Institution: Edinburgh Napier University

Unit of Assessment: 7 - Earth Systems and Environmental Sciences

a. Context

Research carried out in this Unit of Assessment (UoA) derives from the School of Life, Sport and Social Sciences in the Faculty of Health, Life and Social Sciences (FHLSS). It covers a range of environmental disciplines, including marine and aquatic ecology, conservation biology, ecological modelling, animal behaviour, ecological restoration and environmental microbiology. Research here complements that conducted elsewhere in the School, particularly the toxicological testing of nanomaterials (to determine impacts upon humans and the environment) in the Centre for Nano Safety and work on the sociology of environmental issues. Researchers collaborate with Government, business and charities on work of benefit to the public and private sectors. In addition, we engage in public outreach to communicate our science and to engage with the communities in which we operate.

Business engagement: Edinburgh Napier University (ENU) has a record of successful business engagement adopting the priority themes of growth in business engagement income, graduate employability, and industry-informed research. ENU consults with industry to determine its needs for innovation and skills and has established an effective 'innovation pipeline' to ensure good flow of information between academics and industry. The 2012 report *Analysis of the Knowledge Transfer Grant Strategies and Annual Reports* commissioned by the Scottish Funding Council cited ENU as an exemplar of best practice in Knowledge Transfer Grant investment strategy to support business engagement. Key examples of UoA7 commercial engagement are given in section b.

Government and policy makers: Researchers in UoA7 actively engage with Government, including policy makers, ministers and Government research institutions. For example, the Director of the Biofuel Research Centre is an adviser to the Scottish Government, and a member of the Scottish Biofuels Task-force, which advises on the potential of the Scottish Biofuels industry. This select working group was instigated by Scotland's First Minister, Alex Salmond, and reports to his Energy Advisory Board. The work led by Tett (highlighted in the 'Healthy Seas' impact case study) was driven by government policy priorities and involved policy makers from the start. Work on marine carbon and mangrove conservation has been highlighted at presentations in the House of Commons (see the 'New Paths to Mangrove Conservation' impact case study).

Charities: ENU welcomes work with charities, developing long-term partnerships and providing 'in-kind' match funding to compensate for the lack of full economic cost funding from charitable sources. Hence the many charity-funded projects engaged in by UoA7 staff are underpinned by university support. Examples include: work by Briers, funded by the Tweed Foundation, on the environmental quality of rivers in the Tweed catchment; work by Gilchrist, funded by the British Ecological Society, on co-operative breeding in mammals and invertebrates; work by Huxham, supported by Earthwatch Institute, on mangrove conservation and restoration.

Public engagement: We have a long history of outreach and public engagement. The high level of public interest in some areas of our expertise, such as whale and dolphin biology, is reflected in good public attendance at 'ragged university' and 'bright club' outreach evenings presented by ENU staff in the context of the Edinburgh Beltane initiative. We engage with children at open public events (e.g. Bang Goes the Borders Science Festival in Melrose) and in schools (e.g. after school clubs for primary and "speed date a scientist" events to help secondary pupils with career choices). We support structured programmes designed to engage children in science careers, often through showcasing our research. These include: the Nuffield School bursary scheme, offering summer vacation placements to students; Kickstart, a collaboration between ENU, the University of Edinburgh, Queen Margaret University and Scotland's Rural College that provides a fun taster of studying at University; and High Flyers, a scheme designed to give schools, with low university uptake, the opportunity to attend summer workshops. In addition, the department has a number of Science, Technology, Engineering, and Mathematics (STEM) ambassadors who take part in activities such as 'Lab in a Lorry', the Edinburgh International Science Festival and the British Science Festival. Our work overseas includes engagement with primary and secondary students, for example providing 'mangrove day' excursions to field sites for local children.

b. Approach to impact

UoA7 researchers are required to apply three key principles to ensure and enhance impacts of their work on non-academic beneficiaries and users. These are policy relevance, international scope and commercial application.

***Policy relevance*:** Much of the work in the UoA, and particularly that relating to aquatic pollution, ecosystem health and ecological restoration, has been orientated to helping policy makers and has relied on close relationships with user groups. For example the work led by Tett (with contributions from Fernandes, Gilpin, Huxham and ENU postgraduate researchers) on undesirable disturbance in the marine environment (described in the 'Healthy Seas' case study) was in direct response to a policy need identified by the Department for Environment, Food and Rural Affairs. The process followed to complete this work involved establishing a large consortium, which included academic researchers but crucially also policy makers from the UK Government Centre for Environment Fisheries and Aquaculture Science (CEFAS); by advising right from the start they could help direct the work to specific policy outcomes. A similar strategy has been taken in follow-on work concerning the EU Marine Strategy Framework Directive, with a workshop at CEFAS in June 2010 establishing remits, roles and focus and a forthcoming multi-author paper addressing policy requirements written as a result (http://www.int-res.com/prepress/m10539.html).
Similarly, new work within the unit on Climate Compatible Development, funded by the Department for International Development, responds directly to pressing policy needs, in the UK and abroad, to integrate planning for climate change with economic development:http://cdkn.org/project/icoast-understanding-the-fiscal-regulatory-mechanisms-necessary-to-achieve-climate-compatible-development-in-the-coastal-zone/ .The research consortium formed for this project again includes government bodies, consultancies and other academic partners; the University facilitates such cooperative cross-sectoral working with flexible financial and legal support and with research project support based in the Faculty Research Office.

***International scope*:** Four of six staff submitted conduct the bulk of their research abroad and ENU has a long history of supporting international collaboration. This generates impact relevant to the host countries, where ENU staff can contribute their expertise to help solve local problems. For example Gilchrist is working to reduce the stress experienced by game animals hunted in South Africa. ENU's international collaboration also increases the scope and importance of the work by studying topics of global importance. For example Diele and Huxham both work on the carbon dynamics of marine wetlands and their role in mitigating climate change, collaborating with expert members of the relevant Intergovernmental Panel for Climate Change (IPCC) groups (such as Prof Hilary Kennedy at Bangor) to influence international policy (through for example the adoption of new IPCC protocols). To facilitate the international travel and fieldwork involved, the School operates a flexible system of work allocation, allowing staff to take time away from teaching. It also supports research students living and working abroad, but registered at ENU and receiving distance learning support along with face to face supervision during visits to the UK. One measure of the international reach of our impact is how students and members of the public overseas benefit from our research and outreach. For example, Huxham runs intensive training sessions in scientific methods and mangrove management for young developing-country scientists. Funded by the John Ellerman Foundation and held in Kenya, these have to date trained 32 young scientists.

Commercial application: ENU has worked closely with business to develop the commercial potential of research within UoA7. Applications of microbiology to environmental problems have been particularly significant here. The Biofuel Research Centre (BfRC), led by Professor Martin Tangney, was the UK's first centre dedicated to sustainable biofuel. The patented technology arising from this research programme led directly to the establishment of the UK's first biobutanol production company – Celtic Renewables Ltd - and a major industrial partnership with the malt whisky industry. The innovation has been formally recognised with prestigious awards: In February 2012 the Shell Springboard award for Innovation in Low Carbon Technologies and in November 2012 the global Institute for Chemical Engineers Innovator of the Year Award. Another area of applied microbiology involves the desulphurisation of rubber. The bacteria involved in this were first isolated by scientists from ENU and shown to devulcanise rubber. A spinout company Recyclatech, working under the direction of Professor Nick Christofi, is developing a scale-up of the devulcanisation process with the potential to deal with the important environmental problem of waste rubber tyres. These ventures illustrate the ability of staff within UoA7 to utilise University support to maximise commercial impact. Institutional support is reflected in the Faculty management structure, with an Assistant Dean for Professional, Commercial and International Development, a Head of Business and Administration, and the Faculty Director of Research all involved in facilitating commercial impact. This group oversees an Innovation Manager and a

Business Development Executive, who interface between researchers and the non-academic users/beneficiaries of our activity.

Other examples of how ENU has developed mechanisms to increase the reach and significance of commercially oriented research include:
a) Enthusiastic adoption of the Easy Access Intellectual Property (EAIP) model, required by the SFC, to the Scottish SME base. This is being achieved through the Business Innovation Exchange (BIE) Programme, a collaborative exchange venture led by ENU in partnership with Queen Margaret University and the University of St Andrews. ENU is now the leading practitioner in the use of Innovation Vouchers to stimulate demand in the SME sector. Innovation Vouchers provide up to £5,000 to enable academics to devote time to undertake short projects with industrial or public sector partners. Over the past two years, the University has generated 87 new innovation-based relationships with Scottish businesses.
b) ENU led the investment in two significant initiatives to improve communication with business and industry. Firstly, working with Queen Margaret University and the University of St Andrews, a common University to business marketing strategy, "Business Tailor", was developed and refined to meet individual partners' requirements. Secondly, ENU is leading in "Strategic Account Management" (SAM), as a component of University-business collaboration. Where the profile of activity is conducive to SAM (for example, large volume and/or value of business or company size), SAM explores the “whole company” needs, and meets these with a "whole University" response.
c) Researchers in this UoA also respond to enquiries from Interface (http://www.interface-online.org.uk/), a “matchmaker” that connects businesses with Scotland's 24 higher education and research institutes to stimulate innovation and growth.

c. Strategy and plans

The FHLSS research strategy states: “The Faculty is committed to supporting programmatic research that is collaborative, international, and multi-disciplinary, and which fits within the four themes of: Biomedical Science; Human Performance; Environment, Sustainability and Society; and Health and Wellbeing.” Our research informs teaching, enriching the curriculum and driving programme development, enhancing the employability of our graduates. Research-teaching linkages are a focus in all programmes and include a 60-credit research project which often produces publishable work. We also support students who wish to have external placements and have engaged with industry to ensure that graduates and postgraduates have the skills that they require. As part of a current focussed exercise in listening to the needs of employers and building these into our curriculum, we have established a new strategic goal of achieving a work placement for all students to enhance their employability skills. We strive to enable greater impact from our research and to this end, future bids for internal research funding will have to demonstrate tangible impact, in addition to research outputs and new grant proposals. Part of our strategy will involve greater public engagement and promotion of our activities. We will increase research quality and quantity, with the aspiration of doubling the percentage of staff submitted to the next Research Excellence Framework (REF) exercise. Our four research themes provide an internal reporting and monitoring structure for academic outputs; and we are discussing how this can be expanded to assess their future impact and how an ‘impact champion’ could be of assistance with this.

d. Relationship to case studies

Our two UoA7 impact case studies – ‘Healthy Seas’ and ‘New Paths to Mangrove Conservation’ – were chosen for their breadth and depth of impact and because they exemplify key approaches to impact adopted in the UoA. ‘Healthy Seas’ shows how building large cross-institutional teams, including policy makers and end users from the start and combining pure and applied questions, can make a real difference to policy. By identifying a current policy question of urgent political interest that also required basic ecological understanding it resulted in important conceptual publications as well as in practical outcomes. Hence research in a modern university such as ENU, with a traditionally applied focus, can effectively combine pure and applied aspects. ‘New Paths to Mangrove Conservation’ demonstrates how ENU has supported long term, innovative work. It has relied throughout on a wide range of funding sources, including charity and voluntary support which do not bring in full economic costing for researchers’ time. It shows how the University has invested in work that goes beyond fully paid research focused on peer reviewed papers and which needs long-term commitment to see impacts realised