



Independent
Marine Science



since

1884



Annual Report 2014 - 2015

WELCOME

TO SAMS' ANNUAL REPORT 2014-15



PROFESSOR AXEL MILLER, ACTING DIRECTOR

Welcome to our 101st annual report. It has been a true rollercoaster of a year: Institutionally we achieved our greatest ever success in the national assessment of university research but at the same time had to restructure our operations to respond to an ever more challenging external funding environment.

Some key highlights of the year

- 80% of research conducted by SAMS and UHI colleagues in environmental sciences was judged to be of international standing in the 2014 Research Excellence Framework (REF)
- Our new international MSc in

Aquaculture, Environment and Society (a joint initiative with the Universities of Crete and Nantes) was ranked second out of 56 proposals on the Erasmus + programme, the highest form of academic programme in Europe

- Our commercial consultancy, SRSL, moved to Malin House as flagship tenant on the European Marine Science Park, operated by Highlands and Islands Enterprise.

A sad loss

As Acting Director, one of my final tasks was to represent SAMS at the funeral of Mr Michael Gibson CBE, immediate past Chair of the Board to SAMS Council. In

addition to his obituary overleaf, I am compelled to express my very personal sadness at his death.

And new beginnings...

My very final task was to hand over the reins to our new Director, Professor Nicholas Owens. I have known Nick for some time and have always been impressed by his energetic drive; his enthusiasm for people, for knowledge and the wonders of the sea; and for his inspirational leadership style. I am confident that SAMS will thrive under his leadership.

PROFESSOR
NICHOLAS OWENS

OUR NEW DIRECTOR
JOINED SAMS ON 1
SEPTEMBER 2015.



“MICHAEL WAS AN EBULLIENTLY CHARMING MAN. AT SAMS HE WILL BE REMEMBERED FOR HIS COMMITMENT, FRIENDSHIP, GOOD HUMOUR AND OPENNESS.”



OBITUARY

ALEXANDER JOHN MICHAEL GIBSON CBE

Born: Glasgow, June 1952
Died: Dallas, July 2015

Former Chair of the Board to SAMS Council, Michael Gibson CBE, died in July 2015. The 63 year old cattle breeder and founder/director of Macbeth's Traditional Scottish Butcher & Game Dealer will be remembered at SAMS as a lively and driven character, a problem solver and someone wholeheartedly committed to the development of the organisation.

Mr Gibson was a past president of the Highland Cattle Society and former chairman of the Agricultural Committee of the Scottish Landowners Federation. Over 30 years, he developed a reputation as one of the area's most respected cattle breeders. He was a formidable advocate of farming and rural Scotland and he cared passionately about the many causes in which he took a close interest.

Standards Agency in 2000, at a time when the UK had experienced high profile food safety problems including BSE. Over the years the Agency worked closely on very sensitive food safety issues in Scotland. He served under Sir John Arbuthnott, past SAMS President. As members of the newly established Scottish Food Standards Committee they oversaw work on shellfish contamination, foot and mouth and salmon farming.

Coming from an accountancy and business background, Michael was analytical and not afraid to challenge accepted norms. Sir John noted that his supportive but rigorous approach to organisation and management was of great value and played an important part in re-shaping the governance structure of SAMS. Michael always saw problems as there to be solved.

As Chair of SAMS Board, Michael oversaw a transformational change in the governance and management of SAMS, establishing and effectively refining our current system of governance. Despite his strong views and drive for 'making things happen', he was a thoroughly compassionate leader, who was determined to bring out the best in colleagues. Michael was an ebulliently charming man. He will be remembered for his commitment, friendship, good humour and openness. He always brought tremendous enthusiasm and strove for excellence, qualities that were at the core of his family businesses and public roles alike.

Mr Gibson, whose wife, Susan, died last year, leaves behind son Jock, daughter Bridget, and a grand-daughter.

Michael was elected to the inaugural board of the Food

OUR PEOPLE

Highflier of the year: Angela Hatton

This has been the year of SAMS' top woman scientist Angela Hatton, UHI Professor of Marine Biogeochemistry. Only recently taking on research leadership internally as Associate Director for Research, in March 2015 she was appointed as chair of NERC's main scientific advisory committee, the Science and Innovation Strategy Board (SISB).



Angela said: "Over the coming decades, we will face serious challenges in resources, hazards, and environmental change. NERC's investment in environmental science can help to ensure that we are fit to meet these challenges, but in order to do so it will need to prioritise its investments effectively. I'm delighted to be able to take up the challenge of helping NERC achieve this!"

Staff survey

Scotinform conducted a staff survey in 2014 across nine UHI academic partners, with 61% of SAMS employees participating in the voluntary survey. The results found that our employees recommend SAMS as a good place to work, feel that SAMS appreciates its employees and has a supportive culture. Respondents were very positive about their jobs and agreed that they have good working relationships with their colleagues and feel that their work is worthwhile. At the time of the survey 72% described their morale as very high or high.

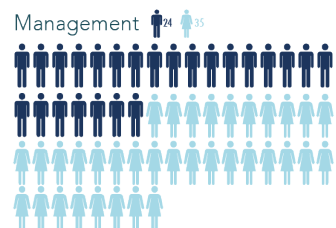
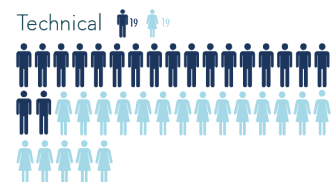
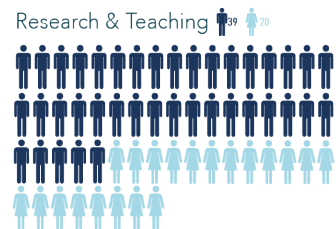
Areas of improvement highlighted by the report were communication about SAMS plans and progress (only 43% were aware of SAMS' strategic plan), and introduction of a flexitime system.

Greater fairness

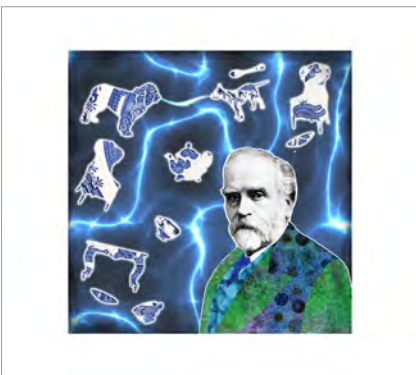
During the reporting year SAMS completed a lengthy and in-depth job evaluation process that unified previously eight pay scales into a single structure reflecting the Universities & Colleges Employers Association (UCEA) system. This process ensured that across the previously different scales jobs of equal size are enumerated fairly and equally to meet legislative requirements. The process used the Hay Group job evaluation method that had previously been used substantially across the higher education sector.

Diversity at SAMS

SAMS staff are diverse, originating from 19 different countries, with a near even distribution between men and women, and a plethora of professional backgrounds. Currently 38% are employed in research and teaching roles, 24% in technical roles, and 38% in management and administration



LEARNED SOCIETY NEWS



Birth of a Scientist
By Alice Strange, 2014

Celebrating the legacy of Sir John Murray

On 14 November 2014 we marked our 100th Annual General Meeting and 130 years since our beginnings with a celebration of the life and legacy of our founding father, Sir John Murray (1841-1914). Over 100 guests came together for a varied programme of talks, films, music, and art exhibitions at SAMS and an evening ceilidh in Oban's Argyllshire Gathering. The event was co-hosted by SAMS President Professor Geoffrey Boulton and Acting Director Professor Axel Miller.

John Murray was introduced as 'The Man who Challenged the Deep' in a new 15 minute film about his life and legacy featuring Nick Owens and Jim Adams as well as Murray's great grandson Alex and great great granddaughter Laura. The film

was made by SAMS filmmaker Andy Crabb, sponsored by The Fishmongers' Company and is available on YouTube and Vimeo.

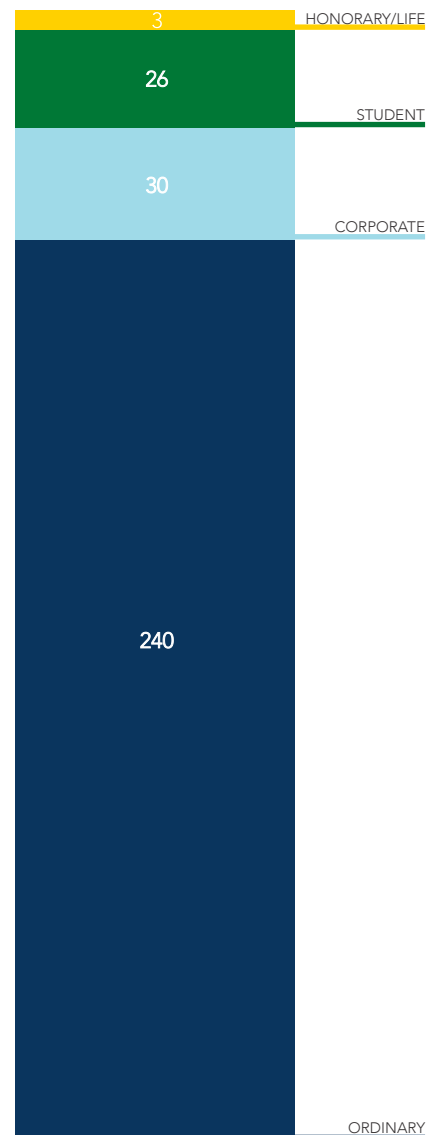
Anne Christine Brusendorff (General Secretary, ICES) summarised the role Murray played in the setting up of the International Council for the Exploration of the Sea in 1902 and reported that Edinburgh was a serious contender to Copenhagen as the headquarters for ICES based on Murray's immense reputation.

Dr Olav Sigurd Kiesbu (Director, Hjort Centre) explored the influence of Murray on Johan Hjort, the Norwegian father of fisheries science. Murray collaborated with Hjort on the ambitious Michael Sars expedition of 1910 that explored life in the deep sea of the North Atlantic, leading to the 1912 publication of 'The Depths of the Ocean' co-authored by Hjort and Murray.

These short talks demonstrated Murray's lasting legacy on international marine science and management.

We then launched a new marine policy centre, the Laurence Mee Centre for Society and the Sea, leading on to the 25th Annual Newth Lecture as the central component of the event.

The state of the membership (Date: 31 March 2015)





NEWTH LECTURE

Chilean marine biologist Dr Patricio Bernal, head of the Intergovernmental Oceanographic Commission of UNESCO from 1998-2009, explored the links between oceanography and ocean policy in an animated and outspoken lecture bristling with information and big picture insights. The presentation ultimately concluded the critical importance of greater public appreciation of the marine environment to achieve international implementation of marine environmental legislation.

Six members of John Murray's family attended the event and Alex Murray presented SAMS with John Murray's microscope in an emotive gesture of bringing family and legacy together. The microscope is now on permanent display in the SAMS reception, occasionally travelling to scientific conferences. In return SAMS presented the Murray family as well as all speakers and outgoing SAMS Council members with a gifts featuring images from the Challenger reports that were custom-made by new local marine science textile company Crùbag. The party then moved into the entrance area of SAMS' main research facility named 'Sir John Murray Building' for a reception and the viewing of the stunning Challenger Exhibition by local artist Alice Strange including three new artworks made for the 130th celebrations.

Music for the day was provided by Piper Aaron Hussein, Gaelic singer Joy Dunlop, and SAMS ecologist and clarsach player

Christine Beveridge who performed her own 'ctenophore tale'. The evening entertainment was courtesy of the Ceilidh Bandidos and science comedy from the Bright Club Scotland.

NEWTH LECTURER

Dr Patricio Bernal

Head of the Intergovernmental Oceanographic Commission of UNESCO from 1998-2009

Office bearers as confirmed at 100th AGM of Association

SAMS President:
Professor Geoffrey Boulton

Chairman of SAMS Board:
Commodore Angus Ross

Council members:
Mark Batho
Stuart Cannon
Prof Robert Ferrier
Prof Jane Francis
Marilyn Jeffcoat
Prof Monty Priede
Ken Rundle
Prof Sandy Tudhope

Audit committee external members:
Dr Keith Duff
Paul Brennan

Council observers:
Paul Fox (NERC)
Douglas Cowan (HIE)
Prof Clive Mulholland (UHI)

SAMS Honorary Fellows

Dr John Gordon
Dr Clive Craik
Prof Jack Matthews
Dr Bob Batty
Prof Murray Roberts
Prof Richard Gowen
Dr Jake Rice
Dr Fiona Hannah
Prof Geoff Moore
Prof Toby Sherwin
Dr Henrik Stahl
Dr Ken Jones

SAMS Honorary Research Associates

Robin Harvey

BREEDING SEABIRDS IN WEST SCOTLAND

J C A Craik (Honorary Research Fellow)

The year 2014 was the twentieth successive year of the Mink-Seabird Project. When I was ringing seabird chicks in the Oban area during 1987-1994, I became aware of the harm being caused by introduced American mink to seabirds nesting on small islands in sealochs and sounds of west Scotland. I was the first to discover and publicise this fact. Since 1995, with great help from local people, we have been protecting the more important colonies by removing mink locally. Each year I assess the effect of mink removal by recording bird breeding numbers and success at these sites and comparing them with sites without mink control. Annual reports have documented the successes and failures of each breeding season, but the results can be appreciated more directly by simple observation. Most unprotected nearshore islands have lost all their nesting seabirds, while similar islands receiving annual mink control have not.

In summer 2014 mink control was undertaken at 26 sites (mostly islets) in twelve sealochs and sounds. As usual, seabirds bred successfully at most of these sites. However, over the years there have been some interesting

failures. In 2014 monitoring continued at two sites where whole-island failures had earlier been caused by predators other than mink.

At Eilean an Ruisg in Loch Feochan, an individual Herring Gull specialised in preying on the eggs and chicks of nesting seabirds, particularly Common Gull, Black-headed Gull, Common Tern, Oystercatcher, Eider and Canada Goose. It was first seen in action in May 2006 and since then has appeared every summer as soon as eggs are laid on the island. It is so persistent that most years no young at all are raised on the island and, by 2014, most nesting individuals and species had gone. Food specialisation is well known among gulls, especially Herring Gulls, but it is perhaps unusual for the activity of a single individual to be recorded for such a long time.

Eilean Mor, Dunstaffnage, is another island where mink have been successfully controlled for many years and, as a result, large numbers of gulls and other species have bred there with great success. On 3 June 2011 an ornithologist visiting the island saw two fox cubs running away

from him. Their small size implied that a vixen was present. The cubs died later in 2011 (I found their skulls in a cave on the island) but the vixen unexpectedly survived two more winters, causing whole-island breeding failure of the seabirds in the summers of 2011 and 2012. The head of a young Common Seal that I found in the interior of the island provided a clue to her winter diet. In view of the severe damage she was causing to all birds nesting on Eilean Mor, including attractive and declining species such as Black Guillemot and Eider, and since this devastation was likely to be repeated in 2013 and beyond, I arranged for the vixen to be shot in March 2013. Some birds returned to nest that summer but, in 2014, counts showed that numbers were still much lower than normal. I will continue to follow the slow recovery from this extraordinary event.

The happenings of the last two paragraphs have been written up and submitted for publication, together with an account of a third episode of predation – the presence and effects of brown rats on both Eilean Mor and Eilean Beag, Dunstaffnage, during 2005-2011. Fortunately, rats have now disappeared naturally from these islands.

A chance discovery

It is well known that thin films of oil on water often show the colours of the rainbow. The colours are caused, not by coloured materials, but by interference of light reflected in the film of oil. Interaction of the different wavelengths (= colours) of sunlight enhances some and diminishes others – hence the display of different colours. A similar effect is sometimes caused by bacteria on pond surfaces, except that here the effect is caused by a thin layer of solid rather than by a liquid. The bacteria often belong to the genus *Leptothrix* and the solid film is usually iron oxide or manganese oxide generated by the bacteria.

In 2014 I came across a group of small intertidal ponds that show this phenomenon to an amazing degree. The best colours and patterns are produced after a spring tide has filled the ponds with sea water. Fresh or brackish water flowing in from the surrounding soil spreads out in a thin film on the denser sea water. Most of the soil is anaerobic and contains reduced (ferrous) iron at high concentration. Bacteria in the surface film are thought to use atmospheric oxygen to convert the reduced iron to oxidised (ferric) iron, which precipitates out as a solid film.

Many of the patterns generated in these ponds are striking. No two successive patterns are alike, probably because the number of variables is so large - for example, salinity of soil water and of pond water, rate and direction of flow, wind direction, air temperature, humidity, water temperature and so on.



BIOGEOCHEMISTRY & EARTH SCIENCES

Highlight publication

Blackford, J, **Stahl, H**, Bull, JM, Berges, BJP, Cevatoglu, M, Lichtschlag, A, Connelly, D, James, RH, Kita, J, Long, D, Naylor, M, Shitashima, K, Smith, D, **Taylor, P**, Wright, I, Akhurst, M, Chen, B, Gernon, TM, Hauton, C, Hayashi, M, Kaieda, H, Leighton, TG, Sato, T, **Sayer, MDJ**, Suzumura, M, Tait, K, Vardy, ME, White, PR & Widdicombe, S. 2014. 'Detection and impacts of leakage from sub-seafloor deep geological carbon dioxide storage' *NATURE CLIMATE CHANGE*, vol 4, no 11, pp 1,011-1,016



IMPACT

RECOMMENDATIONS FOR CARBON CAPTURE AND STORAGE OPERATORS

Carbon Capture and Storage (CCS) is a potential mitigation measure to lessen the increase in global warming and ocean acidification. In 2012 Ardmucknish Bay near SAMS was the site for the first ever field experiment to investigate the environmental impacts from potential leaks at a shallow sub-sea carbon dioxide storage reservoir. The experiment was conducted under the direction of Dr Henrik Stahl. Many of the results from the experiment were published in this reporting year – including in *Nature Climate Change* – and a special issue is being prepared for publication in the International Journal of *Greenhouse Gas Control*.

The PML-led and NERC-funded project 'Quantifying and Monitoring Potential Ecosystem Impacts of Geological Carbon Storage (QICS)' was designed to understand how marine life on the seabed and in the water above might react to a real-life leakage from a CCS site and to determine methods for detection and monitoring of a small-scale CO₂ leak event.

The research found that, for a leak of this small scale, the environmental damage was limited, restricted to a small area and with a quick recovery of both the chemistry and the biology. CO₂-induced chemical changes occurred towards the end of the CO₂ release but impacts including changes to environmental chemistry returned to background

levels within 17 days of turning off the CO₂ release. No biological effect was observed during the early stages of the release. At the end of the release period and early in the recovery period, there was a change in seabed-dwelling communities as well as the gene expression of microbes. These impacts were not catastrophic or long lasting and full recovery was seen in weeks.

A combination of chemical sensors and bubble acoustic techniques proved to provide the optimal monitoring technology to detect leakage or give assurance of no leakage.

QICS made the following recommendations for CCS operators developing risk strategies:

1. CCS site selection should be below dynamic bodies of water to promote dispersal of CO₂ in the unlikely event of leakage.
2. A comprehensive baseline study, encompassing sediment structure and content, seawater chemistry, biological community structure and ambient noise, is required to maximise monitoring efficiency.
3. A combination of chemical pH and bubble-listening sensors will maximise early leakage detection or alternately provide assurance that leakage is not occurring.

Climate mitigation research

Information about possible environmental impacts of carbon capture & storage as a technology to lower rises in carbon dioxide is essential for society to decide if to invest into it.



DNA FINGERPRINTING TO FIND CCS LEAKS?

Following on from some of the issues raised in the QICS project, benthic biogeochemist Dr Natalie Hicks has been working on the Coverall project with the aim to develop a novel monitoring technique for detecting potential leakages from CCS sites. Together with project partners from the University of Oslo, National Technical University of Athens, University of Durham and the Norwegian Geotechnical Institute, she has set up and run a series of experiments simulating a CO₂ leak, and taken a variety of biogeochemical measurements and sediment samples for DNA analysis. The sediment samples are analysed using Next Generation Sequencing and the use of metagenomics. This is to identify any changes in the abundance of CO₂-fixing bacteria, with the overall aim of being able to take a sample of sediment from a CCS site and run it through a DNA fingerprint test to identify if these bacteria are present, and thus being able to detect a leak potentially before any other signs of a leak are apparent. This could prevent many of the ecosystem effects caused by elevated CO₂.

To date, the team has completed the experimental campaign, the metagenomic data is being worked up and papers are being prepared. The SAMS team is particularly curious to find out where the bulk of the CO₂ goes, as the QICS experiment noted around 80% of the injected CO₂ did not come out of the sediment in any measureable form. The Coverall project is funded by the Norwegian Research Council with EPSRC match-funding UK efforts.

Natalie also won NERC funding for a pilot study into the influence of bacteria on benthic ecosystem processes in a changing climate.

MY HIGHLIGHT



Dr Natalie Hicks
Benthic Biogeochemist

I was awarded a funded place on a British Council research workshop in Santa Marta in Colombia. This resulted in Dr Alberto Acosta from Colombia coming to SAMS as a visiting scientist and developing strong links with the University of Javeriana, Bogota. This has already led to a joint research proposal, and we are exploring student exchanges between UHI and the University of Javeriana.

MICROBES RULE IN DEEP TRENCHES

After discovering higher than expected rates of microbial activity in the seabed of the Challenger Deep, Professor Ronnie Glud, Dr Robert Turnewitsch and colleagues continued their research into the biogeochemistry of hadal trenches. As the Mariana Trench lies below nutrient-depleted waters with low productivity, they investigated which other factors may drive the food supply from the surface to deep sediments.

This time they didn't just investigate one but five rather different Northwest Pacific hadal trenches. Using Lead-210 as a tracer they confirmed that surface-ocean productivity alone could not explain the differences between trench sites

and concluded that a combination of fluid- and sediment-dynamical forcing would have to be behind the differences. They were surprised to find that the controlling mechanism involves the intensity of propagating internal tides. In open-ocean settings tides are normally not thought to play an important role in sediment and biogeochemical dynamics.

The negative relation between the internal-tide intensity and sediment focussing is near-exponential and the most intense drop in sediment focussing occurs at moderate internal-tide intensities. This suggests that propagating internal tides may have a subtle but significant influence on particulate-matter dynamics and food supply in hadal trenches in particular, but possibly also in the deep seas in general.

NEW ARRIVAL: GAVIA AUV

A key development for the Biogeochemistry and Earth Science Department was the arrival of an Autonomous Underwater Vehicle (AUV) funded through NOC's Marine Autonomous and Robotics Systems Facility. The Teledyne Gavia is a low-logistics, fully modular AUV. It has field-changeable modules that can be replaced in minutes, allowing rapid sensor reconfiguration and battery replacement. Capable to operate in depths down to 500m the Gavia is fitted with a GeoSwath+ 500 kHz multibeam and colour camera.

RADIONUCLIDES

2014 saw the completion, in glorious summer weather, of the Lo-Rise Irish Sea sampling cruise onboard RV *Prince Madog*. Samples were taken from the mud-patch off the Sellafield nuclear plant and around the Isle

of Man for the measurement of low-level radionuclide transport in the marine environment.

Long-lived Radionuclides in the Surface Environment (LO-RISE) is an eight partner (14 academics) project testing the hypothesis that through mechanistic understanding of radionuclide speciation and of key processes, it is possible to predict physico-chemical transport and ecological transfers of long lived radionuclides in the near-surface environment. Dr John Howe is SAMS' partner in this consortium project.

UHI TEACHING AWARD FOR KIRSTY CROCKET

Only into her second year as a lecturer, and based on a nomination by her students, Kirsty won the Best Assessment Feedback award in this year's University of the Highlands and Islands Teaching Awards. She leads the fourth year module in Palaeoceanography and also teaches on the Polar Seas module on the BSc (Hons) Marine Science programme. One of her students said: "The level of detail and thorough analysis of our work on all levels (content, structure, grammar, presentation etc) has been outstanding and really sets a marker for other lecturers to follow."

Kirsty has also been involved in supervising two honours year projects, conducted coral culturing experiments as pilot data to resubmit an otherwise excellently rated NERC grant proposal, hosted a MASTS funded visiting fellow (Dr Ed Hathorne from GEOMAR) and published two papers, including a method development for measuring Nd isotopes in deep-sea corals as first author.

BILL'S YEAR

For Professor Bill Austin workshops and meetings dominated the year, many of which he organised and convened sessions for. This included a retreat organised in his capacity as Graduate School Convenor of the Scottish Alliance for Geoscience, Environment and Society and a MASTS Biogeochemistry Forum workshop.

Together with Dr Richard Abell Bill took delivery of a new Picarro analyser for high quality stable isotope (oxygen and hydrogen) analysis from seawater, further enhancing SAMS' analytical capabilities.

Bill's talent and efforts as a supervisor came to fruition when his St Andrews' undergraduate student Christine McKenna won four major awards for her dissertation on the ocean's mixing processes awarded by the Royal Geographical Society, Royal Scottish Geographical Society, Marine Science 2014 (Challenger Society, IMAREST and SUT) and St Andrews' Department of Geography and Sustainable Development.

A particularly welcome MASTS funding award in 2014 has allowed the appointment of Cathy Winterton as a new PhD student jointly supervised with Professor Keith Davidson and Dr Eileen Bresnan (Marine Scotland Science) working on a 100-year record of changing toxic algae in Scottish coastal waters related to change in land use and temperature.

2014 also saw the publication of a new

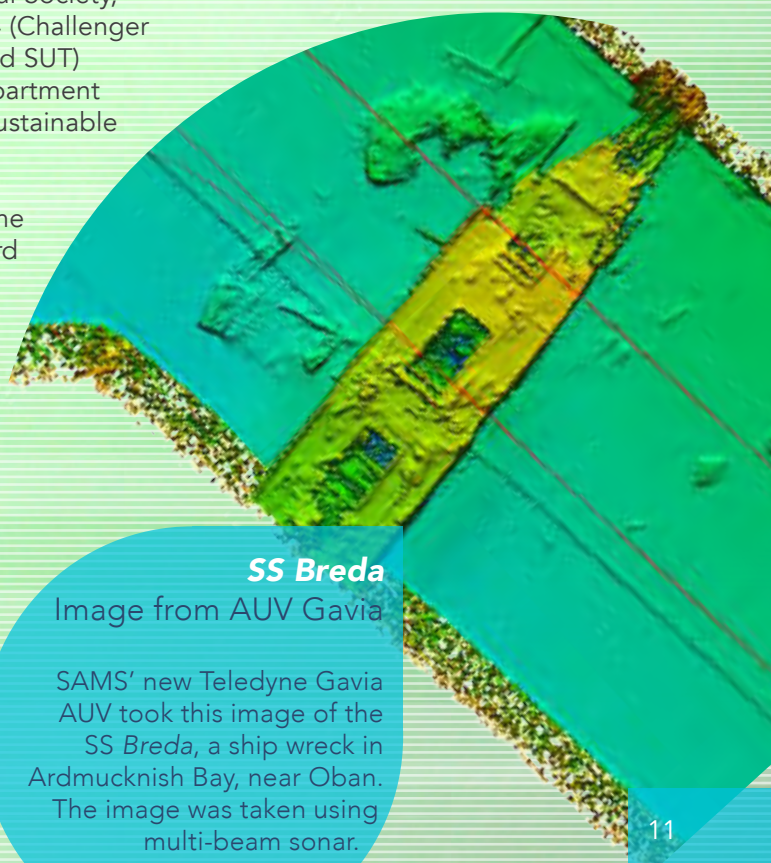
book *Marine Tephrochronology*, published by the Geological Society of London, with a number of contributions from Bill's research group (and former members) at St Andrews.

MY HIGHLIGHT



Dr John Howe,
Marine Geologist

I was delighted with the arrival of our Teledyne Gavia AUV, an addition to the SAMS robotics fleet that increases our ability to map and photograph the seabed in partnership with the National Oceanography Centre.



SS Breda

Image from AUV Gavia

SAMS' new Teledyne Gavia AUV took this image of the SS Breda, a ship wreck in Ardmucknish Bay, near Oban. The image was taken using multi-beam sonar.

MARINE ECOLOGY



CHANGES IN OUR OCEAN'S BIODIVERSITY

With ocean temperature rising, the issues around how climate change is affecting our seas and 'the communities that live beneath them with marine biological communities'.

SAMS' Marine Ecology Department has worked to investigate many of these changes and the effects on the natural environment, from phytoplankton in the Arctic to marine mammals around the tropics.

SAMS (Dr Jorge Garcia-Molinos and Prof Michael Burrows) led research into how climate change is likely to effect the future global redistribution of marine biodiversity and found that the tropics would suffer a nett loss, compared with increasing

biodiversity in higher latitudes.

During 2014-2015 Dr Sheila Heymans contributed to the understanding of ecosystem based management through models with being on the organising committee of the "30 Years of Ecopath" conference. The findings were subsequently published in Reviews in Fish Biology and Fisheries and the Ecopath software was also evaluated against other software for ecosystem based management in the UK. Ecopath is currently being used by Sheila's team in two NERC funded projects (Lo-Rise), tracing radioactive ¹⁴C through the marine food web of the Irish Sea, and in MERP, where Sheila and Dr Natalia Serpetti are updating the existing Ecopath model of the west coast of Scotland (published this year by Dr Karen Alexander and others) to be used for ecosystem based management.



Tanaidacea

This small, shrimp-like crustacean was collected from 2200m depth near the Anton Dohrn seamount off western Scotland. It was the first of its kind found in almost 20 years.

Sheila was also part of the expert group on scenario analysis and modelling of biodiversity and ecosystem services as a lead author on the chapter "Policy support tools and methodologies for scenario analysis and modelling of biodiversity and ecosystem services" for IPBES, the Intergovernmental Platform on Biodiversity and Ecosystem Services. This document will be used as the methodology for modelling changes in biodiversity and ecosystem services.

Dr Bhavani Narayanaswamy, our deep sea benthic expert, has continued her work on the benthic assemblages of the deep Atlantic Ocean with a paper on the Anton Dohrn Seamount, and how the deep sea benthic assemblages can be used to define deep sea biotopes for marine spatial management.

Bhavani has also used her deep-sea experience to look at the impact that deep-sea litter might have on the deep Indian and Atlantic Oceans, even at the most remote sites. Fishing gear dominated deep sea litter in the Indian Ocean, while general refuse was more prevalent in the Atlantic. Bhavani's work will be continued with her new PhD student, Winnie Courtene-Jones, due to start in October 2015.

HOW WILL RENEWABLES INTERACT WITH SEA LIFE?

During 2014 Ben Wilson was awarded a professorship through UHI but has continued his research work at SAMS to identify the impacts of renewable energy extraction on marine mammals. He heads up the Cetaceans and Renewables team at SAMS, which includes Jim Elliot, Dr Steven Benjamins, Nienke van Geel and Dr Denise Risch, who joined in 2014 from Woods Hole Oceanographic Institution. The team was involved in running the international conference Environmental Interactions of Marine Renewables in Stornoway on May 14, 2014, which attracted 220 delegates from 10 countries,

including 10 from SAMS. There were also presentations from the team at international renewables meetings in: Hong Kong (Newton Exchange); Paris (Ocean Energy Europe); Halifax, Canada (ICOE meeting); and Brussels (MARVEN project).

These come on top of contributions to external renewables related committees such as the Scottish Marine Renewable Research Group (Scottish Government), Scottish Marine Animals Strandings Scheme (Scottish Government) and the Marine Renewables Forum (MASTS).

The team ran a major fieldwork campaign for the NERC RESPONSE project looking at how porpoises respond to tidal turbine noise. This involved placing 22 porpoise detectors on the seabed off Scarba and playing turbine noise from an underwater speaker.

Last year saw the conclusion of the Hebridean Marine Energy Futures project, an industry-UHI collaboration with SAMS being a significant player working with Pelamis Wave Power. Work involved monitoring cetaceans around the operating device and its mooring systems through the seasons.

Much of the team's work has covered all corners of the UK: with SMRU Consulting Ltd to advise Natural Resources Wales on mammal issues surrounding the Swansea Bay Tidal Lagoon project; a study of how sound propagates through moving water for the UK Department of Energy and Climate Change (DECC); and several drifting ears campaigns, including off Northern Ireland and the Isle of Wight for commercial tidal energy companies and bottom-mounted recordings for a wave energy company.

CREATURES OF THE POLAR NIGHT

SAMS scientists, along with international partners, spent time studying the Arctic Ocean during the polar night. A rich and diverse place, we know little about what happens there during winter, when it is dark for 24/7 for months on end. Do animals simply hibernate, leave or is it so hostile that they die? Dr Kim Last, Dr Finlo Cottier and PhD student Laura Hobbs from SAMS collaborated with a multinational team led by Jorgen Berge from UNIS and UiT (Norway) to determine how ecosystems respond during this severe period. Focusing on a fjord in Svalbard, Kongsfjorden, the team used a multitude of survey approaches: remotely operated and autonomous vehicles, divers, trawls and acoustics to accurately quantify biological activity across all trophic levels. The response was unexpected: most animals were actually very active, some more so even than during the summer months.

INSHORE FISHERIES

Closer to home, inshore fisheries have become a focus for the Scottish Government following the announcement of plans to greatly increase production from the aquaculture sectors around the Scottish coast. Over the past year work by Dr Clive Fox, alongside Lovro Valcic and Andrea Veszelovski, has contributed towards the Scottish Government programme to improve management of inshore fisheries. Studies by the SAMS group were part of a larger programme funded through the European Fisheries Fund and co-ordinated by SeaFish Scotland.

MINING IN PNG

The department has also collaborated with SRSL on a number of projects, namely a report on the ecological impacts of large-scale disposal of mining waste in the deep sea, a project based in Papua New Guinea that spanned eight years from start to finish. Deep-Sea Tailings Placement (DSTP) from terrestrial mines is one of several large-scale industrial activities now taking place in the deep sea. The scale and persistence of its impacts on seabed biota are unknown.

The SAMS group sampled around the Lihir and Misima island mines in Papua New Guinea to measure the impacts of ongoing DSTP.

At Lihir, where DSTP has operated continuously since 1996, sediment infauna was substantially reduced across the sampled depth range (800–2020 m) and at Misima, where DSTP took place for 15 years, ending in 2004, effects on community composition persisted 3.5 years after its conclusion.

THE NEW LAURENCE MEE CENTRE FOR SOCIETY AND THE SEA

The Centre for Society and the Sea was named after SAMS Director Professor Laurence Mee who had convened its first meeting, following his sudden death in August 2014.

This research and innovation centre looks specifically at aspects of social science, arts and humanities and social-ecological systems research and in November 2014 gained 15 associates from around the world. The centre, led by Dr Jasper Kenter, has helped to implement Marine Conservation Zones, two of which are in the south-east of England.

On December 9, 2014 the LMC hosted its first event, the 'Future Oceans Symposium', to which Dr Heide Hackmann, Executive Director of the International Social Science Council, was invited. The day was chaired by SAMS President Professor Geoffrey Boulton OBE and the symposium voted on what is seen to be the biggest issue facing the oceans, with SAMS researchers making short pitches for topics such as melting polar ice, biodiversity and food from the seas.

In February 2015 SAMS organised its first NERC-funded Marine Policy Masterclass, with 15 PhD and postdoctoral researchers attending. Sessions addressed ocean governance, policy advice, marine law, marine spatial planning and the ecosystem approach, ecosystem health, environmental and ecological economics, and science communication skills. Together this offered an in-depth overview on the subject of marine policy, and was delivered by professionals working on the frontline of decision-making and at the science-policy interface.

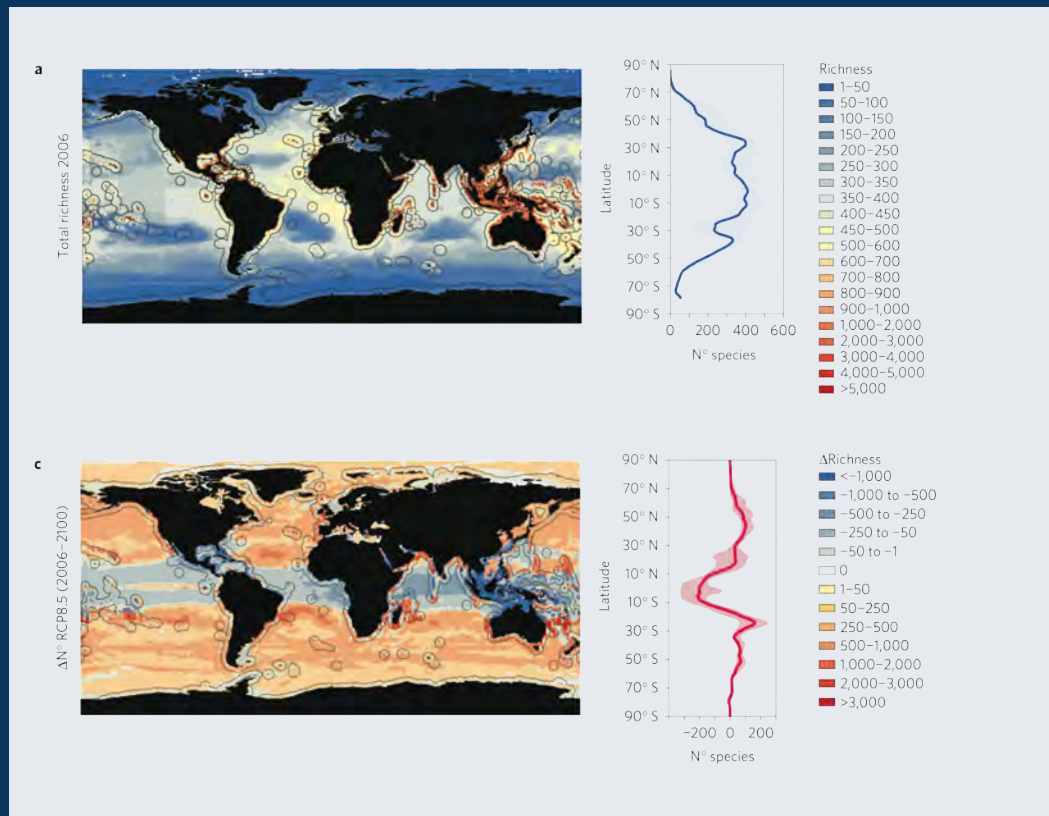
IMPACT

Using climate scenarios from reports by the Intergovernmental Panel on Climate Change (IPCC), a study led by Dr Jorge Garcia-Molinos and Professor Michael Burrows looked at the migration of 13,000 marine species.

The resulting paper 'Climate velocity and the future global redistribution of marine biodiversity' was published in *Nature Climate Change* with Dr Jorge Garcia-Molinos as lead author.

Tropical marine animals that currently thrive in warm habitats around the equator will have to spread north and south to avoid extinction as global sea temperatures rise. The study found that by the end of this century, countries either side of the tropics would have a greater variety of marine species, while the tropics would suffer a net loss in biodiversity.

The study used a measurement called future climate velocity, which combines the rate and direction of movement of ocean temperature bands. Barriers to the movement of species, such as land mass boundaries, depth limits and temperature tolerances were also accounted for.





SEAWEED & FARMING- A GROWING INDUSTRY

SAMS has been leading the foray into seaweed cultivation for uses in food, biofuels, pharmaceuticals, fertilisers and cosmetics.

The EU-funded AT~SEA project, part of the Seventh Framework Programme, devised off-the-shelf seaweed farms for seaweed entrepreneurs. Drs Phil Kerrison and Adam Hughes continue to develop seaweed in aquaculture and have been demonstrating how best to grow seaweed in the natural environment using techniques tested during AT~SEA.

At its Kerrera site, SAMS grows a variety of seaweed: *Alaria esculenta*, commonly known as dabberlocks or badderlocks, is already a high-value food worldwide; sugar kelp; and dulse (*Palmaria palmata*). The scientists have also started growing *Porphyra* – commonly known as laver or nori – which is regarded as the most valuable seaweed in the world because it is used to wrap sushi. In Japan alone annual production value of nori amounts to two billion US dollars. These species are already being harvested in Ireland and sold in the UK as a snack food or ingredients.

Highlight publications

Jones AC, Mead A, Kaiser MJ, Austen MCV, Adrian AW, Auchterlonie NA, **Black KD**, et al. 2014. 'Prioritisation of knowledge-needs for sustainable aquaculture: a national and global perspective.' *FISH AND FISHERIES*, doi: 10.1111/faf.12086

Gascuel, D, Coll, M, **Fox, C**, et al. 2014. 'Fishing impact and environmental status in European seas: a diagnosis from stock assessments and ecosystem

indicators' *FISH AND FISHERIES*, doi: 10.1111/faf.12090

O'Connor MI, Holding JM, Kappel CV, Duarte CM, Brander K, Brown CJ, Bruno JF, Buckley L, **Burrows MT**, et al 2014. 'Strengthening confidence in climate impact science'. *GLOBAL ECOLOGY AND BIOGEOGRAPHY*, vol 24, pp 64-76

Pawlowski, J, Eslin, P, Lejzerowicz, F, Cedhagen, T & **Wilding, T**. 2014. 'Environmental monitoring through protist next-generation sequencing metabarcoding: assessing the impact of fish farming on benthic foraminifera communities' *MOLECULAR ECOLOGY RESOURCES*, vol 14, pp 1,129 – 1,140

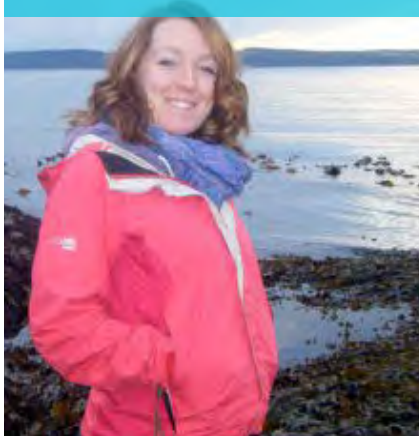
The global seaweed farming industry produces tens of millions of tonnes every year across 44 countries. Scotland has a long history of wild seaweed harvesting but in the past few years, the potential of seaweed as a source of biofuel has re-awakened commercial interest in seaweed.

Often referred to as a 'superfood', seaweed is rich in iodine and calcium and contains natural antioxidants, minerals and amino acids.

As part of the S3EED project, SAMS has teamed up with Mara Seaweed and established aquaculture business, Otter Ferry Seafish Ltd, to develop ways for reliable year round food production of *Ulva lactuca*, *Palmaria palmata*, *Chondrus crispus* and *Osmundea pinnatifida* on a scale to match commercial demand.

The objective of this business driven, collaborative project is to develop protocols for the bulk vegetative growth of four commercially important species of macroalgae in tanks fed by seawater in Scotland.

MY HIGHLIGHT



Iona Campbell
PhD student

Throughout the summer of 2014 I conducted field work on the largest integrated aquaculture site in the world at Qingdao, China.

The scale of the operation was so impressive and my experience there will live long in my memory.

MY HIGHLIGHT



Prof Kenny Black
Marine Ecologist

Getting funding confirmed for the Horizon 2020 project AquaSpace was a particular highlight for me. As co-ordinators of the project, which will explore why the aquaculture industry in EU countries is flatlining, SAMS can count the announcement as a major achievement, given the competition from other proposals around Europe.

In all, the Ecology Department published 52 peer reviewed publications (16 first author papers) and published 18 first author chapters or policy documents in 2014. This is a year-on-year increase from 41 papers in 2012 and 46 papers in 2013.

MICROBIAL & MOLECULAR BIOLOGY



NEW CENTRE FOR MARINE BIOTECHNOLOGY

Marine microorganisms may be small in size but they are gigantic in terms of opportunity. They constitute a treasure chest of largely untapped biological and chemical resources, and biotechnology is a recognised growth sector for Scotland. SAMS has been conducting research into various biotechnology topics for over a decade and is now pulling together this expertise in a new biotechnology research and innovation centre that is already involved in national programmes like the Industrial Biotechnology Innovation Centre (IBioIC). Integrating the Culture Collection of Algae and Protozoa, the SAMS Centre for Marine Biotechnology focuses its research in three areas:

1. Natural products: identifying the composition of target organisms, extracting their bioactive compounds and developing new cultivation techniques
2. Bioremediation: exploring the use of microalgae and seaweeds for removing or neutralizing hazardous substances in aquatic environments
3. Bioenergy and biofuels: discovering innovative ways of using algae for the generation of different forms of bioenergy

The Centre is involved in a range of new initiatives: The BBSRC funded £1.6M PHYCONET network focuses on developing high-value products from microalgae and is co-directed by Dr Michele Stanley. The IBioIC exemplar project Optimax is led by Glycomar, a company hosted at SAMS' European Centre for Marine Biotechnology, and optimizes the production of a commercial strain of microalgae. MISTRA is a 4-year joint project led by the University of Gothenburg looking at cultivation and biorefining of seaweed and is funded through the Swedish Research Council.

The SAMS Centre for Marine Biotechnology is also heavily involved in teaching. Already delivering a module in 'Marine Biotechnology' on the UHI's BSc (Hons) Marine Science programme, the reporting year saw the development and delivery of a new UHI Master by Research in Algal Biotechnology. The team also teaches the elective Blue Biotechnology module for the IBioIC's multi-partner MSc/PGDip Industrial Biotechnology. Finally the Centre delivered a number of 2-3 day professional courses on different aspects of algal biotechnology. The SAMS Centre for Marine Biotechnology is led by Dr Michele Stanley.

SAMS MICROBIAL ECOLOGIST ADVISES ON DESIGN FOR THE UK'S NEXT POLAR RESEARCH VESSEL

Dr Ray Leakey has been senior science representative on the project board for NERC's new £200m polar research vessel and chairman of the science user consultation panel.

The new ice-strengthened ship will be a highly complex and bespoke multi-purpose vessel fit for world-leading multi-disciplinary polar and climate research cruises. Operated by the British Antarctic Survey from 2018, she will have in-built laboratory and deck spaces to accommodate the requirements of modern science as well the capability to deploy new technologies.

Dr Leakey said: "Designing and commissioning the new polar research vessel has been a highly challenging task undertaken by a large team of people, including many scientific colleagues from across the UK and overseas. This is a major challenge due to the differing capabilities required by different science disciplines, and the need to ensure the ship is 'future-proofed' in meeting changing science demands over the 25 to 30 years.

Highlight publications

Day, J & Stacey, G. 2014. 'Putting cells to sleep for future science' *NATURE BIOTECHNOLOGY*, vol 32, no. 4, pp. 320-322

Green, TK & Hatton, AD. 2014. 'The claw hypothesis: A new perspective on the role of biogenic sulphur in the regulation of global climate.' *OCEANOGRAPHY AND MARINE BIOLOGY*, vol 52, pp. 315-335

Strittmatter, M, Grenville-Briggs, LJ, Breithut, L, van West, P, **Gachon, CMM** & Küpper, FC. 2015. 'Infection of the brown alga *Ecotocarpus siliculosus* by the oomycete *Eurychasma dicksonii* induces oxidative stress and halogen metabolism'. *PLANT, CELL & ENVIRONMENT*, doi: 10.1111/pce.12533

NERC is in discussion with Merseyside-based shipbuilders Cammell Laird as preferred supplier to build the as yet unnamed ship. The contract award is expected for November 2015.

Dr Leakey was also an invited witness at the UK House of Lords Arctic Committee in 2014.

ROLES OF MICROBES IN AQUACULTURE

SAMS attracted three new grants from the NERC/BBSRC sustainable aquaculture programme. These projects set out to: a) minimise the risk of harm to aquaculture and human health from advective harmful algal blooms through early warning systems; b) creating satellite-based water quality bulletins for shellfish farms to support management decisions and c) toxic algae and sea-loch sediments.

WINNING ALGAL RESEARCH FUNDING

SAMS has been very successful in attracting new research funding to continue its algal research.

Rare and Overlooked Microbial Eukaryotes (ROME) is a new French consortium project running 2014-16 allowing Claire Gachon's team to study the impact of recurrent fungal infections of bloom-forming diatoms on trophic fluxes in freshwater systems.

Claire's research on marine seaweed pathogens is currently also applying SAMS know-how on algal diseases to commercial micro- and macroalgal cultivation, funded through the Scottish business development fund Genomia.

ALgal microbiome, Friends & Foes (ALFF) is a SAMS-led €3.8M EU funded (H2020 Marie Curie) project with 10 partners from across Europe studying the

interactions between algae and their associated microbes. ALFF will train 15 PhD students from 2015-2018 researching a wide range of topics from disease to symbiosis, addressing both blue-sky and applied research questions. SAMS will host two of these. Claire Gachon is the project coordinator.

GlobalSeaweed is a new NERC funded project aiming to develop a worldwide network to tackle emerging issues such as pathogens, pests and invasives affecting seaweed aquaculture. It brings together research, education, industry and policy advice.

NEW CCAP WEBSITE

The Culture Collection of Algae and Protozoa (CCAP) has been working with the SAMS communications team to re-design its website.

The new 'www.ccap.ac.uk' site is equipped with an improved user interface, enhanced functionality, simplified navigability and cleaner visual identity. The website incorporates a searchable catalogue of all CCAP strains, an online shop for purchasing strains, information on how to deposit strains, ongoing research and upcoming short courses. The website also introduces a Knowledgebase section that brings together a whole raft of information about micro-algae and protozoa, from media to methodologies as well as links to useful websites. This section of the website is planned to expand further in a second phase.

MY HIGHLIGHT



Cecilia Rad Menendez,
CCAP support scientist

As part of the ROME project, I have been investigating the ecology and biology of the bloom-forming diatom *Asterionella formosa* and the pathogenic chytrid *Rhizophyidium planktonicum*. This has been my first contact with the world of chytrids, and it has been really exciting to discover these truly amazing organisms!

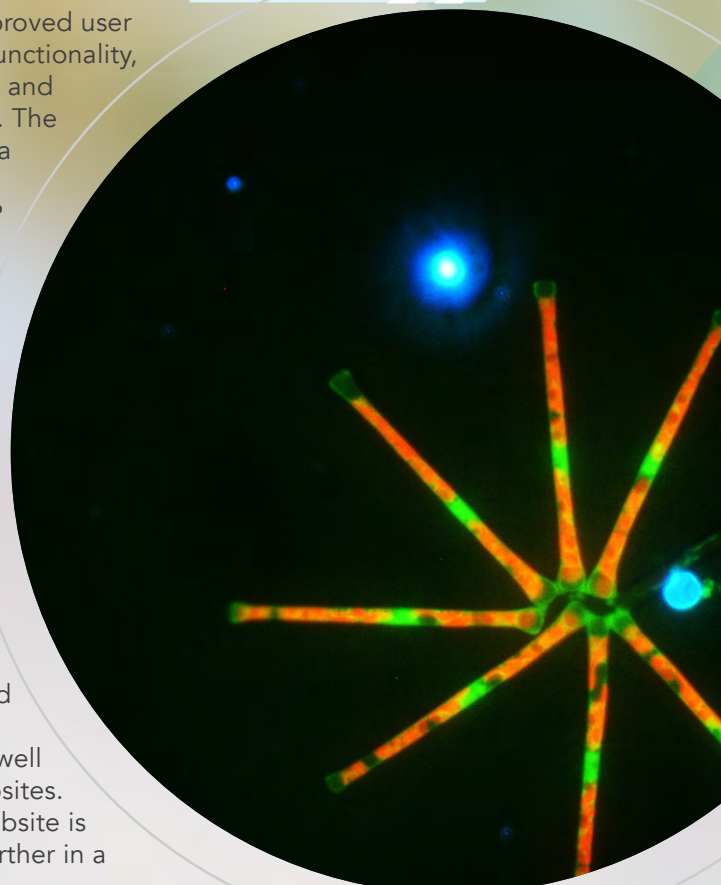


Photo: Melanie Gerphagnon

IMPACT: MAKING SHETLAND'S AQUACULTURE MORE SUSTAINABLE THROUGH BETTER UNDERSTANDING OF HARMFUL ALGAL BLOOMS

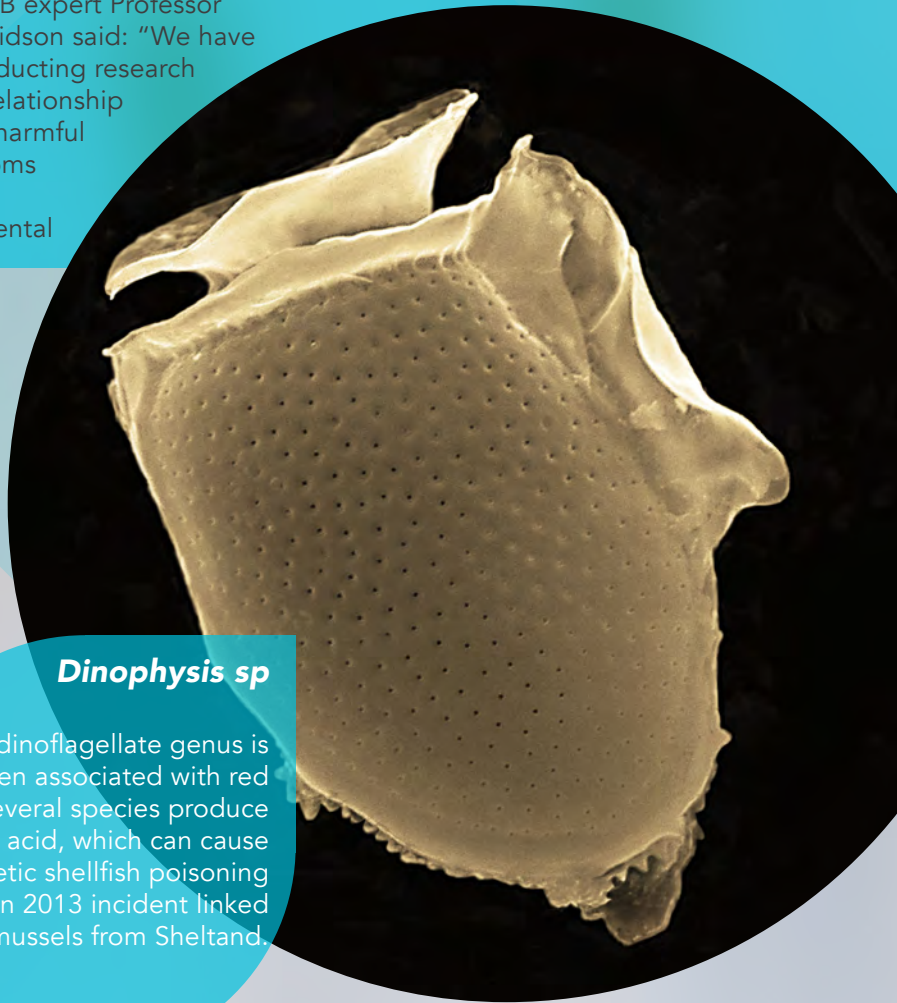
In July 2013, following consumption of mussels harvested in Shetland, many people in southeast England suffered symptoms consistent with diarrhetic shellfish poisoning. Addressing industry and regulator concern, a SAMS team investigated the causes of the event.

Analysis indicated that it was related to a bloom of the harmful dinoflagellate *Dinophysis spp* that was advected to the coast by anomalous wind patterns. This improved understanding of harmful bloom events has been incorporated in the risk

assessment bulletins issued weekly by SAMS to safeguard Shetland aquaculture. This bulletin for shellfish farmers on the status of harmful and toxic algae around Shetland is easy to interpret and helps shellfish farmers in making informed decisions on harvesting.

SAMS HAB expert Professor Keith Davidson said: "We have been conducting research into the relationship between harmful algal blooms and their environmental

drivers for several years around Scotland. It is very pleasing that this research is now being used operationally to support the Shetland shellfish industry." This project was funded through the European Fisheries Fund Axis 4 programme with industry support.



Dinophysis sp

This dinoflagellate genus is often associated with red tides. Several species produce okadaic acid, which can cause diarrhetic shellfish poisoning as in an 2013 incident linked to mussels from Shetland.

Strange microbes

This is a star-shaped colony of eight *Asterionella formosa* diatoms. One is infected by the (fluorescent blue) chytrid *Rhizopyhodium planktonicum* and is dead, so not showing up red/green in epifluorescence microscopy.

TWO NEW UHI PROFESSORS IN THE DEPARTMENT

Professor David W Pond



Professor David Pond is a biological oceanographer and has been Head of the SAMS Microbial and Molecular Biology Department since 1 March 2015. Before joining SAMS in 2012 he held research positions at Plymouth Marine Laboratory (1993-1998), the National Oceanography Centre (1998-2002) and the British Antarctic Survey (2002-2012). He has been awarded his professorship in recognition of his outstanding research at the interface between ecology and biochemistry.

David's research interests are unusually broad, ranging from viruses to seals, from coastal waters to open ocean and from the tropics to the poles. So far he has been working with 147 collaborators from 15 countries generating 78 scientific papers, attracting over 2300 citations and an H factor >31.

Threads running through his research activities are an interest in the role of lipids and the development and application of novel analytical tools. David has researched the role of solid-liquid phase transitions of lipids in the migration and overwintering behaviour of marine copepods and proposed that

the composition of lipids in all plankton is regulated to ultimately control buoyancy. A particular interest of David's is the role of omega-3 fatty acids in shaping biological communities. He found for example that hydrothermal vent shrimp accumulate omega-3 fatty acids from photosynthetic microplankton during their planktonic dispersal phase, thereby demonstrating that hydrothermal vents may not support a fully surface-independent food chain.

Most recently David is pursuing a new interest: thraustochytrids are a wide spread but enigmatic group of marine microbes that occur at high biomass and may well be major decomposers of organic material. Future research will make use of new strains of thraustochytrids that David isolated from local environments and that are now housed at SAMS.



Professor John G Day

As head of the Culture Collection for Algae and Protozoa, Professor John Day has an encyclopaedic interest in algae and protozoa and is an expert in algal biotechnology and cryobiology.

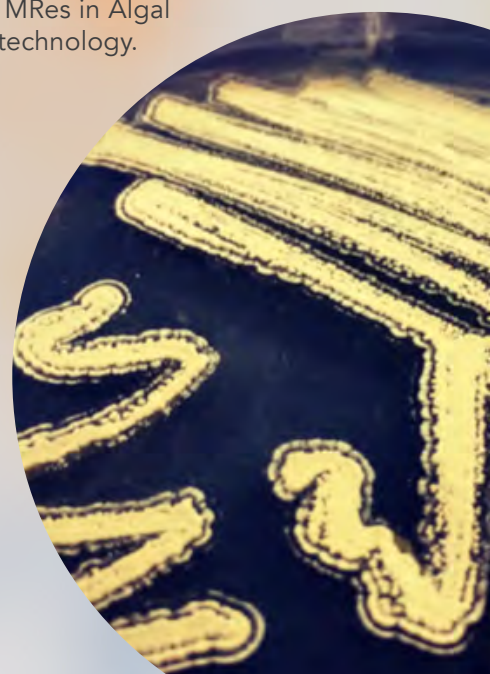
After this PhD he worked in the biotech sector, where he took a biotechnological concept (the heterotrophic production of algae to be used as the basis of a dry aquaculture feed) from the test-tube to a 40,000 L production

fermenter and subsequently to a marketed product within 18 months. Ever since he has been committed to linking blue skies science via applied research to commercial reality. This is a successful formula that has resulted in an income capture for SAMS of > £10 Million in the past decade since John joined SAMS from the Centre for Ecology and Hydrology in Windermere in 2004.

Much of John's research has focused on ways to maintain unicellular organisms in ultra-low temperature suspended animation to avoid damage caused by time or chemical reactivity and thus to conserve the functional and genotypic stability of biological resources. The EU funded multinational COBRA project alone successfully cryopreserved >3000 algal strains and generated >50 publications under John's leadership.

A second strand to John's research effort focuses on the exploitation and conservation of both wild-type and genetically modified biological resources including major projects on algal biofuels and microbial bioprospecting.

John has also been supervising nine PhD students to date and initiated the development of the MRes in Algal Biotechnology.



IMPACT

PLANKTON INDEX TOOL TO ENHANCE MARINE CONSERVATION

Professor Paul Tett has been developing a plankton index tool that monitors the UK's pelagic habitat to protect the marine environment in accordance with the European Commission's Marine Strategy Framework Directive.

The UK plankton community is monitored using the Continuous Plankton Recorder for large-scale information and a network of 15 fixed stations for local information. To detect changes in Good Environmental Status (GES) planktonic species are grouped into functional

types (or lifeforms) and changes in abundance assessed using a state-space systems approach. A purpose built integrated assessment and reporting procedure based on the European Marine Ecosystem Observatory data tools calculates a plankton index of Good Environmental Status. Work is ongoing to identify options for further improving the existing monitoring and to deliver a full monitoring programme for 2016.

MY HIGHLIGHT



Dr Claire Gachon
Molecular phycologist

Aside many funding successes, my highlight of last year was the creation of GlobalSeaweed, an ambitious worldwide network of partners tackling emerging issues in seaweed cultivation using a combination of knowledge transfer and community-oriented research activities.

Blue biotechnology

SeaBioTech takes microbes and algae from the environment to discover what potential they might have to produce novel chemical compounds. These might be turned into powerful new antibiotics, make novel enzymes that improve production of an existing commodity products, or produce new biopolymers with household or industrial uses.

This year's SeaBioTech work has seen SAMS complete the whole genome sequence analysis of three bacteria; isolate over

a hundred different bacterial strains from sediment cores from Antarctica and Scotland; analyse all the different types of chemical compounds an organism can make (= metabolomes) from over 100 different bacteria; and analyse and explore the metabolomes of genetically modified *Nannochloropsis*.

This has yielded a significant number of new and novel microorganisms as well as a vast amount of chemical data which is currently being analysed using bioinformatics approaches and molecular networking. Key findings are that novel marine bacteria can still be isolated from Antarctic sediment cores that are over 10 years old. Chemical compounds produced by some of the novel bacterial isolates are

biologically active, which opens the potential for the development of new drug leads. A novel and functionally interesting marine biopolymer isolated at SAMS can now be produced in quantities over 5 g/L, which makes its production more cost efficient. This has resulted in an award of PhD funding by the Industrial Biotechnology Innovation Centre to develop this biopolymer in conjunction with a large multi-national company.

MMB Seabiotech is an EU FP7 funded project. The SAMS team comprises, John Day, David Green, Michele Stanley and Kate Duncan, with additional help from dissertation student Kevin Purves.



PHYSICS AND TECHNOLOGY

Shane Rodwell
SAMS Engineer

Shane Rodwell flew a custom-built quadcopter in the Arctic as he helped to survey glacier calving in the region.

OCEAN PHYSICS

A NEW FRONTIER – THE YEAR OF THE SEAGLIDER

The rise in the use of robotics to measure changes in our ocean environment was in evidence at SAMS throughout the year, as five new Seagliders arrived at Dunstaffnage to form the backbone of the Scottish Marine Robotics Facility (ScotMRF).

Bringing the total number of Seagliders in the fleet to seven, these new additions began making their mark on major projects involving the department: FASTNEt, measuring exchanges of water from the deep Atlantic onto the UK continental shelf; OSNAP, measuring the North Atlantic Subpolar Gyre; NACLIM, examining the North Atlantic to help climate forecasters and; The Extended Ellett Line, measuring the physics and biogeochemistry of water flowing to and from the Nordic Seas.

Last year saw the first academic paper published using Seaglider data: Deep drivers of mesoscale circulation in the central Rockall Trough. Lead author Prof Toby Sherwin, a SAMS Research Fellow, brought the first Seaglider, Talisker, to SAMS six years ago. The five new autonomous Seagliders, which measure sea temperature, salinity, pressure and oxygen, can spend months at sea on one mission. They are hosted by SAMS on behalf of NERC's Marine Autonomous and Robotics (MARS) community.

Dr Finlo Cottier, Head of Physics and Technology said: "The Seaglider 'boom' really took off in 2014 as we saw an increase in the number of gliders, the number of trained pilots and the number of missions taken on. We employed an extra technician and trained four new pilots.

"There is a constant level of Seaglider activity, 24 hours a day, allowing us to observe the ocean at a high time and space resolution and open up new areas of science."

The Seagliders' capabilities have also led to partnerships with outside agencies, such as BP and the Royal Navy, who are monitoring the vehicles' development.

EYE IN THE SKY – TAKING MARINE SCIENCE TO NEW HEIGHTS

ScotMRF has also allowed the development of RPA team, other autonomous underwater vehicles (AUVs) and drifters.

The airborne robotics group at SAMS, usually referred to as the Remotely Piloted Aircraft (RPA) Team, has taken part in an InnovateUK collaboration with Cella Energy and Arcola Energy to develop a long range, hydrogen powered RPA for use in the marine environment. Hydrogen power is nothing new, but instead of storing hydrogen in a highly-pressurised container the InnovateUK project is working on powering an aircraft by using small pellets which, when heated, decompose into low pressure hydrogen and a residue. The hydrogen then feeds an ultra-low weight fuel cell, which powers the RPA motor.

SAMS is using RPA for research, working with the RPA industry, teaching RPA to the community and leading the UK in developing novel uses for this exciting technology.

SAMS' underwater and aerial



capabilities were demonstrated in a synchronised AUV/RPA mission to observe the same area of sea surface from above and below the waves in Ardmucknish Bay, near Benderloch, Oban. The experiment, a UK first, recorded data in 500-metre long transect strips at a top speed of 1.75 metres per second.

STUART CUNNINGHAM IS OCEANOGRAPHER OF THE YEAR

It was a year to remember for Professor Stuart Cunningham, who gained his professorship and was named UK Oceanographer of the Year.

Stuart has been an integral part of international projects NACLIM and OSNAP. In the summer of 2014 he, and international partners, deployed moorings, gliders and floats across the sub polar North Atlantic during four research cruises. These are measuring the total circulation and fluxes of heat and freshwater between Newfoundland and West Greenland and from Greenland to Scotland to provide data for the projects.

MODEL SCIENTISTS...

Closer to home, local meteorological modelling has been developed by Dr Dmitry Aleynik and Dr Andrew Dale to provide high resolution forecasts and hindcasts for the west coast of Scotland.

With a mesh size of two kilometres, the representation of local topographic effects is much improved from the existing (NOAA) forecast model within which this model is nested. Improved meteorology is also being used to drive the SAMS-based FVCOM (Finite Volume Coastal Ocean Model) ocean circulation model for western Scotland (also Dmitry Aleynik), meaning that near-real time operational runs are becoming a possibility.

ARCTIC ADVENTURES

Much of SAMS' Arctic research has been conducted alongside Norwegian partners, as we strengthen links with like-minded institutions working in the Arctic.

One of the main projects was Circadian rhythms of Arctic zooplankton from polar twilight to polar night (CIRCA) led by Prof Jørgen Berge from the University of Tromsø. The CIRCA project aimed to determine the primary physical and biological factors responsible for the diel vertical migration patterns of zooplankton

in the high Arctic during the polar night and twilight period, and to establish the resultant ecosystem effects.

The research found a surprisingly high level of activity during the polar night, leading to further research projects being conducted in this area.

Funding was granted for on-going collaborative research programmes with the Korean Polar Research Institute in sea ice dynamics, led by Dr Phil Hwang. This relationship allows Dr Hwang to deploy buoys in the polar region when he joins Korean ice breaker cruises each summer.

Dr Hwang has also been working alongside partners from Strathclyde University to lead projects looking at new image analysis technologies for fast and accurate retrieval of sea ice floe size distribution from satellite imagery. These NERC funded projects use image analysis and have devised a new algorithm to measure the size of Arctic sea ice floes.

Dr Hwang is co-principal investigator on a USA ONR-funded programme looking at the application of this new algorithm for the better understanding of the marginal ice zone in the Arctic.

MY HIGHLIGHT



Prof Stuart Cunningham
Physical Oceanographer

The deployment of the OSNAP (<http://www.ukosnap.org/>) array in June and July of 2014 was a particular highlight for me. It felt like the start of the project proper and came after years of proposal work, securing funding and bringing together the international oceanography community.

IMPACT

FLYING ROBOTS TO DETECT ALGAL BLOOMS

As well as providing technical solutions to other aspects of marine science, the RPA Operations Team has also been conducting its own research.

Part of this has been the continued testing of a spectral albedo-meter and integration of the unit onto a bespoke quadcopter. Albedo is the difference between incoming and reflected light, and, being a difference measurement, can be detected

well with relatively cheap and lightweight sensors.

These aspects are essential when fitting the optics, logger and spectrometer into an airborne package that weighs less than one kilogram.

The 'Piccolo' system being used is now being flown on the SAMS main lifting quadcopter, and will be used to detect ocean colour change due to algal blooms.

The ability to detect changes like these serves as an early warning system to industries affected by blooms.

Highlight publications

Inall, M, Murray, T, **Cottier, F**, Scharrer, K, **Boyd, T**, Heywood, KJ & Bevan, S. 2014. 'Oceanic heat delivery via Kangerdlugssuaq Fjord to the south-east Greenland ice sheet.' *JOURNAL OF GEOPHYSICAL RESEARCH-OCEANS*, pp. 631-645

Smeed, D A & **Cunningham, S.** 2014. 'Observed decline of the Atlantic meridional overturning circulation 2004 – 2012' *Ocean Science*, Volume 10, Issue 1, Pages 29 – 38

Watson, A & **Merdith, M.** 2014. 'The Southern Ocean, carbon and climate' *Philosophical Transactions of the Royal Society A-Mathematical Physical and Engineering Sciences*, Volume 372, Issue 2019, Article Number: 20130057



IN THE COMMERCIAL WORLD...

About SRSL

SAMS Research Services Ltd (SRSL) is a specialist marine environmental consultancy that advises international governments and large businesses on managing their marine activities and benefitting from the marine environment in a sustainable way. Our consultancy and survey services include problem solving, de-risking, assurance, scientific legitimacy and data integrity, and all are underpinned by cutting-edge marine science. SRSL has access to a multidisciplinary range of

marine expertise spanning ecology, chemistry, hydro-dynamics, physical oceanography, microbiology and social sciences. The organisation is driven by the commercial and social imperative to understand and manage the marine environment, in order that international communities, governments and/or multi-national corporations can sustainably make use of their marine territories.

SRSL employs 11 skilled members of staff and last year hosted two apprentices/interns.

Global reach

Internationally, SRSL has been appointed by various governments to advise on ocean governance and the sustainable use and protection of their marine environment. This includes the Republic of Seychelles and Marlborough District Council in New Zealand. SRSL also provided expert assessments of environmental impact statements submitted to the Falkland Islands Government.

WWW.SRSL.COM

SRSL - working for regional development

The company also actively supports the competent agencies in developing the socio-economy of the region. SRSL's Managing Director, Dr Tracy Shimmiel, contributes to the Scottish Government's 'Scotland Can Do' Forum; as a member of the Argyll and Bute Economic Forum, Tracy is working with the local Council towards economic growth in the region.

SRSL also collaborates with our regional development agency, Highlands and Islands Enterprise. The company's scientific input to the region includes contracts for the Crown Estate (through Imani Development) considering social cohesion between the aquaculture industry and local communities.

IMPACTS

SRSL instruments monitor sea ice thickness

Sea Ice Mass Balance Arrays (SIMBA) monitor temperature profiles in ice and snow to determine sea ice thickness. In 2014-15 SRSL sold several SIMBA units to organisations around the world, including to China, Australia and Germany.

The use of SIMBA was referenced in three scientific papers during 2014, adding to the growing scientific knowledge base in this topic. SIMBA also featured on the BBC when their science editor, David Shukman, took part in a research cruise with the Norwegian Polar Institute.

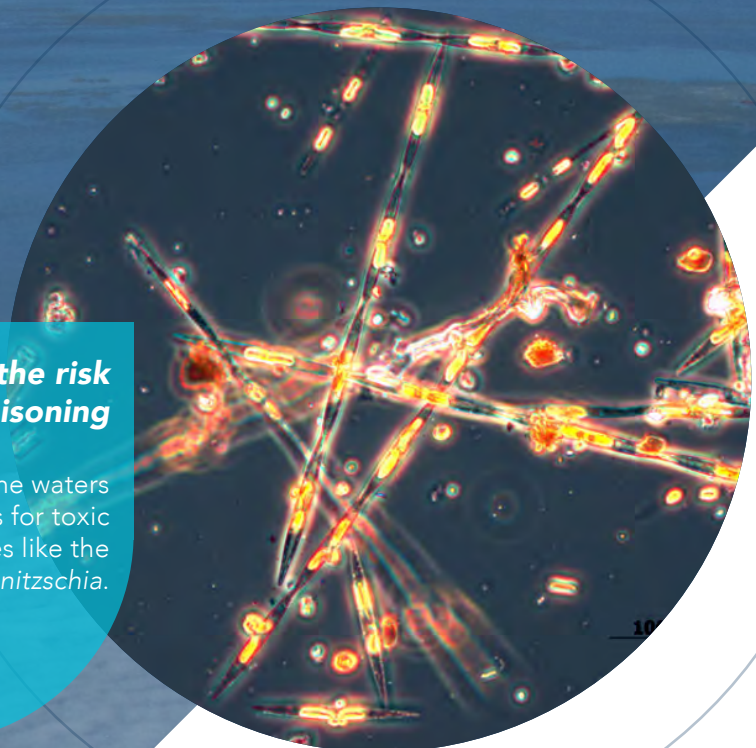
Keeping Scottish aquaculture products healthy

SRSL monitors if Scottish aquaculture waters are free from toxic phytoplankton that could otherwise cause shellfish poisoning. This work is carried out on behalf of the Food Standards Agency and CEFAS.

Seawater samples from 51 sites were submitted regularly to SRSL for the identification and enumeration of potentially harmful algal species during the reporting period.

Lowering the risk of shellfish poisoning

SRSL monitors the waters around shellfish farms for toxic phytoplankton species like the diatom *Pseudo-nitzschia*.



DIVING

MARINE AND MEDICINE – SUPPORTING SCIENCE IN AND OUT OF THE WATER

In science and industry

Additional funding from NERC in 2014-15 (+£100,000) allowed the diving unit at SAMS to completely re-build the NERC portable recompression facility to advanced diving industry standards. In a joint design project with Mimar Marine Ltd, Hull, the containerised system is now state-of-the-art and supports diving operations anywhere on the planet (with temperature limits of +40 to -40°C); the chamber exceeds diving industry size guidelines for a container-based facility. The SAMS unit, through the National Facility for Scientific Diving (NFSD), also obtained capital funding (+£65,000) to increase its capability in underwater stereophotogrammetry techniques.

The Diving Unit at SAMS continues to be funded mainly by NERC, through the NFSD, and the National Health Service, through its emergency recompression therapy facility.

The unit also undertakes other scientific and educational roles supported by a range of other funding organisations, increasing

the scientific and commercial diving activity at SAMS; the unit now supports five full-time diving posts.

NFSD provides divers, equipment, training and scientific/technical support that underpins a wide range of interdisciplinary research in the underwater environment. Primarily, it delivers practical support for diving-related scientific projects by providing additional manpower for groups with limited diving experience, total project management for scientists with no diving experience and/or specialist equipment loans for groups with diving experience but limited resources.

The NFSD is the main service provider and the major supporter of research within the UK that involves scientific diving through: support and maintenance of an extensive underwater research programme; support for the UK Scientific Diving Supervisory Committee (SDSC); interactions with other diving industry bodies; ongoing diving research and evaluation programmes; and a focussed training programme for scientists and technicians involved with working underwater. The NFSD was granted two NERC Advanced Training Programme Awards in 2014-15 jointly with Heriot Watt University through the MASTS initiative.

In addition to diving services, the NFSD also provides support and

training in associated small boat operations and in emergency diving medicine. The Centre also provides a diving support service for the UK National Tide Gauge Network which, in turn, contributes to outputs of the National Tidal and Sea Level Facility (NTSLF); it also has research links with the NERC Field Spectroscopy Facility.

On a consultation basis, the SAMS diving unit now advises Marine Science Scotland, a number of UK universities and the British Antarctic Survey.

In health and safety

During 2014, the emergency recompression facility at SAMS was re-named the West Scotland Centre for Diving and Hyperbaric Medicine in recognition of its new supra-regional status as the only accredited National Health Service (NHS) treatment facility between Cape Wrath in the north and Liverpool in the south. The Centre treated numerous diving emergencies during 2014 for both NHS-Scotland and NHS-England/Wales and there are plans to incorporate more clinical treatments in the future within NHS guidelines. The medical and technical expertise at the SAMS facility continues to lead the NHS appraisal mechanism for the whole of the British Hyperbaric Association.

SAMS provided the main input



AT A GLANCE

to the 2014 revision of the UK Health and Safety Executive (HSE) Approved Code of Practice for Scientific and Archaeological Diving. SAMS was also co-author of the original 1997 edition and provided significant input to the 2014 revision. SAMS now represents the scientific diving sector on both the HSE Diving Industry Committee and the Society for Underwater Technology's Diving and Manned Submersibles Committee.

On a secondary level, the Facility ensures proper adherence to health and safety legislation as applied to diving at work activities. This can be through targeted training programmes, communicating advice and guidance for senior management with legal responsibilities for diving at work, undertaking safety audits on behalf of the NERC Health and Safety management structure and interacting with others in higher education and the Health and Safety Executive.

- **Five full-time posts**
- **More than 800 diving operations**
- **43 ISI-rated science papers published**
- **Six diving/physiology publications**
- **25 abstracts, conference proceedings and edited works**
- **17 papers acknowledging SAMS diving support in a special issue of the *International Journal of Greenhouse Gas Control***
- **Since 2006 NFSD support has generated 135 ISI-rated publications (IF median 2.48; mean 3.25); these have been cited 2,078 times with a current H-index of 24**

Support in 2014/15 was provided to researchers from the following universities/institutes: BAS, CEH, NOC, BGS, PML, SAMS, MBA, Aberdeen, Aberystwyth, Bangor, Bristol, Cambridge, Edinburgh, Exeter, Hull, Leeds, Liverpool, Liverpool John Moores, Natural History Museum London, St. Andrews, Southampton and the University of the Highlands and Islands.



EDUCATION



While our undergraduate programme in marine science is in its 15th year and PhD students are a fully integrated central component of SAMS, 2014-15 was the year when taught postgraduate provision came to the fore: We introduced two new programmes and contributed a new module to an external course alongside existing postgraduate provision.

GLOBAL AQUACULTURE MASTERS APPROVED

SAMS has been developing a specialized 2-year master degree in AquaCulture, Environment and Society (ACES). ACES was designed alongside industry to address major scientific, technological and social obstacles facing the sustainable development of the global aquaculture industry and is one of only seven master courses granted Erasmus+ funding from 58 applications. The course is looking to attract international star students with a first degree in a relevant field of environmental or social sciences and will be run in partnership with the universities of Crete and Nantes.

Students will spend semester one at SAMS UHI before going on to study finfish aquaculture in Greece (Crete) and shellfish aquaculture in France (Nantes). The students will then complete research projects at one of the three centres or one of 18 industrial partners in semester four, before returning to Oban for a final conference. Programme leader at SAMS is Dr Elizabeth Cook, Dr Helen Bury acts as Education Administrator and modules are being led by Dr Maeve Kelly (Overview of Global Aquaculture), Professor Kenny Black (Environmental Interactions of Aquaculture), Dr Adam Hughes (Innovation, Technology and Systems) and Dr Karen Alexander (Governance, Management &

Knowledge Exchange). The first student cohort arrived at SAMS in September 2015.

NEW ALGAL BIOTECHNOLOGY MASTERS

The reporting year saw the arrival of the first two Master by Research students studying algal biotechnology at SAMS. Thomas Butler worked on maximizing the potential of keto-carotenoid (antioxidant) production by the microalga *Haematococcus pluvialis*, and Sonji Kurishita is studying the settlement of the spores of the commercially important seaweed *Porphyra*.

NEW BLUE BIOTECHNOLOGY MODULE

The Industrial Biotechnology Innovation Centre last year launched a unique one-year Masters in Industrial Biotechnology programme to create the next generation of skilled industrial biotechnologists. The course combines expertise from 13 academic institutions across Scotland with input from the industry and is registered through the University of Strathclyde. SAMS delivers an elective residential module in blue biotechnology developed and led by Dr Michele Stanley. It covers taxonomy, systematics and physiology of micro- and macroalgae and equips the students with the knowledge and skills for the biotechnological exploitation of these organisms. The first cohort of nine students arrived at SAMS in March 2015, and one of them has since joined SAMS as a PhD student.

SAMS EDUCATION IN NUMBERS 2014/15

In the last reporting period SAMS educated a total of 124 higher education students, nearly all of which studied full time on one of 5 programmes:

BSc (Hons) Marine Science (UHI): 83 students

MSc Ecosystem Based Management of Marine Systems (StAndrews): 9 students

MRes Algal Biotechnology (UHI): 2 students

Other Master by Research (UHI): 1 student

PhD students (UHI or Uni E'burgh): 29 students

RENEWABLE ENERGY RESEARCH ENGINEERS AT SAMS

The Industrial Doctoral Centre for Offshore Renewable Energy (IDCORE) is a partnership of the Universities of Edinburgh, Exeter and Strathclyde, HR Wallingford and SAMS. It was set up by the Energy Technologies Institute (ETI) and is funded by the ETI and the EPSRC RCUK Energy programme.

IDCORE aims to train the best engineering students to deliver world-class industrially-focused research outcomes to accelerate the deployment of offshore wind, wave and tidal-current technologies. This should support the UK to meet its ambitious 2020 and 2050 targets for renewable energy generating capacity.

During the second semester of their first year the engineering research students come to SAMS to study 'Marine Renewables and the Environment'. In the reporting year 12 students studied this module, the leadership of which transferred from Professor Ben Wilson to Dr Steven Benjamins. SAMS also ran a successful 2-week summer school 'Marine Renewables and Society' that had 13 students and was led by Dr Karen Alexander.

BLOSSOMING INTERNATIONAL COLLABORATIONS

SAMS education has some very well developed international relationships, in particular with the University Centre in Svalbard (UNIS) – which hosts several of our undergraduates during their third year of study – and the German University of Konstanz and the US' Monmouth College in Illinois which send students to SAMS.

In the past year we have been developing a range of new strategic partnerships that we hope will bear fruits in the coming years. We have signed Erasmus+ inter-institutional agreements with the French Muséum National d'Histoire Naturelle, the Spanish Universidad de Alicante and the Universidad Católica de Valencia, the Turkish Qukurova University, the Czech Masaryk University Brno, the Arctic University of Norway. We also signed a number of Memoranda of Understanding in the reporting year, for example with India's Annamalai University and AMET University as well as the Chinese Tianjin University.

MY HIGHLIGHT



Dr Lois Calder
Head of Education

"One education highlight this year has been winning Erasmus+ funding from the EU for our Aquaculture, Environment and Society Masters. ACES addresses employment and research needs and gives students mobility in Europe. The United Nations University are also contributing to delivery of the programme and I am particularly pleased to see SAMS' relationship with this organisation maturing, giving our students a truly global experience."



GRADUATION AND PRIZES

Our annual graduation ceremony took place at SAMS on 12 September 2014 with international filmmaker and photographer Doug Allan delivering an inspirational keynote address.

This year 10 undergraduate students graduated with honours as well as one MRes and three PhD students.

The following prizes were awarded

SAMS UHI student of the year:
Christopher Reilly

Johanna Fehling Memorial Prize for best PhD student publication:
Lisa Eckford-Soper

Prize for best Master project as SAMS:
Natasha Hill

SAMS Council Award for Academic Excellence:
Ailsa Insh

SAMS Award for Overall Achievement:
Tamara Green

Tim Boyd Prize for Oceanography:
Rosie Holding

SAMS UHI Employability Skills Award:
Nuria Sanchez and Sandra Rybicki

MY HIGHLIGHT



Dr Pete Talyor
Business development (SRSL)

The highlight of the year for me would have to be the day that I submitted my PhD thesis. Although I successfully defended my thesis and was honoured with two awards for the work I completed, I will forever remember the feeling of elation, mixed with trepidation, the sense of relief of meeting the deadline and the anxiety for the viva voce that was to come only six weeks later as I put the documents into an envelope and sent them off for examination.



ENGAGING THE OUTSIDE WORLD

Events and school engagement

SAMS is good at events and in the reporting period we had more than 500 visitors attending one or more of them. Events included the 130th celebration covered in detail earlier in the report, talks including by filmmaker Doug Allan, the Oban Winter Festival open days hosted by our final year undergraduates as part of their Science Communication module, and events focusing on whales and dolphins, shark tagging, marine crafts and sea storytelling.

We ran ten different school workshops over the year and trained 921 pupils in total. The Sea Monster project was the main education element of the 2015 Festival of the Sea. During the spring primary school pupils from five schools learnt about deep sea biology and then created their own 'monsters,' learnt to perform with them thanks to the help from puppet artist and performer Nicki Graziano, culminating in the Sea Monster Cabaret event that

showcased pupil learning at the Festival of the Sea in May to a crowd of nearly 500.

We also took learning about SAMS research out to events throughout the Argyll and Highlands region where we engaged closely with 719 visitors – with many more encountering us more superficially at these shows and festivals. We also showed over 100 people around SAMS including visiting groups.

In the news

SAMS continues to feature in national and international news websites and newspapers. We have an excellent uptake of stories also in the local press, important to continue positive relations with our wider community.

Media coverage highlight

In May 2014, the BBC ran a story on marine bioprospecting, which involved CCAP and our diving unit. The story received nationwide radio coverage, was carried on the BBC news website

and led to a filmed piece that featured on breakfast, lunchtime and Newsnight TV programmes.

Websites & social media

The SAMS website consists of 2,000 pages and is the main platform for the outside world to find out about our activities. The annual number of visits to the website over the past two years has doubled, suggesting that it is a valued resource. During the year we realized that the open source content management solution used for the SAMS website (PLONE 3) cannot migrate to a version that supports smart phones or tablets.



MY HIGHLIGHT

Helen McNeill
SAMS Outreach Officer

I particularly enjoyed being involved in the planning and delivery of the primary school sea monster workshops with our Ecology team and Nicky Graziano, a puppeteer from the USA. This education programme generated a 'Sea Monster Cabaret' event attracting 500 spectators at the May 2015 Festival of the Sea and was a tremendous highlight of my year!

We are thus planning to build a new website from scratch in the coming year or two – a mammoth task!

Interest in, and use of, social media continues to grow and has become an integral part of the communications strategy. Twitter has been the most effective online communications tool for news distribution and acts as a portal

to our website, and to engage journalists. Facebook is mostly a platform to engage with alumni and 'friends' of SAMS while we use LinkedIn for recruitment and corporate messages.

Filmmaking

During the reporting period we have developed a 'SAMS News' video feature and produce a visual

news story every few weeks. We also produced promotional film clips both for SAMS, research projects and for commercial clients. In the coming year we aim to promote filmmaker Andy Crabb's fantastic pieces more widely.

DIGITAL COMMUNICATION STATS 2012 - 2015

	2012-13	2013-14	2014-15
Website sessions	87,997	138,828	192,426
Twitter followers	400 – 964	964 – 1,754	1,754 – 2,600
Facebook likes	202 – 352	353 – 594	594 – 889
LinkedIn followers	N/A	208 – 537	537 – 922

OFFICIAL OPENING OF THE OCEAN EXPLORER CENTRE



With the official opening of the Ocean Explorer Centre on 16 June 2014 by Scotland's Cabinet Secretary for Education, Michael Russell MSP, SAMS demonstrated that the engagement with society at large is truly a core SAMS activity alongside research and education.

The Ocean Explorer Centre is an unusual visitor and outreach centre the like of which few other marine research organisations have yet developed to tell their stories directly to the public as our main 'funder,' and to work towards greater appreciation of the marine environment and marine research. Differently to a

traditional science centre it tells the stories of the people and their research working at one centre and thus demonstrating not just the globalised findings but also some of the actual process of science.

Visitors to the Centre learn about the marine environment and a representative selection of research going on at SAMS in a range of engaging, hands-on displays and events. An indoor tourist attraction with associated café in the summer, the Ocean Explorer Centre works to inspire and engage children, locals and special interest groups for the rest of the year.

Over the first year of operation we welcomed around 6,000 visitors – and numbers are rising further as we are learning how to advertise such a visitor facility.

Although in a clear growth trajectory, the centre was not immune from the redundancy process at SAMS and lost its dedicated posts in the summer of 2015. We thus had to re-organise its operations and now operate on a donations basis and staff the facility from the communications team with the help of volunteers and interns for the time being.

FINANCE

SAMS is an independent charity without a substantial grant in aid. Most income has to be won competitively year on year. While SAMS achieved an income of c £10 Million in the reporting year (excluding capital grants)

there was a deficit of £1.092 Million (see table 1). The likely shortfall did not become apparent until the latter half of the year. Analysis indicates that this was due to unfavourable conditions relating to our external funding

environment; and a continuing trend that started a few years earlier. Whilst SAMS decided to restructure its operations and reduce operating costs at the end of the reporting year no impact will be recorded until 2015-16.

Table 1: Summary of SAMS' financial performance in the period 1 April 2014 – 31 March 2015 with the previous year's figures and % change included for comparison.

Financial Summary	2014/15	2013/14	Change
	£000	£000	%
Operating Income excluding capital grants	9,908	10,468	-5.3
Operating Expenditure excluding grant funded depreciation	(11,225)	(10,464)	7.3
Operating (Deficit)/Surplus before exceptional item	(1,317)	4	
Exceptional in year income/exchange rate loss	572	(94)	
Capital Grants received	636	807	-21.2
Depreciation funded by grants received in previous years	(983)	(691)	42.3
(Deficit)/Surplus transferred to reserves	(1,092)	26	

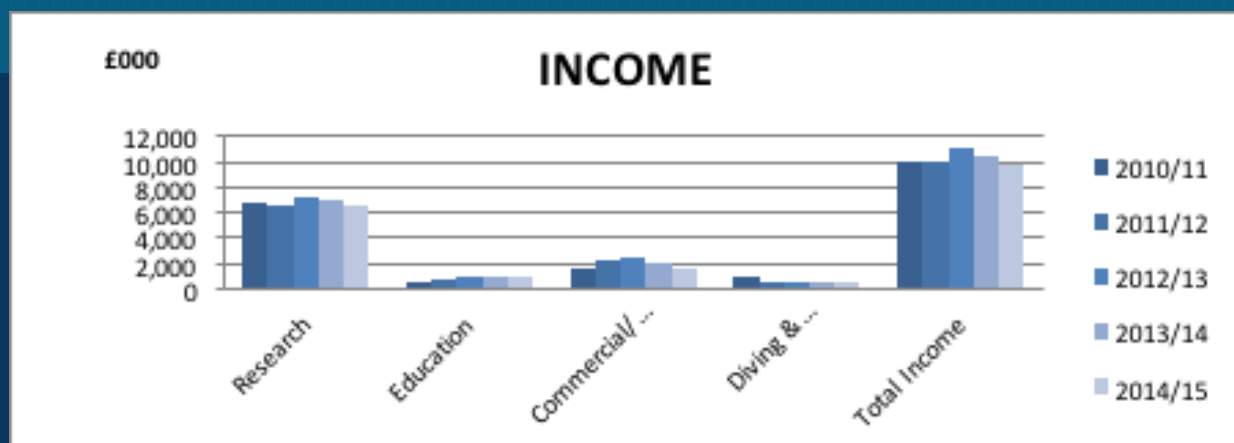


Figure 1: SAMS total income from research, education, commercial activities and diving over the past five years.

Research made up circa 67% of SAMS income in the reporting period. NERC continued to be our single largest research funder, contributing 44% of research and 30% of total income. Overall income from research grants and contracts fell by 3.8% compared to the previous year. For details see table 2.

The Research Excellence Grant (REG) is provided in recognition that research grants do not cover the full economic costs for delivering the research. Funding is awarded according to the quality ranking achieved in a national assessment that compares UK university research by discipline every few years. With our

colleagues in UHI we performed very well in the 2014 assessment and anticipated an increase in our REG income of around £400,000 per annum for the reporting period. However, the Scottish Government decided to phase REG changes in over two years to protect universities who stood to lose significant income. The resulting shortfall in the first two years of the funding cycle will not impact materially until 2015-16.

Undergraduate and postgraduate education, run mostly through the University of the Highlands and Islands, represents 10% of our total income, up from 5% in 2009/10. This is largely due to increasing undergraduate

numbers – income from the BSc (Hons) Marine Science has grown by 15% in the reporting period.

Although PhD funding is increasingly challenging to secure, our numbers remain relatively stable with the fluctuations in figure 2 originating mostly in the timing of new starts and reporting of income between research and education.

Income from Masters courses remains stable. Other education activities, such as field courses and short CPD courses, have decreased in 2014/15 as we focused on core education provision.

Table 2: Summary of sources and amounts of research income for SAMS during the reporting year. For comparison 2013/14 figures are included as is the calculated % change.

Research income summary	2014/15 £000	2013/14 £000	Change %
NERC (including National Capability)	2,949	3,092	-4.6
EU	920	870	5.7
*Other	1,726	2,081	-17.1
Research Excellence Grant	1,080	894	20.8
Total research income	6,675	6,937	-3.8

*Other Research income represents £718,000 of Government Commissions and £1,008,000 from sources such as Marine Alliance for Science and Technology for Scotland (MASTS), Norwegian Research Council, US Office of Naval Research and knowledge transfer initiatives through the Technology Strategy Board (TSB) and Genomia.

EXPENDITURE

62% of SAMS operation costs are staff costs. These rose by 4% in the year, largely as a result of incremental progressions and a 2% cost of living increase. Other operating costs increased by 11%. These are largely as a result of legal fees in pursuing a claim relating to water ingress in the Sir John Murray Building; increased costs for the operation of the trading subsidiary (SRSL) and the cost of implementing job evaluation, which is now complete.

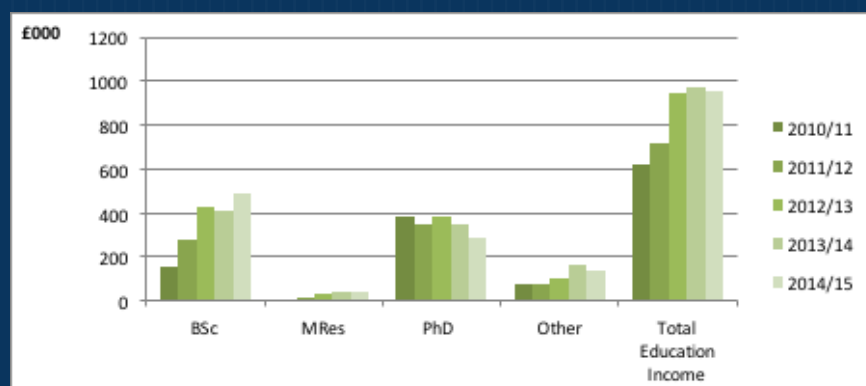


Figure 2: SAMS education income over the last five years.

PEER-REVIEWED PUBLICATIONS

1 APRIL 2014 – 31 MARCH 2015

1. Al Kalbani M, Price MF, Abahussain A, Ahmed M, **O'Higgins T**. 2014. 'Vulnerability Assessment of Environmental and Climate Change Impacts on Water Resources in Al Jabal Al Akhdar, Sultanate of Oman.' *WATER*, vol. 6, pp 3,118-3,135
2. **Alexander, KA, Heymans, JJ, Magill, S**, Tomczak, MT, Holmes, SJ & **Wilding, TA**. 2015. 'Investigating the recent decline in gadoid stocks in the west of Scotland shelf ecosystem using a foodweb model' *ICES JOURNAL OF MARINE SCIENCE*, vol 72, no. 2, pp 436 - 449
3. **Alexander, KA**, Kershaw, P, Cooper, P, Gilbert, AJ, Hall-Spencer, JM, **Heymans, JJ**, Kannen, A, Los, HJ, **O'Higgins, T**, O'Mahony, C, **Tett, P**, Troost, TA & van Beusekom, J. 2015. 'Challenges of achieving Good Environmental Status in the Northeast Atlantic' *ECOLOGY AND SOCIETY*, vol 20, no 1, art 49
4. Attard, K, **Glud, RN**, McGinnis, DF & Rysgaard, S. 2014. 'Seasonal rates of benthic primary production in a Greenland fjord measured by aquatic eddy correlation'. *LIMNOLOGY & OCEANOGRAPHY*, vol 59, no 5, pp 1,555 - 1,569
5. Baumann J, Grottoli AG, **Hughes AD**, Matsui Y. 2014. 'Photoautotrophic and heterotrophic carbon in bleached and non-bleached coral lipid acquisition and storage.' *JOURNAL OF EXPERIMENTAL MARINE BIOLOGY AND ECOLOGY*, vol 461, pp 469-478
6. Begley, C, Bekić, L, Hayward, J, Love, W, Pape, L, Phoenix, H, Pešić, M, **Sayer, MDJ**, Smith, D and Talbot, S. 2014. 'A multi-national scientific diving training programme.' *DIVING FOR SCIENCE 2014: PROCEEDINGS OF THE AMERICAN ACADEMY FOR UNDERWATER SCIENCES 33RD SYMPOSIUM*, (Eckert, GL, Keller, S and Tamone, SL eds), pp 98 - 100
7. Berge, J, **Cottier, F**, Varpe, Ø, Renaud, PE, Falk-Petersen, S, Kwasniewski, S, **Griffiths, C**, Søreide, J & Johnsen, G. 2014. 'Arctic complexity: a case study on diel vertical migration of zooplankton' *JOURNAL OF PLANKTON RESEARCH*, vol 36, no 5, pp. 1,279 - 1,297
8. Berge, J., Heggland, K., Lønne, O.J., **Cottier, F.**, Hop, H., Gabrielsen, G.W., Nøttestad, L., and Misund, O.A. 2015. 'First Records of Atlantic Mackerel (*Scomber scombrus*) from the Svalbard Archipelago, Norway, With Possible Explanations for the Extension of Its Distribution.' *ARCTIC*, vol 68, no 1, pp 54 - 61
9. Blackford, J, **Stahl, H**, Bull, JM, Berges, BJP, Cevatoglu, M, Lichtschlag, A, Connelly, D, James, RH, Kita, J, Long, D, Naylor, M, Shitashima, K, Smith, D, **Taylor, P**, Wright, I, Akhurst, M, Chen, B, Gernon, TM, Hauton, C, Hayashi, M, Kaieda, H, Leighton, TG, Sato, T, **Sayer, MDJ**, Suzumura, M, Tait, K, Vardy, ME, White, PR & Widdicombe, S. 2014. 'Detection and impacts of leakage from

sub-seafloor deep geological carbon dioxide storage' *NATURE CLIMATE CHANGE*, vol 4, no 11, pp 1,011 -,1,016

10. Blenckner, T, Kannen, A, Barausse, A, Fischer, C, **Heymans, JJ**, Luisetti, T, Todorova, V, Valman, M & **Mee, L**. 2015. 'Past and future challenges in managing European seas' *ECOLOGY AND SOCIETY*, vol 20, no 1, 40
11. Brodie, J, Williamson, CJ, Smale, DA, Kamenos, NA, Mieszkowska, N, Santos, R, Cunliffe, M, Steinke, M, Yesson, C, Anderson, KM, Asnaghi, V, Brownlee, C, Burdett, HL, **Burrows, MT**, Collins, S, Donohue, PJC, Harvey, B, Foggo, A, Noisette, F, Nunes, J, Ragazzola, F, Raven, JA, Schmidt, DN, Suggett, D, Teichberg, M & Hall-Spencer, JM. 2014. 'The future of the northeast Atlantic benthic flora in a high CO₂ world' *ECOLOGY & EVOLUTION*, vol 4, no 13, pp 2,787 - 2,798
12. Brown, PF, **Meredith, MP**, Jullion, L, Naveira Garabato, A, Torres-Valdés, S, Holland, P, Leng, MJ, Venables, V. 2014. 'Freshwater fluxes in the Weddell Gyre: results from $\delta^{18}\text{O}$.' *PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY*, vol 372, 20130298
13. Browne NK, Precht E, **Last KS**, Todd PA. 2014. 'Photo-physiological costs associated with acute sediment stress events in three near-shore turbid water corals.' *MARINE ECOLOGY PROGRESS SERIES*, vol 502, pp 129-143
14. Burdett, H, Keddie, V, MacArthur, N, McDowall, L, McLeish, J, Spielvogel, E, **Hatton, A** & Kamenos, N 2014, 'Dynamic photoinhibition exhibited by red coralline algae in the red sea' *BMC PLANT BIOLOGY*, vol 14. 10.1186/1471-2229-14-139
15. Carton, J, **Cunningham, S**, Frajka-Williams, E, Kwon, Y-O, Marshall, D & Msadek, R. 2014. 'The Atlantic Overturning Circulation: more evidence of variability and links to climate' *BULLETIN OF THE AMERICAN METEOROLOGICAL SOCIETY*. 10.1175/BAMS-D-13-00234.1
16. Cinnirella D, Sarda R, Suared de Viver JL, **Brennan R**, Barausse A, Icelly J, Luisetti T, March D, Murciano C, Newton A, **O'Higgins T**, Palmeri L, Palmierie MG, Rauz P, Rees S, Albaiges UJ, Pirrone N, Turner K. 2014. 'Steps towards a shared governance response for achieving Good Environmental Status in the Mediterranean Sea.' *ECOLOGY AND SOCIETY*, vol 19, no 4, art 47
17. **Crocket, KC**, Lambelet, M, de Flierdt, TV, Rehkaemper, M & Robinson, LF. 2014. 'Measurement of fossil deep-sea coral Nd isotopic compositions and concentrations by TIMS as NdO⁺, with evaluation of cleaning protocols' *CHEMICAL GEOLOGY*, vol 374, pp. 128-140. 10.1016/j.chemgeo.2014.03.011
18. **Dale, AC & Inall, ME**. 2015. 'Tidal mixing processes amid small-scale, deep-ocean topography' *GEOPHYSICAL RESEARCH LETTERS*, vol 42, no. 2, pp. 484-491
19. **Davidson, K**. 2014. 'The challenges of incorporating realistic simulations of marine protists in biogeochemically based mathematical models.' *ACTA PROTOZOOLOGICA*, vol 53, pp 129 - 138
20. **Davidson, K, Gowen, R**, Harrison, P, Flemming, L, Hoagland, P & **Moschos, G**. 2014. 'Anthropogenic nutrients and harmful algae in coastal waters' *JOURNAL OF ENVIRONMENTAL MANAGEMENT*, vol 146, pp. 206-216.
21. **Day, J** & Stacey, G. 2014. 'Putting cells to sleep for future science' *NATURE BIOTECHNOLOGY*, vol 32, no. 4, pp. 320-322.
22. Dillon, A, Singhrao, SK, **Achilles-Day, U**, Pearce, M, Morton, LHG & Crean, S. 2014. '*Vermamoeba vermiformis* does not propagate *Legionella pneumophila* subsp. *pascullei* in a simulated laboratory dental-unit waterline system' *INTERNATIONAL BIODETERIORATION AND BIODEGRADATION*, vol 90, pp. 1-7.
23. Falk-Petersen, S, Berge, J, **Cottier, F**, Kovacs, KM & Lydersen, C. 2014. 'At the rainbow's end: A case study of high productivity fuelled by winter upwelling along an Arctic shelf.' *POLAR BIOLOGY*, vol 38, no 1, pp. 5-11.
24. Fernández-Méndez, M, Wenzhöfer, F, Peeken, I, Sorensen, HL & **Glud, RN**. 2014. 'Composition, Buoyancy Regulation and Fate of Ice Algal Aggregates in the Central Arctic Ocean.' *PLOS ONE*, vol 9, no 9, e107452
25. **Fox, CJ**, Targett, TE, Ciotti, BJ, De Kroon, K, Hortsmeyer, L & T. **Burrows, M**. 2014. 'Size variation

- of 0-group plaice: are earlier influences on growth potential a contributing factor?' *JOURNAL OF SEA RESEARCH*, vol 88, pp. 59-66. 10.1016/j.seares.2013.12.015
26. Galil BS, Boero F, Campbell ML, Carlton JT, **Cook E**, Franchetti S, Gollasch S, Hewitt CL, Jelmert A, Macpherson E, Marchini A, McKenzie C, Minchin D, Occhipinti-Ambrogi A, Ojaveer H, Olenin S, Piraino S, Ruis GM. 2014. 'Double trouble': the expansion of the Suez Canal and marine bioinvasions in the Mediterranean Sea.' *BIOLOGICAL INVASIONS*, vol 17, pp 973-976
27. **García Molinos, J** & Donohue, I. 2014. 'Downscaling the non-stationary effect of climate forcing on local-scale dynamics: the importance of environmental filters' *CLIMATIC CHANGE*, vol 124, no. 1-2, pp. 333-346. 10.1007/s10584-014-1077-4
28. **García Molinos J**, Viana M, Brennan M, Donohue I. 2015. 'Importance of Long-Term Cycles for Predicting Water Level Dynamics in Natural Lakes.' *PLOS ONE*, 10(3): e0119253
29. **Gary, S**, Lozier, MS, Kwon, Y-O & Park, JJ. 2014. 'The fate of North Atlantic Subtropical Mode Water in the FLAME model' *JOURNAL OF PHYSICAL OCEANOGRAPHY*, vol 44. 10.1175/JPO-D-13-0202.1
30. Gascuel, D, Coll, M, **Fox, C**, Guénette, S, Guitton, J, Kenny, A, Knittweis, L, Nielsen, JR, Piet, G, Raid, T, Travers-trolet, M & Shephard, S. 2014. 'Fishing impact and environmental status in European seas: a diagnosis from stock assessments and ecosystem indicators' *FISH AND FISHERIES*, pp. n/a-n/a., 10.1111/faf.12090
31. Gilbert A, **Alexander K**, Sardá R, Brazinskaite R, Fischer C, Gee K, Jessopp M, Kershaw P, Los H, Morla DM, O'Mahony C, Pihlajamäki M, Rees S, Varjopuro R. 2015. 'Marine Spatial Planning and Good Environmental Status: A Perspective on Spatial and Temporal Dimensions.' *ECOLOGY AND SOCIETY*, vol 20, no 1, art 64
32. **Glud, RN**, Rysgaard, S, Turner, G, McGinnis, DF & **Leakey, RJG**. 2014. 'Biological- and physical-induced oxygen dynamics in melting sea ice of the Fram Strait.' *LIMNOLOGY & OCEANOGRAPHY*, vol 59, no 4, pp. 1,097-1,111
33. Goulding I, Stopperup K, **O'Higgins TG**. 2014. 'Potential economic impacts of achieving good environmental status in Black Sea fisheries.' *ECOLOGY AND SOCIETY*, vol 19, no 3, art 32
34. **Gowen, R**, Y Collos, **P Tett**, C Scherer, B Bec, E Abadie, M Allen and T O'Brien. 2015. 'The response of diatom and dinoflagellate lifeforms to reduced phosphorus loading: a case study in the Thau Lagoon'. *ESTUARINE, COASTAL AND SHELF SCIENCE*, vol 162, pp 45-52
35. **Graziano, M** & Gillingham, K. 2015. 'Spatial Patterns of Solar Photovoltaic System Adoption: The Influence of Neighbors and the Built Environment' *JOURNAL OF ECONOMIC GEOGRAPHY*, vol 15, no 4, pp 815-839
36. Green, TK & **Hatton, AD**. 2014. 'The claw hypothesis: A new perspective on the role of biogenic sulphur in the regulation of global climate.' *OCEANOGRAPHY AND MARINE BIOLOGY*, vol 52, pp. 315-335
37. **Green, DH**, Echavarrri-Bravo, V, **Brennan, D & Hart, MC**. 2015. 'Bacterial Diversity Associated with the Coccolithophorid Algae *Emiliana huxleyi* and *Coccolithus pelagicus f. braarudii*.' *BIOMEDICAL RESEARCH INTERNATIONAL* 10.1155/2015/194540
38. Grist, JP, Josey, SA, Boehme, L, **Meredith, MP**, Laidre, KL, Heide-Jørgensen, MP, Kovacs, KM, Lydersen, C, Davidson, FJM, Stenson, GB, Hammill, MO, Marsh, R, Coward, AC. 2014. 'Seasonal variability of the warm Atlantic water layer in the vicinity of the Greenland shelf break.' *GEOPHYSICAL RESEARCH LETTERS*, vol 41, pp 8,530 - 8,537
39. Halsen Hammarvold, S, **Glud, RN**, Evjemo, JO, Hagemann, A & Winding Hansen, B. 2015. 'A new large egg type from the marine live feed calanoid copepod *Acartia tonsa* (Dana) - Perspectives for selective breeding of designer feed for hatcheries.' *AQUACULTURE*, vol. 436, pp 114 - 120
40. Hancke, K, Sorell, BK, Lund-Hansen, LC, Larsen, M, Hancke, T & **Glud, RN**. 2014. 'Effects of temperature and irradiance on a

- benthic microalgal community: A combined two-dimensional oxygen and fluorescence imaging approach.' *LIMNOLOGY & OCEANOGRAPHY*, vol. 59, no 5, pp 1,599 - 1,611
41. Heath, MR, Culling, MA, Crozier, WW, **Fox, CJ**, Gurney, WSC, Hutchinson, WF, Nielsen, EE, O'Sullivan, M, Preedy, KF, Righton, DA, Speirs, DC, Taylor, MI, Wright, PJ & Carvalho, GR. 2014. 'Combination of genetics and spatial modelling highlights the sensitivity of cod (*Gadus morhua*) population diversity in the North Sea to distributions of fishing' *ICES JOURNAL OF MARINE SCIENCE*. 10.1093/icesjms/fst185
42. **Heymans, JJ**, Coll, M, Libralato, S, Morissette, L, Christensen, V. 2014. 'Global Patterns in Ecological Indicators of Marine Food Webs: A Modelling Approach' *PLOS ONE*, vol 9, no. 4., 10.1371/journal.pone.0095845
43. Hiddink, JG, **Burrows, MT & García Molinos, J**. 2014 'Temperature tracking by North Sea benthic invertebrates in response to climate change.' *GLOBAL CHANGE BIOLOGY*, vol 21, pp. 117-129
44. Hipkin, R, Day, J, **Rad Menendez, C** & Mock, T. 2014. 'The first evidence for genotypic stability in a cryopreserved transgenic diatom' *JOURNAL OF APPLIED PHYCOLOGY*, vol 26, no. 1, n/a, pp. 65-71. 10.1007/s10811-013-0047-y
45. Holtappels, M, Noss, C, Hancke, K, Cathalot, C, McGinnis, DF, Lorke, A & **Glud, RN**. 2015. 'Aquatic Eddy correlation: Quantifying the artificial flux caused by stirring sensitive O₂ sensors.' *PLOS ONE*, vol 10, no 1, e0116564
46. Hopkins, JE, GR Stephenson, JAM Green, **ME Inall**, and MR Palmer. 2014. 'Storms modify baroclinic energy fluxes in a seasonally stratified shelf sea: Inertial-tidal interaction.' *JOURNAL OF GEOPHYSICAL RESEARCH - OCEANS*, vol 119, no 10, pp 6,863 - 6,883
47. **Houpert, L**, P Testor, X Durrieu de Madron, S Somot, F D'Ortenzio, C Estournel, H Lavigne. 2015. 'Seasonal cycle of the mixed layer, the seasonal thermocline and the upper-ocean heat storage rate in the Mediterranean Sea derived from observations.' *PROGRESS IN OCEANOGRAPHY*, vol 132, pp 333 - 352
48. **Hwang, P**, Elosegui, P and Wilkinson, J. 2014. 'Small-scale deformation of an Arctic sea ice floe detected by GPS and satellite imagery.' *DEEP-SEA RESEARCH PART II-TOPICAL STUDIES IN OCEANOGRAPHY*, <http://dx.doi.org/10.1016/j.dsr2.2015.01.007>
49. Kim, YH, Ha, HK, Lee, SH, Kim, H-C, Lee, HJ & **Hwang, P**. 2014. 'Entrainment induced by near-inertial drift of sea ice and its impact on under-ice biogeochemical processes in marginal ice zones.' *DEEP-SEA RESEARCH PART II-TOPICAL STUDIES IN OCEANOGRAPHY*, DOI: 10.1016/j.dsr2.2014.05.019
50. **Inall, M**, Murray, T, **Cottier, F**, Scharrer, K, **Boyd, T**, Heywood, KJ & Bevan, S. 2014. 'Oceanic heat delivery via Kangerdlugssuaq Fjord to the south-east Greenland ice sheet.' *JOURNAL OF GEOPHYSICAL RESEARCH-OCEANS*, pp. 631-645
51. Jackson, D, Drumm, A, McEvoy, S, Jensen, O, Mendiola, D, Gabina, G, Borg, JA, Papageorgiou, N, Karakassis, I & **Black, KD**. 2015. 'A pan-European valuation of the extent, causes and cost of escape events from sea cage fish farming.' *AQUACULTURE*, vol 436, pp. 21-26
52. Jobstovogt N, Watson V, **Kenter JO**. 2014. Looking below the surface: The cultural ecosystem service values of UK marine protected areas (MPAs).' *ECOSYSTEM SERVICES*, vol 10, pp. 97-110
53. Jones AC, Mead A, Kaiser MJ, Austen MCV, Adrian AW, Auchterlonie NA, **Black KD**, Blow LR, Bury C, Brown JH, Burnell GA, Connolly E, Dingwall A, Derrick S, Eno NC, Gautier DJH, Green KA, Gubbins M, Hart PR, Holmyard JM, Immink AJ, Jarrad DJ, Katoh E, Langley JCR, Lee DO'C, LeVay L, Leftwich CP, Mitchell M, Moore AP, Murray AG, McLaren EMR, Norbury H, Parker D, Parry S, Purchase D, Rahman A, Sanve F, Siggs M, Simpson SD, Slaski RJ, Smith K, Syvret M LeQ, Tibbot C, Thomas PC, Turnbull J, Whiteley R, Whittles M, Wilcockson MJ, Wilson J, Dicks LV, Sutherland WJ. 2014. 'Prioritisation of knowledge-needs for sustainable aquaculture: a national and global perspective.' *FISH AND FISHERIES*, doi: 10.1111/faf.12086
54. Jovanovic, Z, Larsen, M, Quintana, CO, Kristensen, E & **Glud, RN**. 2014. 'Oxygen dynamics and porewater transport

- in sediments inhabited by the invasive polychaete *Marenzelleria viridis*. *MARINE ECOLOGY PROGRESS SERIES*, vol 504, pp 181-192
55. Jovanovic, Z, Pedersen, MO, Larsen, M, Kristensen, E & **Glud, RN**. 2015. 'Rhizosphere O₂ dynamics in young *Zostera marina* and *Ruppia maritima*.' *MARINE ECOLOGY PROGRESS SERIES*, vol 518, pp 95 - 105
56. Jullion, L, Naveira Garabato, AC, Bacon, S, **Meredith, MP**, Brown, PJ, Torres-Valdés, S, Speer, KG, Holland, PR, Dong, J, Bakker, D, Hoppema, M, Loose, B, Venables, HJ, Jenkins, WJ, Messias, M-J, Fahrbach, E. 2014. 'The contribution of the Weddell Gyre to the lower limb of the Global Overturning Circulation.' *JOURNAL OF GEOPHYSICAL RESEARCH: OCEANS*, vol 119, pp 3,357 - 3,377
57. Kalantzi I, Papageorgiou N, Sevastou K, **Black KD**, Pergantis SA, Karakassis I. 2014. Metals in benthic macrofauna and biogeochemical factors affecting their trophic transfer to wild fish around fish farm cages. *SCIENCE OF THE TOTAL ENVIRONMENT*, vol 470-471, pp. 742-753
58. **Kenter JO**, O'Brien L, Hockley N, Ravenscroft N, Fazey I, Irvine KN, Reed MS, Christie M, Brady E, Bryce R, Church A, Cooper N, Davies A, Evelyn A, Everard M, Fish R, Fisher JA, Jobstvogt N, Molloy C, Orchard-Webb J, Ranger S, Ryan M, Watson V, Williams S. 2015. 'What are shared and social values of ecosystems?' *ECOLOGICAL ECONOMICS*, vol 111, pp 86-99
59. Kessler, AJ, Bristow, LA, Cardenas, MB, **Glud, RN**, Thamdrup, B & Cook, P. 2014. 'The isotope effect of denitrification in permeable sediments'. *GEOCHIMICA ET COSMOCHIMICA ACTA*, vol 133, pp 156-167
60. Kessler, AJ, **Glud, RN**, Bayani Cardenas, M, & Cook, PLM. 2014. 'Transport zonation limits coupled nitrification-denitrification in permeable sediments'. *ENVIRONMENTAL SCIENCE & TECHNOLOGY*, vol 48, no 11, pp 6522
61. Kleisner, KM, Coll, M, Lynam, CP, Bundy, A, Shannon, L, Shin, Y, Boldt, JL, Maria F, B, Diallo, I, **Fox, C**, Gascuel, D, **Heymans, J**, Juan Jordá, MJ, Jouffre, D, Large, SI, Marshall, KN, Ojaveer, H, Piroddi, C, Tam, J, Angeles Torres, M, Travers-Trolet, M, Tsagarakis, K & Van Der Meer, GI. 2015. 'Evaluating changes in marine communities that provide ecosystem services through comparative assessments of community indicators' *ECOSYSTEM SERVICES*. 10.1016/j.ecoser.2015.02.002
62. Larkin KE, Gooday AJ, Woulds C, Jeffreys R, Schwartz M, Cowie G, Whitcraft C, Levin L, Dick JR, **Pond DW**. 2014. 'Uptake of algal carbon and the likely synthesis of an 'essential' fatty acid by *Uvigerina ex. gr. semiornata* (Foraminifera) within the Pakistan margin Oxygen Minimum Zone: evidence from fatty acid biomarker and ¹³C tracer experiments.' *BIOGEOSCIENCES*, vol 11, pp. 3,729 - 3,738
63. Lehto, N, **Glud, RN**, Nordi, GA, Zhang, H & Davison, W 2014 'Anoxic microniches in marine sediments induced by aggregate settlement: iogeochemical dynamics and implications.' *BIOGEOCHEMISTRY*, vol 119, pp 307 - 327
64. Levin, N, Coll, M, Fraschetti, S, Gal, G, Giakoumi, S, Goke, C, **Heymans, JJ**, Katsanevakis, S, Mazor, T, Ozturk, B, Rilov, G, Gajewski, J, Steenbeek, J & Kark, S. 2014. 'Biodiversity data requirements for systematic conservation planning in the Mediterranean Sea' *MARINE ECOLOGY-PROGRESS SERIES*, vol 508, pp 261-281
65. Lorente, C, Causape, J, **Glud, RN**, Hancke, K, Merchan, D, Muniz, S, Val, J & Navarro, E. 2015. 'Impacts of agricultural irrigation on nearby freshwater ecosystems: The seasonal influence of triazine herbicides in benthic algal communities.' *SCIENCE OF THE TOTAL ENVIRONMENT*, vol 503-504, p 151-158
66. Loureiro, R, **Gachon, CMM**, Rebours, C. 2015. Seaweed cultivation: potential and challenges of crop domestication at an unprecedented pace. *NEW PHYTOLOGIST*, vol 206, no 2, pp 489 - 492
67. Maclean IMD, Inger R, Benson D, Booth CG, Embling CB, Grecian WJ, **Heymans JJ**, Plummer K, Shackshaft M, Sparling C, **Wilson B**, Wright LJ, Bradbury G, Christen N, Godley BJ, Jackson A, McCluskie A, Nichols-Lee R, Bearhop S. 2014. 'Resolving issues with environmental impact assessment of marine renewable energy installations'. *FRONTIERS IN MARINE SCIENCE*, 1: 75

68. McGinnis, DF, Sommer, S, Lorke, A, **Glud, RN** & Linke, P. 2014. 'Quantifying tidally driven benthic oxygen exchange across permeable sediments: An aquatic eddy correlation study.' *JOURNAL OF GEOPHYSICAL RESEARCH: OCEANS*, vol 119, no 10, pp 6918-6932
69. **Mee, LD**, Cooper, PC, Gilbert, AJ, Kannen, A, **O'Higgins, T**. 2015. 'Sustaining Europe's seas as coupled social-ecological systems.' *ECOLOGY AND SOCIETY*, vol 20, no 1, art 1
70. **Meredith, MP**, Jullion, L, Brown, PJ, Naveira Garabato, AC, Couldrey, MP. 2014. 'Dense waters of the Weddell and Scotia Seas: recent changes in properties and circulation.' *PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A* vol 372, 20130041
71. Metcalf P, Griffiths, G, **Sayer, MDJ** and Ian Gallett, I. 2015. 'The Future of the Society for Underwater Technology: a Collective View.' *UNDERWATER TECHNOLOGY*, vol 32, pp 213 - 215
72. Mieszkowska, N, **Burrows, MT**, Pannacciulli, FG & Hawkins, SJ. 2014. 'Multidecadal signals within co-occurring intertidal barnacles *Semibalanus balanoides* and *Chthamalus* spp. linked to the Atlantic Multidecadal Oscillation.' *JOURNAL OF MARINE SYSTEMS*, vol 133, pp. 70-76
73. Murua, J, **Burrows, MT**, Hughes, RN, Hawkins, SJ, Thompson, RC & Jenkins, SR. 2014. 'Phenotypic variation in shell form in the intertidal acorn barnacle *Chthamalus montagui*: distribution, response to predators and life history trade-offs.' *MARINE BIOLOGY*, vol, 161, pp 2,609 - 2,619
74. **Orr, KK, Wilding, TA**, Horstmeyer, L, Weigl, S & **Heymans, JJ**. 2014. 'Detached macroalgae: Its importance to inshore sandy beach fauna.' *ESTUARINE COASTAL AND SHELF SCIENCE*, vol 150, pp 125-135
75. O'Connor MI, Holding JM, Kappel CV, Duarte CM, Brander K, Brown CJ, Bruno JF., Buckley L, **Burrows MT**, Halpern BS, Kiessling W, Moore P, Pandolfi JM, Parmesan C, Poloczanska ES, Schoeman DS, Sydeman WJ, Richardson AJ. 2014. 'Strengthening confidence in climate impact science'. *GLOBAL ECOLOGY AND BIOGEOGRAPHY*, vol 24, pp 64-76
76. **O'Higgins, TG**, Farmer, A, Daskalov, G, Knudsen, S, **Mee, L**. 2014. 'Achieving good environmental status in the Black Sea: xScale mismatches in environmental management.' *ECOLOGY AND SOCIETY*, vol 19, no 3, art 54
77. **O'Higgins, TG**, Cooper, P, Roth, E, Newton, A, Farmer, A, Goulding, I, **Tett, P**. 2014. 'Temporal constraints on ecosystem management: Definitions and examples from Europe's regional seas'. *ECOLOGY AND SOCIETY*, vol 19, no 4, art 46
78. Panagos C, Thomson DS, Moss C, **Hughes AD, Kelly MS**, Liu Y, Chai W, Venkatasamy R, Spina D, Page CP, Hogwood J, Woods RJ, Mulloy B, Bavington CD, Uhrin D. 2014. 'Fucosylated chondroitin sulfates from the body wall of the sea cucumber *Holothuria forskali*.' *JOURNAL OF BIOLOGICAL CHEMISTRY*, vol 289, no 41, 28,284-28,298
79. Parent, J, **Graziano, M** & Yang, X. 2014. 'Potential of using forest residue to offset coal use in co-fired coal power plants in the eastern United States.' *INTERNATIONAL JOURNAL OF AGRICULTURE AND BIOLOGICAL ENGINEERING*, vol 7, no 4, pp. 99-105
80. Pawlowski, J, Esline, P, Lejzerowicz, F, Cedhagen, T & **Wilding, T**. 2014. 'Environmental monitoring through protist next-generation sequencing metabarcoding: assessing the impact of fish farming on benthic foraminifera communities' *MOLECULAR ECOLOGY RESOURCES*, vol 14, pp 1,129 - 1,140
81. Polzin, KL, Naveira Garabato, AC, Abrahamsen, EP, Jullion, L, **Meredith, MP**. 2014. 'Boundary mixing in Orkney Passage outflow.' *JOURNAL OF GEOPHYSICAL RESEARCH: OCEANS*, vol 119, pp 8,627 - 8,645
82. **Pond DW**, Tarling GA, Mayor DJ. 2014. 'Hydrostatic pressure and temperature effects on the membranes of a seasonally migrating marine copepod.' *PLOS ONE*, vol 9, no 10: e111043
83. Potts, T, **O'Higgins, T, Brennan, R**, Cinnirella, S, Brandt, US, Suarez De Vivero, JL, Troost, T, Paltriguera, L & Gunduz Hosgor, A. 2015. 'Detecting critical choke points for achieving Good Environmental Status in European seas'. *ECOLOGY AND SOCIETY*, vol 20, no 1, art 29

84. Price C, **Black KD**, Hargrave BT, Morris JA Jr. 2015. 'Marine cage culture and the environment: effects on water quality and primary production.' *AQUACULTURE ENVIRONMENT INTERACTIONS*, vol 6, pp 151 - 174
85. Powell, C, **Hughes, AD, Kelly, MS**, Conner, S & McDougall, GJ. 2014. 'Extraction and identification of antioxidant polyhydroxynaphthoquinone pigments from the sea urchin, *Psammechinus miliaris*.' *LWT-FOOD SCIENCE AND TECHNOLOGY*, vol 59, no 1, pp 455 - 460
86. Price, C, **Black, KD**, Hargrave, BT & Morris, JAJ. 2015. 'Marine cage culture and the environment: effects on water quality and primary production.' *AQUACULTURE ENVIRONMENT INTERACTIONS*, vol 6, no 2, pp 151-174
87. Raymond, C, **Kenter, J**, Plieninger, T, Turner, N & **Alexander, K**. 2014. 'Comparing instrumental and deliberative paradigms which underpin the assessment of social values for cultural ecosystem services.' *ECOLOGICAL ECONOMICS*, vol 107, pp 145-156
88. **Risch D**, Castellote M, Clark CW, Davis GE, Dugan PJ, Hodge LEW, Kumar A, Lucke K, Mellinger DK, Nieukirk SL, Popescu M, Ramp C, Read AJ, Rice AN, Silva MA, Siebert U, Stafford K, Van Parijs SM. 2014. Seasonal migrations of North Atlantic minke whales: novel insights from large-scale passive acoustic monitoring networks. *MOVEMENT ECOLOGY*, vol 2, 24
89. Roy HE, Peyton J, Aldridge DC, Bantock T, Blackburn TM, Britton R, Clack P, **Cook E**, Dehnen-Schmutz K, Dines T, Dobson M, Edwards F, Harrower C, Harvey M, Minchin D, Noble DG, Parrot D, Pocock MJO, Preston CD, Roy S, Salisbury A, Schönrogge K, Sewell J, Shaw RH, Stebbing P, Stewart AJA, Walker KJ. 2014. Horizon scanning for invasive alien species with the potential to threaten biodiversity in Great Britain. *GLOBAL CHANGE BIOLOGY*, vol 20, pp 3,859 - 3,871
90. Sarda R, **O'Higgins TG**, Cormier R, Diedrich A, Tintore J. 2014. 'Proposal of a Marine Ecosystem-Based Management System: Linking the Theory of Environmental Policy and Practice of Environmental Management.' *ECOLOGY AND SOCIETY*, vol. 19, no 4, art 51
91. **Sayer, MDJ & Azzopardi, E**. 2014. 'The silent witness: using dive computer records in diving fatality investigations.' *DIVING AND HYPERBARIC MEDICINE*, vol 44, no 3, pp 167 - 169
92. **Sayer, MDJ, Azzopardi, E & Sieber, A**. 2014. 'Decompression management by 43 models of dive computer: single square-wave exposures to between 15 and 50 metres depth.' *DIVING AND HYPERBARIC MEDICINE*, vol 44, no 4, pp 193 - 201
93. **Sayer, MDJ, Taylor, P and Stahl, H**. 2014. 'The use of scientific diving in support of a novel carbon dioxide release experiment.' *DIVING FOR SCIENCE 2014: PROCEEDINGS OF THE AMERICAN ACADEMY FOR UNDERWATER SCIENCES 33RD SYMPOSIUM*, (Eckert, GL, Keller, S and Tamone, SL eds), pp 50 - 54
94. **Schiener, P, Black, K, Stanley, M & Green, D**. 2015. 'The seasonal variation in the chemical composition of the kelp species *Laminaria digitata*, *Laminaria hyperborea*, *Saccharina latissima* and *Alaria esculenta*.' *JOURNAL OF APPLIED PHYCOLOGY*, vol 27, no 1, pp 363-373
95. Schoepf V, Levas SJ, Rodrigues LJ, McBride MO, Aschaffenburg MD, Matsui Y, Warner ME, **Hughes AD**, Grottoli AG. 2014. 'Kinetic and metabolic isotope effects in coral skeletal carbon isotopes: A re-evaluation using experimental coral bleaching as a case study.' *GEOCHIMICA ET COSMOCHIMICA ACTA*, vol 146, pp 164 - 178
96. Schuster, A, Buzzacott, P, Reif, S, Kuch, B, Gerges, A, **Azzopardi, E, Sayer, MDJ** and Sieber, A. 2014. 'Function selection among popular dive computer models: a review and proposed improvements.' *UNDERWATER TECHNOLOGY*, vol 32, pp 159 - 165
97. Sejr, MK, Krause-Jensen, D, Dalsgaard, T, Ruiz-Halpern, S, Duarte, CM, Middelboe, M, **Glud, RN**, Bendtsen, J, Balsby, TJS & Rysgaard, S. 2014. 'Seasonal dynamics of autotrophic and heterotrophic plankton metabolism and P_{CO_2} in a subarctic Greenland fjord.' *LIMNOLOGY & OCEANOGRAPHY*, vol 59, no 5, pp 1,764 - 1,778
98. Severin, T, P Conan, X Durrieu de Madron, **L Houpert**,

- MJ Oliver, L Oriol, J Caparros, JF Ghiglione, M Pujo-Pay. 2014. 'Impact of open-ocean convection on nutrients, phytoplankton biomass and activity.' *DEEP SEA RESEARCH PART I: OCEANOGRAPHIC RESEARCH PAPERS*, vol 94, pp 62 - 71
99. Shannon, L, Coll, M, Bundy, A, Gascuel, D, **Heymans, JJ**, Kleisner, K, Lynam, CP, Piroddi, C, Tam, J, Travers-Trolet, M & Shin, Y. 2014. 'Trophic level-based indicators to track fishing impacts across marine ecosystems' *MARINE ECOLOGY-PROGRESS SERIES*, vol 512, pp 115 - 140
100. Sheen, KL, Naveira Garabato, AC, Brearley, JA, **Meredith, MP**, Polzin, KL, Smeed, DA, Forryan, A, King, BA, Sallée, J-B, St Laurent, L, Thurnherr, AM, Toole, JM, Waterman, SN, Watson, AJ. 2014. 'Eddy-induced variability in Southern Ocean abyssal mixing on climatic timescales.' *NATURE GEOSCIENCE*, vol 7, pp 577 - 582
101. **Sherwin, TJ, Aleynik, D, Dumont, E, and Inall, ME.** 2015 'Deep drivers of mesoscale circulation in the central Rockall Trough.' *OCEAN SCIENCE*, vol 11, no 3, pp 343 - 359
102. Smeed, D, McCarthy, G, **Cunningham, S**, Frajka-Williams, E, Rayner, D, Johns, W, Barringer, M, Duchez, A, Moat, B & Bryden, H. 2014. 'Observed decline of the Atlantic meridional overturning circulation 2004 to 2012.' *OCEAN SCIENCE*, vol 10, pp 29
103. Sørensen, LL, Jensen, B, **Glud, RN**, McGinnis, DF, Sejr, MK, Sievers, J, Søgaaard, DH, Tison, J-L & Rysgaard, S. 2014. 'Parameterization of atmosphere-surface exchange of CO₂ over sea ice.' *CRYOSPHERE*, vol 8, no 3, pp 853-866
104. Smithson, HE, **Anderson, PS**, Dinkova-Bruun, G, Fosbury, RAE, Gasper, GEM, Laven, P, McLeish, TCB, Panti, C & Tanner, BK. 2014. 'Color-coordinate system from a 13th century account of rainbows.' *JOURNAL OF THE OPTICAL SOCIETY OF AMERICA A - Optics Image Science and Vision*, vol 31, no 4, pp A341-A349
105. Stashchuk, N, Vlasenko, V, **Inall, ME & Aleynik, D.** 2014. 'Horizontal dispersion in shelf seas: High resolution modelling as an aid to sparse sampling.' *PROGRESS IN OCEANOGRAPHY*, vol 128, pp 74 - 87
106. **Strittmatter, M**, Grenville-Briggs, LJ, Breithut, L, van West, P, **Gachon, CMM** & Küpper, FC. 2015. Infection of the brown alga *Ecotarpus siliculosus* by the oomycete *Eurychasma dicksonii* induces oxidative stress and halogen metabolism. *PLANT, CELL & ENVIRONMENT*, doi: 10.1111/pce.12533
107. Tarling, GA, **Cottier, FR** & Everson, I. 2014. 'Spatial patterns in the vertical structure of euphausiids in Gullmarsfjord, Sweden: Identifying influences on bilayer formation and distribution.' *MARINE BIOLOGY RESEARCH*, vol 10, no. 6, pp 537-553
108. Thurber, A, Sweetman, A, **Narayanaswamy, B**, Jones, D, Ingels, J & Hansman, R. 2014. 'Ecosystem function and services provided by the deep sea.' *BIOGEOSCIENCES*, vol 11, no 14, pp 3,941
109. Tsirigoti, A, Beakes, GW, Herve, C, **Gachon, CMM**, Katsaros, C. 2014. Attachment, penetration and early host defense mechanisms during the infection of filamentous brown algae by *Eurychasma dicksonii*. *PROTOPLASMA*, vol 252, no 3, pp 845 - 856
110. Turner, A, Higgins, C, **Davidson, K, Veszelovszki, A**, Payne, D, Hungerford, J & Higman, W. 2015. 'Potential Threats Posed by New or Emerging Marine Biotoxins in UK Waters and Examination of Detection Methodology Used in Their Control: Brevetoxins' *MARINE DRUGS*, vol 13, no 3, pp 1,224 - 1,254
111. **Turnewitsch, R**, Falahat, S, Stehlikova, J, Oguri, K, **Glud, R**, Middelboe, M, Kitazato, H, Wenzhofer, F, Ando, K, Fujio, S & Yanagimoto, D. 2014. 'Recent sediment dynamics in hadal trenches: evidence for the influence of higher-frequency (tidal, near-inertial) fluid dynamics' *DEEP-SEA RESEARCH PART I-OCEANOGRAPHIC RESEARCH PAPERS*, vol 90, pp 125-138
112. van Leeuwen, SM, **P Tett, DK** Mills and J van der Molen (2015). Stratified areas in the North Sea: long-term variability and biological and policy implications. *JOURNAL OF GEOPHYSICAL RESEARCH: OCEANS*, vol 120. doi:10.1002/2014JC010485
113. Watson C, **Chivers AJ, Narayanaswamy BE, Lamont P, Turnewitsch R.** 2014. 'Chrysopetalidae (Annelida: Phyllodocida) from the Senghor Seamount, north-east Atlantic: taxa with deep-sea affinities and

morphological adaptations.' *MEMOIRS OF MUSEUM VICTORIA*, vol 71, pp 311-325

114. Woodall LC, Robinson LF, Rogers AD, **Narayanaswamy BE** and Paterson GL. 2015. 'Deep sea litter: A comparison of seamounts, banks and a ridge in the Atlantic and Indian Oceans reveals both environmental and anthropogenic factors impact accumulation and composition'. *FRONTIERS IN MARINE SCIENCE*, 2: 3.

115. **Whyte, C, Swan, S & Davidson, K.** 2014. 'Changing wind patterns linked to unusually high *Dinophysis* blooms around the Shetland Islands, Scotland.' *HARMFUL ALGAE*, vol 39, pp 365-373

116. **Wilding, T.** 2014. 'Effects of man-made structures on sedimentary oxygenation: Extent, seasonality and implications for offshore renewables.' *MARINE ENVIRONMENTAL RESEARCH*, vol 97, pp 39-47

117. Williams, PN, Santner, J, Larsen, M, Lehto, NJ, Oburger, E, Wenzel, W, **Glud, RN**, Davison, W & Zhang, H. 2014. 'Localised Flux Maxima of Arsenic, Lead, and Iron around Root Apices in Flooded Lowland Rice.' *ENVIRONMENTAL SCIENCE & TECHNOLOGY (WASHINGTON)*, vol 48, no 15, pp 8,498 - 8,506

118. Wilson, LJ, **Burrows, MT**, Hastie, GD & **Wilson, B.** 2014. 'Temporal variation and characterization of grunt sounds produced by Atlantic cod *Gadus morhua* and pollack *Pollachius pollachius* during the spawning season.' *JOURNAL OF FISH BIOLOGY*, vol 84, pp 1014-1030

119. Wilson, DJ, **Crocket, KC**, van de Flierdt, T, Robinson, LF & Adkins, JF. 2014. 'Dynamic intermediate ocean circulation in the North Atlantic during Heinrich Stadial 1: A radiocarbon and neodymium isotope perspective.' *PALEOCEANOGRAPHY*, vol 29, no 11, pp 1072-1093

120. Woodall LC, Sanchez-Vidal A, Canals M, Paterson GLJ, Coppock R, Sleight V, Calafat A, Rogers AD, **Narayanaswamy BE**, Thompson RC. 2014. 'The deep sea is a major sink for microplastic debris.' *ROYAL SOCIETY OPEN SCIENCE*, 1: 140317

121. Xu J, Su G, Xiong Y, Akasaka M, **García Molinos J**, Matsuzaki SS, and Zhang M. 2015. 'Complimentary analysis of metacommunity nestedness and diversity partitioning highlights the need for a holistic conservation strategy for highland lake fish assemblages.' *GLOBAL ECOLOGY AND CONSERVATION*, vol 3, pp 288-296

122. Zhu, K, Bruun, S, Larsen, M, **Glud, RN**, & Stoudmann Jensen, L. 2014. 'Spatial Oxygen Distribution and Nitrous Oxide Emissions from Soil after Manure Application: A Novel Approach Using Planar Optodes'. *JOURNAL OF ENVIRONMENTAL QUALITY*, vol 43, no 5, pp 1,809 - 1,912

Publications from SAMS Fellows

Gibson, RN, Nash, RDM, Geffen, AJ & van der Veer, HW (eds). 2015. *Flatfishes: Biology and Exploitation*, 2nd edition. Wiley Blackwell, Oxford, 542 pp.

Gibson, RN. 2015. Introduction. In: *Flatfishes: Biology and Exploitation*, 2nd edition. Wiley Blackwell, Oxford, pp. 1-12.

Gibson, RN, Stoner, AW & Ryer, CH 2015. The behaviour of flatfishes. In: *Flatfishes: Biology and Exploitation*, 2nd edition. Wiley Blackwell, Oxford, pp. 314-345.

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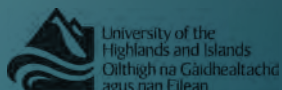


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