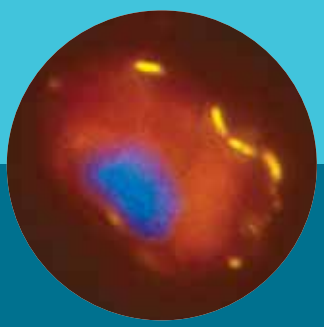
SCOTTISH
ASSOCIATION
for MARINE
SCIENCE



HIGHLIGHTS 03-04

SAMS OFFICE-BEARERS AND BOARD 2003-2004

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HIGHLIGHTS

DIRECTOR'S INTRODUCTION

This year marks the mid-point of our first five-year core strategic science programme - the *Northern Seas Programme* - and the consolidation of our role as a Collaborative Centre of the NERC. The year has seen great public interest in the state of our living marine resources, and the role of "experts" in predicting everything from climate change, to fisheries collapse, and environmental impacts. SAMS has rightly been responding to a welter of consultations and reviews, helping to promote the cause and case for sound, fundamental science, and achieve reality through conversion of our applied work into useful outcomes. Examples covered in this year's *Highlights* document, include novel approaches to reducing the environmental impacts of aquaculture, developments in biotechnology and new ways to interrogate remote instruments, download their data and, if required, re-program them. To achieve this level of contribution to marine science in Scotland and further afield, we continually need to develop the infrastructure and staff expertise at the Association. This year has seen the completion of a momentous change in our capability, with the opening of the new SAMS facilities at Dunstaffnage by HRH The Princess Royal, the acquisition of the former Seafish site and staff at Ardtoe and a major expansion of the Culture Collection for Algae and Protozoa. None of these developments would have been possible without the hard work of SAMS Council and Board, together with staff at Dunstaffnage and Ardtoe. The faith in the future development of the SAMS Group demonstrated by NERC, Highlands and Islands Enterprise and Argyll and Islands Enterprise has been crucial.

The Marine Science Degree course offered at SAMS has developed further, with recognition of the Honours year, marking its evolution to the only full time Honours degree in Marine Science in Scotland. At the AGM in November we conferred graduations on our first cohort of graduate and postgraduate students.

Our science programme goes from strength to strength. New appointments to both SAMS and SAMS*Ardtoe* provide critical mass and depth to a number of subject areas reported here. We are an ocean-going marine research institution; this has been admirably displayed in the Arabian Sea campaign (four one-month cruises off Pakistan) and numerous research cruises to the Arctic and North Atlantic, culminating in an under sea (and ice) voyage to the North Pole as a guest of the Royal Navy for one of our staff. Our collaborating partners are found throughout the pages of this report and the CD ROM. I am proud of the extent to which our scientists interact and develop ideas with others in the UK and abroad. This marks the maturity and confidence in our science, and is demonstrated by our rapid engagement with the EU Framework 6 programme where we lead two STREPs and partner a further two.

As I write this, I am conscious of an important external audit, the Science and Management Audit of SAMS operations, to be conducted by the NERC at the end of this year. Accountability for public funds, and producing the highest quality science, are our collective goals. At this point, I have never been more certain that SAMS has the capability to reach a fully sustainable future built on the collective contribution by all its staff and members. It will be hard work, but it will be worth it.

Graham Shimmield

SAMS NEWS

The past year has been one of the most momentous in the history of SAMS. In October 2003, following much negotiation, the Seafish Industry Authority transferred its Ardtoe aquaculture research facilities and a number of staff to SAMS. The site will be run as a wholly owned subsidiary company, SAMS*Ardtoe* Ltd. The acquisition of a second site marked a major step for SAMS at a time when the new buildings at Dunstaffnage were nearing completion. The new SAMS wing at Dunstaffnage was handed over to us on 26 January 2004 and the long awaited move soon got underway. The improvement in our facilities was immediately apparent - large, bright multi-user laboratories, dedicated areas for specialist activities and the handling of hazardous materials, a new library and, finally, new office accommodation for all. Once settled in, we were able to enjoy the spectacle of the demolition of three wings of the old building from the large windows of the new café on the second floor! On the 6th April, just after the end of the reporting year, HRH The Princess Royal, opened the new SAMS wing and central facilities at Dunstaffnage. It was a splendid day, incorporating the dedication of the William Speirs Bruce Conference Room by Sir Wally Herbert, and an illustrated lecture on Bruce marking the centenary of the return of the Scotia expedition from the Antarctic, given by Dr Peter Speak.

A further small but significant expansion at SAMS occurred when NERC confirmed their desire to see the freshwater part of the UK Culture Collection of Algae and Protozoa (CCAP), held at Windermere, reunited with the marine collection at Dunstaffnage, and for appropriate staff transfers to take place. Two key staff moved to Dunstaffnage in January 2004 and two further support staff were subsequently recruited. As a result of this re-unification, the collection at SAMS has more than trebled in size, with over 2000 strains of algae and protozoa. These provide a source of biodiversity for academic and commercial research along with the commercial supply of 'start-up' cultures for various customers. With the financial support of NERC, purpose-built culture rooms and other specialist facilities have been incorporated into the European Centre for Marine Biotechnology wing of the new building, where CCAP has a complete floor.

SAMS staff and research students have once again participated in research expeditions and cruises to regions as far apart as the Arctic and Arabian Sea, in addition to work in Scottish coastal and offshore waters. A particular focus has been the Svalbard archipelago and surrounding waters, as part of the NERC funded Northern Seas Programme and two EU programmes involving the Sea ice Group at SAMS, one of which included a visit to the North Pole! Details of these campaigns follow or may be found in the science reports on the accompanying CD-ROM.

HRH The Princess Royal, opened the new SAMS wing and central facilities at Dunstaffnage

The new Dunstaffnage Marine laboratory

SAMS REACHES THE NORTH POLE!

The SAMS Flag is unfurled at the North Pole by Nick Hughes (left) and the Torpedo / Anti-Submarine Officer of HMS *Tireless.*

On 27 March 2004 HMS *Tireless*, a Royal Navy Trafalgar-class nuclear submarine, sailed from Bergen in Norway. The only civilian scientist on board was Nick Hughes of the Sea Ice Group, which has a long-standing collaboration with the navy on sea ice monitoring. The cruise covered sites of scientific interest in the Greenland Sea and Arctic Ocean, returning to the UK on 28 April. During the nine full days of the cruise that were allocated to scientific work, *Tireless* visited the site of the deep convective chimney in the Greenland Sea discovered in 2001 by surface ship surveys. After conducting a new survey using onboard oceanographic sensors and expendable probes, *Tireless* proceeded north to the Marginal Ice Zone (MIZ) in Fram Strait (west of Spitzbergen). Here, several days were spent traversing the ice edge and carrying out an oceanographic survey of the Molloy Deep Eddy.

From there, *Tireless* headed north toward 85°N along longitude 5°E, conducting an under-ice survey using upward-looking echosounder and sidescan to measure ice thickness. This replicated tracks taken by previous UK submarine cruises to the Arctic Ocean, thus providing evidence for any decadal change in ice thickness. At 85°N *Tireless* turned west and conducted a transit along this line of latitude, using the ice navigation sonars. This replicated tracks of HMS *Sovereign* in 1976 and HMS *Superb* in 1987. Preliminary results from 2004 showed that ice thickness increased to the west. A concurrent oceanographic survey indicated that Atlantic Water has increased in dominance in this region.

At the end of the 85°N transit line at 65°W, *Tireless* conducted an under-ice survey of the planned site for an ice camp. Although generally around 5 metres in thickness, some ridges over 30 metres thick were detected.

Following some military exercises, *Tireless* surfaced at the North Pole on 19 April, allowing the SAMS flag to be unfurled. The quantity and variety of data acquired on this cruise will be of importance in the study of climate change, allow cross-calibration with other methods of sea ice measurement and contribute to studies of global sea level change.

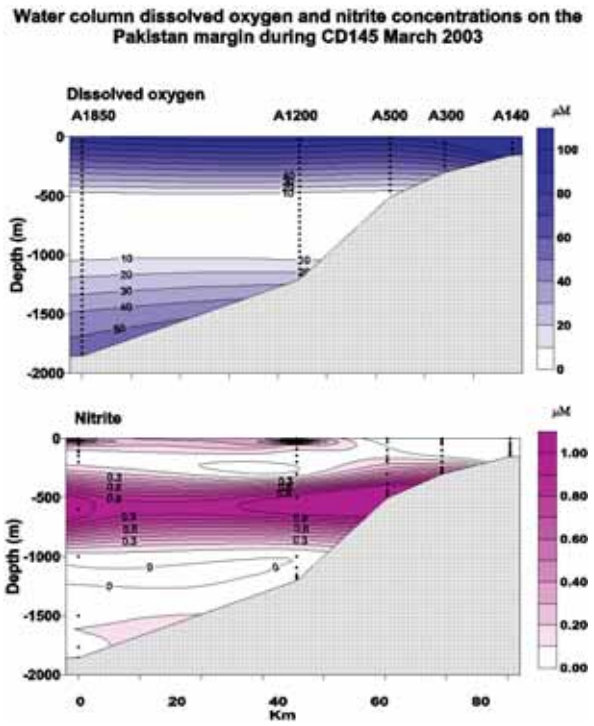
IRIDIUM CONNECTS SAMS TO THE ARCTIC

The Marine Technology group has for many years pioneered the use of satellite communications for the collection of data from ocean platforms such as drifting buoys. With the arrival of the Sea Ice group at SAMS, a new challenge presented itself - the use of satellites to communicate with experiments in polar latitudes. Most satellite systems claim to have global coverage, but in fact only two have true polar coverage; Argos (the favourite of oceanographers for many years) and an impressive newcomer, Iridium. Iridium is unique in that it is a true global 24/7 mobile phone system, thus permitting online dial-up sessions between the polar experiment and the laboratory for diagnostics and control - and for the downloading of large amounts of data.

At SAMS we have been fortunate in being one of the very few non-US labs selected by the US National Oceanographic and Atmospheric Agency (NOAA) to pilot the use of Iridium for environmental applications. As a result we were in the happy position of having early access to Iridium satellite modems - and free air-time. Currently we have five systems operating high in the Arctic Ocean, reporting a wide range of parameters that will help determine whether the Arctic ice is thinning in response to climate change. In this digital age, photographs as well as data can be sent electronically - the image of our Iridium installation north of Greenland was itself sent to the lab over the Iridium link!

Iridium data link installed on sea ice with FS *Polarstern* in the distance

ARABIAN SEA ODYSSEY



Profile of oxygen concentration off the Pakistan margin

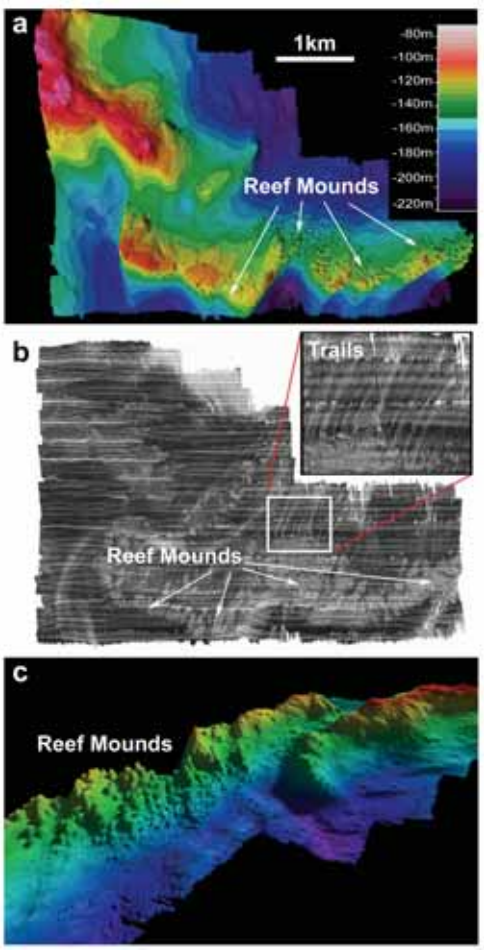
SAMS Elinor and profilur *in situ* landers onboard RRS *Charles Darwin*

The Arabian Sea is of considerable scientific interest, owing to the monsoons that cause upwelling of nutrient rich waters from depth in the water column. These result in seasonally intense primary productivity in the surface waters and, as a consequence, there is a strong variability in the export of organic matter to the sediment surface below. The mid-water zone within the Arabian Sea (roughly 200-1000m depth) is almost entirely devoid of oxygen (see figure) owing to the breakdown of organic matter and where this layer contacts the Arabian Sea's margins, the sediments are essentially devoid of life other than anaerobic bacteria. Chemical exchanges occurring across the sediment-water (benthic) interface in the world's oceans are of major importance to the global cycling and burial of carbon and provide the link between the sedimentary and water-column environments. Yet, because the benthic interface is remote, investigations to date have largely been conducted on recovered sediment cores. As a result, our knowledge of the mechanisms and rates of benthic biogeochemical processes, and especially the roles of benthic communities, remains comparatively poor.

SAMS has been involved in an interdisciplinary seabed study investigating biological and chemical processes in surficial sediments across the oxygen minimum zone on the Pakistan margins, together with colleagues at Edinburgh University, Liverpool University and Southampton Oceanography Centre. To improve our understanding of these processes our research has focused on carrying out the majority of measurements close to or at the benthic interface (*in-situ*) using seabed lander technology (see figure) developed at SAMS, together with a newly developed near-seabed water sampling device. By these means we aim to gain new information on how the biological community living in deep water sediments interacts with the chemical environment, both organic and inorganic, during the breakdown and/or burial of sedimenting organic carbon.

DEEP-WATER CORAL REEF DISCOVERED IN THE SEA OF THE HEBRIDES

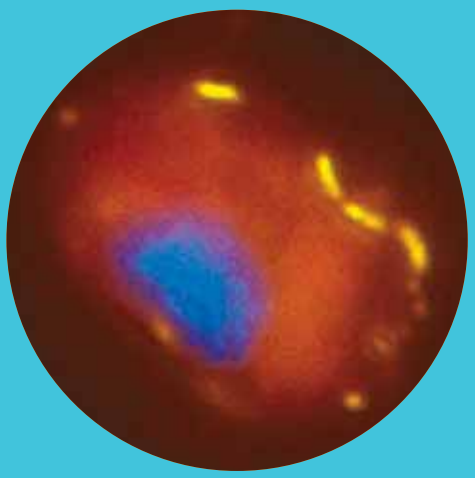
In the summer of 2003, a team led by SAMS set out from Dunstaffnage on the RV *Lough Foyle* to investigate historical records of cold-water corals to the west of Scotland. The Mapping Inshore Coral Habitats or MINCH project included the British Geological Survey, TOPAZ Environment & Marine Ltd, the Department of Agriculture & Rural Development Northern Ireland, the Scottish Executive and Scottish Natural Heritage. Using geological information to guide our choice of survey areas and a multibeam echosounder hired to map the seafloor, we surveyed four areas between the Stanton Banks in the south to western Skye in the north. However, one survey immediately leapt out as distinct from all the others. The area to the east of the island of Mingulay contained many distinctive seabed mounds. When underwater video was used to examine these mounds we found that they were associated with large colonies of cold-water coral. Grab samples confirmed that these colonies were formed by *Lophelia pertusa*, the dominant reef-forming coral in the northeast Atlantic. We found a series of deep-water reefs, the Mingulay Reef Complex, extending for over a kilometre. Samples of coral rubble from the seafloor have been dated and are 3800 years old suggesting that the coral mounds must be considerably older. It seems likely that the reef complex dates to when the ice sheet retreated and sea temperatures warmed 8 to 10,000 years ago. We plan to revisit the reef complex to map its true extent, understand the physical environment that sustains it and carry out detailed high resolution visual surveys using a submersible. The Mingulay Reef Complex is the first deep-water coral reef found within 12 nautical miles of the UK coastline. Its discovery was described by the BBC Radio Scotland documentary *Mapping the Minch* and was reported as a feature in the *Herald* among other reports in the national press.



(a) Multibeam bathymetry showing prominent ridge features and reef complex. (b) Backscatter image clearly delineates the reef mounds and reveals trails extending from them. (c) Three dimensional view of the reef complex from the north east (6x vertical exaggeration).

ALGAE AND BACTERIA - A SYMBIOSIS?

The growth of phytoplankton in the oceans or blooms of toxic algae along our coasts, are fuelled by an interplay of the right nutrients, light, temperature and physical mixing of water. Research at SAMS has now identified a new factor that plays a potentially vital role in the development of benign and harmful algal blooms - the omnipresent bacterial community found living in association with all natural phytoplankton assemblages. Traditionally, the bacteria living with algae have been considered at best, as 'consumers', of the carbon dioxide fixed by these primary producers. Our evidence, however, points to a number of the bacteria living with algae as directly contributing to algal growth. This implies a direct coupling of bacterial activity with algal growth, although what the factor is that bacteria contribute to such growth is not yet understood. Crucially, the implications of these findings are that bacteria may play a vital role in how phytoplankton cope with a changing environment - be that increasing water temperatures or increased eutrophication - through bacteria's ability to rapidly respond to changes and evolve to meet new challenges.



Fluorescent *in situ* hybridisation image of bacteria attached to the outside of an algal cell. The blue colouration results from DAPI staining of the algal nuclear DNA material, whilst the small orange rod-shaped cells result from hybridisation of fluorescently labelled RNA probe to specific RNA/DNA sequences within a bacterium belonging to the phylum Verrucomicrobia.

SUSTAINABLE AQUACULTURE: BIOFILTRATION & BIOREMEDIATION

Assessing and reducing the impact of sea-cage aquaculture is a high priority research topic for the inshore areas of the Scottish west coast and many other regions worldwide. The past year has seen a consolidation and expansion of SAMS's research interests in the integration of species from different trophic levels to aquaculture sites to improve sustainability.

In the three year, European-funded, BIOFAQS (Biofiltration in Aquaculture) project, units seeded with filter-feeding organisms were deployed below sea-cages for fish culture, to measure the efficiency of the filtering communities in removing both dissolved and organic particles from the water column. The biofilters were shown to be effective in reducing nutrient loading in the vicinity of fish farms. The efficiency of the biofilters, however, was affected by the biological succession which changed rapidly from an autotrophic (stripping dissolved nutrients from the water column) to a heterotrophic community (consuming fine particulate material), as well as by seawater temperature, light penetration, seston concentration and the biofilter substrate itself. Although the cost of deploying enough filters for a significant retention of the nutrient wastes was deemed too high to allow the application of this technology at a commercial scale, the research pointed to the potential of using valuable species, rather than natural fouling communities.

This theme of research has continued with the REDWEED project (Reducing the environmental impact of sea cage culture through the cultivation of seaweeds), which focuses on the culture of the edible red seaweed *Palmaria palmata* or Dulse alongside salmon cages. Growth rates of the seaweeds were measured over various depths and distances from the cage-group, matching this information with the immediate hydrography and nutrient distribution. Examining stable isotope ratios ($\delta^{15}N$) suggests this species will incorporate salmon farm derived nutrients at distances of 150m from the cage group and might best be cultured between 50 and 150m from the cage group. The research continues to optimise cultivation of both *P. palmata* and the brown macroalga *Laminaria saccharina*.

The Atlantic Arc Aquaculture Group, in which SAMS is a key player alongside partners from Wales, Ireland, France and Spain, has at its core the theme of sustainability in aquaculture. SAMS research has expanded to investigate combining specially selected and valuable species from three trophic levels (marine plants, filter feeders or grazing invertebrates and fish), on traditional mono-culture farms, to provide an additional harvest and extra incentive for the industry to adopt a more environmentally sustainable approach to cage mariculture.

The first crop of the brown alga *Laminaria saccharina* grown on ropes close to a sea cage farm.

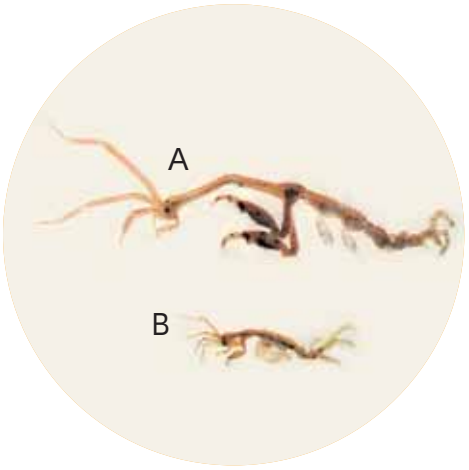
ALIEN INVADER IN SCOTTISH WATERS

An 'alien' caprellid, *Caprella mutica*, commonly known as a skeleton shrimp, has recently been discovered by SAMS scientists. It occurs in densities of up to 10,000 individuals per square metre on artificial structures associated with mariculture activities and marinas on the west coast of Scotland. The natural range for this caprellid is the coastal waters of East Asia and Siberia. The exact date and mode of introduction to Scotland is unknown. The creature does, however, have a track record of turning up in the most unexpected places. In the 1970s and 1980s, it was discovered at various locations along the Pacific coast of North America after being accidentally introduced in shipments of Japanese oysters. More recently it has been reported in European waters, with sightings in the mid-1980s in Norway and the Netherlands. Although the mode of introduction has not been identified, it was probably introduced as a result of mariculture activities or in ballast water.

Unfortunately, very little is known about this 'invader' so the ecological and economic impact of the caprellid on the west coast of Scotland is completely unknown. At present, there is no increasing trend in the number of invasive species that have become established in the UK, unlike other countries. However, a substantial increase in commercial shipping between the Pacific and Europe through the Arctic Sea because of sea ice retreat and a rise in aquaculture related activities in coastal regions in the next few years may change this trend and lead to a significant rise in the number of introductions of non-native species to Europe.

It is important, therefore, to try to understand why certain species are able to colonize 'new' environments more successfully than others, what effect they have on the invaded environment and whether the invader can be eradicated or their spread minimized. Preliminary studies at SAMS are beginning to provide an insight into the biology, ecology and distribution of *Caprella mutica*. Initial results have found that *C. mutica* are typically larger than their native counterparts, the males growing up to 40+ mm in length and the females to 15 mm. The high densities mentioned above are normally reached during the summer months (May - September) and they appear to be distributed throughout the west coast of Scotland, the Western Isles, the south coast of England and the north-west coast of Wales. The eggs are kept in a brood pouch on the female and each female can produce up to 150 hatchlings every 45 - 50 days. It is predicted that reproductive maturity is reached within 2 months of hatching at summer temperatures.

Genetic studies are currently underway to establish the source population and ecological experiments are planned for 2005 to establish the impact of this caprellid on native marine species of both conservation and commercial importance.



Adults of *Caprella mutica:* A. Male B. Female

NEW FRONTIERS IN NATURAL PRODUCTS DISCOVERY

Our oceans contain an enormous wealth of living organisms, a biodiversity that far exceeds that found on land, and a biosphere from which there exists great potential for discovering novel classes of marine compounds. As new and emerging technologies evolve, there is great interest in exploiting this potential, and each year hundreds of research groups and private companies around the world conduct research to isolate and identify compounds from a plethora of different marine sources. Much of this effort is geared towards identifying potential drug candidates that may be incorporated into clinical trials and, if found successful, in the development of marketable drug products. These efforts are driven mainly by the increased occurrence of antibiotic-resistant bacteria (e.g. MRSA), and the current market demand for new classes of pharmaceuticals.

Another important class of compounds with a large market demand (>3 billion tonnes pa) are the surface-active agents. These compounds, more commonly referred to as emulsifiers and surfactants, are used in almost every sector of modern industry, from agricultural formulations and food ingredients to textiles, construction, healthcare and pharmaceuticals. Their importance lies both in their mode of action (i.e. to mix oil-loving and water-loving substances together) and their high market demand which is almost exclusively met by chemical synthesis from petroleum products. Due to the latter, there is concern over their possible impacts on the environment and in human consumption.

SAMS is currently broadening its expertise through its recently implemented Marine Biotechnology research laboratory that focuses on isolating new types of marine natural products. In an effort to lessen industry's huge demand on synthetic surface-active agents, scientists at SAMS recently discovered an innovative approach to isolating natural forms of these compounds (i.e. *bio*-emulsifiers and *bio*-surfactants) from the marine environment. This is particularly important since bio-prospecting marine organisms as sources of such compounds can be a labour-intensive exercise. In just over a year since this work commenced, a handful of lead bio-emulsifiers have been identified, possessing high surface activity when compared to various commercially-used emulsifiers. We are now working to optimize cost-effective production techniques and develop these compounds with a view to applying them commercially.

Scotland's waters hold an enormous diversity of organisms with the potential to supply us with novel chemical compounds

SAMS*ARDTOE LTD*

Ownership of the Ardtoe Laboratory transferred from Seafish to the SAMS in October 2003. The successful transfer resulted from the support of local and national politicians, HIE, Lochaber Enterprise, Highland Council and Seafish, together with the strong support given by the local community.

At Ardtoe, research will continue on the culture of marine finfish species but diversification into wider areas is likely in the future. At a time when stocks of wild fish (especially cod in the North Sea) are under threat, the long term prospects of growing marine fish are attractive. Ardtoe was at the forefront of the development of halibut rearing in the UK, and this was followed by work on a cod demonstration project. Currently the first farmed haddock in Europe have been grown at Ardtoe and there are several other projects on fish feed and nutrition. Ardtoe has been a world leader in marine species culture and has unique facilities in the UK for such work. Additionally, Ardtoe houses a range of broodstocks (cod, haddock, halibut) from several parts of the UK and these are a conservation resource, considering that many of the local stocks are under threat.

ADVANCES IN THE CULTURE OF ATLANTIC HALIBUT

Atlantic halibut (*Hippoglossus hippoglossus*) is a species of increasing importance to the UK aquaculture industry. However, successful commercial production of halibut is currently hampered by high mortality of the larvae during yolk-sac and first-feeding stages. Research at SAMS, undertaken in collaboration with the University of Glasgow and SAMS*Ardtoe*, has developed enhanced larval rearing protocols for this species based on improved understanding of interactions between the larvae and their tank environment.

Our work has demonstrated that the survival and development of larvae can be improved by having a more stable salinity regime in the silos housing the larvae, together with a low salinity surface layer. This reduces interactions of the larvae with surfaces and results in a more even distribution of larvae within the tank. Mortalities and deformities can also be reduced by carefully controlling temperature transfer protocols.

Microbial pathogens are a significant source of larval mortality and we have shown that pathogens depend not on numbers but on the microbial species composition. This can be made more stable by using recirculation systems.

The study has also delivered a better understanding of how the addition of microalgae, or "green water", which is a common practice in commercial hatcheries, improves larval survival and development. To achieve this we tested three species of microalgae (*Nannochloris, Isochrysis* and *Pavlova*) and found that the larvae fed and survived better when *Nannochloris* was used. We also found that addition of algae at densities higher than those normally used in hatcheries produced better survival and growth. This does not appear to result from a strong chemosensory stimulus effect, nor is it a nutritional effect. Instead, it is merely due to the physical presence of the algae, as inert particles can successfully substitute for *Nannochloris*.

Halibut larvae raised at SAMS*Ardtoe*. These have fed successfully as indicated by the full gut.

CATCHING UP IN THE 21ST CENTURY: RESCUING DATA FROM THE CLUTCHES OF THE 20TH

One of the most valuable commodities a scientific research organisation has is its data. Sampling in the field is a costly activity and so data need to be used to their full potential. SAMS has at least 50 years of data trapped in inaccessible formats in the dark recesses of the lab: this is a potential gold mine of information that could be utilised with the right expertise. The NERC Data Archiving project is aiming to resurrect these data, allowing them to be used and made accessible to the wider community through the British Oceanographic Data Centre.

Over 10,000 individual pieces of media have been catalogued in the first nine months of the project: the types of media found include just about anything that data can be stored in or on, from paper notebooks to digital half-inch tape. Examples include over 200 rolls of 70mm aerial film, taken over the past 30 years, showing sea ice - only a fraction of Arctic data which are now stored at SAMS. Much of this research was carried out at a time of accelerated change to the Arctic Climate System and is of current relevance. In other areas, deep sea benthic data from the Rockall Trough area, including species abundance, images and videos, are now being made accessible in a searchable database format. Unique records of the fish stocks in North West Scotland and nutrient concentrations in Scottish Lochs from the 1970s will be the next datasets to be rescued in such a manner.

The data management team has a range of facilities to digitise the media; from manual data input and scanning to converting video footage to DVD. Some media items have been degraded through time and need to be processed very carefully. The 400 reels of magnetic tape which contain sonar, wave records and side looking airborne radar (SLAR) data, require stabilisation, digital sampling and computer programming, to convert the information to a useable format. Gathering the metadata (how, when and where the data were collected) is another important component of the process without which the data are useless. Speaking to the original researchers has proven to be successful not only to obtain information but also to get a feeling for past research.

At the end of the three years of this project it is hoped that a range of long time series will be available for re-analysis. As the last 50 years have seen a considerable amount of technological and environmental change, the data will undoubtedly provide important information about the past which may help us to understand the present and predict future trends with greater certainty.

SAMS / UHI MILLENNIUM INSTITUTE EDUCATION ACTIVITIES

This year has seen several noteworthy outcomes arising from the joint activities between SAMS and UHI: confirmation of the quality of the BSc Marine Science against national benchmarks, validation of the honours year, the first Marine Science graduation and formation of the Marine Science Subject Network, heralding the implementation of UHI's new academic structures. On the postgraduate front SAMS welcomed its largest ever cohort of students and saw the first successes at viva voce examination.

BSc (Hons) Marine Science

The SAMS contribution to the teaching of tertiary-level marine science in Scotland has been significantly strengthened over the reporting period. Following a challenging review in the early part of 2003, the UK Quality Assurance Agency (QAA) published their report on Earth and Environmental Sciences and Environmental Studies across UHI in July. The BSc Marine Science degree was singled out for praise in many areas and was graded 'commended' for *Teaching and Learning* as well as *Learning Resources*.

Over the same period the BSc Marine Science degree course was subjected to the periodic review carried out by the Open University Validation Service (OUVS). Having originally been accredited to offer the BSc in September 1998, the process this year included the first-time validation of the Honours level, H4. This success enabled our first cohort of students to elect for study on Scotland's first BSc (Hons) Marine Science programme.

The fourth cohort of UHI undergraduates arrived in September, providing a full four-year intake for the first time, and the course has continued to receive high praise from our External Examiners. In November, there was a palpable measure of achievement as the first graduate was awarded their degree at the SAMS Annual General Meeting.

UHI Postgraduate Research Activities

This year saw the largest intake of postgraduate students yet to SAMS. A total of 10 new graduates were enrolled through UHI with the Open University; four with NERC funding, several others from Highlands and Islands Enterprise (through UHI) and one on a SAMS bursary. This has consolidated SAMS' position of host to the largest grouping of postgraduates across UHI (22 in total) and has created a vibrant research school community. One of the first year students (Lyndsey Dodds) won an award for best poster presentation at the annual Scottish Marine Group postgraduate meeting at Heriot Watt University.

There have been a number of PhD completions over the year: Toby Jarvis, Maria Otero-Villanueva and Kemi Obajimi have since obtained career positions in Australia, Vietnam and the USA respectively.

Mark Carter, the first UHI / SAMS BSc Marine Science graduate, receiving his certificate from Ian Graham-Bryce, SAMS President, at the SAMS Annual General Meeting.

INVOLVING THE WIDER PUBLIC IN MARINE SCIENCE

Last summer, with grant aid from Scottish Natural Heritage, we set up *Reefwatch* to give the public a rare insight into the underwater world of serpulid (tubeworm) reefs in Loch Creran. The serpulid (*Serpula vermicularis*) reefs in Loch Creran are unique, being the only surviving British examples and are of high conservation status. The worm tubes grow upwards, twisting around each other, to form complex structures up to 1m high. From within the tubes the worms extend feathery tentacles, like flowers, that create a vibrant, living patchwork of red, pink, white and orange.

Using colour underwater television, we relayed real-time pictures from the reefs to a monitor forming the centre of an exhibit set up in the Scottish Sealife Sanctuary on the shores of Loch Creran. The camera was deployed for six weeks during which time over 31,000 visitors were able to watch the worms, along with the fish, crustaceans and other animals that live on and around the reefs. The project also allowed us to record and examine the behaviour of reef worms and associated fauna *in situ*.

'Spikey' is a giant model sea urchin that has been a great success at events throughout the UK. Over 5,500 school children have now seen the model - and all its insides! The model came to the end of it's lifespan in 2003 and a grant ('Spikey and Friends') from Scottish Natural Heritage gave us the opportunity to build a new 'Spikey', a second model starfish 'Star' and to produce an accompanying interpretation board. In early December 2003, the models had their first outing at Oban High when Liz Cook, Anuschka Miller, Elaine Mitchell and Debra Brennan held their annual 2 day event which involves interactive games and talks with all first year pupils. The models have also been used at a variety of talks and open days throughout the year.

A starfish fact file has also been added to the 'Spikey and Friends' website (www.sams.ac.uk/schools/spikey.htm) which provides additional information for the pupils and teachers on subjects covered in the talks.

Spikey & Friends - SAMS Scientist, Dr Liz Cook speaks to school pupils about life history of the Sea Urchin.

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THE NEW DUNSTAFFNAGE MARINE LABORATORY



PHOTOGRAPHY

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