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| **Research Group** | **Ecology and Evolution** |
| **Date due** | **w/c 11/1/2021** |

Please complete this form to tell us about your future plans for your Research Group. You are asked to complete a 1 page strategic three-year plan for your Research Group and also to detail your plans for infrastructure and technical support, highlighting areas where investment is required, what academic hires would help to deliver your strategy, and outline your expected research income generation over the next year.

**Strategic Research Plan for next 3 years 2021-2023**

* *main goals and targets to be achieved.*

**The Ecology and Evolution (EE) research group addresses the following** f**our main research challenges:** **1) achieving sustainable management of ecosystems, 2) identifying traits associated with adaptation and ecological resilience in a changing world, 3) EcoHealth andor predicting and mitigating the effects of vector-borne and zoonotic disease, and 4) understanding and predicting evolutionary genomic, and phenomic and population change** **over space and time.** Our strategic goal is to develop and expand our research strength and activities in order to be recognised as a world leader in these four areas of research. This goal will be evidenced by a critical mass of world-leading research activity and postgraduate training, the sustained delivery of high-quality research outputs, significant societal impact in terms of providing solutions to major ecological challenges, and an international reputation as a leader in the field. The group is well placed to engage with solutions-based environmental research through schemes targeted at sustainable ecosystem management, climate mitigation and biodiversity conservation. These fields are fast moving and universities are recognising these topics as major growth areas. Although we have a strong group, we risk falling behind our competitors and reactivity engaging with opportunities in sustainability and global change research. This is particularly the case in teaching delivery, where group members have proposed innovative and attractive curricula that we are unable to deliver with our current teaching loads and service teaching. Thus, our ability to deliver research and teaching at the forefront of global challenge and sustainability will **r**equire academic hires**.**

*Strategic staffing goals:*

Our ability to deliver the teaching and research we aspire to is exacerbated by major recent staff losses (see below) and the diverse research interests of the remaining staff results in a limited capacity for the group to access and harness the growing number of opportunities in global change ecology. The lack of critical mass has been exacerbated by significant recent staff losses: since moving to SEES (now DEES), the EE group has lost 7 full time staff with no replacement (Prezisozi, Sheffield, Brown, White, De Vries, Rowntree, Chamberlain). In addition, another member of staff is currently on a career break (Semchenko), so will not be able to contribute to research development over the next year. We have gained two new independently funded RCUK research fellows, one tenure-track (Cox) and the other short term (Cordero), but the overall net loss of staff represents a considerable risk to the group in terms of its sustainability and ability to develop and deliver on its research goals, and to deliver new and innovative teaching in timely areas of high relevance to major global challenges of climate change and biodiversity loss. Staff turnover can also be seen as an opportunity to reappoint and build the group to re-build critical mass in key areas related to our research vision in the area of **Global Change Ecology** and other areas. Although we have demonstrated through independent enquiries and applications to advertised positions that we can attract excellent researchers, we have struggled to successfully recruit individuals to our group. *Our staffing objectives are:*

1. Recruitment of three full-time academic positions to replace losses. *See appendix 1 for EE recruitment priorities.*
2. Clarity on recruitment guidelines for supporting independent fellows and establish group level process for handling enquiries.
3. Increase recruitment of international research fellows (e.g. Marie Curie, Newton).

* *Current activities that will grow or reduce.* 
  + A primary objective is to Sustain World Class research in ecology and evolutionary biology. **Evidence**: maintain grant funding from UKRI responsive mode calls at current levels with sustained submission of proposals. Maintain and encourage additional publication output in high impact journals. EE group lead university level initiatives such as the NERC solutions call (Johnson).
  + Given the retirement of key staff that were associated with EE and iCAL (White, Brown, Chamberlain), there is a real risk of losing expertise and capacity in key areas including ancient biomolecules, aquatic ecology. Without replacement, the group’s ability to undertake research in these areas will be reduced. **Evidence**: Recruitment of at least one new staff member in the next twelve months to rebuild expertise.
  + The soil group continues to build on its strengths through successful funding, attracting fellows and high-quality research students. It is imperative that the department ensures that any obstacles to effective research activity are mitigated, particularly in terms of space and any negative impacts of technical restructuring. **Evidence**: solution to ongoing space issues and clarity about impact of technical review on EE staff.
  + The opening of The Firs represents an excellent opportunity to attract staff and funding for experimental plant and soil science. **Evidence**: recruitment of plant focused staff and grant proposal submissions using facilities.
* *future areas for expansion and development. [CW our group could play a lead role in sustainability and ‘future planet’. this is an opportunity to lead the department in a sustainability direction. GJ: we are well positioned to help the university meet its goal for sustainability and carbon neutrality]*
  + Increase engagement in solutions-based research. **Objectives:** members of the group submitting bids to solution-based calls, engagement with university initiatives and development of solutions-based impact cases.
  + Development of an EcoHealth grouping led by the group. **Objectives**: meetings and distribution list for university researchers interested in Ecohealth, GCRF, UKRI or NSF proposals focused on an EcoHealth approach.
  + Encourage more proactive engagement with GCRF bids. **Objectives**: lead or engage with a GCRF bid for a substantial project.
  + Although some members of the group regularly publish in high profile journals, there are likely to be some outputs that could have been more ambitious in their destination. We will encourage members to submit key findings to high profile, less specialized, journals and will support these submissions by encouraging group members to circulate abstracts and drafts prior to submission. **Objectives**: increased number of group members submitting papers to, and being published in, high impact journals.
  + As a group, we should more actively engage with impact cases for the next REF round and encourage group members to start developing cases at the beginning of the REF cycle. **Objectives**: at least one EE impact case from the EE group in the next REF cycle.
  + The lack of departmental enthusiasm for senior fellowship schemes was highlighted as a potential impediment to research opportunities.
* *interactions with other RGs, institutes, departments, faculties*
  + Members of the group collaborate with colleagues in SEED, FBMH and maths. However, there are clear opportunities to build links with social scientists to incorporate ‘human’ aspects of conservation and resource management issues. There are also opportunities to engage with engineering in solutions based sciences.
  + Increase internal collaborative projects both within the group and with other departments and faculties. **Evidence**: co-supervised students developing new links, co-authored papers with colleagues from other groups, departments and faculties, grant proposals which develop new collaborative links.
* *brief reflection on impacts to UN Sustainability goals and CO2 footprint*
  + Members of the EE group focus on research that directly address sustainability goals (i.e. food security, agriculture, biodiversity conservation, disease ecology).
  + In normal years, group members travel extensively for research, networking and conference attendance. Individuals should assess the impact and relative benefits of their travel.
* ***Whats gone well/less well?***

All EE group members, but particularly those with childcare responsibilities have been very negatively impacted by the COVID pandemic. PDRAs and PGR students have not been able to deliver their projects effectively, deliverables on projects and fellowships have been missed and momentum lost on projects. In some cases, those with disruption to long-term experiments have been disproportionately impacted. Moreover, members of EE group are heavily involved with fieldwork and international travel, both of which have been severely curtailed over the past 12 months.

Despite support from the department and school, we have struggled to recruit new staff which is disappointing. We need to review our approach in order to successfully recruit new staff when the opportunity arises.

The whole group notes the issues with inadequate PS staffing which makes it incredibly onerous and frustrating to get admin tasks done. Issues are common with HR, contracts, finance, procurement, IT and student admin. There is a very high hidden cost in understaffing PS both in terms of their morale and in terms of the ability of academic staff to effectively do their jobs. The impact of chronic centralising and understaffing on productivity and morale cannot be overstated.

The group is severely limited due to a lack of critical mass and problems with space, which have been ongoing since 2016 with no signs of being resolved. The growth of the group, and morale, is severely hampered by space issues that have been on-going since 2016: the groups is dispersed across and within three buildings (Michael Smith, Stopford Building, and MIB) often with inadequate offices and desk space for our staff, and there appears to be no appetite, either within FBMH or DEES, to resolve this long standing issue. This not only creates much frustration, but also it is a major distraction from research and severely limits our capacity to grow and consolidate as a group. The current situation where we have no control over space is unsustainable. These issues have been the focus of ongoing discussions but there remains no resolution (Shultz, Bardgett and D. Johnson have all expended considerable time and energy in meetings about space, producing space reports, canvassing the group with no measurable result).

***Strategic space objectives****:*

1) Colocation of the majority of EE staff to the 4th floor of Smith (apart from Sellers, Buckley and G Johnson) or to reasonable space in another building (eg. Stopford)

2) Provision of adequate desk, office and lab for group. D Johnson moving to a suitable office. S Shultz increasing lab footprint.

**Research environment [DJ: how to create an environment that makes UoM more attractive proposition to recruit new members of staff]**

Although the research performance of the group is generally good, with considerable areas of excellence, we have identified a lack of a shared sense of community and shared identity within the group. This is particularly true for early career researchers (PGR and PDRAs) who have little interaction with the larger group. Although our space issues exacerbate this by not having groups collocated and no clear communal space, creating a larger group identity is key to fostering collaborations and exchange of ideas.

*Goals to develop a sense of community and shared research environment:*

1. Creating a group identity with events including a seminar series, away days and annual research day (seminar series started by F Cox, away days hampered by COVID)
2. Developing equipment bids, studentship projects that encourage collaborative thinking.
3. Appointing a group PGR/PDRA representative to Virtual PhD student cohort within group or MERI. Develop more inclusive environment for PGR students. Training and/or other events (explore opportunities).
4. Update ER listserve and increase use to inform the whole group of activities and events. (GJ actioned)
5. Send a regular newsletter email to the group highlighting significant research achievements, outreach and other work, hellos and goodbyes.(SS actioned)

**Outline how you will use university/department infrastructure and technical support in the next year, highlighting where any investment is required**

1. **Controlled Environment Facility Manager**

The Department and University has extensive facilities for controlled plant growth spread across different buildings and sites, including notably the new facilities at the Firs. The Firs has a gardener, but this is not a person with skills that cover the requirements of the new facility.  To make best use of the new investment and to help consolidate and improve the performance of CE facilities on campus we would want a technician with experience working with CE facilities.

1. Most EE members do not use shared facilities in FSE. The use of technical support in FBMH is primarily limited to lab support for stores, glassware and experimental officers. D Johnson, J Johnson and R Bardgett have technicians/lab managers that are supported on the DEES baseline but their skills are not appropriate for pooling with the technical restructure. M Buckley does use core facilities and technical support for his MS work.

**Outline any upcoming staffing changes or gaps and opportunities to achieve strategic goals or maintain existing strengths**

**Appendix 1.** **EE Recruitment Priorities**

1. **Global Change Ecology\***

*Research*: Given the new emphasis on the Environment at the university level, there is an opportunity to increase our transformative understanding of the impacts of environmental change on ecosystem function and biodiversity resilience. Global Change complements MERI strategy. Key areas with opportunities: 1) ecological and evolutionary responses of species, communities and ecosystems to climate change, and applying this knowledge to the development of management strategies for sustainable land use, biodiversity conservation and climate mitigation; (2) ecosystem resistance and resilience to climate change, and diagnosis of thresholds for abrupt change, including the role of multiple stressors; and (3) integration of biotic interactions into Earth system models to predict consequences of climate change and biodiversity loss for biogeochemical cycles across spatial and temporal scales.

*Cross group/department/faculty potential:* Depending on the appointment, there is opportunity for this position to strengthen links with multiple departments and research groups across the university. For example, a global change ecologist that uses genomic technologies to address community change will have synergies with the EGS division in FBMH, environmental genomics research in MIB. An appointment with a focus on large scale spatial ecology will have clear links with Physical Geography in SEED. Another clear area of synergy is with CAS especially David Schultz’s Interdisciplinary Centre for Crisis Studies and Mitigation.

*Teaching*: quantitative skills, spatial mapping/analysis, ecology, field courses

*\*This position was approved by DLT but due to the uncertainty around COVID the recruitment was curtailed.*

1. **Disease ecology OneHealth/EcoHealth- Issues related to plant, animal health disease ecology**

Climate change, land use transformation and introduced contaminants alter biotic interactions and can lead to increased transmission of infectious disease both within and between species. EcoHealth studies how changes in the earth’s ecosystems affect human, plant and animal health. Examples with particular relevance to human health include respiratory disease and air quality, contaminants and pollution impacts on endocrine disruption, cancer and reproductive health, and increased transmission of vector-borne and zoonotic diseases. The ongoing global coronavirus pandemic is an example of the catastrophic impact of zoonotic diseases becoming established in humans. However, disease transmission also affects wildlife and livestock, with economic and ecosystem impacts. Examples of wildlife-livestock disease transmission include Bovine tuberculosis, blue tongue, avian influenza. Plant pathogens also play an important role in population and community dynamics. Anthropogenic environmental change has widespread consequences on disease dynamics and cross-species transmission. These stem from four main areas: 1) evolution of resistance (AMR, pesticide, herbicide), 2) zoonotic and plant pathogen transmission between natural and managed systems, 3) contaminants and pollution impacts on trophic cascades, 4) environmental stressors associated with drought and climate instability impacting on species and community resilience. An appointment in disease ecology would address fundamental evolutionary and ecological questions in disease transmission and dynamics, the evolution of resistance and understanding changes in community and population resilience to diseases.

*Cross group/department/faculty potential:* This position would have clear synergies with FBMH and MIB. A particular area of synergy would be a focus on antimicrobials and resistance via people like Eriko Takano and Patrick Cai. In terms of the links between natural systems and human health, there would be opportunities to link with SEED and public health and disease research in FBMH (Martie von Tongeren, Brockhurst, Dana/Rok, Grencis, Cruikshank etc). Within DEES, there is ICAL interest in the evolution of disease, and human health work related to natural systems (Polya, Webb etc).

Teaching: Lots of opportunities to contribute to FBMH. Depending on area, toxicology, epidemiology, human impacts. Ideal post for university level environmental initiatives. Within DEES, this post could contribute to delivering the **MPEC** degree and community ecology and evolutionary biology units.

1. **Environmental -Omics (including metabolomics, metagenomics)**

*Research*: Increasing capacity, particularly in processing and analysing -omics data would offer collaborative opportunities in EE and with MES to evaluate community and functional change in systems under stress or challenge. A range of technologies including metagenomics, functional genomics, proteomics, metabolomics, can use systems data to address these questions. Building capacity in either sample processing, or potentially more importantly, evaluating large -omics datasets in an evolutionary ecology context could position DEES at the forefront of environmental -omics. Key research opportunities: 1) Functional impacts of microbial community change using metagenomics and proteomics technologies. This area of research can feed into symbiotic communities in the soil, in guts, and in freshwater systems. Currently, our insights into community change are primarily descriptive, whereas the potential of analysing these changes will only be realised when we can predict the functional impact of community change. 2) Metabolomics and proteomics provide footprints of system responses to change, intervention and challenge/stress. As with metagenomics and characterising microbial community, change, untargeted metabolomics and proteomics provide indicators of change but the consequences are speculative. There is enormous potential to develop these tools in an environmental context. 3) Paleo applications (see below).

*Cross group/department/faculty potential:* clear synergy with MIB, MES and FBMH. Given that the university/MIB has lost major metabolomics expertise with R Goodacre, there is potential synergy with MIB. MIB could also be brought in through the tech of metagenomics e.g. via their long-read sequencing focus and MERI by focusing on the need to consider complete communities if we’re to understand ecological feedbacks.

*Teaching*: Environmental genetics, fundamentals of ecology/evolution,

1. **Paleoecologist (stable isotopes and/or ancient DNA)**

Biomarkers Ancient DNA provides a window into past evolutionary changes, migrations, and extinction events.

*Research*: This hits wider EE well, as well as MIB (I believe Mike’s ‘ancient’ work continues to be supported, though I’m not sure what the current logic is for that or how far that extends to DNA), though fewer of us these days (Rob is probably the only one directly involved with both ‘ancient’ and ‘DNA’). Could it be coaxed into taking up more of the links that Terry previously brought to us and beyond e.g.  in terms his crop biogeography or paleo disease work? At the same time, could MERI be brought in e.g. through making it something like ‘**Genomics of ancient environments**’ which could cover anything from what Terry once did ± Andrew to the kind of paleoecology some of the ICAL people care about, using the same kind of logic for MERI as the atmospheric/climate people use – understanding past environments helps understand future environmental change? Also massive potential to increase or ability to deal with paleo -omics (i.e. leaf waxes, stable isotopes,

*Cross group/department/faculty potential: iCAL, Royce, FBMH Palaeoecology also links to the Quaternary Environments and Geoarchaeology research group in Geography*

1. **Environmental biotech**

*Research*: Giles outlined, it has obvious potential to hit all 4 (us, MERI, MIB, wider EE). If it were narrowed to, say, a ‘**microbial community engineering**’ post, that could keep internal appeal, while still being very broad (e.g. it could stretch from engineering soil communities for carbon sequestration to understanding the effect of probiotics in human health). Might there also be potential for hitting ‘inter-school’ priorities by including the word ‘engineering’ like this? Risk: appointment not in an EE area- so we could ‘lose’ out rather than gain a position.

*Cross group/department/faculty potential: MIB, FBMH*

**Research Income Generation for the next year**

See table below for specific applications.

**UKRI and other UK funders (eg Royal Society, Leverhulme)**

*Please identify developing research programmes, highlight topics, large grant opportunities, UK/US collaborations and fellowships in your research area and your plans for targeting these programmes? When will they occur and who in the group will lead and who will contribute to the activity? Are there any obstacles to delivery?*

D Johnson leading on a NERC solutions bid and an Urban ecology highlight bid.

S Shultz and M Buckley will lead with others from Humanities on an EOI Leverhulme Centre bid.

C Walton, S Shultz an dM Buckley may submit a highlight topics on disease (in dicusssion).

**Other funding sources**

*Please identify developing research programmes funded from non-UK sources*

Buckley - global service/consultancy for species identification of bone

**Business engagement**

*Please describe the development of current industrial relationships or consortia and your plans for them. Are there any new industrial partnerships or areas of engagement that you see developing? Who in the group will lead these and what is the projected size and timescale? What plans do you have for applications for Industry Collaboration Funding (IAAs, KTPs) Innovate UK competitions and the Industrial Strategy Challenge Fund competitions? Would you like to enlist the help of the Business Engagement Office to support any of the planned activities of your Group?*

EE has limited direct industrial relationships.

*Please list any planned applications over the next 12 months:*

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| **PI and team** | **Sponsor/Call** | **Research Area/Proposal Title** | **Date** | **Value** | **Chance of success (%)** | **Comments** |
| **Buckley**, Shiels, Stevens | NERC | Developing an Omic Estimation Tool for Sharks | Jan | 591,000 | 30-40 | involves collaborators from Portugal and SeaLife |
| **Johnson D (PI), Cox** | NERC | Short-circuiting the terrestrial phosphorus cycle: symbiotic control of organic phosphorus mineralisation and uptake | Feb 2021 | 800k |  | with UEA (lead UoM) |
| **Johnson D (PI), Cox** | NERC | Climatic drivers | Feb 2021 | 300k |  | Lead Uni of Reading |
| **Johnson D (PI), Bardgett et al** | NERC Highlight | Urban ecology | April | 1M |  |  |
| **Johnson D**, Else, Foreman, Pennock (PI) | MRC | Putting the oil in soil |  | 833k |  |  |
| **Johnson G**, Schwartz, Gallois | BBSRC | Plant Acclimation to Temperature | April | 750K | 15-20% |  |
| **Knight**, **Garwood**, Richardson, Novak-Fraser Krašovec, Gifford, Paszek | Wellcome Trust | Biotic effects on the mechanistic causes and evolutionary consequences of genomic variation | summer | ~4M | 10-20% | Dependent on what Wellcome announce about their new funding schemes (name will change too!) |
| **Knight**, Lovell, Gifford, Bromley | Wellcome Trust | Predicting antimicrobial resistance – beyond resistance determinants | autumn | ~1M | 10-20% | Based on developing collaboration with Shanghai Jiao Tong University |
| **Pittman** with Janneke Balk (JIC) and Simon Andrews (Reading) | BBSRC | Characterisation of iron transporters required for symbiotic N fixation | April | ~600k | 10-20% | a collaboration as co-I |
| **Pittman**, Nixon, Shaver | BBSRC | Microbial degradation of artificial polymers and implications to plant health | Sept | ~700k | 10-20% |  |
| **Shultz**, Codd, Nudds with Borger (Swansea) | NERC | Landscape energetics | July | 800,000 | 30-40? | We received an 8 for a previous submission and were near the cut-off for funding. We will add some pilot data and justify/improve some of the sampling design. |
| **Shultz, Buckley, Walton, Thomas** etc | Leverhulme Centre | Human adaptation to environmental change | Jan (EOI) | <10million | <5% | The initial concept would have to be selected for a full proposal. Not confident that we are internally competitive |
| Theodoropoulos, **Pittman** | BBSRC | Modelling of microalgae bioprocessing for high value products | Apr or Sept | ~700k | 10-20% | As co-I |
| **Walton, Gilman**, Huck, Harris, Foster | MRC | Changing landscape of malaria epidemiology in Northeast India | May | 800k | 10% | with medical and agricultural collaborators in northeast India |
| **Walton** | Wellcome Trust (collaborative grant) | Characterising the spread of human feeding Aedes aegypti in Africa | March | 1,000,000 | 10 | involves several collaborators from Africa |