Institution: University of the Highlands and Islands

Unit of Assessment: 7

a. Context

The achievement of impact has been central to the mission of the UHI since its inception. This is most recently evidenced by aim 4(a) of our Strategic Plan 2012-17 which states that the university aims to "sustain and develop high impact research and knowledge exchange activities". In the context of UoA 7, UHI's impact is delivered through SAMS and ERI working in cooperation and independently. SAMS' primary focus is on leading edge marine science for the protection and sustainable use of the sea. ERI's main purpose is to address contemporary environmental issues and advance understanding of the sustainable use of the Earth's natural resources. The primary beneficiaries are the business sector, government and international agencies.

Relevant to UoA7, SAMS' founder, Sir John Murray, (who coined the word 'oceanography') recognised the commercial importance of some samples from the Challenger expedition and this triggered major phosphate mining in the early 20th century; a century later, SAMS is a global leader in mining impacts on the sea. Continuation of a legacy of work on primary productivity (Michael Droop in the 60s) and plankton ecology (pre and post WW2 work by Sir Alistair Hardy and Marshall and Orr) has put SAMS on the forefront of studies of harmful algal blooms, critically important for public health and aquaculture. SAMS current work on aquaculture - built on the expertise of pioneers such as Alan Ansell (shellfish) and Paul Tett and others (modelling impacts) - is influencing aquaculture planning worldwide. Early deep-sea ecology (work by John Gage and John Gordon) has provided the only baseline for understanding fisheries impacts in the deep North Atlantic. Our current strength in marine dynamics (begun over 50 years ago by Clifford Mortimer and David Ellett) is providing key information on changes in circulation and heat transport of the Atlantic, crucial for designing measures to limit climate change. Today's high tech, high profile achievements, such as SAMS (Glud) deployment of a benthic lander at the bottom of the Marianas Trench in 2011 (http://www.bbc.co.uk/news/science-environment-12183244), will be tomorrow's commercial applications.

ERI is a young, dynamic and rapidly expanding Institute. The majority of research involves close engagement with non-academic user groups, beneficiaries and audiences. ERI's pioneering work regarding Marine Renewable Energy (MRE) resources and their impacts involves continuous engagement with policy makers within Scottish and UK Government and internationally through recent High Commission invited visits to Chile and Canada.

During the REF2014 period three main groups of non- academic beneficiaries or audiences have been targeted and impacted by the research projects conducted by UHI, namely:

1. **Policy makers:** Policy makers at the international, national, and regional levels. **Internationally**: 2010, Shimmield (SAMS) advised the EU and Government of Papua New Guinea on the potential consequences of deep-sea disposal of mine tailings; SAMS (Heymans) was contracted to review marine components of the US$7bn International Waters portfolio of the Global Environment Facility. SAMS' international work led to its selection as the only United Nations University Associate Institute for the marine environment. **National**: Paul Tett's engagement in the new National Ecosystem Assessment (2012-13) including technical development of work on future scenarios with government (Defra, Crown Estate, DECC), private sector and NGO representatives and authorship of the resulting report.
2. **The Private Sector:** Both SAMS and ERI work closely with the private sector. ERI collaborates with marine renewable energy developers (EON, Scottish Power Renewables, Pelamis Wave Power, MeyGen Ltd) on resource assessment. SAMS work in aquaculture, including harmful algal blooms has had a major impact with aquaculture businesses, and SAMS continues to work closely with the aquaculture industry in collaborative projects such as IDREEM, an EU project with 8 SME partners. SAMS work on mining, detailed in Case Study 3, brings together governments, the public and mining companies (e.g. Ramu Nico) to mitigate mining impacts on the marine environment. SAMS key role in technology development for polar science was rewarded by nearly £0.5M orders for the SIMBA instrument for measuring ice thickness and the Queen's award of a polar medal (2011) to its designer David Meldrum.
3. **Local Communities/General Public:** UHI maintains particularly good contacts with local

communities. During the pioneering QiCS project (SAMS) involving the sub-seabed release of CO_2 to simulate a carbon capture and storage accident, public meetings were held to obtain the consent of local people and inform them of progress. At the other end of the spectrum, PIs on the 2008 SAMS Arctic cruise were afforded 14 minutes of primetime TV on Newsnight (http://news.bbc.co.uk/1/hi/programmes/newsnight/7521339.stm).

b. Approach to impact

UHI's strategic plan focuses research effort in areas that have a clear route to regulation and policy and it engages in a wide range of research with a view to commercial applications; the presence of both Institutes (in UK locations often regarded as peripheral) has a significant positive influence/economic impact in Caithness (ERI), Argyll (SAMS) and beyond. SAMS is the biggest non-public sector employer in Northern Argyll and has spawned a number of companies working in the private sector including the wholly-owned SRSL which has a turnover in excess of £2M/yr.

During the REF2014 period we actively engaged with beneficiaries through the following actions:

1. PIs were assigned a time management profile every year that explicitly included time for business development and 'enabling' activities (includes outreach and policy engagement). Support is provided to PIs by business development and communications teams.
2. Coordination of collaborative international and national research projects helped to resolve technological barriers and engage private sector partners. SAMS examples include the UK/Ireland €3M biofuels project BIOMARA (http://www.biomara.org/) which developed a stakeholder group of ~400 organisations and the €5.7M FP7 mariculture project IDREEM (http://www.idreem.eu/) with 8 partner SME's from UK, Ireland, Italy, Norway and Israel.
3. CPD courses attracted 606 delegates to SAMS since 2009, 41% of whom were from industry, 35% academic, 15% government and 9% NGOs. As an indication of profile, the J. Craig Venter Institute sent staff to a SAMS CPD to learn about cryopreservation.
4. Staff were encouraged to take their developments from the lab to the market place, and with the support of in-house business development, legal and commercial managers, commercialisation of SAMS technology developments has been facilitated. Examples include SIMBA, cited earlier, and the development of 'drifting ears' (recorders of undersea noise) deployed to support the offshore renewables industry (Wilson). Drifting Ears devices have been utilised in a contract to DP Energy as part of an Environmental consents monitoring programme for a tidal array delivered by SRSL.
5. SAMS and ERI encouraged fact-finding visits by senior public officials including the Scottish First Minister, cabinet secretaries for Education, for Enterprise, Energy, the UK Scottish Secretary, Members of the Scottish and Westminster parliaments from government and opposition, and the Head of Marine Scotland.
6. Clearly identifiable units were established to act as a two-way interface with beneficiaries. ERI's Centre for Energy and the Environment (£3M, 2012) benefitted from the £4M MaREE project (HIE, SFC, ERDF funded) led by ERI (undertaken with SAMS) and is now a focal point within the Scottish Highlands for Marine Renewable Energy. At SAMS, the Culture Centre for Algae and Protozoa at SAMS (CCAP, funded by NERC National Capability) is one of the largest living collections in the world and an important source of raw material for the biotech industry, evidenced by £106,000 commercial sales in 2012.
7. Staff were encouraged to join advisory groups and networks. As examples, the Director of SAMS chaired the UK Marine Industry Liaison Group, which provides the interface between public-sector funded research and private industry. Narayanaswamy was selected as a member of the United Nations General Assembly Pool of Experts of the Regular Process (March 2013) to help in the production of World Ocean Assessment I. Meredith was a member of the SCAR Action Group on Antarctic Fuel Spills and chaired the Southern Ocean Observing System (SOOS) Scientific Steering Committee. Michele Stanley was appointed by NERC as Director of the Algal Bioenergy – Special Interest Group (hosted by the TSB Biosciences KTN) reflecting SAMS pre-eminence in this area.
8. Extensive use was made of media (local, national and international) to disseminate research findings. For example, the QiCS experimental sub-seabed leak of CO_2 attracted major media coverage (e.g. The Guardian, May 2012).
9. Investments were made in new and enhanced facilities explicitly designed to interface with beneficiaries such as the £3M CfEE for ERI and the £0.5M investment in new aquarium facilities and the £13M Sheina Marshall building at SAMS.

c. Strategy and plans

SAMS and ERI will maintain a strategy that develops research with policy, societal, environmental and commercial impact at its core. Both SAMS and ERI will continue to develop embedded 'Knowledge Exchange Centres' with the explicit purpose of optimising impact.

Within SAMS 6 KE Centres have been identified and are being developed to provide a pathway and incubator for fundamental science to reach application and impact. These 6 Centres represent key priority areas of SAMS science: Aquaculture, Sensors & Technology, Biotechnology, Industry & Oceans, Marine Renewable Energy and Marine Policy (co-developed with the James Hutton Institute). Each centre will be managed by a lead academic and will have a KE specialist as part of the team; two have been appointed already for Aquaculture and Industry & Oceans and recruitment will shortly begin on a third. These centres will provide a two-way interface between researchers and beneficiaries and will also identify opportunities for further business development. The centres will provide a focal point for stakeholder engagement, development of CPD activities and applied research projects with end-user engagement. Through the provision of appointed KE staff, opportunities for commercialisation of research will be identified and, working closely with SAMS wholly owned subsidiary company SRSL, we will seek to develop these opportunities into full commercial application. SAMS counts on its own commercial incubator space to enable these opportunities to flourish, and Highlands and Islands Enterprise has constructed the first building of a £17M science park. The global reach of SAMS science will continue to develop as SRSL opens an office in Papua New Guinea with further office planned for Abu Dhabi.

ERI will continue to develop its Centre for Energy and the Environment, building on its significant success to date with Marine Renewable Energy. This will be reinforced by a new EU FP7 project (MERIKA) awarded to UHI to enhance capacity in the area of marine renewables, providing additional staff to ERI, SAMS and Lews Castle College (Stornoway). At SAMS, global outreach will be enhanced by its recent designation as a UN University Associate Institute for the Marine Environment.

Examples of specific project activities designed to enhance future impact are:

1. The NERC Maremap programme (SAMS is a partner); designed to provide the underpinning knowledge for the sustainable development of the UK's seafloor. A KE Coordinator has been appointed to Maremap to facilitate stakeholder engagement with the programme to ensure Maremap outputs are delivered in a useable format to key marine sectors: renewable energy, aquaculture, resource extraction and to assist in marine planning. In June 2013 Maremap was awarded additional funding (NERC) specifically to engage with the marine renewable energy industry to scope marine data requirements to assist in industry development.
2. Work on the development of autonomous and robotic systems for monitoring the sea (corresponding to one of the Science Minister David Willets eight great technologies to fuel economic growth https://www.gov.uk/government/speeches/eight-great-technologies). Together with NOC, SAMS will implement a major EPSRC technology award that will enable the further development of its pioneering North Atlantic Glider Base, its AUV and ROV capacity and further development of its remotely piloted aircraft.

d. Relationship to case studies

UHI scientists at SAMS and ERI continue to apply their understanding to managing key issues affecting the use of the contemporary marine environment and highlighted in documents such as the UK Marine Strategy, the Marine Strategy Framework Directive, EU Maritime Agenda and the recent EU Maritime Strategy for the Atlantic Ocean Area. Our four selected case studies have therefore arisen naturally from our key priority areas (aquaculture, industry & oceans and marine policy) and through our strategic approach to achieving impact. The selected areas of impact are: (1) optimising the sustainable development of marine aquaculture; (2) reducing the risks of damage to human health and marine aquaculture by harmful algal blooms; (3) finding ecologically acceptable ways to dispose of mine tailings in the marine environment. (4) understanding and mitigating the impacts of human activity on the eutrophic state of coastal waters. Together they represent a significant contribution to the marine and maritime economy of Europe and beyond and can be replicated on larger geographical scales.