SCOTTISH ASSOCIATION *for* MARINE SCIENCE

ANNUAL REPORT 09-10

Front cover The front cover shows a close-up image of the ross worm *Sabellaria spinulosa*. Research at SAMS investigates its sensitivity to burial and sediment suspension. (Photo by Vicki Hendrick, SAMS)

ABOUT US

SAMS is a Company Limited by Guarantee registered in Scotland (SC009292) and a registered Scottish charity (009206). It is a Learned Society with 450 members and employs 143 staff at the Scottish Marine Institute near Oban.

SAMS administers its commercial services through a wholly owned commercial subsidiary company, SAMS Commercial Services Limited (SRSL).

SAMS also hosts The European Centre for Marine Biotechnology. ECMB is a business incubator for new marine biotechnology companies and currently hosts two tenants: Aquapharm Biodiscovery Ltd and GlycoMar Ltd.

SAMS is a collaborative centre of the UK's Natural Environment Research Council www.nerc.ac.uk and an academic partner of the UHI Millennium Institute www.uhi.ac.uk

GOVERNANCE STRUCTURE

SAMS is ruled by its members, who elect office bearers at the Annual General Meeting. SAMS Council, chaired by the SAMS President, has responsibility for strategy, risk management and appointment and performance of executive management. Council is supported by a Board and five committees. Council members are the non-executive directors of the company.

The director of SAMS is responsible for the effective management of the organization and is supported by an executive group. Research and teaching staff are managed within five departments: Ecology; Microbial and Molecular Biology; Biogeochemistry and Earth Sciences; Physics Sea Ice and Technology; and Education.

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Director's Introduction

The past year has been a difficult but exciting one for SAMS. The media was dominated by the economic recession that even the softer euphemism of "downturn" couldn't hide. But those of us that like to take the long view know that a recession, though painful, provides an opportunity to reshape an institution or business in order to make the step change necessary to face the new economic, social and political post-recession environment. The winners are the ones who emerge one step ahead in their thinking and skills. And this has been the case in SAMS.

During 2009, we had to work very hard on our institutional strategy, focusing our science, sharpening our business profile, reinvigorating our educational activities, working with the local, national and international agenda and forging new alliances. In this process, we had to downsize some of the areas of our work that were no longer attracting sufficient funding and upscale areas that were. And so I begin by paying tribute to the staff, Council and Board of SAMS who displayed enormous positive energy, patience and understanding. A few of our staff have moved on or retired early and they did this in a noble way that has helped to maintain the strong corporate spirit for which SAMS is well known in UK marine science. We are emerging from this process with a clear focus, outstanding successes and a balanced and growing budget (for the second year running). But radical restructuring is a stressful process and I hope I never have to do it again.

So what changed in SAMS in 2009 and why? We strongly believe in our mission for independent science, technology and education for sustainable seas. In a world where difficult decisions have to be made about spending on research and education, we need to be able to complete the statement "SAMS is good at…" with a number of topics that our non-scientist stakeholders can understand and hopefully support. And these topics must be underpinned by a range of capabilities that can be used for many purposes. Our science has to be "outward facing" to prosper and we have to engage strongly with the business sector as well as the public sector. Our five key topics designed for the realities of 2010 and beyond can be summarized as Marine Processes and Climate, Marine Renewable Energy, Prosperity from Marine Ecosystems, Industrial Impacts on Oceans, and Arctic Seas. Our main areas of capability include Smart Observation Techniques, Marine operations, Numerical Modelling, Analytical Services, the National Facility for Scientific Diving, and the Culture Centre for Algae and Protozoa (which also includes some of our cutting-edge molecular biology). You will be able to appreciate the range and quality of this work as you read the various sections of the current report.

The outward-facing SAMS is all about engaging with the challenges of our time by providing high quality relevant science and education to reduce management uncertainties in the long term as well as the short term. We meet this goal with the help of strong alliances at the regional, national

and international levels. And this is not a matter of rhetoric; as the biggest non-public sector employer in North Argyll we are critically important to the local economy and are happy to welcome local people through our doors (700 of them on our open day for example); we have helped define the social and economic objectives of the Scottish Marine Bill; we deliver science through UK-wide reports (such as the NERC scoping exercises on marine renewables and on biofuels); we coordinate the research (FP7 KnowSeas) that informs the European Marine Strategy Framework Directive and we are involved in key international science meetings on the Arctic. SAMS has become truly international. Our national alliances include the 9-partner SFC-funded Marine Alliance for Science and Technology Scotland (MASTS) and its elder brother SAGES, the Strategic Alliance for Geosciences, the Environment and Society. We provide the Graduate School for MASTS as well. We also continue as an integral part of the UHI Millennium Institute and as a CollaborativeCentre of NERC.

From my perspective, the two major breakthroughs in the development of SAMS have been in the areas of business development and education. Neither of these have happened suddenly, but have been built on the foundations laid by my predecessor. The creation of the European Centre for Marine Biotechnology - that hosts incubator companies - and our own prestigious 'living library', CCAP, have provided the platform for the new development of a Highlands and Islands Enterprise funded European Science Park next to SAMS. And HIE, together with the Scottish Funding Council and the European Union have funded our exciting joint UHI-SAMS £6 million education and outreach centre that will be one of the finest facilities for all kinds of marine science teaching in the UK.

With all of these exciting developments going on, SAMS is beginning to shape up as an integrated marine science campus. The old site name of 'Dunstaffnage Marine Laboratory' was no longer sufficient to describe us and Council took the decision to change the name to The Scottish Marine Institute, a name that is close to the original identity when we were founded as "The Scottish Marine Station", 126 years ago in March 1884. Very soon, people arriving here will see a new sign The Scottish Marine Institute, home of SAMS. We like it!

During my first two years as Director (and some still call me 'the new Director'), I have enjoyed the support of Sir John Arbuthnott as President. His calm wisdom, positivity and shrewd judgement were hugely important during this period of transition and he graciously agreed to extend his presidency as long as possible to allow the process to continue. He officially retired at the November Council meeting and has been replaced by Professor Andrew Hamnett, former Chancellor of Strathclyde University whom I will introduce in next year's Annual Report. Meanwhile, many thanks to Sir John and to our Chairman, Michael Gibson, who remains at the helm of our Board.

Am I optimistic about the future? You bet I am!

Laurence Mee

RESEARCH HIGHLIGHTS

During the past year the governance structure at SAMS has been changed and five broad research themes have been established. The overall aim is to ensure a more coherent, cross departmental and focused thematic research effort. Key areas of research, where SAMS will excel by providing novel and bench marking science, are currently being defined within the respective themes. The new structure will ensure that SAMS can maintain and strengthen its national and international research profile in the years to come.

SAMS researchers produce high quality science in a wide range of marine disciplines both from the applied and the curiosity driven perspectives. This ensures a good foundation for pursuing research questions relevant to societal needs and for hosting large scale cross-cutting research projects. An excellent example of this is BioMara: an ambitious, SAMS-led five-year project that was initiated in 2009 and which explores the potential of generating biofuel from cultured macro- and microalgae. The project brings together academic, industrial and administrative stakeholders with an overall aim of exploiting alternative energy resources (www.biomara.org).

SAMS hosts the Culture Collection of Algae and Protozoa (CCAP), which provides services for a wide range of national and international research institutions and companies, but it also contributes to high-level research. This year, for instance, CCAP contributed to two major projects of sequencing the genome of a brown algae (*Ectocarpus*) and a water mould (or Oomycete, *Pyhtium ultimum*), a devastating plant pathogen. The outlined genome sequence provides a major tool for combining genomic, genetic, evolutionary and physiological research, and also for understanding the overall function of the organisms in nature and for optimising handling in the context of mari- and agriculture.

During the past year scientists at SAMS have contributed to more than 90 peer-reviewed scientific publications, over 40% of these as first author. There are many research highlights to report and it is difficult to single out a few. I can only recommend interested readers to consult the SAMS website to get a better overview of the exciting and diverse science that has been conducted over the past 12 months.

However, one important output was a series of papers reporting on findings from an expedition to the upwelling region in the Arabian Sea with *RRS Charles Darwin*. Upwelling areas represent biological hot spots where deep nutrient-rich water is dragged up into the photic zone through the right combination of wind, current and bottom topography. The regions are important for the global CO_2 household and nutrient balance, but the stimulated productivity associated with the upwelling also represents enormous feeding chambers for a diverse fauna and they hold some of the most intense fisheries in the world. Yet there are still many open questions regarding the function of these unique but important environments. The data and findings of the cruise have now been digested and presented in a wider context, offering surprising and novel insight especially on the biological function and biogeochemistry of the sediments in these areas – but also on the interrelation between dynamics in the water column and benthic communities. These aspects were also studied in a smaller upwelling region off Japan (Sagami Bay) through a joint venture between SAMS researchers and colleagues from The Japan Agency for Marine-Earth Science and Technology (JAMSTE). Using state or the art technology in the form of several autonomous and cabled robots, we collected unique data directly on the seabed on microbial dynamics, turnover of nutrients and organic material. unique data on microbial dynamics, turn-over of nutrients and organic material we conducted directly on the seabed. The work revealed a previously unresolved microbial microscale dynamic of importance for nutrient regeneration and central for understanding the microbial ecology of marine sediments in general.

More locally, novel insight on cold water corals (*Lopelia pertusa*) were obtained by multidisciplinary work on the Mingulay Reef Complex just off the Scottish west coast. Cold water coral reefs were discovered recently, but represent abundant structures harbouring a diverse invertebrate fauna and a refuge for many fish. The accumulating structures shape the present sea-bed but also hold an inherent 'library' on climatic changes in the past that can be extracted from natural tracers imbedded in the reef structure. A number of surveys gave an important insight on how food supply, food sources, temperature and hydrodynamics affect the living corals and shape the reef complexes; an insight which is significant in order to understand the structure and function of these reefs, and also for predicting how they are affected by change in climate and seawater acidification – a consequence of the ever accelerating global consumption of fossil fuels.

Professor Ronnie N Glud,
Chair of SAMS' science committee

Marine microalgae play a key role as the food resource for higher oceanic life. Optimal performance of the algae does, however, require close association with specific bacteria. New findings document that some of these bacteria help microalgae extracting iron – a limiting micro nutrition in the ocean – from water, while they are rewarded with carbohydrates produced by the algae. This mutualistic relationship has important implications for a better understanding of harmful and beneficial algal blooms and in the biogeography of different algae types. Most of the organic material released by microalgae dissolves in the ambient water where it supports the microbial food web. Using a range of sophisticated techniques the fate of the dissolved organic matter (DOM) was studied in different environments, including local lochs. It was documented that most material is surprisingly labile and efficiently degraded by bacteria but that bacteria also produce their own DOM with different degradation characteristics. Overall there appears to be a net transport of DOM from the coastal sea

to the more open ocean – a transport that has to be accounted for in regional carbon budgets.

SAMS is heavily engaged in Arctic research and one focus is on the importance of sea ice cover for structure and function of the marine food webs. However, recent investigations have also documented that formation and melting of seasonal sea ice induce a significant draw-down of carbon dioxide from the atmosphere to deep waters. This process is not to be confused with the well-know 'biological pump,' where microalgae fix carbon dioxide into organic material, a fraction of which ultimately settles on the seabed. The 'sea-ice' pump is driven by physics and inorganic carbon chemistry in the porous ice matrix. The importance of this gas pump is still unknown but recent model results suggest that it at least scales with the biological pump and that it is gradually reduced due to the global decline in seasonal ice cover. Should the sea-ice pump not be compensated by a stimulated biological pump, this could have profound impact on the ability of the global oceans to buffer the ever rising carbon dioxide levels in the atmosphere.

These highlights in no way fully represent the science that took place in the past year and which will continue in the coming years – other highlights could have been chosen. The summary only provides a glimpse of some of the diverse and exciting science that takes place at SAMS – science that ultimately helps us to not only understand the marine environment but also to exploit the oceans in a sustainable manner.

Professor Ronnie N Glud

THE EUROPEAN CENSUS OF MARINE LIFE (2005 – 2010)

The global Census of Marine Life will have its finale at the Royal Society in London in October 2010 after having been run for ten years. The aim of the Census was to determine the diversity, distribution and abundance of life in the oceans, looking at the past, present and trying to make predictions for the future. There have been more than 2000 researchers from over 80 nations participating in the 14 field projects. The data generated are stored in global information systems. There have also been 13 National Regional Implementation Committees of which Europe is one.

The European Census of Marine Life (EuroCoML) took part in a synthesis to determine the marine biodiversity of the region and the main threats to the European marine environment. The EuroCoML researchers identified >6,000 species in the Baltic, >12,200 along the Western European margin (including the Arctic, North Sea and NE Atlantic), >17,000 in the Mediterranean (excluding the deep-sea) and almost 3000 species in Mediterranean deep waters. They also found almost 1200 invasive alien species currently known in European waters. The number of invasive species varied per region, with the Mediterranean accounting for over 800 of the total. In terms of threats to the marine environment, habitat loss and degradation, fishing and its associated impacts, exploration and extraction of oil/gas and minerals, invasion of alien species and eutrophication were deemed to be the ones that currently had most impact on the marine fauna. The impact of a changing climate was deemed to be a threat that would become more important in European waters. Changes in the climate are already altering the ranges that species can now inhabit: With increasing water temperatures the Norwegian coast has been experiencing an increase in the number of species migrating north. In northern Norway, there has been a 15% increase in the number of species found over a 20 year period.

The final Census meeting will highlight the estimated number of species that live in the world's oceans, the number that have been described since the start of the Census (predicted to several thousand) as well as trying to estimate the number of species that are still waiting to be discovered.

Bhavani Narayanaswamy

URCHINS ARE WHAT THEY EAT

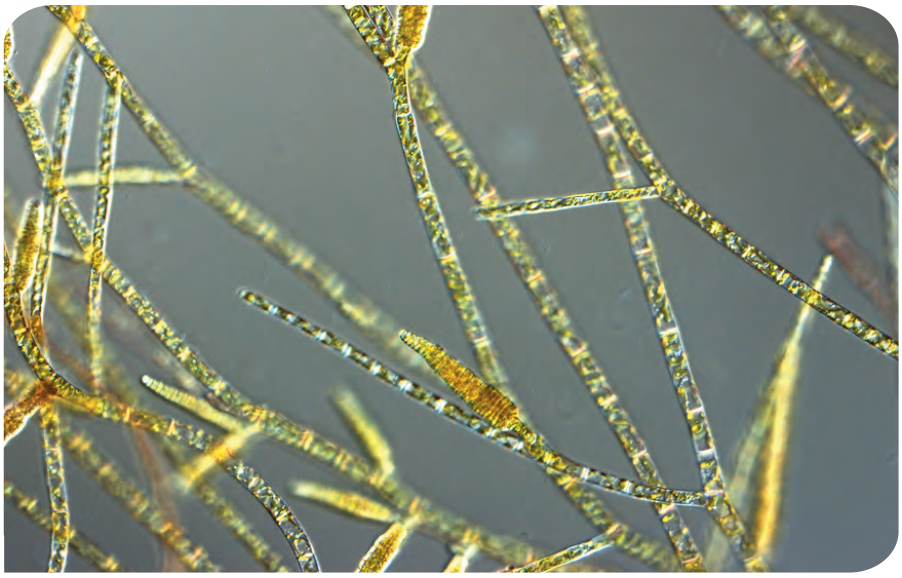
Explosive population growth by sea urchins can change kelp forests into rocky barrens. Once rocky barrens are established, the continued presence of sea urchins ensures that the domain persists for decades. Thus the new ecosystem that juvenile urchins recruit to is dramatically changed from the one their parents experienced. How do sea urchins exist in such markedly different habitats?

We investigate this important ecological phenomenon (as part of the Oceans 2025 programme) by raising urchins on two physically different diets representing different developmental regimes: (1) a challenging diet (live mussels & kelp) and (2) a nutritionally equivalent but easy to consume diet (blended mussels & kelp bound with agar). The two groups of urchins developed very different behavioral and morphological characteristics. This ability of the next generation of sea urchins to phenotypically adapt to the altered environment created by the previous generation may play a crucial role in sea urchins maintaining the transition from kelp forests to rocky barrens.

Adam Hughes, Lars Brunner, Liz Cook, Maeve Kelly & Ben Wilson

FIRST SEAWEED GENOME DECRYPTED

After years of effort, the first ever seaweed genome was published in the journal *Nature* (Cock *et al*, 2010). *Ectocarpus siliculosus* is a small, easily grown brown alga that we use as a model, providing a convenient insight into economically and environmentally important seaweed species, such as kelps (which are important sources of alginates and third generation biofuels, and provide the canopy in rocky shore habitats). We have been working on this project with an international consortium led by the Station Biologique de Roscoff (SBR), France, on this ground-breaking work since 2004. In particular, we manually sorted through over 600 gene sequences, searching for the genes that code for important proteins involved in the seaweed's defence against pathogens. Dr. Heesch, while working at SBR, compiled the genetic map which is instrumental in locating genes on the chromosomes of Ectocarpus.



Sequencing this genome is an important step as it provides us with a powerful tool to investigate the biology of *Ectocarpus*. We are now integrating this information into our research to get insights into the components of algal immune systems. The consequences of disease on algae can incur high costs, both environmentally and economically as seaweeds are used for alginates, biofuel and as food crops. We aim to improve the understanding of pathogen interactions with the seaweed host so that we can improve our understanding of the environmental impact of disease on natural algal populations.

Claire M.M. Gachon, Martina Strittmatter, Svenja Heesch, Frithjof C. Küpper

MAREMAP: MARINE ENVIRONMENTAL MAPPING

SAMS, BGS and NOC are spearheading a new NERC initiative called MARine Environmental MApping Programme (MAREMAP). This programme aims to integrate NERC funding in marine mapping into a coherent programme designed to meet the current and future needs of our science, government and industry. MAREMAP aims to tackle the urgent requirement for increased mapping coverage and detailed geological and habitat maps of the UK Marine Area, in order to address topical issues such as effective conservation of marine habitats and species, sustainable exploitation of natural resources, and identification and assessment of submarine hazards.

At SAMS MAREMAP will apply a uniquely multi-disciplinary approach to marine mapping, incorporating geology, geophysics, biology, oceanography and technology. This approach requires large teams of experienced sea-going scientists and technical support staff, which exist across the participating NERC centres.

The MAREMAP programme will have several key themes, including 1) geological and habitat mapping from the coast to the deep sea, 2) mapping of submarine hazards and archaeological/heritage sites, 3) investigating how seafloor environments change through time (4D mapping), and 4) use of innovative technology and techniques in marine mapping. In addition to collecting new data, the MAREMAP team will work on existing bathymetric maps to produce free-to-access products such as seafloor habitat maps and 3D geological models.

The University of Southampton and Channel Coastal Observatory are partners in the first phase of the programme.

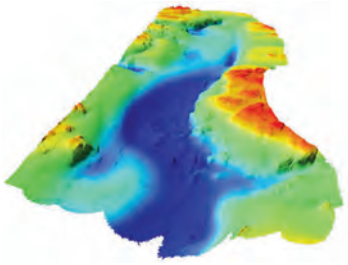


Figure caption: A sun-illuminated, eastward projected multibeam bathymetric map of the Muck Deep. This East-West oriented linear 20km x 5km, 318m deep glacial incision occurs west of the isle of Muck in the Sea of Hebrides. This feature was surveyed from the R/V *Calanus* in May 2009, as part of the Oceans 2025 programme.

J.A. Howe, K.L. McIntyre, M. Burrows & R. Turnewitsch

UK'S FIRST ANALYTICAL FACILITY FOR SHORT-LIVED RADIUM ISOTOPES

As part of SAGES and building on the complimentary expertises at SAMS and the University of Edinburgh, Walter Geibert has been developing the UK's first analytical facility to measure the short-lived radium isotopes 223 and 224 in naturally occurring concentrations. He also set up the methodology for the measurement of actinium, providing both partner institutions with new analytical tools for coastal flux studies.

The facility was initially used to study coastal fluxes on the Antarctic Peninsula, linked to a NERC-funded project in Edinburgh. It also contributed to an international collaboration with the University Paul Sabatier Toulouse funded by the British Council, and has become the cornerstone of Walter's participation in a successful NERC consortium grant bid called GEOTRACES investigating micronutrient cycles in the South Atlantic.

A test cruise on Loch Etive is planned for August 2010, in collaboration with Pieter van Beek from Toulouse and Gideon Henderson from Oxford University.

Walter Geibert

SÙIL NA MARA MICROLANDER

In August 2009 the Sùil na Mara Microlander was deployed for the first time to study the giant cold-water coral reef mounds off Florida. The Sùil na Mara (Gaelic for 'Eye of the Ocean') system is the first purpose-built microlander designed for cold-water coral habitats. Made from ultra-lightweight materials the lander frame supports a novel infra-red digital video camera, current meters and a recording hydrophone. Sùil na Mara is designed to deploy from the Johnson-Sea-Link manned submersible in the USA and the ISIS remotely operated vehicle in the UK. The microlander is securely attached to the submersible for its 750 m deep dive to the coral mounds. Drifting down through the strong Gulf Stream currents requires precise positioning by the sub crew from Florida Atlantic University's Harbor Branch Institute but despite this challenge we successfully found the microlander within the first few minutes of reaching the seabed.

Sùil na Mara is now back in Scotland and this work will be continued with further deployments in 2012 to compare the data from Florida with similar coral mound habitats on the flanks of Rockall Bank. These studies form a component of the new 'Trans-Atlantic Coral Ecosystem Study' TRACES, launched as a European Science Foundation programme in early 2010 (see www.esf.org/eurotraces).

J Murray Roberts, Ben Wilson, Kim Last

Arctic Seas

Research Theme: Arctic Seas

Understanding system changes

The pace and magnitude of environmental change is greater in the Arctic than anywhere else on earth. The impacts of this change will be felt locally, regionally and globally, with massive shifts in marine and terrestrial environments likely to bring radical change to the economic landscape.

Much of the change is manifest and amplified by reductions in Arctic sea ice. The scientific challenge is to quantify the connections between the physical, biological and chemical systems and to predict how these will change, as the Arctic evolves.

Over the past decade SAMS has become a leading centre for Arctic research, occupying a unique position in the UK as home to some of its most experienced marine Arctic researchers. SAMS has developed strong international partnerships with circumpolar nations including Norway, Greenland, Russia, Canada and the USA, providing unrivalled access to Arctic infrastructure and logistics. Our researchers make use of numerous platforms including ships, submarines, aircraft, ice camps, diving and Unmanned Underwater Vehicles to observe and interpret many of the changes manifesting themselves in the Arctic marine environment. This logistical base supports our state-of-the-art observational, experimental and modelling expertise.

ARCTIC SEA ICE PUMPS 50% MORE CARBON DIOXIDE INTO THE OCEANS

A study undertaken by Prof. Ronnie Glud, working with international colleagues, has revealed that Arctic sea ice plays a critical and hitherto unknown role in the removal of the greenhouse gas, carbon dioxide (CO_2) from the atmosphere (Rysgaard *et al.*, 2009)

The Nordic Seas have some of the highest uptake rates of carbon dioxide in the global ocean. Prior to this study, the mechanism by which the CO_2 is absorbed into the ocean was believed to be driven largely by biological draw-down: micro-organisms remove inorganic carbon compounds from the water column, encouraging more CO_2 to dissolve from the atmosphere.

But in this study, the researchers have found that sea ice itself plays an important role in CO_2 capture, effectively pumping this potent greenhouse gas out of the atmosphere. As sea ice forms, it rejects brine, rich in inorganic carbon compounds (derived from atmospheric CO_2), into the underlying seawater; a process further stimulated by carbonate precipitation within the sea ice. The summer sea ice melt liberates water which is strongly depleted in CO_2. The very low concentration of CO_2 in this surface water then drives the extraordinary uptake of CO_2 from the atmosphere.

The team took samples from 50 separate locations on the Arctic sea ice. As well as recording snow and ice thickness and temperature within the ice, they removed ice blocks and cores to examine the inorganic carbon concentration and CO_2 captured within the ice lattice itself. By entering various parameters into a model (including sea ice cover, partial pressure of CO_2, and export rate of sea ice from the Arctic Ocean), the researchers revealed that sea ice itself, during formation and melting, increases the seasonal uptake of CO_2 in the region by 50%.

Current climate models do not factor in the role of sea ice, so these findings will require a reevaluation of the relationship between temperature changes and oceanic CO_2 uptake. The total loss of summer sea ice from the Arctic, predicted to occur within the next few decades, may also have dramatic effects on the ability of the Arctic Ocean to sequester CO_2 from the atmosphere leading to further increases in CO_2 accumulation in the atmosphere.

Reference:

Rysgaard, S., J. Bendtsen, L. T. Pedersen, H. Ramløv, and **R. N. Glud** (2009), Increased CO_2 uptake due to sea ice growth and decay in the Nordic Seas, J. Geophys. Res., 114, C09011, doi:10.1029/2008JC005088

MACROALGAL AND OOMYCETE BENTHIC DIVERSITY IN THE CANADIAN MARINE ARCTIC

An expedition involving a team of seven scientists and professional research divers (from the UK National Facility for Scientific Diving) plus two locally contracted Inuit guides, was conducted to the Cape Hatt area, northern Baffin Island, Nunavut, Canada, (under the leadership of SAMS scientist Frithjof Küpper) from August 15 until September 6, 2009. Overall, the expedition was highly successful. A total of 50 diving operations were conducted for a total bottom time of almost 30 hours.

The expedition has produced over 10,000 images and approx. 20 hours of video footage, much of this under water (which is particularly valuable for a part of the world where the seabed and its living communities have rarely been documented). The collections of seaweeds yielded several hundred herbarium specimens (on paper and microscope slides) which include taxa likely to have arrived in the Arctic recently, possibly due to a warming climate and disappearing sea ice. Over 50 marine sediment samples for microbial / algal isolation work were collected, from which around 70 live isolates of marine algae were obtained in collaboration between Dr. Akira F. Peters (Roscoff) and the Culture Collection of Algae and Protozoa (CCAP). These are currently being characterized by molecular means. Over 150 samples of seaweed tissues have been conserved in DNA- and RNA-stabilizing buffers and silicagel, respectively (for characterizing seaweed-associated oomycetes and other eukaryotic pathogens by high-throughput sequencing). The expedition has also yielded 5 isolates of freshwater cyanobacteria which are being studied in collaboration with Julia Kleinteich and Daniel Dietrich (University of Konstanz, Germany). Additionally, Pieter van West (Aberdeen) has obtained ten isolates of Arctic freshwater oomycetes, which appear to include taxa novel to science. Currently-ongoing follow-up activities include the writing of an inventory of the American Arctic's seaweeds (collaboration with Robert T. Wilce, Amherst MA, USA).

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More details about the expedition are available at

http://www.sams.ac.uk/expedition-blogs/baffin-island-expedition

Participants:

Frithjof C. Küpper (Expedition leader & PI)

Martin D.J. Sayer (Direction of diving operations in the Arctic; UK NFSD)

Elaine Azzopardi (Research diver; UK NFSD)

Hugh Brown (Research diver; UK NFSD)

Pieter van West (Co-PI; University of Aberdeen)

Olivier Dargent (Co-PI, Nice, France)

Hiroshi Kawai (Co-PI, Kobe University, Japan)

This project was co-funded by NERC Oceans 2025 / WP 4.5 and the TOTAL Foundation, Paris.

DRIFTING SEA ICE CAMP IN REMOTE ARCTIC

In the spring of 2009 SAMS scientists joined a consortium of Danish institutions to establish and operate an ice camp on drifting sea ice. This camp was established in one of the most isolated and least studied regions of the Arctic Ocean: the Lincoln Sea north of Greenland. The overarching goal of this programme was to perform interdisciplinary research in order to assess the regional response to climate variability and its link to the Arctic Ocean system. Our role involved sea ice physics, physical oceanography and geo-chemistry

Dr Jeremy Wilkinson

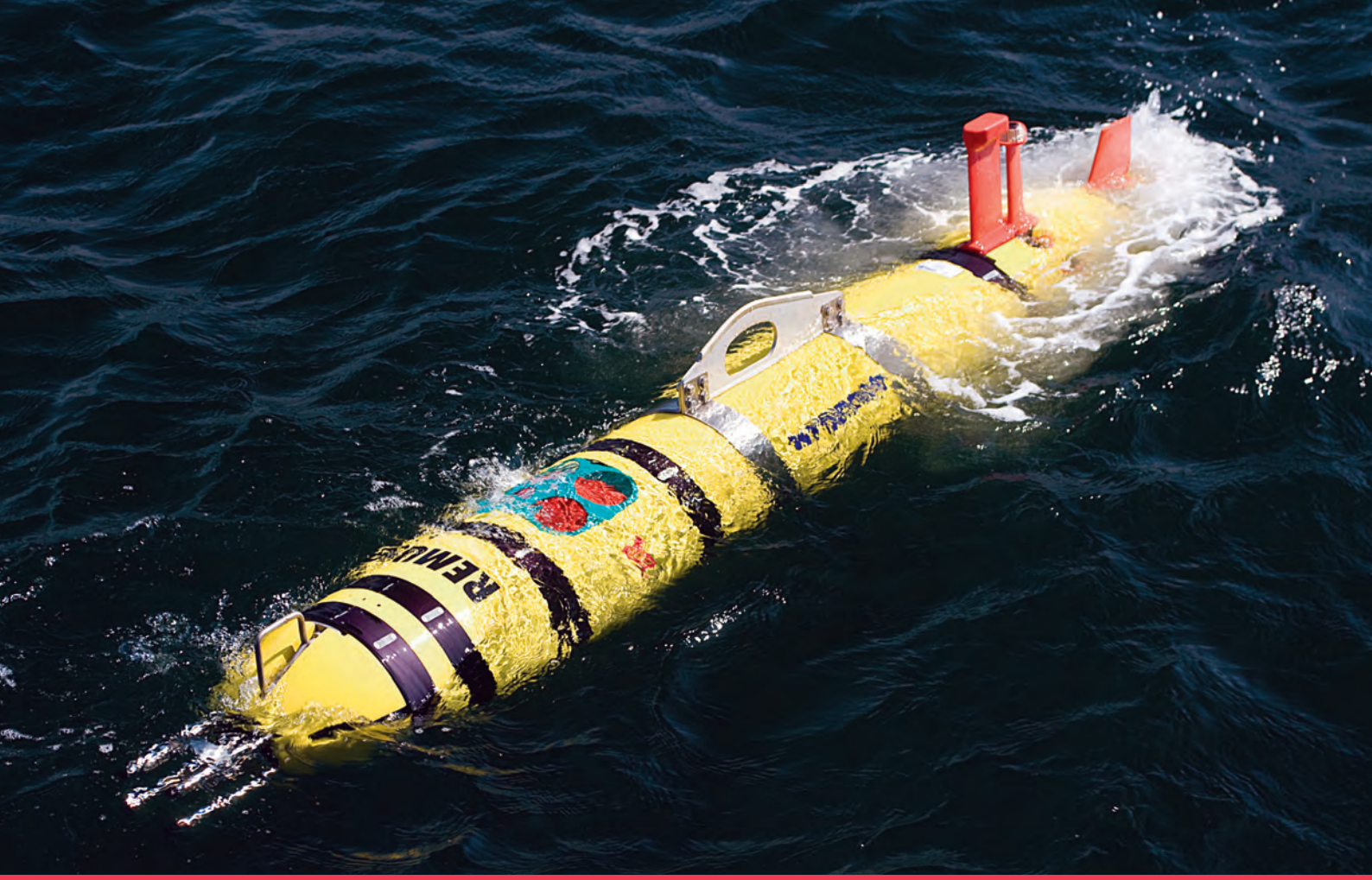
INUIT HUNTERS HELP COLLECT SEA ICE THICKNESS DATA FROM DOG SLED

In many ways sea ice can be viewed as the glue that binds Inuit communities together because it is utilised both for commercial (hunting/fishing) and social (transport network) means. However the sea ice is changing; it is melting earlier and forming later and as a result it is becoming thinner and less stable. These dramatic changes influence global climate as well as the safety of people on the ice, but also the hunting ability of the Inuit, thus threatening the cultural survival of these people. By combining technical innovation with traditional know-how SAMS and our international partners are developing an instrument that can be permanently installed on a traditional Inuit sledge system so that every time a sled is used valuable scientific data will be collected along its track. Over time this will produce a growing temporal and spatial database of key scientific variables (e.g. sea ice thickness, air temperature, air pressure, etc).

Early in 2010 testing of the system was performed from the Greenlandic village of Qaanaaq. Despite bad weather limiting our field programme we were able to test our system on the sleds and almost 200 km of thickness data was obtained in only two days, corresponding to around 20,000 ice thickness measurements. Crucially we were able to attain comprehensive feedback from the hunters about where and how a system should be mounted on a sled, what modifications were needed to ensure the instrument can endure rigorous daily use, and most importantly how they would use the data. We will return in early 2011.

Dr Jeremy Wilkinson

Marine Processes in Climate



Research Theme: Marine Processes in Climate

Global climate change is arguably the most pressing issue facing human civilization, and scientists from all disciplines are working to understand the processes that determine our climate, to observe the pace of change and to produce reliable predictions that allow us to plan for the future. This broad area of endeavour is termed Earth System Science.

The devil, as always, is in the detail and studying the component parts of the climate system in fundamental detail must go hand-in-hand with Earth System Science. To give two examples: 1) James Lovelock's Gaia hypothesis, from which Earth System Science emerged as a 'discipline', required a detailed understanding of the processes within the sulphur cycle; 2) The largest scales of ocean circulation fundamentally depend on the spatial patterns of millimetre-scale turbulent motion in the ocean.

Clearly then processes in the marine environment play a complex role in modulating global and regional climate. Within the theme of Marine Processes in Climate scientists at SAMS use observations, measurements, experiments and modelling to study marine physical, chemical, geological and biological processes that affect climate or are affected by it.

When delivering efficiently the Marine Processes in Climate Theme will both steer Earth System Science by questioning the myriad of assumption necessarily made within Earth System Science, and at the same time drive Earth System Science forward by revealing new links and feedback processes within the Earth's climate system. The theme title deliberately uses the word 'in', rather than 'and' to express the way in which processes are the essential cogs 'in'side the complex machine which we refer to as 'Climate'.

SAMS strengths in this theme all align with understanding the details of processes which inform the bigger picture:

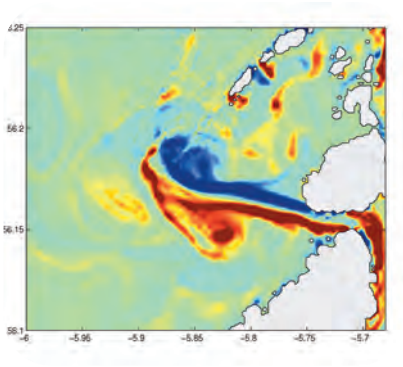
- Mixing and Ocean Circulation: PIs Mark Inall, Andrew Dale, Tim Boyd and Toby Sherwin
- Biogeochemical Processes and Feedbacks: PIs Angela Hatton, Ronnie Glud, Henrik Stahl, Robert Turnewitsch and David Green
- Ecosystem Functional Relationship: PIs Mike Burrows, Keith Davidson, David Green
- Paleo Sedimentary Carbon: PIs Ronnie Glud, Robert Turnewitsch, John Howe and Tracy Shimmield

GREAT RACE PROJECT

The Great Race project is looking at eddying and turbulence in complex coastal environments, with a particular focus on the highly-tidal systems of the west coast of Scotland. Our aim is to improve numerical models of such regions to help coastal managers to make informed decisions regarding marine renewables, fisheries, protected areas etc. Fieldwork will be centred on the Great Race itself, the narrow extension into the Firth of Lorn of the flow through the Gulf of Corryvreckan. Preliminary model simulations suggest that, on each tidal cycle, a pair of eddies forms at the head of the Race, a clockwise eddy to the north and an anticlockwise eddy to the south. These eddies persist for several tidal cycles while evolving, interacting and eventually being displaced.

We are developing an array of drifters which, with the help of mobile phone technology, will track eddy evolution in conjunction with moored, ship-based and Autonomous Underwater Vehicle (AUV) observations. Improved understanding of the energy 'cascade' between scales will be used to evaluate and develop model representations of this complex and energetic behaviour, with the eventual aim being to incorporate accurate small-scale behaviour into larger scale models of western Scotland.

Dr Andrew Dale



Vorticity of the Great Race showing an eddy pair towards the end of westward flow. Blue shows clockwise rotation, red shows anticlockwise

STUDYING SEA ICE IN THE ANTARCTIC

Sea ice has an important effect on the heat balance of the planet because it reflects solar energy back into space. For this reason alone, when sea ice is widespread the planet will tend to be cooler than when there is no sea ice. At the moment the planet is warming and sea ice, especially in the summer Arctic, is disappearing: this will accelerate the warming trend. Unfortunately climate models do not accurately describe the changes we are seeing in the Arctic, and this is affecting the quality of their predictions. The reason the models are struggling is that we do not properly understand how sea ice grows and decays throughout the year, and in different parts of the globe.

In February this year, David Meldrum joined RRS *Ernest Shackleton* in the Antarctic, to set up an experiment on the sea ice. The object of the experiment is to improve our understanding of sea ice dynamics, and so to make the models better. A number of sensor chains were deployed through small holes in the sea ice. The chains comprise 120 tiny sensors which measure temperature changes in the ice as it grows and decays, as well as in the sea under the ice, and in the snow and air above it. The measurements are sent back as e-mails to our lab in Scotland by tiny satellite transmitters. We hope that the equipment will work for at least one year before it melts out into the Southern Ocean.

Eight drifting buoys were also deployed as part of a global effort to populate the world's oceans with barometers and sea surface temperature sensors. The buoys are attached to a sea anchor, both to slow their drift and to give an accurate estimate of the surface current, and should last for at least a year. The data are used in near real time by weather forecasting centres all round the world, and in delayed mode for climate studies, oceanography and satellite sensor validation.

David Meldrum

Further information

See the latest data sent from the sea ice sensor chains at:
http://dalriada.sams.ac.uk/asbo/

See the latest drifting buoy map at Data Buoy Cooperation Panel site:

www.jcommops.org/dbcp

OUTFLOWS FROM SCOTTISH SEA LOCHS

Outflows from Scottish sea lochs are important because they carry nutrients, sediments, larvae and other materials into the coastal ocean where they mix into ambient ocean water. Freshwater from Loch Etive, on the west coast near Oban, is released on the ebbing tide in a pulse that floods into the coastal ocean as a thin layer, the leading edge of which develops into an undular bore or a train of internal solitary waves with strong mixing and associated entrainment. During winter 2009 and spring 2010, SAMS' 600 m depth rated Hydroid AUV was used to observe turbulent bores and internal solitary waves in Ardmucknish Bay, near the entrance to Loch Etive. Results were presented at the IEEE AUV 2010 conference in September in Monterey, California, USA.

Dr Tim Boyd

FIRST GLIDER SURVEY OF THE ELLETT LINE

Talisker (SAMS Seaglider 156) was deployed west of Tiree on 12 October 2009, on the first SAMS exploratory mission to monitor the Ellett Line in the North Atlantic using a marine glider rather than a ship. She was equipped with a Seabird CTD and oxygen sensor as well as a fluorometer with red and blue backscatter sensors. Before recovery on 9 March 2010 she had made 789 dives and completed four crossings of the Rockall Trough. The mission has thus been judged a success, and marks the start of remote monitoring of the North Atlantic by SAMS. A complete summary of the mission data can be found at http://dalriada.sams.ac.uk/glider/

Professor Toby Sherwin

PERMANENT CABLED OBSERVATORY

During 2009/2010 a permanent cabled observatory was installed in the upper deep basin of Loch Etive as a part of the EU-project HYPOX (www.hypox.net). The observatory provides realtime online data on the hydrographical and biogeochemical conditions in the surface and bottom waters of upper Loch Etive. Due to the complex bathymetry and hydrography of Loch Etive, the bottom water of the upper basin is often isolated for extended periods of time, during which the oxygen concentration in the bottom water drops to low levels (hypoxia). The latter has important effects for the overall biogeochemistry of the deep basin and for the organisms living there. Although previous findings indicate that the bottom water is exchanged on average every 16 months, little is known about the dynamics and timing of these overturning events.

The realtime collection of data from the observatory with high temporal resolution, on key parameters such as temperature, salinity, pressure, currents and oxygen will help us unravel these questions. Furthermore, the data from the observatory serve as validation for a hydrographical model which will help us predict the future impact of global warming on the circulation of Loch Etive. The latter is not only important for the loch itself but for our understanding of how climate change might affect circulation and biogeochemical conditions in isolated basins in general.

TopoDeep

As part of the NERC-funded TopoDeep project two major open-ocean cruises to the Senghor seamount (Cape Verde region) and Eratosthenes seamount (Eastern Mediterranean) were conducted successfully.

TopoDeep investigates the impact of kilometre-scale flow / topography (seamount) interactions on key aspects of ocean biogeochemistry within the parameter space of Coriolis force and tidal forcing.

Dr Robert Turnewitsch

VIBRIOFERRIN

For years researchers have suspected that algae can benefit from the bacteria that live with them in the oceans. Addressing this question, we have observed that specific bacterial species can be found in nearly all dinoflagellate and coccolithophores cultures. This implied a species-specific relationship between the alga and bacterium. From this observation, we developed the hypothesis that these bacteria might be providing a nutritional advantage to the alga.

This idea initiated an international collaboration with colleagues of Frithjof Küpper, based at San Diego State University (USA). Over the last 4 years, Prof. Carl Carrano and his PhD student, Shady Amin, demonstrated that these algal-specific bacteria were producing a novel iron-binding compound called vibrioferrin. This joint research has culminated in our publishing a model describing a mutualistic interaction between the bacteria and algae, : the bacteria increase the supply of iron to the alga while the alga provides the bacteria with a food and energy source. These results have important implications for our understanding of the mechanisms driving biogeochemical cycling of iron in the surface ocean. Furthermore, this model suggests that algae and bacteria may affect the evolution of one another, which is important to how life responds to environmental change.

Amin SA, Green DH, Hart MC, Küpper FC, Sunda WG, Carrano CJ (2009) Photolysis of iron-siderophore chelates promotes bacterial-algal mutualism. Proc Natl Acad Sci U S A 106(40):17071-17076 (doi:10.1073/pnas.0905512106)

Drs David Green, Frithjof Kuepper and Mark Hart

HOW TO MEASURE NUTRIENT TRANSFER IN MICROBIAL FOOD WEBS

Microbial communities are a key component of marine ecosystems and play a central role in the global ocean carbon and nutrient cycling. It is, however, notoriously difficult to measure the nutrient transfer though marine food webs accurately, especially for planktonic protozoa. (small single-celled animals which feed on bacteria and micro-algae). We have developed a sensitive dual-radioactive tracer technique to measure both the ingestion rate (feeding) and assimilation efficiency (incorporation of nutrients into new cellular material) of protozoa (Zubkov and Leakey 2009). The new method has been tested using laboratory cultures of the ciliated protozoan *Strombilidium neptuni* (see Figure) feeding on the micro-algal dinoflagellate Heterocapsa triquetra. In contrast to other methods of measuring protozoan feeding, the method entails minimum manipulation of the microbial community and enables the simultaneous assessment of both ingestion and assimilation. It therefore has the potential to significantly improve measurements of nutrient transfer through natural microbial communities.

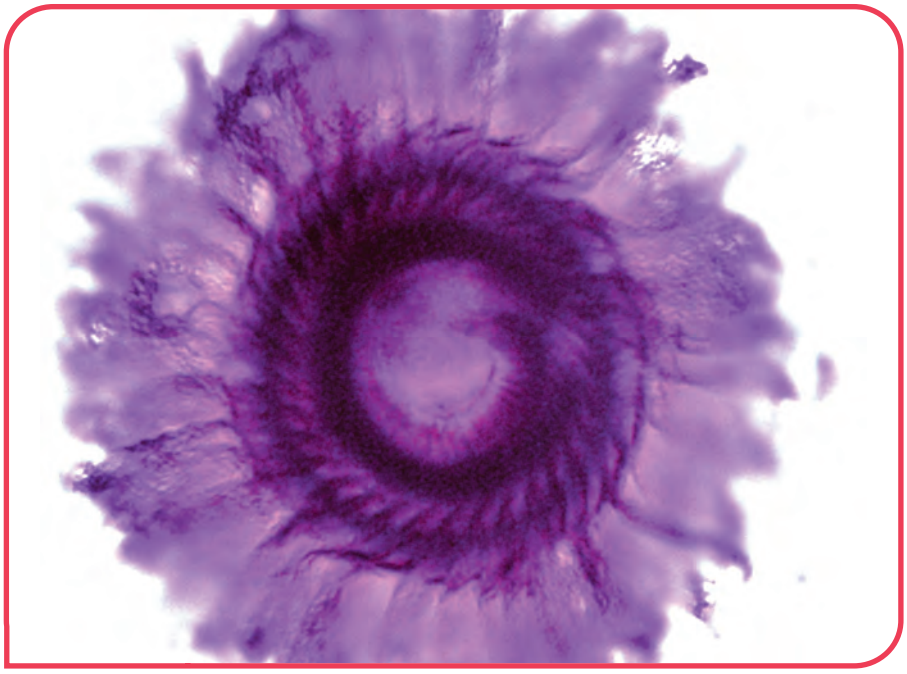


Figure: *Strombilidium neptuni*: a marine ciliated protozoan

Ray Leakey (SAMS)

Mike Zubkov (NOC)

Reference:

Zubkov, M.V., Leakey, R.J.G. (2009). Evaluation of the efficiency of metabolism of dinoflagellate phosphorus and carbon by a planktonic ciliate. *European Journal of Protistology* 45:166-173.

LEARNING FROM THE SCALE OF GEOGRAPHICAL PATTERNS IN ABUNDANCE

Understanding what drives change in ecology often relies on evidence from spatial patterns. Organisms can vary in numbers over 100s of kms but be similarly abundant at sites closer together, while others vary enormously between sites just a few km apart.

A multinational team led by SAMS has developed a method for describing this kind of spatial pattern in rocky shore species. By quantifying variance in abundance at a range of nested spatial scales from 100s to 10s km, patterns of spatial variation in data from point surveys can now be described by power spectra with characteristic slopes. Using this approach with large data sets from the UK MarClim project covering the west of Scotland and southwest England and Wales, we showed that species on the more complex Scottish coast vary more on small spatial scales than in the south.

Patterns of spatial variation differed among species with different life history characteristics. Predators like dogwhelks tended to vary more on small scales, while those species with long-range dispersal tended to vary over larger scales. Insights from these patterns can shed light on what regulates populations and communities: large-scale variation suggests that the likely controlling processes are acting over large scales.

The work involved collaboration with the Universities of Pisa, Bangor and the Marine Biological Association of the United Kingdom.

Burrows, M. T., **R. Harvey**, **L. Robb**, **E. S. Poloczanska**, N. Mieszkowska, P. Moore, R. Leaper, S. J. Hawkins, and L. Benedetti-Cecchi. 2009. Spatial scales of variance in abundance of intertidal species: effects of region, dispersal mode, and trophic level. *Ecology* **90**:1242-1254.

Industrial Impacts

Research Theme: Industrial Impacts

The environmental impacts of extraction of energy, minerals and living resources from the oceans are a constant source of public and scientific concern and are likely to grow in importance over the decades to come. The need for economic growth to maintain the living standards of a rising human population is driving demand for the Earth's non-renewable resources, particularly hydrocarbons and metals. Oil and gas extraction is being extended into ever more challenging environments while the deep-sea bed is increasingly being explored as a source of valuable minerals. The ocean also continues to be used as a repository for waste produced by land-based mines and marine aquaculture, while the development of renewable energy infrastructure such as offshore wind farms and tidal turbines is introducing a further category of large-scale anthropogenic impact into the marine environment.

For all categories of industrial use of the ocean it is essential to identify and measure potential impacts so that these can be minimized and mitigated as far as possible. To achieve this we need a solid base of fundamental research to understand the processes that result from anthropogenic disturbance, and how these activities may enhance or inhibit natural ecosystem processes. Our research builds on SAMS' track record of achievement in fields such as the impacts of coastal aquaculture and the biology and geochemistry of the deep-sea bed. This expertise is readily applicable to emerging issues such as deep-sea mining waste disposal, mineral extraction and renewable energy developments.

Key objectives of this theme

- To apply knowledge and expertise gained from fundamental science research to the practical issues of detection and mitigation of marine industrial impacts
- To exploit the opportunities gained from commercial contracts to carry out new fundamental research and use this to promote our international profile in the scientific community.

Current activities

This theme is the most applied of the SAMS science themes and is closely linked to our commercial activities. We are currently active under the following research areas:

1. Marine disposal of mine tailings

- Environmental impacts of Deep-Sea Tailings Placement (DSTP) in Papua New Guinea

2. Offshore hydrocarbon extraction

- Independent review of Environmental Impact Assessments for oil and gas exploration leases around the Falkland Islands

3. Environmental impacts of marine aggregate extraction

- Effects of resuspended sediment on biogenic reef-building benthos

MINIMISING THE MARINE IMPACTS OF MINING IN PAPUA NEW GUINEA

The world's expanding population will continue to utilise the earth's resources and the environmental impacts of the extraction of non renewable resources such as oil and minerals are a constant source of public and scientific concern. In addition, the marine environment continues to be a repository for waste resulting from both land based and deep sea mining and oil extraction. In all cases there is an urgent need to identify and measure potential impacts so that these can be minimized and mitigated as far as possible.

Papua New Guinea (PNG) is a developing nation with rich mineral resources and an important mining sector. According to the statistics provided by the Bank of PNG, in 2007, 59% of PNG's export value came from copper and gold mining and another 23% from petroleum products. It is generally accepted that the amount derived from mining taxes and royalties is equivalent to the amount spent by the PNG government in the health and education sector.

However the social and environmental impacts of mining have been a controversial issue in the country for many years with the disposal of the waste slurry that results from the extraction of metals, known as mine tailings, being a major issue. PNG is located in the Pacific Ring of Fire which is an area where about 90% of the world's earthquakes occur and is home to approximately three quarters of the world's active volcanoes. Mines in PNG are located in areas of high and frequent seismic activity, with little appropriate land and a high risk of flooding due to high rainfall. This means that the long-term storage of tailings in ponds that are contained by engineered dams is an unsuitable method of dealing with the mine waste in the majority of cases.

Deep-Sea Tailings Placement (DSTP), the discharge of mine tailings via a pipeline into deep water, is an alternative disposal option that eliminates the risk of contamination to land or fresh water. However, there remains the potential for impacts on the marine environment. The PNG Government with the help of the European Union has therefore invested in research to better understand the potential impacts and to investigate how to reduce environmental risk to humans and marine resources.

In 2007, SAMS was contracted to carry out an Independent Evaluation of Deep-Sea Mine Tailings Placement in Papua New Guinea. The study entailed a rigorous scientific study of the impacts of mine tailings at two sites, Lihir Island, where an operational gold mine discharges approximately 4 million tonnes of tailings per year into the ocean, and Misima Island, where DSTP ceased in 2004 after a total discharge of approximately 90 million tonnes. In addition, an environmental baseline study was carried out at the mainland site of Basamuk, a proposed discharge point for tailings from an inland nickel-cobalt mine currently under construction. These three contrasting sites offer the opportunity to establish the pre-impact baseline conditions at Basamuk, to identify and record any impacts of ongoing DSTP at Lihir, and to measure the degree of environmental recovery at Misima.

During October to December 2007, a six week-long research cruise went to Lihir Island in the Solomon Sea and Misima Island in the south-western Pacific. In September 2008 a similar cruise was undertaken in the Vitiaz Basin to survey the natural marine environment of Basamuk and the surrounding area. SAMS has a wealth of experience and a strong track record in multidisciplinary fieldwork in the deep sea, but these cruises nevertheless posed a significant logistical challenge.

The locally-chartered survey vessel, MV Miss Rankin, had room for a small scientific team, and the crew and scientists had to learn how to deploy and recover the sampling equipment that was shipped out from

Exploitation of deep-ocean mineral resources is likely to increase throughout the 21st century, accompanied by pressure to use the deep seabed as a repository for waste

Scotland. Operating in remote areas placed a premium on teamwork, flexibility and improvisation to overcome equipment failures, cyclones and other obstacles that inevitably confront all research cruises.

Both cruises were a great success and we gathered a large amount of data from core and water samples, seabed photographs and plankton hauls. The data is providing a solid environmental baseline for evaluation of any future effects of tailings discharge at Basamuk, increases the understanding of environmental effects of DSTP at Lihir and provides an assessment of any long-term environmental effects at Misima. Additionally, at Misima, we can assess the rate of environmental recovery after mine tailings discharge is discontinued.

As well as carrying out the research cruises SAMS organised and held an international conference on DSTP in Madang during November 2008. The conference was attended by international delegates from mining companies, government bodies, scientific institutions, non governmental organizations and local landowner groups who put forward their viewpoints and discussed how best to minimise the environmental impacts of mining in PNG.

Exploitation of deep-ocean mineral resources is likely to increase throughout the 21st century, accompanied by pressure to use the deep seabed as a repository for waste. The data gathered during this study has placed Papua New Guinea at the forefront of understanding the impact of DSTP and will help the country to make informed decisions regarding the management of its marine environment. It has also placed SAMS at the forefront of research into the impacts of mining and waste disposal in the deep sea.

Dr Tracy Shimmield

Lowering a sediment corer to collect seabed samples off PNG.

Marine Renewables

RESEARCH THEME: MARINE RENEWABLES

Despite the current recession, global energy demands continue to rise while fossil fuel extraction has peaked and is on a downward trajectory whilst also being linked with climate change. In response, national governments are setting challenging targets to increase the generation of electricity from sustainable sources and develop new supplies of transport fuel. These changes are driving a rapidly growing, creative, diverse and global assemblage of new industries. While terrestrial energy sources face many constraints, the marine environment may provide electrical energy from wind, wave, tidal-barrage and tidal-stream devices. The potential to produce renewable transport fuel by culturing and converting marine algal biomass into biofuel is also gathering momentum.

The focus of the SAMS Marine Renewable Energy Theme is on cutting-edge scientific research to underpin the sustainable development of marine renewable energy generation. Our work crosses from developing and testing new technologies to mitigating potential environmental effects. Our work is arranged into three sub-themes:

1) Biofuels from microalgae

In this sub-theme we are evaluating the feasibility and viability of producing biofuels from microalgae and screen the Culture Collection for Algae and Protozoa for new strains of oil producing microalgae aiming to select and characterise suitable strains. We use conventional and molecular DNA-chip technologies, conduct process and product optimisation trials and are interested in scale up and process optimization.

2) Biofuels from macroalgae

We are developing methodologies for generating biofuels from seaweeds. This includes investigating the coastal potential for collecting and farming seaweeds, identifying contender species including their growth capability and fuel potential. We also work on improving fermentation/digestion procedures and investigate the scale-up promise.

3) Environmental interactions

We are interested in a number of research questions addressing the interactions of marine renewable energy devices with the marine environment. These include

- Collision risks for mega-vertebrates
- Acoustic footprints of renewable devices
- Reef effects of offshore structures
- Biofouling
- Smothering/burial
- Physical oceanography
- Ecosystem impacts
- Impacts of mass macro-algal culture and use of wild seaweed resource
- Survey techniques for tidal sites (acoustics & marine mammal abundance)

Funding for this theme comes from a range of sources from the Research Councils and Europe to Government Agencies and developers.

RENEWABLES THEME DRAWS FRESH BLOOD

This year has seen SAMS move into a new phase of our renewables research. Previously our theme work was carried out by existing staff changing their studies to respond to emerging research opportunities. However, this year we cut new ground by recruiting staff and students specifically to work on marine renewable issues. Most obvious is the recruitment of seven PhD students. Three of these (Adrian MacLeod, Karen Alexander & Raeanne Miller) are part of the UHI SuperGen Plus Programme and are studying renewables and biofouling by non-native species, new habitat provision & connectivity of coastal species. Three (Kyla Orr, Peter Schiener & Carol Shellcock) are part of the BioMara project looking into ecosystem implications of seaweed harvest, ethanol production from algae and algal molecular biology. Caroline Carter is investigating the acoustic properties of tidal turbines in relation to marine mammal hearing. Funding from HIE, HIP, ERDF, TCE, INTERREG IVA, SNH & SEPA has made this possible.

Dr Ben Wilson

KEEPING TABS ON SCOTTISH DOLPHINS

For some reason bottlenose dolphins choose particular stretches of coastline to live along and do so in discrete groups known as "communities". Previous SAMS research (in collaboration with Aberdeen and St. Andrews Universities as well as the HWDT) has shown that Scotland has three dolphin communities: one off the east coast, and two off the west. The two west coast communities are very small (one and two dozen animals each) but also very different from each other. One is mobile and ranges along the entire coast of the mainland while the other appears tied to a single pass in the outer Hebrides. We have been observing the outer Hebrides community since the mid 1990s, and checked their status again this year. This ecological "monitoring" is taking on new relevance with the plans to add offshore renewable installations (wind, wave and tide) to significant tracts of the Scottish coastline. These developments may change the environment for bottlenose dolphins for better or worse. We are now well placed to find out how.

Dr Ben Wilson

BioMara

BioMara is a four year project (2009-2012) aiming to demonstrate the feasibility and viability of producing mari-fuels from marine biomass derived from both macroalgal (seaweeds) and microalgal (single celled plants) sources as an alternative to agri-fuels production from terrestrial land plants. In particular targeting specific questions designed to build on the current knowledge base available within this unique set of geographical regions. This will not only provide the areas of Ireland and the west of Scotland with access to a more economically and environmentally sustainable local renewable fuel source, but also help service local public transport infrastructure and build on the regions' technology base. At the same time, development of mari-fuels will help to support traditional ways of life in remoter communities by providing locally produced, relatively cheap, low impact fuel.

The project is utilizing the cultures of CCAP, a NERC facility. BioMara is a collaboration between Scottish and Irish researchers coordinated from SAMS and funded by the EU Interreg IVA programme, Highlands and Islands Enterprise and the Crown Estate. Partners come from the University of Strathclyde; Queen's University, Belfast; the University of Ulster; the Dundalk Institute of Technology; and the Institute of Technology, Sligo.

Dr Michele Stanley

SEAWEEDS AND BIOGAS: RENEWABLE ENERGY RESEARCH AT SAMS

The cultivation of seaweed (macroalgae) for anaerobic digestion to produce biogas is being examined at SAMS as a source of renewable energy. Seaweeds are in culture on long-line systems, similar to those used in Scotland for mussel cultivation; and the total biomass of macroalgae obtainable is being quantified. As part of the BioMara project the algal biomass is then subjected to anaerobic digestion (AD), which is simply the breakdown of the algal matter, by a consortium of bacteria, in the absence of oxygen. The main energy carrying product of AD is biogas, which is 60% methane. This biogas can be used directly just like natural gas to run transport systems or to generate electricity. The AD process is controlled and carried out in dedicated digesters. Research into optimising gas yield is underway by examining a variety of inoculum types (the bacteria which initiate the process), a variety of species of seaweeds, mechanical and enzymatic pre-treatment of the seaweed and the addition of other feedstocks to the digester to alter carbon:nitrogen ratios.

Ian Rae, Lars Brunner, Maeve Kelly and Michele Stanley

OIL FORM MICRO-ALGAE

Micro-algae have the potential for large-scale production of biofuels and high value lipid-based industrials. This very diverse group also has the potential to produce other valuable products such as carotenoids. Our aim is to better understand the factors responsible for oil accumulation in micro-algae to improve biofuel production. The focus in BioMara is on marine micro-algae, to enable cultivation in seawater and so avoid competition for fresh water supplies.

We have screened for high oil-producing strains among the 500 marine strains held at the CCAP collection at SAMS. The next step, which is in progress, is to apply genomics methodology to analyse which genes are switched on during oil production in the high-oil producing strains.

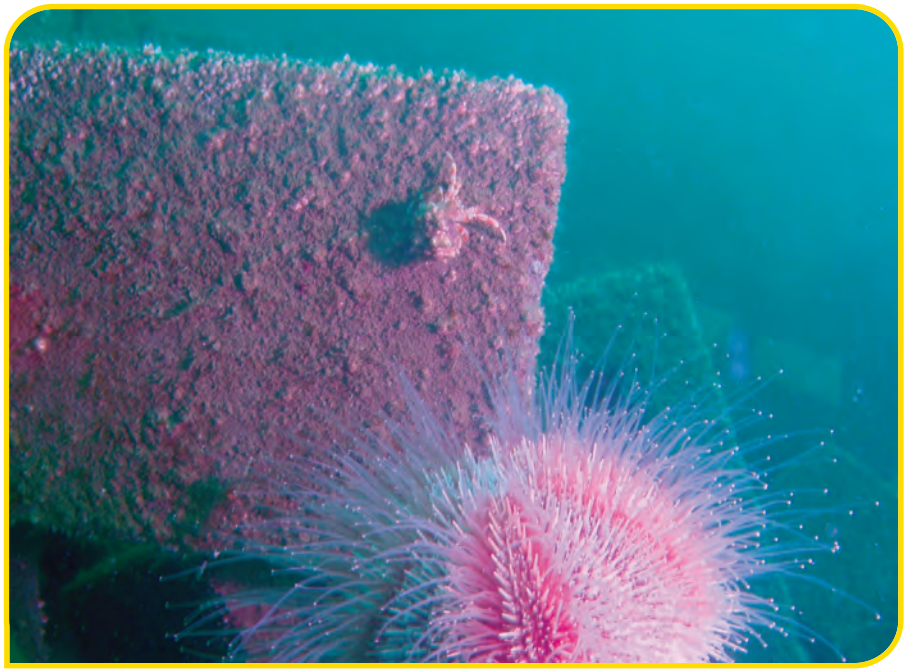
Stephen Slocombe

For regularly updated information on this project please visit www.biomara.org

MAXIMISING THE BENEFITS OF OFFSHORE STRUCTURES

Man is increasingly intervening in the coastal zone through land reclamation, coastal defense and the emplacement of offshore renewable devices. In order to investigate the potential impacts of this type of intervention the Loch Linnhe Artificial Reef was constructed (2001 - 2005). The reef complex was deployed over a range of receiving environments enabling us to study factors that influence the occupancy of man-made habitats, notably the role of habitat complexity and current exposure.

Current reef-based research includes the mathematical modelling of fine-scale tidally driven flows around individual reef-units (in collaboration with Prof. Downie, University of Newcastle) and a socio-political investigation into how offshore structures change seabed access rights and the subsequent effects on coastal communities. This research will enable the prediction of the likely impacts of these new marine structures, and how best to design them to maximise their potential amenity, biodiversity and fishery benefits.



Dr Tom Wilding

BY HOW MUCH DO PORPOISES AND TIDAL-STREAM ENERGY SITES COINCIDE?

Injurious collisions between marine mammals and tidal-stream energy devices are a significant environmental bottleneck facing the fledgling industry. Modelling work on harbour porpoises for the Scottish Strategic Environmental Assessment (Batty & Wilson, SAMS) suggested that encounter rates have the potential to be common enough to warrant significant concern. Without detailed information on densities in tidal-energy sites, the modelling study had to assume that porpoises occurred at the same densities as elsewhere. To investigate whether this is really the case, we set out to measure porpoise density at two prospective tidal energy areas off western Scotland (off Islay and Skye) with funding from the Scottish Government. Surveys were carried out from the Hebridean Whale and Dolphin Trust's research boat *Silurian*. Standard visual and acoustic survey methods needed to be modified as work was carried out in waters moving at up to 8 knots (15 kmh-[1]). Though porpoises were common in the waters around these sites, sightings proved rare in the locations of most interest.

These results will help fine-tune the modelling work. It also highlights the question of how marine mammals will respond when actually encountering underwater turbines.

Ben Wilson & Jim Elliott

Sustaining Prosperity

RESEARCH THEME: SUSTAINING PROSPERITY

The sea supports many aspects of human welfare as a source of food, recreation, transport, energy, minerals and even medicines. But it also provides key services that are not so obvious, buffering much of the greenhouse gases we emit, providing a huge genetic 'insurance policy' for the future, transporting heat, supplying oxygen and seeding clouds. Its capacity to provide these services is limited and we have already put some of them in jeopardy. Rational exploitation of the sea and conservation of its biodiversity is a key challenge for policymakers. Multidisciplinary science is helping them to make wise choices.

SAMS is at the forefront of providing the science to support implementation of the 'Ecosystem Approach', a resource planning and management approach that recognizes the connections between land, air, water and all living things, including people, their activities and institutions. This approach underpins the new marine bills in the UK and Scotland and the European Marine Strategy Framework Directive. SAMS scientists are helping to develop practical ways to manage the marine environment sustainably, observing symptoms of degradation or the arrival of alien species, understanding the trade-offs involved in marine spatial planning, working to avoid or overcome conflicts and support communities, developing more sustainable mariculture and fisheries.

ANNUAL REPORT: PROSPERITY FROM MARINE ECOSYSTEMS

It's been a busy year for the Prosperity theme. While it is early days for 'prosperity', our focus is to advance the understanding of linked social and ecological systems that lies at the heart of sustainable development on the coast and in the sea.

Our vision is to lead multidisciplinary science for the management and recovery of coupled marine social-ecological systems. What we mean by this is that the management of marine resources and the restoration of ecosystems is dependent on understanding the social economic forces that shape our behaviour and institutions within the constraints of natural systems.

SAMS is working hard to be at the front of providing the science base to support the implementation of recent reforms: the Marine (Scotland) Act 2010, UK Marine and Coastal Access Act 2009 and the European Marine Strategy Framework Directive. We are developing pragmatic evidence-based approaches to managing the marine environment, developing more sustainable fisheries and aquaculture, providing the science behind ecosystem restoration, understanding the processes and trade-offs involved in marine spatial planning and working to avoid or overcome conflicts in coastal communities. The researchers in the Prosperity theme have worked together to identify goals and science challenges:

Key goals:

- Understanding how ecological and social systems function and how their resilience can be increased
- Be proactive in providing the scientific basis for sustainable resource exploitation.
- Be actively engaged in building scientific and technical capacity for ecosystem based management
- Be a centre of excellence in marine governance research.

Key science challenges:

- How will marine spatial planning be delivered to ensure environmentally, economically and socially sustainable industries and communities?
- How do we apply the concepts of ecosystem science into scientific, policy and management initiatives?
- What are the effects of cumulative drivers such as climate change, resource extraction, and pollution on the quality of marine ecosystems and the services they provide?

We have split the theme into three research groups;

GOVERNANCE PROGRAMMES

ECOSYSTEM PROGRAMMES

PROVISIONING SERVICES (MARINE RESOURCES) PROGRAMMES

Under each group we are pleased to highlight some of our research successes of the past year.

Dr Tavis Potts

GOVERNANCE PROGRAMMES

KNOWSEAS

KNOWSEAS: Knowledge based development of European Seas. Since its inception meeting at SAMS in April 2009, the scientific research of the KnowSeas project has been developing at pace. A presentation of the scope and goals of the project to experts from European directorates general, International Council for the Exploration of the Seas, WWF and other stakeholders was warmly received at a the project's first Advisory Board meeting in Scotland House in Brussels last December. The first annual scientific workshop was held in Palma de Mallorca in April, there were delegates from each of the projects 30 partners as well as international guests. We have also forged connections with other major projects and organisations including the international group Land Ocean Interactions in the Coastal Zone (LOICZ) and the U.K. Research Council: Living With Environmental Change program (LWEC).

Though still in the early stages the project has already produced articles in high quality journals illustrating innovative ways in which knowledge based sustainable management may be delivered. The project is continuing to gather momentum as new synergies and collaborative opportunities emerge.

SAMS team: Laurence Mee, Tim O'Higgins, Helen Wilson

SPICOSA: SCIENCE AND POLICY INTEGRATION IN COASTAL SYSTEM ASSESSMENT

This year, the FP6 project SPICOSA entered its final year. The team (Branka Valcic, Tavis Potts, Ruth Brennan and Paul Tett) is focussed on developing and testing tools to improve integrated coastal zone management. We have been a part of the Clyde Sea/Loch Fyne study site team, which this year finalised a systems model of sectoral interactions (yachting & shellfish farming in particular) through possible effects of anti-foulants on phytoplankton and thus on mussel growth. Our role in this final stage of the model development was to advise on its economic component, on a possibility of including a social component within the model, and on the visual presentation of the model itself. The model was presented to our policy-stakeholders for feedback and was well received. Much discussion at the policy-stakeholders workshop centred on the future development of the model, particularly for purposes of supporting marine spatial planning.

RESEARCH SUPPORTING THE IMPLEMENTATION OF THE SCOTTISH MARINE ACT

In March 2010 Marine Scotland published a SAMS report (Ruth Brennan, Tavis Potts and Laurence Mee) on Social and Economic Objectives for a Scottish Marine Plan (downloadable from the Marine Scotland website.)

The Marine (Scotland) Act 2010 requires Scottish ministers to prepare a National Marine Plan stating the Scottish Ministers' policies for sustainable development. This report was commissioned in February 2009 to assist in the development of national marine objectives relating to social and economic priorities for the seas around Scotland. The report goes into detail about international, EU, UK and Scottish policy drivers for marine governance with a focus on social, economic, cultural and governance dimensions. It develops a framework of good practice recommendations for selecting or specifying marine social and economic objectives that are based on Scottish priorities. Taking account of the links and balances between environmental, social and economic issues expressed in the Government Economic Strategy, the report takes on board a critical (but often unexplored) issue: how to place people and communities at the heart of the marine planning process.

ECOSYSTEM PROGRAMME

MODELLING THE ASSIMILATIVE CAPACITY OF SEA LOCHS

Work funded by Scottish Aquaculture Research Forum (SARF) has continued on adding a shellfish component to the ACExR-LESV physical-biological model for sea lochs. This already deals with the environmental impact of finfish farms, and the aim of the improvements is to estimate the optimum use of a loch's capacity to absorb and recycle farm waste when more than one kind of farming is carried out. Work in the EC FP6 Spicosa project has included development of theory and practical guidance for describing and modelling ecological, economic and social components of coastal zones as parts of a single system. Some of this has been tested, in collaboration with Napier University, in relation to biological and economic aspects of mussel farming and yachting in Loch Fyne, and has resulted in a modelling tool that has the potential to estimate a loch's carrying capacity for a number of human activities.

ECOSYSTEM MANAGEMENT IN WEST COAST FISHERIES

Sheila Heymans, John Gordon, Mike Burrows and colleagues published a study on the ecosystem approach to fisheries management (EAFM) in the deep sea (Heymans *et al.*, 2010a). They used an Ecopath with Ecosim (EwE) model to examine the possibility of doing EAFM in data-poor deep sea west coast of Scotland fisheries. The results suggest that there are sufficient data available to construct the model, but the quality of the data varies and serious potential sources of error are present. Sharks are used to illustrate the benefits of using an ecosystem model and the results show that both fishing for sharks and fishing for their prey affect the biomass of sharks.

MONITORING THE SPATIAL AND TEMPORAL DISTRIBUTIONS OF JELLYFISH

In February 2010, Thom Nickell in conjunction with Clive Fox, Keith Davidson, Peter Miller (PML) and Graeme Hays (Swansea Univ.) reported on developing the capacity to monitor the spatial and temporal distributions of jellyfish in western Scottish waters. The project was funded by the Crown Estate.

CO-OCCURRENCE OF TOXIC AND NON-TOXIC PHYTOPLANKTON

Keith Davidson, Romain Pete and Sharon McNeill have explored the dynamics of toxic and non toxic shellfish producing phytoplankton. The species of the genus dinoflagellate *Alexandrium* produce biotoxins that are responsible for paralytic shellfish poisoning worldwide. In Scottish waters historical evidence suggests that the high toxicity low biomass North American *Alexandrium tamarense* dominated. However, recent data has suggested the presence of *A.tamarense* blooms without associated shellfish toxicity in some locations. Using whole cell fluorescent *in situ* hybridisation (WC-FISH) we have made the first identification worldwide of both toxic North American and non toxic Western European *A.tamarense* at single locations (both Vaila Sound and Clift Sound in the Shetland isles). The results have implications in the fields of global biodiversity, invasive species and for the shellfish industry.

PROVISIONING SERVICES (MARINE RESOURCES) PROGRAMME

FISHING SUBSIDES AND PROFITABILITY

Sheila Heymans and colleagues from Cefas and Canada used data on fishing subsidies and an ecosystem model to examine the impact that subsidies have on the profitability and ecosystem structure of the North Sea. They found that when fisheries are subsidised gross revenue and catches might increase, but the overall profitability of the fishery declines and the stability of the ecosystem is reduced.

BENTHIC EFFECTS OF LARGE SALMON CAGE FARMS IN SCOTLAND

Thom Nickell, with Chris Cromey, Kenny Black and Andrew Dale, published a report in February 2010 on modelling benthic effects of large salmon cage farms in Scotland. This project looked at the potential for coupling a hydrodynamic model to the SAMS DEPOMOD model to enable predictions of impact from large scale sites in dispersive areas. This project was funded by the Crown Estate, the SSPO and Marine Scotland.

BIODIVERSITY TRENDS ALONG THE WESTERN EUROPEAN MARGIN

This review by Bhavani Narayanaswamy synthesizes published and new biodiversity data across multiple spatial and temporal scales, and from the coast to the deep sea, to provide an overview of what is known along the western European margin. We also highlight threats to the biodiversity of the region, as well as identifying where there are still gaps in our knowledge.

INVESTIGATING THE SEAMOUNTS AND BANKS OF THE UK MARGIN

Work undertaken on the seamounts and banks of the UK margins has been used to identify deep-sea megafaunal epibenthic assemblages for use in habitat mapping and marine protected area network design. This project has been funded by the Joint Nature Conservation Committee; the INTERREG IIIB NEW programme through the Mapping European Seabed Habitats project; the Department for Business, Enterprise and Regulatory Reform; the Department for Environment, Food and Rural Affairs through the offshore Special Areas for Conservation programme.

FISHING SUSTAINABLY

Marine science advice is playing an increasingly important role in determining whether specific fisheries can be labelled as sustainable. As part of this process, Dr Clive Fox, SAMS fisheries scientist, has played a key role on accreditation teams for the Marine Stewardship Council (MSC) during the last year. Fisheries which achieve MSC certification can brand their products with the MSC blue-tick logo. This provides processors and with the public assurance that products bearing the logo come from fisheries which are well managed.

The accreditation process involves site visits and consultation with the fishery and other stakeholders such as environmental NGOs followed by scoring the fishery against three principles: the status of the target stock; the impacts of the fishery on other species and the environment; and the legal and enforcement framework in which the fishery operates. The accreditation process takes up to 18 months but is very open, with all reports being peer reviewed and put on the MSC website. Interested parties can lodge objections during this process. If awarded, certification lasts for five years with annual audits of the fishery during this period to ensure that the standards are maintained or improved. Dr Fox has been involved with assessing the Ekofish group's North Sea plaice fishery which achieved certification last year. A second North Sea fishery group is currently going through the process.

SCOTLAND'S CHANGING SEAS

The Marine (Scotland) Act, which received Royal Assent in March 2010, provides a framework intended to balance competing demands on Scotland's seas. It introduces a duty to protect and enhance the marine environment, for which the creation of a network of Marine Protected Areas (MPAs) is a principal goal. However, there are concerns that an MPA network may not be sufficient in itself to fulfil this objective and that wider measures are needed to promote the conservation of Scottish marine ecosystems beyond the limited confines of protected areas.

In the run-up to the passing of the Marine Act, SAMS was commissioned by Scottish Environment LINK, a forum of over 30 voluntary environmental organizations, to write a report presenting the evidence for degradation of Scotland's marine environment by human activity and assessing the potential for recovery. The report, Recovering Scotland's Marine Environment, written by Dr David Hughes and Dr Thom Nickell, reviewed the historical background of anthropogenic impacts on Scotland's seas and presented detailed case studies of habitats and species for which there is good evidence of decline caused by human activity. These include maerl, file-shell and native oyster beds, North Sea demersal fish communities, and skates and rays. The 63-page report was released in October 2009. It received wide coverage in the Scottish media and was cited during a debate in the Scottish Parliament.

http://www.sams.ac.uk/research/sams-scientific-staff/LINK%20Report%20final.pdf

EU SAMI PROJECT

The world's population is likely to rise to over 9 billion by 2015. This presents significant challenges for food security owing to decreasing availability of agricultural land and significant problems in freshwater supply. Climatic change may compound this by increasing flooding, drought and desertification. In addition, agriculture is highly energy dependent – particularly for the synthesis of inorganic nitrogen fertilisers necessary for the production of high yield densities.

SAMS has been involved in the EU SAMI project which explores whether aquaculture could answer some of these problems considering issues of space, species and feed supplies.

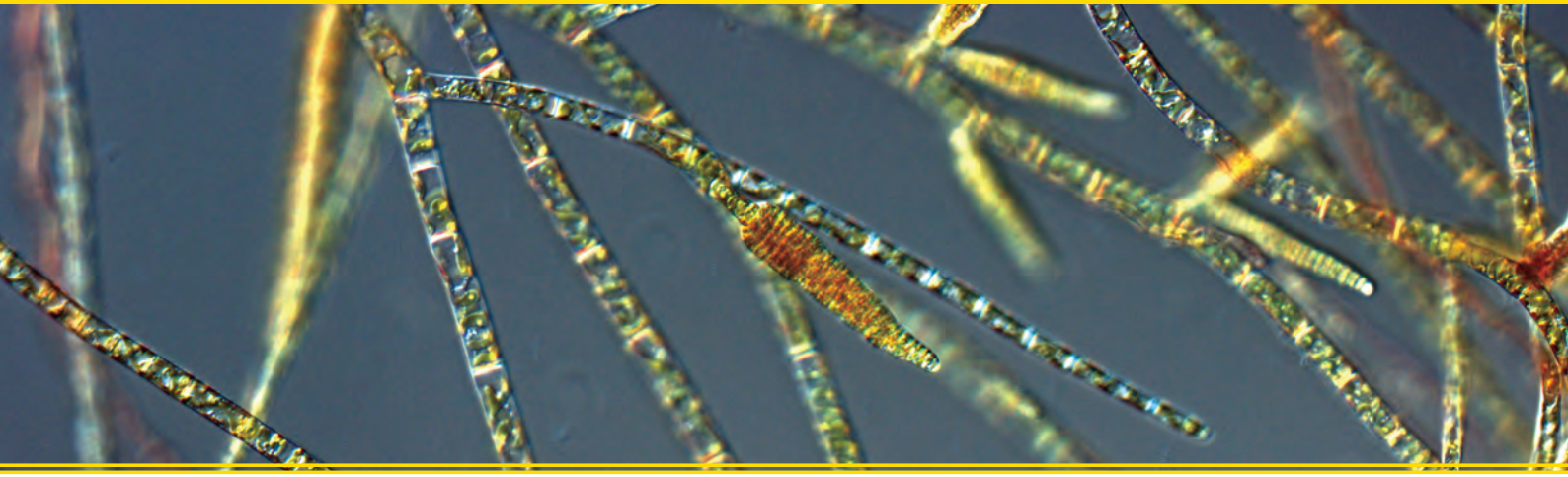
The outcome was highly positive (Duarte *et al.* 2009 *BioScience* **59**: 967-976) but for the effort to be successful, mariculture must:

- close the production cycle to abandon its current dependence on fisheries
- enhance the production of edible macroalgae and filter-feeding organisms
- minimize environmental impacts and
- increase integration with food production on land, transferring water-intensive components of the human diet (i.e., production of animal protein) to the ocean.

Accommodating these changes will enable the oceans to become a major source of food, which will constitute the next food revolution in human history.

Dr Kenny Black

CULTURE COLLECTION OF ALGAE AND PROTOZOA (CCAP)



The NERC funded Culture Collection of Algae and Protozoa (CCAP), located at SAMS, is a component of the UKs' scientific infrastructure. It is a National Facility, which acts as the the UK national service culture collection, or Biological Resource Centre (BRC), providing cyanobacterial, protistan and macroalgal cultures, bioinformatic data, services and advice to the scientific community. The CCAP currently maintains in excess of 3000 strains of algae, cyanobacteria and free-living, non-pathogenic protozoa, held in the publicly accessible collection. In 2009/10, approximately 80 new strains were added to the collection, with 14 being ex-type cultures: newly described taxa to science. A wide taxonomic range of protists have been accessed including multi-cellular red algae, non-pigmented flagellates and amoeboid organisms. Details of all holdings and accessions are listed on the CCAP website www.ccap.ac.uk.

The collection underpins scientific research, training and commercial activities in the UK and world-wide. In 09/10 a total of 670 orders were serviced with the provision of >1600 cultures to non-SAMS users. In addition, CCAP is key to the underpinning of the rapidly developing field of algal biotechnology. In 09/10 eight new patent deposits were made in CCAP, the most in any year to date. Additionally we provided advice/consultancy services, extracted DNA, training courses, contract research and algal identifications.

The CCAP is integral to two SAMS algal biofuel projects: Biomara (www.Biomara.org) and the Carbon Trust funded 'Algal Biofuels Challenge' project Control of Grazers.

The CCAP knowledge-base website www.ccap.ac.uk, launched in 2007, continues to be developed and updated with the addition of still images, video clips, bibliographic references, biogeographical and chemical information as well as nucleotide sequence accession numbers, with 2-way live hyperlinks between nucleotide sequence records in the EBI database and strain records in the CCAP database.

In January 2010 the collection hosted the annual winter meeting of the British Phycological Society. Despite Arctic conditions in much of the UK, over 90 delegates attended the meeting from the UK, mainland Europe, Asia and the USA. The meeting was wide ranging covering both blue-skies and applied aspects of algal science. There were two special sessions during the meeting: "Productivity and photophysiology" organised by Dr Rupert Perkins (Cardiff): speakers included: Prof John Raven (Dundee), Prof Dieter Hanelt (Hamburg), Prof Johann Lavaud (Konstanz), Prof Graham Underwood (Essex) and Dr Jacco Kromkamp (Yerseke). The second special session: "Host pathogen interactions" organised by Dr Claire Gachon (SAMS): speakers included: Prof Gwang Hoon Kim (Chungnam, Korea), Dr William Wilson (Bigelow), Dr Aurelie Chambouvet (Marseille) and Prof Telesphore Sime-Ngando (Clermont Ferrand). In addition the Overseas Vice President, Prof Patrizia Albertano (Rome), gave her vice-presidential address on "Natural and reconstituted phototrophic biofilms in water". In total 50 oral papers and 27 posters were presented, fuller details and abstracts are available in the Phycologist (www.brphycsoc.org/phycologist.lasso).

Dr John Day

Harry Powell, retired SAMS scientist and first Honorary Secretary to the British Phycological Society, with present BSP Secretary Dr Jane Pottas during the evening reception.

NATIONAL FACILITY FOR SCIENTIFIC DIVING (NFSD)

The NERC Facility for Scientific Diving (NFSD) at SAMS provides divers, equipment, training and scientific/technical support that underpins a wide range of high-class interdisciplinary research in the underwater environment. The calendar year of 2009 saw a total of 540 diving operations undertaken for a number of multidisciplinary projects carried out in environments ranging from both polar regions to the tropics.

The science that the NFSD now supports is highly collaborative. Examples are:

Marine benthic monitoring methods

To determine optimum sampling approaches, image-based sampling procedures were compared in a temperate reef habitat. The effectiveness of the various techniques was assessed by comparing the relative efficiency of data collection, extraction and analysis among the sampling procedures. (Brown, van Rein; University of Ulster)

Seasonal foraminiferal biogeochemistry

This work is on-going and further seasonal collections are planed for genetics work and isotope analyses. The work now involves using 'live' SCUBA collections for subsequent genotyping and has recently been augmented through NERC responsive-mode funding (Dr Kate Darling, Edinburgh). (Austin; St Andrews University)

Thermal physiology and ecology of marine ectotherms

Studies have continued to investigate the physiological, genomic and ecological mechanisms that allow cold-blooded Antarctic marine animals to cope with life in the constant cold of the Southern Ocean. Highlights from work based on NFSD support include estimating the long term survival limit (between 1 and 6°C) of more than 20 Antarctic shallow water marine animal species; testing temperature sensitivity of marine animals from the Antarctic Peninsula; and analysing factors driving shell shape in Antarctic limpets. (Peck, Clark, Barnes, Morley; British Antarctic Survey)

Macropalaeontological studies of selected Mollusca

This ongoing project continues to work on 'live' collections of *Arctica islandica* from Lochs Etive and Creran. These collections suggest significant differences in population biometrics (shell height/weight), which may reflect between site differences in shell age and/or growth. The NFSD collections will form a long term repository at National Museums Scotland (registration number: Z.2010.39). (Stott, Austin; St Andrews University)

Macroalgal and oomycete benthic diversity in the Canadian Marine Arctic

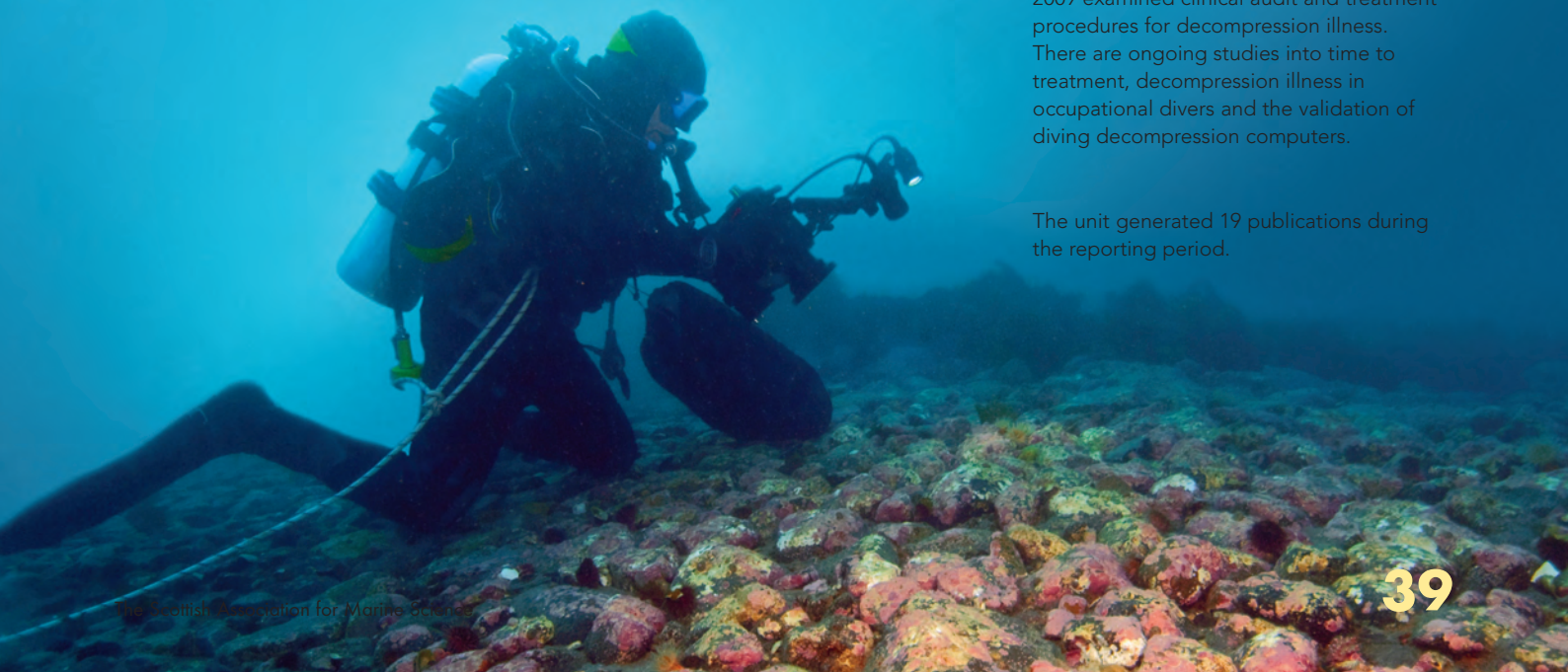
An expedition to the Cape Hatt area, northern Baffin Island, Nunavut, Canada produced collections required for the completion of an inventory of the region's seaweed flora, an assessment of changes in the seaweed community composition, an overview of pathogens affecting Arctic seaweeds and provided the first-ever photographic and video survey / documentation of the seaweed communities dominating the coastal ecosystems of the region. (Küpper; SAMS, & van West; Aberdeen University).

Emergency recompression

SAMS continues to host and run an emergency recompression facility within the diving unit. The facility is NHS-registered and is responsible for providing emergency cover on the west coast of Scotland from Islay to Cape Wrath (including the inner and outer Isles). 15 divers presented to the chamber in 2009; 6 were treated. Unfortunately, during the same period, another four divers lost their lives while diving in our operational sector.

The co-hosting of the NFSD at SAMS along with an emergency recompression facility, provides the unique opportunity to contribute to areas of diving and hyperbaric medical research that has some relevance to occupational scientific diving. Papers in 2009 examined clinical audit and treatment procedures for decompression illness. There are ongoing studies into time to treatment, decompression illness in occupational divers and the validation of diving decompression computers.

The unit generated 19 publications during the reporting period.



Education

SAMS HIGHER EDUCATION

This has been another noteworthy year of higher education activities. In addition to the activities reported below, it should be recorded that the Education Department has grown in personnel and remit as a result of the institution-wide restructuring at the end of the year. A five-year business plan now describes in detail the aspirations for developing education through offering a wide range of continuing professional development (CPD), field studies and masters courses, as well as building our PhD population.

MASTS Graduate School

The Marine Alliance for Technology for Scotland (MASTS) was launched officially in November at Our Dynamic Earth in Edinburgh. This was a particularly rewarding occasion for SAMS Education as it also marked the beginning of the MASTS Graduate School, which we shall be hosting. This places SAMS at the heart of postgraduate training developments for taught postgraduate students and early career researchers in marine science across Scotland.

New Teaching Infrastructure

The other highlight of the year was the agreement between SAMS, Highlands and Islands Enterprise, Scottish Funding Council and UHI to develop new teaching infrastructure at SAMS. Ground works commenced in December for a two-story building containing lecture theatres, laboratories, study rooms and a canteen, as well as the Scottish Ocean Explorer Centre - an education-outreach facility.

Postgraduate Research Training

Over the year a further intake of postgraduate students commenced at SAMS; our largest since 2003. Renewable energy features strongly in the cohort, with groups of students looking at the impacts of energy harvesting devices in the water (SUPERGEN, funded jointly by HIE and the European Regional Development Fund) and production of biofuels (BIOMARA, an INTEREG III programme), as well as our first Scottish Natural Heritage sponsored PhD. Two of our staff members have also enrolled on part-time research MSc programmes through UHI.

Undergraduate and Postgraduate Teaching

The tenth, and largest, cohort of UHI undergraduates arrived in September. This provided our largest undergraduate intake since delivery began, and is a great credit to the growing reputation of the programme. In line with UHI's new status in awarding Taught Degrees, we held our first formal 'UHI Graduation Ceremony' in September, with graduands and staff donning gowns and 'processing' to the ceremony. Anita Eriksson, Andrea Veszelovszki and Heather Robertson received their awards from Dr Jeff Howarth, UHI Vice Principal Research and Enterprise, and the formal address was delivered by Moya Crawford of Deeptek Limited.

The other highlight of the undergraduate year was the despatch and safe return of another third year student - Jill McColl - to Svalbard, where she spent an enjoyable and challenging semester at UNIS, the university centre. She is the third student to transfer to our BSc (Hons) Marine Science with Arctic Studies, which is enabled through the European Union's ERASMUS Exchange Programme.

Prof. Axel E. J. Miller

Head of Education & Academic Development, SAMS

Dean of Graduate Studies, MASTS

Business Developement

Business Developement

Meeting of UAE representatives at SAMS with the Business Development team

Ateeq Khamis Hamad Al Mazrouei, Executive Director - Delma Island Dr Abdoula Hassan Gharib Al Bloushi, Executive Director - Municipal Affairs Salem Rashed Musallam Al Mazrouei, Director - Human Resources Robert Hudson, Director- Government Services (Mouchelle)

SAMS is committed to maximising the external value generated from its outputs through the promotion of good marine environmental governance and the exploitation of SAMS' knowledge base for wealth creation, not only for SAMS but also for the wider regional, national and international communities. Under the present global and national economic conditions it is probable that research funding will decrease, it is therefore prudent that SAMS should develop its commercial sector to ensure that it can deliver additional income to support its science base. During October 2009 SAMS went through a restructuring process and as a result of the process the Business Development Department was formed.

The department consists of four full time and two part time posts including Associate Director and Head of Business Development, Director of Knowledge Transfer, Sales and Commercial Marketing Manager, Business Development and Marketing Manager and two Administrative posts.

Business development at SAMS exists to promote the skills, capabilities, services and products within SAMS using its new trading name SAMS Commercial Services Ltd (SCSL). There are two major areas of Business Development: The first is the commercial arm, the main objective of which is to work within the commercial sector utilising SAMS' skills and capabilities to assist industry. The second is in the area of knowledge transfer, where skills and intellectual property are utilised to develop marketable opportunities from science discoveries and outcomes.

The key market areas in which SAMS Commercial Services Ltd operates and areas it has identified for expansion include providing Environmental Impact Assessments to the Renewable Energy, Nuclear, Oil and Gas and the Mining sectors. In addition SCSL can provide advice in the use of smart technology and remote sensing and on policy issues and development. Nationally there is a growing need for science to input to policy as the UK and Scottish marine strategies are developed. Finally SCSL can provide analytical services for a wide range of materials using its state of the art laboratories and instrumentation.

SAMS is also actively engaged in knowledge exchange within the renewable energy area specifically looking at the use of marine biomass in the production of energy and the production of biofuels from microalgae. This is an area where science and industry are working closely together to develop green solutions for energy production.

Since its establishment the department has been involved in a number of major initiatives. These include a number of successful framework bids such as the Department of Energy Climate Change: Offshore renewables research framework agreement and Scottish Natural Heritage Framework: Provision of Specialist advice on marine mammals and basking sharks. In addition SAMS Commercial Services is carrying out work for clients working in the renewable energy and mining sectors.

The department is developing an initiative with the United Arab Emirates (UAE) to provide marine science skills and facilities. This is in conjunction with government departments and the Higher Colleges of Technology of UAE. Meetings have taken place in Abu Dhabi and Scotland and SAMS is looking forward to a long-term, close working relationship with the various government councils, agencies and education establishments in delivering excellence in marine science and education to the UAE.

The Business Development Department has focussed on developing its team in addition to business in the last nine months. We now have a dynamic team of people with the necessary skills to ensure the development of business for SAMS continues to be successful and will ensure that SAMS science is utilised for the benefit of industry and society.

We are now ready for the challenge of attracting further business and delivering value to our clients over the next year which will be demanding in the present and future economic climate.

SAMS MEMBERSHIP NEWS

During the reporting period SAMS had a total of 456 members (29 corporate, 61 student, 366 ordinary). Annual subscription charges remained unaltered at £60 for corporate members, £12 for ordinary members and £5 for students and unwaged ordinary members.

The 20th Annual Newth Lecture, delivered following the 95th Annual General Meeting on 6 November 2009, was presented by Professor Toby Sherwin of SAMS on the topic of "Charting the circulation of the North Atlantic: the legacy of David Ellett." A summary of the lecture is available in SAMS Newsletter 35, newly renamed 'Ocean Explorer'. There was no meeting of the Scottish Marine Group during the reporting period.

The following four new research bursaries were awarded to members during the reporting period:

Research bursaries

NAME	INSTITUTION	PROJECT TITLE	AWARD
Dr Jonathan Green	University of Liverpool	Relationship between individual quality and energetic efficiency in seabirds	£976
Coleen Suckling	University of Cambridge	Effects of ocean acidification on marine calcifiers	£1000
Dr William Austin	University of St Andrews	Integrating numerical model simulations of basin-water properties with palaeoclimate proxy data from Scottish fjords	£ 476
Virginia Bravo	Heriot-Watt University	Characterisation of the growth and effects of acidophilic bacteria on calcium carbonate and algal coccoliths	£ 957
		TOTAL	£ 3,409

During the reporting year the organisation lost some very prominent members who passed away:

Dr Margaret Barnes (former honorary research fellow at SAMS),

Professor Alasdair McIntyre CBE (SAMS President 1988-1993)

and Professor Peter Boyle (SAMS Council Member).

They are sadly missed and their contribution to this Association shall be remembered with respect and gratitude.

SAMS HONORARY FELLOWS

Honorary Fellowship: Robert Batty

Since my retirement at the end of October, I have continued with work on the environmental impact of marine renewable energy with particular interest in the risk of collision between marine vertebrates (fish, mammals and diving birds) and marine energy converters; i.e. tidal stream turbines. The risks are largely unknown but mathematical models, estimating encounter rate and the probability of evasion or avoidance, can help to indicate the magnitude of problem and need and focus for further investigation and/or monitoring. An evasion model for fish, based on detailed knowledge of fish behaviour in predator-prey interactions, has been developed and will, together with encounter models, be a useful tool to asses the potential risks posed. It is hoped that this work will continue in some form during the subsequent year. I have also continued with teaching on the Marine Science degree, contributing to 3 modules: Behaviour and Biomechanics of Marine Animals (for which I was module leader), Fisheries Ecology and Marine Zoology as well as writing an article on marine renewable energy for the SAMS Newsletter.

Honorary Fellowship: Dr J Murray Roberts

Dr Roberts joined SAMS in 1997 as a marine biologist specialising in the biology and ecology of cold-water corals. In 2009 he moved to Heriot-Watt University as a Reader in Biodiversity and became a SAMS Honorary Fellow in 2010. He is also Adjunct Faculty at the University of North Carolina, Wilmington. Over the last year Dr Roberts has focussed on ocean acidification and developing TRACES, the first ocean basin-scale assessment of cold-water coral ecology and climate records. Dr Roberts was a founding partner of the European Project on Ocean Acidification and established the SAMS cold-water coral aquaria used in this project. After developing the TRACES Science Plan, Dr Roberts secured European Science Foundation support for EuroTRACES, launched as a call for proposals in early 2010. Dr Roberts continues work at the Mingulay Reef Complex which he mapped in 2003. In July 2009 he completed the first Sùil na Mara microlander deployments using the US Johnson-Sea-Link submersible. His SAMS fellowship work will continue this work in the years to come.

Photo captions:

Murray Roberts prepares the Sùil na Mara microlander (photo credit Art Howard)

Sùil na Mara microlander being brought back after its first deployment by the Johnson-Sea-Link submersible (photo credit Liz Baird)

New book 'Cold-water Corals' published by Cambridge University Press

There are more coral species in deep, cold-waters than in tropical coral reefs. This new book by J Murray Roberts (Heriot-Watt University & SAMS Honorary Research Fellow), Andrew Wheeler (University College Cork, Ireland), André Freiwald (GeoZentrum Nordbayen, Germany) and Stephen Cairns (Smithsonian Institution, USA) is the first to synthesise current understanding of all types of cold-water coral covering their ecology, biology, palaeontology and geology. The book begins with a history of research in this now rapidly growing field and goes on to consider coral habitats created by stony scleractinian as well as octocoral species. The importance of corals as long-lived geological structures and palaeoclimate archives represent key themes as are means by which they can be conserved for future generations. This book was launched in May 2009 and is available from the publishers and online book retailers. For more information please see the book's homepage: www.lophelia.org/coldwatercoralsbook.

SAMS OUTREACH

Engaging the public

Since its inception last year, the Communications Group has been working incessantly to develop SAMS' competence and capacity to share our enthusiasm for our science through many different avenues with our various audiences.

We have been developing two major new initiatives: a marine science festival for Oban and an exhibition and outreach centre. We also continue to strive for SAMS science to be covered on television and radio as well as in the press. During the reporting period the SAMS website with its many topical news stories and expedition blogs attracted 116,440 visits.

The SAMS Newsletter 34 was published and focused on marine renewable energy research and we produced a new flagship brochure 'SAMS 2010'.

Oban's first Festival of the Sea

We have been developing a concept and built support for a new community-based festival to run for the first time 21-31 May 2010 in celebration of our marine environment. The festival that is planned to become a regular event addresses six objectives:

1. To increase awareness of the importance of the sea on a local, regional and global scale
2. To engender pride and stewardship in the community towards their local marine environment
3. To excite young audiences about careers based around the sea and in science
4. To provide a discussion forum on how to manage multiple and conflicting uses of the sea
5. To empower participants to understand and question latest advances in marine research
6. To make people associate Oban with the marine environment, marine research and education.

Over 50 events have come together in an exciting programme that can be viewed at www.marinesciencefestival.com.

The steering committee includes representatives from Argyll and Bute Council, Scottish Natural Heritage, local schools, local businesses, charitable organisations and individuals committed to public education.

The festival is funded by the Scottish Government through a Science Engagement Grant, LEADER, and SAMS with further support from Aggregates Industries (Glensanda) and the Scottish Book Trust.

Planning the Scottish Ocean Explorer Centre

The new teaching infrastructure facility – to be known as the Sheina Marshall Building and funded by ERDF, HIE and SFC – includes provision for an exhibition and outreach centre. During the reporting period the concept and business plan for the Scottish Ocean Explorer Centre was developed, and over 37% of the additional funding required was secured from the Robertson Trust.

The SOEC will include an interactive and technologically advanced exhibition area, a small cinema space, a multipurpose room for workshops and events, a marine technology garden, and a small shop. It aims to attract visitors to the area during the summer months with an exhibition on the marine environment moving north from Dunstaffnage with the North Atlantic Drift into the Arctic Ocean.

During the remainder of the year the SOEC will predominantly act as an outreach centre for primary and secondary schools, special interest groups and the local community, supported by a diary of events and a range of workshops.

The SOEC will be at the core of our learned society events, and will have to be financially sustainable through admission charges, sales, grants and donations.

Enthusing the next generation: working with schools, teachers and children

SAMS supports the public STEMNET initiative to inspire more young people about science, technology, engineering and mathematics: During the reporting year alone, 25 of our staff and students became fully trained and registered Ambassadors for STEM (Science, Technology, Engineering and Mathematics).

The Festival of the Sea was underpinned by a major education package involving around 1100 children from 14 local primary schools. Schools had opted into an integrated and multi-disciplinary programme to learn about the marine environment. All seven primary

year groups studied the sea for between one week and a full term addressing the topic 'The Sea – making Scotland healthier, greener and wealthier'. SAMS ran an awareness day for 24 primary school teachers in February to equip them with the knowledge and skills to deliver this programme. We then developed three new workshops that we delivered in over 40 sessions to all the 1100 children in the participating schools as well as home-schooled children around National Science Week in March. This prepared the children to participate in school competitions that fed into festival events: costumes, poems and dances featured as part of the opening parade and ceremony while marine model creatures and friezes made up an exhibition, and P7 pupils filled an evening with public speaking about wealth from the sea.

Beyond the festival SAMS visited or was visited by 18 primary and secondary schools, two nursery groups, the Brownies, and supported the Institute of Physics' Lab in a Lorry with tutors and the MBA's 'Shore Thing' project with scientific 'verifiers'.

SAMS also engaged with environmental education via a schools workshop on marine invasive species during the Argyll and Bute Regional Environmental Education Forum's annual fair, this year in Dunoon on 30 September and 1 October 2009 that attracted over 700 primary pupils. We also displayed our work at various events like the Oban Games, and hosted two Nuffield bursary and five work experience pupils.

SAMS in the news

SAMS continues to engage proactively and reactively with the media by issuing press releases, seeding ideas for programmes and articles, and responding to inquiries.

Media engagement included appearances by staff on national television, including the BBC Politics Show (Scotland), BBC Coast and BBC Landward. In addition, our scientists working on renewable energy featured on international radio station RTL France.

The discovery of an invasive sea squirt in Scottish waters by SAMS scientists led to coverage in magazines and newspapers, and the issuing of over 20 press releases resulted in mentions in national and regional newspapers. Camera crews producing promotional films for the Scottish Government and Highlands and Islands Enterprise visited the Institute, interviewing scientists and filming our modern facilities. We were also fortunate enough to feature some of our images in the UNESCO Intergovernmental Oceanographic Commission's calendar for 2010.

Aquarium opening

On 20 October 2009 we organised an opening event for our refurbished research aquarium newly named after the late Alan Ansell who had worked in the 'old' aquarium for most his professional life. The opening was part of a reception for the annual conference of the Association of Scottish Shellfish Growers.

Anuschka Miller, Helen McNeill, Laila Sadler and Rory MacKinnon

SAMS FACILITIES

A new teaching facility for SAMS

SAMS is constructing a new, two-storey multi-purpose education facility at Dunstaffnage in support of a strategy of increasing education delivery. This new facility will enhance our students' learning experience and ensure that our education facilities will support innovative and excellent approaches to teaching.

Thanks to a £6 M funding package from Highlands and Islands Enterprise, the European Regional Development Fund and the Scottish Funding Council, SAMS purchased the adjacent Argyll College learning centre that is now being refurbished and extended. The new building will include two lecture theatres, three seminar rooms, four laboratories, two computing rooms, a student study area, canteen, library, meeting room, offices and the Scottish Ocean Explorer Centre. The UHI Millennium Institute was the Strategic Delivery Body for this project that will improve the UHI's learning infrastructure and visibility in Argyll.

The building is being delivered by building constructor Barr Construction and is scheduled for completion by the end of October 2010. The design of the new facility is in harmony with the existing main laboratory buildings and built to a high environmental standard, incorporating energy saving technology and local materials.

Alan Ansell Research Aquarium

Our aquarium, which had been extensively refurbished the previous year, was named after the late Alan Ansell in an opening event on 20 October 2009. The guests included Dr Ansell's widow, Joyce, who conducted the official opening, colleagues, and delegates from the Association of Scottish Shellfish Growers' annual international conference.

We also completed the second phase of the aquarium refit, creating another three modern constant temperature rooms. We also removed and replaced compressors which are no longer kept inside the aquarium but outside, creating extra work space on the mezzanine. The facilities team also constructed a dedicated facility for the BioMara project with specially designed tables and lighting to grow algae for biofuel production.

Seawater monitoring systems measuring pH, temperature, salinity and dissolved oxygen content were installed both in the main aquarium and the old aquaculture building (currently jointly used with education). The systems include data-logging capabilities that will enable the streaming and logging of this information online.

Safety improvements were made to the header tanks in the old aquaculture building by introducing walkway access.

Research vessels

SAMS continues to operate two research vessels, *Seol Mara* and *Calanus*, but reduced its permanent full-time boat staff from four to two during the reporting period. Others are hired on a demand basis. The boats support SAMS' scientific projects, are used for SAMS education programmes, and are chartered by external commercial clients and visiting university field courses.

Information services

No major changes have been made to the library, ICT and data services during the reporting period.

Anuschka Miller

Appendix

SAMS STAFF 1 April 2009 to 31 MARCH 2010

Director
Professor Laurence Mee

Deputy Director
Dr Ken Jones

Associate Directors
Ms Fran McCloskey
Dr Tracy Shimmield

Company Secretary
Mrs Elaine Walton

PA to the Director
Ms Lorna MacKinnon

Biogeochemistry and Earth Science
Dr John Howe (Head)
Dr Angela Hatton (Deputy)
Dr Richard Abell
Mr Tim Brand
Miss Bryony Carr
Mrs Anni Glud
Professor Ronnie N Glud
Mr Morten Larsen
Mr John Montgomery
Mrs Leah Morrison
Mr Andy Reynolds
Dr Arlene Rowan
Dr Henrik Stahl
Dr Robert Turnewitsch
Mr Gangi Reddy Ubbara

Ecology
Dr Michael Burrows (Head)
Dr Kim Last (Deputy)
Miss Karen Alexander
Ms Christine Beveridge
Dr Kenny Black
Ms Ruth Brennan
Mr Lars Brunner
Mr Jim Elliott
Dr Clive Fox
Dr Sheila Heymans
Dr Adam Hughes
Dr David Hughes
Dr Maeve Kelly
Mr Peter Lamont
Dr Vicki Last
Ms Shona Magill
Miss Raeanne Miller
Dr Bhavani Narayanaswamy
Dr Thom Nickell
Dr Tim O'Higgins
Dr Tavis Potts
Dr Ian Rae
Dr Murray Roberts
Dr Branka Valcic
Dr Tom Wilding
Dr Ben Wilson

Microbial and Molecular Biology
Dr Keith Davidson (Head)
Dr David Green (Deputy)
Mrs Undine Achilles-Day
Miss Avril Anderson
Dr Elanor Bell
Mrs Debra Brennan
Mrs Christine Campbell
Mrs Alison Clarke
Dr John Day
Mrs Joanne Field
Ms Kat Flynn
Dr Claire Gachon
Dr Mark Hart
Dr Svenja Heesch
Dr Frithjof Küpper
Dr Ray Leakey
Miss Sian Lordsmith
Mr Adrian MacLeod
Mrs Eleanor Martin
Ms Sharon McNeill
Miss Ceci Rad Menendez
Mrs Elaine Mitchell
Dr Michael Roleda
Mrs Rachel Saxon
Mr Peter Schiener
Dr Stephen Slocombe
Dr Michele Stanley
Miss Martina Strittmatter
Ms Sarah Swan
Professor Paul Tett
Ms Andrea Veszelovszki
Mrs Averil Wilson

Physics, Sea Ice and Technology
Dr Finlo Cottier (Head)
Dr Keith Jackson (Deputy)
Dr Dmitry Aleynik
Mr John Beaton
Dr Tim Boyd
Dr Andy Dale
Miss Estelle Dumont
Mr Colin Griffiths
Mr Bernard Hagan
Dr Phil Hwang
Dr Mark Inall

Dr Vladimir Ivanov
Mr Alistair James
Dr Bryn Jones
Mr David Meldrum
Professor Toby Sherwin
Dr Jeremy Wilkinson

Education

Professor Axel Miller (Head)
Dr Lois Calder (Deputy)
Mrs Polly Crooks
Mrs Joyce Moore
Ms Linda Robb

Boats

Mr Chris Ireland
Mr Norman Smith

Business Development

Mr Dave Gunn
Dr Keri Page
Mrs Irene Partridge

Communications

Dr Anuschka Miller (Head)
Mr Rory MacKinnon
Mrs Helen McNeill
Mrs Laila Sadler

Contracts

Mr Derek Black (Head)
Ms Angela Anderson
Ms Gillian Campbell
Mrs Fiona Hart
Ms Helen Wilson

Diving

Dr Martin Sayer (Head)
Miss Elaine Azzopardi
Mr Hugh Brown
Mrs Janet Duncan
Dr Simon Thurston

Facilities

Mr David Mathias (Head)
Mr Alasdair Black
Mr Peter Bentley
Mr Brian Clark
Mr John Hill
John Kershaw (aquarium)

Finance

Mrs Sarah Kennedy (Head)
Mrs Liz Campbell
Ms Sharyn Farmer
Mrs Lindy Lamb
Mrs Lorna Watt

Health and Safety

Mr Ivan Ezzi

Human Resources

Ian Crawford (Head)
Ms Karen Campbell
Ms Jacqueline Cullen
Ms Rachel Culver
Mrs Shirley Kersley
Mrs Margaret Sime

ICT and Information Services

Mr Steve Gontarek (Head)
Ms Olga Kimmins
Ms Nicola Longman
Mr Nigel MacLucas
Ms Elspeth Norris
Mr Lovro Valcic

PUBLICATIONS

Journal: ISI

Abrahamsen EP, Meredith M, Falkner KK, Torres-Valdes S, Leng MJ, Alkire MB, Bacon S, Laxon S, Polyakov I, **Ivanov V**. 2009. Tracer-derived freshwater composition of the Siberian continental shelf and slope following the extreme Arctic summer of 2007. *Geophysical Research Letters*. **36**:(5)

URL: http://dx.doi.org/10.1029/2009GL037341

Adey L, **Black KD**, **Sawyer TT**, **Shimmield TM**, Trueman CN. 2009. Scale microchemistry as a tool to investigate the origin of wild and farmed *Salmo salar*. *Marine Ecology Progress Series*. **390**: pp225-235

URL: http://dx.doi.org/10.3354/meps08161

Ainsworth C, Pitcher T, **Heymans JJ**, Vasconcellos M. 2009. Reconstructing historical marine ecosystesms using food web models: Northern British Columbia from Pre-European contact to present. *Ecological Modelling*. **216**: pp354-368

Amin SA, **Green DH**, **Hart M**, **Küpper FC**, Sunda WG, Carrano CJ. 2009. Photolysis of iron-siderophore chelates promotes bacterial-algal mutualism. *Proceedings Of The National Academy Of Sciences Of The United States Of America*. **106(40)**: pp17071-17076

URL: http://dx.doi.org/10.1073/pnas.0905512106

Amin SA, **Green DH**, **Küpper FC**, Carrano CJ. 2009. Vibrioferrin, an unusual marine siderophore: Iron binding, photochemistry, and biological implications. *Inorganic Chemistry*. **48**: pp11451-11458

URL: http://dx.doi.org/10.1021/ic9016883

Bailey DM, Collins MA, **Gordon JDM**, Zuur AF, Priede I. 2009. Long-term changes in deep-water fish populations in the northeast Atlantic: a deeper reaching effect of fisheries?. . **276(1664)**: pp1965-1969

URL: http://dx.doi.org/10.1098/rspb.2009.0098

Berg P, **Glud RN**, **Hume A**, **Stahl H**, Oguri K, Meyer V, Kitazato H. 2009. Eddy correlation measurements of oxygen uptake in deep ocean sediments. *Limnology And Oceanography*. **7**: pp576-584

Berge J, **Cottier F**, **Last KS**, Varpe Ø, Leu E, Søreide J, Eiane K, Falk-Petersen S, Willis KJ, Nygard H, Vogedes D, **Griffiths CR**, Johnsen G, Lorentzen D, Brierley A. 2009. Diel vertical migration of Arctic zooplankton during the polar night. *Biol Lett*. **5(1)**: pp69-72

URL: http://dx.doi.org/10.1098/rsbl.2008.0484

Berge J, Renaud P, Eiane K, Gulliksen B, **Cottier F**, Varpe Ø, Brattegard T. 2009. Changes in the decapod fauna of an Arctic fjord during the last 100 years (1908-2007). *Polar Biology*. **32(7)**: pp953-961(9)

URL: http://dx.doi.org/10.1007/s00300-009-0594-5

Borja A, **Rodriguez JG**, **Black KD**, Bodoy A, Emblow C, Fernandes TF, Forte J, Karakassis I, Muxika I, **Nickell TD**, Papageorgiou N, Pranovi F, Sevastou K, Tomassetti P, Angel D. 2009. Assessing the suitability of a range of benthic indices in the evaluation of environmental impact of fin and shellfish aquaculture located in sites across Europe. *Aquaculture*. **293(3-4)**: pp231-240(10)

URL: http://dx.doi.org/10.1016/j.aquaculture.2009.04.037

Bottrell SH, Mortimer RJG, Davies IM, **Harvey SM**, Krom MD. 2009. Sulphur cycling in organic-rich marine sediments from a Scottish fjord. *Sedimentology*. **56(4)**:pp1159-1173(15)

URL: http://dx.doi.org/10.1111/j.1365-3091.2008.01024.x

Bourguet N, Goutx M, Ghiglione JF, **Pujo-Pay M**, Mevel G, Momzikoff A, Mousseau L, Guigue C, Garcia N, Raimbault P, **Pete R**, Oriol L, Lefevre D. 2009. Lipid biomarkers and bacterial lipase activities as indicators of organic matter and bacterial dynamics in contrasted regimes at the DYFAMED site, NW Mediterranean. *Deep-sea Research Part II - Topical Studies In Oceanography*. **56(18)**: pp1454-1469(16)

URL: http://dx.doi.org/10.1016/j.dsr2.2008.11.034

Brand T, **Griffiths CR**. 2009. Seasonality in the hydrography and biogeochemistry across the Pakistan margin of the NE Arabian Sea. *Deep-sea Research Part II - Topical Studies In Oceanography*. **56(6-7)**: pp283-295(13)

URL: http://dx.doi.org/10.1016/j.dsr2.2008.05.036

Breuer E, **Law G**, Woulds C, Cowie G, **Shimmield GB**, Peppe OC, Schwartz M, **McKinley S**. 2009. Sedimentary oxygen consumption and microdistribution at sites across the Arabian Sea oxygen minimum zone (Pakistan margin). *Deep-sea Research Part II - Topical Studies In Oceanography*. **56(6-7)**: pp296-304(9)

URL: http://dx.doi.org/10.1016/j.dsr2.2008.06.010

Brigolin D, Pastres R, **Nickell TD**, **Cromey CJ**, Aguilera DR, Regnier P. 2009. Modelling the impact of aquaculture on early diagenetic processes in sea loch sediments. *Marine Ecology Progress Series*. **388**: pp63-80(18)

URL: http://dx.doi.org/10.3354/meps08072

Bunce M, **Mee LD**, Rodwell LD, Gibb R. 2009. Collapse and recovery in a remote small island-A tale of adaptive cycles or downward spirals? *Global Environmental Change - Human And Policy Dimensions*. **19(2)**(Sp.Iss): pp213-239(27)

URL:http://dx.doi.org/10.1016/j.gloenvcha.2008.11.005

Bundy A, **Heymans JJ** , Morissette L, Savenkoff C. 2009. Seals, cod and forage fish: a comparative exploration of variations in the theme os stock collapse and ecosystem change in northwest Atlantic ecosystems. *Progress In Oceanography*. **81**: pp188-206

Burrows MT , **Harvey R** , **Robb L** , **Poloczanska E**, Mieszkowska N, Moore P, Leaper R, Hawkins SJ, Benedetti-Cecchi L . 2009. Spatial scales of variance in abundance of intertidal species: effects of region, dispersal mode, and trophic level. *Ecology*. **90(5)**: pp1242-1254(13)

Carrano CJ, Schellenberg S, Amin SA, **Green DH** , **Küpper FC** . 2009. Boron and marine life: a new look at an enigmatic bioelement. *Marine Biotechnology*. **11(4)**: pp431-440(10)

URL: http://dx.doi.org/10.1007/s10126-009-9191-4

Chance R, Baker AR, **Küpper FC** , Hughes C, Kloareg B, Malin G. 2009. The release and transformations of inorganic iodine by marine macroalgae. *Estuarine Coastal And Shelf Science*. **82(3)**: pp406-414(10)

URL: http://dx.doi.org/10.1016/j.ecss.2009.02.004

Cook EJ , **Kelly MS** . 2009. Co-culture of the sea urchin, *Paracentrotus lividus* and the edible mussel *Mytilus edulis* L., west coast of Scotland, UK. *Journal Of Shellfish Research*. **28**: pp1-7

Cresswell KA, Tarling G, Thorpe SE, **Burrows MT** , Wiedenmann J, Mangel M. 2009. Diel vertical migration of Antarctic krill (*Euphausia superba*) is flexible during advection across the Scotia Sea. *Journal Of Plankton Research*. **31(10)**: pp1265-1281(17)

URL: http://dx.doi.org/10.1093/plankt/fbp062

Cromey CJ , **Nickell TD** , Treasurer JW, **Black KD** , **Inall ME** . 2009. Modelling the impact of cod (*Gadus morhua* L) farming in the marine environment-CODMOD. *Aquaculture*. **289(1-2)**: pp 42-53(12)

URL: http://dx.doi.org/10.1016/j.aquaculture.2008.12.020

Davidson K , Bresnan E. 2009. Shellfish toxicity in UK waters: a threat to human health?. *Environmental Health*. **8**: ppS1-S12

URL: http://dx.doi.org/10.1186/1476-069X-8-S1-S12

Davidson K , Miller P, **Wilding TA** , Shutler J, Bresnan E, Kennington K, Swan SC . 2009. A large and prolonged bloom of *Karenia mikimotoi* in Scottish waters. *Harmful Algae*. **8**: pp349-361

URL: http://dx.doi.org/10.1016/j.hal.2008.07.007

Davies AJ , Duineveld G, Lavaleye MSS, Bergman M, van Haren H, **Roberts JM** . 2009. Downwelling and deep-water bottom currents as food supply mechanisms to the cold-water coral *Lophelia pertusa* (Scleractinia) at the Mingulay Reef complex. *Limnology And Oceanography*. **54(2)**: pp620-629(10)

Davies AJ , **Last KS** , **Attard K** , **Hendrick VJ** . 2009. Maintaining turbidity and current flow in laboratory aquarium studies, a case study using *Sabellaria spinulosa*. *Journal Of Experimental Marine Biology And Ecology*. **370(1-2)**: pp35-40(6)

URL: http://dx.doi.org/10.1016/j.jembe.2008.11.015

Day JG . 2009. Cryobiological challenges for 21st century science: the conservation of type specimens. *Cryoletters*. **30(1)**: pp79-79(1)

De Mol B, Querol N, **Davies AJ** , Schafer A, Foglini F, Gonzales-Mirelis G, Kopke K, Dunne D, Schewe I, Trincardi F, Canals M. 2009. HERMES-GIS: a tool connecting scientists and policymakers. **22(1)(Sp.Iss)**: pp144-153(10)

Denoble PJ, Dunford R, **Sayer MDJ** , Pollock NW, Nord D, Vann RD. 2009. Predicted probability of decompression sickness in 159 treated cases with documented dive profiles. *Undersea & Hyperbaric Medicine*. **36**: pp253-254

Dmitrenko I, Bauch D, Kirillov S, Koldunov N, Minnet P, **Ivanov V** , Hollemann J, Timokhov L. 2009. Barents Sea upstream events effect properties of Atlantic Water inflow into the Arctic Ocean: Evidence from 2005-2006 upstream observations. *Deep-sea Research Part I - Oceanographic Research Papers*. **56**(15)

Dmitrenko I, Kirillov S, **Ivanov V** , Woodgate R, Polyakov I, Koldunov N, Fortier L, Lalande C, Kaleshke L, Bauch D, Hollemann J, Timokhov L. 2009. Seasonal modification of the Arctic Ocean intermediate water layer off the eastern Laptev Sea continental shelf break. *Journal Of Geophysical Research*. **114**(16)

URL: http://dx.doi.org/10.1029/2008JC005229

Dodd J, Baxter L, **Hughes DJ** . 2009. Mapping *Serpula vermicularis* (Polychaeta: Serpulidae) aggregations in Loch Teacuis, western Scotland, a new record. *Marine Biology Research*. **5(2)**: pp200-205(6)

URL: http://dx.doi.org/10.1080/17451000802345858

Dodds L , **Black KD** , **Orr H** , **Roberts JM** . 2009. Lipid biomarkers reveal geographical differences in food supply to the cold-water coral *Lophelia pertusa* (Scleractinia). *Marine Ecology-progress Series*. **397**: pp113-124(12)

URL: http://dx.doi.org/10.3354/meps08143

Duarte CM, Holmer M, Olsen Y, Soto D, Marba N, Guiu J, **Black KD** , Karakassis I. 2009. Will the Oceans Help Feed Humanity?. *Bioscience*. **59(11)**: pp967-976(10)

URL: http://dx.doi.org/10.1525/bio.2009.59.11.8

Feiters M, Meyer-Klaucke W, Kostenko AV, Soldatov AV, Leblanc C, Michel G, Potin P, **Küpper FC** , Hollenstein K, Locher KP, Bevers LE, Hagedoorn P. 2009. Anion binding in biological systems. *Journal Of Physics: Conference Series*. **190**:012196

Ferreira JG, Sequeira A, Hawkins AJS, Newton A, **Nickell TD** , Pastres R, Forte J, Bodoy A, Bricker SB. 2009. Analysis of coastal and offshore aquaculture: Application of the FARM model to multiple systems and shellfish species. *Aquaculture*. **289(1-2)**: pp32-41(10)

URL: http://dx.doi.org/10.1016/j.aquaculture.2008.12.017

Folmer F, Jaspars M, Solano G, Cristofanon S, Henry E, Tabudravu J, **Black KD** , **Green DH** , **Küpper FC** , Aalbersberg W, Feussner K, Dicato M, Diederich M. 2009. The inhibition of TNF-a induced NF-kB activation by marine natural products. *Biochemical Pharmacology*. **78**: pp592-606

URL: http://dx.doi.org/10.1016/j.bcp.2009.05.009

Forster S, **Turnewitsch R** , Powilleit M, Werk S, Peine F, Ziervogel K, Kersten M. 2009. Thorium-234 derived information on particle residence times and sediment deposition in shallow waters of the south-western Baltic Sea. *Journal Of Marine Systems*. **75**: pp360-370

URL: http://dx.doi.org/10.1016/j.jmarsys.2008.04.004

Fox CJ , Harris R, Sundby S, Achterberg E, Allen JI, Allen J, Baker AR, Brussaard C, Buckley P, **Cook EJ** , Dye SR, Edwards M, Fernand L, Kershaw PJ, Metcalfe J, Osterhus S, Potter T, Sakshaug E, Speirs D, Stenevik E, John MS, Thingstad F, **Wilson B** . 2009. Transregional linkages in the north-eastern Atlantic - an "end to end" analysis of pelagic ecosystems. *Oceanography And Marine Biology*. **47**: pp1-76

Fox CJ , McCloghrie P, Nash R. 2009. Potential transport of plaice eggs and larvae between two apparently self-contained sub-populations in the Irish Sea. *Estuarine Coastal And Shelf Science*. **81(3)**: pp381-389

URL: http://dx.doi.org/10.1016/j.ecss.2008.10.024

Friedl T, **Proeschold T** , Lewis LA, Letsch MR. 2009. Symbiosis in green algae: Origin and diversity of a successfull life sustem. *Phycologia*. **48(4)(sup Suppl. S)**: pp89-91(2)

Gachon CM , **Strittmatter M** , Müller DG, Kleinteich J, **Küpper FC** . 2009. Differential host susceptibility to the marine oomycete pathogen *Eurychasma dicksonii* detected by real time PCR: not all algae are equal. *Applied And Environmental Microbiology*. **75**: pp322-328

URL: http://dx.doi.org/10.1128/AEM.01885-08

Geibert W , Gersonde R, Kuhn G, Martinez-Garcia A, Masque P, Rosell A, van der Loeff MR, Verdeny E. 2009. A map of recent terrigenous fluxes to Southern Ocean sediments: Application of Th-230(xs)-normalized Th-232 as a dust flux tracer. *Geochimica Et Cosmochimica Acta*. **73(13)(sup Suppl. S)**:ppA423-A423(1)

Glud RN , **Stahl H** , Berg P, Wenzhofer F, Oguri K, Kitazato H. 2009. *In situ* microscale variation in distribution and consumption of O_2: A case study from a deep ocean margin sediment (Sagami Bay, Japan). *Limnology And Oceanography*. **54(1)**:pp1-12(12)

Glud RN , Thamdrup B, **Stahl H** , Wenzhoefer F, **Glud A** , Nomaki H, Oguri K, Revsbech NP, Kitazato H. 2009. Nitrogen cycling in a deep ocean margin sediment (Sagami Bay, Japan). *Limnology And Oceanography*. **54(3)**: pp723-734(12)

Glud RN , Woelfel J, Karsten U, Kuhl M, Rysgaard S. 2009. Benthic microalgal production in the Arctic: Status of the current database. *Botanica Marina*. **52**: pp559-571

URL: http://dx.doi.org/10.1515/BOT.2009.074

Gooday A, Levin LA, da Silva AA, Bett B, Cowie G, Dissard D, **Gage JD** , **Hughes DJ** , Jeffreys R, **Lamont PA** , Larkin K, Murty S, Schumacher S, Whitcraft C, Woulds C. 2009. Faunal responses to oxygen gradients on the Pakistan margin: A comparison of foraminiferans, macrofauna and megafauna. *Deep-sea Research Part II - Topical Studies In Oceanography*. **56(6-7)**: pp488-502(15)

URL: http://dx.doi.org/10.1016/j.dsr2.2008.10.003

Grosfjeld K, Harland R, **Howe JA** . 2009. Dinoflagellate cyst assemblages inshore and offshore Svalbard reflecting their modern hydrography and climate. *Norwegian Journal Of Geology*. **89**: pp121-135

Gutierrez T , Leo VV, Walker G, **Green DH** . 2009. Emulsifying properties of a glycoprotein extract produced by a marine *Flexibacter* species strain TG382. *Enzyme And Microbial Technology*. **45(1)**: pp53-57(5)

URL: http://dx.doi.org/10.1016/j.enzmictec.2009.04.001

Gutierrez T , Morris G, **Green DH** . 2009. Yield and Physicochemical Properties of EPS From Halomonas sp Strain TG39 Identifies a Role for Protein and Anionic Residues (Sulfate and Phosphate) in Emulsification of n-Hexadecane. *Biotechnology And Bioengineering*. **103(1)**:pp207-216(10)

URL: http://dx.doi.org/10.1002/bit.22218

Hawkins SJ, Sugden HE, Mieszkowska N, Moore PJ, **Poloczanska E**, Leaper R, Herbert RJH, Genner MJ, Moschella PS, Thompson R, Jenkins SR, Southward A, **Burrows MT** . 2009. Consequences of climate-driven biodiversity changes for ecosystem functioning of North European rocky shores. *Marine Ecology Progress Series*. **396**: pp245-259(15)

URL: http://dx.doi.org/10.3354/meps08378

Heymans JJ , Sumaila UR, Christensen V. 2009. Policy options for the northern Benguela ecosystem using a multispecies, multifleet ecosystem model. *Progress In Oceanography*. **83**: pp417-425

URL: http://dx.doi.org/10.1016/j.pocean.2009.07.013

Hughes DJ , **Lamont PA** , Levin LA, Packer M, Feeley K, **Gage JD** . 2009. Macrofaunal communities and sediment structure across the Pakistan margin Oxygen Minimum Zone, North-East Arabian Sea. *Deep-sea Research Part II - Topical Studies In Oceanography*. **56(6-7)**: pp434-448(15)

URL: http://dx.doi.org/10.1016/j.dsr2.2008.05.030

Hunter WR, **Sayer MDJ** . 2009. The comparative effects of habitat complexity on faunal assemblages of northern temperate artificial and natural reefs. *ICES Journal Of Marine Science*. **66(4)**: pp691-698(8)

URL: http://dx.doi.org/10.1093/icesjms/fsp058

Inall ME . 2009. Internal wave induced dispersion and mixing on a sloping boundary. *Geophysical Research Letters*. **36**:(5)

URL: http://dx.doi.org/10.1029/2008GL036849

Inall ME , **Gillibrand P** , **Griffiths CR** , **MacDougal N** , **Blackwell K** . 2009. On the oceanographic variability of the North-West European Shelf to the West of Scotland. *Journal Of Marine Systems*. **77(3)**: pp210-226

URL: http://dx.doi.org/10.1016/j.jmarsys.2007.12.012

Ivanov V , Polyakov I, Dmitrenko I, Hanson E, Repina I, Kirillov S, Mauritzen C, Simmons H, Timokhov L. 2009. Seasonal Variability in Atlantic Water off Spitsbergen. *Deep-sea Research Part I - Oceanographic Research Papers*. **56**:14

Krienitz L, Bock C, Luo W, **Pröeschold T** . 2009. Unexpected high biodiversity of eukaryotic picoplankton of inland waters and its nutritional interaction with grazers. *Phycologia*. **48(4)(Suppl.)**: pp192(1)

Küpper FC . 2009. Iodide in kelp: an inorganic antioxidant in life impacting atmospheric chemistry. *Phycologia*. **48(4)(Suppl.)**: pp197-(1)

Küpper FC . 2009. Oomycete pathogens of marine brown algae. *Phycologia*. **48(4)(Suppl.)**: pp198(1)

Küpper FC , Gaquerel E, Cosse A , Adas F , Peters AF, Muller DG, Kloareg B, Salaun J, Potin P. 2009. Free Fatty Acids and Methyl Jasmonate Trigger Defense Reactions in Laminaria digitata. *Plant And Cell Physiology*. **50(4)**: pp789-800(12)

URL: http://dx.doi.org/10.1093/pcp/pcp023

Küpper H, Mijovilovich A, Götz B, Kroneck PM, **Küpper FC** , Meyer-Klaucke W. 2009. Complexation and toxicity of copper in higher plants (I): Characterisation of copper accumulation, speciation and toxicity in *Crassula helmsii* as a new copper hyperaccumulator. *Plant Physiology*. **151**: pp702-714

Last KS , Bailhache T, Kramer C, Rosato E, Kyriacou CP, Olive PJW. 2009. Tidal, daily, and lunar-day activity cycles in the marine polychaete *Nereis virens*. *Animal Behaviour*. **167**: pp167-183

URL: http://dx.doi.org/10.1080/07420520902774524

Law G , **Shimmield TM** , **Shimmield GB** , Cowie G, **Breuer E** , **Harvey SM** . 2009. Manganese, iron, and sulphur cycling on the Pakistan margin. *Deep-sea Research Part Ii-topical Studies In Oceanography*. **56(6-7)**: pp305-323(19)

URL: http://dx.doi.org/10.1016/j.dsr2.2008.06.011

Lenn Y, Wiles P, Torres-Valdes S, Abrahamsen EP, Rippeth TP, Simpson J, Bacon S, Laxon S, Polyakov I, **Ivanov V** , Kirillov S. 2009. Vertical mixing at intermediate depth in the Arctic boundary current. *Geophysical Research Letters*. **36**:5

URL: http://dx.doi.org/10.1029/2008GL036792

Lonberg C , Alvarez-Salgado X, **Davidson K** , **Miller AEJ** . 2009. Production of bioavailable and refractory dissolved organic matter by coastal heterotrophic microbial populations. *Estuarine Coastal And Shelf Science*. **82(4)**: pp682-688(7)

URL: http://dx.doi.org/10.1016/j.ecss.2009.02.026

Lonberg C , **Davidson K** , Alvarez-Salgado X, **Miller AEJ** . 2009. Bioavailability and bacterial degradation rates of dissolved organic matter in a temerate coastal areas during an annual cycle. *Marine Chemistry*. **113 (3-4)**: pp219-226

URL: http://dx.doi.org/10.1016/j.marchem.2009.02.003

Mackinson S, Daskalov G, **Heymans JJ** , Neira S, Arancibia H, Zetina-Rejón M, Jiang H, Cheng H, Coll M, Arreguín-Sánchez F, Keeble K, Shannon LJ. 2009. Which forcing factors fit? Using ecosystem models to investigate the relative influence of fishing and changes in primary productivity on the dynamics of marine ecosystems. *Ecological Modelling*. **220**: pp2972-2987

URL: http://dx.doi.org/doi:10.1016/j.ecolmodel.2008.10.021

Martinez-Garcia A, Rosell-Mele A, **Geibert W** , Gersonde R, Masque P, Gaspari V, Barbante C. 2009. Links between iron supply, marine productivity, sea surface temperature, and CO2 over the last 1.1 Ma. *Paleoceanography*. **24**:(14)

URL: http://dx.doi.org/10.1029/2008PA001657

McIntyre K , **Howe JA** . 2009. Bottom-current variability during the last glacial-deglacial transition, Northern Rockall Trough and Faroe Bank Channel, NE Atlantic. *Scottish Journal Of Geology*. **45(1)**: pp43-57(15)

URL: http://dx.doi.org/10.1144/0036-9276/01-375

Munk P, **Fox CJ** , Bolle L, van Damme CJG, Fossum P, Kraus G. 2009. Spawning of North Sea fishes linked to hydrographic features. *Fisheries Oceanography*. **18**: pp458-469

URL: http://dx.doi.org/10.1111/j.1365-2419.2009.00525.x

Oldenburg T, Larter S, Adams J, **Rowan A** , Sherry A, Head I, Grigoriyan A, Voordouw G, Fustic M, Hubert C. 2009. Methods for recovery of microorganisms and intact microbial polar lipids (IPLs) from oil-water mixtures lab experiments and natural well-head fluids. *Analytical Chemistry*. **81(10)**: pp4130-4136

Parys S, Kehraus S, **Pete R** , **Küpper FC** , Glombitza K, König GM. 2009. Parys S, Kehraus S, Pete R, Küpper FC, Glombitza K-W, König GM: Seasonal variation of polyphenolics in *Ascophyllum nodosum* (L.) Le Jol. (Phaeophyceae). *European Journal Of Phycology*. **44(3)**: pp331-338

URL: http://dx.doi.org/10.1080/09670260802578542

Peine F, **Turnewitsch R** , Mohn C, Reichelt T, Springer BM, Kaufmann M. 2009. The importance of tides for sediment dynamics in the deep sea-Evidence from the particulate-matter tracer Th-234 in deep-sea environments with different tidal forcing. *Deep-sea Research Part I - Oceanographic Research Papers*. **56(7)**: pp1182-1202(21)

URL: http://dx.doi.org/10.1016/j.dsr.2009.03.009

Pitois SG, Shaw M, **Fox CJ** , Frid C. 2009. A new fine-mesh zooplankton time series from the Dove sampling station (North Sea). *Journal Of Plankton Research*. **31(3)**: pp337-343

URL: http://dx.doi.org/10.1093/plankt/fbn121

Portilla E, **Tett P**, **Gillibrand P** , **Inall ME** . 2009. Description and sensitivity analysis for the LESV model: Water quality variables and the balance of organisms in a fjordic region of restricted exchange. *Ecological Modelling*. **220(18)**: pp2187-2205(19)

URL: http://dx.doi.org/10.1016/j.ecolmodel.2009.05.004

Potts TW , Schofeld C. 2009. T. Across the top of the World? Emerging Arctic Navigational Opportunities and Arctic Governance. *Carbon And Climate Law Review*. **4**: pp472-482

URL: http://dx.doi.org/CCLR 4|2009 472

Revsbech NP, **Glud RN** . 2009. Biosensor for laboratory and lander-based analysis of benthic nitrate plus nitrite distribution in marine environments. *Limnology And Oceanography*. **7**: pp761-770

Roberts JM , **Davies AJ** , **Henry L** , **Dodds L** , Duineveld G, Lavaleye MSS, Maier C, van Soest RWM, Bergman M, Huhnerbach V, Huvenne V, **Sinclair D** , Watmough T, Long D, Green SL, van Haren H. 2009. Mingulay reef complex: an interdisciplinary study of cold-water coral habitat, hydrography and biodiversity. *Marine Ecology Progress Series*. **397**: pp139-151(13)

URL: http://dx.doi.org/10.3354/meps08112

Robertson PKJ, **Black KD** , Adams M, **Willis KJ** , Buchan F, **Orr H** , lawton L, McCullagh C. 2009. A new generation of biocides for control of crustacea in fish farms. *Journal Of Photochemistry And Photobiology B - Biology*. **95(1)**: pp58-63(6)

URL: http://dx.doi.org/10.1016/j.jphotobiol.2008.12.009

Ross J, **Sayer MDJ** . 2009. Emergency recompression: clinical audit of service delivery at a national level. *Diving And Hyperbaric Medicine*. **39(1)**: pp33-37(5)

Rysgaard S, Bendtsen J, Pedersen L, Ramloev H, **Glud RN** . 2009. Increased CO2 uptake due to sea-ice growth and decay in the Nordic Seas. *Journal Of Geophysical Research*. 114

URL: http://dx.doi.org/10.1029/2008JC005088

Sayer MDJ . 2009. What if Darwin had been a diver?. *Diving And Hyperbaric Medicine*. **39**: pp189-190

Stott, K.J., Austin, W.E.N., **Sayer, M.D.J.**, Weidman, C.R., Cage, A.G. and Wilson, R.J.S. (2010). The potential of *Arctica islandica* growth records to reconstruct coastal climate in north west Scotland, UK. *Quaternary Science Reviews* **29**, 1602-1613.

Sayer, M.D.J. (2010). The performance of dive computers at altitude. *Diving and Hyperbaric Medicine* **40**, **47**.

Sayer MDJ , Ross J, Wilson CM. 2009. Analyses of treatment for divers with actual or suspected decompression illness. *Diving And Hyperbaric Medicine*. **39**: pp126-132

Shields MA , **Hughes DJ** . 2009. Large-scale variation in macrofaunal communities along the eastern Nordic Seas continental margin: a comparison of four stations with contrasting food supply. *Progress In Oceanography*. **82**: pp125-136

URL: http://dx.doi.org/10.1016/j.pocean.2009.05.001

Shields MA , Kedra M. 2009. A deep burrowing sipunculan of ecological and geochemical importance. *Deep-Sea Research Part I-Oceanographic Research Papers*. **56(11)**: pp2057-2064(8)

URL: http://dx.doi.org/10.1016/j.dsr.2009.07.006

Shucksmith R , **Cook EJ** , **Burrows MT** , **Hughes DJ** . 2009. Competition between the non-native amphipod *Caprella mutica* and two native species of caprellids *Pseudoprotella phasma* and *Caprella linearis*. *Journal Of The Marine Biological Association Of The United Kingdom*. **89**: pp1125-1132

URL: http://dx.doi.org/10.1017/S0025315409000435

Shucksmith R , Jones NH, Stoyle GW, **Davies AJ** , Dicks EF. 2009. Abundance and distribution of the harbour porpoise (*Phocoena phocoena*) on the north coast of Anglesey, Wales, UK. *Journal Of The Marine Biological Association Of The United Kingdom*. **89(5)(Sp.Iss)**: pp1051-1058(8)

URL: http://dx.doi.org/10.1017/S0025315408002579

Stoker MS, Bradwell T, **Howe JA** , Wilkinson I, **McIntyre K** . 2009. Lateglacial ice-cap dynamics in NW Scotland: evidence from the fjords of the Summer Isles region. *Quaternary Science Reviews*. **28**: pp3161-3184

URL: http://dx.doi.org/10.1016/j.quascirev.2009.09.012

Symonds RC, **Kelly MS** , **Suckling C** , Young A. 2009. Carotenoids in the gonad and gut of the edible sea urchin *Psammechinus miliaris*. *Aquaculture*. **288(1-2)**: pp120-125(6)

URL: http://dx.doi.org/10.1016/j.aquaculture.2008.11.018

van Damme CJG, Bolle L, **Fox CJ** , Fossum P, Kraus G, Munk P, Rohlf N, Witthames P, Dickey-Collas M. 2009. A reanalysis of North Sea plaice spawning-stock biomass using the annual egg production method.. *ICES Journal Of Marine Science*. **66**: pp1119-2011

Wallace M, **Cottier F** , Berge J, Tarling G, **Griffiths CR** , Brierley A. 2009. Comparison of zooplankton vertical migration in an ice-free and a seasonally ice-covered Arctic fjord: an insight into the influence of sea ice cover on zooplankton behaviour. *Limnology And Oceanography*. **55(2)**: pp831-845

Weise AM, **Cromey CJ** , Callier MD, Archambault P, Chamberlain J, McKindsey CW. 2009. Shell fish-DEPOMOD: Modelling the biodeposition from suspended shellfish aquaculture and assessing benthic effects. *Aquaculture*. **288(3-4)**: pp239-253(15)

URL: http://dx.doi.org/10.1016/j.aquaculture.2008.12.001

Welling M, Pohnert G, **Küpper FC** , Ross C. 2009. Rapid biopolymerisation during wound plug formation in green algae. *Journal Of Adhesion*. **85**: pp825-838

URL: http://dx.doi.org/10.1080/00218460903291452

Wilson CM. 2009. British Sub-Aqua Club diving incidents report 2008. Diving And Hyperbaric Medicine. **39(4)**: pp234-235(2)

Wilson CM, Ross J, **Sayer MDJ** . 2009. Saturation treatment in shore-based chambers for divers with deteriorating cerebro-spinal decompression sickness. *Diving And Hyperbaric Medicine*. **39**: pp170-174

Woulds C, Schwartz M, **Brand T** , Cowie G, **Law G** , Mowbray SR. 2009. Porewater nutrient concentrations and benthic nutrient fluxes across the Pakistan margin OMZ. *Deep-sea Research Part II –Topical Studies In Oceanography*. **56(6-7)**: pp333-346(14)

URL: http://dx.doi.org/10.1016/j.dsr2.2008.05.034

Zhang GP, Amin SA, **Küpper FC** , Holt PD, Carrano CJ, Butler A. 2009. Ferric stability constants of representative marine siderophores: Marinobactins, aquachelins, and petrobactin. *Inorganic Chemistry*. **48**: pp11466-11473

Zubkov MV, **Leakey RJG** . 2009. Evaluation of the efficiency of metabolism of dinoflagellate phosphorus and carbon by a planktonic ciliate. *European Journal Of Protistology*. **45(3)**:pp166-173(8)

URL: http://dx.doi.org/10.1016/j.ejop.2008.09.003

Journal: Other Refereed

Cox E, **Day JG** . 2009. Journal Editor. *Eur J Phycol*. 44 (1): pp1-139

Cox E, **Day JG** . 2009. Journal Editor. *Eur J Phycol*. **44 (2)**: pp143-275

Cox E, **Day JG** . 2009. Journal Editor. *Eur J Phycol*. **44 (3)**: pp276-446

Cox E, **Day JG** . 2009. Journal Editor. *Eur J Phycol*. **44 (4)**: pp447-577

Potts TW , Schofeld C. 2009. Boundaries, Biodiversity, Resources and Increasing Maritime Activities: Emerging Oceans Governance Challenges for Canada in the Arctic Ocean. *Vermont Law Review*. **34 (1)**: pp35-55

URL: http://lawreview.vermontlaw.edu/

Reid PC, **Cook EJ** , Edwards M, McQuatters-Gollop A, Minchin D, McCollin T. 2009. Marine non-native species. *Marine Climate Change Ecosystem Linkages Report Card* **2009**. 2009:29

Conference Proceedings

Attard K , **Sayer MDJ** , **Stahl H** . Oct-09. Validating diving as a tool for soft-bottom sediment collection in a shallow coastal setting: a geochemical approach. *Proceedings of the 2nd International Symposium on Occupational Scientific Diving*, p. 16. University of Helsinki.

Azzopardi E , **Sayer MDJ** . Oct-09. A review of the technical specifications of 47 models of diving decompression computer. *Proceedings of the 2nd International Symposium on Occupational Scientific Diving*, p. 6. University of Helsinki.

Sayer MDJ . May-09. Scientific Diving in the UK: training and legal requirements. Freiberg Online Geosciences 22: pp131-136. Technische Universitat Bergakademie Freiberg. *Research in shallow marine and fresh water systems.*

Sayer MDJ , Brown CJ. Oct-09. Block shape, water depth and analysis technique influence the measured profiles of artificial reefs. *Proceedings of the 2nd International Symposium on Occupational Scientific Diving*, p. 18. University of Helsinki.

Sayer MDJ , Wilson CM. May-09. The silent witness: dive computer downloads from fatal diving accidents. South Pacific Underwater Medicine Society 18. South Pacific Underwater Medicine Society. *South Pacific Underwater Medicine Society 38th Annual Science Meeting.*

Wilson CM, **Sayer MDJ**. May-09. The synergies required for an effective diver retrieval system. *South Pacific Underwater Medicine Society 38th Annual Science Meeting.*

Journal: Non-Refereed

Sayer MDJ . Jul-09. Saving Haldane's chambers. *Hyperactivity*. 1: pp8-9

Sayer MDJ , Ross J. Jul-09. Dunstaffnage: the early years. *Hyperactivity*. 1:10

Tomczak MT , **Heymans JJ** , Bleckner T, Niiranen S. Apr-09. Ecological network analysis, indicators of food-web changes int he Baltci Sea. Ices Cm. **2009**: pp1-26

Books: Editor

Sayer MDJ (Eds). 2009. *Underwater Technology*. 38pp. Society for Underwater Technology

Sayer MDJ (Eds). 2009. *Underwater Technology*. 59pp. Society for Underwater Technology

Sayer MDJ (Eds). 2009. *Unmanned Underwater Vehicle Showcase Special Issue*. 51pp. Society for Underwater Technology

Books: Chapters

Boos K, **Ashton G** , **Cook EJ** . 2009. The Japanese skeleton shrimp *Caprella mutica* Schurin, 1935 (Crustacea, Amphipoda) in European coastal waters **In** *Alien Crustacea*. Springer. pp4.

Cook EJ . 2009. *Caprella mutica* **In** *The Invasive Species Compendium*. CABI.pp46.

Davidson K , **Gillibrand P** , **Wilding TA** , Shutler J, Bresnan E, Kennington K, **Swan SC** . 2009. Predicting the progression of the harmful dinoflagellate *Karenia mikimotoi* along the Scottish coast and the potential impact for fish farming **In** Crown Estate ISBN(PB) 978-1-906410-06-3.

Dulvy N, Hyde K, **Heymans JJ** , Chassot E, Platt T, Sherman K. 2009. Climate change, ecosystem variability and fisheries productivity **In** *Remote sensing in fisheries and aquaculture: The Societal Benefits*. IOCCG. pp11-28.

Fedak M, **Wilson B** , Pomeroy PP. 2009. Reproductive behavior **In** *Encyclopedia of Marine Mammals*. Academic Press.pp 943. ISBN(HB) 978-0123735539

Head I, Larter S, Gray N, Sherry A, Adams J, Aitken C, Jones M, **Rowan A** , Huang H, Roling W. 2009. Hydrocarbon Degradation in Petroleum Reservoirs **In** *Microbiology of Hydrocarbons, Oils, Lipids*. Springer.

Strittmatter M , **Gachon CM** , **Küpper FC** . 2009. Ecology of lower oomycetes **In** *Oomycete Genetics and Genomics: Diversity, Plant and Animal Interactions, and Toolbox*. Wiley-Blackwell. pp2.

Multimedia

Minchin D, **Cook EJ** , Bishop JD. Apr-09. UK Invasive Species Database: http://192.171.199.232/daisie/ Media: Web-based dataset

DAISIE - EU Programme

Other Non-refereed

Algoet M, **Davidson K** . 2009. Profiles of lipophilic toxins in Pacific oysters and a description of phytoplankton assemblages in relation to official control diarrhetic shellfish poisoning monitoring results from West Loch Tarbert: Loup Bay, Scotland. Contract report.

Davidson K , McCoy G, Touzet N, Raine R. 2009. Characterisation of mixed *Alexandrium* populations in Scottish waters using whole cell fluorescent *in situ* hybridisation. 24p. Final project report to FSAS.

Gowen R, **Tett P** , Bresnan E, **Davidson K** , Gordon A, McKinney A, Milligan S, Mills D, Silke J, Crooks AM. 2009. Anthropogenic nutrient enrichment and blooms of harmful micro-algae. 225p. Report.

Howell K, **Heymans JJ** , **Gordon JDM** , Ayers M, Jones E. 2009 DEEPFISH Project: Applying an ecosystem approach to the sustainable management of deep-water fisheries. Part 1: Development of an Ecopath with Ecosim model and Part 2: A new aproach to managing deep-water fisheries. 116p. SAMS Report no. 259.

Inall ME , **Gillibrand P** , **Griffiths CR** , **MacDougal N** , **Blackwell K** . 2009. On the oceanographic variability of the North-West European Shelf to the West of Scotland. , pp210-226(17)

URL:
http://dx.doi.org/10.1016/j.jmarsys.2007.12.012

Leakey RJG . 2009. Priorities for future UK marine Arctic research. NERC Oceans2025 SOFI Workshop Report (WS 09 01). 20p. Workshop Report.

Magill SH , **Potts TW** , **Wilson A**. 2009. Socio-Economic Review of the Sound of Mull, 114p. Project Final Report.

Stahl H , **Glud RN** , Davison W, Warnken KW, Zhang H. 2009. A new sensor for simultaneous imaging of 2-D oxygen and trace metal dynamics in irrigated sediments. ASLO conference 2009, Nice, France., 1

poster abstract

Swan SC. 2009. Occurrence of Potentially Toxic Phytoplankton in the Kyles of Little Bernera. Reporting period: June - November 2008. , 5 pp + appendices. Contract Report.

Swan SC , **Davidson K** . 2009. Monitoring Programme for the Presence of Toxin Producing Plankton in Shellfish Production Areas in Scotland. Reporting period: 01 April 2008 - 31 March 2009. 44pp + appendix.

Annual Contract Report.

POSTGRADUATE RESEARCH PROJECTS

(Funding body and supervisors' names in parentheses, SAMS supervisors in blue)

AWARDED

Law GT, Ph.D, The UHI Millennium Institute (NERC). *Cycling of trace metals of organically-rich sediments off Pakistan and Scotland.* (Shimmield TM, Cowie G, Shimmield GB and Ganeshram R)

Lonborg C, Ph.D, The UHI Millennium Institute (Marie Curie – Ecosummer). *The importance of dissolved organic matter in two contrasting marine waters.* (Davidson K, Miller AEJ and Alvarez-Salgado A)

Wilson L, M. Phil, The UHI Millennium Institute (NERC). *Gadoid fish sound production and its role in mate selection, the risk of predation and the impacts of noise pollution.* (Wilson B, and Burrows MT)

ONGOING RESEARCH

Achilles-Day U MSc by Research. The UHI Millennium Institute. *Paramecium bursaria and its endosymbionts* (Gachon CMM, Leakey R)

Alexander, K The UHI Millennium Institute (SUPERGEN). *The impacts of offshore power production: mitigation through habitat provision.* (Wilding TA, Heymans JJ, Potts T, Bryden I)

Andrew G, Ph.D, The UHI Millennium Institute (NERC). *Biodiversity and ecosystem function: trophic diversity versus species diversity in intertidal grazers.* (Burrows MT, Hawkins S and McGill R)

Batty P, Ph.D, The UHI Millennium Institute (NERC). *The influence of structural and functional aspects of benthic organisms on bioturbation and ecosystem function.* (Calder L, Solan M, Nickell T and Black KD)

Bayley S-A, Ph.D, The UHI Millennium Institute (Self-funded). *Towards a brighter future for Scottish salmon - new ideas in socio-economic and political dimensions.* (Smith M and Miller AEJ)

Blicher M, Ph.D, University of Copenhagen (Royal Scientific Investigations Greenland). *Arctic macrofauna.* (Glud RN, Sejr M and Rysgaard S)

Burke K, Ph.D, University of Aberdeen (University of Aberdeen). *The fate of organic matter in marine sediments: The role of macrofauna.* (Witte U and Narayanaswamy B)

Carter, C The UHI Millennium Institute.(Scottish Natural Heritage) *Underwater acoustic interactions between emerging tidal-energy technologies and vulnerable vertebrates* (Wilson B, Burrows MT)

Davies J, Ph.D, University of Plymouth (JNCC). *Identification of areas of nature conservation importance in deep waters of the UK continental shelf, to contribute towards spatial planning and the development of an ecologically coherent network of MPAs in the North-East Atlantic.* (Howell K, Narayanaswamy B, Stewart H, Jacobs C and Johnstone C)

De Francisco Mora, B The UHI Millennium Institute (EPOCA) *Effects of ocean warming and acidification on the cold-water coral Lophelia pertusa* (Last K, Stahl H, Roberts JM)

Douarin M, Ph.D, The UHI Millennium Institute (SAGES). *Secrets from a Deep Reef: Structure, Biogeography and Palaeoclimate Reconstruction from Mingulay Reef Complex Sediment Cores.* (Sinclair D, Long D and Roberts M)

Ekford-Soper, L The UHI Millennium Institute. *The competitive dynamics of toxic and non toxic ribotypes of the harmful dinoflagellate Alexandrium tamarense* (Davidson K, Bresnan E, Turrell E)

Frost J, Ph.D, Univeristy of Hamburg (Euroceans). *Trophic role of gelatinous and semi-gelatinous organisms in the mesopelagic zone.* (St John M and Fox C)

Gontikaki E, Ph.D, University of Aberdeen (Marie Curie-Ecosummer/University of Aberdeen). *Deep sea benthic community response to simulated sedimentation events in contrasting environments.* (Witte U, **Narayanaswamy B** and Tselepides T)

Hughes S, Ph.D, The UHI Millennium Institute (FRS). *Inflow of Atlantic Water to the North Sea: Variability and influence on North Sea climate.* (**Dale A** and Gallego A)

Johnson C, Ph.D, The UHI Millennium Institute (UHI/HIE). *Tracing water masses in the North Atlantic.* (Sherwin T, Shimmield TM and Smyth-Wright D)

MacIntyre K, Ph.D, The UHI Millennium Institute (NERC). *Post-glacial fjordic landscape evolution: the onshore and offshore limits of the Younger Dryas icesheet Western Scotland.* (Howe J, Shimmield T, Bradwell T and Stoker M)

MacLeod, A The UHI Millennium Institute (SUPERGEN). *The impacts of marine renewable energy structures on the invasion of biofouling non-native species.* (Day J, Cook E, Stanley M)

Miller, R The UHI Millennium Institute (SUPERGEN). *Offshore renewable energy structures as artificial islands: implications for dispersal, population connectivity and biogeography of coastal species* (Burrows M, Inall M, Fox C)

Mogg A, Ph.D, The UHI Millennium Institute (NERC). *The role of bacterial associates in the production of dimethylsulphoxide by marine phytoplankton: Significance for the biogeochemical cycle of the climatic feedback gas dimethylsulphide.* (Hatton A, Hart M, Green D and Bavington C)

Moosen H, Ph.D, University of Glasgow (SAGES). *Palaeoclimate reconstructions from Arctic and Nordic shelf seas: development and application of multiple proxies.* (Bendle J, Austin W, Howe J and Cottier F)

Nebot C, Ph.D, The UHI Millennium Institute (UHI). *Human pharmaceuticals in the Scottish marine environment.* (Gibb S, Boyd K and Black KD)

Nordi G, Ph.D, Fiskerrihoejskolen I Torshavn (self funded). *Aquaculture and benthic biogeochemistry.* (Fiskerrihoejskolen and Glud RN)

Orr, K The UHI Millennium Institute (BIOMARA). *Effects of seaweed biofuel production on the ecosystems in western Scotland, Northern Ireland and Ireland* (Heymans JJ, Wilding TA, Hughes DJ)

Porter M, Ph.D, The UHI Millennium Institute (SAGES). *Linking recent variability in Atlantic Ocean circulation and glacier mass balance in Greenland and Norway.* (Sherwin T, Rea B and Mair D)

RadMenendez C MSc by Research. *The UHI Millennium Institute Genetic and phenotypic stability of Thalassoisira pseudonana (Bacillariopyhceae)* (Stanley M, Day J)

Riley J, Ph.D, University of Southampton (NERC SOFI). *Shipboard studies of the influence of inorganic seawater chemistry on calcareous microplankton and the biological carbon pump.* (Achterberg E, Sanders R, Tyrrell T, Rees A and Leakey R)

Rodger A, Ph.D, The UHI Millennium Institute (AIE). *Multi-trophic level culture for environmental remediation – active management of aquaculture initiatives for diversification and sustainability.* (Kelly MS, Gillibrand P and Dring M)

Scheiner, P The UHI Millennium Institute *(BIOMARA) Ethanol production from algal biomass* (Green D, Stanley M, Black KD)

Shellcock, C The UHI Millennium Institute (BIOMARA). *Molecular Aspects of Algal Biofuels for the 21st Century* (Stanley M, Day J, Green D)

Stott K, Ph.D, University of St Andrews (SAGES). *Extending the marine instrumental climate record for European waters using the long-lived marine bivalve: Arctica islandica.* (Austin w, Wilson R and Inall M)

Strittmater M, Ph.D, The UHI Millennium Institute (Marie Curie – Ecosummer). *Molecular biology of the Ectocarpus/ Eurychasma host-pathogen interaction.* (Kupper F, van West P and Gachon CMM)

Turner, G The UHI Millennium Institute. *Benthic oxygen exchange across soft and hard-bottom surfaces using in situ technology: Case studies from the tropics to the Arctic.* (Glud RN, Stahl H, Berg P)

Venables E, Ph.D, The UHI Millennium Institute (NERC CASE). *An investigation of mixing in the Faroe-Shetland Channel.* (Inall M, Sherwin T and W Turrell W)

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Project Leader	Title	Funding body	Duration	Award
Ben Wilson	Distribution, abundance & population structure of Bottlenose Dolphins in Scottish waters	University of Aberdeen	36 months	£68,000
Maeve Kelly	Commercialising Seaweed Production (Redweed 2)	HIE	24 months	£66,588
Clive Fox	Euroceans	EU	24 months	£13,368
Tom Wilding	SARF 036	SARF	24 months	£84,324
Kenny Black	Benthic Recovery Processes	SARF	36 months	£149,498
Mark Inall	SARF shell	SARF	24 months	£123,199
Keith Davidson	Karenia II WP1	The Crown Estate	1 month	£12,198
Keith Davidson	Karenia II WP2	The Crown Estate	3 months	£23,466
Keith Davidson	Karenia II WP3	The Crown Estate	4 months	£4,523
Dave Gunn	Public Sector Research Exploitation Fund	DIUS	33 months	£477,200
Paul Tett	Harmful Algae, Nuisance Blooms & Anthropogenic Nutrient Enrichment	DEFRA	8 months	£19,784
Kim Last	Measuring the effects of suspended particulate matter and smothering on the behaviour, growth and survival of key species found in areas associated with aggregate dredging.	MEPF	30 months	£139,844
Laurence Mee	A Research Study on social & economic objectives for a Scottish Marine Plan	The Scottish Gov't	10 weeks	£13,228
Ben Wilson	The use of acoustic devices to warn marine mammals of tidal stream energy renewable devices	The Scottish Gov't		£37,232
Tom Wilding	A systematic assessment of the environmental impact of Scottish Shellfish farmers	SARF	24 months	£129,580
Ben Wilson	Estimates of collision risk of harbour porpoises and marine renewable devices at sites of high tidal stream energy	The Scottish Gov't	18 months	£49,899
Keith Davidson		The Crown Estate	18 weeks	£29,625
Anuschka Miller		The Scottish Gov't	12 months	£24,650

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Keith Davidson	Developing the capacity to monitor the spatial and temporal distribution of jellyfish in western Scottish waters	The Crown Estate	18 months	£66,009
Keith Davidson	Karenia IV	The Crown Estate		£32,973
Clive Fox	West Coast fishery trails of a twin rig nephrops trawl incorporating a large mesh top sheet for reducing commercial gadoid species bycatch	The Scottish Gov't	4 months	£34,000
Clive Fox	West Coast Forum Desk Study	The Scottish Gov't	4 months	£25,000
Kenny Black	Falklands Desire	Falkland Islands Gov't	1 months	£9,775
John Day	Control of Grazers	The Carbon Trust	36 months	£495,510
Lois Nickell	COBO	EUFP6	36 months	£125,215
Kenny Black	ECASA	EUFP6	36 months	£161,055
Murray Roberts	ECCRE	EUFP6	24 months	£62,473
Maeve Kelly	KEYZONES	EUFP6	24 months	£100,445
Kenny Black	ECASA COORDINATION	EUFP6	36 months	£1,491,763
Lois Nickell	COBO COORDINATION	EUFP6	36 months	£2,088,203
Jeremy Wilkinson	DAMOCLES	EUFP6	48 months	£311,093
Mark Inall	MILLENNIUM	EUFP6	48 months	£63,324
Axel Miller	Ecosystem approach to Sustainable Management of the Marine Environment and its living resources (ECOSUMMER)	EUFP6	48 months	£234,117
Maeve Kelly	Active biological monitoring and removal of toxins in aquaculture ecosystems and shellfish - including the development of a Solid-Phase In-situ Ecosystem Sampler and detoxification of shellfish	EUFP6	36 months	£106,220
Kenny Black	PHILMINAQ	EUFP6	18 months	£90,601
Kenny Black	AQUAGRIS	EUFP6	24 months	£18,492
Kenny Black	Science & Policy Integration for Coastal Systems Assessment	EUFP6	48 months	£108,935
Axel Miller	SOCRATES-ERASMUS Mobility Grant	UK Socrates Erasmus Council	ongoing	£1,205
Murray Roberts	Trans-Atlantic Coral Ecosystem Studies	EUFP6	24 months	£48,517

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Michele Stanley	Blue Energy - Sustainable fuels from marine biomass	EU	36 months	£17,954
Axel Miller	Ecosummer Strittmatter	EUFP6	36 months	£233,365
Axel Miller	Ecosummer Loenberg	EUFP6	36 months	£233,365
Ben Wilson	Equitable testing & Evaluation of Marine Energy extraction devices in terms of performance, cost & environmental impact	EUFP7	36 months	£130,814
Axel Miller	Ecosummer Gontikaki	EUFP6	36 months	£233,365
Kim Last	European Project on Ocean Acidification	EUFP7	48 months	£95,400
Toby Sherwin	THOR	EUFP7	48 months	£380,273
Adam Hughes	Enrichment of aquaculture systems by introduction of commercially underdeveloped marine species from different trophic levels	EUFP7	24 months	£193,234
Laurence Mee	Knowledge based sustainable management for Europe's seas	EUFP7	48 months	£633,000
Laurence Mee	Knowledge based sustainable management for Europe's seas	EUFP7	48 months	£307,887
Claire Gachon	Disease and Immunity in Brown Algae	EUFP7	36 months	£7,500
Bhavani Narayanaswamy	Hotspot Ecosystem Research & Man's Impact on European Seas	EUFP7	36 months	£26,105
Frithjof Kuepper	ASSEMBLE	EUFP7	48 months	£737,509
Henrik Stahl	In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal & open seas and land locked water bodies	EUFP7	36 months	£218,670
Kenny Black	Assessing the causes & developing measures to prevent the escape of fish from sea-cage aquaculture	EUFP7	48 months	£83,626
Kenny Black	An International Research Consortium for promoting & developing Integrated Multi-Trophic Aquaculture	EUFP7	36 months	£21,600
Frithjof Kuepper	ASSEMBLE TA	EUFP7	48 months	£737,509
Maeve Kelly	AAAG	EUFP6	36 months	£367,119
Bhavani Narayanaswamy	Stavros Core	Stavros Niarchos Foundation	36 months	£235,838
Finlo Cottier	Mariclim	Norwegian Polar Institute	36 months	£48,997

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

	Deep Fish	PML	36 months	£71,750
Dave Green	Siderophore	San Diego State University	24 months	£12,654
Keith Davidson	Final	Interreg	33 months	£180,361
Tracy Shimmield	Sages	Scottish Funding Council	48 months	£285,628
Finlo Cottier	Cleopatra	UNIS	12 months	£41,833
Murray Roberts	DCUK II	Esmee Fairbairn		
Ben Wilson	Carter Supervision	ESF	17 months	£7,341
Bhavani Narayanaswamy	DESEO	Individuals	ongoing	£78,750
Maeve Kelly	Supergen	ESPRC	48 months	£68,862
Tavis Potts	The Effectiveness of Certification and Ecolabelling in Improving the Sustainability of Fisheries and Aquaculture Resources	ESRC	24 months	£99,046
Angela Hatton	JOINT MESOCOSM EXPERIMENT	Warwick University/NERC	12 months	£4,624
Elizabeth Cook	ALIENS II	Esmee Fairbairn	36 months	£126,000
Anuschka Miller	MARINE SCIENCE FESTIVAL	Scottish Gov't	12 months	£10,000
Kim Last	Kim Last teaching at University of Newcastle	Newcastle University	12 months	£500
Robert Turnewitch	GAMMA SAMPLING	University of Rostock	12 months	£1,888
David Matthias	SDB AQUARIUM UPGRADE			
Jeremy Wilkinson	BUOY DRIFT	Danish Technical University	48 months	£9,147
Murray Roberts	DOROTHY CHRYSTAL	Dorothy Chrystal	12 months	£40,000
Frithjof Kuepper	LAMINARIA	NERC	ongoing	£196
Anuschka Miller	SHORE THING	MBA	3 months	£150
Dave Green	SIDEROPHORE EXTENSION	San Diego State University	24 months	£10,945
Bhavani Narayanaswamy	Eurocoml Synthesis	Census of Marine Life	12 months	£3,259
Toby Sherwin	Linking recent variability in Atlantic Ocean circulation & glacier mass balance in Greenland & Norway	SAGES	36 months	£36,000

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Mark Hart		Census of Marine Life	12 months	£3,912
Tim Boyd	SCICEX test of submarine-launched digital XCTD's	US Navy Arctic Submarine Laboratory (ASL)	12 months	£9,339
Michele Stanley	BIOMARA	HIE, Interreg, The Crown Estate	48 months	£4,865,992
Lois Calder	SUPERGEN PLUS	SDB, HIE, ERDF & HIPP	40 months	£437,612
Sheila Heymens	EUROCOML 2010	Total Foundation	24 months	£165,118
Dan Sinclair	Secrets from a deep reef: Structure, biogeography & palaeoclimate reconstruction from Mingulay reef Complex sediment cores	SAGES	36 months	£36,000
Sheila Heymens	SLOAN SYNTHESIS	Alfred P Sloan Foundation	11 months	£50,000
Murray Roberts	Development of a cold water coral predictive habitat model for the worlds oceancs	MCBI	7 months	£6,555
Dan Sinclair	Palaeoclimate reconstruction using trace elements and stable isotopes in carbonate deposits	The Royal Society		£4,000
Tavis Potts	ECOBAR: Benthic Indicators for Monitoring the Ecosystem of the Barents Sea.	Research Council of Norway	24 months	£16,000
	MARINE ARCTIC WORKSHOP	SOFI	2 months	£13,445
Thomas Proeschold	RSE ALENA LUKESOVA	The Royal Society	22 days	£1,407
David Matthias	NEW BUILD TEACHING BLOCK	SDB, HIE, ERDF & HIPP		£6,071,887
Toby Sherwin	SFMM 2009	Individuals	1 day	£425
Keith Davidson	WATER	NPP	36 months	£148,982
Sheila Heymans	OAK FOUNDATION	Oak Foundation	ongoing	£22,663
Kim Last	MILLER BURSARY	Nuffield Foundation	3 months	£1,440
Lois Calder	Teaching at Newcastle University	Newcastle University	12 months	£500
Frithjof Kuepper	Macroalgal and oomycyte benthic diversity in the Canadian Marine Arctic	Total Foundation	48 months	£50,000

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Sheila Heymans	GEF	GEF Trust Fund	12 months	£31,006
Michael Burrows	Urban Research on Biodiversity on Artificial & Natural coastal Environments - enhancing by intelligent design	MBA/Esmee Fairbairn	36 months	£19,000
Elizabeth Cook	Effect of ocean acidification on life history traits in native and non native amphipod crustaceans and implications for invasion success	The British Ecological Society	2 months	£2,005
Ben Wilson	Underwater acoustic interactions between emerging tidal-energy technologies and vulnerable vertebrates	SNH/SEPA	36 months	£48,900
Laurence Mee	Friedrich Travel	The Royal Society	12 months	£5,000
John Day	BPS Conference	Individuals	6 months	£10,000
Jeremy Wilkinson	Deployment of ice buoys	Greenpeace	1 months	£30,305
Paul Tett	ICES/JRC Eutrophication Task Group Meeting	Napier University	4 days	£3,320
Michele Stanley	SHELLCOCK PHD BIOMARA	HIE, Interreg, The Crown Estate	36 months	
Sheila Heymans	ORR PHD BIOMARA	HIE, Interreg, The Crown Estate	36 months	
Tom Wilding	ALEXANDER PHD SUPERGEN	SDB, HIE, ERDF & HIPP	36 months	£102,813
Michele Stanley	Supergen phd	SDB, HIE, ERDF & HIPP	36 months	£102,813
Michael Burrows	Supergen phd	SDB, HIE, ERDF & HIPP	36 months	£102,813
Tom Wilding	YASSIR AL BORAE PHD	Saudi Arabian Cultural Office	36 months	£20,000
Phil Hwang	Sea Ice-Ocean-Atmosphere Variability in the Canadian Basin of the Arctic Ocean	The Royal Society	24 months	£12,000
Steve Gontarek	To support the archival of priority marine data sets within the MEDIN DAC network _ Digitisation & Checking of 70's inshore fisheries data	Medin	5 months	£27,000
Steve Gontarek	To support the archival of priority marine data sets within the MEDIN DAC network _ Digitisation of Plankton Data	Medin	5 months	£27,000

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

David Meldrum	International Travel	JCOMM	4 months	£10,200
Elizabeth Cook	NNRAP COOK	Food and Environment Research Agency	12 months	£1,300
Ronnie Glud	Greenland Climate Research Centre	GCRC	5 years	£179,441
Ben Wilson	Marine Renewable Energy & the Environment	UHI ERDF		
Kenny Black	A review of the potential impacts of wave and tidal renewable energy developments on Scotland's Marine Environment	Aquaterra	2 months	£17,100
Kenny Black	Rapid Assessment survey for Didemnum vexillum on behalf of Scottish Natural Heritage	SNH	2 months	£7,469
Phil Hwang	OSI SAF sea ice drift visiting scientist	Norwegian Meteorological Institute	3 months	£11,130
Kenny Black	Kelp Farming Feasibility Study for the Whitby Coastal Area	Atkins Global	6 months	£7,200
		QUB	24 months	£43,000
Claire Gachon	BPS Summer Student	British Phycological Society		£840
Kim Last	Teaching at Newcastle University	Newcastle University	12 months	£500
Jeremy Wilkinson	CRYOSAT	NERC	68 months	£309,788
Axel Miller	ADDITIONAL SKILLS TRAINING	NERC	ongoing	£32,785
Frithjof Kuepper	ECTOCARP	NERC	36 months	£50,313
David Green	ALBA	NERC	36 months	£168,621
Lois Calder	ISFA BATTY	NERC	36 months	£19,338
David Green	COMPAS	NERC	30 months	£15,778
David Meldrum	Arctic Synoptic Basin-Wide Oceanography (ASBO)	NERC	36 months	£219,641
Frithjof Kuepper	IODINE	NERC		
Toby Sherwin	C JOHNSTON PHD EXTENSION	NERC	60 months	£21,116
Angela Hatton	Unravelling the ocean methane paradox	NERC	36 months	£454,509

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Mark Inall	ECOMAR	NERC	60 months	£191,432
Mark Inall	Internal tides over oceanic topography and their influencing on mixing	NERC	36 months	£3,650
Finlo Cottier	Convection & Cascading on Arctic Shelves: a tracer study	NERC	24 months	£68,851
	SASSI	NERC		
Angela Hatton	Production of dimethylsulphoxide by marine phytoplankton: the role of bacterial associates.	NERC	36 months	£39,586
John Howe	Research Studentship (Algorithm) Kate L McIntyre - Post-glacial fjordic landscape evolution: the onshore and offshore limits of the Younger Dryas ice sheet, western Scotland	NERC	36 months	£3,250
Angela Hatton	Sequencing the Sea Sulphur cycle	NERC	24 months	£12,935
Clive Fox	Population structuring of cod around the UK: scale, mechanisms and dynamics	NERC	32 months	£8,359
Murray Roberts	TRACES European Workshop and meetings	NERC	2 days	£6,717
Tim Boyd	Temperature microstructure during the IPY: quantifying the impact of warm subsurface water on melting Arctic sea ice	NERC	24 months	£53,053
Ronnie Glud	Carbon mineralization of shelf and coastal sediments: A holistic approach using state of the art lander technology and the eddy-correlation technique	NERC	36 months	£287,907
Tony Sherwin	Modelling of the Wyville Thomson Ridge overflow	NERC	24 months	£12,272
	EURYCHASMA	NERC		
	ARCBIOMOD	NERC		
Ronnie Glud	Micro-heterogeneity of carbon mineralisation and metal mobilisation in marine sediments	NERC	30 months	£226,404
Mark Inall	DIMES	NERC	60 months	£98,352
Andrew Dale	STRATHLOCHY	NERC	36 months	£129,327
Pushkar Wadke	Novel Ice Characterisation Experiment _ Phase 1	NERC	24 months	£24,061
Colin Griffiths	MOORINGS WORKSHOP	NERC	2 days	£1,695
Martin Sayer	NFSD 2009-2014	NERC	60 months	£1,738,937

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Robert Turneswitch	TOPODEEP	NERC	24 months	£389,415
Toby Sherwin	RAPID WATCH	NERC	36 months	£19,668
Keith Davidson	The competitive of toxic & non toxic ribotypes of the harmful dinoflagellate Alexandrium tamarense	NERC	36 months	£69,311
Ronnie Glud	TURNER PHD	NERC	36 months	£70,138
David Meldrum	SEEBECK - Using the Seebeck effect to power sea-ice instrumentation	NERC	24 months	£36,670
Andrew Dale	Great Race Eddies & Turbulence	NERC	36 months	£380,342
Jeremy Wilkinson	Sea Ice processes and Mass Balance in the Bellinghausen Sea	NERC	42 months	£338,959
Jeremy Wilkinson	INUIT	NERC	12 months	£50,847
Tracy Shimmield	Oceans theme 1 WP 1.6b Pelagic	NERC	60 months	£2,372,240
David Meldrum	Theme 8 WP 8.9 Satellite Communications	NERC	60 months	£410,167
John Day	CCAP NF3	NERC	60 months	£2,997,304
Colin Griffiths	CRUISE COST	NERC	60 months	£402,338
Axel Miller	RAE UHI	UHI		
Axel Miller	UHI TEACHING BSC	UHI		
Axel Miller	UHI COURSE MGT	UHI	ongoing	£32,480
Axel Miller	UHI PHD	UHI		
Axel Miller	FE/HE Articulation	UHI	12 months	£6,000
Axel Miller	SRIF 3	UHI		
Axel Miller	SAMS RDFG	UHI		
Axel Miller	UHI Learning & Teaching Infrastructure	UHI	ongoing	£38,750
Axel Miller/Lois Calder	UHI Hardship allowance	UHI	12 months	£500
Axel Miller	Wider Access Retention Premium	UHI	ongoing	£5,169
Axel Miller	MRES St Andrews	UHI	openended	£0
Dave Gunn	RAE Knowledge Transfer	UHI	36 months	£355,313
Axel Miller	UHI SABBATICAL OFFICER	UHI	5 months	£500

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Research services limited

Project Leader	Title	Funding body	Duration
Martin Sayer	Recompression Chamber		12 months
John Day	CCAP Freshwater Collection	Various	ongoing
Sarah Swan	FSA Monitoring	Food Standards Agency	24 months
Kenny Black	NNRAP	DEFRA (via Central Science Laboratory)	27 months
David Meldrum	Iridium	World Meteorological Organisation	16 months
Keith Davidson	Fish	Food Standards Agency	12 months
Christine Campbell	Oystertox	Food Standards Agency	5 months
Tavis Potts	Mull Sea	Argyll & Bute Council	8 months
Ray Leakey	Phytoplankton Samples	SEPA	6 months
Michele Stanley	Marine Bioenergy	RCUK	1 month
Kenny Black	Scoping Study	RCUK/NERC	2 months
Leah Morrison	PSA/LOI	Lighthouse Caledonia	ongoing
Kenny Black	RSME	Scottish Environment Link	2 months
Ben Wilson	Islay Tidal Energy	DP Energy Marine	14 months
Kenny Black	NNRAP II	DEFRA (via FERA)	24 months
Mark Inall	Remote Sensing	The Scottish Government	3 months
Clive Fox	MSC Assessment II	Moody Marine	3 months
Michael Burrows	Weedmap	ITI Scotland	6 months
Martin Sayer	Grampian Hyperbaric Technical Services	Grampian University Hospitals Trust	12 months
Elaine Walton	Visitor Services	Various	ongoing
Tracy Shimmield	Papua New Guinea	PNG via EU	21 months
Kenny Black	Depomod Licences	Map & Marine	60 months
Tom Wilding	Artificial Reef	Woods Hole Group	2 months
Toby Sherwin	Charting Progress II	POL	2 months

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Kim Last	Antifouling Tests	Ekomarine AB	6 months
Ben Wilson	Tidal Flow Study	Scottish Power	2 months
Robin Harvey	Barra Airport	Highlands & Islands Airport	2 days
Kenny Black	BHP Billiton	Falkland Islands Gov't	6 weeks
Michele Stanley	AEA	AEA Technology	9 months
David Meldrum	EDF Alpine	Electricité de France	10 months
Ray Leakey/Keith Davidson	Fugro Phyto/zoo	Fugro	2 months
Andrew Dale	FOL Modelling II	FRS	ongoing
Keith Jackson	SIMBA	Individuals	ongoing

Financial Statements

31 March 2009

The Scottish Association for Marine Science
Company Limited by Guarantee

Registered No: SC 009292

Directors

Professor Sir J Arbuthnott	(President, resigned 6 November 2009)
Professor Andrew Hamnett	(President, appointed 6 November 2009)
I H Townend	(resigned, 6 November 2009)
Dr R A Scrutton	
Commodore C Stevenson	
Dr K L Duff	
Professor A Ferguson	(resigned, 6 November 2009)
Dr J M Rogers	
G C McAllister	
Dr C J Phillips	
W T S Speirs	
Professor M Bownes	
Professor G M Henderson	
Professor D Paterson	
Professor P H Burkill	
M Gibson	(Chair of the Board to Council)
Mr Michael Robert Francis Wilkins	(appointed 27 April 2010)
Robert Ferrier	(appointed 15 January 2010)
Ken Rundle	(appointed 15 January 2010)

Secretary

E B Walton

Auditors

Ernst & Young LLP
Barony House
Stoneyfield Business Park
Stoneyfield
Inverness IV2 7PA

Bankers

Bank of Scotland
Station Road
Oban PA34 4LL

Solicitors

Wright, Johnston & Mackenzie
302 St Vincent Street
Glasgow G2 5RZ

Registered Office

Dunstaffnage Marine Laboratory
Oban
Argyll PA37 1QA

Charity Number: SC 009206

Council report SC00929

The Council, who are also Directors of the Charity for the purposes of the Companies Act, for The Scottish Association for Marine Science (SAMS) presents its report and the group financial statements for the year ended 31 March 2010.

SAMS is a company limited by guarantee governed by its Memorandum and Articles of Association. It is registered as a charity with the Office of the Scottish Charity Regulator. Anyone can become a member of SAMS and there are currently 456 including 29 corporate and 61 students (441 in 2008), each of whom agree to contribute £1 in the event of the charity winding up.

SAMS is not permitted by its Memorandum of Association to become a trade union or to distribute profits to its members.

SAMS is a Collaborative Centre of the Natural Environment Research Council and an Academic Partner of the UHI Millennium Institute (UHIMI).

Principal activity

The principal activity of the group is to promote the study of marine science through research and education.

There have been no changes in principal activity since the last annual report.

Objectives and activities

"To improve understanding and stewardship of the marine environment, through research, education, maintenance of facilities and technology transfer."

The most significant strategy employed to achieve the charities objectives during the year was restructuring the company. The organisation is now structured over four key areas; science, education, business and infrastructure. Within science five themes were created; Arctic, Marine processes in climate, Marine renewable energy, Prosperity from marine ecosystems and Industrial impacts on ocean. This is intended to facilitate better identification and capture of research opportunities. A new business development department was created and is expected to deliver increased activity in non grant funded work across the organisation. Education will allow focus on both funded and non funded teaching activities. Infrastructure is responsibility for operations. This structure is designed to allow SAMS to navigate through the tough economic climate it now faces.

Business review

Results

The results for the year are detailed on page 9 of the financial statements. The net incoming resources taken to reserves is £949k (2009 - £1,334k).

Charity accounting for capital grants will inflate net incoming resources in the years that capital grants are received as little or no charge is recorded in the same year. In managing the business SAMS considers net income from operations excluding capital grants and related funded deprecation. SAMS has for the first time in recent history achieved a positive result in net income from operations for two consecutive years. £166k (2009 - £30k). Whilst net income remains slightly lower than budget which will affect investment, this result is considered to be a significant indication that the SAMS business model is working.

Future Plans

SAMS is committed to sustaining its status as a collaborative centre for NERC and to providing national facilities for NERC.

SAMS is an Academic Partner of the UHI Millenium Institute and will continue to support the goal of achieving University status.

Council report SC00929

SAMS will continue to seek grants and service contracts from new and diverse funds.

During the year SAMS obtained full funding for a capital project to build a new teaching facility on the Dunstaffnage site. This facility, costing £6m will provide state of the art teaching labs and lecture theatres as well as a visitor and outreach centre. SAMS expects this facility to open in November 2010.

Risk statement

SAMS Council has an established risk management strategy which comprises:

- an annual review of the risks which the charity may face
- the establishment of systems and procedures to mitigate those risks identified in the plan; and
- the implementation of procedures designed to minimise any potential impact on the charity should any of those risks materialise.

Revisions to the Risk Register are considered by the Council, the Board to Council and relevant Committees. The regular process of consideration and review of the appropriateness of the Register is delegated to the Executive Group which reports back to Council.

Directors

The directors, who served the charitable company as Council Members, during the year are listed on page 1.

Reserves policy

The primary aim of the reserves policy is to ensure that we hold adequate funds to maintain the longer term sustainability of the marine science research undertaken by our scientists and to manage short term volatility in income or liquidity. The policy is designed to ensure that the Association can:

- Continue to meet its ongoing financial commitments within agreed terms of credit
- Deploy the required funds promptly in a planned way to react to new opportunities and strategic decisions undertaken by the Associations' Executive Group
- Ensure that the Association is not forced into short term decisions that might impact on its longer term vision and strategy because of any short term setback, whether operational or in key sources of income, such as NERC funding under Oceans 2025

The policy aims for the Association to hold, in future, in general unrestricted reserves a minimum of 3 months annualised expenditure in order to provide adequate working capital levels for the continued operation of the Association and completion of existing projects.

The accumulated reserves and available funds will be applied towards the objectives of the Association. The Trustees accept that this may involve the use of funds in excess of the income generated in one year while in other years the cycle of the Associations activities does not allow the distribution of all funding received (particularly in respect of capital grants).

A designated fund for fixed assets reflects the need to demonstrate the level of funds required to provide the assets necessary for delivering marine science research. Unrestricted undesignated funds reflect the amount of reserves freely available to spend on any of the charity's purposes, including those stated above. Whilst the total of unrestricted funds is positive, the undesignated element is negative following the creation of the designated fixed asset fund. This exists because of the loan obtained to complete the main research building at the Dunstaffnage site. SAMS will aim to achieve the policy aims stated above but in reality the existence of the long term loan will make their achievement also long term in nature. SAMS is satisfied that this does not affect the sustainability of the Group.

Council report SC00929

The Council

The members of the Council, who act as trustees and directors, are all guarantors of the company, of an amount not exceeding £1, during the period of their appointment as Council members and for a year after resignation. The Council is appointed in accordance with the Memorandum and Articles of Association, which allows trustees to serve a maximum of two consecutive 3-year terms.

The members of the Governing Council during the year are listed on page 1.

Both the Natural Environment Research Council (NERC) and Highlands & Island Enterprise (HIE) have observer status at SAMS Council meetings.

Any member of SAMS can nominate a new trustee to serve on Council. The SAMS Director has the responsibility to outline the duties and responsibilities to potential trustees. A new trustee is nominated and seconded at the AGM.

New trustees attend a briefing meeting with the SAMS Director or Company Secretary and are provided with the relevant guidance notes from Companies House and the Office of the Scottish Charity Regulator.

SAMS Council meet quarterly with an annual retreat. A new governance structure has now been put in place and the Council is served by a Board and five sub-committees; Finance Committee, Audit Committee, Research Committee, Education Committee and Business Development Committee that now incorporates the SRSL Board. The SAMS Council, the Board and its Committees approve the Group's strategy and the implementation of the strategy is delegated to the Executive Group led by the SAMS Director.

Investment policy and performance

The Council has considered the most appropriate policy for investing funds and has found that short to medium term investment of funds should be held in a mixture of current and investment accounts to optimise interest earned.

Executive Group

Management of the Charity is delegated by the Council to the Director and the SAMS Executive Group. The members of the Executive Group during the reporting period were:

Prof Laurence Mee – Director
Dr Ken Jones - Deputy Director
Dr Kenny Black- Head of Ecology (resigned 1 November 2009)
Dr Michael Burrows - Head of Ecology (appointed 1 November 2009)
Dr Mark Inall – Head of Physics, Sea Ice and Technology (resigned 1 November 2009)
Dr Finlo Cottier – Head of Physics, Sea Ice and Technology (appointed 1 November 2009)
Dr Ray Leakey – Head of Microbiol and Molecular Biology (resigned 1 November 2009)
Dr Keith Davidson – Head of Microbiology and Molecular Biology (appointed 1 November 2009)
Dr John Howe – Head of Biogeochemistry and Earth Sciences (appointed 1 November 2009)
Prof Axel Miller – Head of Education
Dr Tracy Shimmield – Assistant Director, Business Development (resigned as Head of Biogeochemistry and Earth Sciences 1 November 2009)
Ian Crawford – Director of Human Resources
Fran McCloskey – Assistant Director, Corporate Strategy, Performance and Finance
Elaine Walton - Company Secretary
Anuschka Miller – Communications Manager (until 1 November 2009)
Steve Gontarek – ICT and Data Services Manager (until 1 November 2009)
Derek Black – Contracts Manager (until 1 November 2009)
Dave Gunn – Knowledge Transfer and Commercialisation Manager (until 1 November 2009)

Council report SC00929

Equal opportunities

The company is committed to provide full opportunity for the development of individuals' talents by using criteria based on merit and job performance alone in employment related decisions. It is further committed to ensure it does not discriminate on grounds of gender, marital status, race, colour, ethnic or national origins, age, religious belief, sexual orientation or disability.

Directors' statement as to disclosure of information to auditors

The directors who are members of the Council at the time of approving the directors' report are listed on page 1. Having made enquiries of fellow directors and of the company's auditors, each of the directors confirms that:

- to the best of each director's knowledge and belief, there is no information relevant to the preparation of their report of which the company's auditors are unaware; and
- each director has taken all the steps a director might reasonably be expected to have taken to be aware of relevant audit information and to establish that the company's auditors are aware of that information.

Auditors

A resolution to reappoint Ernst& Young LLP as auditors will be put to the members at the Annual General Meeting

By order of the Council

E B Walton

Company Secretary

Statement of Council's responsibilities in respect of the financial statements

The Members of Council (who are directors for the purposes of company law) are responsible for preparing the Annual Report and the financial statements in accordance with applicable law and regulations.

Company law, the Charities and Trustees Investment (Scotland) Act 2005 and regulation 8 of the Charities Accounts (Scotland) Regulations 2006, requires the Members of Council to prepare financial statements for each financial year. Under that law the Members of Council have elected to prepare the financial statements in accordance with United Kingdom Generally Accepted Accounting Practice (United Kingdom Auditing Standards and applicable law). Under company law the Members of Council must not approve the financial statements unless they are satisfied that they give a true and fair view of the state of affairs of the charitable company and the group and of the surplus or deficit of income over expenditure of the group for that period. In preparing those financial statements, the Members of Council are required to:

- select suitable accounting policies and then apply them consistently;
- make judgements and estimates that are reasonable and prudent; and
- prepare the financial statements on the going concern basis unless it is inappropriate to presume that the group will continue in business.

The Members of Council are responsible for keeping proper accounting records which disclose with reasonable accuracy at any time the financial position of the group and to enable them to ensure that the financial statements comply with the Companies Act 2006, the Charities and Trustees Investment (Scotland) Act 2005 and regulation 8 of the Charities Accounts (Scotland) Regulations 2006. They are also responsible for safeguarding the assets of the group and hence for taking reasonable steps for the prevention and detection of fraud and other irregularities.

Independent Auditors Report

for the year ended 31 March 2010

We have audited the group financial statements of The Scottish Association for Marine Science for the year ended 31 March 2010 which comprise the Group Statement of Financial Activities, the Group Balance Sheet, the Balance Sheet, the Group Statement of Cash Flows and related notes 1 to 20. These financial statements have been prepared in accordance with the accounting policies set out therein.

This report is made solely to the members, as a body, in accordance with our appointment under section 44(1)(c) of the Charities and Trustee Investment (Scotland) Act 2005 and Chapter 3 of Part 16 of the Companies Act 2006. Our audit work has been undertaken so that we might state to the company's members those matters we are required to state to them in an auditors' report and for no other purpose. To the fullest extent permitted by law, we do not accept or assume responsibility to anyone other than the company and the company's members as a body, for our audit work, for this report, or for the opinions we have formed.

Respective responsibilities of Members of Council and auditors
As stated in the Statement of Directors' Responsibilities set out on page 6, the members of Council (who are also the directors of The Scottish Association for Marine Science for the purposes of company law) are responsible for the preparation of the Financial Statements in accordance with applicable law and United Kingdom Accounting Standards (United Kingdom Generally Accepted accounting Practice) and for being satisfied that the financial statements gives a true and fair view.

We have been appointed auditor under section 44(1)(c) of the Charities and Trustees Investment (Scotland) Act 2005 and under the Companies Act 2006 and report to you in accordance with those Acts.

Our responsibility is to audit the financial statements in accordance with relevant legal and regulatory requirements and International Standards on Auditing (UK and Ireland).

We report to you our opinion as to whether the financial statements give a true and fair view, have been properly prepared in accordance with United Kingdom Generally Accepted Accounting Practice, and have been prepared in accordance with the Companies Act 2006, the Charities and Trustee Investment (Scotland) Act 2005 and regulation 8 of the Charities Accounts (Scotland) Regulations 2006. We also report to you whether, in our opinion, the information given in the Trustees' Annual Report is consistent with those financial statements.

We also report to you if, in our opinion, the charitable company has not kept adequate and proper accounting records, if the charitable company's financial statements are not in agreement with the accounting records and returns, if we have not received all the information and explanations we require for our audit, or if certain disclosures of trustees' remuneration specified by law are not made.

We read the Trustees' Report and consider the implications for our report if we become aware of any apparent misstatements with the financial statements.

Basis of audit opinion

We conducted our audit in accordance with International Standards on Auditing (UK and Ireland) issued by the Auditing Practices Board. An audit includes examination, on a test basis, of evidence relevant to the amounts and disclosures in the financial statements. It also includes an assessment of the significant estimates and judgements made by the directors in the preparation of the financial statements, and of whether the accounting policies are appropriate to the charitable company's circumstances, consistently applied and adequately disclosed.

We planned and performed our audit so as to obtain all information and explanations which we considered necessary in order to provide us with sufficient evidence to give reasonable assurance as to whether the financial statements are free from material misstatement, whether caused by fraud or other irregularity or error. In forming our opinion we also evaluated the overall adequacy of the presentation of information in the financial statements.

Independent Auditors Report

for the year ended 31 March 2010

Opinion

In our opinion:

- the financial statements give a true and fair view of the state of affairs of the charitable group as at 31 March 2010 and of its incoming resources and application of resources, including its income and expenditure, for the year then ended;
- the financial statements have been properly prepared in accordance with United Kingdom Generally Accepted Accounting Practice;
- the financial statements have been prepared in accordance with the Companies Act 2006, the Charities and Trustee Investment (Scotland) Act 2005 and regulation 8 of the Charities Accounts (Scotland) Regulations 2006; and
- the information given in the Council Report is consistent with the financial statements.

Eunice McAdam, Senior Statutory Auditor,
for and on behalf of Ernst & Young LLP, Statutory Auditor

Inverness

Group statement of financial activities (incorporating the income and expenditure account)

for the year ended 31 March 2010

	Notes	2010 Unrestricted funds Undesignated £000	2010 Designated £000	2010 Restricted £000	2010 Total £000	2009 Total £000
Incoming resources						
Incoming resources from generated funds:						
Voluntary income		-	-	-	**-**	**500**
Activities for generating funds		201	-	-	**201**	**193**
Investment income		2	-	-	**2**	**16**
Incoming resources from charitable activities	3	1,720	154	8,542	**10,416**	**10,286**
Total incoming resources		**1,923**	**154**	**8,542**	**10,619**	**10,995**
Resources expended						
Cost of generating funds	4	3	-	34	**37**	**44**
Charitable activities	5	1,617	299	7,646	**9,562**	**9,581**
Governance costs		71	-	-	**71**	**36**
Total resources expended		**1,691**	**299**	**7,680**	**9,670**	**9,661**
Net incoming resources before transfers		**232**	**(145)**	**862**	**949**	**1,334**
Fund balance brought forward at 1 April 2009		**3,004**	**369**	**9,405**	**12,778**	**11,444**
Transfers between funds		**(4,272)**	**4,312**	**(40)**	-	-
Total Funds carried forward at 31 March 2010		**(1,036)**	**4,536**	**10,227**	**13,727**	**12,778**

Group statement of financial activities (incorporating the income and expenditure account)

for the year ended 31 March 2010

Statement of total recognised gains and losses

There are no recognised gains or losses other than the net incoming resources of £949k in the year ended 31 March 2010 and £1,334k in the year ended 31 March 2009.

Group balance sheet

at 31 March 2010

	Notes	March 2010 £000	March 2010 £000	March 2009 £000
Fixed assets				
Tangible assets	10		14,761	14,026
Investments	11		-	53
			14,814	**14,079**
Current assets				
Cash at bank and in hand			2,122	1,187
Debtors	12		3,227	2,861
Total : Current Assets			**5,349**	**4,048**
Creditors: amounts falling due within one year	13		(4,507)	(3,299)
Net current assets (liabilities)			**789**	**749**
Total assets less current liabilities			15,603	14,828
Creditors: amounts falling due after more than one year				
Loans	14		(1,876)	(2,050)
Total net assets			**13,727**	**12,778**
Capital and reserves				
Restricted Funds	15(a)		10,227	9,405
Unrestricted funds				
Undesignated		(1,036)		
Designated	15(b)	4,536		
			3,500	3,373
Total capital and reserves			**13,727**	**12,778**

Chair of the Board: Michael Gibson

President of Council: Prof Andrew Hamnett

Company balance sheet

at 31 March 2010

		March 2010	March 2010	March 2009 Restated
Fixed assets	*Notes*	**£000**	**£000**	**£000**
Tangible assets	10		14,698	13,946
			14,698	**13,946**
Current assets				
Cash at bank and in hand			1,848	959
Debtors	12		3,547	3,116
Total : Current Assets			**5,395**	**4,075**
Creditors: amounts falling due within one year	13		(4,506)	(3,245)
Net current assets (liabilities)			**889**	**830**
Total assets less current liabilities			15,587	14,775
Creditors: amounts falling due after more than one year				
Loans	14		(1,875)	(2,050)
Total net assets			**13,712**	**12,725**
Capital and reserves				
Restricted Funds	15(a)		10,117	9,268
Unrestricted funds				
Undesignated		(989)		
Designated	15(b)	4,584		
			3,595	3,457
Total capital and reserves			**13,712**	**12,725**

Chair of the Board: Michael Gibson

President of Council: Prof Andrew Hamnett

Group statement of cash flows

for the year ended 31 March 2010

	Notes	**2010** **£000**	2009 £000
Net cash inflow from operating activities	17(a)	**2,457**	1,964
Returns on investment and servicing of finance	17(a)	**(153)**	(142)
Taxation		**-**	-
Capital expenditure	17(a)	**(1,705)**	(1,465)
Financing		**336**	(153)
Increase in cash	17(b)	**935**	204

Reconciliation of net cash flow to movement in net funds

	Notes	**2010** **£000**	2009 £000
Increase in cash		**935**	204
Repayment of long term loans		**(336)**	153
		599	357
Net debt at 1 April		**(1,028)**	(1,385)
Net debt at 31 March	17(b)	**(429)**	(1,028)

Notes to the group financial statements

at 31 March 2010

1. Accounting policies

Accounting convention

The accounts are prepared under the historical cost convention modified to include the revaluation of investments, in accordance with applicable accounting standards and the Statement of Recommended Practice "Accounting by Charities" (SORP 2005) issued in December 2005 with the exception of the accounting treatment of a substantial capital grant received from NERC in March, 2007 (see note 15a on page 26).

Status

The Association is a company limited by Guarantee and not having a share capital. The liability of the members who constitute the Association is limited to £1 per member.

The affairs of the Association are managed by an elected Council of Members, who constitute Directors of the Company for Companies Act purposes. The Association is a registered charity, Scottish Charity Number SC009206, and is not liable to income tax or corporation tax on its income under the Income and Corporation Taxes Act 1988.

Basis of consolidation

The consolidated accounts incorporate the accounts of the company and its subsidiary undertakings for the year ended 31 March 2010. Unless otherwise stated, the acquisition method of accounting has been adopted. Under this method, the results of subsidiary undertakings acquired or disposed of in the year are included in the consolidated profit and loss account from the date of acquisition or up to the date of disposal.

In accordance with section 408 of the Companies Act 2006, The Scottish Association for Marine Science is exempt from the requirement to present its own profit and loss account. The result of the financial year dealt with in the financial statements of The Scottish Association for Marine Science is disclosed in note 16 to these accounts.

Fixed assets and depreciation

Individual items of capital equipment are included in the balance sheet only if their cost exceeds £5,000 (including irrecoverable value added tax where appropriate).

Depreciation is provided on all tangible fixed assets at rates calculated to write off the cost or valuation, less estimated residual value, of each asset evenly over its expected useful life, as follows:

Property	-	20 to 50 years
Vessels	-	5 to 30 years
Scientific instruments and equipment	-	2 to 20 years
Computer equipment	-	5 years
Fixtures & Fittings	-	5 to 20 years

Value added tax

As the group is registered partially exempt for VAT purposes, expenditure and fixed assets are shown inclusive of irrecoverable value added tax where applicable.

Leasing

Rentals paid under operating leases are charged to income on a straight line basis over the lease term.

Notes to the group financial statements

at 31 March 2010

Accounting policies (continued)

Pensions

The Association participates in the Universities Superannuation Scheme ("USS"), a defined benefit scheme which is contracted out of the State Second Pension ("S2P"). The assets of the scheme are held in a separate trustee-administered fund. Because of the mutual nature of the scheme, the scheme's assets are not hypothecated to individual institutions and a scheme-wide contribution rate is set. The institute is therefore exposed to actuarial risks associated with other institutions' employees and is unable to identify its share of the underlying assets and liabilities of the scheme on a consistent and reasonable basis and therefore, as required by FRS17 "Retirement benefits", accounts for the scheme as if it were a defined contribution scheme. As a result the amount charged to the income and expenditure account represents the contributions payable to the scheme in respect of the accounting period.

For staff that are NERC employees, pensions are fully funded and guaranteed by NERC.

Incoming resources

Income represents NERC core grants receivable in the year, other research income receivable from outside bodies and other miscellaneous income. Other funds received of a revenue nature are credited to deferred revenue income and credited to the Income and Expenditure Account as the related research costs are incurred.

Resources expended

Direct charitable expenditure represents the full cost of the research performed. It includes the cost of direct staff, consumable stocks, indirect costs and the apportioned support costs. Support costs have been apportioned to direct charitable expenditure on a percentage basis of total charitable expenditure. Fundraising and publicity expenditure represents the cost of obtaining funds for research, promoting the work of the Association and recruitment of staff. Governance costs represent the necessity of compliance with statutory and constitutional requirements.

Investments

Investments include bank balances for the Sheina Marshall Bequest and the Yonge Fellowship, and equity investments.

Foreign currency transactions

All foreign currency gains and losses are taken to the income and expenditure account as incurred. Monetary assets and liabilities denominated in foreign currencies are translated at the rate of exchange ruling at the balance sheet date.

Restatement

In 2009 the company balance sheet and related notes did not reflect an intercompany debtor of £103k in respect of the gift aid. Debtors and reserves have been restated in the company balance sheet and related notes. Group balance sheet and related notes are unaffected.

2. Voluntary Income

During the year SAMS received a grant of £NIL. (2009: £500K) from HIE to be used for the furtherance of activities. The grant was received following an independent report commissioned by HIE into SAMS' existing governance structures and infrastructure.

Notes to the group financial statements

at 31 March 2010

3. Incoming resources from charitable activities

	Unrestricted				
	Unrestricted	Designated	Restricted	**Total**	Total
	2010	2010	2010	**2010**	2009
	£000	£000	£000	**£000**	£000
Education and Knowledge Transfer Grants	219	-	344	**563**	397
Research Income, National Capability and Facilities	1,501	-	8,198	**9,699**	8,882
Recompression	-	154	-	**154**	325
Infrastructure	-	-	-	**-**	682
	1,720	154	8,542	**10,416**	10,286

4. Cost of generating funds

	Unrestricted				
	Unrestricted	Designated	Restricted	**Total**	Total
	2010	2010	2010	**2010**	2009
	£000	£000	£000	**£000**	£000
Marketing, publications and newsletters	3	-	34	**37**	44

Notes to the group financial statements

at 31 March 2010

5. Cost of charitable activities

	Unrestricted				
	Unrestricted	Designated	Restricted	**Total**	Total
	2010	2010	2010	**2010**	2009
	£000	£000	£000	**£000**	£000
Staff Costs	1,105	76	4,530	**5,711**	4,793
Other Costs	512	223	3,116	**3,851**	3,964
	1,617	299	7,646	**9,562**	8,757

6. Net incoming resources

Net incoming resources are stated after charging:	**2010**	2009
	£000	£000
Auditors' remuneration – audit services	**11**	11
– other services	**5**	17
Depreciation and amortisation	**859**	820
Loss on disposal of fixed assets	**80**	-
Operating lease charges	**54**	56

7. Remuneration of the members of the Council

The non-executive Council members received £5,380 (2008 - £6,875), in the form of reimbursable expenses, in total from the Association during the year. The following directors received remuneration:

	2010	2009
	£000	£000
Michael Gibson - work done in 2008/9 paid in 2009/10	**16**	16
- 2009/10 work done and paid	**17**	-
Gordon McAllister	**3**	2
Dr R A Scrutton	**3**	1
Charles Stevenson	**3**	1
Mary Bownes	**3**	2

Notes to the group financial statements

at 31 March 2010

8. Staff costs

	2010	2009
	£000	£000
Wages and salaries	**3,903**	3,396
Social security costs	**304**	267
Other pension costs	**516**	423
	4,723	4,086

The average number of full-time equivalent persons employed by the group during the year was as follows:

	2010	2009
	No.	No.
Scientific	**87**	88
Office management	**36**	33
	123	121

The average number of full-time equivalent persons employed by NERC working for the group during the year was as follows:

	2010	2009
	£000	£000
Wages and salaries	**767**	876
Social security costs	**62**	75
Other pension costs	**159**	188
	988	1,139

The average weekly number of NERC employees during the year was as follows:

	2010	2009
	No.	No.
Scientific	**13**	14
Office management	**6**	7
	19	21

Notes to the group financial statements

at 31 March 2010

8. Staff Costs (cont'd.)

Remuneration of higher paid staff earning in excess of £50,000, excluding employer's pension contributions were in the following ranges:

	SAMS 2010 No.	NERC 2010 No.	**Total 2010 No.**	Total 2009 No.
£50,000 - £60,000	10	3	**13**	10
£60,001 - £70,000	3	1	**4**	2
£70,001 - £80,000	1	-	**1**	-
£80,000 - £90,000	1	-	**1**	-
£90,000 - £100,000	-	-	-	-
£100,000 - £110,000	-	-	-	-
£110,001 - £120,000	1	-	1	-

9. Investment income

	2010 £000	2009 £000
Interest receivable	**2**	16

Notes to the group financial statements

at 31 March 2010

10. Tangible fixed assets

Group	Assets under Construction £000	Property £000	Vessels £000	Fittings and Equipment £000	Total £000
Cost:					
At 1 April 2009	71	13,744	527	7,131	21,473
Disposals	-	-	-	(188)	(188)
Additions	1,372	5	31	298	1,706
At 31 March 2010	1,443	13,749	558	7,241	22,991
Depreciation:					
At 1 April 2008	-	2,072	488	4,887	7,447
Disposals	-	-	-	(107)	(107)
Charge for year	-	287	23	580	890
At 31 March 2010	-	2,359	511	5,360	8,230
Net book value:					
At 31 March 2010	**1,443**	**11,390**	**47**	**1,881**	**14,761**
At 31 March 2009	71	11,672	39	2,244	14,026

Notes to the group financial statements

at 31 March 2010

10. Tangible fixed assets (contd.)

Company	Assets under Construction £000	Property £000	Vessels £000	Fittings and Equipment £000	Total £000
Cost:					
At 1 April 2009	71	13,744	527	6,812	21,154
Disposals	-	-	-	(155)	(155)
Additions	1,372	5	31	282	1,690
At 31 March 2010	1,443	13,749	558	6,939	22,689
Depreciation:					
At 1 April 2009	-	2,072	488	4,648	7,208
Disposals	-	-	-	(74)	(74)
Charge for year	-	287	23	547	857
At 31 March 2010	-	2,359	511	5,121	7,991
Net book value:					
At 31 March 2010	**1,443**	**11,390**	**47**	**1,818**	**14,698**
At 31 March 2009	71	11,672	39	2,164	13,946

Notes to the group financial statements

at 31 March 2010

11. Investments

	Group		Company	
	2010	2009	**2010**	2009
	£000	£000	**£000**	£000
Other investments	**-**	53	**-**	-

Company

Details of the investments in subsidiary undertakings held by The Scottish Association for Marine Science are as follows:

Subsidiary undertakings	*Holding*	*Proportion of voting Rights and shares held*	*Nature of Business*
SAMS Research Services Limited	Ordinary shares	100%	Marine and research Support services
The European Centre for Marine Biotechnology	Limited by guarantee	Sole member	Non trading

SAMS Research Services Limited gift aid all of its taxable profits to The Scottish Association for Marine Science. A summary of the trading results is shown below:

	SAMS Research Services Ltd.
	2010
	£000
Turnover	**1,126**
Cost of sales and administrative expenses	**(1,155)**
Interest receivable and other operating income	**2**
Interest payable	**(2)**
Net profit before Gift Aid and tax	**(27)**
Amount gifted to charity	**0**
Profit for the year	**(27)**
The assets and liabilities of the subsidiary at 31 March 2010 were:	
Fixed assets	**63**
Current assets	**773**
Creditors: amounts falling due within one year	**(826)**
Aggregate share capital and reserves	**10**

Notes to the group financial statements

at 31 March 2010

11. Investments (cont'd.)

The results of The European Centre for Marine Biotechnology for the year ended 31 March 2010 are not material to the group. This company ceased trading on 31 March, 2008.

12. Debtors

	Group		Company restated	
	2010	2009	**2010**	2009
	£000	£000	**£000**	£000
Trade debtors	**130**	68	-	-
Other debtors	**1,364**	1,026	**1,364**	1,026
Prepayments and accrued income	**1,733**	1,767	**1,422**	1,139
Due from group undertakings	**-**	-	**761**	950
	3,227	2,861	**3,547**	3,116

13. Creditors: amounts falling due within one year

	Group		Company	
	2010	2009	**2010**	2009
	£000	£000	**£000**	£000
Current instalment due on bank loan (note 14)	**176**	165	**676**	165
Other Loans	**500**	-	**-**	-
Payments received in advance	**2,812**	2,579	**2,850**	2,563
Taxation and social security	**205**	152	**205**	152
Sundry creditors and accruals	**813**	403	**775**	366
	4,507	3,299	**4,506**	3,245

The bank loans and overdraft facilities are secured by a bond and floating charge over the whole assets of the company and a standard security over Dunstaffnage Marine Laboratory, Oban in favour of the Bank of Scotland, HIE Argyll and the Islands and UHI Millenium Institute. Other loans include a loan from the UHI Millenium Institute. This loan has the sole purpose of managing the cashflow requirements of the new build and will be repaid on receipt of the capital grant funding.

Notes to the group financial statements

at 31 March 2010

14. Loans

	Group		Company	
	2010	2009	**2010**	2009
	£000	£000	**£000**	£000
Not wholly repayable within five years:				
£2,900,000 bank loan at 1.25% above LIBOR per annum, repayable in monthly instalments of £25,419 commencing 3 March 2004	**2,051**	2,215	**2,551**	2,215
Less: included in creditors: amounts falling due within one year (note 13)	**176**	165	**676**	165
	1,875	2,050	**1,875**	2,050
Amounts repayable:				
In one year or less, or on demand	**176**	165	**676**	165
In more than one year but not more than two years	**188**	176	**188**	176
In more than two years but not more than five years	**646**	603	**646**	603
	1,510	944	**1,510**	944
In more than five years	**1,041**	1,271	**1,041**	1,271
	2,051	2,215	**2,551**	2,215

Notes to the group financial statements

at 31 March 2010

15(a) Restricted funds

	01 Apr 2009 £000	Income £000	Expenditure £000	Transfers £000	**31 Mar 2010 £000**
Group					
Fixed asset funds	9,336	1,705	(817)	-	**10,224**
Sheina Marshall Bequest	26	-	(26)	-	-
Yonge Fellowship	3	-	-	-	**3**
Argos	40	-	-	(40)	-
Research Projects	-	6,837	(6,837)	-	-
	9,405	8,542	(7,680)	(40)	**10,227**

	01 Apr 2009 £000	Income £000	Expenditure £000	Transfers £000	**31 Mar 2010 £000**
Company					
Fixed asset funds	9,239	1,690	(815)	-	**10,114**
Sheina Marshall Bequest	26	-	(26)	-	-
Yonge Fellowship	3	-	-	-	**3**
Research Projects	-	6,679	(6,679)	-	-
	9,268	8,369	(7,520)	-	**10,117**

Capital grants are recognised as restricted income in the year in which they are received and the depreciation on all fixed assets funded by capital grants is recognised as an expense against the restricted fund. The only exception to this is a capital grant of £978k received from NERC in March 2007, under Oceans 2025. The individual items of capital equipment for Oceans 2025 are of a specialist nature and to date not all have been delivered by the suppliers to the Associations' scientists. For this reason the Trustees consider it more appropriate to include as income in the 2009 financial statements only the capital grant for those items delivered, commissioned and tested. The amount included in income this year is £184k. The balance of £345k is included within creditors, payments received in advance in note 13 on page 24.

The Sheina Marshall Bequest is an amount left by the late Dr Sheina Marshall OBE, DSC to the Association. The sum bequested was used by the Association to purchase a dwelling property in Oban which is used to accommodate visiting researchers.

Notes to the group financial statements

at 31 March 2010

The Yonge Fellowship is to commemorate the late Professor Sir Maurice Yonge. Awards will be made from the fund to suitable marine science projects.

15(b) Designated funds

	01 Apr 2009	Income	Expenditure	Transfers	**31 Mar 2010**
	£000	£000	£000	£000	**£000**
Group					
Fixed asset funds	-	-	-	4,536	**4,536**
Recompression	369	154	(299)	(224)	**-**
	369	154	(299)	4,312	**4,536**

	01 Apr 2009	Income	Expenditure	Transfers	**31 Mar 2010**
	£000	£000	£000	£000	**£000**
Company					
Fixed asset funds	-	-	-	4,584	**4,584**
Recompression	369	154	(299)	(224)	**-**
	369	154	(299)	4,360	**4,584**

SAMS had designated a reserve in respect of the recompression service. This service is delivered by SAMS Research Services Limited, a wholly owned subsidiary of SAMS. Following a review a decision was taken to remove this designation. The remaining balance on this reserve has been transferred to unrestricted undesignated funds.

SAMS has designated a reserve for fixed assets. A restricted reserve already exists for fixed assets and this reflects the level of grant funding received for the assets held by SAMS. The restricted reserve does not, however, reflect the full amount of funds held in tangible fixed assets held for the charity's use. The designated fund represents the balance between the net book value of assets held and the restricted reserve.

16. Income and expenditure account

In accordance with the exemption allowed by section 408 of the Companies Act 2006 the company has not presented its own income and expenditure account or statement of financial activities. The net incoming resources for the financial period attributable to members of the parent company dealt with in the accounts was £987k (2009 – £1,221k).

Notes to the group financial statements

at 31 March 2010

17. Notes to the statement of cash flows

(a) Reconciliation of net incoming resources to net cash inflow from operating activities

	2010	2009
	£000	£000
Net incoming resources	**949**	1,334
Net interest paid	**153**	142
Depreciation and amortisation	**890**	819
Losses on disposal of fixed assets	**81**	-
(Increase)/decrease in debtors	**(366)**	(110)
(Decrease)/increase in creditors	**750**	(221)
Net cash inflow from operating activities	**2,457**	1,964

Returns on investment and servicing of finance	**2010**	2009
	£000	£000
Interest received	**2**	16
Interest paid	**(155)**	(158)
	(153)	(142)

Capital expenditure and financial investment	**2010**	2009
	£000	£000
Payments to acquire investments	**-**	(8)
Payments to acquire tangible fixed assets	**(1,705)**	(1,457)
	(1,705)	(1,465)

Financing	**2010**	2009
	£000	£000
Cashflow financing for new building	**500**	-
Repayment of long term loans	**(164)**	(153)
	336	(153)

Notes to the group financial statements

at 31 March 2010

17. Notes to the statement of cash flows (contd.)

(b) **Analysis of changes in net debt**

	At 1 April 2009	Cash flow	**At 31 March 2010**
	£000	£000	**£000**
Cash at bank and in hand	1,187	935	**2,122**
Debt due within one year	(165)	(511)	**(676)**
Debt due after one year	(2,050)	175	**(1,875)**
	(1,028)	599	**(429)**

18. Pension commitments to pension fund

The Association participates in the Universities Superannuation Scheme, a defined benefit scheme which is contracted out of the State Second Pension. The assets of the scheme are held in a separate fund administered by the trustee, Universities Superannuation Scheme Limited.

The appointment of directors to the board of the trustee is determined by the company's Articles of Association. Four of the directors are appointed by Universities UK; three are appointed by the University and College Union, of whom at least one must be a USS member; one is appointed by the Higher Education Funding Councils; and a minimum of two and a maximum of four are co-opted directors appointed by the board. Under the scheme trust deed and rules, the employer contribution rate is determined by the trustee, acting on actuarial advice.

The Association participates in the Universities Superannuation Scheme ("USS"), a defined benefit scheme which is contracted out of the State Second Pension ("S2P"). The assets of the scheme are held in a separate trustee-administered fund. Because of the mutual nature of the scheme, the scheme's assets are not hypothecated to individual institutions and a scheme-wide contribution rate is set. The institute is therefore exposed to actuarial risks associated with other institutions' employees and is unable to identify its share of the underlying assets and liabilities of the scheme on a consistent and reasonable basis and therefore, as required by FRS17 "Retirement benefits", accounts for the scheme as if it were a defined contribution scheme. As a result the amount charged to the income and expenditure account represents the contributions payable to the scheme in respect of the accounting period.

The latest triennial actuarial valuation of the scheme was at 31 March 2008. This was the first valuation of USS under the new scheme-specific funding regime introduced by the Pensions Act 2004, which requires schemes to adopt a statutory funding objective, which is to have sufficient and appropriate assets to cover their technical provisions. The actuary also carries out a review of the funding level each year between triennial valuations and details of his estimate of the funding level at 31 March 2010 are also included in this note.

The triennial valuation was carried out using the projected unit method. The assumptions which have the most significant effect on the result of the valuation are those relating to the rate of return on investments (ie the valuation rate of interest) and the rates of increase in salary and pensions and the assumed rates of

Notes to the group financial statements

at 31 March 2010

18. Pension commitments to pension fund (contd.)

mortality. The financial assumptions were derived from market yields prevailing at the valuation date. An inflation risk premium adjustment was also included by deducting 0.3% from the market-implied inflation on account of the historically high level of inflation implied by government bonds (particularly when compared to the Bank of England's target of 2% for CPI which corresponds broadly to 2.75% for RPI per annum).

To calculate the technical provisions, it was assumed that the valuation rate of interest would be 6.4% per annum (which includes and additional assumed investment return over gilts of 2% per annum), salary increases would be 4.3% per annum (plus an additional allowance for increases in salaries due to age and promotion reflecting historic Scheme experience, with a further cautionary reserve on top for past service liabilities) and pensions would increase by 3.3% per annum.

Standard mortality tables were used as follows:

Male members' mortality	PA92 MC YoB tables – rated down 1 yr
Female members' mortality	PA92 MC YoB tables – no age rating

Use of mortality tables reasonably reflects the actual USS experience but also provides an element of conservatism to allow for further improvements in mortality rates. The assumed life expectations on retirement at age 65 are:

Males (females) currently aged 65	22.8 (24.8) years
Males (females) currently aged 45	24.0 (25.9) years

At the valuation date, the value of the assets of the scheme was £28,842.6 million and the value of the scheme's technical provisions was £28,135.3 million indicating a surplus of £707.3 million. The assets were sufficient to cover 103% of the benefits which had accrued to members after allowing for expected future increases in earnings.

The actuary also valued the scheme on a number of other bases as at the valuation date. On the scheme's historic gilts basis, using a valuation rate of interest in respect of past service liabilities of 4.4% per annum (the expected return on gilts) the funding level was approximately 71%. Under the Pension Protection Fund regulations introduced by the Pensions Act 2004 it was 107% funded; on a buy-out basis (ie assuming the Scheme had discontinued on the valuation date) the assets would have been approximately 79% of the amount necessary to secure all the USS benefits with an insurance company; and using the FRS17 formula as if USS was a single employer scheme, using a AA bond discount rate of 6.5% per annum based on spot yields, the actuary estimated that the funding level at 31 march 2008 was 104%.

The technical provisions relate essentially to the past service liabilities and funding levels, but it is also necessary to assess the ongoing cost of newly accruing benefits. The cost of future accrual was calculated using the same assumptions as those used to calculate the technical provisions except that the valuation rate of interest assumed asset outperformance over gilts of 1.7% per annum (compared to 2% per annum for the technical provisions) giving a discount rate of 6.1% per annum; also the allowance for promotional salary increases was not as high. There is currently uncertainty in the sector regarding pay growth. Analysis has shown very variable levels of growth over and above general pay increases in recent years, and the salary growth assumption built into the cost of future accrual is based on more stable, historic, salary experience. However, when calculating the past service liabilities of the scheme, a cautionary reserve has been included, in addition, on account of the variability mentioned above.

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at 31 March 2010

18. Pension commitments to pension fund (contd.)

The scheme wide contribution rate required for future service benefits alone at the date of the valuation was 16% of pensionable salaries and the trustee company, on the advice of the actuary, increased the company contribution rate to 16% of pensionable salaries from 1 October 2009.

Since 31 March 2008 global investment markets have continued to fluctuate and at 31 March 2010 the actuary has estimated that the funding level under the new scheme specific funding regime had fallen from 103% to 91% (a deficit of £3,065 million). Compared to the previous 12 months, the funding level has improved from 74% (as at 31 March 2009) to 91%. This estimate is based on the funding level at 31 March 2008, adjusted to reflect the fund's actual investment performance over the two years and changes in market conditions (market conditions affect both the valuation rate of interest and also the inflation assumption which in turn impacts on the salary and pension increase assumptions).

On the FRS17 basis, using a AA bond discount rate of 5.6% per annum based on spot yields, the actuary estimated that the funding level at 31 March 2010 was 80%. An estimate of the funding level measured on a buy-out basis at that date was approximately 57%.

Surpluses or deficits which arise at future valuations may impact on the company's future contribution commitment. A deficit may require additional funding in the form of higher contribution requirements, where a surplus could, perhaps, be used to similarly reduce requirements. The sensitivities regarding the principal assumptions used to measure the scheme liabilities are set out below:

Assumption	Change in assumption	Impact on scheme liabilities
Valuation rate of interest	Increase/decrease by 0.5%	Decrease/increase by £2.2 billion
Rate of pension increases	Increase/decrease by 0.5%	Decrease/increase by £1.5 billion
Rate of salary growth	Increase/decrease by 0.5%	Increase by £0.7 billion
Rate of mortality	More prudent assumption. Move to long cohort future improvements from the medium cohort.	Increase by £2.2 billion

USS is a "last man standing" scheme so that in the event of the insolvency of any of the participating employers in the USS, the amount of any pension funding shortfall (which cannot otherwise be recovered) in respect of that employer will be spread across the remaining participant employers and reflected in the next actuarial valuation of the scheme.

The trustee believes that over the long-term equity investment and investment in selected alternative asset classes will provide superior returns to other investment classes. The management structure and targets set are designed to give the fund a major exposure to equities through portfolios that are diversified both geographically and be sector. The trustee recognises it would be theoretically possible to select investments producing income flows broadly similar to the estimated liability cash flows. However, in order to meet the long-term funding objective within a level of contributions that it considers the employers would be willing to make, the trustee needs to take on a degree of investment risk relative to the liabilities. This taking of investment risk seeks to target a greater return than the matching assets would provide whilst maintaining a prudent approach to meeting the fund's liabilities. Before deciding what degree of investment risk to take relative to the liabilities, the trustee receives advice from its internal investment team, its investment consultant and the scheme actuary, and considers the views of the employers. The strong positive cash flow of the scheme means that it is not necessary to realise investments to meet liabilities. The trustee believes that this, together with the ongoing flow of new

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at 31 March 2010

entrants into the scheme and the strength of covenant of the employers enables it to take a long term view of its investments. Short-term volatility of returns can be tolerated and need not feed through directly to the contribution rate although the trustee is mindful of the desirability of keeping the funding level on the scheme's technical provisions close to or above 100% thereby minimizing the risk of the introduction of deficit contributions. The actuary has confirmed that the scheme's cash flow is likely to remain positive for the next ten years or more.

The next formal triennial actuarial valuation is due as at 31 March 2011. The contribution rate will be reviewed as part of each valuation and may be reviewed more frequently.

At 31 March 2010, USS had over 135,000 active members and the institution had 113 active members participating in the scheme.

The total pension cost for the group was £611,000 (2009 - £611,000). This is net of £ outstanding contributions at the balance sheet date. The contribution rate payable by the company was 16% of pensionable salaries. The contribution rate payable by the group was 14% of pensionable salaries.

19. Capital commitments

	Group		Company	
	2010	2009	**2010**	2009
	£000	£000	**£000**	£000
Capital commitments contracted for	**3,553**	86	**3,553**	86

20. Other financial commitments

At 31 March 2010 the group had annual commitments under non-cancellable operating leases as set out below:

	Group		Company	
	2010	2009	**2010**	2009
	£000	£000	**£000**	£000
Operating lease which expire:				
within one year	**24**	14	**24**	14
within two to five years	**-**	40	**-**	40
	24	54	**24**	54

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