Institution: University of Essex

Unit of Assessment: 5 – Biological Sciences

a. Context

The School of Biological Sciences' two research groups, **Environmental and Plant Biosciences (EPB)** and **Molecular and Cellular Biosciences (MCB)** achieve impact in the areas of *Food Security*, *Living with Environmental Change*, and *Lifelong Health and Wellbeing*. The School has a strong multidisciplinary research environment, in which staff actively engage with a range of users outside of academia, including: i) biotech companies and agri-businesses working in the private sector; ii) public sector organisations and NGOs operating in the health and environment sectors, and; iii) hospitals and patient groups, who benefit from research translated from the bench to the bedside. The School's productive engagement with these research users has underpinned a broad range of impact; this is illustrated by a number of notable examples:

- Research on coastal water quality, microbiological loadings, shellfish and eutrophication led to environmental and public health impacts enabled by Underwood's interaction with **government agencies and NGOs** (e.g. UK Environment Agency, Natural England and Essex Wildlife Trust).
- Research on photosynthesis has led to development of equipment and approaches for phenotyping crop plants. This achieved commercial impact via the **spin-out company** *Technologica,* through **uptake by other equipment manufacturers** (such as PSI and Walz) and through deployment by major multi-national companies, including Syngenta and Monsanto.
- Research on coral reef biodiversity led to designation of a UNESCO Biosphere Reserve, assisting the Indonesian government to achieve environmental, policy, and societal impacts. This also enabled the establishment of a **research-tourism business model**, leading to commercial impact for the company Operation Wallacea.
- Optimisation of a novel bioprocessing matrix, as part of basic research on tumourigenesis, led to **product development** by Porvair Filtration Group Ltd, to achieve commercial impact.

In many areas the School is also undertaking research having more emergent impact, for example:

- Research on **bioremediation of hydrocarbon pollution with the oil industry** (e.g. Whitby with OilPlus) is being undertaken to achieve commercial and environmental impacts.
- Research on plant-environment interactions aimed at **increasing crop productivity** is being undertaken to enable agri-business to achieve commercial impact (e.g. Mullineaux in collaboration with Plant Biosciences Ltd).

b. Approach to impact

Biologists at Essex are proactive in maximising the impact of their research. Supported by the School and University, a range of approaches are adopted; these are outlined below.

Researchers establish non-academic partnerships and networks involving industry, government, NHS, charities, and other groups, to identify impact opportunities. For example: the Essex Biomedical Sciences Institute brings together University researchers with top clinicians from regional hospitals to promote and foster translational research, thus ensuring that cutting-edge research in health and medical sciences is targeted to public and patient needs. The Coral Aquarist Research Network, established by a NERC KE Fellow at Essex, brings together coral growers, importers, educators, outreach organisations and scientists (including those of the School's Coral Reef Research Unit) to share expertise, initiate research and expand awareness of the plight of reef systems. The Essex Research into Ageing Unit and the Ageing and Assisted Living Network facilitate initiatives to better understand ageing processes and promote the translation of assisted living technology into practice and care environments.

Researchers obtain funding to support impact. In the period 2008-2013, academics within the School obtained ~£2.71m in funding from impact-specific RCUK schemes (e.g. Pathfinder, Follow-on-Fund, KE-Fellowship, Industry Interchange, People Exchange and the Developmental Pathway Funding Scheme). The East of England Iceni seedcorn fund has provided a total of £240k to support the commercialisation of research and the Colchester Catalyst charity has funded a PhD studentship. Where external funds are not available, the School provides financial support through its research promotion fund (this is exemplified in the *Micro-porous Polyethylene* case study).

Researchers pursue activities that have the primary objective of underpinning impact. For example: plant scientists at Essex participate in the Crop Improvement Research Club (CIRC).

Funded by BBSRC and the private sector, CIRC aims to develop crop varieties with increased productivity and higher quality products. Another example is the EU FP7 funded ABSTRESS project, led by the UK Food and Environment Research Agency, which uses state-of-the-art plant breeding and genetic tools to produce crops with greater drought and disease tolerance.

Researchers develop professional relationships with user groups. For example: Underwood was a member of the Defra Science Advisory Panel (Marine Conservation Zone Policy and Implementation, 2009-2012), and the Environment Agency's Regional Flood and Coastal Committee, which has responsibility for prioritising and advising on current and future investments. Klenova is a member of the Research and Development Steering Group, Colchester Hospital University NHS Foundation Trust (CHUFT). This has a role in developing and advising on translational research strategies, policies and investments.

Research groups develop plans to ensure that research is shared with users. In some cases research is also directly informed by users, to maximise its utility in wider contexts. For example, the EPB research group works with the Environment Agency to ensure that data from river and coastal ecosystems research are compliant with the requirements of the Water Framework Directive, and so can directly contribute to water quality assessments and management decisions.

School and University support systems aid researchers capitalising on research outputs with significant impact potential, and help to ensure impact can be delivered effectively and efficiently. The School's Research Strategy Group (RSG) reviews the School's impact policies, projects and achievements and the School's Research Director ensures that the impact agenda is prioritised across all activities. The School provides financial support for achieving impact via its research promotion fund, and human support through its Research Administrator, Technicians, Research Fellows and Research Officers. Research and Business Partnership Managers (RBPM) in the University's Research and Enterprise Office (REO) assist researchers in developing commercial impacts through a range of pump-priming funding schemes; through support in identifying and making contact with potential research users; a business incubation hub; and advice on securing start-up funding and patents. A postgraduate consultancy service provides opportunities for PhD students to engage with employers and translate research concepts towards user applications.

Annual performance and development reviews, undertaken for all staff, include discussion of current and planned impact activities. A workload model assists staff in allocating effort amongst research, impact and other activities. Finally, the School and University consider the impact activities of staff in decisions on permanency and promotion at all levels. For example, Underwood's broader experience in impact-related activities was recognised in his appointment to Executive Dean for the Faculty of Science and Health.

c. Strategy and plans

The School of Biological Sciences' goal is to produce high quality research that addresses major challenges faced by society and industry, building on strengths in Plant Science, Environmental Biology, Disease Mechanisms and Molecular Biophysics. Central to achieving this goal will be the continued monitoring and assessment of the School's research outputs and impact activities, to further develop strengths and support the introduction of new ideas. Assessment will continue at the individual level through annual professional development reviews, at the research group level during strategy meetings, and at the School level through the Research Strategy Group. A number of on-going research projects showing **significant potential for impact** have been identified:

- Research into a novel electron transfer pathway in haemoglobin is being undertaken with the objective of **developing an improved pathogen-free blood substitute**. Since 2008, awards totalling £2.56m (£2.14m of which was obtained in 2013) have been won from a range of sources, all specifically intended to support the translational potential of this work.
- Research on BORIS, a protein found in blood cells, has shown potential to be a **biomarker for early detection of breast cancer** and monitoring efficacy of pre-operative chemotherapy; Klenova and Metodiev are collaborating with CHUFT with the aim of realising health impacts from their research.
- Research on new peptide-based amyloid inhibitors is being undertaken with the aim of developing **treatments of age-related diseases** including Alzheimer's and Parkinson's. In collaboration with fayju.com, Mason is developing an Alzheimer's game for the Apple iOS.

In developing impact, the School will continue to make use of the expertise, funds and personnel of the University's REO. This will include working closely with RBPMs, who have a strong track

record in translating research insight towards non-academic applications. The role of the Impact Officer for the Faculty of Science and Health is also being expanded to support knowledge exchange by assisting in building partnerships with potential research users. With the support of the REO and University management structures, the School will encourage and facilitate researchers in:

- Identifying impact opportunities **at an early stage** of research and promoting commercialisation of research, for example through the REO's Knowledge Transfer Innovation Fund.
- Obtaining resources **to demonstrate the commercial value of ideas**, for example by providing assistance in preparing applications for RCUK Follow-on Funds and similar resources. Where appropriate, seedcorn funding and technical assistance will be provided by the School and University, through, for example, the School's Research Promotion Fund.
- Development and implementation of **Pathways to Impact from RCUK projects**.
- Establishing **research-update days, targeted at user audiences,** to showcase research and capitalise on the expertise and knowledge of non-academic partners.

Building on the approaches employed in the 2008-2013 REF period, the School also plans to:

- Develop new impact vehicles similar to the Coral Aquarist Research Network and the Essex Biomedical Sciences Institute.
- Support new interfaces, platform sciences and technologies, to bring together different disciplines and create new high-quality cognate themes and capacities with a greater potential for exploiting impact (e.g. in the area of Behavioural Genomics).
- Strengthen relations with UK, European and global organisations that have impact potential.
- Increase external funding to support impact from RCUK schemes (e.g. TSB funding through links with industrial partners) and increase involvement in national and international research projects (e.g. ABSTRESS, CIRC) that are explicitly designed to underpin impact.

d. Relationship to case studies

Chlorophyll Fluorescence Imaging case study: In pursuing the patent and establishing the spinout company (*Technologica*) researchers used knowledge and expertise from the University REO to support the transition of research insight through to a self-supporting company. Via proactive dissemination of key concepts in peer-reviewed journals, this research also led to commercial impact for other instrument manufacturers. Concepts developed at Essex demonstrated the use of chlorophyll fluorescence imaging in practical applications, promoting on-going uptake by the agri-business sector. Researchers continue to engage with user groups in industry, which provides mutual benefit. Active dialogue continues with *Technologica*, with regard to further product development, and also with *Chelsea Technologies Group Ltd* as it develops chlorophyll fluorescence-based technologies for assessing environmental quality.

Wakatobi Marine National Park (WMNP) case study: This exemplifies where impact was intended to be a key outcome from the outset of research. In partnership with Operation Wallacea, the Essex Coral Reef Research Unit designed and implemented a research-tourism business model which enabled the research to underpin the designation (in 2012) of the WMNP as a UNESCO Biosphere Reserve. The long-term research conducted under the direction of Essex University scientists, and involving school and university students (from the UK and overseas), volunteers, and private sector companies (e.g. Mitsubishi), resulted in peer-reviewed scientific publications. In turn this led to social impact benefitting participants by providing a stimulating research experience, commercial and economic impacts through raising the profile and scientific credentials of the industry partner, and environmental and policy impacts through enhanced international awareness of the biological and cultural diversity of the WMNP.

Micro-porous Polyethylene case study: In contrast to the first two case studies, this impact arose with research already in progress, without being an explicit original aim. Working closely with an REO Business Manager, researchers identified the potential for a commercial product and the group formed collaborative links with the commercial partner Porvair Filtration Group Ltd. The School's Research Strategy Group provided financial support for product development.

The successful approaches employed in the case studies have informed the development of the School's impact strategy in a significant way. They demonstrate the value of building collaborative partnerships and networks with external user groups. New groups such as the Coral Aquarist Research Network (section b) have been formed as a result, and this has also informed the intention to develop further networks as a means of delivering future impact.