Institution: Bangor & Aberystwyth Universities - Biosciences, Environment & Agriculture Alliance

Unit of Assessment: 07 Earth Systems and Environmental Sciences

a. Context

Uniting Bangor and Aberystwyth Universities' environmental research in the **Biosciences, Environment and Agriculture Alliance (BEAA)**, our common vision is to increase the utility and accessibility of science to inform decision making across the environment sector. Non-academic users of the unit's research are classified into five categories (shown with illustrative examples):

- **UK Government, international and intergovernmental agencies:** Defra, DfID, the Environment Agency (EA), Natural England, Natural Resources Wales (NRW), Governments of Qatar and Madagascar, European Commission, UN FAO, UNEP
- **National and international environmental NGOs:** Marine Stewardship Council, the Prince's Charities, Woodland Heritage, Conservation International
- **Large multi-national and SME industry:** water (Welsh Water), energy (Siemens), minerals (Rio Tinto), fisheries (Young's Seafood), retail (Waitrose), forestry (UPM Tilhill), tourism
- **Local/national land users and advisors:** Forestry Commission, National Trust, utility companies, Velcourt, ADAS, farming unions
- **The general public:** through targeted events (e.g. on managing ecosystems for people, nature and economy) we increase public understanding of science

The unit achieves three main types of impact through provision of evidence to users:

- **Improved regulation, public policy and services in the environmental sector** benefitting the environment, health and welfare, and international development
- **Evidence-informed management decisions** supported both through targeted primary research and 'what works' evidence synthesis, benefitting resource users and society, including benefits to the environment and improved public education
- **Improved sustainable practices for industries and improved access to markets** resulting in direct economic benefits

b. Approach to impact

Our approach is user-driven, involving end-users and stakeholders in the development of research questions and project designs. To make this approach effective, we have established a co-ordinated set of applied research centres and networks which each target a different subset of our user groups to maximise the future impact of current research.

Evidence of nature of relationships and interactions:

Our approach has prioritised early engagement with users to understand their evidence needs and to generate research questions that address these needs. The Centre for Applied Marine Sciences (CAMS) is a good example of how focused centres within the unit act as interfaces between academic research and end-users, creating platforms for interaction with companies and the public sector on technology transfer and economic development. CAMS' research is entirely defined by industry needs, with over 30 externally-funded staff delivering a range of grant- and industry-funded projects. A number of the major projects exemplify interaction with the fisheries industry and the marine renewable energy sector. Close involvement of fishers, fisheries boards and government agencies in the *Ireland-Wales Celtic Sea Trout Project* has led to improved management advice to regulatory authorities on Irish Sea trout stocks, while across a wider range of marine fisheries, the £2.5M European Fishery Fund project on *Sustainable Fisheries in Welsh Waters* (2012-2015) led by CAMS is an innovative model of industry-university research partnership, generating data to inform evidence-based fisheries management. CAMS also leads a consortium of European aquaculture centres and companies (*SEAFARE*) to promote diversification of the industry through development of novel integrated farming systems. CAMS works closely with the rapidly-growing marine renewable energy sector (e.g. Marine Current Turbines, a Siemens company) with a focus on spatially-explicit environmental impacts, matching industry with research council and EU funding.

Globally we work with the UN Food and Agriculture Organisation (FAO) on climate change impacts and developing the evidence base for carbon sequestration and adaptation of agroecosystems, and our academics are engaged in the IPCC process through the Blue Carbon

Initiative. We are a partner in the CGIAR programme on forests, trees and agroforestry, a global partnership that links research to impact via explicit outcome mapping. At a national level our staff serve on the UK and Welsh Governments' Climate Change Groups and on the Secretary of State for Wales' Business Advisory Group with particular responsibility for the green economy.

Evidence of follow-through to identify resulting impacts:

Our SEACAMS (*Sustainable Expansion of the Applied Coastal and Marine Sectors*) EU-funded programme has worked with 149 companies, assisted an additional 265 individuals, created 30 new jobs, and launched 9 new products/processes and 4 new enterprises in the first 3 years of its operation (2011-13). BEAA's research on mitigation of climate change through bioenergy crops and biorenewable products is closely linked to industrial research users, as exemplified by the BEACON (*Biorefining Centre of Excellence*) project. This is led by Aberystwyth in partnership with the Bangor BioComposites Centre. In its first 2.5 years BEACON has assisted 45 enterprises, established collaborative R&D projects with 14 companies and generated external investment of £3.6M. It is one of 4 projects shortlisted in the "Sustainable growth: Green growth and jobs through Bio-economy" category of the 2014 EU RegioStars Awards. The unit's research on *Miscanthus* genetics and breeding is being carried out in close collaboration with plant breeding companies (>£3M commercial investment, including >£1M by CERES Inc., USA), and has led development and implementation of UK and international policy under the UN Convention on Biological Diversity for conservation of genetic diversity of this crop. Furthermore, substantial funding (£721k since 2007) from the EPSRC SUPERGEN-Bioenergy programme supports research on the bio/thermal conversion of this biomass, and conversion to transport fuels and renewable chemicals in collaboration with industry. The unit has a well-established record of progressing fundamental research into development and commercialisation of new biorenewable products and technologies, exemplified by substantial commercial investment currently being made in a 7,000-t production plant of a new bioresin discovered through our research.

The Bangor Acidophile Research Team collaborates closely with industry (notably the multinational company Rio Tinto) through a Royal Society Industrial Fellowship which has led to the discovery of a new technology for "biomining", using newly isolated bacteria to extract metals from ores. This technology, currently at the commercial testing stage on the path towards incorporation in industrial-scale mining operations, has huge commercial potential, being described as the "greatest change in the mining industry of the past 50 years" by experts in the field (C. Du Plessis, previously Vale Pty, now Biohydrometallurgy Consultancy and Innovation).

Evidence of agile approach to opportunities:

Because of the nature of our collaborations, we have developed a flexible approach to research, adapting to the evidence-needs and decision-making timescales of end users and collaborating organisations. To enable this, we have placed a high priority on establishing specialist networking units targeted at achieving research impact, as demonstrated by the following 2 examples.

We lead the Climate Change Consortium of Wales (C3W) that builds capacity and co-ordination of interdisciplinary climate change-related research in Welsh universities. Through working with policy, education and business sectors (e.g. UK Governments, Natural Resources Wales, the UK Met Office, and UK-wide museums and schools), C3W identifies key research needs and opportunities, and focuses the incorporation of the unit's research outputs into the design and delivery of research impact plans and strategies (e.g. Wales Environment Strategy, Climate Change Strategy), increasing their evidence base, depth and effectiveness.

The Welsh Institute for Sustainable Environment's Network (WISE) is an EU-funded collaboration between Aberystwyth, Bangor and Swansea Universities that enables SMEs to take full advantage of the growth in the Green Economy by developing sustainable products, processes and services. Initial contact with a wide range of businesses identifies those whose needs can best be met through collaborative research: to date this has resulted in 17 new joint projects.

Supporting and enabling staff:

Three specific examples of how we support and enable individual staff to achieve impact from their research are provided. (i) Prof. Michel Kaiser's contract has been modified to enable him to undertake public appointments that include board membership of the Seafish Industry Authority and the Joint Nature Conservation Committee. Through these, Kaiser directly interacts with end-users of the unit's research across the seafood, fisheries and conservation sectors in UK, Europe and internationally, as evidenced by his address on Marine Conservation Zones to the House of Commons All Party Committee on Biodiversity in February 2013. (ii) Prof. James Scourse has

been facilitated to take on the national role of Director of C3W through appointment of an additional member of staff to cover his teaching role for 4 years. (iii) Dr Julia Jones has been relieved of her teaching duties and Bangor administrative commitments for 3 years to lead work in Madagascar with 12 local and international academic, government and NGO partners using our research to influence the development and implementation of ecosystem service payment schemes in the interests of poverty alleviation.

Use of institutional facilities, expertise or resources:

The unit makes extensive use of its Environment Centre Wales (ECW) to enhance research impact. The ECW is a partnership between NERC, Welsh Government and Bangor University that aims to facilitate new linkages amongst researchers and policy makers on current environmental issues. ECW actively fosters collaboration with research users in Natural Resources Wales (NRW) by providing them with hot desks for collaborative work with our researchers. Linkage to Welsh policy-makers is promoted through ECW's Wales Environment Research Hub, a collaboration between Bangor University, Welsh Government, NERC Centre for Ecology and Hydrology and NRW. The Hub acts as a one-stop-shop for evidence needs for policy, showcasing our research to users, e.g. through co-ordinating focussed meetings with policy-formers. It frequently hosts visits by Welsh Government policy-makers bringing them into close contact with our research teams. In June 2013 the hub ran, for NERC, a well-attended UK workshop on Communicating Environmental Science which emphasised our interdisciplinary commitment to knowledge exchange and mobilisation rather than impact through uni-directional 'knowledge transfer'. Good examples of collaborative working as a pathway to impact at UK and international levels are provided by all of the university research groups centred on ECW. Our catchment, soil and microbial science research group works closely with EA, local authorities, NHS boards, Food Standards Agency, Health Protection Agency, Public Health England/Wales, food, waste and mineral industries, and individual farmers. The microbial genomics research group has achieved substantial impact at European and international levels through industrial partnership in EU FP7 grants and other international consortia led or co-led by the group.

Bangor University's research vessel, Prince Madog, is a pre-2008 investment of £4.3M, including £1.5M from industry, but her capacity for research impact was greatly enhanced in 2011 with £310k investment in a multi-beam system for seafloor mapping. This is being heavily used by a broad range of industry-university collaborative research projects.

Other mechanisms:

The unit's research frequently uses participatory approaches. We have a sophisticated and broad approach to the communication of research findings to user groups, using a wide range of media including outputs in the form of policy briefs, best practice manuals targeted at practitioners and layman's summaries targeted at the general public. We run regular public open days and lecture series, e.g. 10 weekly C3W lectures on climate change culminating in a BBC-broadcast Question Time debate. We attend a wide variety of public events annually, including The Royal Welsh Show. We also maintain an active schools programme with a dedicated web presence and some 60 specialist lectures. We participate actively in National Science and Engineering Week (e.g. through the annual Bangor and Aberystwyth Science Festivals), Fascination of Plants Day and locally our staff contribute strongly to the Bangor and Aberystwyth Science Cafés.

c. Strategy and plans

We aim to deliver a research service that informs decision making through the provision of scientific evidence from both primary and secondary research, across the environment sector. Our strategy is based on engaging with decision makers and understanding their evidence needs in the context of scientific research. Impact within the Biosciences, Environment and Agriculture Alliance (BEAA) is led by the respective heads of Institute and College (Powell and Jago) supported by the Directors of Research (Newbold and Healey). In 2013, Bangor introduced a new Research and Enterprise Strategy to provide stronger central leadership, co-ordination and support for research impact, through a significant reorganisation and strengthening of the university's Research and Enterprise Office to enhance collaborative working with our researchers. To advance our strategy, we will also create a vibrant, world-leading (£35M) Innovation Campus at Aberystwyth and closely linked (£10M) Science Park at Bangor which together will be a destination for existing and new companies, investors and entrepreneurs, designed to drive and capture new economic

opportunities based on integrating interdisciplinary research for impact. We will include the following flagship initiatives: (i) an interdisciplinary centre for the bio-economy building on the WISE project to provide technical solutions and mechanisms to bring products and processes to market; (ii) an upland research platform for the UK built on the two universities' land use research centres at Henfaes and Pwllpeiran to capitalise on our strong basic science by translating it into innovative systems of land use and technologies that will improve UK and global uplands environments; (iii) an integrated platform for the development of national capability for bio-prospecting, and industrial biotechnology building on BEACON to develop a range of low carbon technologies as substitutes for fossil fuels; (iv) a Public-Private-Producers-Partnership for Food, Nutrition and Energy Security. The operation of this BEAA outward-facing innovation campus will build on the principle of the EU *Smart Specialisation* regional approach to innovation, where Aberystwyth and Bangor have a record of excellence and scientific expertise, long-term strategic funding, unique facilities, environmental and biological resources, capability and commercial acumen. Through this approach we will accelerate the translation of environmental research for the benefit of the UK economy, and will provide new opportunities for student training and employability, thus catalysing the establishment of start-up companies.

d. Relationship to case studies

Establishment and maintenance of close relationships and interactions between the ECW molecular ecology and fisheries group and a range of governmental and NGO bodies, e.g. Defra, Cefas, EA, UN FAO, European Commission and governments' expert groups, and the International Council for the Exploration of the Sea (ICES), has facilitated the development of an agile approach to meet major needs in the area of fisheries policy. By linking this to Bangor's substantial expertise and facilities in this field, we were able to secure large-scale FP7 funding in partnership with key policy/industry institutions for the FishPopTrace project (**DNA forensics** case study).

Success in interaction with industry and subsequent follow-through to identify impact is well illustrated by the Bangor spin-out company Footprints for Food, which played a critical role in the successful take up of the unit's research by leading supermarkets and fresh food producers reported in the **carbon footprinting of food sources** impact case study. This demonstrates the unit's commitment to the research-impact linkage, with industry needs informing our research agenda and an effective pathway for uptake being embedded in our research process.

The major impacts achieved by integrating our interactions with industry, NGOs and policy makers were facilitated by supporting and enabling a key staff member. This is a significant lesson emerging from our **sustainable fisheries** case study. Our identification of business needs showed the requirement for research which provided evidence of the mitigation of harmful environmental impacts through improved fishing methods. The success of this research has greatly improved co-operation between industry and regulators and resulted in new Marine Stewardship Council certification of the sustainability of major fisheries. The **turbulence-ocean forecasting** case study demonstrates the long gestation from research to major impact in earth system science related to the global grand challenge of climate change. Subsequent developments in complex modelling, facilitated by our international research collaborations, were essential to realise the impact of our fundamental research discoveries about ocean turbulence processes.

Our strategy for interaction with research users, coupled with excellent expertise and facilities, is also exemplified by our case study on **peatland carbon storage**, based on the research of the unit's Wolfson Carbon Capture Lab. An essential factor in our success was identification of the synergy in the needs of water industry, land managers and regulatory agencies, as well as of climate change policy makers. This has resulted in important evidence informing new policy and practice to improve peatland management, conservation and restoration to enhance carbon sequestration and water quality, of societal, commercial and environmental benefit.

Finally, it is noteworthy that common features linking all five case studies are the history of university support in the form of protected academic time to facilitate implementation activity and the provision of support staff dedicated to development of projects targeting impact and engagement with research users. Thus, we feel that our policy of actively supporting research with impact has already borne fruit and will enable us to enhance the social, economic, cultural and environmental benefits of our research to the local region, the UK and the world.