

It is a great pleasure to record the events of 2005-6 for the Association. Having completed all the major capital building work and science audits of the two previous years, this promised to be a year of consolidation and future planning. In this first year of the new SAMS President, Sir John Arbuthnott, SAMS has a major opportunity to play a pivotal role in marine science strategy in Scotland at both an academic and Our academic strategic level. contribution was recognised by a significant award of £5.6 million to SAMS as part of the £11.4 million Addressing Research Capacity (ARC) award to the UHI Millennium Institute. The Scottish Funding Council (SFC), Highlands and Islands Enterprise and



NORTHERN SEAS PROGRAMME NSP

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Fundamental research into mixing processes in restricted coastal systems (sea lochs, or fjords) has challenged the accepted wisdom that those systems with texture and geochemistry. Cruise JR127

NORTHERN SEAS PROGRAMME NSP

ancient volcanic cones, slide scars and the terraced slopes of the bank. Deep-ocean currents flowing around the base of the seamount have mounded and sculpted the seafloor around the entire seamount, including generating two fields of giant sediment waves. Current meter mooring and oceanographic measurements indicate that the western flanks of the seamount are strongly influenced by

NORTHERN SEAS PROGRAMME NSP

Brr Ar, L, P.

Biological enhancement of particle and solute movement in response to environmental drivers can have critical implications for the burial and remineralisation of organic carbon in the marine environment. At more northerly particles were used to examine sediment processing rates and bioirrigation and any changes induced by the addition of algal organic carbon. Measurements of benthic metabolism provided a further indication of changes in organism behaviour and activity rate. Early results indicated that organism responses,



latitudes, input of organic carbon is highly seasonally pulsed and it is possible that organisms show rapid behavioural responses in order to exploit this ephemeral resource. During an Arctic cruise in Sept/ Oct 2005 on the RRS James Clark Ross, shipboard core incubations with added fluorescent



fluorescent particles, and burial by animal activity.

including fluxes of nutrients, were complex and did not show linearity. Periodicity was evident in bioirrigation rates which may be of great significance in influencing organic carbon degradation rates.

The objectives of this bioturbation work complement those of the European Union funded project Coastal Ocean Benthic Observatories (COBO) which seeks to integrate innovative technologies to provide *in-situ* monitoring of coastal sediment habitats, providing information on processes, such as bioturbation and bioirrigation, and their role in regulating ecosystem function.

L Nickell and S Harvey

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In coastal marine environments, the supply of nitrogen frequently limits phytoplankton production. Nitrogen may be introduced into surface waters from deeper water as regenerated inorganic nitrogen but may also enter in inorganic or organic form via aquaculture inputs, freshwater run-off from land or sewage discharges. These additional sources, many of which result from human activity, may perturb planktonic ecosystems leading to coastal eutrophication. The importance of inorganic nitrogen for the nutrition and growth of marine phytoplankton is widely recognised; however, the influence of organic nitrogen on the planktonic



Experimental mesocosms used to test the effect of inorganic and organic nitrogen on planktonic microbial communities (Image: Linda Gilpin)

microbial community and subsequent carbon cycling in shelf seas has received less attention. We therefore investigated the effect of organic nitrogen on a coastal

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Unique data from our mooring in Kongsfjorden, Svalbard, have allowed SAMS scientists to establish the link between exchange of Arctic and Atlantic water sediment cores;

- SITHOS (Sea Ice Thickness Observing System), the development of a European monitoring system for sea ice thickness and related parameters for climate change detection, environmental protection and support to sea transport and offshore operations;
- IRIS (Ice Ridging Information for Decision Making in Shipping Operations), a study of the mechanics of ridge building and ridge structure, and the relationship between ridging parameters and ice resistance forces on vessels.

On-going funded projects include:

- The NERC funded Cryosat validation programme;
- The EU funded IPY-CARE (International Polar Year - Climate of the Arctic and its Role for Europe) programme, whose role is to prepare a pan-European science and implementation plan for Arctic

BIOGEOCHEMISTRY AND EARTH SCIENCES DEPARTMENT



BIOGEOCHEMISTRY AND EARTH SCIENCES DEPARTMENT

This year, much of our fieldwork has again focused on marine processes in the Arctic, but we have continued to work up data from Arabian Sea cruises of past years and also took part in a cruise to Antarctica. In addition to the staff listed under each topic, the Department relied heavily on the commitment of the following SAMS support scientists; T Brand, K Doig, C Haidon, M Harvey, S McKinlay and T Sawyer.



Twelve stations in the northern Weddell Sea, Antarctica, and adjacent waters have been sampled using sub-bottom profiles, seabed camera and short box cores and multicores as part of the ANDEEP (ANtarctic benthic DEEP sea biodiversity: colonization history and



recent community patterns) programme. The German icebreaker RV Polarstern spent three months collecting these data during 2005. The cores were studied using x-rays and particle size analysis, and by describing their sediment texture and composition, in order to determine their depositional history and thereby identify and characterise the recent and ancestral (Holocene) sedimentary

environments. Two cores from the Weddell Abyssal Plain and Bransfield Strait were examined for excess ²¹⁰Pb activity. Six sedimentary provinces were identified: Agulhas Basin, a pelagic province; the eastern Weddell Slope, a hemipelagic and contouritic province with turbiditic input; northern Weddell Abyssal Plain, hemipelagic with evidence of recent and ancestral turbiditic input; Powell Basin, a hemipelagic and contouritic province; Bransfield Strait, hemipelagic with a sedimentation rate of 0.8mm yr⁻¹ indicated by the excess ²¹⁰Pb profile; and Bellingshausen Sea, a hemipelagic and contouritic province.





Iron (Fe) and manganese (Mn) are ubiquitous components of most marine Whilst the behaviour and sediments influence of sedimentary Fe and Mn are well constrained in truly oxic and anoxic environments, detailed biogeochemical information in organic rich, transitional suboxic environments, such as those found in Oxygen Minimum Zones (OMZ), is limited. SAMS geochemists, working with a number of international collaborators, recently presented a novel data set at the European Geosciences Union 2006 Here, sedimentary Fe/Mn meeting. biogeochemistry throughout the Pakistan margin OMZ was detailed. Through pore water modeling and sedimentary analysis, the kinetics of reactions involving Fe/Mn within the OMZ were revealed. The study showed that under the suboxic conditions present within the OMZ, Fe/Mn minerals played a significant role in microbial



carbon degradation. Fe and Mn were also found to greatly affect the behaviour and distribution of other important trace metals as shown in the figure.

G Law, T Shimmield, G Shimmield (SAMS) and G Cowie (Edinburgh University)

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The 'oceanic methane paradox' questions how the production of methane, a strictly anaerobic process, can occur within the oxygenated upper ocean. Attempts to resolve the methane paradox, have linked methanogenesis with particulate material, e.g. zooplankton faecal pellets, as microenvironments that facilitate oxygen depletion.

identified Work at SAMS has methanogens within copepod faecal pellets and sedimenting particles using 16S rRNA gene analysis. Furthermore, one cluster of sequences was closely methanogens related to of the Methanosarcinaceae family, that metabolise methylated compounds including dimethylsulphide, a sulphur gas that affects the Earth's albedo. Therefore, zooplankton faecal pellets could be instrumental in facilitating both the production of methane and the removal of



One of the pollutants under examination is mercury (Hg). As a known toxicant it is believed to be present in some regions at levels that pose a threat to both the environment and Arctic populations. Four sediment cores have been analysed for total Hg concentrations in the

DMS. We have recently received NERC funding to further investigate the interactions of these biogeochemical cycles and the role that anaerobic microbes play in this process. A combination of laboratory and field-based research is expected to further unravel the ocean methane paradox.

S Wilson, A Hatton, M Hart, Axel Miller and D Green

ECOLOGY DEPARTMENT

В к_у – , г. г. г.

It is well known that tropical coral reefs support many species and that around the world biodiversity is being lost at an alarming rate. Recent work by the coldwater coral research team at SAMS is showing that these deep-water reefs not only support a similar biodiversity to tropical reefs but contain a surprising number of species unknown to science. With fellowship funding from the European Commission's Marie Curie scheme, Dr Lea-Anne Henry, formerly of the Bedford Institute of Oceanography in Canada, has been examining the animal communities in samples from cold-water coral ecosystems along the European margin. These include the recently discovered giant carbonate mounds from the Porcupine Seabight off SW Ireland,

the Darwin Mounds off NW Scotland and the inshore, shallower Mingulay Reef Complex from the Sea of the Hebrides. Hundreds of species have been identified from each area and taxonomic experts have so far confirmed that several are undescribed including an isopod, four hydroids, a pycnogonid, a bryozoan and an aplacophoran mollusc. Several others await confirmation. As well as new species, one hydroid and the aplacophoran require new genera.

In addition to revealing animals previously unknown to science, this work has shown fundamental differences in the communities on carbonate mounds compared to those on the surrounding seafloor. Because the reefs are such rich storehouses of species, they are helping us better understand species distributions and biogeography. Over the last five years it has become clear that many cold-water coral ecosystems, including the Darwin Mounds and some carbonate mounds, have been damaged by bottom trawl fishing. This project is clearly showing how little we understand about the biodiversity of these fragile, long-lived ecosystems and how important it is to document biodiversity and biogeography if we are to develop meaningful networks of protected areas in the future.

M Roberts, A Davies and L - A Henry



I r APPPr

Integrated aquaculture, the combination in culture of species feeding from different trophic levels, has been purported to be of benefit to both the species in culture and to the environment. In the project REDWEED, the ability of seaweeds to utilise dissolved nitrogen originating from salmon farms was examined. This three year study is focused on the culture of edible species of seaweed; the red dulse or Palmaria palmata and the brown sugar kelp or Laminaria saccharina around Loch Duart's salmon farms in north-west Scotland. By growing these additional crops on the salmon farm, the aim is to achieve a harvest of financial value which also represents a loss of nitrogen from the system, ameliorating the impact of salmon farming in that respect.

Both seaweeds were successfully cultured on seeded ropes suspended from longlines adjacent to the salmon farms. *L. saccharina* in particular benefited from proximity to this nitrogen source, showing enhanced growth rates while growth of *P. palmata* was influenced both by nutrient availability and water motion. The use of stable isotopes revealed that the seaweeds were utilising farm-origin nitrogen and that in some circumstances the nitrogen from the farm could be detected over distances of > 1 km.

The data suggest that, were cultivation to be scaled up, a seaweed farm occupying 1 ha could remove up to 30% of the dissolved nitrogen resulting from the culture of 500t of farmed salmon. Research continues into ways of scaling up productivity, preventing bleaching of the plants and minimising fouling.

Other projects at SAMS; SPIINES2, **MERMAIDS** and AAAG (www. sams.ac.uk) are currently investigating the co-culture of salmon, seaweeds, sea urchins, pacific oysters and scallops. This year also saw the completion of Professor Hui Liu's stay at SAMS, our first Marie Curie Incoming International Fellow. Hui, from the Yellow Seas Fisheries Research Institute in China collaborated with our researchers in sea urchin and scallop cultivation and on the impact of ASP, the amnesic shellfish poison. SAMS is pleased to announce that we have signed a 'Sino-

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ECOLOGY DEPARTMENT

Education and Outreach is also of importance to EuroCoML. A Deep-Sea Education and Outreach (DESEO) workshop was funded, allowing the project officers of the four European led deep-sea CoML projects to exchange ideas and to collaborate. The first activity planned for 2007 is a travelling exhibition on the Mid-Atlantic Ridge and an associated book describing different environments which can be encountered in the deep-sea. The website, www.eurocoml.org, is another area where the science carried out by the different programmes is highlighted.

Graham Shimmield (EuroCoML Chairman)

Bhavani Narayanaswamy (EuroCoML Project Officer)

www.eurocoml.org

MICROBIAL AND MOLECULAR BIOLOGY DEPARTMENT

Dr Keith Davidson, Dr John Day, Miss Gosia Gaj, Dr Tony Gutierrez, Dr David H Green, Dr Mark Hart, Miss Sharon MacNeill, Mrs Elaine Mitchell, Dr Thomas Pröschold Miss Rachel Saxon (Admin), Dr Damodar Shenoy, Ms Sarah Swan, Mr Tim Wilkinson Department members: Dr Ray Leakey (Head), Dr Frithjof Küpper (Deputy), Mrs Undine Achilles-Day (part time), Mrs Debra Brennan, Mrs Christine Campbell (part time)

M r r

There are approximately 3000 known species of marine phytoplankton of which around 100 are thought to have harmful or toxin producing properties. In Scottish waters, harmful algal blooms are of most concern through the potential for humans to consume shellfish that have ingested sufficient phytoplankton such that toxin levels within their flesh have become concentrated to dangerously high levels.

To ensure shellfish safety, there is a requirement for EU member states to monitor the presence and geographic distribution of marine biotoxin-producing phytoplankton in shellfish harvesting areas on a regular basis. In Scotland, phytoplankton monitoring has been carried out by SAMS scientists on behalf of the Food Standards Agency Scotland since September 2005. This monitoring

A fundamental aspect of biology is the cataloguing of new organisms. It is therefore a privilege that we have joined the list of biologists to name a new species; in this case, a bacterium that appears to live exclusively with marine microalgae. The organism is now known as Marinobacter algicola [Marinobacter, rod of the sea; algicola, an inhabitant of algae] found associated with a range of Northern Hemisphere marine dinoflagellates and coccolithophores (see Figure). Interestingly, the M. algicola isolates we have came from algal cultures from different oceanic regions, yet, they are nearly all identical to one another despite their origins being so far apart. This remarkable conservatism suggests that this bacterium is highly specialized to life with dinoflagellates а and coccolithophores. We therefore think it may play an important function in the lifecycle of the algal host.

One approach to identifying what a bacterium can do is to sequence its genetic blueprint – the genome. *M. algicola*, along with two other bacteria we have isolated from marine dinoflagellates, were chosen by the Gordon and Betty Moore Foundation Marine Microbial Genome Sequencing Initiative for whole genome sequencing by the J Craig Venter Institute in the USA. These data will greatly

CCAP .

The CCAP is the largest algal culture collection in Europe, covering a wide range of protistan biodiversity. It continues to act as the UK Service Collection for the The Diving Unit continues to deliver a

SAMS/UHI M P I . . . P. E P . A . . .

This year has provided noteworthy activity on both the undergraduate and postgraduate fronts.

BS (H.) Mr S

The sixth cohort of UHI undergraduates arrived in September. In November, our third graduation ceremony was held in conjunction with the SAMS AGM. To mark the occasion, two sponsored awards

SAMS MEMBERSHIP ACTIVITIES

SAMS is a learned society with a total membership of 451 in four categories. During the reporting year members received SAMS Newsletters 30 (April 2005) and 31 (November 2005) as well as the SAMS Annual Report 2004-05.

AGM N L Pr

The Association's 91st Annual General Meeting took place on 7 November 2005. The 16th Newth Lecture followed the AGM and SAMS UHI Graduation, and was delivered by Dr Michel Kaiser from the School of Ocean Sciences at the University of Wales, Bangor. Dr Kaiser's well attended and discussed presentation was on 'Can't see the fishermen for the fish: net benefits demand a wider perspective.' A summary of the lecture was published in SAMS Newsletter 32 and on the SAMS website.

S.... Mr GrP

Dr Hamish Mair from Heriot-Watt University convened the Scottish Marine Group for a sixth and final year. The theme for the autumn meeting on 27 October 2005 in Stirling was 'Scottish Marine Science Overseas'. Dr Mair presented work he and a number of his students postgraduate had been conducting at the Las Perlas Archipelago in Panama. At the end of the meeting Dr Mair stood down as convenor, and was given a warm and sincere thank you for his long-standing and successful efforts on behalf of the Scottish marine science community.

Susan Chambers, curator for marine invertebrates at the National Museums of Scotland, agreed to take over as SMG convenor for 2006.

SAMS BPt r.

SAMS offers up to four bursaries every year of up to £1000 to support worthy research or scholarship activities of its members. During the year, two bursaries were awarded:

Dr Teresa Fernandes (Napier University): Does turbidity affect how fish use mangrove habitats? Award: £810.

Dr Andrew Brierley and Dr Valery Smith (University of St Andrews): Studies on *Calanus finmarchicus* diapause. Award: SAMS research vessel time.

Anuschka Miller



Speakers at the autumn 2005 SMG meeting. From left: Colin Graham (BGS), Dr Hamish Mair (Heriot Watt), Dr Trevor Telford (Stirling), Dr Finlo Cottier (SAMS), Dr Evanthia Karpouzli (Scottish Executive), Dr Martin Biuw (Gatty).

SAMS OUTREACH ACTIVITIES

stand, while we also showcased more

POSTGRADUATE RESEARCH PROJECTS

MacDonald A, M.Phil, The UHI

Millennium Institute. Salmonid survival in

J Pr : ISI .

Brown, CJ, 2005. Epifaunal colonization of the Loch Linnhe Artificial

Elbrachter, M and Taylor, F, 2005. Nomenclatural note on a *Thecadinium* species (Dinophyceae, Gonyaulacales), which was described as new independently three times within two months. *Journal of Phycology* **41**: 1284-1286.

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Cottier, F, MacLachlan, S and **Howe, JA**, 2005. Rapid Shifts in Arctic Marine Climate: Observations and archives in a Spitsbergen fjord.

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RESEARCH GRANTS AND CONTRACT

Project Leader	Title	Funding body	Duration	Award
RS Batty				
RS Batty				
RS Batty				
K Black				
K Black				
C Brown				
M Burrows				
M Burrows				
M Burrows				
EJ Cook				
P Gillibrand				
P Gillibrand				
P Gillibrand				
P Gillibrand &				
T Sherwin				
SJ Gontarek				
JDM Gordon				
D Green				
A Hatton				
M Inall				
K Jones				
MS Kelly				
MS Kelly				

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

Project Leader	Title	Funding body	Duration	Award
MS Kelly	Atlantic Arc Aquaculture	Interreg IIIB	12/03 – 11/06	£559k
MS Kelly	To investigate sustainable biological carrying capacities of key European coastal zones	EU	02/05 – 01/07	£100k
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	Sea urchin production in integrated systems, their nutrition and roe environment	EU	01/05 – 12/0/	£193k
MS Kelly	Algal toxins in shellfish	EU FP5	01/03-04/05	£162k
MS Kelly & JG Day	Microalgae as cell factories	EU FP5	01/03-01/06	£30k
F Küpper	Marine algal characterisation and exploitation	NERC	06/04 - 05/05	£21k
F Küpper	The role of bacterial symbiotic metabolites in the development of toxic phytoplankton blooms	California Sea Grant	03/06 - 02/08	£5k
RJG Leakey	Assessment and management of coastal pollution	British Council	04/03 – 03/06	£21k
S Magill	Ribotyping E.Coli in Loch Etive	HIE/The Crown Estate	02/06 – 03/06	£10k
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
DT Meldrum & ME Inall	Mitigation of the effects of high power sonars on marine mammals	NERC & MOD	09/02-07/05	£85k
AEJ Miller	Ecosystem approach to sustainable management of the marine environment and its living resources	EU FP6	01/06 – 12/09	£233k
AEJ Miller	Additional skills training	NERC	10/05 - 09/06	£17k
AEJ Miller	US Undergraduate funding	Uni of Dayton	10/05 - 03/06	£3k
AEJ Miller	UHI Capital Resources	UHI	04/05 - 07/05	£7k
AEJ Miller	UHI learning & teaching infrastructure	UHI	08/05 - 07/07	£45k
AH Miller	Runrig Bursary	Commun Na Mara	02/06 - 03/06	0.5k
B Narayanaswamy	EuroCoML core funding	AIE	02/05 – 01/08	£21k
JM Roberts	Deep sea conservation for the UK	Esmée Fairbairn Foundation	03/05 – 02/07	£146k
JM Roberts	Biodiversity and vulnerability of European cold-water reef ecosystems	EU Marie Curie Fellowship	01/05 – 12/06	£106k
JM Roberts	Hotspot ecosystem research on the margins of European seas	EU FP6	04/05 – 03/09	£170k
MDJ Sayer	Enhancing marine biodiversity with artificial reefs	Project Aware (UK)	07/05 – 06/06	£30k
MDJ Sayer	National Facility for Scientific Diving	NERC	04/05 -03/06	£91k
T Sherwin	Meridional overturning exchange with the Nordic seas	EU	12/02 – 11/05	£126k
GB Shimmield	Addressing research capacity	UHI	04/05 - 07/05	£21k
GB Shimmield	EuroCoML core funding	Stavros S Niarchos Foundation	02/05 – 02/08	£241k
GB Shimmield & L Nickell	Coastal ocean benthic observatories	EU FP6	03/04 – 02/07	£163k

RESEARCH GRANTS AND CONTRACT INCOME RECEIVED

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DT Meldrum	HOMing Environmental Recorder: A deep water vertical profiling vehicle	NERC
DT Meldrum	Oceanology International	AIE
DT Meldrum	Argos satellite services	Commercial services
AEJ Miller	DOC analyses	CEFAS
B Narayanaswamy	SEA7 Seagoing staff & equipment	Geotek
JM Roberts	Norwegian deep water program	Akvamiljo
MDJ Sayer	Grampian hyperbaric technical services	Grampian University
MDJ Sayer	NHS recompression facility	NHS
T Sherwin	LAGRANGE	EA
T Sherwin	SEA7 technical report - hydrography	Geotek
GB Shimmield	Knowledge Transfer Officer grant	AIE
K Black	SEA7 technical report - benthos	Geotek
E Walton	Visitor services	Various
J Watson	Vessel hire	Various
T Wilding	Review of reef effects of offshore windfarm structures and potential for enhancement and mitigation	Plymouth Marine Lab
J Wilkinson	Sea Ice Nautical Pilot Revisions	UK Hydrographic Office
B Wilson	Support to HSE Tier III lenders audit	

Director Professor Graham Shimmield

Deputy Director Dr Ken Jones

Physics, Sea Ice and Technology

Dr Mark Inall	(Head)
Mr David Meldrum	(Deputy)
Mr Bruce Barr	
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