing to better surveillance for plant pathogens and sustainable marine management practices. We have increased the scale and quality of our research in this REF period: our number of research outputs has risen by 37% and more than 20% of our publications feature in the top 20% of most-cited articles worldwide (SciVal). Professor Mike **Wood** was awarded the *Times Higher Education Research Project of the Year* in 2016 for his research on radiation and biodiversity in Chernobyl.

To achieve our aim of enhancing critical mass and ensuring a sustainable research environment, our staff development and recruitment strategy has focused on two main research themes: **Sustainable Environments** and **Infectious Diseases**, with investment in staff complemented by significant investment in related infrastructure and facilities. Many staff work across both themes but are listed against their primary affiliation.

Sustainable Environments (18.0 FTE; 13 Male: 5 Female): **Armitage**; **Beck**; **Benvenuto**; **Boubli**; **Coscia**; **Danson**; **Entwistle**; **Ferry**; **Hardman**; **Hutchinson**; **James**; **Jehle**; **McDevitt**; **Meyer**; **Mondal**; **Wood**; **Yates**; **Young**. Research includes: biodiversity and conservation, including mammalian evolution (**Beck**), invasive species (**McDevitt**) and endangered species (**Boubli**, **Jehle**, **Meyer**, **Young**); terrestrial and freshwater systems, including soil health, glacier retreat related to climate change and remote sensing (**Armitage**, **Danson**, **Entwistle**, **Hutchinson**); environmental pollution, including heavy metals in agriculture systems (**Mondal**), and ecological recovery from major radioactive pollution such as Chernobyl and Fukushima (**Wood**); marine conservation, including fisheries management and policy (**Benvenuto**, **Coscia**, **Yates**); microbial ecology and biotechnology (**Ferry**); green infrastructure, urban agriculture and urban ecosystem services related to human and urban environmental health (**Hardman**, **James**). **Wood**'s research on changing practice and perception of radioactivity and **Hardman**'s research on mainstreaming urban agriculture are part of our REF3 submission.

Infectious Diseases (6.0 FTE; 5M:1F): **Antwis**; **Birtles**; **Jackson**; **Martin**; **Mastin**; **Parnell**). This group links environmental and ecological facets with human health through a 'one health' approach and comprises 11 staff in total, with five researchers who focus on the characterisation and epidemiology of human pathogens submitted to UoA3 (and **Birtles'** research impact stemming from investigating antimicrobial resistance in low and middle-income countries (LMIC) settings is submitted to UoA3). Research includes computational modelling to understand the epidemiology of major agricultural and plant pathogens (**Mastin**, **Parnell**). This research has led to an impact case study on strengthening national and international plant biosecurity surveillance policy and practice (REF3). Other research includes host-parasite interaction and eco-immunology (**Jackson**) and infectious diseases of importance to species conservation, soil, plant and pollinator health and endemic zoonoses (**Antwis**, **Birtles**, **Martin**).

Research and impact achievements 2014 – 2020

The EERC was formed in 2015, bringing together environmental scientists with urban and physical geographers in an interdisciplinary group to develop new directions and develop high quality and

impactful science. The EERC Steering Committee, led by **James**, is responsible for developing and implementing research strategy and monitoring performance and research integrity against Key Performance Indicators. Our objectives were to **enhance capacity**, **increase income**, **improve quality and quantity of outputs** and **impact** in our core research areas. We achieved these aims as follows:

- **Increased capacity:** eight submitted staff have been recruited into EERC this REF cycle, including one Professor, seven Lecturers and one Postdoctoral Research Fellow. This has supported achievement of our aim in REF2014 to grow molecular ecology expertise in line with the Strategy for UK Life Sciences (2012), as five new staff have core research strengths in this area (Section 2), which was complemented by >£500k investment in genomics and bioinformatics infrastructure (Section 3).

- **Increased income:** we have increased our Research Council funding by 154% since REF2014. Particular award successes have included NERC, through which we have received funding for 13 new projects during this period. In addition, two NERC projects leading into the next REF cycle have been awarded in 2020 for **Beck** as PI on the genomics of New World primates and **Parnell** as Co-I on the SMARTIES project led by Rothamsted Research to investigate epidemiology of Ash Dieback. Following a period of supportive development of our existing research staff and strategic hiring of complementary expertise the proportion of submitted staff with externally funded awards has increased from 30% in 2014 to 67%.

- **Improved the quality and quantity of outputs:** we have increased the quantity of our outputs by 37% to 582) and have a field-weighted citation impact of 1.55 in 'Life Sciences' (across 2014-19, SciVal). EERC members shared 634 publications plus other products of research on our institutional repository (USIR) and outputs were downloaded 191,607 times.

Moving into this REF period we were focused on two priority areas of research, described in our REF2014 returns to UoA5 (Biological Sciences) and UoA17 (Geography, Environmental Studies and Archaeology): i) **Develop capacity in using molecular methods to detect irregularities and fraud in the global seafood market**, and ii) **Develop capacity in methods for biodiversity assessment** and **monitoring, including environmental acoustics.** Our achievements in these areas include:

i) **Combatting fraud in the global seafood market:** through supporting existing staff and complementary hiring of new expertise, we attracted EU funding through the Interreg programme, a Marie Skłodowska-Curie postdoctoral fellowship and CEFAS to develop internationally adopted standardised methods for seafood traceability, establish seafood mislabelling rates for multiple species at a continental scale and identify labelling inaccuracies of highly valued fish species. Working with governmental agencies (e.g., Marine Management Organisation) and EU stakeholders, we have **improved stock identification and assessments in multiple commercially important deep-sea fisheries** in the Atlantic Ocean and Mediterranean Sea. Further, this research has changed stakeholders' use of genetic-based evidence within policy decisions (e.g. Inshore Fisheries Conservation Authorities) and informed policy development by the European Commission Directorate-General for Maritime Affairs and Fisheries (**Coscia,** Mariani (leaver)).

ii) **Developing capacity in methods for biodiversity assessment:** working with the Biological Dynamics of Forest Fragments Project (BDFFP), the National Institute for Amazonian Research, Federal University of Pará and the Brazilian Government (CAPES) has led to three PhD and nine MSc by Research students and generated data that have fed into four global data synthesis initiatives (PREDICTS, BIOTIME, CESTES and FragSAD). This has resulted in six publications on the effects of mining sound pollution on Atlantic Rainforest and Cerrado wildlife in Brazil and also to the development of automated classifiers for Amazonian bats. **Meyer** has published the

first echolocation key for Amazonian bats including novel descriptions for several species and developing and publishing deep learning methods for bird detection in soundscape recordings.

Underpinned by the University's Industry Collaboration strategy, much of our research is co-created with research end users, thereby driving our ability to embed impact into our research to address key international challenges. The extent of these collaborations is evidenced through ~50% of our research income deriving from, or directly involving, research end users. In addition, we produced 50% of our research outputs together with non-academic institutions.

Key impact achievements have been ensured through support from a dedicated School Impact Coordinator (**Wood**) and institutional support through the provision of internal and external impact training, internal funding streams and dedicated workload allowances. Our University impact development framework supports staff to develop individual annual action plans around their research projects and, of eight existing action plans in EERC, three are presented in REF3. These epitomise how we work with research end users to solve real-world challenges as each case study lead (**Hardman**, **Parnell**, **Wood**) co-developed research with stakeholders and end users, co-authored guidelines and policy documents and took on roles on national and international advisory boards, ensuring translation of research into practice.

Other impact activities in development are led by: **Entwistle**, who is leveraging expertise from our consultancy AquaUoS to develop remote sensing research applications in hydromorphology, river restoration, catchment connectivity, ecohydraulics and fluvial and glacial sediment dynamics; **McDevitt** and **Coscia**, who are developing citizen science-led investigations into invasive and endangered mammals in collaboration with Natural England, the Essex Wildlife Trust and Peoples Trust for Endangered Species; **Mondal** who is working in India, Peru and Nigeria to remove arsenic and lead contamination through environmental health policy making on the Nutri-SAM project ('Nature and nurture in arsenic induced toxicity of Bihar, India').

The EERC has harnessed University expertise in media and digital creativity to bring our science to life through public engagement projects such as Virtual Chernobyl and work around urban agriculture (**Hardman**, **Wood**, see Section 4). The University's television and radio studios at MediaCityUK provide a valuable resource for developing media communication skills amongst our researchers. As a result, the research of 60% of our returned staff has formed the basis for news features, television programmes and documentaries for national and international media outlets (see Section 4).

Future research and impact strategy

EERC's vision is: *to understand the biological, physical, and social dimensions of environmental change and its impact on humans, animals and plants through high-quality impactful research*, *becoming a leading international voice in these fields influencing the wider research community and global public policy*.

To enhance the international impact of our work and its use to inform standards in environmental assessment and good practice, we have adopted the UN Sustainable Development Goals (SDG) as a method to improve alignment with global development priorities, using this nomenclature to improve communication with the international public policy community. We will:

- Increase our internationally focused research in **Sustainable Environments** and **Infectious Diseases**, expanding our contribution to the discipline and impact on environmental policy making across every continent.

- Expand interdisciplinary collaborations with health researchers, both externally through networks in Uganda and Nigeria, and internally (School of Health and Society), to undertake **capacity building to combat infectious diseases** of public health and economic importance. Sustainable Environments will expand research with external partners in our city-region and internationally around **food security**, **green infrastructure,**

green spaces and urban sustainability. Collectively, these activities will address SDG2 – Zero hunger, SDG3 – Good health & Wellbeing and SDG11 – Sustainable Cities and Communities.

- Develop **novel molecular ecology tools to understand the evolution and distribution of species**, working closely with non-academic partners to protect endangered taxa (SDG14 – Life Below Water, SDG15 – Life on Land) and develop **technological innovations in disease ecology**, especially in relation to monitoring and management.

We intend to maintain our two themes and deliver our contribution through the following aims:

- ***Increase the diversity and number of staff*** by developing early career researchers (ECRs) through supporting them to develop their networks and establish new funded collaborations, and where appropriate making strategic appointments at senior level, seeking to increase representation of staff identifying as female and BAME.

- ***Increase the number of postgraduate researcher (PGR) enrolments and completions*** in EERC through growth in domestic and international recruitment. This will allow us to boost our knowledge base, enrich our scholarly community and grow the next generation of scholars.

- ***Increase the value and duration of external research funding*** to allow for greater stability in our activity. This will be achieved through the three-year research planning process and increased participation in larger collaborative research grant applications.

- ***Expand the breadth and depth of impact of EERC research*** for a diversity of non-academic users through continued staff development in this area, with a focus upon the deployment of novel methodologies, service delivery and informing policy related to environmental assessment and standards.

- ***Maximise the use of strategic infrastructure investments on campus.*** The new £65m Science, Engineering and Environment (SEE) building (to open in 2022/23) will have dedicated facilities for EERC research to support our two themes. As part of the Campus Masterplan development the campus itself will become a 'living lab' to create and test new sustainability initiatives. We will work closely with SEE researchers in built environment and urban planning (UoA13) to exploit these opportunities to develop solutions with global applicability.

Open research with integrity

Integrity is managed via the School Research and Enterprise Committee (SREC); a research oversight committee of academics, technicians and PGR students chaired by the Associate Dean for Research and Innovation (ADRI). EERC researchers adhere to the University's Research Code of Practice, maintaining research integrity and promoting an open research environment. We endeavour to make our research discoverable and accessible; all our researchers have ORCID identifiers, deposit research in USIR and publish gold Open Access wherever possible, with Article Processing Charges met through UKRI and University funding.

We have EERC-specific frameworks for research integrity, including a **CITES** (Convention of Trade in Endangered Species of Wild Fauna and Flora) registration since 2019, which allows us to exchange animal samples from endangered species via the use of a labelling scheme (and supports upcoming NERC-funded research of **Beck** and **Boubli**). We also hold a **DEFRA** (Department of Environment, Farming and Rural Affairs) licence to import, move and keep prohibited soils for chemical and physical analysis (which supports NERC-funded research by **Mondal** and **Wood**). These licences are administered by a **specialist technician** and support the research of around half of our returned staff. Individual research teams ensure all other sampling permits, licences and/or shipping samples are in place prior to conducting research. Due to the

breadth of international collaborative activity, UoA7 led the University response to the **Nagoya Protocol on Access and Benefit Sharing,** shaping policy and driving improved research integrity across the institution, supported by a central point of contact (Research Governance Officer). For projects with a molecular ecology aspect, all sequence data are deposited in the National Centre for Biotechnology Information (NCBI) and/or other archives. Similarly, our environmental science data are openly available through repositories such as the Environmental Information Data Centre (EIDC).

Our integrity in research extends to research assessment. After the University became a signatory to DORA a Task & Finish Group was set up, which is chaired by **Wood**, and ensures that the DORA principles are implemented across the University. Within EERC, we maintain a clear focus on these principles when mentoring colleagues and in other aspects of staff development.

2. People

Staffing strategy

In our REF2014 submission the Sustainable Environments and Infectious Diseases groups totalled 27.2 FTE. This has now increased to 29.0 FTE split between this and our UoA3 submissions, which highlights the sustainability of these groups over time through investment in new expertise, especially ECRs. Given the institutional priority of industry collaboration, we have actively supported all staff in developing partnerships with non-academic partners, leading to all new early-career staff establishing such collaborations within the first year of appointment, evidenced through research outputs or collaborative funding awards.

Of our 24 staff, eight are Professors (0F:8M), six are Readers (3F:3M), four are Senior Lecturers (1F:3M), five are Lecturers (2F:3M) and one is a Postdoctoral Research Fellow (1M). On the census date five staff (3F:2M) were within five years of their first permanent appointment. One third of our staff are Professors, ensuring that the groups benefit from senior leadership expertise for development of EERC and group strategy and effective mentoring of junior staff. 42% of our staff are mid-career and 25% are ECRs ensuring that there is a development pipeline to allow staff to progress into more senior roles. Promotion opportunities during the REF period have ensured staff are supported to progress their careers at Salford and workshops are held to encourage a range of applications from diverse groups. Nine staff have been promoted during the REF period (4F:5M): two from Lecturer to Senior Lecturer (**Ferry**, **Hardman**); six to Reader (**Benvenuto**, **Jehle**, **Mondal**, **Parnell**, **Yates**, **Wood**) and two from Reader to Professor (**Boubli**, **Wood**).

For academic appointments, a senior research academic is part of the shortlisting panel and interview panels include a member of the School management team (usually the ADRI) and a panel member focused on assessing research potential and alignment. Following this strategy, we have recruited nine staff into EERC since 2013, including one professor (**Jackson**) and seven lecturers to their first substantive posts (**Antwis**, **Beck**, **Coscia**, **McDevitt**, **Meyer**, **Parnell**, **Yates**; 4F:4M). To meet our REF2014 aim to grow molecular ecology research, five staff recruited since 2014 have core research strengths in this area. Eight new staff have been returned with SRR (significant responsibility for research) status (3F:5M) and one is being supported as a next-generation researcher to commence their research.

Sabbaticals
Sabbaticals are awarded for a period of 3-12 months, primarily based on the alignment of the proposed research activity with the strategic aims of the EERC. Sabbaticals were awarded to seven staff during the REF period (Adams, **Beck**, Benvenuto, **Danson**, Mariani, **Martin, Mondal**; 4M:3F). Many of these sabbaticals included time at international institutions including five US universities (e.g. University of Massachusetts, Boston and Harvard University), the National Agricultural labs in South Africa and with various research partners in Brazil, France, Hawaii, Peru, Malaysia and India, thus leading to strengthened partnerships. During their sabbaticals, staff collectively presented at 10+ conferences and published over 30 peer-reviewed articles.

Research workload
Staff are allocated a research workload as part of the Academic Career Framework, as detailed in REF5a. We have developed a new process to support academics' research, where researchers can provide a summary of their current level of researcher development and produce plans for their research and support needs over a three-year period. Reviewed by a panel of senior research academics, through the EERC, the professoriate and the ADRI, staff agree on individual research workloads and support plans. The EERC steering committee links the University-level management structures and strategy, through the ADRI, facilitating the coordination and delivery of research objectives. Three-year plans feed into an annual Performance and Development Review process that manages objective setting, progress review and workload setting.

Training and development for high-quality bids, outputs and impact
All EERC staff have access to the University-wide researcher training and development (SECRET) programme (REF5a). At the School level, EERC staff participate in the SEE early-career and Professorial Networks that have been established (led by **Wood**) to develop and integrate research with teaching and enterprise and to give a voice to all sections of the research community. We facilitate **interdisciplinary collaboration** through research centre meetings, away days and weekly School research seminar series that invite prominent external speakers to talk and foster collaboration.

Dedicated development opportunities are organised by the EERC and School. These include access to a **peer-review network** and **funding for external research bidding training** to develop bid writing skills and enhance bidding success. Constructive review and feedback are offered through this network for all external research bids and it is an institutional requirement for UKRI, GCRF and other large bids. **Impact training**, including competitive internal funding to resource impact generation and workload to develop major impact activities, is supported by a dedicated Impact Coordinator (**Wood**). Furthermore, monthly School-wide open meetings on research impact facilitate knowledge sharing across Research Centres, foster an impact culture amongst the broader staff base and provide a supportive environment to help staff develop their impact strategies.

We support the development of research management and leadership expertise for ECRs through their membership of the EERC Steering Group. 13 staff (3F:10M) across a range of career stages have served on the panel, thus enhancing their research career development and ensuring EERC leadership succession planning.

All staff have access to a University-wide mentoring and training scheme (REF5a, organised by **Wood**), especially during their probation period to facilitate their integration into the EERC. New staff have additional support through reduced teaching loads for one year and prioritisation for internal PhD studentships. Ten staff further benefitted from a VC's Scholarship with an additional 20% research time allocation for one year. Staff have access to competitive pump-priming awards of up to £5k from the EERC. Bidding support strategy for new lecturers has focused on starting with smaller bids (e.g. charitable funders, start-up awards and priority access to internal funding streams), building towards larger bids. UKRI (NERC, BBSRC) bids are supported by internal peer review prior to development and submission. As a result of this support, new staff have generated **£2.7m in research income** since their appointment, including ECRs:

- **Parnell:** £861k from Horizon 2020, USDA, BBSRC, NERC and DEFRA, among others
- **Beck:** recently awarded £648k for a NERC New Investigator Grant as PI (with **Boubli** as Co-I – start delayed by COVID-19 to September 2020).
- **Yates:** NERC: Knowledge Exchange Fellowship (£94k), Innovation Grant, Landscape Decisions, iCASE (total: £274k) and a British Ecological Society-DEFRA Policy Fellowship (£20k)
- **Antwis, Coscia** and **McDevitt** have collectively won over £270k from a range of funders including The Royal Society, NERC, DEFRA, NatureScot and various other trusts, societies, charities and philanthropic funders

Internal funding schemes
Internal funds, recovered from a proportion of overheads from grant income, are devolved to the EERC to strategically pump-prime research and support the purchase of equipment that will benefit multiple researchers. Funding is disbursed through a **competitive bidding scheme** (which develops grant writing and review skills amongst EERC members). **Novel interdisciplinary research** is prioritised to engender a collegiate culture of multidisciplinary collaboration that facilitates new research directions. During this REF cycle, over £70k of EERC funds have been distributed to pump-prime research projects in the EERC, improving publication and track records for these researchers. ECRs are further prioritised to establish new research projects and, with the recognition that this is a group with a higher proportion of female staff, ensures equality and diversity is considered in our mechanisms for support.

In addition to EERC funds, staff have been supported by over £124k of funding from centrally administered internal schemes, including the Research Impact Fund (£17.5k), the VC Scholarship Award (six staff), pilot project and bidding support, as well as conference travel. Additional support to cover the cost of Article Processing Charges for publishing in peer-reviewed journals is provided by the University's Open Access Support Fund, which 19 of our staff have accessed, in addition to open access agreements with publishers.

Ensuring an excellent postgraduate research experience

We have enhanced support for students through the development of new research studentships that are jointly funded through HEIF and investment from non-academic partners. EERC staff supervised 12 University of Salford iCASE PhD studentships, totalling over £1.1m. Matched funding has been provided by The Pew Foundation, Mersey Gateway Environmental Trust, Bee Disease Insurance, Operation Wallacea, DEFRA, NERC, CEFAS, Rushmore Estate, Chester Zoo, Natural England and NatureScot (formerly Scottish Natural Heritage). Expanding on this model is a strategic priority for PGR support and development going forward and we will leverage our networks to increase the proportion of PGRs working on projects with NGOs, charities and policymaking organisations.

We have awarded **61 doctoral degrees this period: an increase of 15%** from the 53 reported to UoA5 and UoA17 in REF2014. In addition, because of increased auditing of the progression journey and mandatory supervisor training, our on-time (four years full-time; seven years part-time) **PhD completion rates have risen from 71% to 92%**. 43% of our PhD students completing in the period were female and we have excellent representation of BAME students (40%) within our completions, representing 16 countries and reflecting our international approach to research and collaboration.

PhD progression is closely monitored through the SREC, chaired by the ADRI, and any issues with progression are identified and resolved at an early stage; four members of EERC (**Danson**, **James**, Mariani, **Wood**) have served on SREC. All staff contribute to progression and final *viva voce* assessments (as examiners or independent chair), ensuring a common understanding of expectations across supervisory teams and an independent audit of PhD progression. Students have monthly formal meetings with their supervisory team, ensuring an excellent supervisor-supervisee relationship develops throughout their PhD studies. Supervisory teams are usually comprised of a main supervisor and a co-supervisor, often with ECRs paired with more senior researchers to develop new staff. In line with our industry collaboration strategy, 20% of our supervisory teams include non-academic partners**,** which supports students to understand and develop impact activities in their research. One such advisor is Dr Vincenzo Lorusso, Global Scientific Manager (Parasitology) at pharmaceutical company Vetoquinol.

To complement the Salford Postgraduate Research Training (SPoRT) programme, SEE runs a first year PhD student symposium with training in giving scientific presentations. PGRs contribute to the SEE seminar series and the University-run Salford Postgraduate Annual Research Conference (SPARC; **Wood** served on organising committee), where students and ECRs present

their research and gain feedback. EERC has developed a bespoke training course in statistical analysis for environmental sciences, including R software, which is offered to all PGR students. All PhD students are encouraged to apply for grants, publish and present their work during their PhDs in order to build a track record. Examples of our PhD students' grant successes are:

- Brettell, who published eight papers and presented at five conferences
- **Mastin**, who published five papers during his PhD and presented at a range of national and international conferences, subsequently becoming a Postdoctoral Research Associate at the University (with funding from the USDA, H2020 and UKRI) and is now being returned in this submission.
- Passos, who published eight papers and won a Gold Award for Research from the British and Irish Zoo and Aquarium Association (BIAZA)
- Sales, who was awarded £20k as a co-PI from the People's Trust for Endangered Species and published seven papers during her PhD

In addition to many of our students securing postdoctoral or lectureship positions, many also go on to work in non-academic sectors, particularly in government, for example: Aramrun is Head of Nuclear & Radiation Emergency Coordination for the Thai Government; Baillie is a statistician for the Department for International Development; and Perrin is a scientific policy advisor for the Animal and Plant Health Agency. Many of our students also return to their home countries to take up academic or industry positions, for example: Abdulghani and Althomali took up lecturing positions at universities in Libya and Saudi Arabia respectively, and Goulart and Kaizer returned to Brazil to work for an environmental company (Bicho do Mato) and to run a wildlife NGO (Muriquis do Caparoa, National Geographic Young Conservation Leader) respectively.

Equality and diversity

Our former School of Environment and Life Sciences (ELS) successfully achieved Athena SWAN Bronze in 2018. Following the unification of ELS into the School of Science, Engineering and Environment (SEE) with two other Schools, we will apply for interim Athena SWAN Bronze in 2020/21. The EERC supports staff with relevant individual circumstances (whether protected characteristics or not) to make use of institutional mechanisms of support where necessary, which further enables productive engagement with research.

Increasing our representation of women and BAME academics is a priority for EERC, SEE and the wider University and this is especially the case at Professor level. Over the current REF period we have had equitable recruitment of women to men at Lecturer level and achieved equitable representation of women to men at Reader level. Moreover, although only 25% of our returned staff are female, 43% of sabbaticals, 40% of promotions and 33% of central research funding was awarded to women including 40% of VC Scholarships. In alignment to our REF2021 Code of Practice, the attribution of REF2 outputs to staff has been subject to an equality impact assessment. Our REF2 submission reflects the gender ratio of our submitted staff, with 27% of outputs attributed to a female author (+2% compared to the proportion of female submitted staff). 3% of outputs are attributed to staff from a BAME background (-1% compared to the proportion of BAME submitted staff). We recognise that this is low and as part of wider work within SEE relating to our Race Equality Charter submission we have committed to addressing diversity more widely within our research community.

Since 2017, as part of the Athena Swan action plan, **Wood** has been delivering workshops at an institutional level to support those considering Readership/Professorial promotion. This was identified as a priority area for support in each School and subsequently there has been a significant increase in the number of women achieving senior academic promotions, evidenced by 44% of promotions in this submission awarded to women. These workshops, coupled with specific mentoring of those seeking promotion, will be continued.

3. Income, infrastructure and facilities

Research income

We generated close to £3.9m in income with 112 active projects during this REF period. We have been predominantly supported by Research Council funding (£1.7m; 44% of the total), mostly from NERC schemes. Income from EU sources totalled £659k (17%) and we have also generated £532k from UK charities (14%), £493k from non-EU sources (13%) and £343k from UK government sources (13%).

The School has an established internal peer review process, which provides mentorship and interdisciplinary, constructive feedback to grant applicants to help develop rigorous proposals for successful external funding. For major applications with strategic alignment to the School and University, a dedicated senior research development manager (a former UKRO European Adviser) provides technical & proposal/academic partnership development support as well as training and guidance on UK/EU research funding programmes and policy. The KTP and Partnerships Office is key for supporting the researcher community in developing academic-commercial partnerships and the joint preparation of Knowledge Transfer Partnerships (KTP) and iCASE studentship applications.

Key grants and associated non-academic partnerships during this REF cycle within our two broad areas of **Sustainable Environments** and **Infectious Diseases** include:

Sustainable Environments:

- **£1.2m** award from the **EU's Urban Innovation Actions** initiative for the IGNITION project (**James** as Co-I). This is led by colleagues in our Sustainable Urban Futures group (UoA13) bringing together 12 partners from local government, universities, NGOs and businesses to identify innovative financing and delivery of natural climate solutions in Greater Manchester. **James** also received £35k in NERC funding to understand the role of green infrastructure in promoting health and wellbeing in cities
- **£505k of NERC and EC income** to Mariani to investigate seafood mislabelling in collaboration with the Spanish government and other European partners
- **£400k in NERC and other income** to Mariani and **McDevitt** to explore the use of environmental DNA (eDNA) in terrestrial and aquatic species distribution mapping in collaboration with end users including DEFRA and various wildlife trusts
- **£334k in EC income** to Collins (†) for the HighNoon project to understand the adaptation to changing water availability in northern India as a result of Himalayan glacier retreat and changing monsoon patterns
- **£271k from NERC to Wood** to undertake the science required to reduce uncertainty in radiological risk assessments for humans and wildlife, using the Chernobyl Exclusion Zone as a natural laboratory (TREE project) and a further **£100k+ from NERC and NATO** to study the environmental impacts of radiation, including the development of biomarker-based methods
- **£248k from NERC to Yates** to develop and evaluate UK marine spatial planning and management
- **£59k** in **Newton** funding to **Benvenuto** to understand the current status and future directions of demand, supply and food security of crustaceans in Brazil
- **£47k** in **British Council** funding to **Mondal** and **Danson** to investigate arsenic induced toxicity in India
- **Hardman** generated **£54k** in funding from Manchester and Oldham City Councils, World Conservation Monitoring Centre, Wythenshawe Community Housing Group and other non-academic partners to develop a body of research around urban farming and food bank use

- Our extended network in Brazil, developed by **Boubli**, **Meyer** and **Young**, has led to >£1.1m of in-country research funding that has supported two postdocs and eight PhD students.

Infectious Diseases:

- Over **£1m of EU**, **NERC**, **BBSRC**, **USDA**, **The Royal Society** and **DEFRA** awards to **Antwis**, **Mastin** and **Parnell** to understand the spread and impact of invasive tree diseases, including **£217k from BBSRC** to enhance UK surveillance and response to *Xylella fastidiosa* in collaboration with the John Innes Centre, FERA and the Forestry Commission; a further **£139k in EC funding** to understand the containment of this pathogen in Europe; **£149k from NERC** for the surveillance and management of resilient treescapes through the integration of epidemiology and stakeholder behaviour
- **£593k from NERC** to **Jackson** to understand immunodynamics and infectious disease risk in the natural environment
- **£463k from Wellcome Trust** to Craig to understand multi-species transmission of *Echinococcus* on the Tibetan plateau
- **£328k from the Brazilian National Council**, **the Beekeepers Association**, **Project Apis-m** and other non-academic partners to **Martin** to understand the spread and impact of deformed wing virus and varroa mites in bee populations in the UK and US.

These collaborations with non-academic stakeholders have opened up access to new resources and led to future projects for our researchers. For example:

- **Antwis'** iCASE studentship is supported by Rushmore Estate, which allows student access to sampling sites and training in forestry techniques. In collaboration with other project partners including DEFRA, Natural England and Chester Zoo, this project aims to identify effective strategies for reducing the impact of ash dieback on commercially important forest stands, the results of which will be used to inform management practices both nationally and internationally.

- **James**' iCASE partnerships with the Mersey Gateway Environmental Trust have shaped the development of policies and management of habitats. Through this partnership, staff and students were able to access sites for various research projects and the results were used to directly shape the management plans for the Upper Mersey Estuary. One of the students was subsequently employed by the Mersey Gateway Environmental Trust and the other joined an ecological consultancy.

- **Jehle's** iCASE was facilitated by Operation Wallacea, who provided access to sites and samples, leading to the establishment of the Morelet's crocodile as a flagship species for a UNESCO World Heritage Site and Biosphere Reserve (Calakmul, Mexico) and resulted in several follow-up projects and proposals involving local stakeholders and Operation Wallacea.

- **Martin's** two iCASE studentships with Bee Diseases Insurance facilitated access to a network of beehives for research and a platform for communication with beekeepers. Funding secured through that iCASE partnership also supported the purchase of dedicated molecular equipment for bee research. These resulted in monthly talks to beekeepers both nationally and internationally, the production of a 'BBKA Special Issue' and a further $30,000 USDA grant with partners in Hawaii.

- **McDevitt**'s two recently initiated iCASE studentships focus on the application of novel molecular tools in monitoring species of concern in multiple geographic regions. One is a partnership with CEFAS, for applying portable DNA barcoding techniques to improve traceability and reduce illegal wildlife trade in CITES-listed shark and ray species in Indonesia. The other is a partnership with NatureScot, informing management and

eradication strategies on a national level by applying cutting-edge environmental DNA techniques to monitor endangered and invasive mammals in the UK.

Infrastructure and facilities

Our growth has been supported through the following targeted infrastructure investment aligned with our strategy to support expansion of molecular ecology and collaborations with industry and end users:

- A new **Genomics Facility** (£525k) complete with Illumina MiSeq and MinION Nanopore sequencing capacity and associated high performance computing equipment (£160k) to support eDNA and microbiome research involving half our submitted staff (5F:7M), resulting in 20+ peer-reviewed publications and new collaborations with several other universities and institutions (e.g., University of Manchester, Aberystwyth University)

- A new **soils and DEFRA research lab** (£252k) complete with Inductively coupled plasma atomic emission spectroscopy (ICP-AES) and X-ray fluorescence facilities, which have led to 10+ publications and support the research of 25% (2F:4M) of returned staff and the commercial projects of AquaUoS (see Section 4)

- The development of an **eDNA laboratory** (£55k) that supports six (4F:2M) of our submitted staff and has led to 10+ peer-reviewed publications and external funding totalling £345k, including new collaborations with DEFRA, NatureScot, Essex Wildlife Trust and The Vincent Wildlife Trust that aim to identify declining and elusive mammals in the UK and to reduce the illegal trade of shark products in Indonesia.

Within this REF period we have also secured major institutional investment for a new **£65m SEE building as part of the Campus Masterplan**. This will include high specification laboratories, staff accommodation and flexible teaching space over 15,700m^2, bringing SEE together under one roof to drive interdisciplinary research. The new **Acoustics building** (REF5a) will further expand the infrastructure and facilities that support our environmental acoustics research. Our interdisciplinary research on environmental acoustics for biodiversity assessment and monitoring would not have been possible without access to the physicists and facilities within the Acoustics Laboratories; the semi-anechoic and reverberation rooms have been key for characterising and calibrating environmental acoustics equipment prior to deployment in places such as the Chernobyl Exclusion Zone.

Salford's **MakerSpace** has been crucial to the development of our research programmes, providing design and fabrication capabilities that allow us to create equipment for our research. A notable example of this is the development of the Radioanalysis Of Small Samples (ROSS) detector for live measurement of radioactivity in small animals. Developed by **Wood** and one of his PhD students, this first-of-its-kind detector uses many parts manufactured within MakerSpace and enables non-lethal radioecological studies to be undertaken (thereby making an important contribution to realising the 3R agenda within our research and that of others internationally). MakerSpace and THINKlab have also been used extensively by EERC researchers to develop public engagement and educational resources based on their research. Examples include VR installations and a 3D model of the Chernobyl Exclusion Zone over which people can practice flying drones whilst learning about our drone-based research.

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

EERC research addresses both national and international needs and priorities within our two themes, partnering with the relevant overseas organisations to conduct research that leads to impact.

Sustainable Environments: biodiversity and species conservation

The impacts from habitat destruction and environmental pollution on species and ecology, including humans, is a core strength and focus of our international collaborations and we have developed approaches and new methods for global monitoring of endangered and invasive species with key organisations, for example:

- **Boubli** works with the *International Union for Conservation of Nature (IUCN) Primate Special interest group* having described two new genera and four new primate species and assessed their conservation status using predictive modelling of deforestation.

- **Jehle** worked with *Kinday University (Japan), National Taiwan University, Paris Natural History Museum* and *Hellenic Agricultural Organisation* to reveal how seven eel species share common breeding grounds in the South Pacific and to identify how amphibian biodiversity is impacted by biogeographical change.

- **Meyer** advanced understanding of bat responses to fragmented landscapes in Amazonia, culminating in an F1000-recommended synthesis of their findings, through a project with the *Brazilian National Institute for Amazonian Research (INPA)*.

- Working with *Chornobyl Center*, *the State Agency of Ukraine for Exclusion Zone Management* and *UK Centre for Ecology and Hydrology*, **Wood** demonstrated that the abandoned Chernobyl Exclusion Zone (CEZ) has become a wildlife stronghold. This recognition of the CEZ's conservation value further supported the Ukrainian Government decision to designate it as a biosphere reserve. Through NERC funding, our environmental radioactivity research has expanded significantly over the last three years to include 15 Salford academics (5 from EERC).

- **Boubli** collaborates with the *Brazilian Ministry of Environment* and *Centre for the Triage of Wild Animals (CETAS)* to relocate or house animals impacted by illegal animal trade. **Boubli**, **Coscia**, **Mariani** and **McDevitt** work with the *IUCN*: **Boubli** has authored threat status assessments on 20 endangered primate species; **Coscia**, **McDevitt** and Mariani revised the Red List status of the Killarney shad *(Alosa killarnensis)* to 'vulnerable' to ensure appropriate conservation measures. **Beck** and **Boubli** will be combining fossil, morphological and genomic data to reconstruct the phylogeny of New World monkeys (NERC, awarded mid-2020) with multiple international partners, including the Barcelona Institute of Science and Leibniz Institute for Primate Research.

- We are leaders in developing methods for eDNA applications to marine, freshwater and now terrestrial systems. This work has led to a suite of collaborations across Europe, North and South America, Asia and Africa including with government agencies (e.g. *DEFRA, Natural England, Scottish Natural Heritage, Marine Management Organisation*) and conservation organisations (e.g. *People's Trust for Endangered Species, Operation Wallacea*). Major impacts have been improving stock identification in multiple commercially important deep-sea fisheries and changing stakeholders' use of genetic-based evidence within policy decisions at the UK, European and global levels through **Coscia's** role on the '*ICES Working Group on Application of Genetics in Fisheries and Aquaculture'*.

Sustainable Environments: better environmental health and management

Our groups also collaborate widely to inform impacts of environmental change and wider studies on the human environment:

- **Mondal** is an adviser to the *Bihar State Pollution Control Board* on arsenic and lead in the rice-producing regions of India. **Mondal's** work contributed to revised guidelines by the World Health Organisation for arsenic in drinking water.

- **Wood's** radioactivity research has played a significant role in establishing the *International Atomic Energy Agency* (IAEA) handbook of parameter values for the prediction of

radionuclide transfer to wildlife; the key resource for countries to assess the environmental impacts of radioactivity (e.g. releases from power stations and nuclear medicine facilities) (REF3). **Wood** has been appointed as an international expert for the IAEA, including advising the *Fukushima Prefectural Government* and invited to Chair the UK Government consultation on the development of new radiation protection.

- **Yates** contributes to marine spatial management through her role on the Management Committee of the *MarCons European Cooperation in Science and Technology (COST) Action*, 2016-2021). MarCons consists of over 100 academic and practitioner scientists from 27 countries, with 17 journal articles and 12 policy briefs published to date.

Capitalising on the University's partnership with the Greater Manchester Combined Authority (GMCA), research by **Armitage**, **Hardman** and **James** has underpinned major sustainability initiatives throughout the Greater Manchester region. For example:

- Our £4m interdisciplinary IGNITION project with *GMCA* is developing nature-based solutions to tackle socio-environmental challenges including flooding, water security, air quality, biodiversity and human health and wellbeing, towards a 30% increase in Greater Manchester green infrastructure.

- The *Royal Horticultural Society (RHS)* Bridgewater project (opening 2021) – a 63-ha garden including community garden areas – has been developed in collaboration with **Hardman** and **James**. **James** further contributes to the *Local Nature Partnership in Greater Manchester* and his advice, based on his research, has contributed to initiatives such as Natural Course (*Mersey Rivers Trust*, as part of an EU LIFE 10-year project) and the *DEFRA* Urban Pioneer project, to quantify the natural capital value of private gardens. His work influences Greater Manchester's strategy on green space through the highly influential *UK National Ecosystem Assessment* and the Health and Wellbeing Influences on an Ageing Population project (NERC, AHRC and ESRC) as part of the Valuing Nature Programme.

- **Hardman**'s research on upscaling urban farming has informed environmental and policy change in the UK, South Africa and more widely across Europe, leading to large-scale development, job creation and support tools. Furthermore, our outreach activities and research have fed into the creation of *Northern Roots*, the UK's largest urban farm and eco-park (65ha; £31m) that is now is a driver for employment across Oldham and Greater Manchester and has resulted in a further £2m investment into the area. Funding from charities, ESRC, local authorities and housing groups has facilitated further policy change, with a new national code of practice developed with *Care Farm UK* and a range of regional policies generated through research on urban agriculture (*Manchester's Food Board*), including social prescribing practices (REF3).

Infectious Diseases: improving monitoring and management of disease threats

We have made key contributions to methods for monitoring of infectious diseases and influencing related policy change globally, for example:

- **Birtles** established USALTI-*Afrique* with Dr Lorusso from the international pharmaceutical company *Vetoquinol* (also a Salford honorary Research Fellow). USALTI-Afrique is a collaboration between five European and five African universities aiming to improve African capacity in infectious disease and 'one health' research. We have established a Memorandum of Understanding with *Gulu University* and *Makerere University* in Uganda to strengthen links for future projects.

- **Martin** has expertise in honeybee ecology and health, including the parasitic mite (*Varroa destructor*) and an emerging viral pathogen, deformed wing virus (DWV). He works directly with stakeholders throughout the UK (national and local *Beekeepers associations*),

Australia (*Department of Agriculture and Fisheries*), China, South Africa (*Agricultural Research Council*), Brazil (*UFRB*), Czech Republic and USA (*University of Manoa*, *Hawai'i*). **Martin** also sat on the 2016 *DEFRA* committee to develop the white paper on pollinator health.

- **Mastin** and **Parnell** work closely with UK (*DEFRA*), US (*Department of Agriculture*, *USDA*) and European organisations (*European Food Safety Authority*) on pathogen surveillance and computational epidemiological modelling as applied to economically and ecologically important plant species such as olive and citrus trees (as crops) and oak and ash trees. This has led to improved risk assessment, national surveillance strategies and plant health policy in multiple countries, including new European-wide laws on 'Europe's most deadly plant bacteria': *Xylella* (REF3).

Outreach and public engagement

A priority for the EERC is to involve the public in our research. Many staff also write for *The Conversation*, helping to disseminate their research to a wide audience. Our media engagement is extensive, with many of our research activities forming the basis for new pieces and or documentaries, for example:

- **Beck**'s research on mammal evolution has been covered by international media including the *Washington Post* and *USA Today* and he delivered two popular science pieces on dinosaurs for the children's BBC news programme, *Newsround*.

- **Hardman**'s work on urban agriculture has led to over 200 media appearances including with international outlets such as CNN (*'Can Urban Farms Feed Our Cities?',* 2016) and national media including the BBC (e.g. '*The Beast from the East*' documentary, 2018). Approximately 40 media articles followed his talk at the Royal Geographical Society on the impact of informal food production in cities in 2015/16.

- A long-term study by **Martin** and colleagues in Brazil uncovered a 4000-year-old network of 200 million termite mounds across an area roughly the size of the UK. Engagement with international mainstream media outlets (e.g. *BBC*, *The Atlantic*, *Washington Post*) raised the public's awareness of the importance and scale of social insect colonies.

- A seedcorn award to **McDevitt** and **Coscia** funded a citizen science-led eDNA monitoring trial programme for invasive and endangered mammals in Essex, conducted in collaboration with the *Joint Nature Conservation Committee*, *Natural England* and charities the *Essex Wildlife Trust* and *Peoples Trust for Endangered Species*.

- **Wood**'s research on the wildlife of Chernobyl has received international coverage including the *BBC*, *Channel 4*, *ABC*, *CNN*, *LA Times*, *National Geographic*, *TIME*, *New Scientist*, and *The Telegraph* and featured in two documentaries.

We actively and regularly seek to engage directly with the public on our research through science festivals, exhibitions and other events. International pop-up events have included Virtual Chernobyl (**Wood**: UK, Austria, Japan, Thailand, USA and Ukraine) reaching ~10,000 people and changing public perception of radiation and its impacts. **Hardman** has delivered a suite of public engagement events around urban agriculture, including Allotment of the Future in Manchester city centre, heading the launch of the new *Social Farms and Gardens* national organisation and launching a National Award for engaging young people around sustainability with the *Royal Horticultural Society*. Other engagement has been through installations at the Manchester Science Festival and the Big Bang Fair.

Contributions to the sustainability of the discipline

Selected leadership roles within learned societies and professional organisations

- **Antwis** – Royal Society's International Exchanges Committee (2020-); British Herpetological Society Council (2016-2019); Founder and Chair of the *British Ecological Society*'s Microbial Ecology Special Interest Group
- **Armitage** – Founding Member of the Food Geographies working group of the Royal Geographical Society; Member of the Earth Observation Advisory Committee of the UK Space Agency (2015-2019); Chair of the *Photogrammetry and Remote Sensing Society* and Council Member of *European Association of Remote Sensing Laboratories*
- **Coscia** – ICES working group (advisory); FSBI council (society)
- **Hardman** – Expert for the Food Standards Agency; Founder of the Royal Geographical Society's Food Geographies Research Group
- **James** – Chair CIEEM medal committee (their highest individual award); Chair of Mersey Gateway Environmental Trust Research Board; Trustee of Lancashire Wildlife Trust
- **Jehle** – Council of Tropical Biology Association. Executive Committee of World Congress of Herpetology
- **Martin** – IBRA executive board; Fellow of the Royal Entomological Society (FRES)
- **McDevitt** – Council member of Mammal Society
- **Mondal** – Member of UK and Ireland Exposure Science Group, Society of Environmental Geochemistry and Health
- **Parnell** – European Food Safety Authority (*EFSA) Working Group on Surveillance*
- **Wood** – Chair of UK Government Consultation on development of new radiation protection legislation; Trustee and Member of Council for Society for Radiological Protection (SRP); Member of SRP 'Outreach Committee' & 'Awards & Sponsorship Committee'.

In addition, four staff have chartered status from: the *Royal Geographical Society* (**Entwistle**, **Hardman**), the *Royal Society of Biology* (**James**) and the *Society for Radiological Protection* (**Wood**).

Peer reviewing for councils, charities and government organisations

Staff contribute expertise to grant panels or undertake reviews for UK Research Councils including NERC (~50% of staff), BBSRC (25%) and ESRC, MRC, EPSRC, STFC and UKRI (Future Leaders Fellowships). Similarly, staff review for research charities and learned societies such as the Royal Society, the Leverhulme Trust and the British Ecological Society. Half of our staff undertake reviews for international funding bodies including: the US National Science Foundation (**Antwis**, **Martin**) and Department of Agriculture (**Parnell**), the European Research Council (**Beck**, **Martin**), National Institute of Amazonian Research in Brazil (**Boubli**), the Icelandic Research Fund (**Coscia**), Finnish Academy (**Danson**), Austrian Science Fund (**Jackson**), for NSERC (**McDevitt**), SSHRC (Canada; **McDevitt**), FNRS (Belgium; **McDevitt**) and NCN (Poland, **McDevitt**), NRF (South Africa; **Meyer**) and European Commission (**Yates**), as well as multiple international governments (**Martin**, **Young**).

Honorary positions

Honorary positions at other institutions include the following organisations: Institute of Zoology (**Antwis**); University of Manchester (**Antwis**, **James**); American Museum of Natural History and University of New South Wales (**Beck**); University of Liverpool (**Birtles**, **Wood**); University of Aberdeen (**Birtles**); University of KwaZulu Natal, James Hutton Institute and Ryseron University, Toronto (all **Hardman**); Mammal Research Institute (**McDevitt**); University of Queensland (**Yates**); Federal University of Ourobreto, Brazil (**Young**).

Selected keynotes, plenaries, panels and awards

- **Antwis –** British and Irish Association of Zoos and Aquariums Gold Research Award 2014

- **Armitage** – seven invited talks including Royal Geographical Society and Remote Sensing & Photogrammetric Society (RSPSoc)
- **Beck** – Keynote speaker at Molecular Paleobiology of Australia (2016)
- **Benvenuto** - Keynote at the XXIII Brazilian Ichthyological Meeting (2019)
- **Boubli** - Keynote speaker for the III Congress of the Latin American Primatological Society
- **Coscia** - World Fisheries Congress 2020 panel member
- **Danson** – Keynotes at RSPSoc (2014) and Spanish Remote Sensing Society (2018)
- **Hardman** – 18 invited talks, including Chair of UNESCO Workshop on the Urban/Rural Divide and Invited Speaker for UNESCO Special Programme on Sustainable Cities (2017)
- **Jackson** – Invited speaker to British Society of Parasitology (2018)
- **Meyer –** Keynote at 5th British Bat Research Symposium (2018)
- **Mondal** – Keynotes at Arsenic (2018) and Royal Geographical Society Conference (2019)
- **Wood** - Awarded Times Higher Education Research Project of the Year (2016) and the Founder's Medal from the Society for Radiological Protection

Conference organisation
National and international conferences organised with expertise from our staff include: Amphibian Conservation Research Symposium and four events for the British Ecological Society (**Antwis**; 2015-2018) including a simultaneous multi-city 'Pint of Science' public engagement event (May 2017); Joint Chair of the UK Earth Observation Conference (**Armitage**; 2018); Organising committee member for Society of Vertebrate Palaeontology and Comparative Anatomy annual meeting (**Beck**; 2018); The Royal Society terrestrial laser scanning revolution in forest ecology conference (2017) and the Laser Scanner International Interest Group in 2014 (**Danson**); Executive Committee of World Congress of Herpetology, including Member of the Organising Committee of the 8th Congress in 2016, China (**Jehle;** 2008-2020), UK DNA Working Group (**McDevitt**; 2017); NATO symposium on radiation biomarkers (**Wood**; 2017).

Journal Editorships
Seventeen staff have served on editorial boards for more than **30 peer-reviewed journals**. For example: *The Herpetological Journal* (**Antwis** and **Jehle**), *Scientific Reports* (**Beck** and **Benvenuto**), *Journal of Mammalian Evolution* (**Beck**), *IJSM* (**Birtles**), *Biological Journal of the Linnean Society* and *Journal of Fish Biology* (**Coscia**), *Quaternary* (**Hutchinson**), *Parasitology* (**Jackson**), *Environmental & Sustainability Indicators* (**James**), *Animal Conservation* (**Jehle**), *Applied and Environmental Microbiology*, and *Journal of Chemical Ecology* (**Martin**), *Biological Invasions* and *Mammal Research* (**McDevitt**), *Diversity* (**Meyer**), *Frontiers in Science* and *International Journal of Environmental Research and Public Health* (**Mondal**), *Journal of Radiological Protection* (**Wood**), *ICES Journal of Marine Science* (**Yates**), *Applied Animal Behaviour science* and *Frontiers in Animal Science* (**Young**). **Danson** edited the Royal Society Interface Focus Special Issue, 2018.

Books
Returned staff have collectively **written over 30 books and book chapters** since REF2014. Examples from across our discipline areas include: '*A Field Guide to the Bats of the Amazon*' by **Meyer**, the first book of its kind for the region, now widely used by bat biologists, bat conservation NGOs, and environmental consultancies in Brazil and the wider region; **Yates**' book on '*Offshore Energy and Marine Spatial Planning*' that brings together the ecological, economic and social implications of offshore energy and explores the direct and indirect impacts on the uses of marine space; and **Antwis** as lead editor of '*Host Microbiomes of Soils, Plants and Animals: An Integrated Approach*' (Cambridge University Press).