

**Institution: Oxford Brookes University**

**Unit of Assessment: 5**

### **1. Unit context and structure, research and impact strategy**

#### 1.1 Unit Context and Strategic Goals

Our submission comprises 43.06 FTE; 37.8 from the Department of Biological and Medical Sciences (DBMS) in the Faculty of Health and Life Sciences (FHLS) and 5.26 from the Department of Social Sciences (DSS) in the Faculty of Humanities and Social Science (FHSS), and thus overall > 90% of eligible academic staff. This represents an increase of 47% FTE compared to REF2014 (25.6 FTE) reflecting our aim to increase staff and activity in our REF2014 strategy. This is further evidenced by the increase in our PhD completions from 35 to 81 compared to the last REF. We have therefore built a strong, diverse and sustainable environment for research and teaching excellence across the biological sciences with economic and societal impact to help deliver the UKRI strategic prospectus. This has been achieved by focussing on five strategic goals during this REF period.

First, to strengthen and sustain the synergistic benefits from the rich diversity of our research portfolio, researchers with complementary research interests and expertise, across all career stages, are clustered into four linked themes: **Ecology and Evolution, Genetics and Genomics, Biomedical Science, and Cell and Developmental Biology**. This allows us to address a broad range of questions in biological sciences while ensuring strength and critical mass in these key areas and embedding collaborative approaches capturing the benefits of joint student supervision, joint grant applications and higher impact outputs (see 1.2.3).

Second, we built on our existing research strengths to support researchers across these four themes, providing platforms for collaboration and building expertise and capacity in two growing and unifying areas of biological science – bioimaging and genomics. To achieve our goal we established two new research Centres: The **Oxford Brookes Centre for Bioimaging** (CfB) and the **Centre for Functional Genomics** (CfG) (see 1.2.4).

Third, we have strategically funded our research to support areas of excellence recognised in REF2014 and with successful grant capture, and to nurture and promote researchers with great potential. This included providing world-class labs and other facilities (see 3.2), as well as access to all necessary specialist equipment. The allocation of funded studentships and central research funds (CRF) was prioritised to sustain areas of excellence, underpin promising new research, and support early career researchers (ECRs) (see 1.2.2).

Fourth, we have developed structures to increase the commercial and societal impact of our research. Central to our approach to impact has been our commitment to work in partnership with our Research and Business Development Office (RBDO) and the Faculty Innovation Team (FIT) headed by **Meredith**. Our researchers are also encouraged to work closely with our Research Engagement Officer to ensure our achievements are publicised through press releases and social media. We have established the BioInnovation Hub (BioH), a bioincubator for Oxford Brookes University (OBU) spinouts and external companies, hosting several biotech companies since 2015, including Oxford Expression Technologies (OET), which is part of our REF2021 Impact Cases portfolio (see 1.3).

Fifth, to build and sustain excellence, capacity and critical mass, we have recruited, promoted and retained ECRs in all four research themes and the two Centres, while continuing to mentor and develop other staff to nurture and sustain experience in all areas. We ensure that with all recruitment and staff development we promote diversity and equality of opportunity (see 2.1-2.3) as described in the Institutional Environmental Statement (section 3).

#### 1.2 Mechanisms for Implementation of Strategy

##### 1.2.1 Development and Management

Research in this UoA is led by a Research Lead (RL; **McGregor**), a university role for a Senior Professor. The RL is a member of the Faculty and University Research and Knowledge Exchange Committees and chairs an inclusive cross-faculty research management team comprising 50% women, 10% BAME, with representatives from each theme and Centre, and career levels from doctoral students to Professors. This team provides an interface between researchers in DBMS and DSS to enhance interactions within and between themes and Centres as well as to plan and implement research strategy. For example, this forum recognised cross-faculty interests and needs in genomics and so developed and launched our CfG (see 1.2.4.b). Research is supported by Faculty Research Office teams supporting research administration as well as the FHLS and FHSS Associate Deans for Research and Knowledge Exchange and postgraduate (PG) tutors. All members of the UoA have ownership of the strategy as it is developed through research sessions at consultation meetings and away days, including technical, support and contract research staff, and doctoral students. There is also an annual networking event of flash-talks, enabling awareness of one another's research and facilitating collaborations.

#### 1.2.2 Implementation of strategic funding of research

We have targeted internal funding (QR and Royalty funding from IP licensing) to support our strategic aims. In this REF period we have funded a total of 46 PhD studentships (c.£2,000,000 2015-2019). PhD studentships are routinely prioritised to small teams of supervisors preferably combining staff at different career stages (e.g. **M. Kittelmann/Bermudez, Sunter/Vaughan, McGregor/Nunes, Gerth/Thompson, Kanda/Nekaris**). We have targeted start-up funding for new projects that represent collaborations within and between research themes and our two Centres (e.g. **Schoenauer/McGregor, Pink/Carter, Ragge/CfG, Solana/CfG, Newbury/CfG, Gerth/CfG, Kanda/Nekaris/CfG**), for example, totalling £45,000 in 2019-20.

During this REF period, we have taken advantage of the c.£21,500,000 reconstruction of the Sinclair Building to replace our laboratories and provide specialist-use research space (see 3.2). The new researcher-led, architect-designed large multi-user laboratories and offices, built to the highest current specification, facilitate collaboration and interaction. An example of this is our new dedicated specialist facilities for invertebrate research to support growing strength in this area, now represented by ten research groups compared to three in REF2014. At the same time, an adjacent building was internally reconstructed (c.£2,600,000) to co-localise the laboratories and equipment of the CfB, and the Tonge laboratories were fully refurbished internally for the BioH (c.£160,000).

#### 1.2.3 Establishment of Research Themes

To realise our strategic aim to better encourage and support collaborative research, we have organised research into four overlapping complementary themes: **Cell and Developmental Biology, Ecology and Evolution, Genetics and Genomics** and **Biomedicine**. This was partly catalysed by our need to respond to advances in sequencing and data analysis by expanding our expertise within the new research grouping of Genetics and Genomics through targeted staff recruitment. This grouping of our researchers was also designed to align our expertise with strategic priorities of UKRI, including BBSRC (Animal Health, Data Driven Biology, Synthetic Biology, Systems Approaches to the Biosciences, and the Replacement, Refinement and Reduction (3Rs) in research using animals), MRC (Global Health and Precision Medicine, Regenerative Medicine, and Antimicrobial Resistance, and NERC (Managing Environmental Change).

##### 1.2.3.a Cell and Developmental Biology

Our Cell and Developmental Biology grouping encompasses researchers studying protozoans, plants and animals, underpinned by equipment and resources provided by our two Centres. Across this grouping we have research excellence in complementary specialist areas including cell signalling and communication (**Carter, M. Kittelmann**), developmental biology (**Jennings, McGregor, Schoenauer**), and parasitology (**Sunter, Vaughan**). Moreover, we have built on the legacy of the late Chris Hawes in the area of plant cell biology (**Evans, Graumann, Kriechbaumer, McKenna, Runions**), for example, through the promotion of **Runions** to

Professor, the appointments of **Kriechbaumer** and **McKenna**, and establishment of the **CfB** (see 1.2.4.a).

The effectiveness of the strategic grouping of researchers at different career stages in this theme to promote collaboration is evidenced by publications co-authored by, for example, **Kriechbaumer and M. Kittelmann** (Nature Communications, 2019), **Vaughan and Sunter** (J. Cell Biology, 2020), **McKenna, Hawes and Runions** (PNAS USA 2019), as well as a recent joint BBSRC grant awarded to **M. Kittelmann and McGregor**.

#### 1.2.3.b Genetics and Genomics

Since REF2014, we have brought together a team in Genetics and Genomics, including five ECRs, spanning gene mapping (**Newbury, Ragge**), genetic diversity (**Jones**), genome evolution (**Kanda**), single cell analysis (**Solana**), functional genomics (**Lees**), gene regulation (**S. Kittelmann**), transcriptomics (**Hens**), and **Poolman** continues genome-scale metabolic modelling, following the retirement of **Fell**. This allows us to apply a systems, data-driven, approach to biosciences (**BBSRC**), and to address global health issues supporting the development of precision medicine (**MRC**). At the global level, this team collaborates with over 30 world leading institutes (LMB, Sanger, Quadram, CRG Barcelona, Humboldt University, National Cancer Institute (USA), Max Planck) including partners in developing nations such as Indonesia (**Jones, Kanda**), Chile and Brazil (**Newbury**). The strategic expansion of these networks demonstrates expertise developed since REF2014 and provides a strong basis for the future.

Outputs from this theme include the pioneering single cell analysis from **Solana** (Science, 2018), which was designated as the *Breakthrough of the year* by the journal Science, and pattern recognition algorithms which contribute to the ELIXIR framework from **Lees** (Nucleic Acids Research, 2015). The application of these methods promote research excellence and impact research strategies nationally and globally. These new methods are complemented by a data-driven approach supported by the **CfG**, which allows us to generate, house and analyse large bioinformatic datasets, providing further avenues for interdisciplinary collaboration and potential for translational research. **Newbury's** investigation of medical datasets through Genomics England, has identified risk variants in human neurodevelopmental disease (Molecular Psychiatry, 2018) providing overlaps with the Biomedical Science theme and clear applications to personalised medicine.

#### 1.2.3.c Biomedicine

Our Biomedicine grouping is a multidisciplinary team with complementary expertise that spans biochemistry to cell biology and physiology including: neurobiology (**Bermudez**), microbiology (**King, Hong**) membrane transport proteins (**Meredith**), radiation biology (**Kadhim**), cell division (**Bolanos-Garcia**), cell surface glycans in cancer (**Brooks**), extracellular vesicles (**Pink**), fetal growth and development (**Forhead**), and cardiorespiratory physiology (**Moosavi**). Strengthening this grouping and aligning to the UKRI strategic priorities 'bioscience for an integrated understanding of health' (BBSRC) and 'multimorbidities' (MRC) we have recruited two investigators with specialties in aging (**Potter**) and metabolic disease (**Gathercole**) since REF2014.

Outputs from this theme evidence the success of our strategy in Biomedicine to take advantage of internal synergy (**Brooks and Kadhim**, Cancer Letters, 2016; **Forhead and Meredith**, Journal of Physiology, 2017; Thyroid 2020), as well as building external collaborations with exceptional external partners, as evidenced by outputs from **Gathercole** (PNAS USA, 2014) and **Potter** (Nature Communications, 2016).

In line with UK strategy, we are actively exploring and promoting the translational and commercialisation potential of our work. In a clinical trial, **Moosavi** demonstrated that in patients with heart failure who inhaled furosemide, a repurposed diuretic, leads to a clinically relevant improvement in breathlessness (Clinical Trial Identifier: ISRCTN14593637 and NCT04130815). In 2019, **Meredith** was awarded funding through Innovate UK's Innovation to Commercialisation of University Research (ICURE) to market-validate a technology enabling injection-only

pharmaceutical drugs to be formulated into pills for oral delivery, based on his work into intestinal peptide transporters. Following promising results, internal HEIF Proof-of-Concept and MRC Confidence in Concepts funding has been awarded to develop the technology in order to apply for spinout funding. **Pink** and **Brooks** with **Carter** also won ICURE funding, which led to the establishment of a new spin out company (see 4.3).

#### 1.2.3.d Ecology and Evolution

The Ecology and Evolution theme comprises diverse expertise in biogeography and ecology (**Shreeve**), evolutionary genetics (**Arif, Breuker, Nunes**), wildlife trade (**Nijman**), primatology (**Campera, Donati, Nekaris, Svensson**), and conservation (**Cheyne, Thompson**). Members of this grouping are based in DSS and DBMS, providing a truly multidisciplinary research setting. Since REF2014, staff numbers have more than doubled and research priorities strengthened through promotions (**Cheyne, Donati, Shreeve, Svensson**). Strategic new appointments were made to foster collaborations within the theme (**Arif, Campera, Gerth, Tan**), and **Arif** was made Scientific Director of the CfG to stimulate collaborations between DSS and DBMS and between Ecology and Evolution and other research themes. The success of this strategy to foster internal and external collaboration is illustrated, for example, by outputs from **Campera, Nekaris** and **Nijman** (Current Biology 2020), **Breuker** (PNAS USA, 2017), **Nunes** (PNAS USA 2019), and **Nunes** and **Arif** (Molecular Biology and Evolution 2020). Researchers in this theme have also attracted funding from a wide range of external organisations including, NERC (**Nunes**), the Royal Society (**Gerth**), National Geographic (**Nekaris, Tan**), and the Starr Foundation (**Tan**). Outputs and external collaborations have contributed to practical community-involving conservation measures for declining species (**Nekaris**), revised conservation prioritisation and strategies on Mediterranean archipelagos (**Shreeve**) and increasing evidence-based management of game conservancies in east Africa (**Thompson**).

#### 1.2.4 Establishment of Research Centres

The Centres for Bioimaging and Functional Genomics were strategic developments to invest in our strengths in these areas and to support research in our four themes academically and commercially.

##### 1.2.4.a The Oxford Brookes Centre for Bioimaging (CfB)

Our advanced light and electron microscopy facilities have been important for research in this UoA for the past 25 years. **Hawes** (dec<sup>d</sup>) built a highly successful plant cell biology grouping with an emphasis on advanced bioimaging. A BBSRC strategic review of bioimaging in 2018 highlighted the importance of bioimaging as a dominant set of technologies for analysis of molecules, cells and tissues. Therefore, continuing from the success of **Hawes**, the bioimaging facilities have now been awarded Centre status under the new Director **Vaughan**, who has 25 years bioimaging expertise. The CfB is a flagship strategic research component for OBU, which has invested in this Centre heavily with the construction of a custom building 4 years ago (c.£2,600,000). During this REF period we have strategically hired four Research Fellows (RFs) with advanced bioimaging expertise (**Kriechbaumer, McKenna** – confocal; **Sunter** – confocal and widefield; **M. Kittelmann** – electron microscopy). Moreover, **Graumann** and **Kriechbaumer** have both been promoted from RFs to Senior Lectureships.

The Centre is fully embedded in our PhD programme and supports 35 doctoral students. In recognition of our bioimaging expertise, it is a Zeisslabs@location partner and also partners RMC Boeckler microscopy equipment, supporting industry funded projects. The CfB has a strong collaboration with the Harwell Central Laser Facility (CLF) with RCUK-funded access (see 4.1.2).

There has been an increase in successful externally funded research with a bioimaging element to c.£3,500,000 during this REF period including parasitology (**Vaughan, Sunter**), plant science (**Evans, Runions, Graumann, Kriechbaumer**), cancer cell biology (**Carter, Pink, Brooks, Bolanos-Garcia**); radiation biology (**Kadhim**); virology (**King**) and developmental biology (**McGregor, Santos-Nunes**). This research base has an excellent international reputation with field-leading collaborators from all over the world (see 4.1.2).

#### 1.2.4.b The Centre for Functional Genomics (CfG)

This Centre provides research and teaching excellence for the interdisciplinary study of genomes and gene expression through the generation and analysis of sequencing data. The CfG is led by **McGregor** with a scientific director (**Arif**) supported by two RFs (**Hens, S. Kittelmann**) funded by strategic investment from CRF. The CfG provides in-Faculty and cross-university opportunities building on current collaborations, especially with the primatologists in this Unit, fostering new collaborations and consultancy with external researchers from academia and industry. It also provides training for researchers at all levels in bioinformatics to up-skill our staff and students in this developing area and opportunities for individuals to participate in its current research projects to enhance their skills through active research. The Centre has a broad and multidisciplinary research base in relevant areas including bioinformatics (**Arif, Lees, Poolman, Kanda, Hens, S. Kittelmann**) evolutionary genomics (**McGregor, Breuker, Solana, Nunes**), biological anthropology (**Nekaris, Nijman, Donati**), conservation genetics (**Shreeve, Gerth, Thompson**), biomedical genomics (**Carter, Pink, Ragge, Newbury, Bermudez, Bolanos-Garcia Jones**), microbial genomics (**King, Jeon-Hong**), and plant genomics (**Kriechbaumer, Graumann**). Researchers associated with this Centre have won funding from NERC, Leverhulme, BBSRC, Horizon 2020 and the Royal Society, and published 18 papers since the CfG was launched in 2019.

### 1.3 Implementation of Impact and Dissemination Strategy

#### 1.3.1 Management of Impact and Dissemination

To deliver our strategy on impact, we work with the Faculty and University Research Office (RO) to realise the commercial and societal impact of our research. Building on past successes in the commercial licensing of antibodies generated by **Groome** (see Impact Case Studies; ICSs), we have responded strategically to broaden engagement in research impact.

At the research grant application stage, staff are supported by a mentor and the RO team, who advise on impact statements. We use an annual review of rolling three-year research plans, developed by all staff, to advise on strategies to enhance impact. These annual reviews are linked to personal development review and may result in the allocation of workload plan time for knowledge exchange (KE) and innovation. Support is available for staff from the FIT established to encourage engagement with KE and with the University Business Developers. Support includes expert advice on patents, licensing, spinouts or establishing charities (e.g. Loris conservation charity fund) for economic or societal benefit. The FIT-RBDO partnership has strengthened industry links by co-organising events with Innovate UK and promoting participation in VentureFest Oxford, OBN (Oxford Biosciences Network), BioTuesday and the Oxford Academic Health Sciences Network. This strategy has led to funding from Innovate UK (**Carter, Meredith**), internal HEIF investment (**Carter, Ragge, Meredith, Bolanos-Garcia**) and MRC (**Meredith**) during this REF period. These projects are for commercial applications of novel technologies in diagnostic and therapeutics. The success of this strategy is illustrated through our REF2021 ICSs, where the joint work of **Nekaris** and RBDO established a University Loris conservation fund and secured external funding from zoos and wildlife conservation societies worldwide, which have aided establishing the Little FireFace project in Java. A further example, not included as an ICS, is the joint work of **Ragge**, Faculty RO, RBDO and the West Midlands Regional Genetics Service to commercialise a customised 350 eye gene panel for clinical use to diagnose genes in eye development disorders. This partnership helped to secure the Baillie Gifford Professorial Chair in developmental/eye genetics (**Ragge**), worth c.£4,000,000.

#### 1.3.2 Establishment of the Bioinnovation Hub (BioH)

Central to our strategy for impact is the BioH. This hub was established in 2017 and its aim to provide a centre, linked to the CfB and CfG and across the research themes, supporting impact through translational activities. This includes fostering links between university research and industry, and providing IP-secure lab space and technical support for commercially-sensitive projects (**King, Groome, Bolanos, Carter**) as well as a platform for student experience in industry.

The BioH also hosts local biotech companies through rental of research and office space. They engage with Unit researchers and students through projects, work experience and specialist

teaching. This has proved to be successful; for example, OET, based in the BioH collaborates with researchers within the UoA funding contract research projects, provides sandwich year placements and has funded PhD studentships, including a current iCASE. Orbit Discovery joined the BioH in 2017 and successfully grew their company until moving to larger premises; during the period at the BioH they hosted student projects and work experience and contributed to bioinnovation-related academic activities. Two new start-ups have since joined the BioH. Commercially important antibodies developed by **Groome** are held and produced in the BioH, generating income supporting our research, and there is regular interaction between the BioH staff and **Groome** to continue to develop applications for these and to supply as contracted. It is planned that the BioH will house further spin-out companies, the first established by **Carter, Brooks** and **Pink** for breast cancer diagnostics. This success contributed to OBU being awarded an EPSRC 'Inclusion Matters' funded 'Woman and Spinouts' project run by **King** and Manfredi (UoA17 ICS, Centre for Diversity Policy Research and Practice). This builds on the great success of **King** with OET (see ICS).

### 1.3.3 Impact Case Studies

During this period, our Unit, in partnership with RBDO, has continued to support the development of the **Groome** and **King** ICSs (as well as **Nekaris** - see 1.3.1). The **King** case study is an example of how our UoA and RBDO work closely to secure the commercial success of the spin-out company OET, led by **King**. OET has become a centre of excellence for baculovirus technology, drug discovery and vaccine development, thus ultimately improving medical treatments globally. To enable OET's success, our UoA has provided access to the BioH and other university facilities like bioimaging, bioinformatics, management of patent portfolio and collaborations on projects such as an Innovate UK Newton grant, PhD studentships and three other Innovate UK grants, including a contract under the global vaccines initiative to undertake pre-clinical vaccine studies for Crimean Congo Haemorrhagic Fever Virus (PHE Porton, Oxford Jenner Institute and OBU as collaborators) and a recent grant to support a partnership with Vaxine Pty Ltd to develop a vaccine for COVID-19.

Through managing **Groome's** patent portfolio with RBDO and maintaining the collaborative work that characterises our Unit's approach to academic and translational research, we have increased the reach and significance of **Groome's** novel monoclonal antibodies to Inhibin B and anti-Mullerian hormone (AMH) and the assay protocols have achieved a worldwide impact in fertility and reproductive health and ovarian cancer, leading to two new independent ICSs (Inhibin B and AMH). These have provided the university with a royalty income of over £15,000,000 during the REF period; indicative of cumulative sales in excess of US\$315,000,000 from the testing of millions of women globally.

### 1.3.4 Outreach and Dissemination

Dissemination has been embedded through the REF period. Initially this focussed heavily on outreach and public engagement (PE), with the UoA leading the Science Bazaar, our annual showcase event for people of all ages and families, which is a key plank of OBU's strategy for widening participation, particularly school children from deprived areas. Researchers also participate in a range of external activities, for instance a BBSRC funded microscopy outreach to the visually impaired (see 4.4). This commitment continues and CRF has been made available for research students and staff to develop PE projects. We support a wide range of activities, for example the annual Slow Loris Outreach week since 2012 with worldwide activities focused on raising awareness of the plight of Asian lorises (see 4.4).

Central to our strategy to increase dissemination of our research and commercial achievements and activities is the partnership between our PIs and researchers with the Faculty Research engagement officer and the University Press Office. Through this partnership we secure dissemination through the web, social media and OBU press releases. The success of this approach and our commitment to disseminate research is illustrated by, for example, **McGregor's** interviews with BBC radio outlets and on BBC Future about spider genome evolution in 2017, and **Nekaris** and **Nijman** on Slow Loris conservation, and online wildlife trade across various media

outlets in 2020, as well as the increased contribution to OBU News Releases from 0% in 2014 to providing 38% of OBU news stories in 2020.

#### 1.3.5 Implementation of strategy for open access, data sharing and accessibility

Our strategy for Open Access and data sharing has been to require the use of the University Open Access RADAR (Research And Digital Assets Repository) repository and to apply for central funds for open access publishing where appropriate. Staff have been supported in this in several ways; by the University RADAR team and by the RL during annual review process, where publication strategies are considered. RADAR also provides a facility for uploading data and images; however images generated in bioimaging and other large data sets are shared through public image repositories like Omero. Genomic data from the Unit is submitted to public Open Access repositories, and many papers are preloaded to prepublication platforms like bioRxiv. The role of RADAR is to share the intellectual product of OBU freely as appropriate internally and with the global academic and public community. Data can be assigned a DOI to aid its discovery and citation and recorded on the UK Research Data Discovery Service to enable its retrieval and usage.

#### 1.4 Future Strategy

In the next REF period we aim to build on our success through retention of current RFs in permanent positions, further strategic recruitment of RFs and doctoral students, and nurturing of collaborative, impactful research through our Centres. This will allow us to both continue to enhance current areas of research excellence and further build capacity and quality in others.

We will enhance research capacity and impact in two areas through recruitment of new RFs and targeted University/Faculty QR funds. First we aim to build on our existing expertise in Biomedicine and take further advantage of our extensive local network (University of Oxford, MRC Harwell, Oxford Academic Health Partners) as well as other world leading national and international institutes (University of Cambridge, King's College London, NASA). This strategy has already been actively promoted with internal funding through Groome PhD studentships (**Gathercole, Moosavi, Forhead**), BBSRC DTP studentships (**Kadhim**) and CRF Research Excellence Awards (**Potter, Gathercole**). However, we will now aim to develop our research in basic and translational aspects of regeneration, neurobiology, physiology and the genetics of disorders as this complements our strengths in Cell and Developmental Biology and Genetics and Genomics as well as the CfG. We envisage that this will enhance the impact of our research at the nexus of Biomedicine, and Genetic and Genomics, including the work of **Ragge** and **Newbury** on eye development diseases and speech, respectively.

Second we aim to further build Ecology and Evolution with a research programme in Conservation Genomics that integrates the work of **Nekaris, Nijman, Donati, Thompson, Tan** on primates and other vertebrates, with the work of **Arif, Breuker, Gerth, Shreeve**, on invertebrates, enhanced by a CRF Research Excellence award to **Shreeve** and the genetics expertise of **Kanda, Nunes, Newbury**, all underpinned by the CfG. For example, we have already received a CRF studentship and funding for genomic sequencing for a Slow Loris Genome project to **Kanda, Nekaris**. We foresee that this combination of field biology and genomic expertise and the external collaborations/partnerships of these researchers will greatly impact policy and practice in conservation, and in combating the illegal trade of endangered animals. We also envisage that developing integration of genetic, ecological and biogeographic studies of invertebrates, with strong international links, will contribute to the conservation of declining invertebrate taxa in the UK and mainland Europe.

We will continue to build our impact and links with industry (4.3) as well as supporting innovation through the BioH and supporting our spin-out companies. We will invest in identifying application and impact from our research, provide staff time and training for innovation and fund pathways to impact through HEIF and Faculty funds. We will continue to develop access to our facilities and expertise for external partners, taking advantage of our position in the Oxford Cambridge ARC, within the Oxford and Thames Valley ARC Universities Group Life Science Innovation Network,

membership of Oxford Academic Health Partners, and to lead industry engagement events on our campus. Examples of our successes to date are provided (see 4.3).

## 2. People

### 2.1 Staffing strategy

To address our goals of maintaining excellence and building further capacity in our four research themes and two Centres we have strategically recruited new staff. Central to this strategy is to appoint RFs, initially from royalty/QR income transitioning to departmental funding, with a clear plan to develop appointees for permanent academic positions as well as making direct appointments. We have recruited eleven RFs in this REF period; three funded by our new David Fell RF Programme (see 2.2), one CRF Vice Chancellor's Fellow and seven supported by central/faculty research funds, including royalty income. These RFs were strategically recruited to Cell and Developmental Biology/CfB (**M. Kittelmann, Kriechbaumer, McKenna, Schoenauer, Sunter**), Genetics and Genomics/CfG (**Hens, S. Kittelmann, Solana**) and Ecology and Evolution (**Campera, Cheyne, Svensson**). These appointments also further strengthened our excellence in bioimaging and in evolutionary developmental biology as well as supporting our previously recognised research strengths in plant cell biology, parasitology and primatology. In this REF period we also recruited three permanent staff in each of the Genetics and Genomics (**Newbury, Lees, Kanda**), Biomedicine (**Gathercole, Hong, Potter**) and Ecology and Evolution (**Arif, Gerth, Tan**) themes. All appointments were made consistent with OBU recruitment policies and practices to ensure fairness and transparency and avoid bias in shortlisting or appointment by gender or ethnicity.

Our strategy also allows succession planning, ensures continuity of excellence in our areas of strength and continual leadership development in our Unit. Since the last REF five staff have been promoted to full Professor (**Brooks, Carter, McGregor, Runions, Vaughan**), while **Moosavi** and **Newbury** have been promoted to Reader and **Newbury** is Deputy Director of the CfG. These promotions evidence our UoA's successful recruitment and retention strategy as, for example, **Runions** and **Vaughan** were recruited as ECRs and are now full professors, while the latter is also Director of the CfB (see section 3 of the Institutional statement). In addition, PhD students in the **McGregor, Evans, Nijman** and **Fell** labs have progressed to RF (**Schoenauer, Campera**), Senior RF (**Poolman**), Lecturer (**Svensson**) and Senior Lecturer (**Arif, Graumann, Kriechbaumer**) positions. Moreover, succession planning meant **Kriechbaumer, Graumann** and **Runions** were in permanent posts to continue the legacy of plant cell biology research left by **Hawes**. We have also reviewed and re-aligned our UG and PG programme portfolio with our research expertise. This includes a new MRes programme in Primatology and Conservation (**Nijman**) and a new MSc degree in Medical Genetics and Genomics (Biomedicine theme/CfG).

### 2.2 Staff development

All staff have annual personal development reviews with the RL linked to their 3-year rolling research plan developed in the light of our UoA strategy and used to support career and research progression. The annual reviews identify research and career development priorities and goals, and inform the allocation of hours for research in alignment with Unit strategy and defined OBU workload plan research bands. The University operates a transparent workload planning model, with generous research allocations for new staff giving time to build research.

All new academic appointments are supported with a robust and well-tested development programme: 'Your First Three Years'. This programme supports the development of skills required for research, including supervisor training, research team leadership and management, project and finance management, writing grants, IP and business aspects. These courses are also available to existing staff. In addition to this, staff at all levels participate in OBU's research mentoring scheme and are encouraged to participate in Aurora, Springboard and OBU in-house programmes to develop further leadership skills. Staff (**Gathercole, Potter, Moosavi, Kriechbaumer, Bolanos Garcia, Carter, Forhead, Jones, Breuker, Newbury**) have won CRF Research Excellence awards designed to fund strategic enhancements to their research linked to career development. **Melling and Kenny** won equivalent awards in the first round of awards for post-doctoral researchers in 2019 to support first steps to independence in research.



We have implemented measures to promote grant funding success. The RL holds annual meetings with academic staff to discuss their grant application strategy. Staff receive a monthly Faculty newsletter including grant opportunities and deadlines. Staff are encouraged to present their grant applications at a weekly 'Grants Lab' for peer feedback (junior research staff and PhD students also attend, creating a vital learning experience). Prior to submission all grants are peer reviewed by colleagues, and if the grants are rejected the RL and applicant discuss feedback and its use to improve future grant applications. This strategy has helped to increased grant capture over the REF period to over £8,000,000.

Conference and networking are an integral part of staff development and funding is available that ensures all academic staff can maintain a presence in their respective fields (for example to cover child care as well as conference attendance). Several of our staff's ongoing national/international collaborations can be traced back to interactions made possible by this funding (for example: **Carter** now has a BBSRC grant with Simpson (University College Dublin), and **McGregor** has NERC and Leverhulme grants with Sumner-Rooney (University of Oxford).

Postdoctoral researchers are also supported by access to training programmes and staff developmental funds. This has helped to ensure the success of postdocs while they are hosted at OBU and in their research careers thereafter. This is evidenced by postdocs going on to win prestigious fellowships including Marie Curie (Almudi) and JSPS (Tanaka) awards, and securing independent positions including at Goettingen University, the Universidad Autónoma de Madrid, and University of Barcelona. **Graumann, Kriechbaumer, Schoenauer, McKenna, M. Kittelmann, S. Kittelmann** were recruited as RFs after very successful postdocs at OBU. We have also attracted stellar postdocs with fellowships from EMBO, DFG and Newton in this REF period.

Our strategy to support and develop our RFs with the intent of appointing them to permanent academic positions (done previously with great success, see for example 2.1 and below) has been formalised by David Fell RFs (awarded to **M. Kittelmann, Solana, Sunter**). This scheme recruits and develops the most promising ECRs and prepares them for academic positions. This scheme is a 3+2 year model to enable independent researchers to establish their research with a rigorous 3-year review and in the final two years there is a focus on their development and appointment as lecturers at the end of their Fellowships with Fellows undertaking limited teaching and gaining FHEA status. The early success and future promise of this scheme is evidenced by our RFs winning substantial external research funding from BBSRC, MRC, Leverhulme, the Royal Society and JSPS.

For academic staff, the University has clear promotion routes and runs roadshows each year to explain details and encourage applications. There are examples of staff benefitting from this strategy and evidencing its success at all career stages: **Runions** and **Vaughan** (then part time), recruited as RFs reaching Senior Lectureships for REF2014 are now Professors. **Newbury** and **Donati** joined as Senior Lecturers and have been promoted to Reader; **Kriechbaumer** joined as a PDRA, won a Vice Chancellors' RF in 2017 and was promoted to Senior Lecturer in 2020 and is Deputy Director of the Bioimaging Centre; **Graumann** was a Leverhulme Fellow and is now a Senior Lecturer; **Nunes** and **Svensson** were previously PDRAs and are now Senior Lecturer and Lecturer, respectively.

We continue to support our staff at all levels with significant resource to promote research success. Our RFs are supported through the allocation of PhD studentships (seven awarded since 2017) and internal research funding (totalling c.£100,000 since 2017). Established staff are also supported with internal funding and studentships, and our more recent strategy is to focus support on collaborative projects between multiple staff. This strategy has led numerous collaborative publications and successful grant applications (see 1.2.3 for examples in each research theme).

### 2.3 Support and promotion of equality, diversity and inclusivity

We achieved Silver Athena Swan Awards in 2014 and 2018 with our Fellowship scheme to support career progression of research students/postdocs into permanent academic appointment, which has since been adopted by the wider university, flagged as good practice. The Charter principles supporting university policies such as parental, carers, paternity and maternity leave, flexible working, are embedded in the UoA. The Institution holds a HR Excellence in Research award, with good practice from this filtered down to all support staff (including those supporting this Unit). OBU is committed to the promotion of race equality as part of our equality, diversity and inclusion agenda and is implementing a Race Equality Strategy including all UoA staff undertaking unconscious bias training. In addition, OBU has developed its policy for staff inclusion into REF2021 through broad and open consultation at faculty and UoA levels.

The inclusive approach at OBU has been applied over many years and has resulted in our UoA5 submission having a vibrant balance of gender and ethnicity, with no discrimination of any staff with protected characteristics. Our recent Equality Impact Assessment shows no significant difference in outputs selected for REF2021 by gender or disability, and although there were on average fewer selected outputs for LGB and BAME staff, there was no bias identified in eligible staff selected for submission and all outputs submitted were chosen based on their scientific excellence and impact, verified by two Department staff and an external assessor. There was also no significant difference between full and part-time staff. Flexibility of contract to permit part-time working is frequently offered to support staff with parental or other caring responsibilities. To support staff following family leave, we provide enhanced workload time for research on return as well as either a PhD student or postdoctoral support (**Graumann, Kriechbaumer, Nunes**).

We celebrate not only our diversity, but also our achievements. We have several research and impact recognition pathways in place such as CRF Research Excellence Awards, ACE awards, and the Brookes People Awards. Departmental “good news” letters as well as Faculty Research Newsletters frequently publicise individual and group achievements.

#### 2.4 Research student recruitment

An active cohort of research students is essential for a vibrant research environment, so we strategically prioritise fully funding ~5-10 internal studentships per year from QR and royalty income streams. The latter, known as the Nigel Groome Studentships, recognise that the royalties stemming from **Groome's** research (see ICSs) should support future generations of scientists. We are also a key member of the Oxford Interdisciplinary Biosciences Doctoral Training Partnership (Oxford DTP, see below). Several other income sources, including Research Councils (regular and iCASE Oxford DTP studentships), industry, and self-funding (full- and part-time) students all support a healthy and diverse postgraduate student research body, averaging 20 FTE per annum. Recruitment follows the university policy for equality and diversity and we widely advertise every studentship on multiple web platforms to maximise our reach. All candidates are interviewed by a panel of 2-3 academics (including at least one PG tutor) and all Unit staff involved in shortlisting or interviewing undertake unconscious bias, and recruitment and selection training. Our application/selection process is recorded systematically within the Faculties, allowing us to monitor the fairness of our recruitment/selection. These processes strengthen the talent and diversity of our student cohort, which over the past REF period has had a 60:40 women:men gender balance and ~20% BAME. Indeed, the gender ratio and the ethnicity of our students does not differ significantly from the benchmark for the sector.

#### 2.5 Research student training

We have designed our PhD programme (including training, supervision and community) to maximise the support and potential of the individual, while enhancing the cohort identity and providing opportunities for cross-faculty interactions (for both personal growth and potential cross-disciplinary work).

All research students are members of the University Graduate College and the Biosciences Doctoral Training Programme. Students are given a designated PG tutor who is part of a team of tutors always available for pastoral care and practical assistance. These tutors also meet formally

each year with PhD students to review progress and to address any potential issues. These processes help to imbue a sense of support and community for each student.

Supervisory teams consist of Director of Studies, second supervisor and further supervisors where necessary, who are often external to the University. All supervisors are required to attend a supervisor training programme and additional staff development sessions include topics such as 'Cultural awareness and working with International students' and 'Listening to students' stories: impact on their identity', which are designed to improve integration and understanding in a culturally diverse setting. All research students undertake 70h of training and professional development per year pro rata based on an annual training needs analysis carried out with their supervisors. Training comprises Departmental and University-wide courses, and includes an annual Graduate College exhibition, and introductory training in teaching. Topic-specific training, including statistical analysis, bioinformatics, and bioimaging is available as needed. Students receive funding to attend and present at external conferences; (including international) to develop presentation skills, all research students present a talk and a poster at an annual postgraduate symposium, chaired by RFs and contract researchers), and a formal presentation in the weekly seminar series, organised and hosted by research students, who obtain external sponsorship. This process, placing students at the centre of the seminar series, gives them the opportunity to gain leadership and organizational skills as well as introducing and networking with high-profile academics.

The success of our PhD training and supervision is evidenced by recent students obtaining positions at other organisations in the UK and abroad, including the Francis Crick Institute (Burrell), Johns Hopkins University (Hagen), The Quadram Institute (Singh), University College London (Leite), Cambridge University (Livraghi), the University of Heidelberg (Holzem), State University of New York at Buffalo (Poindexter), University of KwaZulu Natal (Ehlers-Smith) and the National Cancer Institute, USA (Bonatto Paese).

### 2.6 Doctoral Training Partnership

Since 2015 OBU has been an active partner of the Oxford Interdisciplinary Bioscience DTP, (renewed for 5 years in 2019) together with Oxford University, Harwell, Diamond Light, Pirbright Institute, and The Rosalind Franklin Institute. It was awarded a multimillion-pound grant from the BBSRC to offer comprehensive training to a new generation of multi-disciplinary scientists. Students recruited to the DTP benefit from training in key research skills, including bioinformatics, mathematics, programming, bioimaging and data analysis. Students also acquire translational skills, including presentation, networking, management and entrepreneurship. These students select two 3-month 'rotations' in labs across the partnership, then choose the lab for their PhD. Students benefit from a 12-week 'placement', chosen to complement their future career aspirations; examples include work with learned societies, science think tanks, start-up biotech companies, and industry giants such as Amazon. Students graduating from this programme therefore have an enhanced skillset and greater potential to generate impact in future years.

OBU plays a full role in the programme, assisting in its management, contributing to training and offering rotations and projects across the partnership. OBU registered ten students over 2015-2019, who were all recruited in alignment with BBSRC EDI regulations, along with another ten for the 2020-2025 period. OBU has also been awarded four additional iCASE studentships (to **King, Jones, Solana, Carter**) in which students are recruited to specific projects that are supported by an industrial partner. It is a testament to our research environment that over the first four intakes of students we have had seven Oxford University-registered DTP students who have elected to do rotations in OBU labs. Of these, two elected to remain at OBU for the rest of their PhD and one is continuing at Oxford University in a close collaboration with a second supervisor at OBU. The OBU- and Oxford University -registered DTP and iCASE students enhance the research output of the Unit and help to foster a truly interdisciplinary and collaborative environment.

Our investment in the DTP is well aligned with our strategic research goals. Much of our work is within the remit of the BBSRC, and as such most of our Unit staff routinely offer projects to the students on the programme. Through this DTP funding there has been a particular benefit to our

areas of strategic importance, including cell biology and developmental biology, which have benefitted by increased interactions with academics across the partnership. This has directly led to new collaborations between academics at OBU and other partners across the DTP, in some cases leading to collaborative research publications (e.g. Pain et al., 2019, Nature Communications).

### 2.7 Student/Staff integration

We view our PhD students as a vital part of a wider and vibrant community who contribute significantly to our research outputs. Indeed, together with our postdoctoral researchers they are the life force of our research capability and are valued as such. They are integrated into the fabric of our departments and work closely with our staff at all levels. They have a voice on appropriate decision-making bodies (including the CfB and CfG committees, Faculty Research and Knowledge Exchange, and Research Degrees committees), they integrate with staff in delivering public outreach programmes, and they join staff as equals at away days. Our strategy is to continue to integrate our PhD students in this way, as the close collaboration imbues an additional layer of community, reinforcing the sense of belonging at all levels and allowing staff and students to deliver on their research goals.

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

### 3.1 Income

In this REF period we have secured over £8,000,000 in external funding from diverse sources including Research Councils (BBSRC, STFC, MRC, NERC), the Royal Society, European Commission (Framework projects), various charities (Leverhulme Trust, British Heart Foundation, Cancer & Polio Research Fund, VICTA, Society for Reproduction and Fertility, CRUK), Mexican Government, fellowships from JSPS, EMBO, DFG (German Research Foundation) and Innovate UK. In addition, **Ragge** has attracted over £4,000,000 in funding from corporate and private donations to sustainably support her research on eye abnormalities. Our strategy has been to continue to increase and diversify research funding supported by our RO publicising opportunities and supporting applications. Our success in attracting funding from a range of sources reflects our broad research base and vindicates our policy to recruit and promote ECRs (e.g. **Solana**, MRC and **M. Kittelmann**, BBSRC) as well as the strategic allocation of pilot funding and PhD studentships to prime longer-term projects (e.g. **Carter**, BBSRC, **Vaughan**, BBSRC; **McGregor**, NERC).

Our researchers also have access to considerable funds (currently c.£600,000 per annum) from royalty income generated from IP on previous research, which along with QR funding is reinvested in the Groome PhD studentship scheme and also to support Research Fellowships.

### 3.2 Infrastructure and facilities

Through a recent £21,500,000 investment in Life Sciences at OBU, including an award of £4,100,000 HEFCE funds for new facilities in the biosciences, UoA5 has exceptionally well-equipped lab space with a state-of-the-art suite of control temperature/humidity rooms, growth and tissue culture facilities, and open plan office and shared social space, to meet the needs of research. Equipment was also extensively renewed (c.£300,000 initial spend) and there is an annual equipment round so researchers can request equipment (c.£200,000 per annum available). All researchers, including doctoral students have dedicated PCs with an appropriate specification, as needed linked to a dedicated server (e.g. metabolic modelling, bioimaging); Access to university and cloud storage and resources is freely available and we fund access to Oxford University servers for applications requiring big data. All equipment is communal to ensure good access to equipment for research is achieved. Centralised services for laboratory support and a team of support staff is provided covering technical support, grant management, financial reporting, safety, IT, personnel recruitment.

A dedicated building for the CfB houses the microscopes, associated equipment and research groups with bioimaging as their core activity. **Vaughan**, **Kriechbaumer**, **Graumann**, **Sunter**, **Runions**, **Gathercole** and **McKenna** occupy high specification, purpose designed labs and offices to enable collaboration, sharing of expertise and ease of use of the facilities. The Unit has

dedicated expert microscopists who give technical support, hands-on, training and advice on our range of bioimaging equipment from light and confocal microscopy to electron microscopy e.g. SEM, TEM, SBF-SEM, and the processing of image data e.g. assembly of 3-D tomography images and techniques for sample preparation e.g. fixation, sectioning, high pressure freezing. Considerable CRF investment has been made with two new confocal scanning laser microscopes and a new TEM during this REF period.

Since 2015 our dedicated Cat2 Facility in the Tonge Building has undergone two phases of refurbishment to provide facilities suitable for supporting research and innovation activities, including the BioH, in the short to medium term. We have also benefited from CRF investment to provide facilities to support innovation e.g. a freeze dryer funded in the 2016 round to aid protein work. Note that HSS staff in this UoA have access to their own dedicated research space including shared laboratory space for analysis of field samples as well as wet laboratories and computing for genomics.

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

##### 4.1 Research collaborations, networks and partnerships

Collaboration is integral to our research strategy and culture as evidenced by our publications and grants data; all but one of our submitted outputs include at least one collaborating author. 27% of our papers include internal collaborations and over 60% include an international collaborator. Of the 103 live funding projects in our current database, 41 (40%) include external partners and 63% of these partners are International.

##### 4.1.1 Strategic support of collaboration and partnership

Researchers are encouraged to develop collaborative research programmes through CRF Research Excellence Awards (<https://www.brookes.ac.uk/about-brookes/at-a-glance/research-excellence/>) which may be used to foster collaborations across departments or externally (UK, EU and international being given equal importance). For example, **Jones** used an award in 2017 to establish a partnership with Universidad de Concepción, Chile to study the decline of bees, **Kanda** and **Bolanos-Garcia** used their 2019 award to support a Mexican visiting fellow. Partnerships through industry are supported through the iCASE DTP studentships and engagement with the BioH. More formal Unit-wide collaborations include the Oxford DTP and Groome studentships, which drive research collaboration through the students' jointly supervised research programmes. Almost half of current studentships include joint supervisory groups (including all those recruited for 2020 and advertised for 2021) and almost one third of our BBSRC DTP students have an industrial partner, for example **Solana** and Oxford Nanopore Technologies.

Since REF2014, development of interdisciplinary research has been supported through development of cross Faculty networks. Staff contribute to the Children and Young People's (**Newbury**) and Healthy Aging Networks (**Potter**). CfG researchers work on cross-faculty projects linking biological anthropology and biology (**Arif**, **Kanda**, **Nekaris**). New collaborative opportunities are supported internally by events such as away days, and internal seminar programmes, and virtually through internal newsletters and dedicated twitter feeds. Initiatives such as these afford a better awareness of cross-departmental research and help researchers to recognise new collaborative opportunities.

##### 4.1.2 Participation in national networks and collaborations

Links with external partners are encouraged and fostered through local, National and International networks such as the Oxford Academic Health Partners (<https://www.oxfordahsc.org.uk/>), which includes OBU, the Oxford University NHS Foundation Trust (OUHT), Oxford Health Foundation Trust, Oxford Academic Health Science Centre and Oxford University. **Moosavi** has collaborated with OUHT staff in a British Heart Foundation project on inhaled drug treatment for chronic obstructive pulmonary disease. In developing a clinical diagnostic for eye abnormalities, **Ragge** has led a HEIF-funded multidisciplinary team with numerous external stakeholders, including the West Midlands Regional Genetic Lab.

Researchers in the CfB have strong collaboration with the Central Laser Facility (CLF) at Harwell with access grants totalling approximately £400K (**Hawes (dec<sup>d</sup>)**, **Kriechbaumer**, **Vaughan**, **Sunter**, **Carter**, **M. Kittelmann**, **McGregor**). This includes two consortium program access grants (The Plant Cell Initiative I and II), four direct access grants and RCUK funded access from the BBSRC (**M. Kittelmann**, **McGregor**), and NERC and Leverhulme (**McGregor**) in collaboration with colleagues at the Oxford University Museum of Natural History. CLF provides access to microscopy not widely available in the UK and links OBU with a centre of national expertise in microscopy complementing our partnerships with Zeiss and RMC Boeckler (see 1.2.4.a). The broader impact is exemplified by **Kriechbaumer** being invited as a speaker to the CLF-organised African Laser Centre student workshop and ALC Workshop on Laser Tissue Interaction and Laser Imaging, in Stellenbosch.

#### 4.1.3 Participation in international networks and collaborations

Our research strategy encourages participation in international networks and promotes and supports collaboration with colleagues around the world. **Evans** and **Graumann** are members of the Impact of Nuclear Domains On Gene Expression and Plant Traits (INDEPTH) COST action including five working groups and over 120 researchers from across Europe and America. **Newbury** studies speech and language development on Robinson Crusoe Island, which was funded by an ESRC Newton Award, and in Brazil, which is funded by a British Academy award; **Poolman** is involved in EU funded projects to adapt photosynthesis to climate change (AccliPhot II with Heinrich Heine University and six other partners) and to tackle antimicrobial resistance with Copenhagen University and eight others. **McGregor** successfully led a large international collaboration with the i5K consortium (based at the Baylor College of Medicine) to sequence and analyse arachnid genomes (Schwager et al., BMC Biology, 2017).

Our International collaborations have been supported by Global Challenge Research Funds (GCRF) and Newton Awards (**Vaughan**, **Sunter**, **Bermudez**, **King**, **Bolanos-Garcia**, **Carter**, **Newbury**). **Vaughan** and **Sunter** are involved in a collaborative project with the University of Ghana, the Food and Agricultural Organisation of the UN and the Ghanaian tsetse fly control unit to undertake research of African trypanosomiasis in Europe and Africa. **Newbury** piloted a reading intervention programme in Chile leading to work with DFID and GCRF funding to extend this programme to Brazil. International research networks have been used to increase the reach of impact, influence economy and drive policy change as exemplified by the Nocturnal Primate Research Group (**Nekaris**, **Donati**, **Nijman**, **Svensson**, **Campera**). This provides an international forum for coordination of research on nocturnal primates, with a network of collaborative links with academic institutions, conservation NGOs, enforcement agencies, wildlife societies, zoological museums and zoos. Its field studies help to determine the distribution and status of some of the most neglected species and to indicate the condition of declining habitats. Research has resulted in policy change including the implementation of wildlife trade regulations through the Convention on International Trade in Endangered Species. Further international collaboration, initially supported by iDiv, German Centre for Integrative Biodiversity Research. Halle-Lepizig, established a European network (including **Shreeve**) developing European-scale Lepidopteran data sets to improve the evidence-base for prioritising conservation efforts for rapidly declining taxa.

#### 4.2 Contributions to the research base

We contribute to and engage with the research base in several ways, from our involvement with funders, publication and conferences, as well as through the training and courses that we provide. **McGregor** and **Runions** are members of the BBSRC Pool of Experts, **King** has been a member of the BBSRC Fellowships Committee and UKRI Future Leaders, and **McGregor** is a panel member for the French National Research Agency. **Potter** is a member of the BBSRC Aging Mouse Resources and NC3Rs Rodent Age working groups, and **Pink** serves on the International Society for Extracellular Vesicles Blood Extracellular Vesicle Advisory Team.

In addition, academics in this area serve as editors on over 20 journals (including Nucleus, PLoS One, Frontiers in Ecology and Evolution, Frontiers in Zoology, British Journal of Pharmacology, Genetics and Genomics, Scientific Reports, Mammalian Genome, Folia Primatologica, Zoology,

Journal of Applied Ecology, Endangered Species Research, Journal of Anthropological Sciences). Our staff also serve as members of the committees of learned societies including the Society for Experimental Biology (**Evans, Graumann**), Society for Endocrinology (**Gathercole**), and Royal Microscopical Society (**Brooks**). In addition, **McGregor** has served on the committee of the British Society for Developmental Biology since 2015. In 2018, he helped to organise the 70<sup>th</sup> anniversary meeting, which attracted over 600 delegates. In 2019, the annual Population Genetics Group meeting was organised by **Kanda, McGregor, Nunes, Arif** and held at OBU (>200 delegates). The NPRG have hosted several large international conferences at OBU, including Evolution of Nocturnal Behaviour in Humans and other Primates in 2015 (~200 delegates), the 8th European Federation of Primatology Congress in 2019 (~400 delegates). In 2019, **Ragge** hosted the Genetics of Ocular Development conference. This event was complemented by the publication of a special issue of the journal Human Genetics, which **Ragge** edited. Moreover, the hosting of the UK Extracellular Vesicle Forum at OBU led to the foundation of the UK society for Extracellular Vesicles (<https://www.ukev.org.uk/>), of which **Carter** is President and **Pink** is a board member.

Many of our staff host visiting researchers and run summer schools and courses for researchers in the UK and from abroad. **Nekaris, Donati, Nijman** have accommodated four visiting fellows since REF2014 each for one or two years, from Universities in China, Denmark and Mexico. Furthermore, the CfB has provided training for several African researchers and **Newbury** has organised training for Chilean researchers in genomic technologies and bioinformatic analyses. Through these training opportunities we build relationships with primary stakeholders in key areas. Going forward this model is being adapted by our other research groups and the CfG has launched a programme to provide training in genomics and bioinformatics.

Our staff host two summer schools at OBU and participate in several others. **Breuker, McGregor** and **S. Kittelmann** have hosted a biennial Eco-Evo-Devo summer school since 2012, which has trained over 60 external and internal postgraduate students. The CfB also offers a microscopy summer school, has held Zeiss/RMC external workshops, and hosts the Royal Microscopy Society Summer School. In addition, **Kriechbaumer, Runions**, and **McKenna** have all served as lecturers on the prestigious Gatsby Plant Summer School.

#### 4.3 Contributions to Industry and Economy

OBU is ranked in the top 10 UK universities for IP-related income almost entirely resulting from licensing of our inhibin and activin antibodies (ICSs: **Groome**). Building on this legacy, we made a strategic decision to strengthen our interactions with industry. We have encouraged staff to attend development courses on IP and KE, and our RBDO works closely with the FIT headed by **Meredith**. We established the BioH as a bioincubator for OBU spinouts and external companies. We are supported by an IP and Commercialisation manager and business developer, who steered two successful applications to the Innovate UK ICURE programme (**Meredith, Carter**). Several research groups have established or expanded their industry links (e.g. **Carter/Brooks/Kriechbaumer** with Porton Biopharma Ltd, **Carter** with Merck). **Brooks, Carter, Pink** were awarded £210,000 from Innovate UK to cofound a spinout company. **Poolman** has succeeded **Fell** on the Management Board of the BBSRC Network in Industrial Biotechnology and Bioenergy CCnet, where his role is to oversee systems approaches and run genome scale, metabolic modelling workshops for novel strain design.

#### 4.4 Contributions to Society

All staff and research students are encouraged to participate in public engagement activities. To promote this OBU's first ever Research and Science Communications Senior Lecturer was appointed (initially **Osterrieder**), who coordinated all outreach activities. **Osterrieder** left OBU in 2019 and **Nekaris** was appointed to lead this with assistance (0.5 FTE) from Beaman, former PhD student and a postdoc in DBMS. Outreach activities include the annual Brookes Science Bazaar, with over 3000 attendees in 2019, interdisciplinary partnerships between sciences and humanities, the 'Amazing Acts' Festival at the Pegasus Theatre and 'CSI Oxfordshire' at local schools. Online public engagement training workshops for researchers across OBU have been developed and these are also run for the Society of Experimental Biology and the Royal Microscopical Society. **Runions** has a weekly science spot on BBC Radio Oxford as Dr Molecule explaining "current hot

topics” to a general audience. **Hawes** and **Hughes** were funded by BBSRC for an innovative activity to bring microscopy to the visually impaired. **Kanda** coordinates Soapbox Science annually in Oxford. **Nekaris** conducts considerable outreach and social and mainstream media work around primate conservation particularly the global “Little Fireface” campaign and for eleven years the Slow Loris Outreach Week (**Nekaris, Nijman**). Our researchers took part in the European Researchers Night Curiosity Carnival held across Oxford. Staff also run a range of outreach activities with school children. For example, **McGregor, S. Kittelmann, Schoenauer, Nunes** have taken their “Arthropods up close” activity to six schools and other organisations as well as events at the Oxford Natural History Museum and Cowley Road Carnival.