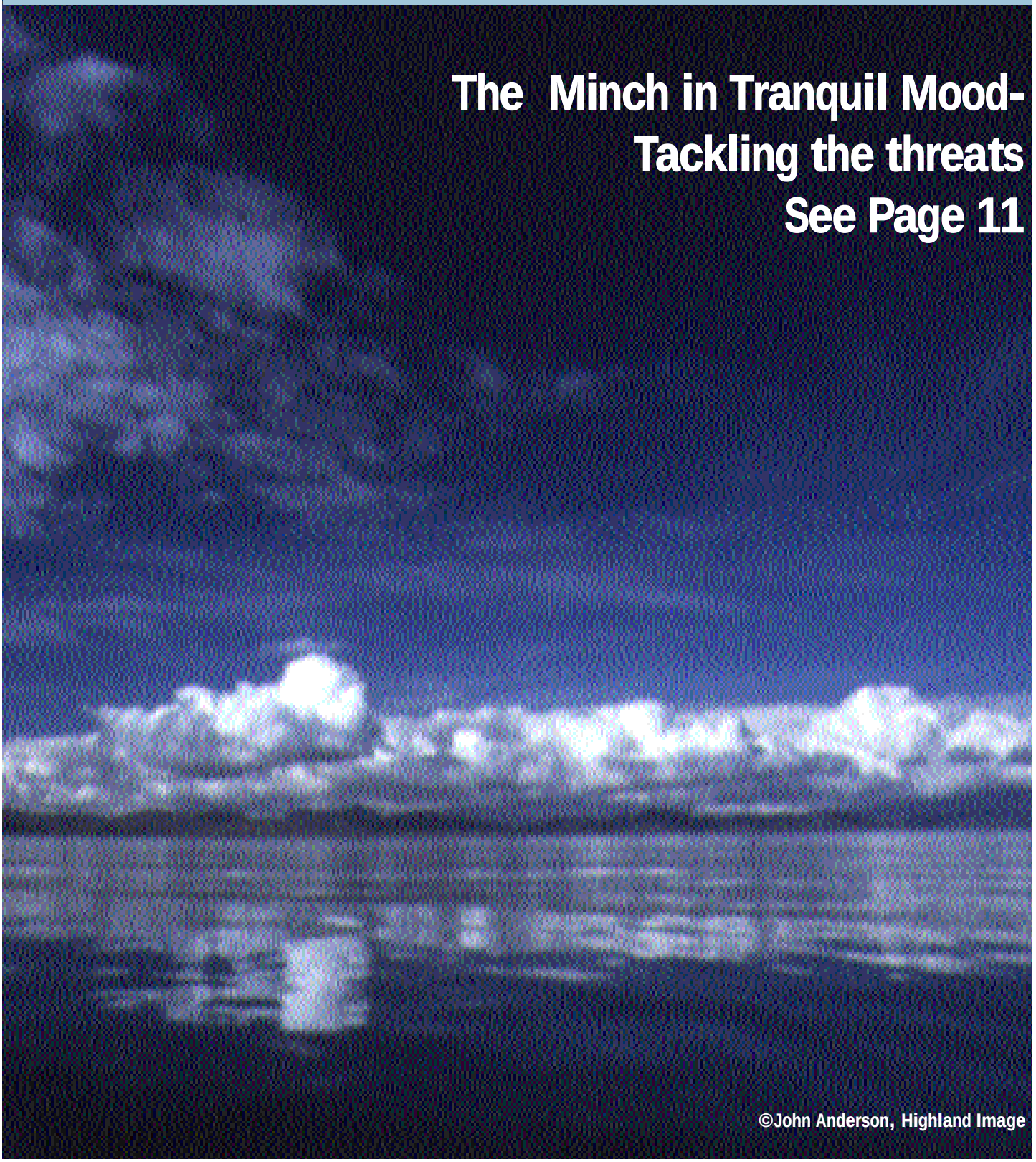
SAMS

OCTOBER 2000
NEWSLETTER 22
THE SCOTTISH ASSOCIATION FOR MARINE SCIENCE



The Minch in Tranquil Mood-Tackling the threats

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SAMS Board

Invitation

TO JOIN SAMS

Categories of membership -

Ordinary: All individuals interested in marine science

Subscription - £10 p.a.

Student: All persons under 18 years old or registered students at a Higher Education Institute

Subscription - £5 p.a.

Corporate: Organisations interested in supporting marine science.

Subscriptions - £50 p.a.

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Email: hea@dml.ac.uk.

Scottish Marine Group

SMG
Autumn Meeting 2000

Thursday, 26 October
1000-1030 hrs
University of Stirling

Sustainable Development in the Marine Environment

Contact: Dr Hamish Mair
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SAMS AGM

6 November 2000

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Congratulations

to

Graham Shimmield
who has been granted an Honorary Professorship by the University of St Andrews

and to

John Gage
who has been granted an Honorary Professorship by the University of Aberdeen

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Assistance received from Dr Clive Craik in the production of this Newsletter is acknowledged with thanks.

Designed by Design Links, Edinburgh

SAMS News

Professor Graham B. Shimmield

Director of SAMS and Dunstaffnage Marine Laboratory

Left to right: Graham Shimmield, Ray Michie, MP, George Lyon, MSP, and Scottish Fisheries Minister, John Home Robertson, MP, MSP, beside the DML recompression chamber during their visit to Dunstaffnage. © John Anderson, Highland Image.

The last two months have seen radical changes in how marine science in the UK will be funded. The NERC Council has dissolved the Centre for Coastal and Marine Sciences (CCMS), allowing its three sites at Dunstaffnage, Bidston and Plymouth to reconstitute themselves with local and regional partnerships.

At Dunstaffnage, the Laboratory will probably revert to sole operation and management by SAMS, effectively returning to the pre-1989 constitution. Funding from NERC will have to be won in competition and bid for over the last few months of this year whilst SAMS re-negotiates its relationship with NERC. Despite the initial dismay and major uncertainty over the implications of this decision, I am confident that our skill base, infrastructure and location at Dunstaffnage give us a sound basis on which the future of the Laboratory, as the headquarters of SAMS, will be built.

Over the past few years, SAMS has established key relationships with the university sector, especially the University of the Highlands and Islands project, and with the private sector. More recently, there has been the emerging research and development effort supported by Highlands and Islands Enterprise and the Scottish Executive, to establish Dunstaffnage as a location of independent marine scientific excellence. In July, we were privileged to receive a visit by John Home Robertson, Scottish Fisheries Minister, by Ray Michie, Member of Parliament and George Lyon, Member of the Scottish Parliament.

NERC's decision gives SAMS the opportunity to emerge as a key institution able to provide the scientific base for policy and legislation in marine science issues affecting not only Scotland but also the UK and Europe. In this Newsletter, articles on the deep water fisheries and fish stocks to the west of Scotland are supreme examples of the value and relevance of our work. Over the coming months, the staff at Dunstaffnage, the Directorate, Council and individual members will all be able to play an important role in shaping the Association's research and teaching agenda.

SAMS News continued *Professor Graham B. Shimmield*

A warm 'thank you' and welcome

The first of August marked another occasion: Sir David Smith stepped down after being President of SAMS for over six years. Throughout my tenure as Director of SAMS, Sir David steered the Association through some difficult political and operational issues with great insight and vision. He provided integrity in our relationship with NERC, reminding SAMS Council and members of the value of true partnership and mutual respect between the organisations. His period as President saw the emergence of a major portfolio of SAMS research and teaching commitment. Personally, I benefited tremendously from the frankness and support he gave me.

Sir David Smith

At this challenging moment in the Association's development, we are extremely fortunate to welcome as our new President Dr Ian Graham-Bryce, formerly Principal of the University of Dundee. Ian brings knowledge and background gained as a chemist, an industrialist and the Principal of a university with a major research reputation. He was also a Member of NERC Council and Chairman of the Prior Options (1996) Review Committee.

I am sure I speak for the entire membership of SAMS in thanking Sir David for his dedication and in welcoming and thanking Ian for picking up the mantle of President.

The remainder of this millennium year will prove to be very interesting!

Dr Ian Graham-Bryce

Marine Science Degree

By the time you receive this Newsletter, one of SAMS objectives will have been realised – the arrival of the first cohort of undergraduate students at Dunstaffnage, studying for a BSc in Marine Science with the University of the Highlands and Islands project.

The gestation of this new University has been challenging and rewarding, with much to celebrate and admire. For the first time, students in Scotland can register for an interdisciplinary degree in marine science at a fully operational research facility where they will have access to vessels, aquaria, and diving facilities a few meters from the environment they are studying. This unique educational experience has been achieved through the vision of Professor Jack Matthews and SAMS Council, the hard work of the Marine Science degree team and the support of Dr John French in his role as Head of Academic Development with the UHIp. The teaching and dissemination of marine science knowledge is part of the SAMS constitution and I am absolutely confident that this year will be seen as a defining moment in the history of the Association.

Rockall Plateau now in International Waters - the fleets move in

John D.M. Gordon
The Scottish Association for Marine Science

In 1997, the UK Foreign Office ratified the United Nations Convention on the Law of the Sea.

This Convention excludes uninhabited rocks being used to support territorial claims. Britain's most westerly claim then became the St Kilda group of islands but Rockall itself remained within the UK 200-mile exclusive fishery zone. However, as the UK could no longer claim a 200 mile fishing zone around "the rock", large areas of the Rockall Plateau and the Hatton Bank became international waters (see figure). The UK National Federation of Fishermen's Organisations immediately condemned the decision which was made without consultation. The Chief Executive of the Scottish Fishermen's Federation, Bob Allan, was quoted as saying, "The whole principle of giving up an area of that size is something we cannot support. It now means our boats will face international competition if they want to develop a fishery for unexploited deepwater species out there" (The Scotsman 29.7.1997).

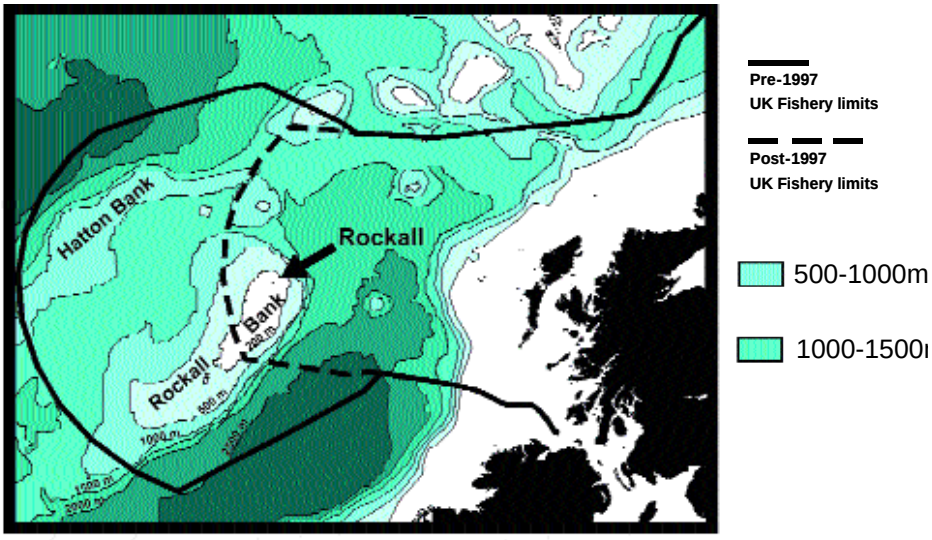
For many years the Rockall Plateau has supported a regulated fishery for haddock by UK and Irish fishing vessels. However, this year (2000) a Russian fleet moved into the international sector of the plateau and is fishing for haddock without any restrictions, despite almost weekly protests by all sections of the fishing industry.

The resolution of the haddock problem will require agreement between the European Union and the Northeast Atlantic Fisheries Commission which has jurisdiction over international waters. However, a glance at the bathymetric chart with the former and new fishing limits superimposed (see figure) shows that there are likely to be even greater problems with deep-water species. Large areas of the slopes of the Rockall Bank and most of the Hatton Bank lie between depths of about 500 and 1500 m where there are stocks of deep-water species such as roundnose grenadier, black scabbardfish, blue ling and deep-water sharks. Several countries previously excluded from fishing in this area are now carrying out exploratory trawl and longline surveys or are actively fishing in the area. These stocks are not subject to any management regulations and the scientific advice is that they are being harvested beyond safe biological limits.

At their May meeting, the Advisory Committee on Fisheries Management of the International Council for the Exploration of the Sea (ICES) recommended up to 50% reductions in fishing effort on some species and that there should be no directed fishery for blue ling. Since all the deep-water species straddle the boundary between coastal state jurisdiction and international waters it will tax the ingenuity of the politicians to devise a system that will be effective in conserving these stocks.

Dr John Gordon is a Senior SAMS Fellow and has been researching deep-water fishes since 1975. Between 1995 and 2000 he chaired the ICES Study Group on the Biology and Assessment of Deep-sea Fishery Resources and co-ordinated the European Deep-fisheries Project.

UK fishery limits in the Rockall and Hatton Bank areas



Fishing moves to Deeper Waters

John D.M. Gordon and Paul Crozier*
The Scottish Association for Marine Science

The bulk of the UK's marine fisheries are in shallow, continental shelf waters and many, if not most, are considered to be overfished. In particular, the North Sea cod stocks are in a serious state. As the stocks of fish that are managed by fixed quotas diminish, fishermen turn their attention to non-quota species and several European countries have begun to modify their vessels to fish in deeper waters for new species.

The un-regulated deep-water fish of the continental slope to the west of Scotland and Ireland are at depths between about 500 and 1500 m. The landings of deep-water species, such as roundnose grenadier, black scabbardfish and sharks, increased rapidly during the early 1990s and for some species appear to have stabilised. However, landings tell us little about the state of the stocks because, as stocks decline, more effort is required to catch the same amount of fish. Effort is difficult to measure when the target species is continually changing and improvements in the technology of deep-water fishing greatly increase the efficiency.

However, a group of colleagues at the French Fisheries Institute (IFREMER), led by Pascal Lorance, have used their detailed knowledge of the fishery to allow them to estimate catch per unit of effort for all the main species. This shows that catch per unit of effort has decreased considerably in recent years and has led scientists at the International Council for the Exploration of the Sea to conclude that deep-water species are presently being harvested beyond safe biological limits.

Successful management of any fish stock requires a sound knowledge of the life history and biological characteristics of the species or species groups. John Gordon's team at SAMS has been studying the deep-water populations of the Rockall Trough and Porcupine Seabight almost continuously since 1975 and this work has added further weight to the assessments of the state of the stocks. Recently, through co-ordinating a major European deep-water fisheries project, SAMS has closely linked this work with that of other research teams, most notably the Fisheries Research Services, Marine Laboratory (Aberdeen), the French Fisheries Institute, Ireland and Germany.

Studies on the ecosystem effects of fisheries have become an increasingly important and political issue. SAMS has access to an almost unique data set on the deep-water fish populations that pre-dates the fishery and is already capitalising on this by linking with the University of the Highlands and Islands Project in funding Paul Crozier's PhD research on *The impact of the fishery on deep-water sharks*.

RV *Thalassa*

Paul Crozier recording biological data on deep water sharks on board the French research vessel Thalassa. *Photographs © A. Carpentier - IFREMER*

*Corresponding Author

ASP – Causes, Effects and Consequences

Maeve Kelly Christopher Bolch* and Dirk Campbell*
The Scottish Association for Marine Science
Dunstaffnage Marine Laboratory

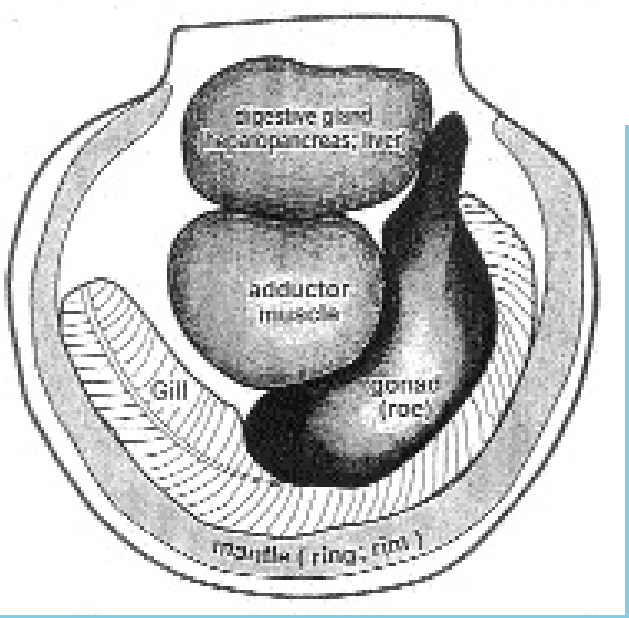
Amnesic shellfish poisoning (ASP) continues to threaten Scotland's scallop industry. Scientists report below on their work and recent advances in our understanding of this phenomenon.

ASP occurs when people eat shellfish contaminated by domoic acid (DA), a neuro-excitatory toxin produced by diatoms of the genus *Pseudo-nitzschia.* The symptoms can be severe and prolonged, including diarrhoea, vomiting, gastric bleeding and neurological disorders, such as disorientation and indefinite memory loss in severe cases.

The systematic ASP testing of shellfish from Scottish waters in early 1999 was followed by detection of widespread ASP contamination of king scallops *Pecten maximus* in July 1999. ASP toxins above the internationally accepted closure limit (20 µg DA g^{-1} of tissue) were detected along the Irish coast and western and northern Scottish waters. No confirmed human poisonings occurred but closure of many areas of the fishery persisted into Spring 2000 resulting in crippling financial hardship to the scallop dredging, diving, cultivation and processing industries.

To determine the cause and distribution of the ASP toxin, scallop and plankton samples were collected from a variety of sea loch and deep water environments in December 1999. This research was funded by Highlands and Islands Enterprise, the Highland Council and the Scallop Association. We examined geographical variation in toxin content by measuring the amount of ASP toxin within the adductor (white meat), gonad (roe), and the remaining visceral tissue (gut and mantle). The DA analysis was conducted by the Biotoxins Laboratory, National Oceanic and Atmospheric Administration, S. Carolina, USA. Toxicity among individual scallops from the same site varied greatly, ranging from 0.1-1845 µg DA $g^{-1}$of viscera. Variation also occurred between neighbouring populations within the same sea loch (<1 km apart) and between separate populations (up to 5 km apart).

The toxin content could not be related to age or size of the scallop or to depth of collection. Despite this variability, viscera consistently accounted for over 90% of the total toxin burden. Of the edible tissues, the gonad typically contained less than 6% of the total toxin and the adductor contained negligible amounts of toxin (0.4%). One solution for the industry may be to follow the US practice and discard the more highly toxic tissues.



Compartmentalised representation of scallop organs.

Dirk Campbell on board a scallop grower's boat, collecting dive-caught king scallops for toxin analysis.
© Maeve Kelly

Pseudo-nitzschia diatoms were dominant and widespread in Scottish coastal waters during August and September 1999. However they were absent or only in low concentrations from October to December 1999. Despite this, scallop toxicity remained above the ASP closure limit in many west coast areas well into the year 2000. Scallops thus appear to retain ASP toxins for long periods. Our laboratory experiments confirmed that the toxins in the viscera did not decrease significantly over a four month period from December to April. This long retention time for phycotoxins may also be compounded by the king scallops' low over-winter metabolic rate.

With the assistance of Ms N. Lundholm of the University of Copenhagen, we identified seven potentially toxic species of algae in the 1999 blooms. Three of these species were isolated for growth in the laboratory at DML to confirm toxicity. The most abundant species from the 1999 blooms, *P. australis*, has now been shown to produce high levels of domoic acid in the laboratory (Dr P. Hess, Fisheries Research Services, Marine Laboratory, Aberdeen). Another common species, *P. pungens*, has so far proved to be non-toxic.

In June-August 2000, a complex mix of *Pseudo-nitzschia* species returned to western Scottish waters and this was followed by the detection of ASP in Scottish scallops. Continuing research to characterise and confirm the causative species and determine their optimal growth conditions will be aided by a University of Highlands and Islands Project studentship grant beginning in October 2000.

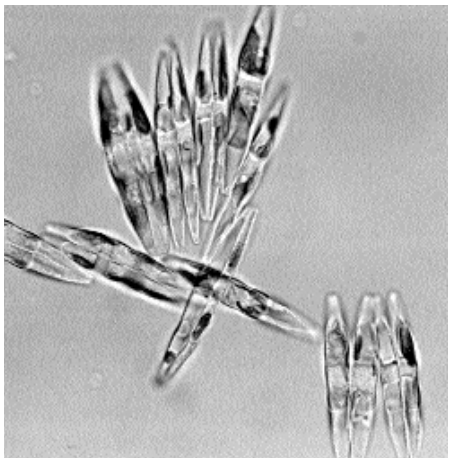
ASP and other phycotoxins will continue to threaten the economic viability of Scotland's scallop industry. Improving our understanding of the yearly variability of blooms, the factors controlling growth of the causative algal species and the up-take and retention of toxins in scallops, can underpin ways for both industry and regulators to manage the damaging impact of toxic blooms on the shellfish industry.

Dr Maeve Kelly is a SAMS Research Associate and leads the Invertebrate Biology and Mariculture Group.

Dr Christopher Bolch is Head of the Culture Collection of Algae and Protozoa at Dunstaffnage Marine Laboratory.

Dirk Campbell is a SAMS Research Associate.

Dirk Campbell sampling plankton to identify and assess the abundance of Pseudo-nitzschia *spp at the scallop sampling sites.*
© Helen Anderson



Cells of the toxic diatom Pseudo-nitzschia australis *from a laboratory culture at DML's Culture Collection of Algae and Protozoa*

*Corresponding Authors

WWF'S OCEANS RECOVERY CAMPAIGN

The seas around our shores are home to an amazing variety of species, including whales, dolphins, turtles, seals and sea horses. We even have deep-sea coral reefs, rich and diverse like those found in the tropics! However, decades of mismanagement have led to unprecedented pressures on our marine life.

Our seas are incredibly important. In addition to their nature conservation value, they represent an important part of our heritage and economy, providing us with food, jobs and recreation. To help revitalise our seas, in July 2000 WWF launched the Oceans Recovery Campaign (ORCA). ORCA draws attention to the multiple threats facing our marine wildlife and coastal communities, and lobbies for greater protection and commitment to oceans recovery.

WWF is working with the fishing industry to ensure a healthy marine environment where life is thriving and fishermen are able to fish in perpetuity. This involves the creation of regeneration areas, such as piloting Fishing-Free Zones, to enhance fish stocks. WWF is looking to government to set up an improved network of marine protected areas to cover UK waters to 200 nautical miles. In the longer term, ORCA is seeking commitment from governments to marine ecosystem management by the introduction of an Oceans Act.

In all of this, organisations such as SAMS are vital for providing quality, independent science.

Find out more about ORCA by visiting our website www.wwf-uk.org/orca or calling our hotline number 0845 121 0500

SCOTTISH MARINE GROUP

SAMS Prize Meeting – May 2000
at Heriot-Watt University, Edinburgh
Marine Science Studies in Scotland

Abstract

A New Study into the Fish Populations of the Lower Forth Estuary

Marin Greenwood
Forth Estuary Ecology Group, University of Stirling
Winner of SAMS prize of £100 for the best postgraduate presentation

The fish populations of the Forth Estuary have been regularly monitored for more than 20 years by the Forth River Purification Board and its successor, Scottish Environment Protection Agency (SEPA) East Region.

Surveys were carried out using Agassiz trawling, a method suitable primarily for sampling benthic and demersal species, such as flatfish and gadoids. Inevitably, midwater species such as clupeids (sprat and herring) are mostly missed when sampling in this way. This lack of knowledge about midwater species becomes significant when looking at the species composition of fish removed by cooling water abstraction at Longannet Power Station. In a study by Peter Maitland for Scottish Power, clupeids dominate numbers recorded in these samples.

My research project, which is funded by Scottish Power, involves carrying out novel midwater trawling, as well as Agassiz trawling by SEPA's Research vessel *Forth Ranger*, to obtain further knowledge about the lower Forth Estuary's ichthyofauna. This is combined with a more intensive sampling programme at Longannet Power Station than previously undertaken. By looking at rates of impingement over a year, and with varying tidal heights, as well as in the light and in the dark, it is hoped a reasonably accurate estimate of fish removal by the power station can be obtained, and that this can then be related to estimates of fish abundance and biomass obtained by trawling.

Initial results from 1999 suggest that a combination of midwater and Agassiz trawling produces more comparable data to that from power station sampling. In both methods sprat account for approximately 50% of total numbers, then herring (25%) and whiting (between 5 and 10%). These three most common species use the estuary seasonally, coming in during autumn and winter, and leaving in summer time. This is best shown by the much more apparent seasonal trends in the results from the power station, where sampling is more frequent. Both sampling methods illustrate an ichthyofauna typical of northern temperate estuaries, in which environmental conditions vary sharply, consisting of relatively few species. In the Forth, ten of the most common species account for over 95% of total abundance of fish.

The judges found it difficult to choose the winner from the presentations, the others being made by Melanie Bergmann (University Marine Biological Station, Millport/University of London), Rhys Bullman (University of Stirling), Stephen Craig (SAMS/University of Aberdeen), Edward Salter and Xiao Hua Zhang (Heriot-Watt University).

Dr Hamish Mair, SMG Convener, Heriot-Watt University, is thanked for organising this enjoyable and interesting meeting and the use of the Heriot-Watt University facilities.

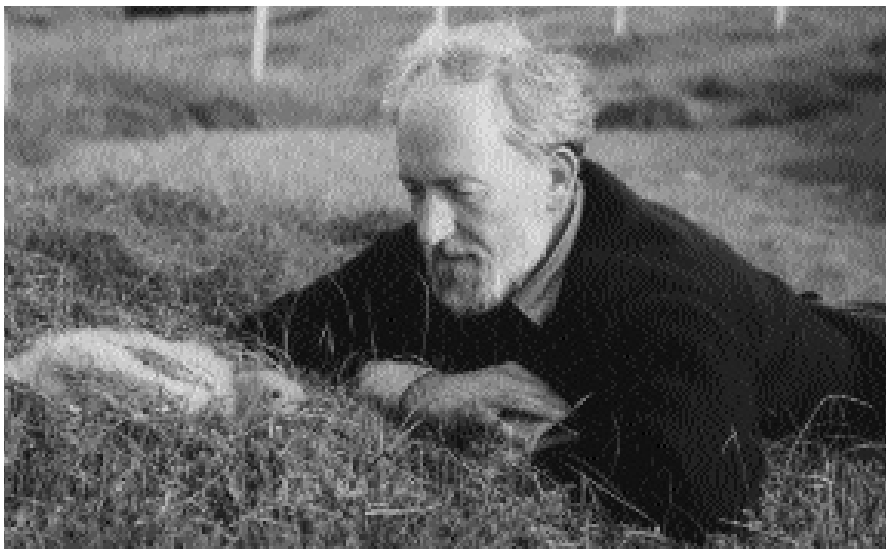
Managing fisheries to protect seabird communities

Bob Furness
Institute of Biomedical and Life Sciences, University of Glasgow

It is difficult to assess whether reductions in prey fish abundance have been caused by fisheries or by environmental factors, but such reductions can lead to region-wide seabird breeding failures. By contrast, the 25 million tonnes of fish discarded worldwide each year support huge numbers of large scavenging seabirds, which upsets the natural balance in seabird communities. Can fisheries management adjust to become 'seabird friendly'?

The answer is yes, and many organisations have been pressing for such developments. Two aspects affect Scotland; the North Sea sandeel fishery and changes in discarding rates from the Scottish demersal fisheries.

Breeding success of many species of seabirds tends to be higher where large populations of small, schooling, lipid-rich fish are available since they provide a high-energy package to carry to chicks. In the southern North Sea, seabirds can feed on sprats, young herring, and sandeels, but in the northwestern North Sea there are few sprats or young herring and so sandeels are of primary importance for breeding seabirds. The northwestern North Sea holds the largest numbers of breeding seabirds, but that is probably related to the availability of cliff nesting and island habitat. However, it is striking that so many seabirds depend while breeding on a fish with a short life-span and highly variable annual recruitment and which become available to surface feeding seabirds only when they feed on plankton during spring and summer. Sandeels are also the target of the biggest fishery in the North Sea. Around 700,000 tonnes are harvested annually, mainly by Danish and Norwegian fishermen, for conversion into fish meal. Despite growth of the sandeel fishery over the last 30 years, seabird numbers in the North Sea continued to increase, at least until very recently. However there has



been concern that sandeel fishing might affect seabird breeding success through stock depletion, especially in areas close to major seabird colonies. Breeding performance of some seabirds is affected by reductions in sandeel abundance.

At a political level, agreement has been reached to monitor seabird breeding success in a specific area of the North Sea where dependent predator numbers are high, and to use performance of kittiwakes as a criterion for the closure or reopening of sandeel fishing in that specific area, but without reduction of the overall North Sea quota for the sandeel fishery. This represents a small but significant step forward in fishery management, taking account of the needs of wildlife as well as fishermen.

Most discarded offal and roundfish are consumed by large scavenging seabirds. Discards and offal are particularly important foods for seabirds in winter, but some breeding seabirds also take large quantities of discards, such as breeding great skuas in Orkney and Shetland. Over recent decades discarding has declined, partly due to declining stocks and catches, but also to changed technical measures. With this decline, great skuas have been switching away from feeding on discards to killing other seabirds; as a result kittiwake breeding numbers in Shetland have fallen by more than half and several colonies near skua breeding areas have been extirpated. While nobody is likely to favour high levels of discarding just to feed scavenging seabirds, the effect of reduced discarding on seabird community structure and stability might be an important seabird conservation issue in coming decades.

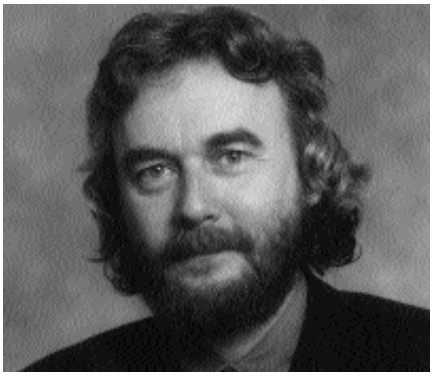
Further reading: Furness & Tasker 2000. Seabird-fishery interactions: quantifying the sensitivity of seabirds to reductions in sandeel abundance and identification of key areas for sensitive seabirds in the North Sea. Mar. Ecol. Prog. Ser. 202: 253-264.'

Bob Furness is Professor of Seabird and Fishing Interactions at the University of Glasgow. He is currently on three years study leave funded by IFOMA (International Fishmeal and Oil Manufacturers Association) to work full time on seabird-sandeel fishery interactions.

Web: http://www.gla.ac.uk/ibls/DEEB/rwf/

Member's View
The Minches - Better management of hazardous traffic

Councillor Dr Michael E.M. Foxley, Highland Council



In 1990, the then Regional Council discussed a report on contingency plans for oil pollution as any significant incident in the Minches would be disastrous for the environment and economy of the coastal communities which depend heavily upon tourism, fishing and fish farming. This was the start of the campaign to manage hazardous shipping in the Minches.

In 1993, we had the Braer incident off Shetland and could see the potential disaster waiting to happen. After discussions with our colleagues in the Western Isles Council and SNH, a joint paper requested:

- All vessels with oil and hazardous cargoes to carry transponders to ensure accurate identification and plotting of vessel routes.
- Radar to monitor all shipping movements through the Minches.
- A permanent rescue tug to be based in Stornoway.
- Specific ring-fenced funding to ensure development of contingency plans to cope with a modest oil spillage.
- Compulsory coastguard reporting for all shipping moving through the Minches. (The coastguards recommend traffic separation routing for north and south bound traffic. In 1995, 78% used the correct route and 22% were either failing to report or not using the correct route. By 1999, 94% of vessels were using the correct route. However, 3% were failing to report and a further 3% were not using the correct route. It is likely that those failing to report are not using the correct route.)
- Vessels to use an extended deep water route to the west of the Hebrides and ideally to the west of St. Kilda to protect the west coast of the Western Isles.
- All vessels carrying hazardous cargoes to use pilots when passing through the Minches.
- Removal of the Right of Innocent Passage from the Minches - the key issue to ensure the above management takes place.

For several years, Councillor Bill Fulton and I have jointly chaired the joint committee with the Western Isles Council to campaign for these changes. Following the Braer disaster, Lord Donaldson recommended that Marine Environmentally High Risk Areas (MEHRA) be established where there was a significant concentration of shipping and a high risk of environmental damage. In October 1998, representatives of Highland Council and Western Isles Council met the Minister of Transport in London. We asked for the Minches to be safeguarded by removing the Right of Innocent Passage and that the area be designated a MEHRA. Over a year later, the UK Government has carried out a consultant's study on MEHRAs which was inadequate and incomplete to the point of incompetence. As an example, there was no serious reflection of the environmental sensitivities around our coastline. The recent Marine Special Area of Conservation for the Sound of Arisaig was judged by the consultants to be of the lowest ranking of environmental sensitivities!

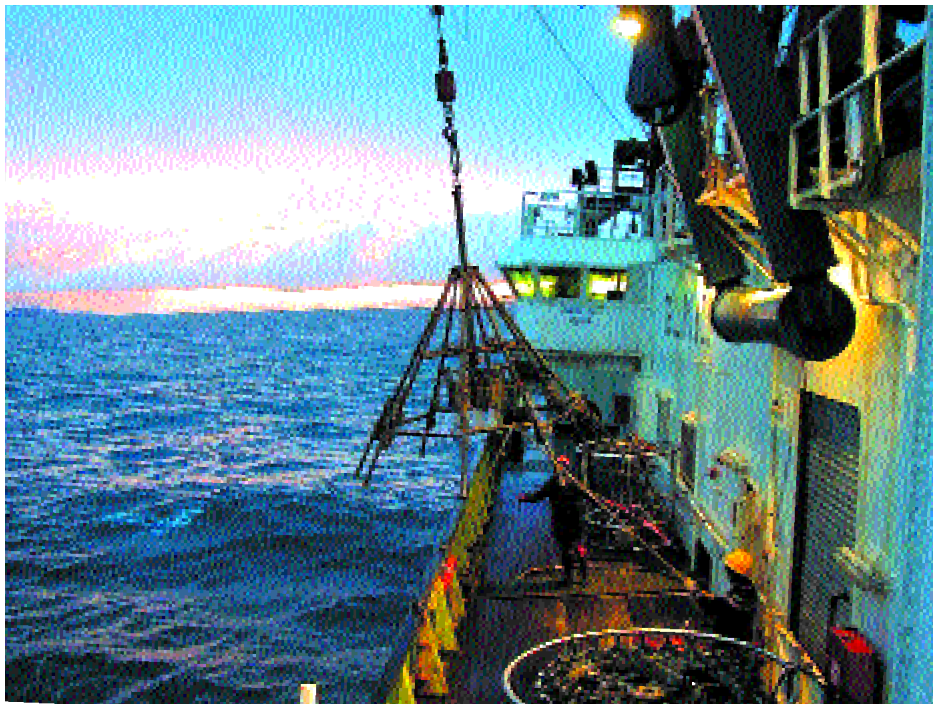
This campaign has now lasted a decade and we have achieved a permanent tug at Stornoway and an improvement in vessels using the correct route. However, "the accident is still waiting to happen" unless we can remove the Right of Innocent Passage and manage shipping in the Minches to avoid an environmental and socio-economic disaster for the coastal communities.

We intend to mount a major campaign this winter and shall seek the support of the Scottish Parliament to try to force the UK Government to take this seriously as the control of shipping is reserved for the UK Parliament. We must succeed to safeguard our future.

Vessel passing through the Minch off Waternish, Isle of Skye. © John Anderson, Highland Image.

Biogeochemistry west of the Inner Hebrides

Drs Ken Jones, Kenny Black and Tracy Shimmield are interested in what happens to material transported onto the western Scottish shelf from the Irish Sea, the mainland and the oceans. Attention has focused on sites up to 300 metres deep west of the Inner Hebrides which are periodically isolated from the general circulation. Investigations are underway into how these accumulate organic matter and contaminants of human origin, such as radionuclides, transported in the Scottish coastal current. Among other things, these areas may shed light on recent biogeochemical recycling processes and environmental changes since the last ice age.



© Phil Taylor, Research Vessel Services.

Autosub samples Loch Etive

The MV *Terschelling* near Bonawe in Loch Etive in April 2000, working on the Autosub Science Missions project 'Manganese cycling in sea lochs'.

The *Terschelling*, based in Plymouth, usually operates as a salvage vessel. For this work, she was equipped with a cradle which enabled her to launch the NERC autonomous submersible vehicle *Autosub 2* – which is yellow and can be seen on the stern. *Autosub 2* was fitted with an *in situ* manganese analyser, an oxygen meter and a water sampler which measured and mapped the distribution of dissolved and particulate manganese and oxygen in the deep waters of the upper basin of Loch Etive. The results will be used to quantify the cycling of manganese through the water column. The high concentration of manganese found in Loch Etive (and other sea lochs) is probably related to the low oxygen concentration (hypoxia) which is found in the deep bottom waters.

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