Institution: University of Liverpool

Unit of Assessment: 5 - Biological Sciences

a. Context

Research in the Department focuses on evolution, ecology and behaviour. Most impact activities thus centre on natural environment issues, most notably with regard to effects of climate change (Evolutionary Ecology Research Group, EE), the management and conservation of natural resources (EE and Mammalian Behaviour and Evolution, MBE) and the management of environmental hazards (EE).

There is also a wide range of research that has impact on health and welfare, particularly on animal welfare (MBE) and public health, especially with regard to infectious diseases (Ecology, Evolution and Genomics of Infectious Disease (EEGID) and EE), and food security (MBE).

There are impacts, too, in the spheres of the economy and commerce, both in MBE and EE.

In addition, and most generally, established structures and practices are in place to ensure that our research has significant societal impact through improving public understanding and stimulating public debate.

External contacts have been key in ensuring that many projects are have impact on the quality of life in developing countries, especially in regard to public health and conservation.

b. Approach to impact

All staff at Liverpool have access to the University's Department for Partnerships and Innovation, which includes (i) Business Gateway, aiding commercialisation and developing and managing KE projects, including negotiating the exploitation of intellectual property; (ii) The Liverpool Intellectual Property Unit, overseeing the initial identification and evaluation of intellectual property; (iii) International Development Office, identifying and developing international collaborations and institution-level partnerships; and (iv) Public and Regional Engagement, helping develop partnerships with stakeholders and participation in public and regional forums. The University has a budget to pump-prime KE activities from its HEIF allocation using a 'KE voucher' scheme (value up to £10,000), incentivising links between staff and commercial partners. The University pump-primes, too, through grants encouraging impact related to the University's Research Challenges. Activity within this unit related to each is described below. *Realise*, a bi-annual UoL publication, shares news stories and case studies about successful collaborative projects impacting on the UK's economy and society; it is circulated to c3,000 contacts in industry, intermediary Governmental and non-Governmental organisations and the media. The University's KE activities are also showcased in the KE Prospectus http://www.liv.ac.uk/business/media-gallery/research-expertise-and-facilities-guide.

At the Faculty level, the Research and KE Manager develops this approach through interaction with the research Institutes. The Faculty has been awarded £100K by BBSRC ("Sparking Impact") to support early stage preparation for commercialisation. These funds have been distributed on a competitive basis during 2013, with six awards of up to £20K made.

At the Institute (IIB) level, early in the reporting period we identified, and put in place measures to overcome, four major challenges: (i) Impact was not centrally recorded; (ii) Impact was not sufficiently rewarded or encouraged; (iii) we had too few collaborations with industry; (iv) the Impact culture was not sufficiently valued by peers. Our on-going strategy in response to this analysis is elaborated under 'c', below.

Within this unit, the first stage of any project is a presentation of the scientific case for support, prior to grant writing and submission (see REF5). Internal peer review ensures that applicants have identified likely or possible impacts and beneficiaries at this early stage, and, wherever possible, are including these beneficiaries (and inputs from them) in the grant application itself – an approach carried forward to the grant when successful. This allows impact to stem naturally from the research itself, and to extend beyond it, rather than being a *post hoc* attempt to apply research findings in order for impact to be achieved. We believe that impact and the highest quality research form a natural partnership.

The following are recent examples of grant applications to major funders where strategic partnerships have been key in maximising impact: controlling leptospirosis in Brazilian favelas with the local public health agency, FIOCruz, (NIH; Begon); temperature physiology and management

of Atlantic cod stocks with CEFAS (DEFRA; Berenbrink); using species interactions in the control of pests, with commercial companies and USDA (BBSRC; Fenton); developing new strategies for rodent pest control based on the use of scent signals, with pest control companies, environmental health authorities and food manufacturers (BBSRC; JHurst); utilising meiotic drive to mass produce a single sex for pest control, with biotechnology company Oxitec (Price; BBSRC); furthering public understanding of industrial melanism with Cambridge, Cardiff and Liverpool Museums (NERC; Saccheri); manipulating life histories in insect pest control, with the Warwick Crop Centre (NERC; Speed).

Examples of using University pump priming include a KE voucher to promote collaboration with the National Bee Health unit at FERA in evaluating the importance of symbionts in bee health and pollination efficiency (GHurst); an international workshop in Liverpool, funded by the Living with Environmental Change (LWEC) theme, to explore the role of contemporary evolution in responses to global environmental change (Plaistow); and an LWEC grant tracing effects of symbionts on midge transmission of veterinarily-important arboviruses (GHurst).

Among projects where impacts of top quality research are already being felt, the following are examples in **Public Health.** Wellcome Trust-funded work on plague control (Begon) with colleagues from the Kazakh government KSCQZD led to publications proposing methods for predicting plague outbreaks taken up and field-tested by local public health authorities. Research with clinicians at the Liverpool Heart and Chest Hospital (Paterson) led to a key publication documenting novel analysis of the diversification of *Pseudomonas aeruginosa* infections in cystic fibrosis patients, currently being used to develop new methods of disease diagnosis and control. In **Conservation,** Hodgson was recently awarded a NERC KE grant in a scheme funding translation of recent primary research into tangible tools that will have an impact on the economy or public life: here, a GIS model to optimise plans to restore functioning ecological networks. The grant's many partner organisations are already actively involved in the model's development. Thompson used his work funded by the Environment Agency and others to understand the habitat requirements of one of Europe's most threatened insect species, *Coenagrion mercuriale*, to direct its first successful re-introduction, supported by Devon Wildlife Trust and broadcast by the BBC. Work funded by NERC and the Wellcome Trust (JHurst, Stockley), with staff at Chester Zoo, is applying reproductive endrocrinology to improve captive breeding programmes for rhinos and contributing to the implementation of DEFRA/EAZA guidelines for welfare and nutrition of captive elephants and orang-utans. In the **Commercial** sphere, research on variation in male ejaculates (Stockley) is being applied in the artificial insemination sector with Genus plc. Further examples feature as case studies.

Impact of our research in the areas of **public understanding and debate** has been underpinned by key external collaborations, with dissemination often being achieved by widespread international media coverage (e.g. Atkinson, Fenton, Price, Saccheri). In addition, Price made use of the Parliamentary Pairing Scheme to spend a week shadowing local MP Andrew Miller, Chair of the Science and Technology Select Committee, who subsequently spent a day within this unit talking to staff about Impact and a further day at the 2013 IIB Impact Day (see below). Plaistow and Watts obtained a Royal Society Partnership grant, with St Mary's School, Crosby, in response to recent honeybee decline and aimed at comparing bees' performance in plastic 'Beehaus' and traditional hives. The launch attracted considerable media attention and has resulted in a permanent public installation at Knowsley Safari Park (http://www.knowsleysafariexperience.co.uk/bees-money). GHurst was one of six enablers for the Wellcome Trust 'Evolving Words' project, designed to enhance societal awareness of the impact of Darwin's work and involving creative writers, dissemination through performance, and wider press coverage. Funding from NERC and others to Montagnes supported development of two on-line guides to plankton routinely used by researchers, governments and commercial companies (>30 countries). Begon's work on plague was a feature on Radio 4's *Material World*. Berenbrink's work on the evolution of mammalian diving capacity featured across BBC television news, radio, and online platforms.

c. Strategy and plans

Impact strategy across IIB is directed by the Impact Working Group (comprising senior and junior academics, PDRAs and PGRs) and we have appointed an Impact Officer to develop processes to tackle the issues we identified (see 'b', above). Central to the strategy is the need for impact by our

staff to be recognised and rewarded. Impact activities are recorded for staff, PDRAs and PGs in a database, reported and discussed within the Professional Development Review (PDR) process, and recognised in workload management and promotion. This policy is now being implemented in other areas of the University. Incentives for staff have also been created by prioritizing Doctoral Training Grant support to PhD projects with CASE partners.

We have introduced an Impact Seminar Series – recent speakers include Luke Alphey (Oxitec, BBSRC Innovator of the Year) on Control of Pest Insects, and Dr Evan Harris (ex-M.P.) on Science into Policy – and in January 2014 we will have our third annual Impact Day, where the whole of IIB meets to showcase the best examples of impact locally but also to gain guidance and inspiration from influential external experts. Speakers at the 2013 Impact day included Andrew Miller MP (see above), Ted Bianco (Welcome Trust) and Andrew Willmott (NERC).

Key to our strategy is the need to move beyond requiring staff simply to consider impact implications, towards fully incorporating it into our research culture, especially in the staff we train. Thus, we have further adapted our strategy to encourage more involvement from PDRAs and PhD students and to improve our performance in social and policy impacts. We have initiated focused training days and the Institute Postgraduate Group organises various impact events and training. We have designed a new module now being taken by all Masters and first year PhD students. This includes formal sessions on “Research Ethics”, “Public Understanding of Science” and “Making a Business out of Science” (delivered by 2-Bio Ltd). All publicly-funded PhD students must enter a BBSRC or NERC “YES” competition with training provided by external consultants. The team from our unit was highly commended in the most recent Environment YES competition. Our PG students must attend the Impact Seminar Series.

Looking forward, our new NERC DTP will support placements for all PhD students within industry, the public or third sectors (1–3 months, including overseas opportunities), providing funding towards additional travel and accommodation expenses, and extending the student stipend accordingly. They will also all attend two-day workshops on Entrepreneurship, Policy, and Media Training. Currently, around 30% of our staff have CASE Studentship support. Our aim, aided by the 28 partners allied to the DTP (where 40% of all Studentships will be CASE), is to increase that figure to at least 50%. We are committed, too, to ensuring that at least 20-30% of staff apply to one of the University’s KE pump-priming initiatives, and a similar proportion for KE Partnership awards. An important new opportunity will arise with the imminent investment of £1.5m by UniLever in IIB’s Centre for Genomics Research (Paterson Co-Director) to address a range of issues including microbial communities on skin and ecotoxicology, with which members of the unit will be closely involved.

d. Relationship to case studies

The three case studies exemplify our general approach and philosophy. Reflecting the academic make-up of the Department, all are examples where high quality research has had impact relating to human, animal or wildlife welfare and sustainability. All were motivated initially by the combination of perceived ‘problems’ (global climate change, laboratory animal welfare, land degradation by an invasive species) and a conviction of the need to apply rigorous science to these. All involved close contact with policy agents prior to and during the research (Environment Agency, Broads Authority, NC3Rs, Nature Conservancy Council, DEFRA) and clearly afterwards in the application/impact phase, as elaborated in the case studies themselves. All have been the subject of on-going research beyond that which originally generated the impact. All have been chosen as examples where impact has been direct and focused, rather than public understanding impacts, much more widespread throughout the unit, that are more diffuse and hence less appropriate for case studies. And finally, all have been instrumental in moulding our current strategy, especially in terms of ensuring that our research not only has impact in principle, but that the impact is also explicitly nurtured through continuing close collaboration with strategic partners.