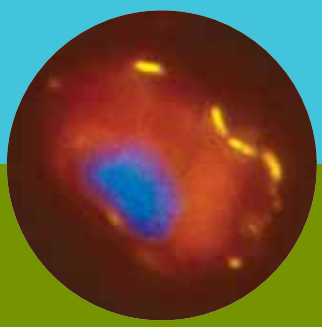
SCOTTISH
ASSOCIATION
for MARINE
SCIENCE



HIGHLIGHTS 03-04

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HIGHLIGHTS

SAMS NEWS

The past year has been one of the most momentous in the history

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.

SAMS REACHES THE NORTH POLE!

The SAMS Flag is unfurled at the North Pole by Nick Hughes

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

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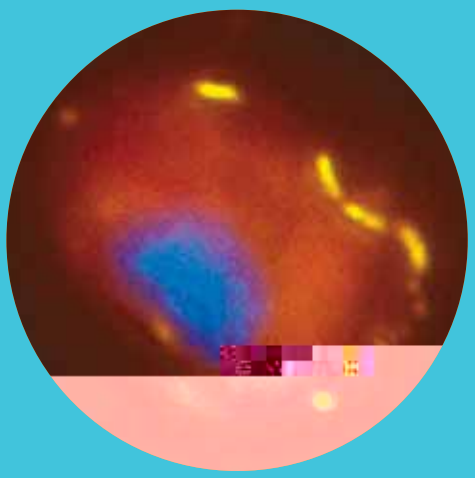
In the summer of 2003, a team led by SAMS set out from Dunstaffnage on the RV *Lough Foyle* to investigate historical records of cold-water corals to the west of Scotland. The Mapping Inshore Coral Habitats or MINCH project included the British Geological Survey, TOPAZ Environment & Marine Ltd, the Department 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

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.

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

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

SAMSARDTOE 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.

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*.

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

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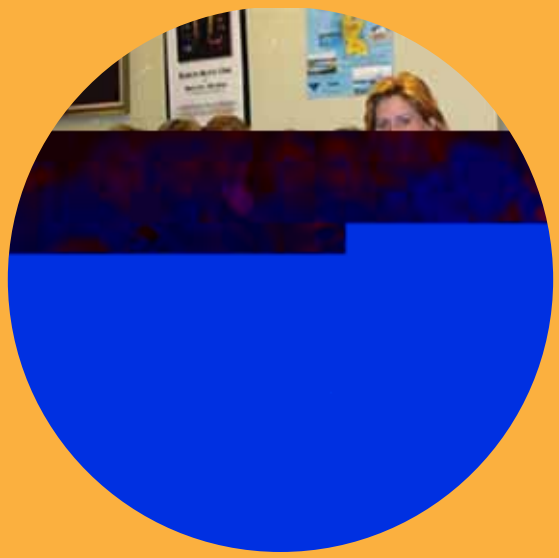
INVOLVING THE WIDER PUBLIC IN MARINE SCIENCE

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*.

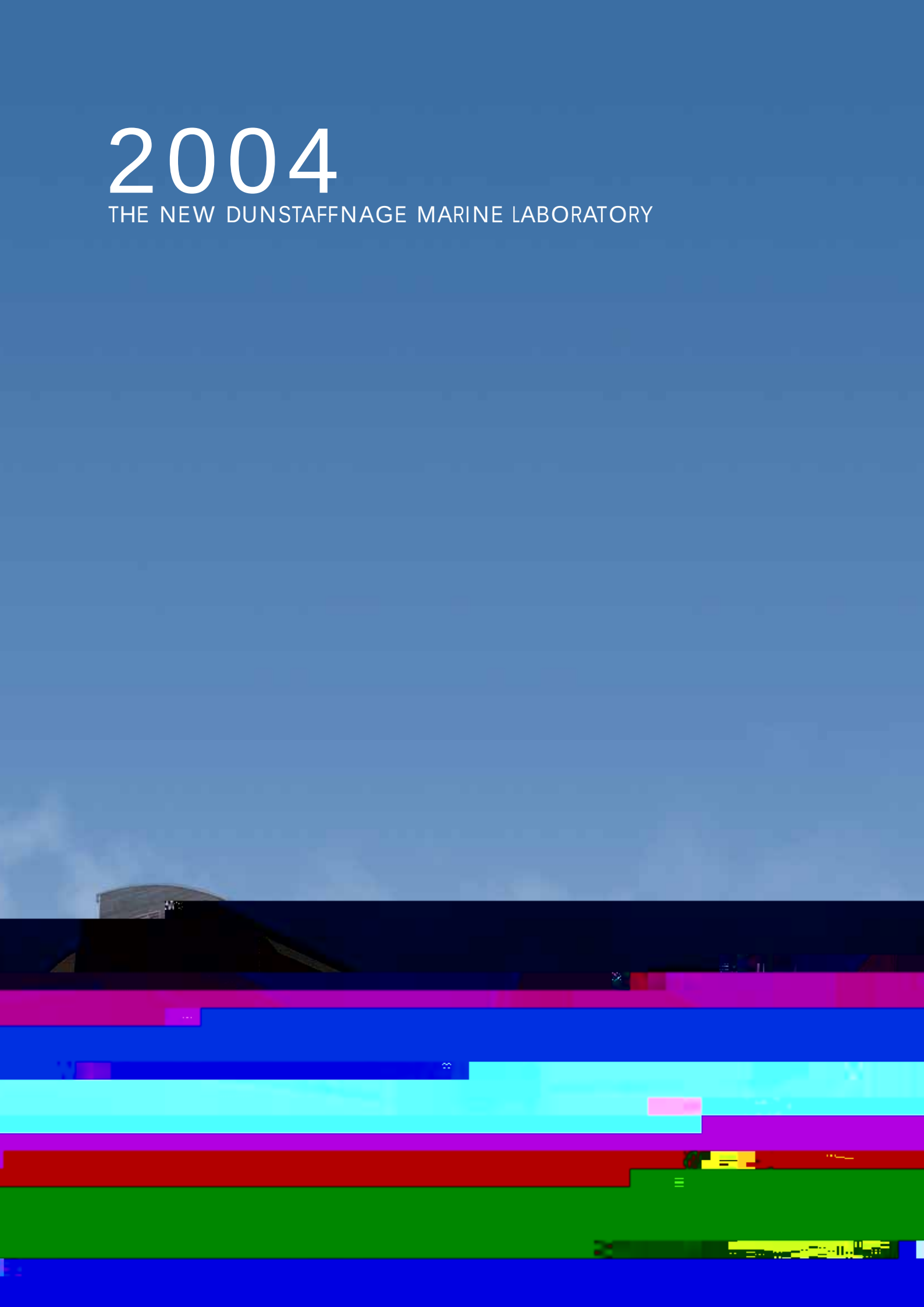
'Spikey' is a giant model sea urchin that has been a great success at events throughout the UK. Over 5,500 school children have now seen the model - and all its insides! The model came to the end of it's lifespan in 2003 and a grant ('Spikey and Friends') from Scottish Natural Heritage gave us the opportunity 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.

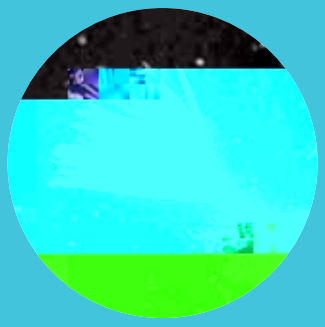


A starfish fact file has also been added to the 'Spikey and

2004

THE NEW DUNSTAFFNAGE MARINE LABORATORY





PHOTOGRAPHY

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