Institution: University of Aberdeen

Unit of Assessment: 5 - Biological Sciences

a. Context

Delivering impact from research is a central strategic priority for our staff in UoA5. Impact is embedded within the University Strategic Plan and is a principal deliverable to our *Outcome Agreement* for research funding with the Scottish Funding Council. The three constituent research institutes involved in this submission have different foci for impact given their different target end-user, stake-holder and policy-making groups. However they share an overall philosophy, vision, strategy and procedure to encourage, support and facilitate translational research and ensure impact and influence across the public, private and "third" sectors. Examples of impact are illustrated by, but not limited to, our range of submitted case histories.

The *Institute of Medical Sciences (IMS)* is focused on early preclinical research that impacts on **health and welfare**, through disease treatment and discovery of novel therapeutic agents. These cover a range of disorders including those affecting the nervous system, such as Alzheimer's disease and other cognitive disorders of ageing (Wischik and Harrington) and the application of cannabinoids to treat neuropathic pain (Pertwee). Drugs that modulate the immune system have been developed to treat inflammation and autoimmune disorders (Greig). A further focus has been the development of new approaches for drug design such as phage display antibody engineering techniques (Porter) and the identification of new antifungal drugs and diagnostics (Munro, Gow).

The *Institute of Biological & Environmental Sciences (IBES)* has a comprehensive research portfolio across the biological sciences with a focus on integrative physiology, ecology and evolution. Research has impacts on (i) the **environment**, in defining **government policy and planning decisions** for the **management and conservation of natural resources**, exemplified by work on: conflict management in upland ecosystems (Redpath); establishment of special areas for conservation (SACs) for iconic bird and mammal species (Reid, Thompson); impacts of ecotourism on marine mammals (Lusseau); impacts of marine renewable energy development on dolphin distributions (Thompson); marine fisheries management (Marshall, Fernandes); and invasive species management and eradication (Lambin); (ii) enhancing aquaculture **production and economy**, for example work on fish immunology and immunogenomics (Secombes, Zou, Wang, Martin); and (iii) **health and welfare**, exemplified by work on energy balance, ageing and obesity (Speakman); and predicting and mitigating zoonotic disease emergence and spread in wildlife populations (Telfer).

The *Rowett Institute of Nutrition and Health (RINH)* has through its 100 year history focused on relationships between nutrition and health, and its research therefore impacts on **health and well-being, food industry economy and commerce**, and **public policy issues.** Nutrition is at the centre of global challenges such as ageing, food security and obesity with its well documented co-morbidities such as cardiovascular disease, cancer and diabetes. A major focus has been on understanding and mitigating the obesity epidemic**,** through informing the food industry how to reformulate food for health, exemplified by work on nutrient sensing by the intestine (Barrett); factors inducing satiety (Adam, Morgan); the impact of diet on gut microbiota and metabolic health (Flint, Louis); and micronutrients in foetal programming (McArdle).

Research from all three institutes impacts on the **economy** and on **commerce** through revenue from spin-out business, and industrial collaborations that enhance economic return through products, services and technologies that have been developed and commercialised. Similarly, all institutes impact **society and culture** through **public understanding of science** and **knowledge exchange** activities. This is exemplified by the *Obesity Roadmap* - a Scottish Government policy document on combating obesity in Scotland that was developed in collaboration with IBES and RINH staff to improve public understanding on perception of healthy diet and lifestyle. Similarly, IBES staff contributed to the *Living with Environmental Change* (LWEC) Climate Change Impact Report that provides a summary resource for the public and practitioners of how climate change affects UK Biodiversity, with recommendations for effective natural resource management.

b. Approach to impact

UoA5's *Impact and Engagement Strategy* details for researchers the mechanisms, opportunities, support and procedures through which we maximise the impact of our translational research and ensure findings are communicated broadly. The effectiveness of our strategy has been recognised by a £100k BBSRC "*Sparking Impact*" award (2013) and a £300k RCUK "*Public Engagement with Research Catalyst*" award in acknowledgement of past successes with impact and knowledge exchange (KE). Our approach to impact is structured around the following routes:

(1) Researcher Training – Impact training is embedded in staff development programmes for researchers at all levels. A *Researcher Development Unit* (www.abdn.ac.uk/develop/index) delivers tailored training for IBES, IMS and RINH staff on how to consider and deliver impact from development through execution of a project. It provides workshops, good-practice case studies and networking opportunities across the institutes and disciplines with focus on knowledge exchange, communicating research to the public, interacting with end-users, entrepreneurship and research commercialisation.

(2) Engagement with end-user, stake-holder and decision making groups – UoA5 recognises that impact is maximised through effective and recursive interaction with key end-user groups. This ensures that the research being undertaken is relevant to address stake-holder needs, and that UoA staff are positioned to influence research priorities and future research agendas to place us at the forefront for new and emerging areas. In many cases our relationships with end-users are based upon successful, long-term interactions (e.g. Scottish Natural Heritage, Royal Society for the Protection of Birds, James Hutton Institute, Centre for Ecology & Hydrology, Beckley Foundation). We ensure relationships are maintained by inclusion of end-users in student supervision and as collaborators on research grants where appropriate, by researcher placement in end-user organisations, and by funding research showcasing events, colloquia, catch-up sessions and workshops relevant to industry, policy makers and practitioners. Examples include the programme of high-profile engagement events associated with the 100th anniversary of RINH (2013), which brought together government, and public health and food industry stake-holders; and workshops run within IBES to train Scottish fishermen on fish catch analysis as part of a Scottish Government initiative to engage stakeholders in science. The 2013 workshop was attended by the Scottish Government Cabinet Secretary for Rural Affairs and Environment.
The UoA has a Political and Policy Engagement (PPE) team, who are dedicated to assisting researchers in promoting their research and expertise to political and civic audiences.

We support and encourage staff to participate in Boards, Committee and Advisory Groups where there are clear opportunities for end-user engagement and to leverage impact and influence. Examples include - GW Pharmaceuticals (**Pertwee, Mackenzie**), International Association for Cannabinoid Medicines (**Pertwee**), Juvenile Diabetes Research Foundation (**Docherty**), International Council for Exploration of the Seas (**Fernandes, Pierce**), Scientific Advisory Committee on Nutrition for Public Health England (**McArdle**), UK Advisory Committee on Novel Foods and Processes for the Food Standards Agency (**McArdle, Flint**), Scottish Government Health & Environmental Sustainability Expert Working Group (**Morgan**), Scottish Government's Strategic Research Programme (**Morgan -** Chair of the Director's Executive Committee for the Scottish Government Funded Research Institutes), BBSRC Basic Bioscience Underpinning Health Strategy Panel (**Morgan**), BBSRC DRINC Steering Group for Food and Drink Industry Club (**Morgan**) DEFRA Marine Protected Area Science Advisory Panel (**Scott**), Science Advisory Panel for Scottish Natural Heritage (**Scott, Lambin**), Marine Scotland Science Advisory Board (**Thompson**), Scottish Government Maternal & Infant Nutrition Strategy (**Wallace**), International Whaling Commission Scientific Committee (**Lusseau**), IUCN Specialist Groups (**Piertney**), NERC Special Commission on Seals (**Thompson, Piertney**), NOAA Science Panel (**Lusseau**).

(3) ***Knowledge exchange and public engagement -*** The UoA is supported by: **(i)** a dedicated Public Engagement Unit ((PERU); www.abdn.ac.uk/engage) which has a remit to implement the University's strategy around researcher-led public engagement. To that end, PERU organises a programme of events such as the Café Scientifique, Café Med, Café Controversial and Café Light

programmes; *TechFest*, Aberdeen's annual science festival; and the British Science Festival which was hosted by Aberdeen in 2012. PERU holds an RCUK *Public Engagement with Research Catalyst Award* to expand training and development of PE activity. **(ii)** Dedicated internal funds to promote impact and KE. These include a central Knowledge Exchange and Transfer Fund to pump-prime projects that enhance relationships with industry, public or third sector partners; discretionary funds held by Institute research directors seeded from research grant overheads to re-invest in KE activity; **(iii)** a dedicated Communications Team (CT) which forms the critical link between researchers and public through local, national, specialist and international media. The CT issues ~ 400 press releases a year, in addition to regularly placing stories with key media, and identifying researchers for expert comment. Key examples where the press office has produced worldwide exposure for high impact research include: i) results from **Wischik** and **Harrington's** clinical trial of the Alzheimer's drug *rember* covered on major UK and US TV news networks, made front page news in several newspapers and featured as major articles in the *Economist*, *FT*, *La Stampa*, *Le Figaro* and *Die Welt*. 1000 articles appeared globally with more than a quarter of a million blog posts. The BBC documentary "*Terry Pratchett: Living with Alzheimers*" and a similar documentary in Germany both centred on this research. This publicity led to an increase in investment supporting the clinical trials based in Aberdeen and elsewhere; ii) **Jamieson's** pioneering work in deep ocean biology led to articles in many national and international newspapers, *National Geographic* and *Nature*, and many TV and radio appearances worldwide, including Children's TV *Blue Peter*. A YouTube summary attracted three million hits and a follow-up feature on the BBC website had two million hits in 48 hours. Consequently, the BBC commissioned a programme on the research and asked Jamieson to provide commentary on James Cameron's expedition to the Mariana Trench.

***(4) Exploitation of commercialisation potential* -** UoA5 is supported by a Research and Innovation (R&I) team (www.abdn.ac.uk/research-innovation) of business development and commercialisation professionals to translate research excellence into commercial application and knowledge transfer activities. There are dedicated R&I staff in IBES, IMS and RINH to ensure the most appropriate routes to impact are identified and exploited. They help develop a researcher's *Pathways to Impact* plans and provide administrative and logistical support to ensure its implementation, which includes protection of intellectual property, patent application and spin-out companies. This support for effective commercialisation placed the University 6th in the UK by PraxisUnico, from 2010-12 for success in spinning-out research into commercial company formation. Staff submitted to UoA5 are involved in multiple University spin-out companies and since 2008 have secured 14 patents. As examples, R&I supported translational aspects of **Teismann's** research on the pathogenesis and treatment of Parkinson's disease by securing a Knowledge Transfer Grant to enable collaboration with commercial chemists to develop more efficient derivatives of a substance that showed neuroprotective effects in animal models. They then organised a subsequent patent application. Similarly, R&I organised a spin-out company (*Saccade Diagnostics*) to develop novel diagnostic tools based on **St Clair's** research on the specificity of eye movement abnormalities for schizophrenia, bipolar disorder and severe recurrent depression. This project was first prize winner of Converge Challenge 2013, the largest business competition in Scotland. Likewise, R&I facilitated an industrial collaboration between **Ross** and Organon to study the potential allosteric binding site on the cannabinoid receptor and aided further grant capture to develop allosteric enhancers for treatment of neuropathic pain and allosteric inhibitors for the treatment of type-II diabetes. Both have been incorporated into a University spin-out (*Signal Pharma*), for which R&I are aiding venture-capital funding.

R&I also oversee the *OceanLab* business unit, which offers the offshore oil and gas industry use of spare capacity in the unique deep ocean facilities and infrastructure developed by **Priede, Jamieson, Witte** and **Mayor**. Revenue is invested directly to pump-prime new pure and applied research within the UoA that has direct impact potential.

c. Strategy and plans

The UoA5 research and impact strategy aims to deliver **excellent**, **relevant** and **accessible** cutting-edge research that is designed with recursive dialogue with end-users to ensure relevance,

robust knowledge translation and downstream impact. The associated operational plan is reviewed and revised annually in response to research priorities, collaborative opportunities and emerging routes for communicating research, and benefits from input across multiple organisational levels. The overarching University research and impact strategy is governed by the Committee for Research, Impact and Knowledge Exchange (CRIKE). This feeds into the College of Life Sciences and Medicine Research and Commercialisation Committee, which in turn feeds into the three Institution Research Committees. Each level has a research director tasked to ensure a "pipeline" of training and support that facilitates translational research and secures impact (see b). The Unit's strategy and plans moving forward include:

To develop further the UoA's capacity and internationally excellent research portfolio The UoA has identified key research groupings that deliver internationally recognised research excellence in areas that directly inform key issues of societal importance in biological and biomedical sciences. These have been targeted for strategic investment in staff and infrastructure to further enhance capacity and impact. This is exemplified with the *Aberdeen Fungal Group* (AFG), which is the largest academic centre for fungal research with a focus on preclinical research directed at the treatment and diagnosis of *Candida albicans* and other fungal infections that claim 2-3 million deaths per year worldwide. A £1M investment in staff and infrastructure has been made to enhance research, training and field capacity to develop novel antifungals, diagnostics, immunotherapies that will lead to direct impact through disease prevention and treatment. Similarly, the *Scottish Fish Immunology Research Centre* (SFIRC) is a centre of excellence in pure and applied research on fish health in aquaculture. A £1M investment was made to provide new state-of-the-art aquarium facilities and appoint two new academic staff to increase impact through focus on new species models and novel approaches for gene discovery and vaccine development.

The University has invested in four key multidisciplinary research themes that address major global challenges and areas of fundamental societal concern: *Environment and Food Security*, *Pathways to a Healthy Life*, *Energy* and *The North*. Focus on the first two Themes is a consequence of success and activity within UoA5. Dedicated theme leaders promote cross-disciplinary research and communication with end-users through workshops, sand-pit meetings and KE activity. UoA5 researchers have exploited the opportunities for multi-disciplinarity that have arisen from the Themes. This is exemplified in a new collaboration which has emerged between IMS staff (**Scott, Riedel**), chemists (submitted to UoA8) and industry to produce synthetic variants of natural pore-forming molecules from marine sponges that improve delivery of anti-cancer drugs into cancer cells that form solid tumours.

Future research impact will be enabled through the **Centre for Genome Enabled Biology and Medicine (CGEBM)** facility, where there has been a major investment in academic and bioinformatics support staff, research infrastructure and high performance computing to enable 'omics research across the medical and life sciences; a £36M investment for a new **Rowett** building adjacent to IMS which will enhance interactions and collaborations in high-impact areas such as nutritional and neuroscience research; the **Kosterlitz Centre for Therapeutics** which provides capacity for drug discovery by linking with industry.

Within IBES, a specific horizon-scanning group has been created to identify new and emerging research areas and opportunities for impact. This group feeds into institutional strategy development and recommends targeted strategic investment in staff or infrastructure that positions the UoA so that it remains at the forefront of research, and enhances impact activity.

To exploit further potential for impact The directors of research oversee a support network for staff to ensure that potential impact and influence are identified and realised as part of the research process. Potential for impact will be a key recruitment criterion, with applicants for all academic positions being assessed for impact activity and a bespoke impact mentoring process put in place for new starts. To incentivise activity for existing staff, impact is now an integral part of staff appraisal and promotion criteria. Impact registers are held to monitor impact activity and evaluate the effectiveness of the impact strategy, which will be reviewed and revised annually.

To promote further end-user engagement We will continue to train, support and facilitate researchers to engage with key practitioners, end-users, stake-holders, policy makers, government

and guideline developers. This is achieved by: 1) encouraging staff to join advisory panels across the public, private and 3rd sectors; 2) ensuring outreach activity between researchers and potential end-users where collaboration could address issues of relevance and deliver impact.

To promote further and support University spin out companies We will use the Life Science Innovation building (developed through a £3.5M investment in partnership with Scottish Enterprise and European Regional Development Fund) as a hub to promote spin-out activity. This contains a range of state-of-the-art facilities with modular laboratory and office space to house future spin-out companies. Key players in previous spin-out success are central to this initiative to raise the profile of spin-out potential, mentor staff and highlight mechanisms to maximise impact. Commercialisation activity is incentivised by University policies on distribution of licensing income, IP, consultancy and spin-out companies that enable personal rewards for researchers. An internal Knowledge Exchange and Transfer (KEFT) award scheme is in place to pump-prime new commercialisation activity, and continued participation in the *SFC Innovation Voucher Scheme* will enable collaboration with small and medium enterprise (SME) companies.

To maximise further communication and public engagement at all levels We have identified individuals within the UoA Institutes to act as public engagement champions to work alongside the University's Public Engagement Unit. The UoA will continue to exploit key partners (e.g. TechFest, Satrosphere (local public science centre) and specific events (e.g. British Science Festival) to ensure science is communicated to the public. A major initiative is the development of the University *Natural History Centre* specifically for teaching and outreach with Schools. UoA staff will contribute talks, demonstrations, field classes and CPD for teachers.

d. Relationship to case studies

The impact case studies exemplify the range of translational research activity undertaken, highlight the spectrum of end-users, stakeholders and policy makers that benefit, and illustrate the UoA impact strategy in practice. They represent only a proportion of our activity that is benefitting the awareness, attitude, behaviour, capacity, performance, policy, process and understanding of various end-user groups, from local community to government and industry.

The case studies led by **Pertwee** (*Cannabis as a source of medicines: development of the world's first licensed cannabis-based medicine, Sativex®*), **Porter** (*Commercialisation of shark antibodies as a platform for biologics drug discovery and development*), **Morgan/Barrett** (*From melatonin receptors to Valdoxan – a novel and effective therapeutic anti-depressant drug*), **Greig** (*Discovery and commercialisation of novel anti-inflammatory drugs*) and **Wischik** *(Discovery and commercialisation of an entirely new drug for the treatment of Alzheimer's disease*) are all associated with the development of drugs and therapeutic agents (**impact – patient health and welfare; changes to clinical practice**). In these cases, development was mediated through spin-out companies organised by R&I support (**impact – creation of jobs**), who also provided input on IP issues, business development and patent processing.

The case studies led by **Lusseau** (*Changing the way nations manage the impacts of human disturbances on the conservation status of wild animals*), **Reid** (*Population science shapes conservation policy for rare Red-billed Choughs in Scotland*), **Thompson** (*guidelines for assessing and lessening impacts of offshore energy developments on protected marine mammal populations*) and **Lambin** (*Eradication of an invasive alien predator through empowering community conservation stakeholders*) exemplify how long term, large scale basic ecological research provides the underpinning biological information to develop robust and effective management, conservation and mitigation strategies that were ultimately embedded into different types of legal framework. This reflects our strategy of maintaining long-term collaborative relationships with key practitioners who can embed our research into policy (**impact – national and international policy and decisions; management and conservation of natural resources; management of environmental risk and hazard**).

In all cases, the case study authors benefitted from impact training, support from R&I to develop pathways to impact and the University PERU to disseminate findings across a broad audience.