Institution: University of the Highlands and Islands (UHI)

Unit of Assessment: 7

a. Overview

The University of the Highlands and Islands (UHI) is an innovative higher education institution comprising 13 academic partners, which achieved University status in 2011. This submission describes "*Earth System and Environmental Science (UoA7)*" conducted within the School of Science, Environment and Rural Resource Management by the two UHI partners: **Scottish Association for Marine Science (SAMS)** and the **Environmental Research Institute (ERI)**.

SAMS has been an international centre for fundamental and applied research in marine physics and biology since 1884, with a continuous track record of academic achievement underpinned by active involvement at the highest level in UK strategically-driven research and marine governance. SAMS hosts three national capabilities: the *Culture Collection for Algae and Protozoa (CCAP), North Atlantic Glider Base (NAGB)* and *National Facility for Scientific Diving (NFSD)*. *SAMS Research Services Ltd* provides services to industry in the UK and abroad, including consultation and review, planning and delivery of environmental surveys, impact assessment and instrument manufacture. **ERI**, established in 2000 in Caithness, combines modern research facilities with access to some of Europe's most distinctive coastal, terrestrial and freshwater habitats. In addition to its growing academic portfolio, ERI provides an increasing range of commercial services to economic sectors including the renewable energy and aquaculture industries.

SAMS and ERI share interests in three thematic areas (TA); *Understanding and Responding to Environmental Change (UREC), People and the Environment (PatE) and Energy from Natural Resources (ENR).* Site based coordination is through themes (Fig. 1), each addressing a range of connected issues of current scientific importance and societal concern:

Figure 1 University of the Highlands and Islands (UoA7)

TA	SAMS	ERI
UREC	**Theme 1: Arctic Seas** - further understanding of the rapidly-changing Arctic	**Theme 1: Carbon, Climate and Water** - further understanding of terrestrial carbon storage, freshwater transport and climate change
UREC	**Theme 2: Dynamic Oceans** - investigate fundamental patterns and processes, with focus on the key drivers of climate change	
PatE	**Theme 3: People and the Sea** - study the links and feedbacks that drive coupled social-ecological systems	**Theme 2: Environmental Contamination and Ecological Health** -understand impacts on human and wildlife health
ENR	**Theme 4: Marine Renewables** - underpin sustainable development of the marine renewable energy sector	**Theme 3: Renewable Energy and the Environment** - underpin sustainable development of the marine and terrestrial renewable energy sector

b. Research strategy

i) Achievement of strategic research aims during assessment period 2008-13

In RAE2008 we set out a Plan of Action for research group development, identifying five **Priority Research Areas** in which we aimed to increase our reputation and scientific leadership: (a) climatic and environmental change; (b) ecology, biodiversity and ecosystem function; (c) sustainable use of natural resources; (d) analysing environmental health; (e) applied research and commercialisation. Each was set up to address fundamental scientific issues, with 14 specific objectives identified. Our success in meeting these objectives is demonstrated by high impact publications and related measures of international recognition. Since RAE2008 we have published 13 books, 60 book chapters, >850 articles, including >650 peer-reviewed papers, and awarded 25

PhDs. We have won £62M funding, including £24M from Research Councils with a 33% success rate, £11.5M in EU funding, £2.5M in other international awards and £24M in additional UK and international government and commercial contracts. SAMS now successfully leads large scale national (FASTNet, MAREMAP) and international (e.g. EuroCoML, Knowseas, Biomara, IDreem) research programmes, contributes to core UK scientific strategy (SISB) and policy advice (MSCC), has expanded its postgraduate training programmes and increased its staff from 90 to 161. Meanwhile, ERI has expanded its research capacity, now employs >30 staff, and in 2011, opened the £3M *Centre for Energy and the Environment* (CfEE).

The **Priority Research Areas** have developed into the three thematic areas (Fig. 1). We highlight key examples which demonstrate both specific objectives and synergy with our research strategy.

Thematic area 1 - Understanding and Responding to Environmental Change

RAE objective A1 "We shall continue long-term monitoring and collaboration programmes with Scandinavian researchers in the Eurasian Arctic, under the auspices of the IPY".

Accurate real-time measurements are key to understanding the rapidly-changing Arctic. The SAMS Arctic observatory (AO) in Svalbard is the only long-term UK marine monitoring facility in the Arctic, generating physical, biological and geochemical data. It is ideally placed to monitor the response of Arctic processes to changes in Atlantic Water inflow. New technologies (SIMBA, SATICE) have delivered novel data on variability in ocean tides and sea ice thickness, contributing to coupled ice-ocean-atmospheric models. UHI Arctic research has been instrumental in the delivery of many UK and internationally funded projects including Oceans 2025, SOFI, Arctic TAP, Ocean Acidification TAP and programmes with the US Office of Naval Research, with SAMS leading 3 research cruises and 6 ice camps since 2008.

RAE Objective A2 -"Studies will continue to address fundamental issues related to anthropogenic impacts and climate change in the ocean margins"

High-latitude deep-water formation in the subpolar Atlantic is an important driver of ocean circulation and global climate. Global warming is predicted to result in a slowing of the overturning circulation (OC), with potentially huge consequences for the ocean's role in climate. Notable is the proposed 30% decline in OC. Our research (Cunningham) has shown that this decline reduces northward heat transport, with subsequent cooling of the North Atlantic Ocean, in turn linked to the extreme UK winters of 2009/10. UHI is at the forefront of Atlantic climate research as a leading UK partner in a joint US/UK programme (OSNAP), recently announced by the Science Minister, Mr Willetts.

RAE Objective B2 -"Targeted investigations of the effects of environmental change on biodiversity and species ecology will be applied to key environments and ecosystems".

Ecosystem response to environmental change is a key focus of our science strategy. We play a leading role in the NCEAS *Marine Climate Impacts* group, bringing together researchers from America, Europe and Australasia to assess the extent of climatic impacts on marine biodiversity and ecosystem function. Several publications, including two (led by Burrows) in *Science* and *Nature* are highlighted in the current IPCC assessment (AR5: Chapter 30 and the policy maker's summary). This high-profile collaboration has generated new predictions from meta-analysis of global patterns of response to climate, which can now be tested at local and regional scales. We have also recently established the *Flow Country Peatland Research Hub* (Andersen); both a national focal point and a platform for international collaboration (e.g. with Russia and Canada).

RAE Objective A4 -"We lead the UK capability in autonomous lander developments and foresee major advances in sensor technology giving fresh insights into benthic ecology"

SAMS is a UK leader in the development and use of *in situ* lander and microsensor technology. We have conducted the first *in situ* benthic lander measurements in the Marianas Trench, studying the role of trenches as hotspots for benthic carbon turnover. Development and use of novel Eddy covariance techniques for non-invasive measurements and of new point- and planar-optode systems, have led to significant advances in understanding of microscale processes on heterogeneous seabeds. We have contributed significantly to Ocean Acidification research in the UK and coordinate the world's first *in situ* sub-seabed CO_2 release experiment (under the NERC QICS project). Results will be used by government, industry and regulators to improve methods for

detection and quantification of CO_2 leakage from sub-seabed Carbon Storage reservoirs and will enhance understanding of potential environmental consequences.

Thematic area 2: People and the Environment.

RAE Objective C2 - "A primary emphasis will be on interactions between the conservation of biodiversity and sustainable development"

UHI leads the European project IDreem (*Increasing Industrial Resource Efficiency in European Mariculture*, €5.7M). By developing innovative methods to promote long-term sustainability of European aquaculture, the project will help the industry adopt more environmentally and economically efficient practices.

RAE Objective C4 -"Interfaces with social science will be developed to address issues of marine regulation and legislation"

Environmental degradation of European seas affects marine organisms and ecosystems and also impacts the welfare of human communities reliant on them. The Ecosystem Approach to management, now a part of European Policy, aims to sustainably manage our seas to optimize ecological and social well-being. SAMS leads the €7.4M FP7 *Knowledge-based Sustainable Management for Europe's Seas* (KnowSeas) project, providing guidance for implementation of the Marine Strategy Framework Directive, producing >30 peer reviewed papers, several policy briefs and a dedicated special issue of the journal *Ecology and Society*.

Thematic area 3: Energy from Natural Resources

RAE Objective C5 -"In marine renewables we shall engage with HIE and energy companies to create opportunities for building upon the capacity established through SRDG funding"

Renewable energy is at the forefront of Scottish/UK Government's drive to reduce CO_2 emissions and is also supported by several EU initiatives. In response to expanding global interest in 'green' energy, UHI research focuses on harnessing the full potential of marine power and mitigation of its environmental impacts. Our expertise feeds into many aspects of marine renewable energy (MRE) production, including algal biofuels and the environmental impacts of large-scale MRE production. Since 2008 UHI has been part of biofuels projects worth ~£22M (value to UHI £4.9M), at a national level (The Carbon Trust and BBSRC), European level (FP7) and through Structural funds (e.g. Biomara). We contribute to advisory groups and strategic decision-making bodies through membership of the Energy Research Alliance Bioenergy Programme, the NERC review of UK Energy Research 2013 and the Bioenergy Cross Research Council Group. Through the €4M MaREE project, SAMS+ERI have worked closely to support capacity building in the Scottish MRE sector, focussing on resource and risk, environmental interactions and sustainability. Staff have been invited on International missions to Chile, Canada and Taiwan to engage with policy makers regarding MRE and UHI recently hosted the 1st International EIMR conference dedicated to the environmental interactions of MRE.

ii) Forward vision and strategy for next five years

UHI's vision is to be an internationally excellent research-based university able to generate and transfer high impact knowledge. Our research portfolio will have global reach that draws on our regional strengths and opportunities. It will inform our teaching and create economic and social benefit in Scotland and beyond. To support this broad strategy, ERI and SAMS have implemented procedures and structures to maintain a productive and sustainable research community.

Research excellence is fundamental to our future and underpins our work. To ensure research remains at the heart of our mission, a new position of **Associate Director for Research (ADR)** was created in 2012. In 2013 UHI appointed our first **Vice Principal for Research (VPR)**. Our research programme is reviewed annually by an externally appointed Advisory Board and the internal Research and Strategy Board, ensuring progress is monitored, new initiatives are reviewed and staff promotion is audited and externally calibrated.

We expect **Key Challenges** driving research activity over the next five years to be the effects of global climate change and their regional consequences (e.g. sea level, sea ice decline, impacts on terrestrial and marine biodiversity), and the realisation of the vital role of the environment in resource security (particularly for food and energy). The **Policy Drivers** determining research

funding will emerge through the EU Horizons 2020 programme, the European Research Council, and in the UK through the strategic and responsive modes of RCUK. We closely monitor the activities of the UK Marine Science Coordination Committee set up in 2009 to advise Westminster on marine policy-related issues. We also provide fundamental research and advice to the Scottish Government, which has regulatory responsibility for 63% of the UK total sea area.

With these factors in mind, our **overarching research objectives for the next six years are to:**

- Increase our understanding of the marine system and its response to environmental change, including in the context of climate variability (TA UREC)
- Further our understanding of terrestrial and marine carbon storage and freshwater transport in terms of climate change (TA UREC)
- Enhance our understanding of physical, chemical, biological and socio-economic aspects of Arctic marine systems (TAs UREC and PatE)
- Underpin sustainable development of the renewable energy sector and strengthen links with Government and stakeholders in offshore wind, wave and tidal-stream industries (TA ENR)
- Understand how environmental contaminants impact human and ecological health (TA PatE)
- Contribute to ecosystem-based management, studying the links and feedbacks that drive coupled social-ecological systems and underpin good marine governance. (TA PatE)

c. People, including:

i. Staffing strategy and staff development

Staffing in relation to research strategy and physical infrastructure

This submission includes 32.45 FTE research active staff. Regular theme meetings keep staff informed of strategy and policy, provide a forum for discussion, and allow staff to propose ideas. UHI actively recruits early career researchers (ECR), with 26 ECRs in post in 2013; including three NERC KT Fellows (Pitt, MacDonald, Alexander), and a MASTS Fellow (Hughes). We have made several senior appointments to strengthen key research areas: in polar oceanography (Meredith), thermohaline circulation (Cunningham), paleoceanography (Austin) and zooplankton dynamics (Pond). Mid-career appointments have been in peatland ecology (Andersen) and ecotoxicology (Taggart). Promoting a balance between ECRs and established leaders allows long term sustainability and career progression. To maintain this balance, all potential new posts must be justified through a manpower process and approved by a senior executive committee with close reference to our strategic aims.

Support for research staff career development

Annual Performance Reviews (APR) are conducted for all staff, allowing performance evaluation against previous mutually-agreed targets. Appraisal meetings allow us to identify and resolve problems; ensure staff are fully equipped to carry out their roles and to identify CPD/training priorities. All APRs are conducted by line managers and countersigned by a senior manager, who ensures CPD requirements are implemented and staff are considered appropriately for promotion.

UHI promotes professional development for all categories of staff. This includes a programme of in-house training courses (e.g., statistics, modelling) and external certificated courses with the Social Enterprise Academy and ACAS (e.g., academic leadership, time management). The range of courses available is designed to aid staff at all levels in achieving the skills required for promotion and career development. In addition, UHI has an academic mentoring scheme and schemes to support researcher participation in conferences, exchanges and fieldwork. We have a small grant scheme for pump-priming ideas and an equipment scheme to enhance capability. This is open to all research staff, supporting new scientific ideas and allowing ECRs to gain experience and success in obtaining research funding. In addition, a *Reward to Innovators* scheme allows staff to share in the proceeds from commercialisation of their ideas. The new VPR is leading a review of research support which will be reported to senior management in 2014.

UHI has a sabbatical scheme and a secondment scheme allowing all categories of staff up to six months to focus on an area of strategic research in an international context.

UHI has a growing cohort of Postdoctoral Research Associates, and has designed a number of in-house CPD courses to enhance ECR career development. These include NERC grant proposal writing, undergraduate and Master's level teaching and supervisory skills. ECRs are encouraged to contribute to teaching and co-supervise PhD and Master's students. UHI research staff have formed an *ECR Development Group*, which guides management decisions regarding potential CPD courses and issues that concern ECRs. This has also led to the creation of a *Young Physicists Group*, allowing ECRs to discuss both science and career opportunities.

Implementation of the Concordat

UHI supports the implementation of the Concordat for Researcher Development and recognises the importance of recruiting and retaining staff with high potential to achieve research excellence, whilst recognising and valuing their contribution to all aspects of our strategy. This includes adopting flexible working policies for staff with family commitments and offering open-ended contracts to researchers in place for 4 years. Several senior faculty first joined as PDRAs, e.g., Cottier (now SAMS Head of Physics), O'Higgins (now Course Leader for the Marine Science BSc) and Stanley (now Director of the NERC Algal Biofuels-Special Interest Group).

International appointments and visitors

Over the 2008-13 period, we have strengthened our international connections by appointing new staff from Russia, Italy, Germany, Spain, France, Denmark, Hungary, Canada, USA and Australia, and by attracting visiting Professors, Fellows and researchers from Taiwan, Norway, Australia, Czech Republic and the US (among others). Visiting scientists also come from nations with a less well-developed research base including Egypt, India and Nigeria. In the last two years alone, researchers from 19 nations have spent a total of 77 months FTE working at UHI. Senior academics from the Universities of Tasmania, Washington, and Tromsø have visited on research sabbaticals. International visitors are attracted by opportunities to collaborate with our researchers and to make use of our unique facilities and environment.

In 2012 SAMS became the first marine research institute in the world to be appointed an associated institution of the **University of the United Nations** (UNU). This will ensure future opportunities to work internationally to promote research, postgraduate training and knowledge exchange on coastal and marine resource management, safe water provisioning and water health, focusing especially on the challenges faced by developing nations.

Support for equalities and diversity

UHI is committed to delivering equal opportunities and avoiding discrimination. We strive to ensure that staff can achieve their goals and attain leadership positions irrespective of gender, nationality, ethnicity or personal circumstances. We promote a working environment free from harassment and bullying, and ensure that all are treated with dignity and respect. Procedures are in place through line management and, independently, through HR to address issues should they arise.

Keeping in Touch days have been introduced to allow staff members up to 10 paid working days, to ensure they do not feel isolated during maternity and paternity leave. All staff have the right to request flexible working; at SAMS 100% of the 15 women taking maternity leave since 2008 have returned on a part-time basis. Male staff have also changed to part-time on returning from paternity leave. SAMS runs a childcare voucher scheme for all parents.

UHI is applying for Athena Swan Accreditation to confirm that the processes and procedures in place are supportive to all staff. UHI has a strong representation of women at all levels. For example, 36% of staff returned under REF are women, and 50% of SAMS executive board are women. Hatton, who joined SAMS as a NERC Postdoctoral Fellow in 1997, was promoted to Senior Lecturer in 2006 and awarded a UHI Personal Chair in 2012. Hatton took two periods of maternity leave and was able to return initially under flexible working conditions.

ii. Postgraduate research students (PGRs)

PGR recruitment

All studentships are advertised and appointed through an open process with funding awarded to the best eligible candidate. Studentship topics are selected on science excellence, guided by our overall research strategy; ensuring students have the necessary support and training available in-

house. Since 2008 we have had PGRs join from Germany, Italy, Nigeria and France.

PGR training and support

PGRs are an integral part of the academic community at UHI. Our PGRs are supported through a wide variety of funders (NERC, ERDF, HIE, SFC, ESF, and private sector). Registration, progress monitoring and training is co-ordinated through UHI GradSchool in partnership with host organisations, supervisors and the students themselves. MASTS Graduate School is coordinated by UHI (Miller), with a large proportion of UHI PGs associated with the school benefiting from its training events. We foster an open and informal working environment which promotes interaction between students and staff. Students have daily contact with research staff and equitable access to infrastructure and facilities. PGRs are actively encouraged to give seminars, organise journal clubs, write articles and contribute to scientific discussion in theme meetings. PGR projects can draw on a superb range of facilities and resources, including access to dedicated IT and technical support, use of marine infrastructure such as research aquaria, diving, research vessels and access to analytical instrumentation. Young researchers enjoy many opportunities to participate in field research. In the 2008-13 period 22% of our PhD students took part in research cruises to destinations including the Arctic, Indian Ocean and the South Atlantic. Commitment to postgraduate training at UHI is informed by the requirements of the Research Councils Joint Skills Statement for training researchers and the Concordat for Researcher Development.

All PGRs receive training in generic skills, e.g. scientific writing and communication skills, statistics, etc. PGRs have access to travel, conference and training funds to support their research and enhance their subject-specific skills. They participate in an annual multidisciplinary conference which provides a platform for professional development and training as well as an environment for network building. Students are actively supported to apply for additional funding, e.g., Tosin Obata (SAMS) won a MASTS small grant allowing him to conduct research with experts in his field, and Paul Gaffney (ERI) has been awarded an EU INTERACT travel/access grant to support peatland fieldwork in Western Siberia. Other students have also been awarded places at international Summer Schools in Turkey, Bermuda, Hawaii, China, Norway and Spain.

Progress monitoring for PGRs

PGR progress monitoring is co-ordinated by UHI GradSchool via Research Degrees Sub-Committee (chaired by UHI Dean of Research). Every PGR at UHI has a Director of Studies and a supervisory team. Students also meet with an independent Thesis Panel yearly and are supported through a network of 'Third Party' monitors (with whom they can discuss issues independently). This provides the student with additional support, and gives the UHI GradSchool an independent assessment of progress. Progress is collaboratively managed through our *Postgraduate Structured Management Framework* alongside our Code of Practice. The result is that each student receives the highest quality of professional and personal support, as reflected by our high completion rates (only 1 withdrawal and 1 conversion to M.Phil since 2008).

PG outcomes

UHI has registered 32 new PhD students and secured 34 PhD completions since June 2008 (25 graduating within the REF period). In addition, 7 MSc by research and 27 MRes students graduated. This compares positively to 28 registered and 10 graduating PhD and 6 MSc students over the RAE2008 period. The quality of the training and research experience received by our PhD students is demonstrated by the number that have gone on to further careers in science/academia. Of 34 students completing their PhD since 2008, 22 have gone on to careers in environmental science, with 16 taking academic positions (11 UK, 5 overseas). Our doctoral graduates can be found working in prestigious academic institutions such as Universities of Hawaii, Montpellier, Southampton, Manchester, Uppsala, Swansea and Hangzhou, and in research organisations such as British Antarctic Survey and Oceanlab. In addition, 4 remain at UHI and are now PDRAs.

d. Income, infrastructure and facilities

Provision and operation of specialist infrastructure and facilities

The research goals of UHI are underpinned by world class facilities and specialist infrastructure, transformed since RAE2008. **SAMS** operates from a modern facility near Oban and hosts state-of-the-art equipment for chemical, molecular, microbial, sedimentological and ecological analysis

(e.g., GC, SIMS, confocal microscope, flow cytometer, ICP-MS, ICP-OES, HPLC). Facilities also include research vessels RV *Calanus* and *Seol Mara*, 7 Gliders, an Autonomous Underwater Vehicle, a fleet of remotely piloted aircraft, a fully equipped 160 m^2 aquarium, historic archive of deep-sea benthic samples, and a rare collection of historic marine documents and books. SAMS also hosts several specialist units and research centres, including two (**NFSD** and **CCAP**) with long-standing international reputation. These centres collectively constitute a resource of national significance for UK marine science. SAMS ensures that its excellence in responsive and strategic research is accessible to stakeholders through knowledge exchange centres including the *Centre for Smart Observations*, consolidating a long-standing reputation in the development of autonomous and *in situ* observational technologies and the *Centre for Marine Bioenergy*, capitalising on growing interest in the commercialisation of marine biomass. The *Centre for Sustainable Coasts* (developed jointly with the James Hutton Institute) strengthens the links between science, society and policy, supporting efforts to sustainably manage and conserve marine resources. The new *Ocean Explorer Centre* enhances our contribution to public understanding of Science. The *European Centre for Marine Biotechnology* (ECMB) acts as an incubator facility for biotechnology companies, providing start-up enterprises with access to world-class marine expertise, outstanding research facilities and sampling opportunities. ECMB is already home to a number of pharmaceutical and nutraceutical discovery companies.

ERI operates from two buildings in Thurso overlooking the dynamic waters of the Pentland Firth, with ease of access to the Flow Country Peatland (prospective World Heritage site). The first site (Castle St) houses the majority of analytical chemistry/biochemistry capacity, while the second, the new £3M *Centre for Energy and Environment* (CfEE) hosts state-of-the-art marine renewable energy facilities (including wave rider buoys, seabird tagging equipment, RoV, sonar). ERI has advanced analytical facilities (e.g., GC-MS, ICP-OES, LC-MS^n, HPLC, SEM-EDX and phytotron units) and its own research vessel, RV *Aurora,* with a full complement of marine field equipment.

Current and planned investment in infrastructure and facilities

Since RAE2008, research and teaching facilities at UHI have expanded significantly. At **SAMS**, support for teaching at undergraduate, PG and CPD level has led to a new £13M EU/RDF/HIE funded teaching centre (**Sheina Marshall Building**). The **Alan Ansell Aquarium** has been fully refurbished with controlled facilities for culture of invasive species, CO_2-controlled systems for ocean acidification experiments and a dedicated room for maintenance of cold-water corals. Our scientific vessel fleet has been expanded by addition of a new research vessel (*RV Spirit of Genie*), and a 9 m rigid-hulled inflatable boat.

At **ERI**, in addition to fully renovating and upgrading the Castle St facilities, the new **CfEE** was officially opened in 2012. The facility (funded by SFC/HIE/UHI/ERDF) was awarded the highest sustainability rating of any HE building in the UK, through the Buildings Research Establishment Environmental Assessment Model (BREEAM). Since completion, EU ERDF grant funding has provided the new centre with ~£500K worth of advanced research equipment (e.g. wave rider buoys, ADCPs, RoV, sonars, seabird tagging facilities). UHI has also made significant investments in IT and data management.

Looking ahead, the **NAGB** at SAMS is set to receive a significant (~£1M) boost from a recent capital injection of £10M by BIS under the *Eight Great Technologies Initiative*. At ERI, together with stakeholders including the RSPB, CEH and other UK/international universities, the *Peatland Research Hub* is being established (supported also by the Heritage Lottery Fund).

Research funding portfolio

From 2000, SAMS operated as a NERC Collaborative Centre within the framework of the core-funded Oceans2025 programme (ended April 2011). NERC core funding contribution to SAMS' research programme income has declined from ~50% in 2007 (£3.8M at last RAE) to 0% in 2012, with £1.9M funded for national capability provision through the NOC Association. All NERC research funding is now won competitively through Responsive Mode and Theme Action Plan (TAP) programmes. SAMS has been extremely successful at obtaining NERC grants, with these representing ~35% of our income, and our staff having a NERC success rate of 33% compared to the national average of ~25%. We have also been successful in obtaining TAP funds, including the Ocean Acidification, Shelf Sea Physics, Shelf Sea Biogeochemistry, Macronutrients, Biodiversity

and RATE programmes *(with total value of > £15M)*. These high success rates testify to the ability of our researchers to identify topical and important scientific questions and translate them into innovative and convincing grant proposals in a highly competitive funding environment.

Concerns over climate change, sustainable resource management, food security, energy production and mineral extraction are all strongly reflected on the international stage. In response to these key research drivers, we have diversified our strategic research areas, leading to an increase in funding through the European Union, UK government contracts and other international funding routes (e.g., US Office of Naval Research, Norwegian Research Council). In 2007/8 EU funding amounted to £1.5M, by 2011/12 this had increased to £2.7M, with an additional £0.5M from EU industry, commerce and public funds.

UHI have also benefited from significant funding for capacity building through the European Research Development Fund, in particular through the £4M MaREE project (Marine Renewable Energy and the Environment). This provided a platform to secure involvement in the Atlantic Areas Programme ENERGYMARE (Cooperation for use of renewable energies in the Atlantic arc 2012-14) and obtain leadership of a new €4M FP7-REGPOT project MERIKA (Marine Energy Research Innovation and Knowledge Accelerator; 2013-16). This ambitious initiative seeks to establish UHI as a reference research and innovation hub for European marine energy research, will create 9 new research posts, and establish a mobility/exchange programme with organisations in 7 European Countries. UHI participation in the EU Northern Periphery program (NPP; 2007-13) has also generated >£1M (Clim-Atic, CoastAdapt, RASLRES, BioPAD) and established strong working relationships with academic, stakeholder and regulator organisations across Northern Europe.

Consultancies and professional services

Commercial services play a vital role in supporting our research; ~£5M in income has been gift-aided back to UHI since 2008 via wholly owned subsidiaries. This income is reinvested into the development of infrastructure and facilities to underpin our research capabilities. Our commercial work includes impact assessment, survey and monitoring programmes for government bodies and commercial companies, chemical analysis for the aquaculture industry and the renewable energy sector. In addition we provide a range of Environmental Consultancy services for NGOs, industry and government bodies in the UK and abroad.

e. Collaboration or contribution to the discipline or research base

Research collaborations with academia and industry

Our research staff have a strong history of international collaboration, both at an individual level and through large-scale international programmes. Since 2008 UHI's collaborations have led to the creation of an international *Marine Climate Impacts Group*, contributing to the Fifth IPCC Assessment, and the successful funding of the OSNAP programme. Our work with US, Canadian, Norwegian, Danish and South Korean research communities has enhanced understanding of the impacts of climate change on Arctic Systems. The international project office for the European Census for Marine Life (led by Narayanaswamy), has been awarded an **Outstanding Achievement Award** for building research communities, and the NFSD, which supports scientific diving world-wide, has been awarded a BSAC **Colin MacLeod Award** for furthering international cooperation in diving (Sayer). Our research collaborations have allowed UHI to secure international funding in partnership with India (Taggart), Norway and U.S. Office of Naval Research (Boyd), Canada (Andersen) and Papua New Guinea (Shimmield).

European funding has further expanded our international collaborations. UHI **leads** 5 programmes worth a total of £21M (BioMara, MaREE, OceanFlux Greenhouse gases, KnowSeas and IDreem), and contributed to a further fourteen EU partnerships (ACCESS, MIDAS, EnAlgae, BLUETECH, CLim-ATIC, SeaBiotech, At-Sea, Prevent Escape, Azimuth, WATER Supergen SATICE, Equimar and RASLRES). UHI is also a partner in the EU FP7 research infrastructure initiative, ASSEMBLE, comprising a network of marine research stations. This programme allows researchers to work in other marine institutes across Europe, enhancing international collaboration, benefitting ECRs and allowing access to a range of modern facilities.

Within the UK, UHI are involved in a number of NERC programmes, including **leading** the FASTNEt and MAREMAP projects. We are partners within the Shelf Sea Biogeochemistry

(CaNDyFLoSS and Benthic), MacroNutrients, RATE (Lo-Rise) and Ocean Acidification (Benthic ecosystems and Sea-surface biogeochemistry) programmes. Furthermore, SAMS was a partner in the NERC core programme Oceans2025 and provides national capability through contribution to the Ellett Line programme. DEFRA are driving initiatives to coordinate and streamline long-term time-series for marine monitoring; we are at the forefront of this field through the use of smart technologies delivered through the NAGB. UHI activities are also supported by key strategic alliances. Two of these are framed by Scottish Funding Council Research Pooling Initiatives (SAGES and MASTS), with our researchers playing a major role in developing joint Research Themes, i.e. leading the Dynamic Properties of Marine Systems and three of the six research forums (Deep Sea, Marine Energy and Biogeochemistry). MASTS have also given UHI the opportunity to recruit four new academic staff. In 2013, SAMS became an Associate Institute of the University of Edinburgh, and initiated a PhD programme with 4 jointly supervised projects. This has now led to the successful funding of a joint UoE / SAMS NERC Doctoral Training Partnership.

Leadership within the academic community

Staff have acted as co-authors of the **Fifth IPCC Assessment Report** (Cunningham*)*, Vice-Chair of the **JCOMM Observations Programme** (Meldrum), Vice-Chair of the **UNESCO/WMO Joint Task Force** for submarine communication for ocean and climate monitoring and disaster warning (Meldrum) and **Special Scientific Advisors to the SCICEX Scientific Committee** for use of US Submarines in the Arctic *(*Boyd) and the **Svalbard Integrated Arctic Earth Observing System** (Cottier, Leakey). Our staff sit on several **ICES working groups**, including on Invasive Species, Harmful Algal Bloom Dynamics, Holistic Assessment of Marine Ecosystems, European Atlantic and Mediterranean Marine Ecosystems and the **STECF Expert working group** on the Development of Ecosystem Approach to Fisheries Management in European Seas. We have strong links with government departments, research councils, learned societies and external stakeholders, contributing to strategic decisions at the highest levels, including the NERC Science and Innovation Strategy Board (**SISB;** Hatton), Peer review College Pool of Chairs (Hatton) and the Marine Science Coordination Committee (**MSCC**; Mee), advising Westminster on marine policy-related issues. We also provide research and advice to the Scottish Government related to governance and regulatory compliance in high priority areas, such as marine protected areas, marine renewables and water quality.

In the UK academic community we have contributed to NERC Programme Advisory Groups including those for **Ocean Acidification, Arctic and Technology** and have had representatives on the steering committees for several NERC Thematic Programmes (**SOLAS, RAPID, QUEST**). Our researchers contribute to peer-review moderating panels in the UK (16 since 2008, including as panel Chair; Hatton), and we review grants and contribute to moderating panels for the U.S. National Science Foundation, Canadian NSERC, Israel Research Council, Norwegian Research Council, Netherlands Organisation for Science Research (NOW) and the EU.

Over the past five years our researchers have contributed to the organisation of 7 international conferences, including hosting the 5th International *Ectocarpus* Conference (2011) and the International conference on Environmental Interactions of Marine Renewable Energy Technologies in 2012. They have been invited speakers at ~60 conferences (30 international) including keynote addresses at the 5th International symposium on Biological and Environmental aspects of DMS, (India, 2011; Hatton), the “Ecopath 25 years” conference (Vancouver 2009; Heymans), Gordon Research Conference on Coastal Ocean Circulation (USA 2010, 2012; Inall & Cottier).

Currently 10 staff sit on the editorial boards of major scientific journals, including *Oceanography and Marine Biology, European Journal of Phycology, Hydrobiologia, Estuarine, Coastal and Shelf Science, Aquatic Invasions, Progress in Physical Geography and Biodiversity and Conservation*.

Since RAE2008 four members of staff (Davidson, Hatton, Heymans, Stanley*)* have been elected Fellows of the Society of Biology, one (Inall*)* as a Fellow of the Institute of Physics, and four (Cook, Cottier, Hughes and Inall) as Fellows of the Higher Education Academy. The scientific achievements of UHI researchers have also been recognised by the award of the **Polar Medal** to Meldrum and a **Challenger Fellowship** to Hatton. In addition, five senior academics (Black, Burrows, Davidson, Hatton, Inall) have been awarded UHI Personal Chairs in the past five years.