SCOTTISH ASSOCIATION *for* MARINE SCIENCE

ANNUAL REPORT 04-05

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Director	Professor G B Shimmield

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DIRECTOR'S INTRODUCTION

This Annual Report records a year of considerable progress for the Association, marked by some significant peaks and, regrettably, one trough. In the fourth year of the new agreement with NERC, SAMS has a diverse and challenging portfolio of activity ranging from the core science programme (The Northern Seas Programme), to a wide variety of commissioned research activities, teaching via the UHI Millennium Institute and commercial activity with its subsidiary companies. We also endeavour to increase the public's awareness and appreciation of our science as well as serving our members, who receive regular newsletters and access to scientific meetings and seminars. There were several significant milestones in the history of SAMS during the year.

SAMS Director Professor Graham Shimmield, reflecting on the past year during a SAMS Northern Seas research cruise in the Arctic

The first of these was the quinquennial Science and Management Audit (S&MA) conducted by NERC in the last part of 2004. The S&MA was part of a national review of all NERC-supported marine science laboratories. Following intensive compilation of supporting documentation and science reports, an international peer review panel chaired by Professor Ian Johnston of St Andrews University, made the following comments in their comprehensive report to the NERC Chief Executive, Sir John Lawton:

"[SAMS'] high risk, high reward strategy has resulted in generating sufficient support to fund and build a £11.2 million new laboratory and rejuvenate SAMS during the few years of the review period. Staff morale is high. SAMS is an excellent example of managing change successfully and the Director and his supportive Council and senior management team deserve full credit for this achievement." "The SMA Team was very impressed with the Culture Centre for Algae and Protozoa and endorsed the decision by NERC to unite the freshwater and marine collection at SAMS, which was completed in 2004." "External stakeholders submitted very positive inputs to the SMA process, evidencing the Team view that SAMS performs well in all the areas of knowledge transfer. This includes their high quality advice to UK Government consultations and those of the Devolved Administration."

These endorsements for the activity of the Association have been well received, although there remains a substantial challenge to raise the scientific profile and output to match the leading international marine laboratories around the world. I would like to take this opportunity to thank all the staff for this excellent review result, and in particular SAMS Council under the Chairmanship of Dr Ian Graham-Bryce within whose watch, the new laboratories and the NERC-SAMS Agreement were transformed from ideas to reality. At the 2004 AGM, SAMS elected its new President, Sir John Arbuthnott, to succeed Dr Ian Graham-Bryce.

The aspiration of re-establishing the former Seafish-owned research facility at Ardtoe, as a significant capability in experimental and applied marine ecosystems and environmental impact of white fish aquaculture, regrettably failed to be sustainable. The news that the SAMS owned subsidiary company, SAMS Ardtoe Ltd, would need to go into liquidation with the potential loss of 12 jobs was a blow. SAMS Ardtoe Ltd was seeking core funding support from the Scottish Executive, but unfortunately the case for support was not accepted. Luckily, a buyer was found, and between Viking Fish Ltd and SAMS all but two staff were kept in employment. In addition, the irreplaceable broodstock of halibut, cod and haddock were maintained, although a key strategic academic research facility was lost.

DIRECTOR'S INTRODUCTION

Within the education activity undertaken in partnership with the UHI Millennium Institute, SAMS was delighted to award First Class and Upper Second Class Honours Degrees in the first year of Honours graduation for the BSc in Marine Science. The post-graduate school continues to build with 35 excellent students spending some or all of their time at Dunstaffnage, making a significant difference to both the intellectual and social atmosphere of the laboratory.

SAMS staff in front of the new building

Highlights of SAMS' commercial activity in the area of Marine Biotechnology were the arrival of the first tenants for the European Centre for Marine Biotechnology, and its formal opening by Baroness Susan Greenfield on the 5th April 2005. Aquapharm Biodiscovery Ltd, are now fully integrated into the ECMB development concept and have been enjoying a national increase in awareness of the value of Marine Biotechnology, and the opportunities available to early start-ups. In this area, SAMS has enjoyed substantial and unconditional support from its Local Enterprise Company, Argyll and the Islands Enterprise, and its parent, Highlands and Islands Enterprise.

Baroness Susan Greenfield opens the European Centre for Marine Biotechnology

As I approach my tenth year in the role of Director of SAMS, I am more reflective than ever on the huge privilege it is to work with the staff, members and Council that create the spirit that pervades the Association. Nearly everyone I meet comments on this very special aspect of the organisation that it is impossible to create deliberately, but is the product of team work, an adventurous approach, and a determination to succeed. I hope that you will find within the pages of this report, the excitement associated with the scientific and operational endeavours of our last year's work that provides the foundations on which the Association is moving forward.

Graham Shimmield

NORTHERN SEAS PROGRAMME NSP

Melting summer sea ice off East Greenland

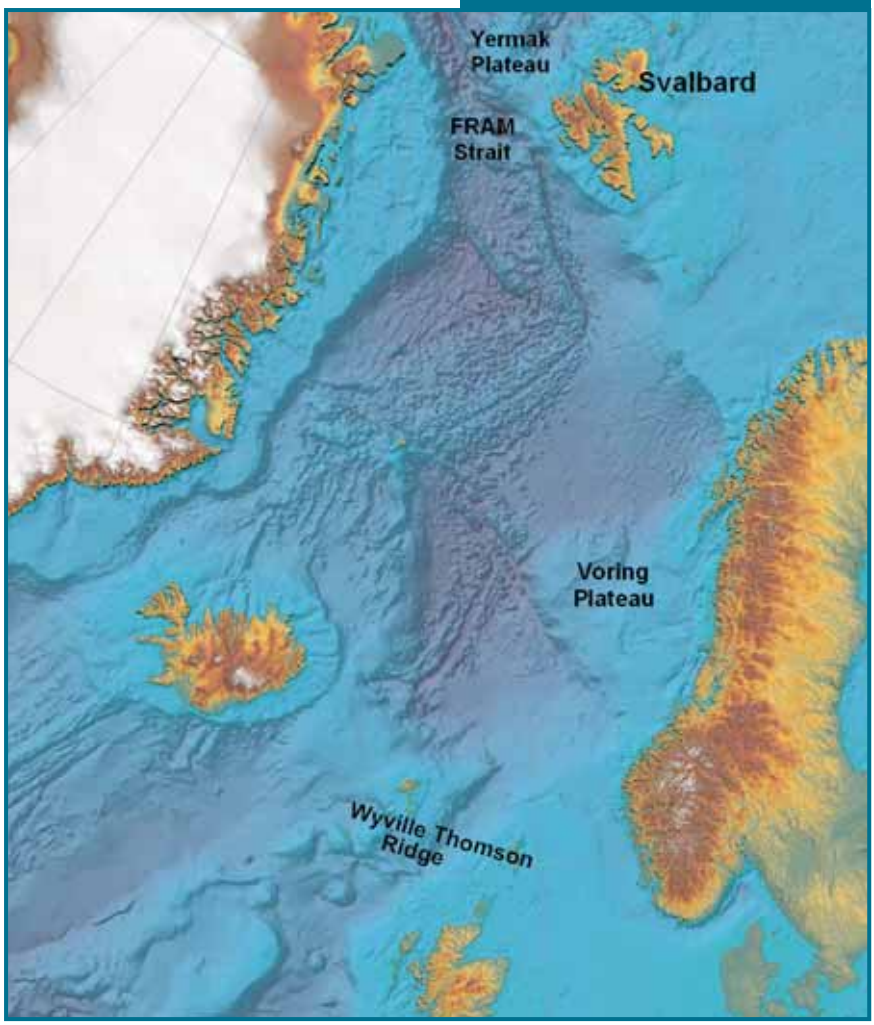
NORTHERN SEAS PROGRAMME NSP

The overall objective of this 5 year NERC – funded programme is to improve our understanding of how the sensitivity of marine ecosystems to environmental perturbations, both natural and anthropogenic, varies along a latitudinal gradient. There are three themes to the programme:

Theme A: Understanding fjordic systems - insights for coastal and oceanic processes.
Theme B: Ocean margins - the interface between the coastal zone and oceanic realm.
Theme C: Measuring and modelling change - sea sensors and bioinformatics.

The research conducted by SAMS has become increasingly global since the 1970s, but until recently we had little involvement in the Arctic. The NSP has allowed us to take our expertise in environmental research northwards to the waters around Spitsbergen and, at the same time, broaden it. Some of the highlights of the programme from the past year are summarized below.

The SAMS Northern Seas Programme study area



Rapid Shifts in Arctic Marine Climate

Kongsfjorden in northwest Spitzbergen is a key location for studying water mass exchange across the West Spitzbergen Shelf. With additional financial support from the Royal Society, we have been working in close co-operation with colleagues from Norwegian Polar Institute and the University Centre in Svalbard to understand the mechanisms and impacts of the seasonal shift in hydrography in this region. The significance of this work relates to the variability of northward transport of heat and salt to the Arctic and its impact on regional ecology and ecosystem function. During late spring, the fjord experiences a rapid hydrographic shift switching from an Arctic state (cold and fresh) to an Atlantic state (warm and salty). Using data from moored instruments we have been able to unravel the processes that determine how Atlantic water propagates across the shelf and fills the fjord. The magnitude of this switch varies between years and we are beginning to explore the controlling parameters and how this event is recorded in the sediment record. Rapid exchanges of water masses impact significantly on the ecosystem structure, notably the zooplankton populations. Through our understanding of the exchange process we have been able to interpret the seasonal change in zooplankton populations which is key to understanding the transfer of food energy through the pelagic ecosystem.

F Cottier and M Inall

NORTHERN SEAS PROGRAMME NSP

A new category of Sea Loch

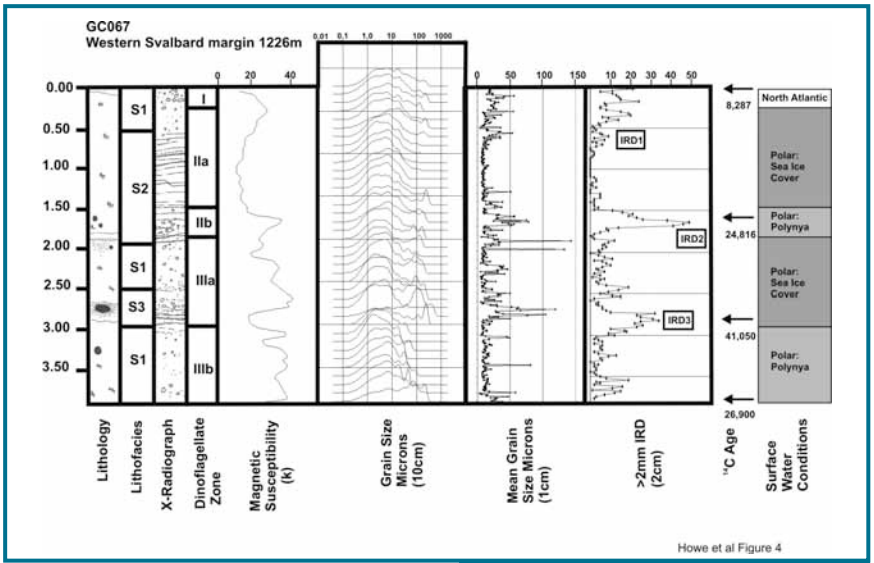
The tidal regime of the fjord Loch Etive has been long studied. Nevertheless, aided by new observations and computer models (in collaboration with colleagues at the University of Plymouth), we have defined a new category of fjord. In terms of the popular classification that separates fjords into two categories: jet-type or wave-type, we find that Loch Etive possess characteristics of both. There is a very weak non-linear response due to strong supercritical conditions over the sill and a quite remarkable linear signal produced by the subcritical part of the sill. In this respect Loch Etive is defined as a ``hybrid-type'' fjord, and we now suggest that many jet-type fjords should correctly fit into this new category.

M Inall

Glacial sedimentation and surface water conditions from the Fram Strait

Two sites in the Fram Strait have been surveyed and sampled using multibeam bathymetry, sub-bottom profiling and coring, providing a record of climatic variability over the last 46ky. On the western Svalbard margin, a sediment mound in 1226m of water is interpreted as a sediment drift. It is 80m high and 5km in lateral extent and contained at least 100m of acoustically well-laminated sediments. A 4m long core from it revealed fine-grained laminated muds with abundant ice-rafted debris. These sediments are interpreted as fine-grained laminated silty turbidites, the product of downslope sedimentation with muddy-silty contourites, the result of the alongslope flow of the West Spitsbergen Current. Radiocarbon dating indicates an age range of early Holocene (8.2ky BP) to mid-late Weichselian, including the Last Glacial Maximum 26.9ky BP. In contrast, the Yermak Plateau nearby is characterized by acoustically well-laminated sediments draped on the margin in a water depth of 961m. A 3.5m long core recovered fine-grained, faintly laminated muds, with minor amounts of ice rafted debris. These sediments are interpreted as silty contourites. Radiocarbon dating of this core revealed ages between 8.6 – 46.4ky BP (Holocene-middle Weichselian). Analysis of dinoflagellate microfossils contained in the sediments at both sites indicates changing surface water conditions. The Early Holocene-post Last Glacial Maximum interval, (9 -26.9ky BP approximately) is dominated by temperate, North Atlantic water with high productivity and open water conditions. The Last Glacial Maximum is characterised by severe, high polar conditions, although with some short-lived polynyas (open water in the sea ice). The pre-Last Glacial Maximum contained severe polar conditions although again with some short-lived phases of open water and limited surface productivity.

JA Howe



Core from the western Svalbard Margin showing the range of features studied. ^{14}C ages are indicated as well as summary surface water conditions and position of ice-rafted debris events IRD1-IRD3.

Biogeochemical cycling and the transport of pollutants within Northern Seas

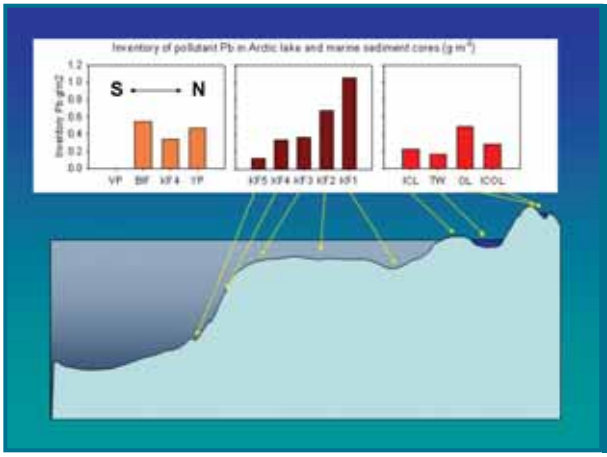
Marine sediments support complex and diverse animal communities, and many studies clearly demonstrate the impact of individual species on organic matter burial, sediment-water solute fluxes and other geochemical processes. At a larger scale, it has been estimated that 21% of benthic carbon mineralization in the Atlantic is mediated by benthic fauna. Work in this science area has been focused in two areas, firstly on the natural 'experiment' provided by the Wyville

NORTHERN SEAS PROGRAMME NSP

Thomson Ridge, where two sharply contrasting seabed environments lie in close geographic proximity under a common surface water mass and secondly, a series of deep-water stations along the Norwegian Sea continental margin. These stations are subject to local contrasts in organic input from shelf and sea-ice production superimposed on a latitudinal gradient in timing and intensity of pelagic flux.

One scientific issue that has been studied is the transport and magnitude of anthropogenic pollutants within Northern seas; an understanding of which is important when assessing the impact of pollutants on both the ecology and the indigenous people of the area. The isotopic composition and the concentration of lead in marine sediments provide information on the magnitude and source of pollutants reaching these areas. Sampling at stations north and south of the Wyville-Thomson Ridge has revealed different anthropogenic signatures with the northerly station, Arctic influenced, showing a larger anthropogenic input compared to the southern station, influenced by the temperate, North Atlantic. This is the antithesis of the traditionally-held view of northward advection of anthropogenic pollutants. However this higher anthropogenic input may be a reflection of the extremely large freshwater catchment draining into the Arctic basin.

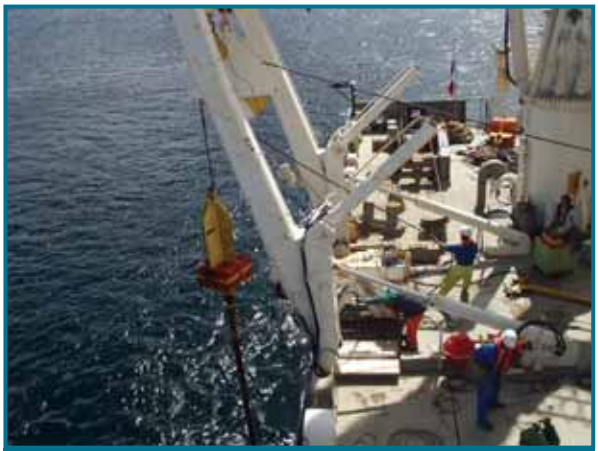
TM Shimmield



Stable Pb isotope results from cores taken around the Svalbard archipelago. Graph A shows little variation along a latitudinal transect from S to N. Graph B shows a decreasing pollutant Pb inventory from coastal areas (Kongsfjorden, KF1-3) to the deep-ocean (KF5). Graph C shows Pb levels in lake cores (atmospheric lead source). BIF, Bear Island Fan: VP, Voring Plateau: YP, Yermak Plateau.

A record of Holocene climate and sea level change, Loch Sunart, western Scotland

During June 2004 the French research vessel, R/V *Marion Dufresne* obtained the longest core ever taken from Scottish coastal waters. The 22m continuous core was collected by SAMS as part of the NSP, in on-going collaboration with the Universities of St Andrews and Caen. Preliminary results indicate that the core contains a detailed record of environmental change over the last 10,000 years, preserving an indication of changing climate, sea levels and the influence of man on the surrounding land.



The giant (30m) piston corer being deployed from the R/V *Marion Dufresne* in Loch Sunart.

Benthic faunal composition and size structure in northern waters

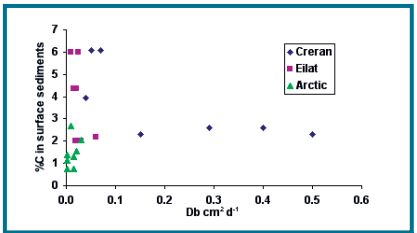
The cancellation of the 2004 *Discovery* cruise meant that no new sampling was carried out during the year. Recent results from benthic biological samples from the 2002 *James Clark Ross* cruise to the Norwegian Sea and the 2003 *Poseidon* cruise to the Wyville-Thomson Ridge suggest that there are significant changes in the size structure of benthic communities between stations along the Norwegian Sea continental margin. An interesting result from the 2003 *Poseidon* samples is the finding of representatives of the enteropneust worm family Torquaratoridae at the study site north of the Wyville-Thomson Ridge. This family was formally described as recently as March 2005 and was known only from the Pacific.

Data collected by the 1998-2000 NERC BENBO Thematic Programme have provided models for forthcoming publications from the NSP and will allow ocean basin-scale comparisons of benthic community structure and biogeochemistry between the deep Norwegian Sea and temperate NE Atlantic.

DJ Hughes

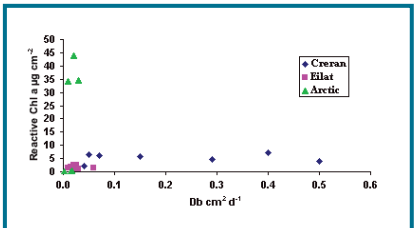
Bioturbation

Bioturbation is the process of sediment mixing through animal activities. Mixing intensity depends on properties of the benthic biological community present e.g. its abundance, distribution and activity. In soft sediments, the benthic community is a function of food supply and, for a given community, the rate of bioturbation will depend on the temporal variability of that supply. Thus, bulk carbon content and more particularly labile carbon content, should be related to bioturbation rates. We now have data on sediment carbon



Biodiffusion coefficient and % carbon in surface sediments.

content (%C) and chlorophyll a inventories, together with chlorophyll a profile-derived biodiffusion coefficients (Db) from 3 widely differing environments: Loch Creran, the Gulf of Eilat and the



Biodiffusion coefficient and reactive chlorophyll in surface sediments

Arctic (Kongsfjord). Db is much greater at 2 stations (replicated) in Loch Creran than at any other station. In the oligotrophic Gulf of Eilat, the benthic fauna are very sparse and mixing is correspondingly low. The fauna of the Kongsfjord, however, are relatively abundant and so the low mixing rates measured there may be a consequence of a different community behavioural response to OM input compared to Loch Creran. Other factors may confound the relationship, including the type and nutritional quality of available carbon, depth and temperature, which will influence activity rates. Further measurements to be made in the Arctic in 2005, will help to elucidate these relationships and potentially reveal any latitudinal component.

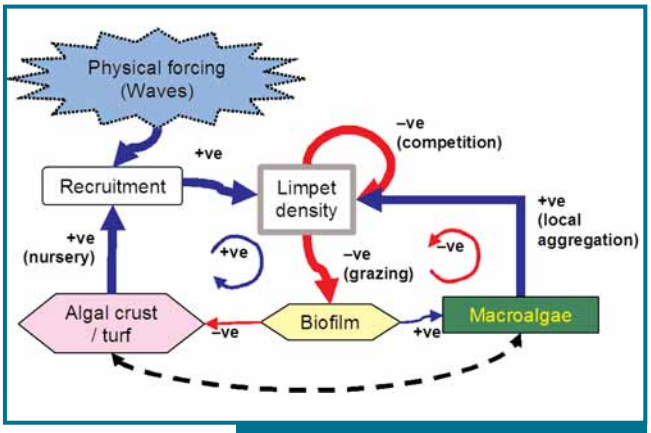
KD Black and staff of the Ecology, Biogeochemistry and Earth Science Departments

Grazing limpets can control rocky shore ecosystem structure

An important element in structuring rocky shore communities is so-called 'keystone' species such as macro-algae, grazers, mussels and barnacles. While the small-scale ecology of some of these is well known, their role in determining large-scale patterns of community structure on rocky shores is less well understood. However, by treating groups of shores along the Scottish west coast mainland and selected islands as spatially replicated rocky shore systems, we hoped to examine grazing effects at a number of scales. In the latest phase of this study we chose the common grazing limpet *Patella vulgata* to assess its role and thus develop models of the interactions involved.

We have discovered that grazer control in this system seems to involve two feedback loops operating at different spatial scales. Over whole shores, grazing by limpets appears to promote the development of grazer-resistant crusts and turfs, which in turn promotes recruitment of juvenile limpets: positive feedback. At small scales (<1m), 'escapes' of larger macroalgae cause limpets to aggregate around them and further inhibit local growth of macroalgae: negative feedback. In addition, grazer control seems to be driven by a number of complex processes involving the population dynamics of the grazers themselves and interactions between grazers, the microbial biofilm and larger macroalgae. These processes can be summarized in a conceptual model, as the first step toward modelling the consequences of such controls.

MT Burrows, L Robb and R Harvey



A putative interaction web for processes controlling rocky shore community structure.

PHYSICS, SEA ICE AND TECHNOLOGY DEPARTMENT

Department members: Dr M Inall (Head), Mr DT Meldrum (Deputy Head), Dr P Gillibrand, Dr P Provost, Dr T Sherwin, Mr B Barr, Mr F Cottier, Mr C Cromey, Mr M Doble, Mr C Griffiths, Mr N Hughes, Mr D Mercer, Mr O Peppe, Mr J Wilkinson

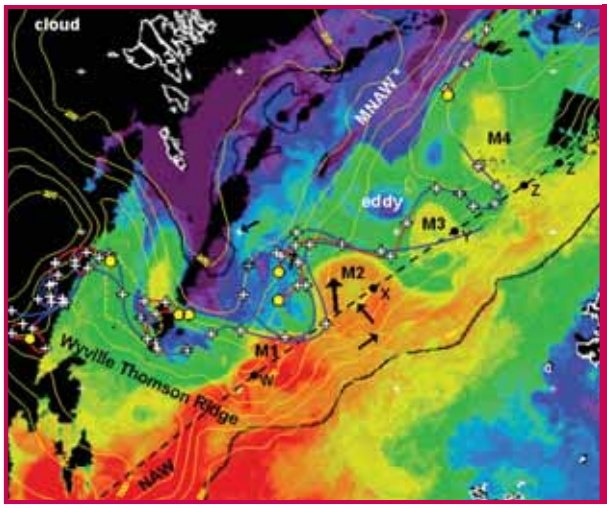
CTD with rosette water sampler being deployed

PHYSICS, SEA ICE AND TECHNOLOGY DEPARTMENT

Restructuring at SAMS now brings the former Marine Physics, Sea Ice and Technology Groups under a single Department structure. Here we highlight activities carried out over a diverse range of projects.

Thermohaline circulation in the North-East Atlantic

In collaboration with partners from FRS and other North European laboratories, we have continued to monitor and investigate the thermohaline circulation in the North–East Atlantic. This circulation plays an important role in controlling the climate of Western Europe. Although temperature and salinity in the Faroe-Shetland Channel have been regularly observed since the 19th century it has only recently been recognised that the channel has a very dynamic physical regime. By studying global archives of drifter and satellite altimeter data, physicists at SAMS have demonstrated that large mesoscale meanders and eddies mix two important surface water masses, from the eastern and western sides of the Atlantic, and help to condition the North Atlantic Current as it enters the Norwegian Sea. Current speeds of up to 0.7 m s^{-1} can be found in the centre of the channel.



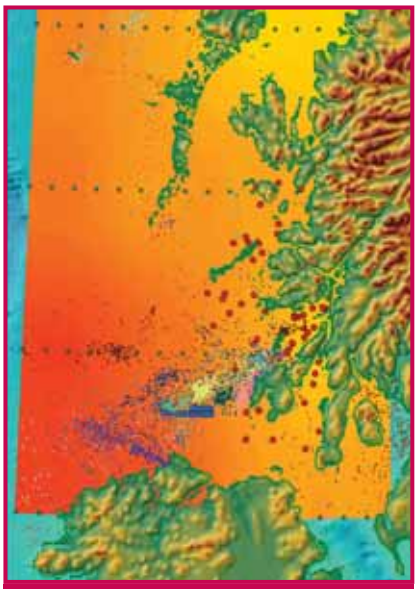
AVHRR image of sea surface temperature in the Faroe-Shetland Channel at 04:23 19 May 1999 in which M1 to M4 are meanders of a pronounced front between different water masses. Surface drifter tracks are coloured red from 14 May to 19 May and blue until 24 May with yellow circles at the start, and '+' signs at midnight each day. Near surface current vectors from the highest bin of four ADCPs are scaled to the drifter tracks. The dashed line is TOPEX/Poseidon track 37, with peaks in sea surface height 'W' to 'Z'.

Further research has been undertaken to monitor and quantify the southward overflow of cold water across the Wyville Thomson Ridge, part of the return flow of the thermohaline circulation from the Arctic. Data from ADCP current meters moored on the ridge reveal that the magnitude of the overflow on its southern side is about 0.6 Sv ($6x10^5$ m^3 s^{-1}), with a mean current speed of about 0.35 m s^{-1}. The flow itself is very variable, and work is continuing to understand and quantify the processes that drive the overflow and give rise to its variability.

T Sherwin

The distribution and abundance of marine mammals in relation to physical oceanographic variables in Scottish waters

SAMS is collaborating with the NERC Sea Mammal Research Unit (SMRU) to investigate the distributions and abundances of marine mammals in waters to the west of Scotland, and relate them to physical oceanographic variables. The goal of the study is to develop a predictive tool that can assess the likely presence or absence of marine mammals based on the observed physical environment. Such a tool is required by the Ministry of Defence so that naval operations can be planned to have minimal effects on marine mammal populations. In addition to extracting relevant data from historical sources, observations of seal and cetacean distributions in the Minch and Sea of the Hebrides were made during two cruises on SAMS' research vessel *Calanus* in 2004. During the cruises, contemporaneous measurements of water temperature, salinity and chlorophyll a concentrations were made using state-of-the-art undulating CTD technology. In addition, satellite data of sea surface temperature and ocean colour for the region going back to 1999 have been acquired from the Remote Sensing Data Analysis Service at Plymouth Marine



A GIS image showing locations of CTD data obtained from the SAMS research vessel RV *Calanus* and the Hebridean Whale and Dolphin Trust vessel *Silurian*, locations of temperature profiles obtained from tagged grey seals (data from SMRU), and the climatological sea surface temperature for the Malin and Hebridean shelf regions (data from the UK Hydrographic Office). The data are all overlain on a map of the seabed bathymetry.

PHYSICS, SEA ICE AND TECHNOLOGY DEPARTMENT

Laboratory, and numerical model predictions of sea temperature, salinity, current speed and direction, phytoplankton and zooplankton biomass and primary productivity for the entire NW European continental shelf for 2002-2004 have been provided by the Meteorological Office.

The environmental data collected have been processed and archived in a database which is accessed by a Geographical Information System (GIS). These data will be analysed in relation to observational data on seal and cetacean distributions collected by SMRU. We will be seeking to identify the strongest environmental predictors of marine mammal abundance so that the presence of these animals can be reliably predicted in future.

P Gillibrand

Retreat of Arctic sea ice

Satellite data have shown a gradual reduction in the area of perennial (multi-year) ice throughout the Arctic. In addition, measurements performed by the group from submarines travelling under the ice reveal that the summer ice thickness over much of the Arctic Basin has declined by some 40% since the 1970s, amounting to a reduction in mean thickness of 1 – 1.3 m. If this trend continues, computer model predictions suggest that the Arctic could be ice-free in summer within a few decades.

In order to better understand these changes we are co-ordinating an EU funded programme GreenICE (Greenland Arctic Shelf Ice and Climate Experiment), which involves five other partners from Denmark, Germany and Norway. We aim to measure the changes in the structure and dynamics of sea ice that have occurred in recent years, in the part of the Arctic north of Greenland where data are sparse, and to relate the causative mechanisms to the long-term (greater than 2000 years) variability as revealed by sediment cores. In addition we are partners on another EU programme, SITHOS (Sea ice thickness observing system) co-ordinated by the Nansen Centre in Bergen, which involves the evaluation and development of different basin wide ice thickness mapping techniques. The group has been evaluating the use of ice thickness measurements from tilt meter buoys, Autonomous Underwater Vehicles (AUV) and submarines in order to obtain reliable basin wide data. Nick Hughes participated in the mission by the submarine HMS Tireless to the North Pole in 2004 and the group had the use of the NERC AUV Autosub from the James Clark Ross in the region of north-east Greenland and also the Weddell Sea in the Antarctic.

M Doble, N Hughes, P Wadhams and J Wilkinson

Autonomous Platforms – landers, Homer and ice-buoys

As part of our general philosophy of moving away from expensive and unrepresentative ship-based observations of the ocean, we have continued development of sea-bed observatories (landers) and a unique sea-bed-resident profiling vehicle (Homer). While much of the lander work is described elsewhere in this document, further developments of sediment probing techniques and incubation chambers have been funded under the EU COBO programme. In parallel, Homer, a buoyant sensor sphere tethered to a sea-bed winch, has now been demonstrated in a number of different environments, from the shallow waters of Loch Etive to the deep cold waters of the Denmark Strait. This vehicle is attracting much interest because of its potential to routinely gather water column data without requiring a permanent (and vulnerable) mooring. We are being funded by DEFRA to develop a Homer-based prototype Deep Water Observing System, to be based close to a Meteorological Office moored buoy. The continued deployment and development of the highly successfully sea-ice buoys, under both NERC and EU funding, has continued. Within this year a further eight buoys were deployed in the Arctic as part of the EU GreenICE programme and one in the Antarctic for the NERC funded Autosub Under Ice programme. Within the next year we will deploy a further 16 of these buoys in the Arctic.

DT Meldrum, M Inall, M Doble and J Wilkinson

Web-based interactive science

The aim is to follow the outreach philosophy of major activities such as the US 'Neptune' programme to foster the public understanding of science through public real-time web access to scientific data, and even allow the opportunity to participate in the scheduling of experiments. As a first step, we have initiated a pilot web-site to publish in near real time a sub-set of the Arctic data described above: see http://dalriada.nsm.ac.uk/php.

D Mercer

BIOGEOCHEMISTRY AND EARTH SCIENCES DEPARTMENT

Department members: Dr TM Shimmield (Head), Dr K Howe (Deputy), Dr A Hatton, Dr A Miller, Mr T Brand, Mr E Breuer, Miss K Doig, Miss C Haidon, Mrs S M [illegible], Mrs S McKinlay, Miss T Sa[illegible]er

SAMS Sediment profiling seabed lander on the deck of RRS *James Clark Ross*

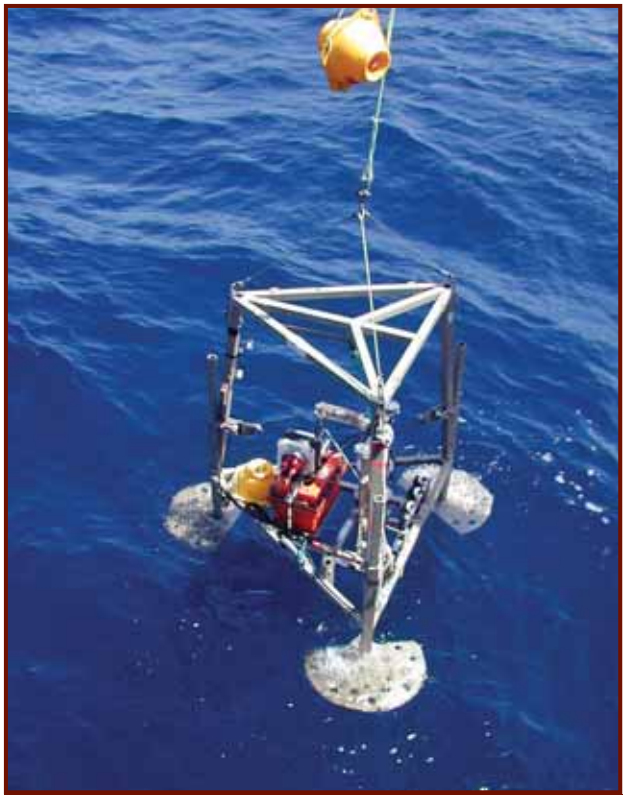
BIOGEOCHEMISTRY AND EARTH SCIENCES DEPARTMENT

Coastal Ocean Benthic Observatories (COBO)

The Coastal Ocean Benthic Observatories (COBO) project aims to develop innovative technologies from several scientific and engineering disciplines (physics, chemistry, biology, imagery, electronics, communication technology) to produce *in situ* systems that will enhance our present understanding of complex physical and biogeochemical interactions between benthic biota (their function and diversity) and the sedimentary environment.

Coastal ecosystems are particularly vulnerable to anthropogenic perturbation, affecting biodiversity and ecosystem stability and resilience. Shallow water sediments and their associated biota represent a reservoir for biodiversity, hosting resting and reproductive stages of planktonic organisms, and regulating carbon and nutrient cycles. However, the relationship between tightly coupled biological and geochemical processes in this environment is poorly known. Existing technologies have limited spatial and temporal sampling resolutions which have hampered progress in determining the fundamental processes and in explaining the biogeochemical patterns and processes needed to model ecosystem dynamics. Improved *in situ* technologies such as seabed landers are required to provide rigorous scientific information on processes regulating this unique and fragile habitat and for assessing, controlling and reducing human impact on European coastal waters. New benthic instruments from disparate scientific disciplines will provide powerful tools to significantly advance our understanding of organism -sediment relations under dynamic coastal conditions and enhance predictive capability. COBO represents a major step towards the development of permanently operating benthic observatories, aiding in coastal management.

E Breuer



The electrode lander being deployed in the Arabian Sea. The lander can stay on the bottom for up to a month collecting data.

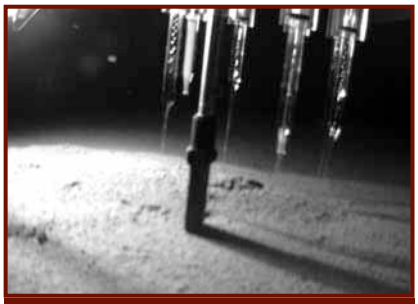


Image of the oxygen and pH electrodes slowly being inserted autonomously into the seabed at 300m depth in the Arabian Sea. These in situ measurements allow us to obtain high resolution oxygen and pH profiles with depth into the sediment without the disturbance created by bringing sediment back to the ship for measurements.

Benthic Biogeochemistry of the Arabian Sea

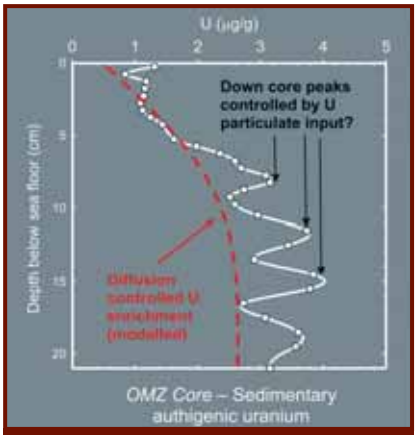
The SAMS Geochemistry group, together with colleagues from the University of Edinburgh, the University of Liverpool and the National Oceanography Centre, has been involved in a major NERC – funded research programme investigating the benthic biogeochemistry of the Arabian Sea Oxygen Minimum Zone (OMZ). Here, monsoon driven upwelling and the resultant bio-productivity sustains what is reputed to be the most expansive OMZ present within the modern oceans. Spanning a nominal depth range of some 800m, the underlying seafloor offers a unique natural laboratory for the study of benthic biogeochemical processes.

Over the entire monsoon cycle of 2003, SAMS scientists completed a demanding experimental programme that combined traditional sampling procedures, such as coring, with novel sampling techniques utilizing seabed lander technology. The research programme thus far has provided a multitude of novel insights into the workings of the OMZ benthic

BIOGEOCHEMISTRY AND EARTH SCIENCES DEPARTMENT

environment. Of particular interest has been the observation of trace metal cycling across the benthic boundary layer and within the underlying sedimentary environment. This novel study aims to address the many unanswered questions regarding the behaviour of certain trace metals which are increasingly used as environmental proxies in palaeo-climatic reconstructions. Indeed, results have highlighted that the conventional view of Uranium (U) geochemistry within the Ocean may need some serious revision. Traditionally, U is attested to portray purely conservative behaviour in the aqueous environment, irrespective of water column redox properties. Removal of dissolved U from the Ocean is only thought to occur in suboxic-anoxic sedimentary environments. Consequently, for many decades the presence of enriched U in the sedimentary record has been accepted as an indicator of sedimentary deposition occurring under reducing conditions. In contrast, observations and mass budget modeling of U within the OMZ has revealed that significant particulate U formation and export to the sedimentary environment occurs in the water column. Such findings dictate that increased concentrations of U in the sedimentary record not only reflect past suboxic/anoxic sedimentary environments, but in some cases may reflect the presence of extensive oxygen deficient conditions within the overlying waters.

G Law, T Shimmield and E Breuer



Observations of Uranium particulate formation from the Arabian Sea.

Recovery of a core from an Elinor benthic lander.

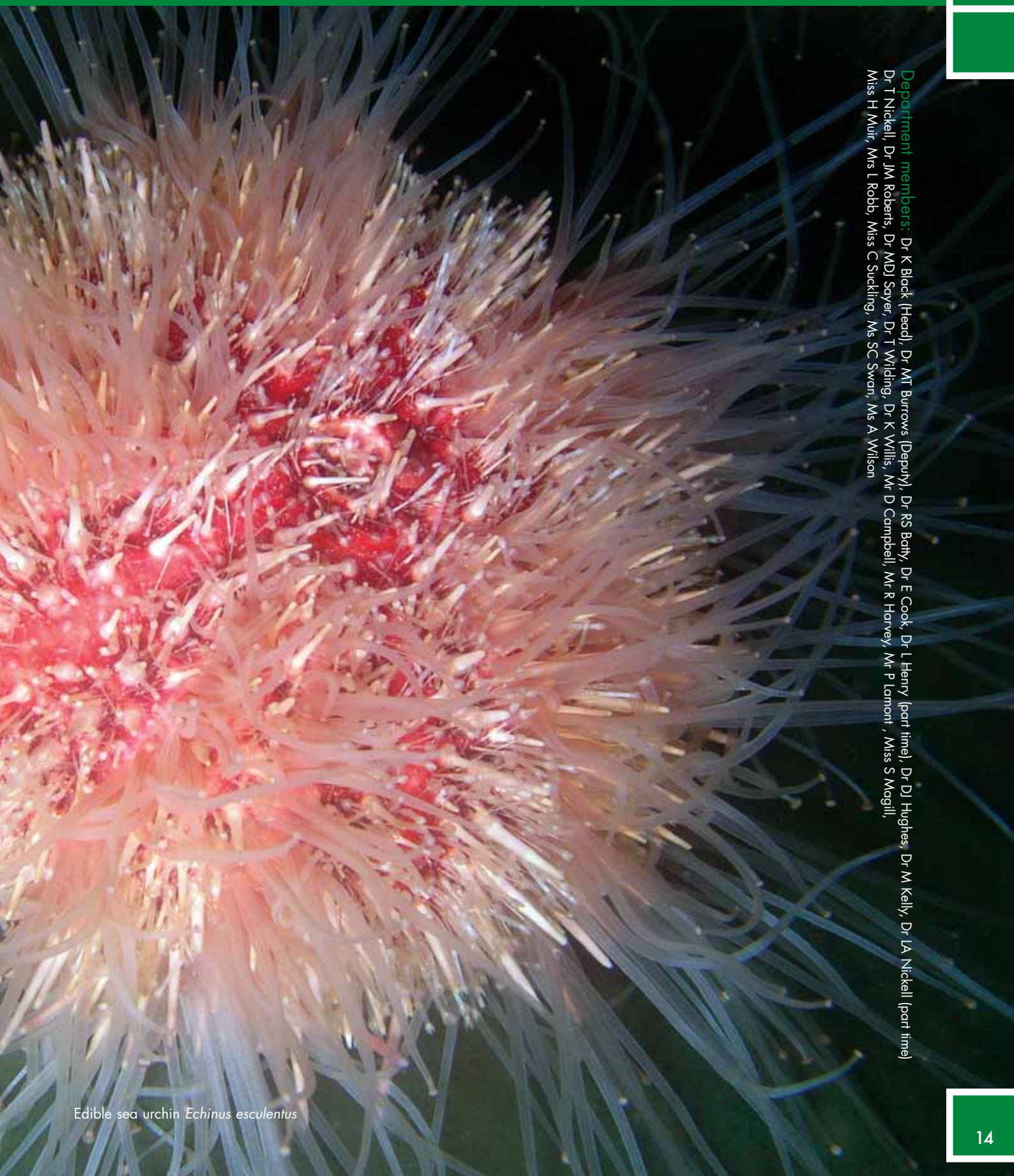
Environmental Marine (Littoral and Sub-Littoral) Baseline Survey

An extensive programme of field and analytical studies was undertaken by SAMS Research Services Limited on behalf of the United Kingdom Atomic Energy Authority (UKAEA). The survey was required to inform the Dounreay Site Wide Environmental Statement (SWES) which is part of the decommissioning plan for the Dounreay site. The study covered the biology of both the littoral and sub-littoral environments and investigated the metal and radiochemistry of both sediment and biota within the specified area. In support of the analytical work, desk top studies were undertaken to identify trends in both temporal and spatial concentrations of key elements of interest and comparisons have then been undertaken in order to position the findings of this study in the context of past discharges and natural variations inherent in the marine ecosystem.

T Shimmield

The Dounreay Site on the coast of the Pentland Firth.

ECOLOGY DEPARTMENT



Department members: Dr K Black (Head), Dr MT Burrows (Deputy), Dr RS Batty, Dr E Cook, Dr L Henry (part time), Dr DJ Hughes, Dr M Kelly, Dr LA Nickell (part time) Dr T Nickell, Dr JM Roberts, Dr MDJ Sayer, Dr T Wilding, Dr K Willis, Mr D Campbell, Mr R Harvey, Mr P Lamont , Miss S Magill, Miss H Muir, Mrs L Robb, Miss C Suckling, Ms SC Swan, Ms A Wilson

Edible sea urchin *Echinus esculentus*

ECOLOGY DEPARTMENT

The Ecology Department comprises staff and research students formerly in the Ecology and Behaviour, Deep Sea Benthos, Animal Environment Interaction and Coastal Impacts Groups.

'Green water' enhances background contrast and hence visibility of prey to larval fishes

Aquaculturists have observed enhanced prey consumption, growth and survival in fish larvae grown in water with unicellular algae added to it – 'green water'. Earlier experiments had shown that turbidity, rather than other possible factors, is responsible for this phenomenon. We subsequently investigated whether increased turbidity might affect prey discrimination, using underwater macro photography focusing on objects at the reaction distance of fish.

The addition of *Nannochloris atomus* to produce turbidities in the range 0 to 11 NTU altered the contrast between prey organisms and the background. In horizontal views, prey appeared brighter than the background but contrast reduced as turbidity increased until *Artemia* could no longer be resolved. When viewing vertically upwards or in an oblique view, prey appear dark against a bright background and contrast of prey items at the reaction distance of 1 cm does not decrease with increasing turbidity. More distant, out of focus, prey become less visible, however. Larval fish tend to react to and capture prey above the horizontal and within the area of Snell's window – the bright disc of light at the surface. Low levels of turbidity will therefore not reduce the encounter rate with prey but will make the background more even, reducing confusion for the predator.

RS Batty and R Leakey

Rigged? Cold-water corals are growing on oil platforms.

We now know that coral reefs are not only tropical phenomena. Large, spectacular cold-water coral reefs are found in deep waters around the world. At SAMS we began studying the biology and ecology of cold-water corals in the late 1990s. Then cold-water corals fell under the spotlight of environmental pressure groups concerned that the waste cuttings from deep-water oil drilling would smother the reefs. At the time no studies on cold-water corals were available and comparisons were drawn from work on shallow-water tropical corals. In 1999 we surveyed the reef framework-forming coral (*Lophelia pertusa*) growing on the legs of a North Sea oil platform. It had also been found on the infamous Brent Spar. But were these rare occurrences and were corals only found well away from any drilling discharges?

White and orange colonies of Lophelia pertusa, soft corals and sea anemones growing on a North Sea oil platform (Lundin Petroleum Ltd.)

For the last two years Susan Gass has been studying the corals growing on oil platforms in the North Sea as part of her PhD. By reviewing hundreds of video tapes we have discovered that *Lophelia* is widespread, colonising 13 of the 14 platforms studied. We negotiated with companies including Shell and BP so that during their routine platform inspections they would divert remotely operated vehicles (ROVs) to inspect and sample the coral colonies - no mean feat given the operating costs of these ROVs and their support vessels. These surveys have shown that in some places the platforms are smothered in corals, sometimes very close to drilling discharges. In collaboration with Rhian Waller at the Woods Hole Oceanographic Institution, we have found that the corals on these oil platforms are reproducing and shown that the platforms have provided a new sub-population of *Lophelia* in the North Sea. Our results will help future management of this important habitat-forming species.

M Roberts and S Gass

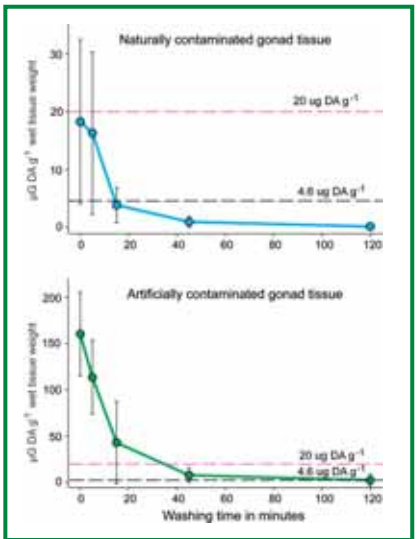
Amnesic Shellfish Poisoning in Scallops? Now you can forget it!

A breakthrough in the study of toxin-loss in scallop tissues is set to change the

management of both the scallop fishery and cultivation industry. Since its detection in 1999, the presence of the Amnesic Shellfish Toxin - Domoic Acid (DA) - in Scottish scallop tissues has literally cost the industry and the regulatory authorities millions of pounds. First, there were extensive closures on harvesting and then costly biotoxin monitoring. However, recent research at SAMS, conducted as part of the EU TALISMAN project, has produced a protocol which will reduce the toxin burden of edible scallop tissues to well below the regulatory safeguard of 20 ug g^{-1}. The research shows the DA of the edible parts (the adductor muscle and the roe) is not intracellular or bound to the surface of the tissues. In fact extra washing in running tap water can reduce even grossly contaminated gonad from values of > 200 ug g^{-1} to < 20 ug g^{-1} in 40 minutes. The protocol has been tested in both the laboratory and in a commercial processing facility. The loss of toxin during washing of the tissues is not linear and by adding an extra 2 – 3 minutes to the washing time during 'shucking' even commercial processors can reliably reduce DA to acceptable levels. Effectively, there is now no need for any edible tissues to fail an end product test for DA. These findings have far-reaching consequences for how the regulators and the industry monitor DA and how they protect the consumer. Research at SAMS continues into ways of encouraging live king scallops to depurate their toxin burden, which they can retain for more than a year, and also to determine whether there is any ecological significance to long-term toxin retention.

M Kelly and D Campbell

A: Professional processors 'shucking' scallops at Loch Fyne Seafarms,
B: The un-washed product showing contaminating pieces of hepatopancreas and gut content,
C: The final roe-on product after 5 minutes washing.



Mean and standard deviation of DA concentration (µg DA g^{-1}) of artificially and naturally contaminated gonads washed for 0, 5, 15, 45, 120 minutes. All scallops were collected from the closed area SM16 in Dec.04. The 20 µg DA g^{-1} statutory level and 4.6 µg DA g^{-1} action level are given.

Ecological effects of sealice medicines

We recently completed a five year project investigating the ecological effects of medicines used for controlling sea lice on farmed salmon. All chemical discharges have some effect on the receiving environment and it is a general principle of pollution control that such perturbations should be confined to the immediate environment - the mixing zone. We attempted to look beyond ephemeral, local effects and concentrated on trying to detect long-term changes beyond the immediate mixing zone. Comprehensive sampling programmes were undertaken at four active salmon farm sites on the west coast of Scotland in Lochs Diabaig, Craignish, Kishorn and Sunart. Aspects studied included: examination of littoral and sub-littoral settlement panels to assess whether early stages of flora and fauna are affected by chemical usage; sampling of sediments around and away from the farms for meiofauna, macrofauna and the presence of medicines; zooplankton sampling before, during and after medications and as a time-series to assess natural variability and time-series measurements of phytoplankton populations and nutrient concentrations. Physical data included acoustic ground discrimination to determine substrate types around each farm and the use of Differential Global Positioning System (DGPS) drifters and current meter arrays to allow modelling of the dominant water movement processes and simulate dispersion of the treatments used at each site.

Taking all the results together, we did not detect any clear effect of medicine usage, or indeed other farm activities, beyond the local scale. The processes of species succession and population dynamics that we observed were well within the range of what might be expected or predicted for fjordic sea loch systems.

The project has achieved much by helping to improve our understanding of natural variability in relatively unstudied systems and, most especially, by demonstrating that wide-scale ecosystem-level effects from medicine use, if they exist at all, are likely to be of the same order of magnitude as natural variability and, therefore, inherently difficult to detect. The full study report can be downloaded from the SAMS website at http://www.sams.ac.uk/research/coastal%20imapcts/ecol.htm.

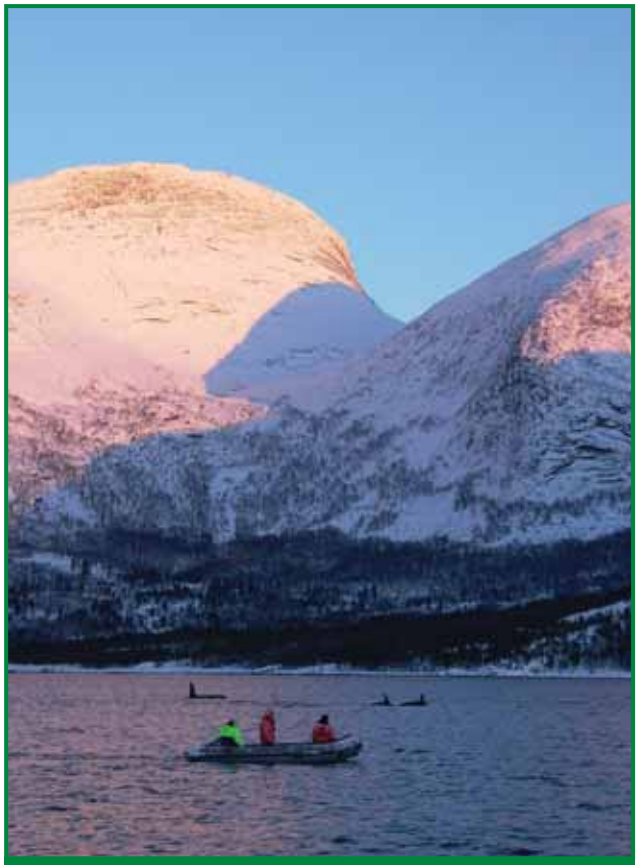
T Nickell, K Willis, C Cromey, J Duncan and K Black

Killer whales give herring a sharp slap!

Since October 2002 we have been involved in a 3-year EU-funded project with four partners, investigating the effect of turbidity and hypoxia on the behaviour of coastal marine fishes (ETHOFISH). Killer

Lightweight stereo video equipment. The yellow case contains two digital camcorders and time code generators. The twin cameras are mounted on the ends of the T bar and the system is powered by a battery in the square grey case.

Whales hunting herring work as a team to corral a school of herring into a tight ball, then deliver a slap with the tail which kills and stuns a number of fish. This is referred to as carousel feeding. We wondered whether the tightness of the ball limits the amount of oxygen that the herring can obtain, thus affecting their swimming performance, endurance and potential ability to escape the whales. In November 2004, Bob Batty and Sarah Swan headed north to Tysfjord in Norway where killer whales and herring come to feed on over-wintering herring each year. Together with partners from IMC, Sardinia we collaborated with Dr Tiu Similä and her NORCA project. We aimed to obtain



Tysfjord, Norway - a spectacular location for killer whale and herring research.

Close approach to the feeding whales requires skill and patience. Photo: Tiu Similä.

oxygen measurements from within the herring balls and also stereo underwater video footage. Stereo video enables us to calculate nearest neighbour distances between herring, allowing us to compare these with spacing in more normal herring schools.

Working from Dr Similä's yacht and using a small inflatable dinghy with an electric outboard motor we were able to get in among the killer whale pods and video several carousel feeding events while simultaneously obtaining oxygen measurements and sound recordings with a hydrophone. Oxygen saturation values in the range 60-70% were recorded on several occasions, but whether these are likely to reflect minimum values must await detailed analysis of the video footage. It is possible that the oxygen electrode may not have been located in the part of the school likely to have the lowest oxygen levels, as being able to place the electrode in the optimum location in a rapidly whirling ball of fish is largely a matter of chance.

MICROBIAL AND MOLECULAR SCIENCE DEPARTMENT

Department members: Dr R Leakey (Head), Dr F Kuepper (Deputy), Dr K Davidson, Dr J Day, Dr D Green, Dr T Gutierrez, Dr M Hart, Dr T Proeschold, Mrs U Achilles-Day (part time), Mrs D Brennan, Mrs C Campbell (part time), Miss M Gaj, Miss S McNeill, Ms E Mitchell, Miss R Saxon

'*Marinobacter algicola*' DG893; a new species of oil-degrading bacterium found living with toxic dinoflagellates.

MICROBIAL AND MOLECULAR SCIENCE DEPARTMENT

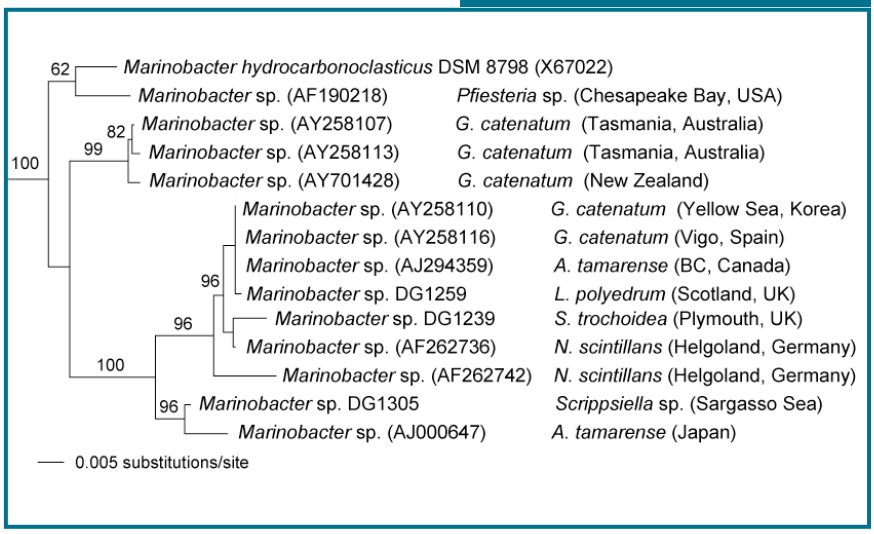
This department unites the expertise of the former Pelagic Plankton and Marine Algal Research Groups.

Bacterial biodiversity patterns of phytoplankton.

Research seeking to understand bacterial diversity patterns associated with phytoplankton has continued apace. The rationale behind this work is to begin to understand how the bacterial community living with phytoplankton may influence the health and vigour of phytoplankton and ultimately, how environmental change (e.g. increasing CO_2 levels) may be understood to impact on primary productivity of the oceans. Our focus is to use bacterial culture techniques, improved in-house to enable rare and difficult bacteria to be cultured, in conjunction with genetic identification of the bacteria. Our focus has now moved on from the dinoflagellates to bacteria associated with the calcifying phytoplankton *Emiliania huxleyi* and *Coccolithus braarudii*, and a range of coastal diatoms, including the amnesic shellfish poisoning (ASP) diatom *Pseudo-nitzschia*.

From our preliminary results, the most striking feature is that the bacterial diversities of dinoflagellates and coccolithophores are more remarkable for their similarities than their dissimilarities. The figure illustrates the conservation of one genus of bacteria consistently found associated with dinoflagellates from many regions of the world. Strikingly, the conservation of communities is observed, irrespective of where the algal culture has originated from. We are interpreting the conservation of bacterial community structure to mean that the phytoplankton may have physiological requirements for specific bacterial taxa. The foremost question in our minds is what this is and why. Another highlight comes from continuing collaborative work between ourselves and S. Bates and colleagues in Canada (Fisheries and Oceans Canada and Mt Alison University), on the bacteria associated with the ASP diatom, *Pseudo-nitzschia*. This has revealed that specific bacterial taxa have a role in provoking the production of the ASP toxin, domoic acid.

Specificity of bacterial association. Neighbour-joining tree (with bootstrap support) depicting known dinoflagellate-associated *Marinobacter* spp. The dinoflagellate host and its isolation origin are noted in parentheses.



This represents the first evidence of the link between harmful algal bloom toxicity and specific bacterial groups.

D Green and M Hart

First demonstration of genotypic stability of conserved microalgae

The stability of organisms in any collection of biological materials: animal, plant or microbial is of vital importance, as these represent important reference and/or starting materials for scientific research. They are in effect "biological standards" and without "standards" comparative taxonomic, physiological, eco-toxicological or *ex situ* ecological studies are impossible or, at best, problematic. The recently reunited Culture Collection of Algae and Protozoa at SAMS has been the coordinating partner of an EU funded project focusing on the cryopreservation of algae and cyanobacteria. A key component of this project has been the development, and subsequent validation, of genotypic stability testing methods. The objective was to develop a robust transferable method that was sensitive enough to detect small changes that may occur in the genome after prolonged serial transfer of live cultures and those that may result from employing sub-optimal cryopreservation (ultra-low temperature) protocols.

An Amplified Fragment Length Polymorphism (AFLP) protocol was developed to investigate the genetic stability of microalgae. AFLP permits the simultaneous analysis of many loci widely spread over the entire genome, without prior sequence knowledge of the

organisms under study. Cross consortium validation involved nine strains of *Chlorella vulgaris*. In addition, the AFLP procedure was performed on the SAG 211-11b strain before and after cryopreservation. Electrophoresis of all AFLP reactions was performed on a capillary sequencer at the SAG culture collection in Gottingen.

It was demonstrated that the AFLP protocol resulted in reproducible banding patterns between partners. Banding patterns of all duplicate strains were found to be virtually identical. Furthermore, patterns before and after cryopreservation were identical, if non-reproducible fragments were excluded from the analyses. The method

Silver stained polyacrylamide gel demonstrating reproducibility of the method. Virtually identical banding patterns were obtained from different DNA extractions of the algae tested.

was shown to be extremely sensitive and relies on good quality DNA extraction and standardisation of subsequent steps. During the developmental stages of the protocol, even the use of different PCR machines within the same laboratory by the same scientist could generate different results, so the eventual validation of the method by different laboratories across Europe was a major step forward in the cross-validation of culture collections and preservation techniques.

T Friedl and J Mueller, (SAG, Univ Göttingen)
M Hart, T Pröschold and JG Day
(SAMS)

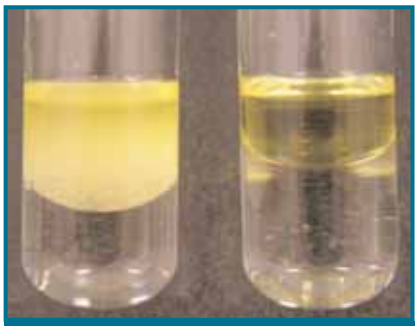
New marine surface-active agents clearing a path to market

While man has used natural products from terrestrial sources for millennia, expoitation of the oceans has lagged behind, partly because synthesis from petroleum products has become the main source for many chemicals. With petroleum reserves dwindling and techniques such as molecular biology, genetic engineering and biofermentation becoming routine, there is renewed interest in the wealth of novel biochemicals that may be found in the huge diversity of marine organisms that inhabit our oceans. Surfactants and emulsifiers are an important group: their mode of action (i.e. to mix oil-based and water-based substances together) is significant to the extent that their global demand and industrial usage is greater than 4 billion tonnes per annum.

At SAMS we are investigating new types of surface-active agents that are produced naturally by marine bacteria, i.e. biosurfactants and bioemulsifiers. From an initial screen for novel surface-active agents, we found four that act as powerful emulsifiers with properties similar to, or better than, existing commercial emulsifiers. The novelty here lies on the fact that these bioemulsifiers are natural and possess a high molecular weight (MW), which is rare since most of the emulsifiers discovered or produced and used today are of low MW. Being of high MW gives these compounds enhanced rheological and thixotropic properties – i.e. gelling and viscoelasticity respectively – which are desirable characteristics in the food ingredients sector, amongst other industrial sectors. In addition, the fact that they are derived from a natural, non-pathogenic and sustainable resource is a potentially useful marketing asset.

Production, purification and characterisation of our emulsifiers has been greatly enhanced by our acquisition of an HPLC and biofermentor. A patent was filed in September 2004 covering our four most promising emulsifiers. Support for this work has been generously provided by a grant from Argyll & Islands Enterprise that commenced in September 2004. This grant will significantly advance exploitation of the commercial potential these emulsifiers have. Indeed, a number of companies are seeking milligram to kilogram quantities of our emulsifiers for product evaluation purposes. Our challenge is now to be able to produce larger quantities, as cheaply as possible, to meet these demands.

T Gutierrez and D Green



One of our novel emulsifiers mixing olive oil and water (left) alongside its control without emulsifier.

CULTURE COLLECTION OF ALGAE AND PROTOZOA (CCAP)

CCAP developments

CCAP has seen major changes in 2004, with the reunification of the marine and freshwater sections, following the relocation of the latter from the Windermere Laboratory to Oban, and the appointment of several new staff members. CCAP now totals 9 permanent staff, maintaining around 2300 algal / protistan strains in the public domain for a worldwide academic and commercial customer base. In total, 1356 cultures were sold, and over a hundred provided on a collaborative basis. Two strains were received as patent deposits under the Budapest treaty.

A NERC grant, Marine Algal Characterization and Exploitation (MACE), enabled us to implement a new strain accession policy and to considerably enhance the marine strain holdings. In particular, CCAP launched a new website (www.ccap.ac.uk), with the strain database being enhanced by an image base and literature references (under development).

CCAP scientists constantly strive to support the forefront of algal research by working closely with academic and industrial researchers worldwide, identifying current and new areas of interest and depositing strains of importance for ongoing research. For the coming years, we are aiming to provide molecular marker information for every single strain available in the collection.

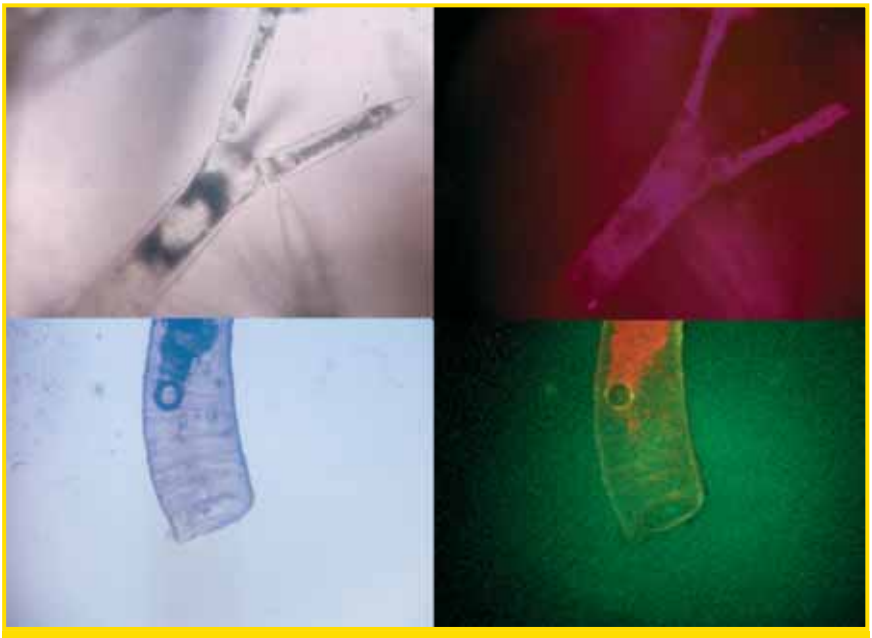
CCAP scientists have conducted and contributed to research in the fields of algal taxonomy (especially green and brown algae and diatoms), algal pathology and natural products chemistry.

Collaborative research

Over the last year, we have been involved in a number of international collaborations, one of which is highlighted here:

During a month-long visit to the University of California, Santa Barbara, Frithjof Küpper contributed to a study resulting in the detection of nitric oxide (NO) in the wound response of the unicellular macroalga *Dasycladus vermicularis*. This constitutes the first ever finding of this important signalling molecule in a macroalga and its relation to injury. The synergistic relationship between reactive oxygen species and NO was examined. In a reciprocal manner, the addition of a nitric oxide donor caused an increase in detectable H_2O_2 around the localized site of injury. By use of selected pharmacological probes, our results indicate that H_2O_2 production involves the upstream activation of G-proteins, protein kinases, ion channels and calcium channels as seen in higher plant physiology.

F Kuepper



Histochemical detection of nitric oxide by the fluorescent probe DAF-FM.
Top: Uninjured control. Below: 25 min post injury. Scale bar = 3 mm.

NERC FACILITY FOR SCIENTIFIC DIVING (NFSD)

In recognition of the specialised nature of scientific diving, the NERC Facility for Scientific Diving (NFSD) was established in 2001 and is hosted at Dunstaffnage by SAMS. The facility exists to promote health and safety in diving operations at work, to provide training and diving support to the wider scientific community, and to advance UK underwater science.

Measuring the rate of erosion on gypsum 'cakes' placed at contrasting locations on the Loch Linnhe Artificial Reef provides data on local differences in current speed created by the reef.

In 2004-5, courses were given on open circuit nitrox, recompression familiarisation, and small boat training. The British Antarctic Survey (BAS) used the facility to familiarise their divers with diving techniques, small boat handling and recompression chamber operation prior to travelling south for the austral summer fieldwork season. To support this function NFSD staff attended a Diving Under Ice workshop at Ny Alesund in February 2005.

Equipment evaluation trials are ongoing on voice communications and digital SLR photography. The communications evaluation will be published in the general literature and the photography evaluation will form the basis for developing a course relevant to scientific requirements. Technical evaluations were made on surveying techniques and full-face mask bail-out options.

Support through the NFSD continued for the Scientific Diving Supervisory Committee (SDSC; the HSE-recognised representative body for the scientific and archaeological communities) that represents the employers of scientific and archaeological divers. The Society for Underwater Technology (SUT) hosts two committees (the Underwater Science Group, and the Diving and Manned Submersibles Committee) that serve the scientific diving community in different ways, and the Facility represented NERC on both. In 2004, we coordinated a joint diving industry conference on emerging technologies in diving (jointly with the SUT), and we are assisting in the planning and organisation of an international conference on diving for science and archaeology to be held at Oceanology International 2006.

The facility continued to provide guidance and advice to the NERC Safety Office on matters related to diving and small boat use. In addition, advice was provided to many divers and diving organisations that dive at work under the scientific and archaeological Approved Code of Practice.

MDJ Sayer

SAMS HIGHER EDUCATION

SAMS/UHI Millennium Institute Education Activities

This year has provided noteworthy results arising from the joint undergraduate activities between SAMS and UHI, most notably the first Marine Science (Hons) graduation. On the postgraduate front SAMS welcomed another cohort of NERC-funded postgraduate students and saw an equal number successful at viva.

BSc (Hons) Marine Science

Once again the degree course received high praise from our External Examiners during the summer Board. In November, our second graduation ceremony was held in conjunction with the SAMS AGM. Marking a significant landmark for the degree course, our first honours graduates were presented with their certificates by SAMS President, Dr Ian Graham-Bryce. To mark the occasion, two sponsored awards were made: the SAMS Council Prize for Academic Excellence was awarded to Louise (Izzie) Wilson, who obtained a First Class degree, while the SAMS Prize for Overall Achievement went to Daniel Vincent, who received an Upper Second degree.

Izzie Wilson, one of the first UHI/SAMS BSc (Hons) Marine Science graduates receiving her prize at the SAMS AGM from SAMS President, Dr Ian Graham-Bryce, flanked by UHI Principal, Professor Robert Cormack (left) and SAMS Director, Professor Graham Shimmield.

During the vacation period, one of our final year undergraduates, Saul Reynolds, was successful in obtaining the SAMS Neil MacDougal Bursary, allowing him to participate in a research cruise, aboard the German vessel FS *Humbolt*, surveying cold water outflow from the cold Arctic water into the north east Atlantic in the region of the East Greenland Shelf.

UHI Postgraduate Research Activities

In the early part of the year, SAMS, in collaboration with UHI, was successfully accredited for the registration of postgraduate students through the University of Aberdeen; complementary to the ongoing agreement with the Open University. In October, a further intake of NERC-funded postgraduate students commenced at SAMS, including two CASE awards: one jointly with West Minch Salmon (North Uist), the other with Scottish Natural Heritage. This has strengthened SAMS' position, hosting the largest grouping of postgraduates across UHI (25 in total), and continuing to support a vibrant research school community. For the second year running, one of the first year students (Richard Shucksmith) won an award for best poster presentation at the annual Scottish Marine Group postgraduate meeting, University of St. Andrews.

BSc (Hons) Marine Science students receive a rigorous academic education that is supported by much practical and analytical work. The image shows two students engaged in fieldwork during their third year at SAMS UHI.

There have been a number of PhD completions over the year and Johanna Fehling, Clara Mori and Jose Gonzalez Vecino have since obtained career positions in the UK and abroad.

A E J Miller

SAMS OUTREACH ACTIVITIES

The research activities at SAMS are regularly showcased in public events e.g. open evenings, environment fairs and other exhibitions, school visits, on the SAMS website and by engagement with the media.

Public accountability – informing and engaging the public

Ray Leakey and Peter Wadhams gave invited lectures at the *Scotia* centenary celebrations at Millport in July 2004. The SAMS seminar series at Dunstaffnage was organized by Toby Sherwin this year. The seminars are free and open to the general public. Although mainly given by SAMS staff and research students, visiting scientists frequently contribute lectures. Once again, SAMS exhibited its work at the annual Argyllshire Gathering in Oban in August.

SAMS works to enthuse the next generation about the marine environment, as seen here at an open day.

SAMS works to inspire the next generation

SAMS continued its engagement with the Argyll and Bute Regional Environmental Education Forum (ABREEF), both on the organising committee and as exhibitors. Coordinated by Debra Brennan and Elaine Mitchell, SAMS participated at the ABREEF environment fairs on Mull in May 2004, and in Dunoon during September. There were 28 exhibitors at the Dunoon event which was visited by 13 primary schools and Dunoon grammar school with a total of 740 children. Around 250 people attended the public evening session. An evaluation form was sent to all the teachers attending and 185 were returned. SAMS was voted the 5th favourite activity of the event. SAMS has developed a variety of fun activities that teach children about food chains and the 'childhood' of marine organisms. SAMS also participated at the Dalriada event, where Jenny Beaumont and Steve Gontarek engaged with visiting school classes about marine science. About 25 primary school children from Islay also experienced SAMS at first hand during a school trip to Oban.

To increase interest in marine science careers - particularly in girls, SAMS hosted a group of girl guides from North Connel on 10 March, who received talks from female students and staff at SAMS. The event was organised by Christine Campbell. We also provided week-long work experience placements for three pupils from Oban High School and one from Auchinleck Academy.

SAMS in the media

The research and education undertaken at SAMS were widely reported in the international, national, regional and local press as well as on radio, and occasionally on television. The most widely covered story emanating from SAMS was the work done by Bob Batty, Ben Wilson and Larry Dill on the frequent repetitive ticks (FRTs) released by shoaling herring during the night. The attention this research attracted was spawned by the award to the team of the Annual IgNobel Prize in Biology at a ceremony at Harvard University, Massachusetts in November 2004. These awards are given for research which first makes one laugh and then think (see www.improbable.com).

Visitors to SAMS

The opening of the new SAMS laboratory on 6th April 2004 saw over 80 visitors from politics, academia, funding bodies and the general public at SAMS. The opening was conducted by HRH The Princess Royal.

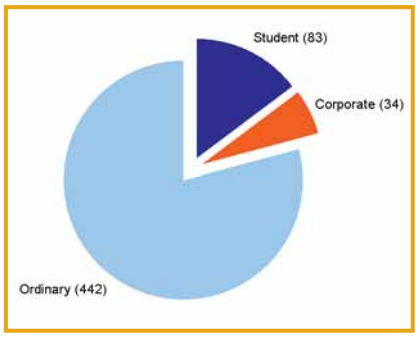
In addition to a wide range of visitors, too numerous to list here, we also overcame our remote location by having a briefing with Scottish MEPs via a video-conference link between Brussels and Oban.

A number of university groups, including Edinburgh, Heriot-Watt, St Andrews and Liverpool conducted field classes using SAMS vessels and laboratory facilities.

Anuschka Miller

SAMS MEMBERSHIP ACTIVITIES

SAMS is a learned society with a total of 565 members from three categories.
During the reporting year, members received two SAMS Newsletters (issues 29 and 30), the 2003-04 Annual Report, and were invited to the Annual General Meeting, the 15th Newth Lecture, and two Scottish Marine Group meetings. The SAMS research bursary enabled members to conduct small projects. SAMS members are entitled to the free use of the SAMS library during working hours. Subscription charges for SAMS membership have not changed since 1997.



Scottish Marine Group

Dr Hamish Mair from Heriot-Watt University continued as convenor of the Scottish Marine Group (SMG) and organised two meetings within the reporting period:

About 85 participants at the autumn SMG meeting on 11 November 2004 at Dunstaffnage considered applications of advanced technologies for marine science research. Presentations were given by Dr Craig Brown (SAMS) on acoustic seabed mapping methods, Mr David Meldrum (SAMS) on advances in satellite communictions, Drs Steph Rigby and Rayne Longhurst (Robert Gordon University) on chemical sensors, Dr Tracy Shimmield (SAMS) on marine applications for ICP-OEs and ICP-MS, and by Dr Val Smith (Gatty Marine Laboratory) on quantitative real-time PCR.

The spring meeting, at which postgraduate research students present their work, was held on 6th April 2005 at St Andrews University, and was hosted by Professor Chris Todd. The SAMS prize for the best postgraduate presentation went to Andrew Desbois (St Andrews) for his talk on 'Marine microalgae as a source of novel anti-microbial compounds'. The SEPA-sponsored prize for the best visual presentation was awarded to Lara Meischke (St Andrews). Other presenters included Julian Augley (Napier), Sarah Benfield (Heriot-Watt), Helen Fraser (Aberdeen), Phil Harrison (St Andrews), Adam Hughes (SAMS), and Gareth Law (SAMS). The SAMS prize for the best poster went to Richard Shucksmith (SAMS).

The prize winners at the 2005 SMG meeting: Andrew Desbois (left), Lara Meischke and Richard Shucksmith.

Annual General Meeting

The Association's 90th AGM took place on 2nd November 2004 at Dunstaffnage. The presidency passed from Dr Ian Graham-Bryce to Professor Sir John Arbuthnott. The list of current office bearers can be found at the front of this publication. The meeting was followed by the 2nd SAMS graduation ceremony and the 15th Annual Newth Lecture was delivered by Professor Chris German (Southampton Oceanography Centre) on 'Hydrothermal exploration can lead you a long way: Oases for life in distant oceans?'

SAMS Research Bursary

Two research bursaries were funded by SAMS. Applications were considered quarterly by the Director. The bursaries are reserved for SAMS members.

Scientific meetings and lectures

During the year SAMS was involved in hosting, organising and funding, often in partnership with other organisations, a range of conferences, workshops and courses. Topics included UK Arctic Marine Science, Europe's Hidden Coral Worlds, Technical Advances in Diving, Coastal Zone Management (in Pakistan), the UHI Postgraduate Conference and training in the use of SAMS environmental modelling software. Several EU and other project meetings were also hosted.

Anuschka Miller

Postgraduate Research Projects

(Supervisors' names in parentheses; SAMS supervisors in bold)

DEGREES AWARDED DURING THE REPORTING YEAR

Fehling J, Ph.D, The UHI Millennium Institute. *Amnesic shellfish poisoning in Scottish waters.* (**Davidson K, Bolch CJS** and Tett P)

Gonzalez-Vecino J, Ph.D, The UHI Millennium Institute. *The use of nucleotide-enriched diets for broodstock nutrition.* (**Batty RS** and **Cutts C**)

Morri C, Ph.D, The UHI Millennium Institute. *North Atlantic deglaciation: the influence of palaeocurrent pathways on Late Quaternary deep-water sedimentary environments.* (**Howe JA,** Stoker MS and **Shimmield GB**)

ONGOING RESEARCH

Adey (née Osborne) EA, Ph.D, The UHI Millennium Institute. *Distinguishing wild from farmed salmon.* (**Black K** and **Shimmield TM**)

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

Ashton GV, Ph.D, The UHI Millennium Institute (NERC). *Biological invasions-quantifying the impact of alien species on marine ecosystems, using the introduction of the amphipod* Caprella mutica *to the west of Scotland as a case study.* (**Cook EJ**, **Willis K** and **Burrows MT**)

Beaumont J, Ph.D, The UHI Millennium Institute (NERC). *Quantifying biotic interactions with inshore subtidal structures: comparisons between natural and artificial reefs.* (**Sayer MDJ**, **Brown C** and **Shimmield GB**)

Corner R, Ph.D, Stirling University. *Reduction of fish farm impacts using smart automatic feeders.* (**Black KD** and Telfer T)

Corripio, Y, Ph.D, Aberdeen University. *Immunology in haddock.* (Secombes C and **Treasurer J**)

Cousins S, Ph.D, Aberdeen University. *An Investigation of the processes involved in* Pecten maximus *contamination by Amnesic Shellfish Poisons.* (Gallagher S, **Kelly MS**, Eddie B and Taylor A)

Cox (née MacLachlan) SE, Ph.D, The UHI Millennium Institute. *Geochemical signals of environmental change in the Arctic: from freshwater lake to the deep ocean.* (**Howe J**, **Shimmield TM**, **Shimmield GB** and Austin W)

Cresswell K, Ph.D, The Open University. *Penguin-krill interactions at South Georgia.* (Tarling GA, Trathen P and **Burrows MT**)

Crozier P, Ph.D, The UHI Millennium Institute. *The impact of deep-water fisheries on elasmobranch populations in the north east Atlantic.* (**Burrows MT**, **Batty, RSB** and **Swan SC**)

Darrock L, Ph.D, The University of East Anglia. *Dimethylsulphoxide: origin, fate and cycling.* (Liss PS, Malin G and **Hatton AD**)

Dean R, Ph.D, The UHI Millennium Institute. *Biogeochemical cycling in fish farm sediments.* (**Shimmield TM**, **Black KD** and **Gillibrand P**)

Dodds L, Ph.D, The UHI Millennium Institute (NERC). *The physiological ecology of the cold-water coral* Lophelia pertusa. (**Roberts JM**, Taylor A and **Gage JD**)

Farooq S, Ph.D, University of Karachi. *Nutrient and trace metal cycles in a tidally-influenced tropical mangrove.* (**Shimmield TM**)

Forbes H, Ph.D, Glasgow University. *The developmental ecology of cannibalism in cod.* (Huntingford, F and **Cutts, C**)

Gass S, Ph.D, The UHI Millennium Institute (AFEN). *The Environmental Sensitivity of Cold Water Corals.* (**Roberts JM**, **Gage JD** and Tudhope AW)

Hughes A, Ph.D, The UHI Millennium Institute (NERC). *Sea bed biota scrapers and shapers: urchins in control.* (**Kelly MS** and Barnes D)

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

Law GT, Ph.D, The UHI Millennium Institute (NERC). *Cycling of trace metals of organically-rich sediments off Pakistan and*

POSTGRADUATE RESEARCH PROJECTS

Scotland. (**Shimmield TM**, Cowie G, **Shimmield GB** and Ganeshram R)

Loh P-S, Ph.D, The UHI Millennium Institute. *Terrigenous organic carbon in Scottish sea loch sediments.* (**Miller AEJ**, Reeves A, and **Harvey SM**)

MacDonald A, M.Phil, The UHI Millennium Institute. *Salmonid survival in an upland river.* (**Miller AEJ** and Chisholm N)

Mitra A, Ph.D, The UHI Millennium Institute. *The Influence of micro-zooplankton on marine productivity.* (**Davidson K** and Flynn KJ)

Pete R, Ph.D, The UHI Millennium Institute. *The influence of organic nutrient perturbation on microbial community dynamics.* (**Davidson K**, **Miller AEJ** and **Leakey R**)

Pillans J, Ph.D, Newcastle University. *DMS photochemistry.* (**Hatton AD**, Uher G and Upstill-Goddard R)

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

Rose C, Ph.D, Newcastle University. *The role of habitat complexity in determining community development on the Loch Linnhe Artificial Reef.* (**Wilding T**, Downie M and Bentley M)

Sanderson JC, Ph.D, The UHI Millennium Institute. *Reducing the environmental impact of sea-cage farming through cultivation of seaweeds.* (**Kelly MS** and Dring M)

Shelmerdine R, Ph.D, The UHI Millennium Institute (NERC). *Large-scale forcing of coastal communities.* (**Burrows MT** and **Hughes DJ**)

Shields ME, Ph.D, The UHI Millennium Institute. *Gradients in benthic community structure and bioturbation along the northern seas continental margins.* (**Hughes DJ** and **Gage JD**)

Shucksmith R, Ph.D, The UHI Millennium Institute (NERC). *Biological invasions: The role of biodiversity in determining community susceptibility to invasion.* (**Cook EJ**, **Burrows MT** and **Hughes DJ**)

Smith J, Ph.D, Aberdeen University. *The effects of the presence of physical exploration and production structures in both the North Sea and the Gulf of Mexico on marine organisms.* (**Sayer MDJ** and Pierce G)

Vare LL, Ph.D, The UHI Millennium Institute (NERC). *An investigation of temporal trends of pollutant inputs within the Arctic environment: from freshwater lake to deep ocean.* (**Shimmield TM**, **Shimmield GB** and **Black K**)

Ware S, Ph.D, University of London. *Inshore fisheries ecology.* (Atkinson RJA, **Sayer MDJ** and Bailey N)

Waller RG, Ph.D, University of Southampton. *Gametogenesis and larval biology of deep-sea corals.* (Tyler PA and **Gage JD**)

Wilson S, Ph.D, The UHI Millennium Institute. *Plankton and climate change.* (**Hatton AD**, **Miller AH** and Law C)

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SAMS authors in bold type

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Breuer, E, Stevenson, A, **Howe, JA**, Carrol, JL and **Shimmield, GB**, 2004. Drill cutting accumulations in the Northern and Central North Sea: a review of environmental interactions and chemical fate. *Marine Pollution Bulletin* **48**: 12-25.

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Brown, CJ, Hewer, A, Limpenny, DS, Cooper, KM, Rees, HI and Meadows, WJ, 2004. Mapping seabed biotopes using sidescan sonar in regions of heterogeneous substrata: Case study east of the Isle of Wight, English Channel. *Underwater Technology* **26**: 27-36.

Brown, CJ, Hewer, A, Meadows, WJ, Limpenny, DS, Cooper, KM and Rees, HI, 2004. Mapping seabed biotopes at Hastings Shingle Bank, Eastern English Channel. Part 1. Assessment using sidescan sonar. *Journal of ihe Marine Biological Association of the United Kingdom* **84**: 481-488.

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Clarke, A, Prothero-Thomas, E, **Beaumont, JC** and Brey, T, 2004. Growth in the limpet *Nacella concinna* from contrasting sites in Antarctica. *Polar Biology* **28**: 62-71.

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Cottier, F, **Inall, ME** and **Griffiths, CR**, 2004. Seasonal variations in internal wave energy in a Scottish sea loch. *Ocean Dynamics* **54**: 340-347.

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RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Project Leader	Title	Funding body	Duration	Award
RS Batty & RJG Leakey	Rearing protocols for Atlantic halibut larvae during transition from endogenous to exogenous nutrition.	MAFF Link Aquaculture	01/00 – 06/04	£146k
RS Batty	Effect of turbidity on marine fishes (ETHOFISH)	EU Framework V	10/02 – 09/05	£204k
RS Batty, RJG Leakey & C Cutts	Green water larval rearing	Seafish	09/04 – 08/06	£40k
KD Black	The ecological effects of sea lice treatment agents; extension of funding	Veterinary Medicine Directory of DEFRA, The Scottish Executive, and SNIFFER	08/02 – 08/04	£453k
KD Black	Shellfish Submersible	Seafish Industry	12/03 – 03/05	£25k
KD Black	Cod Environmental Project	Crown Estates, HIE, SFIA	12/03 – 09/06	£111k
KD Black	Ecosystem approach for sustainable aquaculture (ECASA)	EU	01/05 – 02/08	£227k
KD Black & C Cromey	AZEDEPOMOD	SEPA	05/04 – 11/04	£12k
C Brown	MESH	QUB (EU Interreg)	04/04 – 03/07	£108k
MT Burrows	Marine biodiversity and climate change (MarClim)	English Nature, SNH plus a consortium of 10 other bodies	04/01 –04/06	£45k
EJ Cook	Spikey and Friends	Scottish Natural Heritage	07/03 – 05/04	£2k
EJ Cook	ALIENS	Esmee Fairbairn Foundation	04/04 – 03/07	£145k
F Cottier	Travel grant	UHI	12/04	£600
F Cottier	Water mass modification in an Arctic fjord	Royal Society	07/03 – 06/05	£12k
C Cromey & ME Inall	Larval supply and the relationship to hydrographic parameters	NERC	02/03 – 12/04	£13k
JG Day	Conservation of scientific and biotechnological resource:micro algae & cyanobacteria (COBRA)	EU Framework V	11/01 – 03/05	£168k
P Gillibrand & T Sherwin	Scottish Marine Observatory	FRS	12/04 – 11/06	£5k
JDM Gordon	Towards accreditation and certification of age determination of aquatic resources (TACADAR)	EU Framework V	11/02-03/06	£3k
SJ Gontarek	Data Rescue and Archiving Project	NERC	06/03 – 10/06	£225k
D Green	Novel bio-discovery: biosurfactant bacteria	HIE Research Challenge Fund	06/03 – 07/04	£95k
A Hatton	Methanogenesis in oxygenated marine environments	Nuffield Foundation	03/04 – 06/06	£5k
ME Inall	Marine instrument development at SAMS	NERC SBRI	06/03 – 05/06	£136k
ME Inall	UK Marine Environmental Change Network	DTI	03/02-01/05	£2k
J Howe	Antarctic travel grant	Trans Antarctic Association	07/04 – 03/05	£2k
KJ Jones	Factors determining the magnitude of solar fluorescence peaks in water-leaving radiance spectra from shelf seas.	NERC	01/02 – 12/04	£27k
KJ Jones	Recruitment campaign	AIE	09/04 – 03/05	£20k
MS Kelly	Atlantic Arc Aquaculture	Interreg IIIB	12/03 – 11/06	£559k
MS Kelly	Reducing the environmental impact of sea-cage fish farming through cultivation of seaweeds	Highland Council and HIE	02/03-01/06	£112k
MS Kelly	Algal toxins in shellfish (TALISMAN)	EU Framework V	01/03-04/05	£162k
MS Kelly & JG Day	Microalgae as cell factories	EU Framework V	01/03-01/06	£30k
MS Kelly	KEYZONES	EU	02/05 – 01/07	£100k
MS Kelly	SPINES	EU	01/05 – 12/07	£193k
MS Kelly	MERMAIDS	AIE	10/04 – 09/07	£36k
FC Küpper	MACE	NERC	06/04 – 05/05	£21k
FC Küpper	Travel fund	Boehringer Ingelheim fund	03/05	£1k
RJG Leakey	Assessment and management of coastal pollution	British Council	04/03 – 03/06	£21k
DT Meldrum	Homing environmental recorder instrument development (HOMER)	NERC SBRI	04/03 – 03/06	£200k

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Project Leader	Title	Funding body	Duration	Award
DT Meldrum	Proof of Concept: Molecularly imprinted polymer sensors	Scottish Enterprise	10/02 – 09/04	£78k
DT Meldrum	Deep water observation system: Phase II	DEFRA	02/02 – 07/04	£174k
DT Meldrum & ME Inall	Mitigation of the effects of high power sonars on marine mammals	NERC & MOD	09/02-07/05	£85k
DT Meldrum	Molecularly Imprinted Polymers	SE/RGU	01/05 – 05/05	£7k
DT Meldrum & ME Inall	Prediction of marine mammal aggregations by reference to oceanographic observations	NERC & MOD	07/02 – 06/05	£65k
AEJ Miller	UHI Postgraduate Induction and research conference	UHI	09/04 – 03/05	£21k
AH Miller & GB Shimmield	Marketing for BSC (Hons) Marine Science	AIE	06/04 – 01/05	£20k
BE Narayanaswamy	Antarctic travel grant	Trans Antarctic Association	06/04 – 03/05	£2k
TD Nickell	Genetic isolation in selected Scottish sea lochs	Liverpool John Moores University	07/02-07/05	£3k
JJ Oliver	ECMB Fit Out	AIE	10/03 – 12/04	£1.2M
JJ Oliver	Marketing Project	AIE	03/03 – 12/04	£90k
JJ Oliver & JAC Smith	HOMER pre-commercialisation grant	AIE	09/03 – 04/04	£95k
E Poloczanska & DJ Hughes	Serpulid reef conservation studies	SNH & Esmee Fairbairn Foundation	02/04 – 09/05	£16k
JM Roberts	Environmental sensitivity of cold water corals (PhD project)	AFEN	10/02-09/05	£58k
JM Roberts	Biodiversity and vulnerability of European cold-water reef ecosystems (ECCRE)	EU Marie Curie Fellowship	01/05 – 12/06	£106k
JM Roberts	Deep sea conservation for the UK	Esmée Fairbairn Foundation	03/05 – 02/07	£146k
JM Roberts	Collaboration on aquarium culture of cold-water water corals	The Deep	12/03 – 10/06	£15k
MDJ Sayer	Recompression treatment in Scotland: technical audit and website construction	NHS Scotland	12/99 – 12/05	£53k
MDJ Sayer	National Facility for Scientific Diving	NERC	04/03 -03/05	£80k
MDJ Sayer & JAC Smith	Whole Ecosystem Modelling	AIE, Leader plus	09/03 – 03/04	£50k
MDJ Sayer	Marine artificial habitat manipulation: prediction and measurement of environmental impacts	NERC	09/01 – 08/04	£233k
MDJ Sayer & J Beaumont	Reef fauna diets and stable isotope analysis	NERC	11/04 – 07/05	£10k
T Sherwin	Meridional overturning exchange with the Nordic seas (MOEN)	EU	12/02 – 11/05	£126k
GB Shimmield	UHI Teaching	UHI	04/01 – 03/06	£85k
GB Shimmield	PhD student support	UHI	02/99 onward	£1.5k per student place
GB Shimmield & JAC Smith	Coastal ocean benthic observatories (COBO)	EU FP6	03/04 – 02/07	£163k
GB Shimmield	SAMS group development - facilitator	AIE	07/04 – 03/05	£5k
GB Shimmield	EuroCoML facilitation	Sloan foundation, Handover	10/04 – 03/05	£24k
GB Shimmield	EuroCoML core funding	Stavros S Niarchos Foundation	02/05 – 02/08	£241k
TM Shimmield	Late Holocene and shallow marine environments of Europe (HOLSMEER)	EU Framework V	01/00 – 06/04	£47k
TM Shimmield	El Nino Southern Ocean circulation	NERC	01/04 – 12/06	£17k
TM Shimmield, JD Gage, AEJ Miller & GB Shimmield	Benthic processes in the Arabian Sea	NERC	10/01 – 12/05	£360k
JAC Smith & KD Black	Integrated coastal zone management (ICZM)	AIE	04/03 – 03/05	£12k
JAC Smith	Quality Assurance Project	AIE	03/03 – 12/04	£11k
JAC Smith	Workforce development	AIE	11/04 – 12/06	£30k
JAC Smith	EuroCoML core funding	AIE	02/05 – 01/08	£21k

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Project Leader	Title	Funding body	Duration	Award
IM Vassie	Arctic-subarctic ocean flux array for European climate (ASOF-W)	EU Framework V	02/03-07/05	£259k
P Wadhams	Greenland Arctic shelf ice and climate experiment (GreenICE)	EU Framework V	12/02 – 11/05	£385k
P Wadhams	Sea ice thickness observation system (SITHOS)	EU Framework V	12/02 – 11/05	£175k
P Wadhams	Ice ridging information for decision making in shipping operations (IRIS)	EU Framework V	01/03 – 12/05	£184k
P Wadhams	Cryosat Consortium Grant	NERC	02/04 – 02/07	£228k
K Willis	Raising awareness of invasive species	SNH	12/04 – 11/06	£5k
K Willis	Travel grant Poland	British council	06/04 – 12/04	£300

SAMS Ardtoe

Project Leader	Title	Funding body	Duration	Award
KD Black	Raising awareness	NERC	10/04 – 03/06	£137k
C Cutts	Cod cannibalism	HIE	11/03 – 09/06	£43k
C Cutts	Cod diet trial	BIOMAR	03/04 – 05/04	£14k
C Cutts	Green Water	HC, Seafish	04/04 – 03/06	£24k
J Treasurer	Haddock farming development	HIE	11/03 – 03/05	£29k
J Treasurer	Egg quality	HIE, Lochaber Enterprise	04/04 – 03/05	£8k
J Treasurer	Cod cage environment	CE, HIE, SFIA	11/03 – 09/06	£68k
J Treasurer	Haddock photoperiod	HIE, Lochaber Enterprise, Highland Council, Seafish	11/03 – 03/05	£74k
J Treasurer	Cod and haddock microbiology	HIE	04/04 – 03/05	£29k
J Treasurer	Haddock and cod immunology	Seafish	11/03 -12/04	£41k
J Treasurer	Consultancy	Angle Technology	05/04 – 06/04	£5k
J Treasurer	Cod & haddock larval nutrition	EWOS	11/03 – 06/04	£25k

SAMS Research services limited

Project Leader	Title	Funding body	Duration	Award
KD Black	Hatfield Sub	SAMS-Ardtoe	12/04 – 01/05	
KD Black	Slice (review of emmamectin)	Schering Plough	07/04 – 09/04	
KD Black	Cod environment_SRSL	CE, HIE, SFIA	11/03 – 09/06	
KD Black & L Nickel	Sea6ben	Geotek	02/05 – 04/05	
C Cromey & KD Black	Evaluation of cage farms	Akvaplan Niva	11/04 – 01/05	
C Cromey & KD Black	MERAMOD	Akvaplan Niva	01/05	
S Gontarek	SEPA database modification	SEPA	10/04	
T Gutierrez & JAC Smith	BIOBAC II	AIE	09/04 – 08/06	
M Inall & JAC Smith	Scottish Water Solution survey	SWS	03/05 – 04/05	
F Kuepper	CCAP culture collection	Commercial Sales	01/04 – 03/05	
KJ Jones	Benthic taxonomy	Panfish Ltd	01/04 – 04/04	
DT Meldrum	Argos satellite services	Commercial services	04/02- 04/05	
DT Meldrum	Greenland communications consultancy	Danish Met Institute	10/04 – 03/05	
AEJ Miller	DOC analyses	CEFAS	10/04 – 04/06	

Commercial in confidance

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

SAMS Research services limited

Project Leader	Title	Funding body	Duration	Award
JM Roberts	Mingulay grab sample analysis	Scottish Executive	02/04 – 04/04	
JM Roberts	Analysis of the Darwin Mound samples	AFEN	03/03 – 06/04	
JM Roberts & JD Gage	Norwegian Deep Water Program	Akvamiljo	07/04 – 06/06	
MDJ Sayer	NHS recompression facility	NHS	04/03 –03/05	
MDJ Sayer	Foster Yeoman Survey	Foster Yeoman	09/04 – 03/05	
T Sherwin	LAGRANGE	EA	03/04 – 05/05	
TM Shimmield, MT Burrows & JAC Smith	Offshore environmental baseline survey	UKAEA	11/03 – 11/04	
TM Shimmield	Analytical Services	Various	04/04 – 03/05	
JAC Smith	Marine Natura website	Argyll & Bute Council	04/03 – 09/04	
JAC Smith & ME Inall	Hydrographic survey	METOC	11/04	
JAC Smith & ME Inall	Seil Island survey	METOC	01/05	
JAC Smith & ME Inall	Kilmelford survey	METOC	01/05	
JAC Smith	Marine Harvest Survey	Marine Harvest Ltd.	10/04 - 12/04	
JAC Smith & GB Shimmield	Knowledge Transfer Officer grant	AIE	03/05 – 02/08	
JAC Smith & DT Meldrum	Oceanology International	AIE	03/05 – 04/06	
JAC Smith & J Wilkinson	Sea Ice Nautical Pilot Revisions	UK Hydrographic Office	10/03 – 08/05	
E Walton	Visitor Services	various	04/04 – 03/05	
J Watson	Vessel hire	Multiple Sources	04/04-03/05	

Commercial in confidance

Director
Professor GB Shimmield

Deputy Director
Dr KJ Jones

Physics, Sea Ice and Technology
Dr M Inall (Head)
Mr DT Meldrum (Deputy Head)
Dr P Gillibrand
Dr P Provost
Dr T Sherwin
Mr B Barr
Mr F Cottier
Mr C Cromey
Mr M Doble
Mr C Griffiths
Mr N Hughes
Mr D Mercer
Mr O Peppe
Mr J Wilkinson

Ecology
Dr K Black (Head)
Dr MT Burrows (Deputy)
Dr RS Batty
Dr E Cook
Dr L Henry (part time)
Dr DJ Hughes
Dr M Kelly
Dr LA Nickell (part time)
Dr T Nickell
Dr JM Roberts
Dr MDJ Sayer
Dr T Wilding
Dr K Willis
Mr D Campbell
Mr R Harvey
Mr P Lamont
Miss S Magill
Miss H Muir
Mrs L Robb
Miss C Suckling
Ms SC Swan
Ms A Wilson

Microbial & Molecular Biology
Dr R Leakey (Head)
Dr F Kuepper (Deputy)
Dr K Davidson
Dr J Day
Dr D Green
Dr T Gutierrez
Dr M Hart
Dr T Proeschold
Mrs U Achilles-Day (part time)
Mrs D Brennan
Mrs C Campbell (part time)
Miss M Gaj
Miss S McNeill
Ms E Mitchell
Miss R Saxon

Biogeochemistry & Earth Sciences
Dr TM Shimmield (Head)
Dr JA Howe (Deputy)
Dr A Hatton
Dr A Miller
Mr T Brand
Mr E Breuer
Miss K Doig
Miss C Haidon
Mr S M Harvey
Miss S McKinlay
Miss T Sawyer

SAMS Honorary Research Fellows
Prof JD Gage
Prof JBL Matthews
Dr JCA Craik
Dr RN Gibson
Dr JDM Gordon
Dr J Overnell
Dr T Pearson

IT & Data Services
Mr ST Gontarek
Miss S Drain
Mr R MacKinnon
Mr N MacLucas
Mrs K Smalley

Activities Manager
Dr A Miller

Company Secretary
Mrs EB Walton

Director's Secretariat
Miss J McLoughlin
Mrs A Kloosterhuis-Koelstra

Financial Controller
Mrs P Whyte

Accounts
Mrs F Hart
Mrs P Claxton
Mrs L Lamb (part time)
Miss S Farmer
Mrs H Harrison
Mrs L Watt

Contracts & Knowledge Transfer
Dr J Smith
Dr K Rowley
Mrs A Black (part time)

Health & Safety Adviser
Mr IA Ezzi

Personnel
Ms CM Bonomy
Ms K Campbell
Mrs L Thomson (part time)

Reception
Mrs I Partridge (part time)

Assistant Librarian
Mrs P Thomson

Aquarium Manager
Mr A Keay

Estates/Ship's Husband
Mr J Watson

UHI IT
Mr C Rydings
Mr I Lipkowitz
Miss N Longman
Miss H MacDougall
Mr GC Ryan

NERC National Diving Facility
Dr MDJ Sayer
Mr H Brown
Dr S Thurston

RV Calanus
Mr R MacNeil (Master)
Mr J MacFarlane
Mr D MacNeill
Mr N Smith

RV Seol Mara
Mr D McAlpine
Mr S Douglas

Electrical Maintenance
Mr B Clark
Mr J Hill

Engineering workshop
Mr A Connelly
Mr M Robertson (Apprentice Engineer)

Building Maintenance
Mr D MacKinnon

Storeman
Mr A Black

Seas@SAMS
Mrs J Duncan
Mrs J Moore (part time)

SAMS Ardtoe
Dr T Atack
Dr C Cutts
Dr D Schoeman
Dr J Sherwood
Dr J Treasurer
Dr B Wilson
Mr M Bleasdale
Mr D Cameron
Mrs H Cameron
Mr J Clark
Mr L Ford
Mr G McAlpine
Mrs K Robins

SAMS ACCOUNTS

Company Information

Directors
Professor Sir J Arbuthnott (President)
Mrs M M Crawford
Dr A Goodlad
Mr W Balfour
Dr P Thompson
Professor M J Cowling
Professor I Boyd
Professor J I Sprent
Mr R Thwaites
Mr I H Townend
Dr R A Scrutton
Dr A B MacKenzie

Secretary
Mrs 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
21 Vincent Place
Glasgow G1 2EQ

Registered Office
Dunstaffnage Marine Laboratory
Oban
Argyll PA37 1QA

Charity Number: SC 009206

Secretary's Report

Secretary's Report for the year ending 31 March 2005

The 90th Annual General Meeting of Association took place on 2 November 2004 at Dunstaffnage Marine Laboratory and was chaired by Dr I Graham-Bryce.

Vice Presidents

The following had been nominated by Council and were unanimously elected to serve as Vice-Presidents for a period of one year. Professor Sir F Holliday, Kt, CBE, BSc, DSc, FIBiol, FRSE; Professor AD McIntyre, CBE, BSc, DSc, FIBiol, FRSE; Sir David Smith, MA, Dphil, FRSE, FRS; Dr JH Steele, BSc, DSc, FRSE, FRS; Professor Sir W Stewart, Kt, BSc, PhD, DSc, FIBiol, FRSE, FRS; Professor SA Thorpe, BSc, BA, PhD, FRS and Dr I Graham-Bryce, MA, BSc, Dphil, FRSE, FRSA, Cchem, FRSC.

SAMS Board

The following had been nominated and were unanimously elected to serve as Board members for a period of one year. Professor R Cormack, (representing UHI), Professor R Crofts, (representing SNH), Lord E Strathcona, (representing Fishmongers Co.)

SAMS Council

Dr I Graham-Bryce and Dr A W Tudhope stood down. Mr JHowarth became the new HIE Council Observer.

The following new nominations were appointed: Professor Sir J Arbuthnott as President, Dr R A Scrutton and Dr A B MacKenzie as members of Council. Mr W Balfour and Dr P Thomson agreed to serve another 3 years. Messrs Ernst and Young were re-appointed auditors for the Association.
The AGM was immediately followed by the Fourteenth Newth Memorial Lecture given by Dr Chris German (SOC).The lecture was entitled "Hydrothermal exploration can lead you a long way: Oases for life in distant oceans".

The Board of SAMS also met at Dunstaffnage on 2 November 2004 to discuss SAMS strategy, the new building developments and the relationships with NERC and UHI Millennium Institute (UHI). Four meetings of Council were held during the course of the year.

The Council was served by the Finance and General Purposes Committee chaired by Professor M Cowling, and the Research and Strategy Committee chaired by Professor J Sprent.

Membership of the Association

At 5 August 2005 total membership was 564(586), including 39(40) Corporate and 83(97) students. Figures for 5 August 2004 are shown in brackets. The apparent reduction is due to a review of the database to remove lapsed members who have not responded to numerous attempts to contact them.

COUNCIL REPORT

The Council for The Scottish Association for Marine Science presents its report and the group financial statements for the year ended 31 March 2005.

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.

Business Review

The financial year 2004/05 has proved to be another year of significant and rapid development for the SAMSgroup.

With almost a year to the day of the official opening of the new laboratories by HRH the Princess Royal, the financial year ended with the completion and opening of the European Centre for Marine Biotechnology (ECMB) by Baroness Susan Greenfield. This completes the entire new build project which started in 2002. Two thirds of the ECMB wing is now occupied by the combined NERC marine and freshwater Culture Collection for Algae and Protozoa (CCAP), and two tenant marine biotechnology SMEs.

The SAMSgroup enjoyed considerable success with EU funding. Over 3 M Euros for six projects spanning a three year period commenced within the financial year.

The SAMSgroup has further extended its expertise to the commercial sector and has seen an increased demand for its services through a broadening of its project portfolio. 2004/05 saw the completion of the first marine environmental baseline survey related to the decommissioning of a nuclear facility.

Unfortunately, despite significant efforts to secure funding for SAMS Ardtoe Ltd it was with regret that the subsidiary company went into liquidation on 13th April 2005.

Results

The results for the year are detailed on page 42 of the financial statements. The net incoming resources taken to reserves is £15,944 (2004 – £1,904,450).

The Council confirms that on a fund by fund basis, the assets of £8,027,201 are adequate to fulfil the objectives of the group.

Directors

The directors, who served the charitable company as Council Members, during the year are listed on page 40.

There are no directors' interests requiring disclosure under the Companies Act 1985.

Reserves policy

The policy is to retain sufficient funds required to meet the costs of salaries, insurances and other regular commitments to allow for orderly wind down of the organisation or to allow for the sums necessary to meet the cost of replacement of computer equipment. Council reviewed its reserve policy during 2004/05 and has planned for a break-even budget for financial year 2005/06 with a view to moving towards rebuilding its reserves in the following year.

The 5-year core research programme that was the subject of the 2001 NERC/SAMS agreement has been extended for a further year adding some certainty for the financial planning of SAMS to April 2007. NERC have invited a submission for a further 5-year strategic programme from April 2007.

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 Register of Risks were considered during 2004/5 at meetings of SAMS Council, the Finance and General Purposes Committee and the SRSL Board. This process of periodic consideration of the appropriateness of the Register and the need for future revisions is a continuing process.

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.

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.

The members of the Governing Council during the year were:

	Date appointed		Date resigned
Professor Sir J Arbuthnott (President)	2 November 2004	-	
Dr Ian J Graham-Bryce (President)	1 August 2000	-	2 November 2004
Mrs M M Crawford	1 November 1999	-	
Professor M J Cowling	6 November 2000	-	
Dr A Goodlad	6 November 2000	-	
Mr W Balfour	6 November 2001	-	
Dr A W Tudhope	6 November 2001	-	2 November 2004
Dr P Thompson	6 November 2001	-	
Professor I Boyd	4 November 2003	-	
Professor J I Sprent	4 November 2003	-	
Mr R Thwaites	4 November 2003	-	
Mr I H Townend	4 November 2003	-	
Dr R A Scrutton	2 November 2004	-	
Dr A B MacKenzie	2 November 2004	-	

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.

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 board

EB Walton Secretary

4 October 2005

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

Company law requires the Members of Council (who act as directors) to prepare financial statements for each financial year which 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 accounts, 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 company 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 accounts comply with the Companies Act 1985. They are also responsible for safeguarding the assets of the company and hence for taking reasonable steps for the prevention and detection of fraud and other irregularities.

AUDITORS' REPORT

Independent Auditors' report to the Members of The Scottish Association for Marine Science

We have audited the group's financial statements for the year ended 31 March 2005 which comprise the Group Income and Expenditure, Group Statement of Financial Activities, Group Balance sheet, Balance Sheet, Group Statement of Cash Flows and related notes 1 to 23. These financial statements have been prepared on the basis of the accounting policies set out therein.

This report is made solely to the company's members, as a body, in accordance with Section 235 of the Companies Act 1985. 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 directors and auditors

As described in the Statement of Council's Responsibilities the charity's 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 United Kingdom law and accounting standards.

Our responsibility is to audit the financial statements in accordance with relevant legal and regulatory requirements and United Kingdom Auditing Standards.

We report to you our opinion as to whether the financial statements give a true and fair view and are properly prepared in accordance with the Companies Act 1985. We also report to you if, in our opinion, the Council's Report is not consistent with the financial statements, if the charity has not kept proper accounting records, if we have not received all the information and explanations we require for our audit, or if information specified by law regarding directors' remuneration and transactions with the charitable group is not disclosed.

We read the other information contained in the Council's Report, and consider whether it is consistent with the audited financial statements. We consider the implications for our report if we become aware of any apparent misstatements or material inconsistencies with the financial statements. Our responsibilities do not extend to any other information.

Basis of audit opinion

We conducted our audit in accordance with United Kingdom Auditing Standards 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 Members of Council in the preparation of the financial statements, and of whether the accounting policies are appropriate to the charitable group's circumstances, consistently applied and adequately disclosed.

We planned and performed our audit so as to obtain all the information and explanations which we considered necessary in order to provide us with sufficient evidence to give reasonable assurance that 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.

Opinion

In our opinion the financial statements give a true and fair view of the state of affairs of the charitable company and of the group as at 31 March 2005 and of the incoming resources and application of resources of the group, including its income and expenditure, for the year then ended and have been properly prepared in accordance with the Companies Act 1985.

Ernst & Young LLP
Registered Auditors

Inverness
7 October 2005

GROUP INCOME AND EXPENDITURE ACCOUNT

FOR THE YEAR ENDED 31 MARCH 2005

	Notes	2005 £	2004 £
Turnover			
Continuing operations		8,299,137	8,127,604
Discontinued operations		678,519	248,377
		8,977,656	8,375,981
Cost of sales	3	7,238,496	4,910,163
Gross surplus		1,739,160	3,465,818
Administration expenses	3	1,647,615	1,499,121
		91,545	1,966,697
Other operating income	3	130,589	49,886
Operating (deficit)/surplus			
Continuing operations		329,969	2,018,369
Discontinued operations		(107,835)	(1,786)
		222,134	2,016,583
Interest receivable	11	14,826	68,155
Interest payable and similar charges	7	(221,016)	(180,288)
Surplus on ordinary activities before taxation		15,944	1,904,450
Tax on surplus on ordinary activities		-	-
Surplus retained for the financial year		15,944	1,904,450

Statement of total recognised gains and losses

There are no recognised gains or losses other than the surplus of £15,944 in the year ended 31 March 2005 and the surplus of £1,904,450 in the year ended 31 March 2004.

ACCOUNTS

GROUP STATEMENT OF FINANCIAL ACTIVITIES

FOR THE YEAR ENDED 31 MARCH 2005

	Notes	2005 Unrestricted funds £	2005 Restricted funds £	2005 Total £	2004 Total £
Incoming resources					
Northern Seas programme		2,412,453	80,799	2,493,252	2,289,257
NERC research grants		301,436	-	301,436	254,880
UHI teaching income		629,795	27,324	657,119	626,239
		3,343,684	108,123	3,451,807	3,170,376
From operating activities					
Activities in furtherance of objectives	2	4,475,421	1,050,428	5,525,849	5,205,605
Activities in generating funds:					
Investment income	11	14,637	189	14,826	68,155
Others		130,589	-	130,589	49,886
Total incoming resources		7,964,331	1,158,740	9,123,071	8,494,022
Resources expended					
Cost of generating funds	4	53,406	-	53,406	72,729
Charitable expenditure					
Cost of activities in furtherance of the objectives	5	5,660,397	394,742	6,055,139	4,047,257
Support costs	6	1,129,951	-	1,129,951	790,177
Management and administration	7	1,434,378	434,253	1,868,631	1,679,409
Total charitable expenditure	8	8,224,726	828,995	9,053,721	6,516,843
Total resources expended		8,278,132	828,995	9,107,127	6,589,572
Net (outgoing)/incoming resource before transfers and tax		(313,801)	329,745	15,944	1,904,450
Taxation		-	-	-	-
Transfers between funds		-	-	-	-
Net (outgoing)/incoming resources for year		(313,801)	329,475	15,944	1,904,450
Fund balances brought forward at 1 April 2004		468,696	7,542,561	8,011,257	6,106,807
Fund balances carried forward at 31 March 2005		154,895	7,872,306	8,027,201	8,011,257

GROUP BALANCE SHEET

AT 31 March 2005

	Notes	2005 £	2004 £
Fixed assets			
Intangible assets	12	3,924	5,232
Tangible assets	13	12,348,078	11,558,123
Investments	14	40,678	40,489
		12,392,680	11,603,844
Current assets			
Debtors	15	1,482,420	1,748,896
Cash at bank and in hand	174,987	331,187	
		1,657,407	2,080,083
Creditors: amounts falling due within one year	16	3,453,666	2,976,227
Net current liabilities		(1,796,259)	(896,144)
Total assets less current liabilities		10,596,421	10,707,700
Creditors: amounts falling due after more than one year			
Loans	17	2,569,220	2,696,443
		8,027,201	8,011,257
Capital and reserves			
Unrestricted funds		154,895	468,696
Restricted funds	18	7,872,306	7,542,561
		8,027,201	8,011,257

COMPANY BALANCE SHEET

AT 31 March 2005

	Notes	2005 £	2004 £
Fixed assets			
Tangible assets	13	12,223,242	11,502,671
Investments	14	40,678	40,489
		12,263,920	11,543,160
Current assets			
Debtors	15	1,242,325	1,321,454
Cash at bank and in hand		19,286	139,630
		1,261,611	1,461,084
Creditors: amounts falling due within one year	16	2,902,610	2,333,450
Net current liabilities		(1,640,999)	(872,366)
Total assets less current liabilities		10,622,921	10,670,794
Creditors: amounts falling due after more than one year			
Loans	17	2,569,220	2,696,443
		8,053,701	7,974,351
Capital and reserves			
Unrestricted funds		508,781	702,666
Restricted funds	18	7,544,920	7,271,685
		8,053,701	7,974,351

These financial statements were approved on behalf of the Council on 30 September 2005 and were signed by:

I H Townend Acting Chair of Finance and General Purposes Committee

GROUP STATEMENT OF CASH FLOWS

AT 31 March 2005

	Notes	2005 £	2004 £
Net cash inflow from operating activities	20(a)	1,007,076	3,206,320
Returns on investment and servicing of finance	20(a)	(206,379)	(112,286)
Taxation		-	(660)
Capital expenditure	20(a)	(1,348,132)	(5,499,396)
Financing		(127,223)	2,889,776
(Decrease)/increase in cash	20(b)	(674,658)	483,754

Reconciliation of net cash flow to movement in net funds

	Notes	2005 £	2004 £
(Decrease)/increase in cash		(674,658)	483,754
Cash inflow from increase in loans		-	(2,889,776)
Repayment of long term loans		127,223	-
		(547,435)	(2,406,022)
Net debt at 1 April		(2,670,157)	(264,135)
Net debt at 31 March	20(b)	(3,217,592)	(2,670,157)

NOTES TO THE GROUP FINANCIAL STATEMENTS

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 2000) issued in October 2000.

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 nor 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 2005. 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 230(4) of the Companies Act 1985 and paragraph 304 of SORP 2000, The Scottish Association for Marine Science is exempt from the requirement to present its own profit and loss account or statement of financial activities. The result of the financial year dealt with in the financial statements of The Scottish Association for Marine Science is disclosed in note 18 to these accounts.

Depreciation

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	-	50 years
Vessels	-	25 years
Fittings and equipment	-	5 - 10 years
Motor vehicles	-	5 years

The expected useful life of certain items of fittings and equipment has been changed from 5 years to 10 years. The impact of this in the current year is given in note 12 to the financial statements.

Taxation

Income is stated net of Value Added Tax and expenditure includes Value Added Tax where this is not recoverable.
The group's financial statements include the relevant corporation tax in respect of the subsidiary undertaking.

Leasing

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

Pensions

The Association participates in the Universities Superannuation Scheme, a defined benefit scheme which is externally funded and contracted out of the State Second Pension. The liabilities are valued every three years by a professionally qualified independent actuary using the projected unit method, the rates of contribution payable being determined by the trustee on the advice of the actuary. In the intervening years, the actuary reviews the progress of the scheme. Pension costs are assessed in accordance with the advice of the actuary, based on the latest actuarial valuation of the scheme, and are accounted for on the basis of charging the cost of providing pensions over the period during which the Association benefits from the employees' services. For staff who 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. All core NERC grants are recognised as revenue in the year they are received. 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 and indirect costs. Fundraising and publicity expenditure represents the cost of obtaining funds for research, promoting the work of the Association and recruitment of staff. Management and administration expenditure represents the necessity of compliance with statutory and constitutional requirements, and any other costs which are not direct charitable expenditure or fundraising and publicity expenditure.

Investments

Investments represent property and bank balances for the Sheina Marshall Bequest and the Yonge Fellowship.

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.

2. Analysis of income received

	2005 Unrestricted funds £	2005 Restricted funds £	2005 Total £	2004 Total £
Furtherance of objectives				
Computing services	-	-	-	4,710
Research grants	3,740,385	22,162	3,762,547	2,012,024
Research contracts	144,773	97,113	241,886	130,879
Scientific services	499,117	378,350	877,467	779,344
Sales of cultures	91,146	-	91,146	29,564
Receipt of government grants	-	552,803	552,803	2,249,084
	4,475,421	1,050,428	5,525,849	5,205,605

	2005 £	2004 £
Project income received		
Coastal Impact Research	2,391,239	725,088
Geochemistry	581,380	581,657
Pelagic Plankton	239,949	239,519
Marine Technology	497,708	683,704
Deep Sea Benthos	173,622	201,081
Ecology and Behaviour	238,418	246,530
Animal Environment Interaction	-	569,229
Computing Services	-	4,710
Marine Physics	315,735	173,851
Marine Algal Research	534,410	192,010
Shared Research Cruise	52,333	73,824
Sea Ice Research	384,474	256,513
Biological Services	14,678	9,105
	5,423,946	3,956,821

3. Cost of sales and operating expenses

	Continuing £	Discontinued £	2005 Total £	Continuing £	Discontinued £	2004 Total £
Cost of sales	6,523,803	714,693	7,238,496	4,696,949	213,214	4,910,163
Administrative expenses	1,544,215	103,400	1,647,615	1,462,173	36,948	1,499,121
Other operating income	98,850	31,739	130,589	48,685	1,201	49,886

4. Cost of generating funds

	Unrestricted funds 2005 Staff costs £	2005 Other £	2005 Restricted funds £	2005 Total £	2004 Total £
Marketing, publications and newsletters	9,895	43,511	-	53,406	72,729

5. Cost of activities in furtherance of the objectives

	Unrestricted funds 2005 Staff costs £	2005 Other £	2005 Restricted funds £	2005 Total £	2004 Total £
Coastal Impact Research	406,151	1,506,597	188,943	2,101,691	672,712
Geochemistry	295,578	220,885	-	516,463	571,842
Pelagic Plankton	230,921	66,422	-	297,343	283,046
Marine Technology	173,213	91,464	205,799	470,476	549,179
Deep Sea Benthos	122,939	69,545	-	192,484	245,680
Ecology and Behaviour	206,675	35,545	-	242,220	235,287
Animal Environment Interaction	-	-	-	-	422,177
Computing Services	-	-	-	-	5,229
Marine Physics	190,981	43,238	-	234,219	208,980
Marine Algal Research	300,147	78,812	-	378,959	191,344
Sea Ice Research	159,294	205,465	-	364,759	258,017
Directorate Science	95,397	555,382	-	650,779	181,540
Shared Research Cruise	7,462	45,778	-	53,240	73,824
Ardtoe Science	280,947	203,535	-	484,482	133,134
Biological Services	60,160	7,864	-	68,024	15,266
	2,529,865	3,130,532	394,742	6,055,139	4,047,257

6. Support costs

	Unrestricted funds 2005 Staff costs £	2005 Other £	2005 Restricted funds £	2005 Total £	2004 Total £
Vessels	160,386	96,437	-	256,823	168,228
Scientific support	71,098	76,040	-	147,138	128,088
Buildings	283,245	442,745	-	725,990	493,861
	514,729	615,222	-	1,129,951	790,177

NOTES TO THE GROUP FINANCIAL STATEMENTS

7. Management and administration

	Unrestricted funds				
	2005 Staff costs £	2005 Other £	2005 Restricted funds £	2005 Total £	2004 Total £
Meetings	-	13,172	-	13,172	5,923
Bursaries	-	3,580	-	3,580	6,041
Council expenses	-	-	-	-	4,491
Postage and telecom	-	33,504	-	33,504	27,716
Insurance	-	114,151	-	114,151	52,997
Library and printing	-	12,209	-	12,209	16,829
Other professional fees	-	47,301	-	47,301	55,901
Travel, subsistence and interviews	-	33,756	-	33,756	36,623
Bank charges	-	11,434	-	11,434	16,380
Bank interest	-	221,016	-	221,016	180,288
Depreciation	-	125,232	434,253	559,485	628,977
Administration, services and equipment	55,318	96,756	-	152,074	81,871
Administration salaries	578,858	-	-	578,858	519,784
IT licences and maintenance agreements	-	41,204	-	41,204	40,041
Training	-	22,014	-	22,014	10,570
Sundries and subscriptions	-	3,620	-	3,620	1,202
Exchange loss	-	15,911	-	15,911	12,057
Increase/(decrease) in bad debt provision	-	5,342	-	5,342	(18,282)
	634,176	800,202	434,253	1,868,631	1,679,409

8. Total charitable expenditure

Total charitable expenditure includes:

	2005 £	2004 £
Auditors' remuneration		
- audit services	11,200	12,100
- other services	2,425	1,150
Depreciation and amortisation	559,485	629,687
Operating lease charges - motor vehicles and equipment	62,252	31,731
- property	9,795	10,545

9. Remuneration of the members of the Council

The non-executive Council members received £5,177 (2004 - £4,491) remuneration, in the form of travel expenses, in total from the Association during the year.

Professor G B Shimmield is a director of the subsidiary undertakings, SAMS Research Services Limited, The European Centre for Marine Biotechnology Limited and both Professor G B Shimmield and Dr K J Jones are directors of the subsidiary undertaking, SAMS Ardtoe Limited. They were paid total remuneration of £141,443 (2004 - £176,103) and pension contributions of £16,600 (2004 - £23,169), as employees of The Scottish Association for Marine Science.

10. Staff costs

	2005 £	2004 £
Wages and salaries	1,924,727	1,962,910
Social security costs	147,248	157,390
Other pension costs	240,739	234,138
	2,312,714	2,354,438

The remuneration of the employees of NERC working for the Association was as follows:

	2005 £	2004 £
Wages and salaries	913,172	867,590
Social security costs	74,167	70,047
Other pension costs	89,627	85,256
	1,076,966	1,022,893

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

	2005 No.	2004 No.
Scientific	57	57
Scientific services	9	10
Office management	11	10
	77	77

The number of employees who received in excess of £50,000 per annum was as follows:

	No.	No.
£50,000 - £60,000	2	2
£60,001 - £70,000	-	-
£70,001 - £80,000	1	1

The total pension contributions paid by the company for the above members of staff were £21,830 (2004 - £25,794).

11. Investment income

	2005 £	2004 £
Interest receivable	14,826	68,155

12. Intangible fixed assets

Group

	Intellectual Property £
Cost:	
At 1 April 2004 and 31 March 2005	6,540
Amortisation:	
At 1 April 2004	1,308
Provided during the year	1,308
At 31 March 2005	2,616
Net book value:	
At 31 March 2005	3,924
At 31 March 2004	5,232

The estimated useful life of the intellectual property has been assessed as 5 years by the directors of the group.

13. Tangible fixed assets - Group

	Assets under construction £	Property £	Vessels £	Fittings and equipment £	Motor vehicles £	Total £
Cost:						
At 1 April 2004	1,091,643	10,251,461	416,678	3,684,558	4,000	15,448,340
Additions	-	1,082,861	-	265,271	-	1,348,132
Transfers	(1,091,643)	1,091,643	-	-	-	-
At 31 March 2005	-	12,425,965	416,678	3,949,829	4,000	16,796,472
Depreciation:						
At 1 April 2004	-	812,992	416,678	2,659,747	800	3,890,217
Charge for year	-	237,158	-	320,219	800	558,177
At 31 March 2005	-	1,050,150	416,678	2,979,966	1,600	4,448,394
Net book value:						
At 31 March 2005	-	11,375,815	-	969,863	2,400	12,348,078
At 31 March 2004	1,091,643	9,438,469	-	1,024,811	3,200	11,558,123

The change in useful life from 5 years to 10 years of certain items of fittings and equipment has resulted in a decrease in the depreciation charge for the year of £62,324.

Tangible fixed assets - Company

	Assets under construction £	Property £	Vessels £	Fittings and equipment £	Total £
Cost:					
At 1 April 2004	1,091,643	10,251,461	416,678	3,617,112	15,376,894
Additions	-	1,082,861	-	160,679	1,243,540
Transfers	(1,091,643)	1,091,643	-	-	-
At 31 March 2005	-	12,425,965	416,678	3,777,791	16,620,434
Depreciation:					
At 1 April 2004	-	812,992	416,678	2,644,553	3,874,223
Charge for year	-	237,158	-	285,811	522,969
At 31 March 2005	-	1,050,150	416,678	2,930,364	4,397,192
Net book value:					
At 31 March 2005	-	11,375,815	-	847,427	12,223,242
At 31 March 2004	1,091,643	9,438,469	-	972,559	11,502,671

The change in useful life from 5 years to 10 years of certain items of fittings and equipment has resulted in a decrease in the depreciation charge for the year of £62,324.

14. Investments

	Group		Company	
	2005 £	2004 £	2005 £	2004 £
Sheina Marshall Bequest:				
Flat at cost	25,673	25,673	25,673	25,673
Bank balances	13,469	13,280	13,469	13,280
Debtor	1,536	1,536	1,536	1,536
	40,678	40,489	40,678	40,489

NOTES TO THE GROUP FINANCIAL STATEMENTS

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	Advancement of education, research and knowledge in marine science
SAMS Ardtoe Limited	Limited by guarantee	Sole member	In liquidation

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

	SAMS Research Services Limited 2005 £	SAMS Ardtoe Limited 2005 £
Turnover	1,217,840	678,519
Cost of sales and administrative expenses	(1,236,825)	818,093
Interest receivable and other operating income	2,881	33,555
Interest payable	(175)	-
Net loss	(29,507)	(106,019)
Amount gifted to charity	-	-
Taxation	-	-
Loss for the year	(29,507)	(106,019)
The assets and liabilities of the subsidiary were:		
Fixed assets	120,631	8,129
Current assets	401,936	112,063
Creditors: amounts falling due within one year	(455,520)	(226,211)
Deferred government grants	(90,258)	-
Aggregate share capital and reserves	(23,211)	(106,019)

The results of The European Centre for Marine Biotechnology for the year ended 31 March 2005 are not material to the group. SAMS Ardtoe went into liquidation on 13 April 2005.

15.Debtors

	Group		Company	
	2005 £	2004 £	2005 £	2004 £
Trade debtors and grants due	337,623	649,519	177,538	149,922
Other debtors	1,246	30,843	1,226	1,634
VAT debtor	25,009	103,583	25,009	103,583
Prepayments and accrued income	1,118,542	964,951	916,700	902,933
Due from group undertakings	-	-	121,852	163,382
	1,482,420	1,748,896	1,242,325	1,321,454

16.Creditors: amounts falling due within one year

	Group		Company	
	2005 £	2004 £	2005 £	2004 £
Current instalment due on bank loan (note 17)	193,333	193,333	193,333	193,333
Bank overdraft	630,026	111,568	630,026	21,954
Payments received in advance	1,779,739	1,229,701	1,541,081	857,826
Deferred creditors	-	75,064	-	75,064
Taxation and social security	133,318	89,353	78,706	47,247
Sundry creditors and accruals	717,250	1,277,208	459,464	1,080,052
Due to group undertaking	-	-	-	57,974
Corporation tax	-	-	-	-
	3,453,666	2,976,227	2,902,610	2,333,450

The bank loans and overdraft are secured by a bond and floating charge over the whole assets of the company and a standard security over Dunstaffnage Marine Laboratory, Oban both in favour of the Bank of Scotland.

17. Loans

	Group		Company	
	2005 £	2004 £	2005 £	2004 £
Not wholly repayable within five years: £2,900,000 bank loan at 1.25% above LIBOR per annum, repayable in monthly instalments of £16,111 commencing 3 March 2004	2,762,553	2,889,776	2,762,553	2,889,776
Less: included in creditors: amounts falling due within one year (note 16)	193,333	193,333	193,333	193,333
	2,569,220	2,696,443	2,569,220	2,696,443

	Group		Company	
	2005 £	2004 £	2005 £	2004 £
Amounts repayable:				
In one year or less, or on demand	193,333	193,333	193,333	193,333
In more than one year but not more than two years	193,333	193,333	193,333	193,333
In more than two years but not more than five years	579,999	579,999	579,999	579,999
	966,665	966,665	966,665	966,665
In more than five years	1,795,888	1,923,111	1,795,588	1,923,111
	2,762,553	2,889,776	2,762,553	2,889,776

18. Restricted funds

Group	1 April 2004 £	Income £	Expenditure £	31 March 2005 £
Fixed asset funds	7,237,980	787,680	(434,253)	7,591,407
Sheina Marshall Bequest	40,489	189	-	40,678
Yonge Fellowship	3,093	-	-	3,093
Recompression	218,569	158,035	(188,943)	187,661
Argos	42,430	212,836	(205,799)	49,467
	7,542,561	1,158,740	(828,995)	7,872,306

Company	1 April 2004 £	Income £	Expenditure £	31 March 2005 £
Fixed asset funds	7,228,103	683,088	(410,042)	7,501,149
Sheina Marshall Bequest	40,489	189	-	40,678
Yonge Fellowship	3,093	-	-	3,093
	7,271,685	683,277	(410,042)	7,544,920

Capital grants are recognised as restricted income in the year in which they are received and the depreciation is recognised as an expense against the restricted fund.

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.

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

19. Profit and loss account

In accordance with the exemption allowed by section 228(7) of the Companies Act 1985 the company has not presented its own profit and loss 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 £79,350 (2004 – £4,656,381).

20. Notes to the statement of cash flows

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

	2005 £	2004 £
Operating surplus/(deficit)	222,134	2,016,583
Depreciation and amortisation	559,485	629,687
Decrease in debtors	266,476	539,909
(Decrease)/increase in creditors	(41,019)	20,141
Net cash inflow from operating activities	1,007,076	3,206,320

Returns on investment and servicing of finance	2005 £	2004 £
Interest received	14,637	68,002
Interest paid	(221,016)	(180,288)
	(206,379)	(112,286)

Capital expenditure and financial investment	2005 £	2004 £
Payments to acquire intangible fixed assets	-	(6,540)
Payments to acquire tangible fixed assets	(1,348,132)	(5,492,856)
	(1,348,132)	(5,499,396)

Financing	2005 £	2004 £
New secured loan	-	2,900,000
Repayment of long term loans	(127,223)	(10,224)
	(127,223)	2,889,776

(b) Analysis of changes in net debt

	At 1 April 2004 £	Cash flow £	Other changes £	At 31 March 2005 £
Cash at bank and in hand	331,187	(156,200)	-	174,987
Debt due within one year	(304,901)	(391,235)	(127,223)	(823,359)
Debt due after one year	(2,696,443)	-	127,223	(2,569,220)
	(2,670,157)	(547,435)	-	(3,217,592)

21. Pension commitments to pension fund

The Association participates in the Universities Superannuation Scheme, a defined benefit scheme which is externally funded and contracted out of the State Second Pension. The assets of the scheme are held in a separate trustee-administered fund. It is not possible to identify each institution's share of the underlying assets and liabilities of the scheme and hence contributions to the scheme are accounted for as if it were a defined contribution scheme. The cost recognised within the surplus/deficit for the year in the Statement of Financial Activities being equal to the contributions payable to the scheme for the year.

The latest actuarial valuation of the scheme was at 31 March 2002. 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. In relation to the past service liabilities the financial assumptions were derived from market yields prevailing at the valuation date. It was assumed that the valuation rate of interest would be 5.0% per annum, salary increases would be 3.7% per annum and pensions would increase by 2.7% per annum. In relation to the future service liabilities it was assumed that the valuation rate of interest would be 6.0% per annum, including an additional investment return assumption of 1% per annum, salary increases would be 3.7% per annum and pensions would increase by 2.7% per annum. The valuation was carried out using the projected unit method.

At the valuation date, the market value of the assets of the scheme was £19,938 million and the value of the past service liabilities was £19,776 million leaving a surplus of assets of £162 million. The assets therefore were sufficient to cover 101% of the benefits which had accrued to members after allowing for expected future increases in earnings.

The company contribution rate required for future service benefits alone at the date of the valuation was 14.25% of salaries but it was agreed that the company contribution rate will be maintained at 14% of salaries. To fund this reduction of 0.25% for the period of 12 years from the date of the valuation (the average outstanding working lifetime of the current members of the scheme) required the use of £82.5 million of the surplus. This left a past service surplus of £79.5 million (including the Supplementary Section) to be carried forward.

Surpluses or deficits which arise at future valuations may impact on the company's future contribution commitment. The next formal actuarial valuation is due as at 31 March 2005 when the above rates will be reviewed.

The total pension cost for the company was £240,739 (2004 - £234,138). The contribution rate payable by the company was 14% of pensionable salaries.

22. Capital commitments

	Group		Company	
	2005 £	2004 £	2005 £	2004 £
Contracted for	177,415	1,315,837	177,415	1,315,837

23. Other financial commitments

At 31 March 2005 the group had annual commitments under non-cancellable operating leases as set out below:

	Group Land and buildings		Group Other		Company Other	
	2005 £	2004 £	2005 £	2004 £	2005 £	2004 £
Operating lease which expire:						
within one year	-	-	14,478	1,532	8,517	-
within two to five years	-	2,500	47,631	37,733	47,631	22,412
over five years	-	8,045	-	3,362	-	3,362
	-	10,545	62,109	42,627	56,148	25,774

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