ENVIRONMENTAL CHANGES
IN NORTHERN SEAS SEE PAGE 5-7

SAMS OWNS AND OPERATES THE DUNSTAFFNAGE MARINE LABORATORY

On the 1st May 2002, the President of SAMS signed the new Agreement with NERC placing the entire management and operation of the laboratory back with SAMS after 13 years under the NERC lease arrangement. Although it has taken considerable effort on the part of all concerned to achieve this Agreement, I am very optimistic that it represents an innovative and flexible arrangement for the delivery of international quality marine research at SAMS. Embedded within the Agreement is the provision for NERC to fund the £5 million Core Strategic Research Programme on the Northern Seas (see page 5 in this Newsletter).

One aspect following from this change in responsibility has been the increased involvement and support provided by Highlands and Islands Enterprise. At the time of a UK-wide review of the value and links with the Regional Development Agencies and Enterprise Companies by Research Councils UK, it is important to recognise the vision and expertise provided by HIE (and its subsidiary, Argyll and Islands Enterprise), without whose help the new building project and the future for Dunstaffnage would not have been realised.

UHI PUBLISHES ITS STRATEGIC PLAN

The beginning of August marks the start

SAMSnews CONT.

SAMS IN THE POLITICAL AND PUBLIC EYE

On 1 August SAMS published the Review and Synthesis of the Environmental Impacts of Aquaculture under the auspices of the Central Research Unit of the Scottish Executive. This milestone document, co-ordinated and edited by Dr Kenny Black, provides an up-to-date and comprehensive view on the state of the environment influenced by the marine aquaculture industry. The recommendations contained therein will form the basis for future governmental deliberation, and the scientific research agenda. It is timely and appropriate that SAMS should take a lead in identifying the challenges for a sustainable industry operating with due environmental criteria, and not shy away from the strong opinions held by the proponents in the debate on the future of the industry.

NEW STAFF MEMBERS

The rapidly evolving organisation of SAMS has required two key new posts to be created. Patricia MacDonald joins SAMS from the SEPA management team as our new Financial Controller, in charge of a £4.5 million year turnover and an £8 million capital project! Dr Jo Oliver has been appointed as Project Executive for the European Centre for Marine Biotechnology. Jo has a distinguished research and commercial venture career to date with Moredun Scientific Ltd and New Park Management Ltd. The experience and ability of Trish and Jo will significantly enhance the capability and operation of SAMS, and we wish them every success with their new careers.

PROGRESS ON THE NEW BUILDING

by Dr Ken Jones, Deputy Director

The developments that have taken place on the Dunstaffnage site since the last Newsletter have been dramatic, and staff and visitors are now in no doubt that some major changes to the laboratory facilities are afoot. Behind the scenes there has been furious interaction between the development design team and representatives of the scientific groups in the laboratory to refine architectural and services specifications, whilst, on the ground, building activity has begun.

A new car park has been constructed around the Aquaculture Laboratory, which has allowed the contractors, the ERDC Group, to 'take over' the construction site at the front of the existing building. Unfortunately, the once pleasant gardens at the front of the laboratory have gone to be replaced by a levelled building site. In order to get to this stage the contractors had to break and remove large quantities of concrete (the foundations of the second world war military base which predated the present lab) and then provide a stable footing for the new building by vibro-compacting about 400 gravel columns into the upper layers of the sandy sediments that compose the site. Concerns that the vibrations associated with these activities might result in premature demolition of the old buildings have proved unfounded, but many staff can justifiably claim that the "earth moved" for them in the last two months. The steelwork for the new building is finally on site and the building 'skeleton' is being erected – a real milestone in the construction. Contractors hope to have a wind- and watertight building by Christmas, and the move to the new building should take place in autumn 2003.

The building projects is funded by ERDF, AIE, NERC, and private sector finance. For readers interested in seeing the transformation taking place, the SAMS website offers a web-cam view of the site **www.sams.ac.uk** ●

A graduate of the University of Glasgow, Robin Millar joined the staff of the then Scottish Marine Biological Association (SMBA) at Millport in 1947 where he specialised in the study of ascidians and quickly gained an international reputation for his research. He became a world authority on the classification and identification of this complex genus, and his advice and expertise were much sought by marine scientists throughout the world. Between the late 1940s and the mid 1960s he was also closely involved with the development of oyster cultivation in Scotland.

Robin was Deputy Director of the SMBA from 1964 until he retired in 1978, a period which incorporated the relocation of the Association's headquarters from Millport to its present home at Dunstaffnage. He was appointed a fellow of the Royal Society of Edinburgh in 1955 in recognition of his outstanding contribution to marine science, and was awarded a D.Sc. by the University of Glasgow in 1963.

Never keen to take centre stage, Robin was nonetheless the inspiration to many scientists as they embarked upon their careers, and was always willing to offer them the benefits of his extensive knowledge on a wide range of subjects. There are many scientists, some still in service, others retired, who owe much to his generosity of spirit, for he gave freely of his time and knowledge.

An accomplished artist, Robin exhibited his watercolours at many art exhibitions. There is little doubt that, had he so wished, he could have had a successful career as a professional artist. He was also a knowledgeable and talented gardener, not overly impressed with the current fashion in garden design, but rather gardened as nature intended. ●

Drs John A Howe & J Murray Roberts, SAMS

Such grand plans can have inauspicious beginnings, and this cruise started with a very grey, wet day spent at Leith docks loading the vessel. The JCR is a purpose-built polar research ship, launched in 1990. The ship works in the Antarctic during our winter, supporting British Antarctic Survey science, and in the summer months she is found ploughing the Arctic seas. An amazing array of equipment was loaded during that depressingly wet day, everything from landers for recording data from the seabed *in situ* to dangerous-looking giant box corers for collecting sections of soft seafloor. As Leith slipped away, we began our safety briefings and were on our way north at last.

As the ship made her way along the Norwegian coast, we approached the first station, by the Sula Ridge. Here we deployed a photo lander designed to monitor and photograph the seabed along a 14 km cold-water coral reef complex. When the lander was safely on the seabed, the JCR continued northwards – the lander would – hopefully - be recovered on our return, three weeks later.

Once in the Arctic, the serious business of working each sampling station began. Quickly the running order became familiar. First the area was surveyed using sophisticated multibeam and TOPAS echo-sounding equipment. As the ship moved at 6 knots, these acoustic systems worked together to provide a detailed picture of both the seafloor and the structures below it so that sampling areas could be identified.

Having completed the survey and found a suitable site, a routine of water and sediment sampling began. Sediment was collected with box corers, multicorers, megacorers and finally a 6 m long gravity corer. The sediment from the box corers was carefully sorted by biologists looking for large animals capable of turning the sediment over rapidly (a process known as bioturbation) as well as for smaller animals which were preserved for later work. The mud from the smaller multi- and megacorers was

ABOVE: Kongsfjord

ABOVE: The RRS *James Clark Ross* – here seen from Ny Alesund - took the Northern Seas research team into the Arctic.

divided between the geochemists, for chemical analysis and oxygen consumption profiles, and the biologists, who would try to relate this to the animal communities in the cores. To complement this work on board the ship, a self-contained lander was lowered to the seabed to record the depth of oxygen penetration into the mud. In contrast to the lander that was deployed on the Sula Ridge, this lander was recovered once it had completed the measurements after about 12 hours on the seafloor. Deployment and recovery of such delicate equipment can be difficult depending on the sea state and the composition of the seabed. After several successful deployments, the lander became stuck in the mud at a deep sampling station off Svalbard, and could not be recovered despite much time spent attempting to free it. There it remains, for the time being at least.

Life on board was not all hard graft. Work tended to be very concentrated on the sampling stations. Once these were completed and the ship was on passage to the next site, scientists and crew had

My PhD Project

Why should this be of interest, you ask? Well, the answer is one of scale. It has been estimated that, over the whole of the world's oceans, roughly a billion tons of zooplankton swim into the surface layers each and every night, only to descend again at dawn. The interesting story is this: a proportion of the food eaten at the surface at night is released at depth during the day through excretion, defaecation and respiration. This food contains important elements such as carbon which, for the most part, originated in the atmosphere. If taken sufficiently deep, these elements will be stored in the watery depths for substantial periods of time (maybe thousands of years). The DVM of these unassuming creatures might therefore be helping to reduce atmospheric concentrations of carbon dioxide, which, as we all know, is the primary cause of the dreaded 'greenhouse effect'.

So will it be zooplankton to the rescue? It has actually proven surprisingly difficult to establish this. In 1997, it was suggested that simply measuring the dawn/dusk difference in the body carbon content of individual migrants would provide the necessary information. In 1999, three very different study sites were chosen for field trials of this technique: the Clyde Sea in Scotland, the Sargasso Sea off Bermuda, and Doubtful Sound in New Zealand. A year-long time-series study in the Clyde Sea built on a rich history of zooplankton studies in this region, most notably those of the Scottish Marine Biological Association since 1894. A three-month visit to Bermuda, funded by a SAMS bursary and the Graduate Internship Program at the Bermuda Biological Station for Research, enabled me to test the technique in one of the most heavily documented oceanic environments in the world. A two-month visit to Fiordland in New Zealand, funded by the Link Foundation/Anglian Water Fellowship Award, brought the technique to a remote and beautiful corner of the world to test its applicability even further.

These field trials revealed a variety of interesting results. It was found that the nature of DVM, especially in the Clyde Sea, was variable and often difficult to interpret with the conventional sampling methods used. This resulted in an inability to apply the technique satisfactorily as

Jane's scientific career started in 1985 at Edinburgh University where she studied geology and gained a B.Sc. (Hons.) degree. She remained at Edinburgh for the following two years working in the geology department with her interest in geochemistry eventually taking her back to university to complete an MSc in Geochemistry at the University of Leeds in 1993. After gaining her masters Jane returned to Edinburgh University to work for Graham Shimmield and Brian Price on the Land Ocean Interaction Study - Shelf Edge Study. This marked the beginning of her sea-going career, an aspect of her work at which she excelled and which she enjoyed immensely, eventually working in many of the world's oceans.

In 1996 Jane moved to Oban as Graham Shimmield's research assistant working for NERC at Dunstaffnage Marine Laboratory. Here her scientific career broadened and she studied the geochemistry of sediments off SW Africa (IMAGES), worked within the Atlantic Database for Exchange Processes at the Deep Sea Floor and the Baltic Sea Study. Besides the many national and international scientific programmes, Jane was actively involved in the core strategic science within both the Centre for Coastal Marine Science and – after joining SAMS in August 2001 – the SAMS Northern Seas Programme. At SAMS Jane was an invaluable member of the geochemistry group participating in deep-sea cruises, presenting scientific results at national and international conferences and publishing her research findings in peer reviewed journals.

Jane lived life to the full and found happiness and fun in all that she did - including her work. She was a great person to have at sea in good or rough weather. She worked hard while keeping everyone amused with witty anecdotes; but woe betide the person that took up the Scrabble or Monopoly challenge, as there was no mercy and Jane took no prisoners! Back on land she was a member of the social club and was always the first to offer to help arrange the many and varied fun evenings that are a part of SAMS. These ranged from *It's a Knockout* and fancy dress parties to Autumn Balls.

Jane's death from cancer came all too suddenly. But true to form, Jane's sense of humour was evident to the end.

The marine community has lost an excellent scientist. Friends and colleagues have lost a great friend and a truly lovely person. But Jane left us all with some wonderfully happy memories which will remain with us always. ●

When I arrived in Scotland two years ago to start a PhD on the environmental benefits of using adaptive feeding systems in the cage culture of Atlantic salmon, *Salmo salar*, I knew little about fish farming and even less about the high feeling that surrounds the issue. Initial concerns, that there might be little

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While hand feeding still dominates the production of Atlantic salmon in Scotland, adaptive feeding systems are increasingly being used to improve food conversion ratios and thereby reduce costs. But do these new feeding systems also bring environmental benefits? Adaptive feeding systems provide the optimum level of food that the fish require and should thus result in reduction of particulate waste - especially uneaten food pellets - released from cages.

This study investigates the flow of feed, faeces and particulate matter from a cage to the seabed at a farm site at Portavadie on Loch Fyne that uses an adaptive feeding system. A series of sediment traps were deployed at increasing distances from a 22 m circular cage for one tidal cycle. The traps were sampled every three days. Hydrographic data was collected over the same period.

To-date the study has shown that the amount of carbon reaching the seabed does not vary significantly over the two-week sampling period. This is not very surprising as fish biomass and feed quantities change very little over two weeks. Comparisons between samples collected in February and October, when fish biomass had increased significantly, are currently under way.

Carbon was found to decrease exponentially with distance from the cage centre. There were statistically significant differences between samples from under the cage, 5 m distance, and all remaining sample sites. Variability in carbon content also decreased with increasing distance from the cage centre, which highlights the patchy nature of particulate settlement under and around cages. Mean carbon sedimentation rate 25 m from the cage edge - while low at 1.99 gC m^{-2} d^{-1} - was still more than seven times higher than background levels, which suggests that cage outputs continue to influence the seabed beyond 25 m.

The results from this study are used in the testing and validation of computer models. Particulate tracking models are now regularly used to assess the likely effects of fish farming. The DEPOMOD model is frequently used both by regulators and decision-makers. Using the Institute of Aquaculture's own spreadsheet model, the results from this study suggest that the model overestimates nutrient loading directly beneath cages. Further validation is under way and includes comparisons with 'hand fed' sites, an assessment of nutrient deposition relative to feed input and fish growth, and a benthic survey, all of which is required to fully assess the benefits of using adaptive feeding systems. ●

Richard Corner is a second year PhD student at the University of Stirling, working under the supervision of Trevor Telfer (Stirling), Donald Baird (Stirling), James Deverill (Akvasmart), and Kenny Black (SAMS). *His project is funded by a NERC Case Award and Akvasmart Limited.*

The European Centre for Marine Biotechnology

For the past two years l0.00020q3 6bhe own and

Scotland has a thriving biotechnology sector, well able to hold its head up in Europe and the wider world, and yet to date we have paid little attention to our richly resourced coastline, offshore deep-water sites and sea lochs. Marine biotechnology is too often interpreted to mean biotechnology as applied to the marine environment and as a consequence often appears to be irrelevant to those operating outside the field of marine science. In an era when biotechnology will impact on each and every one of us, I hope to turn this definition on its head and show that marine biotechnology is much more about deriving biotechnology based products and solutions from the sea; learning from marine flora and fauna of ways to tackle everyday issues from healthcare to agriculture. Throughout, we need to be ever mindful that we are only temporary guardians of this vast, untapped, natural resource, and our pursuit of answers must have no lasting environmental impact.

As ECMB takes shape over the next two years it will emerge as both a company in its own right, conducting its own commercial marine biotechnology programme, and as a state-of-the-art incubation facility for home-grown and incoming organisations operating in and related to the field of marine biotechnology.

The scientific work programme will most likely be governed by the elements of the existing SAMS programme that are most closely aligned with biotechnology, in addition to the superb natural resource available. When considering these two factors it is perhaps not surprising that exploitation of high-value products from micro- and macroalgae comes readily to mind, and work has already been initiated in these areas working with groups located elsewhere in Scotland.

It is now well recognised that business incubators greatly increase young company survival rate, providing a supportive environment from which to grow. It is intended that the ECMB will provide commercial, incubation-style laboratory and office accommodation, attracting organisations wishing to operate from the centre of a marine focused cluster. A tailored package of business support will be available to all tenants, along with an extensive range of support services. Moreover groups will have access, on a pay-as-you-go basis, to the well equipped scientific facilities, thereby reducing, and possibly negating, the need for expensive capital outlay. It is intended that graduation space will also be available in the area allowing companies to plan for the long-term.

ECMB will actively encourage networking between tenant organisations and will seek to form strategic alliances with groups operating from the site and in complementary geographic regions, within Europe and further afield. The aim will be to establish in each case a multi-layered relationship where, as appropriate, teaching, research, and commercial collaboration can be nurtured. The longer-term aim is to position ECMB as part of a network of facilities, with individuals, groups and companies moving freely between centres located across the globe, thereby greatly facilitating market penetration and further enhancing collaborative opportunity. ●

Dr. Jo Oliver is the newly appointed ECMB Project Executive and a member of the SAMS directorate.