SAMS

SEPTEMBER 2001
NEWSLETTER 24
THE SCOTTISH ASSOCIATION FOR MARINE SCIENCE

Marine Conservation: Developments in Argyll

See page 7

Diver exploring a rocky reef in the Firth of Lorn cSAC

Scottish Marine Group

Autumn Meeting 2001

Thursday, 1 November 2001
Stirling University

Marine progress on Rio+10

The details of the event are currently being arranged and the final programme will be circulated widely in advance.

For information contact:
Dr Hamish Mair
Tel: 0131 451 3314
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Email: j.m.mair@hw.ac.uk

Underwater Optics Conference

9 October 2001
at
The Institute of Physics London
Contact: Derek Pilgrim
University of Plymouth
01752 232457

The British Association Festival of Science

Marine Science can it really save our oceans?

Session organised by SAMS with the National Museums of Scotland

Friday, 7 September 2001
9.30am to 1.30pm
University of Glasgow
Room H13, Main Building

About SAMS

The Scottish Association for Marine Science (SAMS) is a charity committed to promoting research and education in marine science. It is based at Dunstaffnage Marine Laboratory near Oban, and is a full academic partner in the UHI Millennium Institute.

SAMS is funded by an agreement with the Natural Environment Research Council for its Northern Seas Programme, by commissioned research for other organisations, and by donations and subscriptions from its 500+ members from all over the world.

SAMS Membership

Ordinary: anyone interested in marine science
Subscription - £12 p.a.

Student: any person under 18, or registered students at Higher Education Institutes
Subscription - £5 p.a.

Corporate: organisations interested in supporting marine science
Subscription - £60 p.a.

For further information and application materials please contact the editor.

Marine Foresight Panel

one-day workshop in
Marine Biotechnology

3 October 2001
9am – 4.30pm
Royal College of Physicians
Edinburgh
More details on www.sams.ac.uk

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SAMS AGM

& Annual Newth Lecture
Professor Peter Wadhams

"Convective Chimneys in the Greenland Sea"

Tuesday, 6 November 2001
4pm
Dunstaffnage Marine Laboratory

Nominations for Council Members should be sent to Mrs Elaine Walton, SAMS, DML, Oban, Argyll PA34 4AD, Tel: 0631 559000, E-mail: ebw@dml.ac.uk

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To keep up-to-date on events at SAMS, visit our website:

www.sams.ac.uk

The editor would like to thank Drs Clive Craik and Axel Miller for their help with editing this Newsletter.

Designed by Design Links, Edinburgh

Dear SAMS member,

These are times of change and new beginnings at SAMS, which makes it very exciting for me to be joining the team. I am the new editor for this Newsletter, and one of my privileges is to act as your first contact with the Association. To give you a brief idea who you will encounter at the end of that phone, here are a few words about me: I am a marine biologist and biogeochemist and studied at the Freie Universität Berlin, the University of Wales, Bangor, and Heriot-Watt University. I did my PhD at Bangor on methane in temperate coastal marine environments, and was at Plymouth Marine Laboratory before moving to Oban.

And now down to business... SAMS has members in all parts of the world except South America. The recruitment of a South American member would thus make us a truly global organisation, and I am appealing for your support in this. Perhaps you could pass the word to any marine contact you may have in South America, and I will be delighted to offer a year's free membership to the first subscriber from South America.

Anuschka Miller

SAMS News

Professor Graham B. Shimmield
Director

Over half a century ago, Winston Churchill said "the farther backward you can look, the farther forward you are likely to see". I believe this quotation is particularly apt for two reasons. Firstly, the recent Bonn Agreement on the implementation of the Kyoto Protocol, and thus the role of paleoclimatology in predicting future man-enhanced climate and environmental change, is a milestone in co-operative agreement for the future health of the planet. Secondly, with significant historical precedent, I am delighted to report considerable progress towards the third major episode in the history of the SMBA and SAMS. Following the initiation of the Association at the Millport Laboratories on Cumbrae, and the move from Millport to Dunstaffnage, this third episode is defined as the Association once more being entirely responsible for the research and education activities of its staff.

© John Anderson, Highland Image

Independence

SAMS has now assumed the full management and operation of the Dunstaffnage site. Under an agreement with the NERC, SAMS - as an independent research organisation (and company limited by guarantee) with charitable status - can now harness the significant new opportunities that are envisaged for the Association. In particular, the partnership with the UHI Millennium Institute affords important higher education institution status on the Association. Furthermore, SAMS' new science programme - The Northern Seas Programme - has recently been approved for five years funding as a major core strategic research programme for the NERC. I expect confidently that a lasting agreement will be signed with the NERC that will allow the foundation for future delivery of marine science in Scotland.

SAMS News continued

SAMS director Professor Graham Shimmield and Scottish Deputy Finance Minister Peter Peacock MSP in front of the development plans for the new Marine Research and Biotechnology Centre.

New facilities come on-line

On 14 August Peter Peacock MSP, the Scottish Deputy Finance Minister, visited Dunstaffnage Marine Laboratory to announce £2.34 million European Regional Development Fund (ERDF) allocation towards a new Marine Research and Biotechnology Centre. This European grant completes an £8.3 million funding package - further involving the NERC, AIE, and private sector finance. The new building already has planning permission and the agent, ERDC in Partnership, will now begin the detailed planning of the project with the aim of starting building work in November.

By early 2003 the new building will replace much of the current laboratory at Dunstaffnage with state-of-the-art facilities that will better equip us to continue delivering cutting edge research in marine science. The new building will also house a biotechnology wing for the European Centre for Marine Biotechnology – a joint development between SAMS and Heriot-Watt University – as well as lease accommodation for other businesses and researchers in this sector. Thanks to funding from ERDF and AIE we will shortly be advertising for an experienced business development manager who will be charged with establishing the European Centre for Marine Biotechnology as a new company.

Two months ago we completed the construction of the new Lander facility within a joint project funded by the Joint Infrastructure Fund, in collaboration with Aberdeen and St Andrews Universities. The final stage of the programme is to complete the floating pontoon and walkway to enhance our shore side equipment handling facilities for our research vessels.

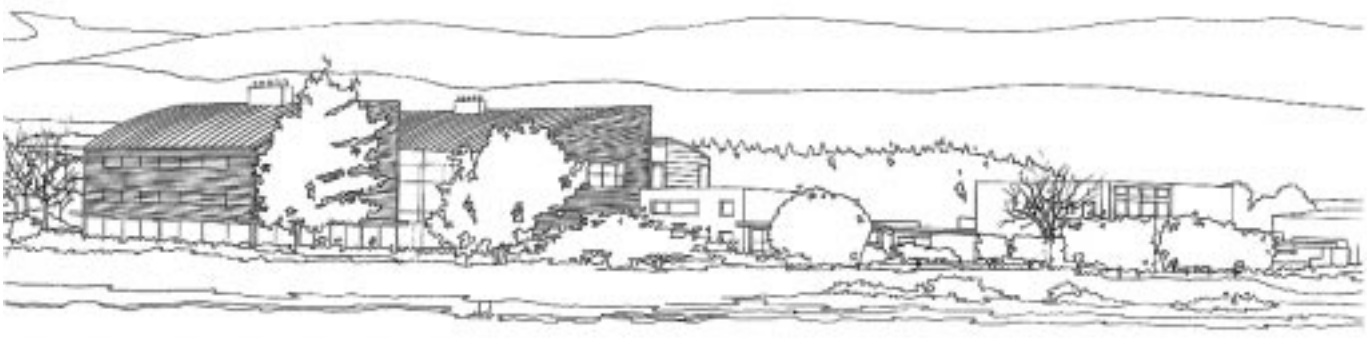
Developments in higher education at SAMS

In May, SAMS made an important step forward in its strategy to develop as a major academic institution researching marine science. This step was a joint submission with some of our UHI Millennium Institute academic partners (North Highland College and Perth College) for the 2001 Research Assessment Exercise. We look forward to the outcome of the RAE in December this year, which will benchmark this key development of our educational activity at Dunstaffnage.

In September we will welcome the second cohort of BSc Marine Science students to the Dunstaffnage campus.

Newsletter news

Our education activities bring me to my last point. This issue of the Newsletter marks the start for our new Chief Editor, Dr Anuschka Miller. Anuschka joined SAMS as Activities Manager replacing Helen Anderson, and is also a valuable new addition to the Marine Science degree course team where she will be lecturing marine biology. I am delighted to welcome her on board and I am certain that we will see new exciting activities develop under her strong guidance and creativity.



Artist's impression of the new Marine Research and Biotechnology Centre at Dunstaffnage

Question: What is huge, naked, and Scottish?

Answer: A new species of naked foram from the Scottish west coast

Tom Wilding, Dunstaffnage Marine Laboratory, SAMS

Foraminifera - forams for short - are an ancient, ubiquitous group of protists (single-celled organisms). Most foram species are marine and make an important contribution to both planktonic and bottom-dwelling communities. Normally they live inside an intricate shell, the test, which they secrete. These tests are well preserved in the fossil record, and forams are important in stratigraphy. In the past they have been so abundant that their remains have contributed to rocks, indeed, the Egyptian pyramids are made from a limestone that consists almost entirely of the fossilised remains of one foram species, *Nummulites gizehensis*. Within the foram group there are also naked forms, but the lack of a test has resulted in a poor representation within the fossil record, and hence little interest from stratigraphers. These naked forams, however, are abundant, but their role in both deep and shallow sea processes remains largely unknown. Studying these organisms is difficult because they are normally small (less than 1mm) and difficult to isolate and maintain, particularly those from the deep sea.

In 1999, a new foram species was discovered during routine surveys of the seabed around the N. E. end of Lismore. Its novelty to science was confirmed by small subunit ribosomal DNA sequencing by Jan Pawlowski at the University of Geneva, Switzerland. The new species has subsequently been named *Toxosarcon alba*.

On the seabed *T. alba* is indicated by the presence of a slightly raised mound in the muddy sand in which it lives. This mound is up to 35 mm in diameter and the numerous holes that penetrate it make it look somewhat like a pepper pot. Through these holes the opaque, white, branching cell body can occasionally be seen a few millimetres under the sediment (Figure 1). When excavated the foram resembles a stringy piece of chewing gum but, when transferred to an aquarium, soon 'settles in' and, using time-lapse video, can be seen to move around both on top of and below the sediment surface.

Figure 1: Toxosarcon alba shown as most frequently observed in situ. The cell lies approximately 5 mm below the sediment surface. Note the presence of numerous perforations. This cell is about 20 mm across.

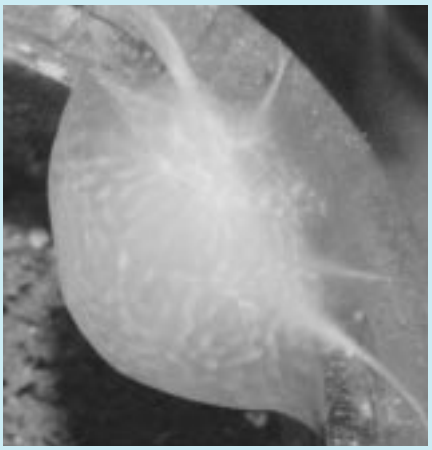


Figure 2: T. alba when consolidated into well-defined spheroid form. Reticulopods attach this individual to the substratum but occasionally they are totally detached. Note the delicate pattern within the cell and the more translucent nature when compared with the ramifying forms. This cell is about 30 mm long.

The organism exhibits a strange and intriguing form-changing behaviour that has never previously been witnessed in forams. The normally diffuse cell gathers itself up and forms a consolidated spheroid of one to three centimetres in diameter, with a highly defined boundary (Figure 2). In this condition *T. alba* has a cell volume of over 10cm^3, making it a giant in the realm of protists. To achieve this, the cell must either (a) be very diffused and extend considerably beyond the resolution of the naked eye prior to the change, or (b) actually increase its volume during the change. This mysterious form-changing behaviour occurs occasionally and generally follows a period of high activity.

The evolution of this ancient group has puzzled phylogeneticists for some time. In 1999 Pawlowski and co-workers predicted 'that naked foraminiferans similar to their hypothetical ancestors might still be living in the marine environment. Finding these species is essential for future molecular studies'. The discovery of this giant, abundant, easily collected and maintained species is greatly assisting in the characterisation of this important, but little known group.

Reference: Pawlowski, J., Bolivar, I., Fahrni, J., de Vargas, C. and Bowser, S.S. (1999) Naked foraminiferans revealed. *Nature,* **399**, 27.

Tom Wilding works as a research assistant in the Animal Environment Interaction group at DML. He is currently registered for a part-time PhD developing the Loch Linnhe Artificial Reef research programme.

Artificial rockpools:

Art meets science on the rocky shore

Dr. Michael T. Burrows, Dunstaffnage Marine Laboratory, SAMS

Better understanding of the processes that control biological communities and ecosystems has been a major goal of the Behaviour and Ecology Group at Dunstaffnage Marine Laboratory (DML) for many years. We have concentrated on organisms living in shallow water and between the tidemarks because the accessibility of these habitats allows the intensive study of the basic processes controlling populations of key species.

On rocky shores it has become increasingly evident that the complexity of the surface has a major influence on the balance of the community, mainly through provision of shelter for mobile species.

Unbeknown to us, someone else was thinking about structure and form on rocky shores and was contemplating a large-scale artificial installation. Niki Holmes, an artist based at the architectural and engineering practice *bconsultants*, saw the possibilities of an artificial rockpool structure in an industrial landscape. The parallels with our own work were immediately obvious. Here was a chance for a genuinely productive meeting of two cultures. Niki developed the project into a proposal to the SciArt Consortium (http://www.sciart.org/), and in April 2001 we (Niki Holmes, *bconsultants*, DML and PML) were awarded £10,000 to develop the idea further.

An extract from the SciArt website makes the artistic case for the project: "In 'Artificial Rockpools', the process of creating the works will lie within the physical and temporal reactivity of material, environment and lifeforms: Juxtaposing and amalgamating the hard orthogonality of groynes, jetties and sea defenses with eclectic organic forms and erosion. The 'Rockpools' will offer kaleidoscopic micro-worlds.... By varying the materials and structures used to create the 'synthetic' pools, they will facilitate colonisation by marine organisms and remain accessible to visitors for research and reflection.

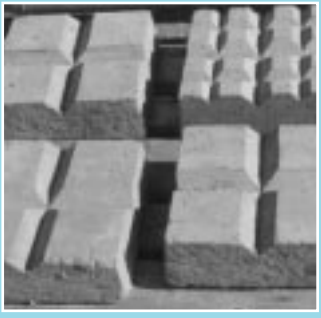
Nicola will seek to allow the 'Rockpools' to be in a continued condition of becoming, an arena for focusing on the impossibility of a static reality and the need to adapt to change both natural and manmade. From the naïve curiosity and collections of childhood, through to the exploration and analysis of science, they will provide an iconic image of discovery and a means to appreciate the richness and hazards of our environment and our place within it."

The scientific case is equally challenging. Rockpools can be considered as islands of isolated habitats. Processes that shape marine communities and ecosystems are played out in miniature in an easily observed and manipulated arena. The rules that govern the dynamics of pools can be expanded into generalisations about how animal and plant communities are assembled from component species, and about the factors that control biodiversity.

The next step is to develop the construction, and devise a scientific experiment that can be incorporated into the design. One route is to develop mathematical models that predict the development of the community on the artificial structure as a consequence of its chosen form. These landscape ecology models will deliver the greatest scientific products of the project. Broader application of the principles developed can help us understand the role of surface complexity in the dynamics of communities in natural habitats. We may even be able to engineer whatever communities we want. As part of coastal defenses against climate-driven sea-level change, bio-engineering of communities might mitigate a variety of problems as well as enhance biodiversity.

Mike Burrows is Operational Group Leader of the Behaviour and Ecology Group and a member of the Executive Group at Dunstaffnage Marine Laboratory.

Colonisation and complexity – before and after



Mike Burrows photographing a rockpool in the Scillies, 4/99

The artist, Niki Holmes, Hartlepool 6/01

SCOTTISH MARINE GROUP

Marine candidate Special Areas of Conservation in Argyll

Dr. Jane Dodd, Scottish Natural Heritage, Oban

Special Areas of Conservation (SACs) are areas of sea or land that hold the regional representations of one or more of the habitats or species which are considered rare, endangered or vulnerable within Europe. There are currently four marine candidate SACs (cSACs) in Argyll: Loch Creran, the Firth of Lorn, Eileanan agus Sgeirean Lois Mór, and the Treshnish Isles. These are part of the 33 proposed marine SACs in Scotland, which in turn contribute to a Europe-wide network of conservation areas known as Natura 2000.

Loch Creran

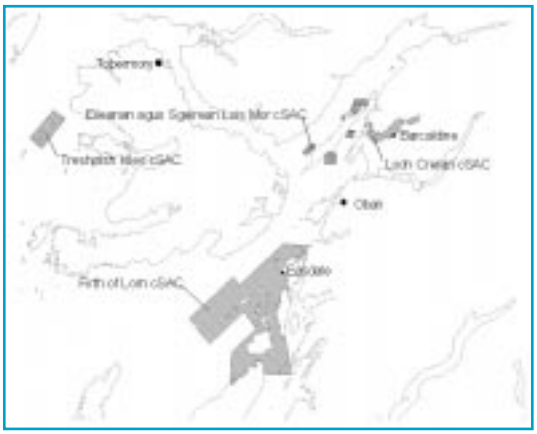
Loch Creran is of international importance because it supports extensive biogenic reefs formed by the tube worm *Serpula vermicularis* (SAMS Newsletter 19, April 1999). It is particularly significant because it is the only known location within the UK where live and extensive serpulid reefs can still be found. Serpulid reefs are even very scarce in European terms. Only four other sites are known outside the UK, and those reefs cover much smaller areas.

© *Graham Saunders*

A serpulid reef in Loch Creran cSAC

The Firth of Lorn

Some of the most powerful tidal currents in the UK flow through the narrow complex sounds separating the small islands of the Firth of Lorn. The tides force huge volumes of particle-rich water over extensive rocky reefs supporting filter-feeding communities, which contain some rare organisms such as the brown alga *Desmarestia dresnayi* and the sea fan *Swiftia pallida*. The powerful tidal currents and the extensive rocky reefs of the Firth of Lorn combine to make this site one of the finest examples of current swept reef habitat in the UK.



Map showing the marine cSACs in Argyll

Eileanan agus Sgeirean Lois Mór (the Islands and Skerries of Lismore)

The small islands and skerries around Lismore consistently support a nationally important breeding colony of the common seal *Phoca vitulina*. The site is also a haul-out for around 600 adult seals, one of the larger discrete colonies of common seals in the UK, representing around 2% of the British population. Eileanan agus Sgeirean Lois Mór cSAC is one of a series of sites around the UK coast selected to maintain the geographic range and status of the common seal population. The littoral and shallow sublittoral reefs within the site are important in maintaining a food supply for the seals.

The Treshnish Isles

The Treshnish Isles support a breeding colony of grey seals, *Halichoerus grypus*, which produced around 2.7% of all British pups in 1999 (SMRU). The Treshnish Isles contribute to a series of sites around the coast selected to maintain the geographic range and status of grey seal breeding colonies in the UK. The Isles are fringed by excellent representatives of very exposed Atlantic west coast reefs, which are influenced by the warm waters of the North Atlantic Drift. The near-shore habitats, particularly shallow bedrock reefs, are important foraging grounds for the seals.

Consultation

During a consultation process all identified groups with an interest in the sites - including SAMS - were invited to comment. Scottish Natural Heritage (SNH) responded to all comments and discussed unresolved issues with interested parties. SNH summarised the responses in a report to the Scottish Executive. Scottish Ministers then decided to forward all four sites to the European Commission as cSACs, and the consultees were informed of this decision in March 2001.

Management

SNH (the statutory conservation agency) is currently developing the conservation objectives for each ▶

©John Baxter

Common seals

cSAC. These, together with advice on operations within sites, will form the basis on which a site can be sustainably managed. For marine sites which are used for a variety of activities (such as Loch Creran and the Firth of Lorn) any relevant authority may establish a group to consider the long-term management of the site. If this approach is pursued it is unlikely that SNH will take the lead role in setting up the Management Groups. For example management of the Sound of Arisaig SAC was successfully lead by the Local Authority under the EU Life-funded, UK Marine SACs Project. SNH would, however, be included in any Management Group along with representatives of other relevant authorities and user groups. Through close liaison with interested parties, the aim of the Management Groups is to develop suitable voluntary management schemes for the sites to protect their marine natural heritage whilst allowing continued sustainable development.

Jane Dodd is the Natura Project Officer (Marine) for Argyll and Stirling, and is based at the SNH office in Oban (Tel: 01631 567228, E-mail: jane.dodd@snh.gov.uk). She studied for her PhD in the behaviour of intertidal fishes at Dunstaffnage Marine Laboratory from 1996-1999.

Dangerous Liaisons?

Dr. David Green, Dunstaffnage Marine Laboratory, SAMS

The global extent and frequency of harmful algal blooms (HABs) has increased steadily throughout the last century. The effects of HABs are profound, such as mass kills of marine fauna and aquaculture stocks, and shellfish unsafe for human consumption due to the potent toxins contained in their flesh. The underlying reasons and causes of HABs are far from clear, and many fundamental questions remain unanswered.

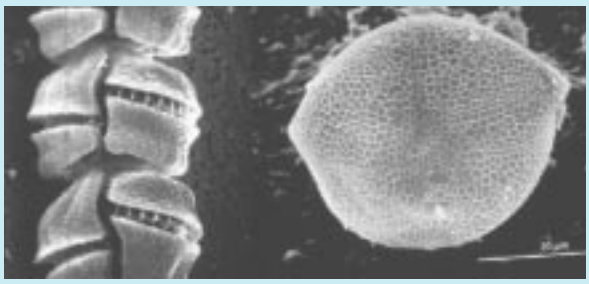
The role of bacteria in the production of the paralytic shellfish toxins (PST) by the globally-distributed dinoflagellate, *Gymnodinium catenatum*, is the focus of a new postdoctoral fellowship, funded by the New Zealand Foundation for Research, Science and Technology. The interactions between the algal cell and algal-associated bacteria are crucial for toxin production according to research by Dr Christopher Bolch, the fellowship's host mentor and director of the Culture Collection of Algae and Protozoa–Marine at SAMS.

Initially we will describe and characterise the microbial flora associated with *G. catenatum*, with a particular emphasis on those bacteria which induce or enhance PST production. From here, we will focus on the mechanisms by which toxin production is modulated, using a combination of laboratory culture, life-cycle manipulation and molecular genetic approaches. The principal questions this work will address are:

- Who is producing the paralytic shellfish toxins, - the algal cell, the bacteria, or both?
- Which specific group of bacteria induces PST production and how?
- When and how is the bacteria-alga relationship established?
- Is bacterial cell signalling between bacteria or between bacteria and the algal cells important in establishing and maintaining the bacteria-alga relationship?

Gymnodinium catenatum, the dinoflagellate associated with the production of paralytic shellfish toxins. Left as a vegetative chain, right in its resting stage as a cyst.

Image: © C. Bolch and G. Kaltegraeff



The goal, culminating from this work, is to define the "phycosphere" of *G. catenatum*, and to determine how the relationship between the bacteria and alga fuels the development of a toxic algal bloom. Once the mechanisms that induce cell toxicity are understood, it may become possible to employ measures to mitigate PST toxicity in natural bloom populations.

David Green, originally from Nelson, New Zealand, gained his doctorate in microbial water quality and environmental virology from the University of Otago, Dunedin. Thereafter he worked on sporulation genetics of Bacillus subtilis at the Royal Holloway University of London. His fellowship should keep him at Dunstaffnage Marine Laboratory until at least 2004.

SCOTTISH MARINE GROUP

Advances in Marine Science and Technology Research

SAMS prize meeting for postgraduate students

8 March 2001 at the University of Glasgow

Hamish Mair of Heriot-Watt University once again organised a very enjoyable and well-attended meeting of the Scottish Marine Group. The SAMS £100 prize for the best postgraduate presentation was awarded to James Massey of the Glasgow Marine Technology Centre, University of Glasgow. A spontaneous prize for the best visual presentation sponsored by the Scottish Environmental Protection Agency East was won by Maria del Mar Otero Villanueva of SAMS/UHI, Dunstaffnage Marine Laboratory.

Excellent presentations were also given by Jae-Young (Napier University), Marco Pizzamei (University of Wales, Bangor and Marine Laboratory, Aberdeen), Evanthia Karpouzli (Heriot-Watt University), Helen Davis (Stirling University), Jill Shaw (University of Glasgow), and Clare Muller (University of Edinburgh).

Thanks are due to Professor Mike Cowling and Lynn Cullen of the Glasgow Marine Technology Centre for the use of the facilities and for ensuring that the day progressed smoothly.

Helen Anderson

Mapping biological information in the North Sea

James Massey, Glasgow Marine Technology Centre, University of Glasgow

There is increasing legislative pressure for environmental impact assessment (EIA) as burden of proof against environmental impact moves closer to industry. Environmental information is continually collected at great cost to the offshore oil industry. There are currently no tools for quantitative EIA using biological information in predictive models. Although the volume of web-based data sets is increasing, effective access remains poor, thus restricting the availability of information for EIA evaluation.

This project aims to evaluate existing sources of biological information to allow effective site-specific EIA by the offshore industry.

Environmental consultancies, agencies and oil and gas companies have been contacted to identify areas lacking in information. There is a perception amongst the offshore industry that little biological data is available, such that new information is collected for each project. In addition there appears to be little awareness of applicable databases developed from previous surveys.

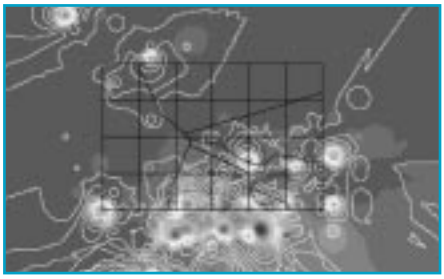
The project aims have thus developed to:

- use existing data sets to compile a coherent biological resource
- allow effective access to useful information
- promote multi-level access through a Geographical Information System (GIS)
- enable biological evaluation to be used in risk assessment

A GIS database has been created using data from sources including the International Council for the Exploration of the Seas (ICES) 1986 survey of the North Sea, and the UKBenthos database of environmental survey reports, compiled by Heriot-Watt University for the UK Offshore Operators Association (UKOOA). The database information is being used to interpret biological information for the study area.

The Biotope classification is coded according to the Joint Nature Conservation Committee (JNCC) classification system (BioMar). This ▶

A bathemetric surface - showing echinoderm density - created from the depth samples from various datasets. Figure demonstrates technique that can be used with sonar data to provide habitat information.



Contours of crustacean density overlaid on a map of the study area. The greyscale background is the total organism sample density.

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can be entered into the EU Nature Identification System (EUNIS) classification scheme that is currently under development. The availability of species data means that areas where rare or red-listed species have been found will be highlighted. Information from the database will be linked to the Marine Life Information Network (MarLIN), which will provide sensitivity information to allow risk-based management.

An assessment of sensitivity to impact of a coastal habitat is currently being undertaken using MarLIN data. It is hoped that as the classification system for the sublittoral and pelagic habitats in the EUNIS system is completed, this can be applied to the study area. The end result should be a complete risk assessment.

James Massey is in the third year of his PhD at the University of Glasgow under the supervision of Professor Mike Cowling. James studied for his first degree in Marine Biology at Heriot Watt University. He is a member of the Institute of Environmental Managers and Assessors.

What to feed your sea urchins...

Maria del Mar Otero-Villanueva, UHI Millennium Institute, SAMS

The green sea urchin, *Psammechinus miliaris*, is an opportunistic omnivore that occurs in dense populations in the inter- and subtidal zones of Scottish sea lochs. For some years now it has been extensively studied as a potential candidate species for cultivation. In particular its suitability for polyculture, growing alongside salmon, has been closely investigated at SAMS. However, before sea urchin farming can be viable, the biology and physiology of the species concerned must be thoroughly understood.

Sea urchin roe is a greatly undersupplied luxury food product which is traded as a substitute for caviar. High gonadal growth rates are therefore particularly desirable for successful echinoculture. For this reason the partitioning of energy between somatic and gonadal growth in response to diet type has been investigated in *P. miliaris*. Energy allocation, mean feeding rate and absorption efficiency were all affected by type of diet. Lowest growth rates were observed when urchins fed exclusively on a plant diet of macroalgae, while ingestion of mussel flesh stimulated somatic and gonadal growth. However, commercially available salmon feed with its high lipid and protein content stimulated the highest gonad growth rate.

The green sea urchin, Psammechinus miliaris, is popular for its roe, which is traded as a substitute for caviar.

The results of such experiments are contributing to completing a detailed energy budget for the sea urchin, a crucial first step towards optimising artificial sea urchin diets. Furthermore they increase our understanding of the importance of the grazing activity of this echinoderm in structuring inshore benthic communities.

Maria del Mar Otero-Villanueva is a third year UHI PhD student working under the supervision of Dr Maeve Kelly at the Scottish Association for Marine Science. She previously studied marine sciences at the University of Vigo, Spain, and completed a Masters degree in marine biology, fisheries and aquaculture at the University of Wales, Bangor.

Member's view
Experimenting in the ocean

Dr. John H Steele, Woods Hole Oceanographic Institution

The controlled experiment epitomises the scientific method. It is standard procedure in physics, difficult in terrestrial ecology, but almost impossible in the ocean. In oceanography the term "experiment" is often used where it is not really appropriate for sets of long-term or intensive observations (*e.g.* the World Ocean Circulation Experiment and the Fladen Experiment).

So, what can we do in the sea, as distinct from experiments in beakers in the laboratory?

Mesocosms

On land we can take plots in a field, give them different treatments, and then observe differences within and between replicates of each treatment. We have tried this in the sea using large plastic bags - the polite term is "mesocosms" - that can hold 100 to 1000 cubic metres of sea water and all the plants and animals within it. Scottish sea lochs have been used for mesocosm experiments.

These have shown us how difficult it is to "control" such large volumes of seawater, and how, over the summer, the communities in the mesocosms gradually diverge from those in the water outside. The major problems with mesocosm studies are lack of replication and the fact that even such large containers still inhibit the free mixing of water, animals and plants.

Chemical markers

Another approach to the problem is to tag a patch of seawater with a chemical that can be detected at very low concentrations (such as sulphur hexafluoride SF_6) and follow it over time. The surrounding untreated water acts as a control. This technique is used to see how nutrient enrichment could stimulate the productivity in the open ocean to take up some of the excess CO_2 we have put in the atmosphere and sequester it in the ocean depths. The treated patch, however, diffuses into the untreated, so that it is difficult to study the long-term effects further up the food chain.

Comparative studies

Controlled experiments with human populations are forbidden, but we learn much from comparative studies of economic developments under different political regimes. In the sea we can make similar comparisons of populations and communities subject to different "regimes". In fact we are currently involuntarily conducting such a large scale "experiment". We have severely over-fished many North Atlantic cod stocks with harsh socio-economic consequences on both sides of the ocean. But important ecological lessons could be learnt from the situation. We should view the dramatic impacts we have had on these fisheries as opportunities to increase our understanding of the ecosystems that support them.

We often separate "fisheries research" from "marine biology" and both of these from the study of "ocean climate". What is required, however, is a comparative study not only of the fish stocks but also of the food webs and the physical environment on which these populations depend. All three subject areas must be considered to deal with the vexed question of the causes of changes in fish stocks. Are they entirely due to over-fishing, or is there an environmental component? And, even more important, what must we do to ensure recovery? These very large scale, long term, but uncontrolled, experiments may be the best we can achieve towards increased knowledge of marine ecosystems.

Dr John H Steele is Vice-President of SAMS and President Emeritus of Woods Hole Oceanographic Institution. His main research interest is the dynamics of marine ecosystems.

In the member's view section we publish contributions from SAMS members on all marine-related issues. The editor would particularly welcome responses to or further thoughts on the problem of experimenting in the ocean. Articles should be 300 to 500 words long.

Being a UHI student at SAMS

The BSc Marine Science undergraduate experience

Being a UHI undergraduate at Dunstaffnage Marine Laboratory has to be quite a unique experience! As one of less than a dozen students of all ages everybody knows each other, as well as almost everyone else at the lab, which gives a real sense of belonging.

Marine Science undergraduate students and staff during fieldwork

The lecturers are full of enthusiasm and are always ready to help, as are many of the PhD students, postdoctorals and others working at Dunstaffnage who have become involved with the course. To sit in a lecture with only a handful of other students, where the major distraction is the view over the Lynn of Lorn, is a privilege.

The computer room and laboratory facilities in Argyll College are modern and bright if rather oversubscribed at times. An added bonus is the opportunity even in the first year to spend time on the SAMS research vessel, RV Calanus, experiencing an oceanographer's real working environment.

There are no student union bars or University sports facilities. However, Oban, being a tourist town, has its fair share of nightclubs, restaurants and pubs, and the beautiful playground of Argyll with the sea and mountains more than compensates.

Izzie Wilson is one of the first cohort of UHI undergraduate students at SAMS. She is a mature student and worked in software development before enrolling on the marine science degree course.

The postgraduate perspective

I am a UHI/Open University PhD student working at SAMS on "Amnesic shellfish poisoning (ASP) in Scottish waters". I investigate the algal species and environmental conditions associated with the production of the toxin that causes ASP. For my research I need to sample phytoplankton and other water column parameters regularly, identify, isolate and culture algae, and test whether they produce the ASP toxin. Toxic species are then analysed genetically to species level, and used for laboratory experiments.

Dunstaffnage Marine Laboratory (DML) is located on the sea shore and SAMS owns two research vessels. This enables me to sample plankton regularly and from chosen sites. The national Culture Collection of Algae and Protozoa – Marine, which is hosted by SAMS, allows me to culture algae and conduct experiments. A well-equipped genetic lab facilitates all genetic analyses.

The SAMS library subscribes to most journals I need and runs an inter-library loan system. Two of my supervisors work at DML and are there whenever I need them.

I had been offered two other interesting PhDs in Germany, but decided for SAMS. This was because I always wanted to work abroad, was interested in improving my skills in genetics, and had heard about SAMS from other scientists. But most of all it was because I was enchanted by the laboratory and especially the dazzling surroundings when I came for my interview.

Johanna Fehling is a first year UHI PhD student at SAMS working under the supervision of Drs Christopher Bolch, Keith Davidson and Professor Paul Tett. Before moving to Scotland she studied marine biology at Kiel University in Germany, and worked in Kiel at the Institute for Polar Ecology, and the Institute for Marine Science.