

Annual Report

Independent marine science since 1884

2018-19

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Trustees and Directors of the Charity

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Professor GS Boulton
OBE (2018)
Ian Dunn (interim 2019)
Diana Murray CBE
(2019)

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Baxter, Prof John	McNeill, Dr Deborah
Brown, Sarah	Watts, Susan
Brownlee, Prof Colin	Tudhope, Prof Alexander
Chilton, Lisa	



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About SAMS

Our mission

SAMS delivers world-leading marine science by creating new knowledge through transformational scientific enquiry; disseminating this knowledge through inspirational education and public engagement; and harnessing this knowledge to help the development of sustainable seas.

SAMS' research embraces the great challenges of our time: how to provide a growing human population with sustainable food and energy from the sea while safeguarding the health, biodiversity and productivity of the marine environment. To do this we conduct ocean-related research across the globe, disciplines and at all scales with our partners and stakeholders. To make our new knowledge have impact we educate, inspire, advise and collaborate with all sectors of society, from school children to university students, from industry to world leaders.

SAMS is a company limited by guarantee (SC009292) and a registered Scottish charity (009206) with a membership. The liability of the members is limited to a maximum of £1 each.

SAMS has two wholly owned active subsidiary companies: SAMS Research Services Ltd (SRSL) exists to provide knowledge, know-how and services, primarily to commercial entities, for them to better carry out their business. SAMS Limited provides specialist services, particularly the provision of algal cultures and to manage the rental of SAMS infrastructure for tenants.

SAMS is a founding partner of the University of the Highlands and Islands; an Associate Institution of the United Nations University; a partner in the Marine Alliance for Science and Technology for Scotland and the Scottish Alliance for Geoscience, Environment and Society.

Registered office:
Scottish Marine Institute,
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United Kingdom



Welcome

The external environment we operate in has continued to change at a rapid speed: the relationship the UK research community will have with the European Union, which contributes about 20% of our current funding, remains uncertain since the Brexit referendum three years ago; UK Research and Innovation (UKRI) is changing the funding landscape for research in the UK and, closer to home, the University of the Highlands and Islands is discussing its future governance structure.

In such a turbulent political climate, some organisations rise while others may disappear. Making the right governance and management decisions is thus particularly important for SAMS as an independent charity with its finely balanced financial setup. With this in mind, we have restructured our governance and recruited a substantial number of new trustees with diverse experiences and skills to help steer us to our future. They have been busy helping us develop and scrutinising our work to devise a new strategy for the next five years.

The six-year tenure of Professor Geoffrey Boulton as SAMS President came to the end at the last AGM, and our experienced trustee Ian Dunn took up the role of Interim Chair until Diana Murray was elected by members at the Extraordinary General Meeting on 29th March 2019 as Chair of SAMS Board and my new boss. I want to express my gratitude to Geoffrey for his dedication during his time as President, to Ian for

his support and welcome our new chair Diana to SAMS.

Our new internal science structure with three research areas has been settling in and has much improved the information flow between researchers and between research, education and enterprise. The management of SAMS continues to improve and we have been working hard on developing Netsuite as an integrated management and finance tool. Netsuite continues to challenge us daily but the financial information it can provide allows us to make more financially informed management decisions.

It's been a busy year, with staff having worked on 125 research and 34 commercial projects, publishing 81 peer-reviewed publications and a similar number of technical, project and commercial-in-confidence reports. Financially we are reporting a deficit, more than half of which related to an unexpected and very substantial increase in pension contributions.

Against the backdrop of the challenges, SAMS research and education are of increasing relevance to a society that faces a climate emergency, ongoing human population growth, a plastic waste crisis and unprecedented species extinction rates. On the last day of this reporting period a humpback whale visited SAMS, maybe a call for scientists to redouble our efforts for a healthy and sustainable marine environment.



Professor Nicholas JP Owens
SAMS Director



“

“SAMS research and education are of increasing relevance to a society that faces a climate emergency, plastic waste crisis and unprecedented species extinction rates. We scientists must redouble our efforts for a healthy and sustainable marine environment,”

01

02

Activities

4

TAUGHT PROGRAMMES1 Undergraduate
3 Masters

34

COMMERCIAL
contracts

81

PEER-REVIEWED
publications

125

FUNDED
research
projects

539

SCHOOL
pupils trained

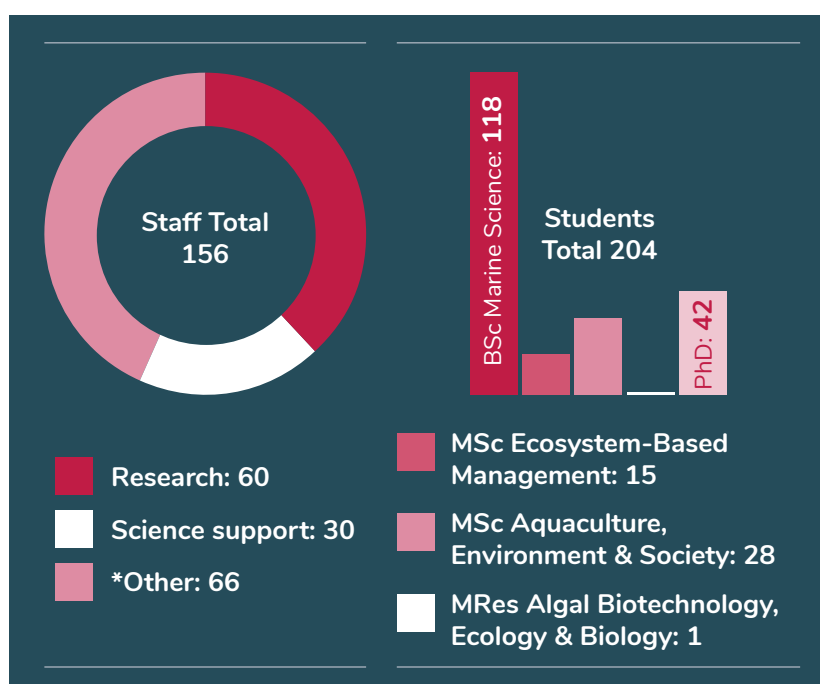
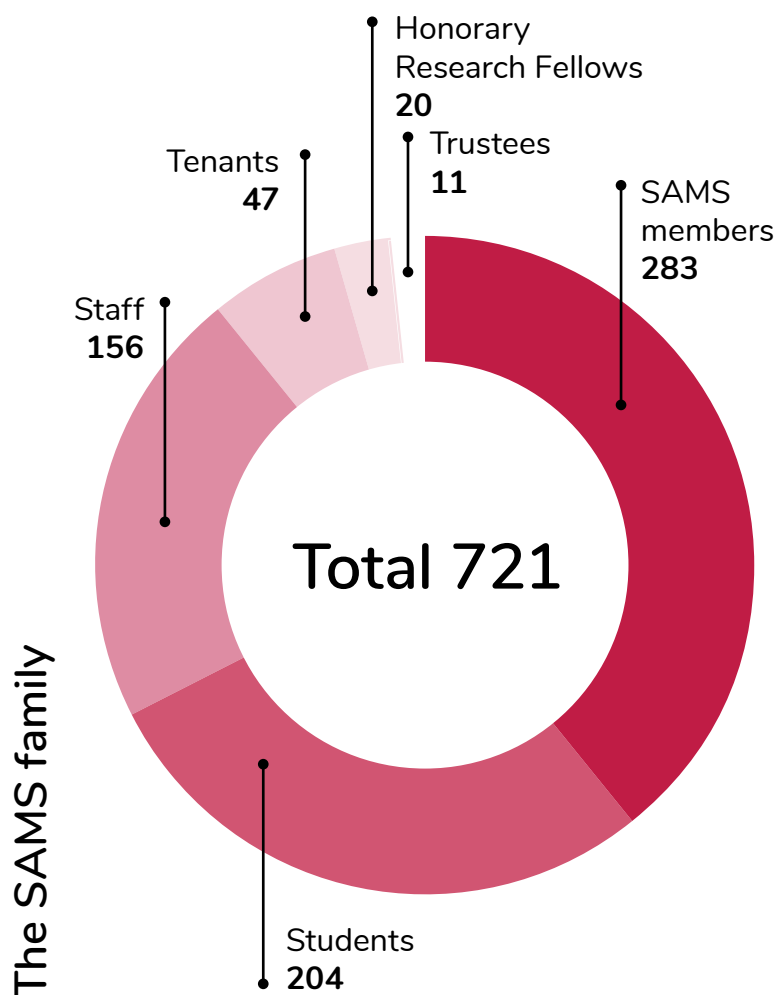
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ALGAL CULTURES
supplied
www.ccap.ac.uk

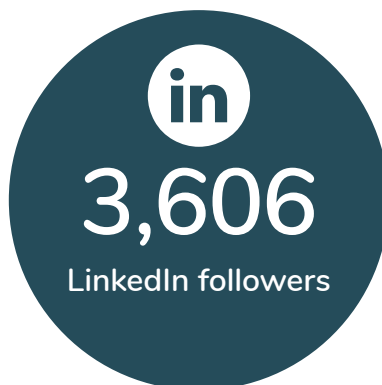
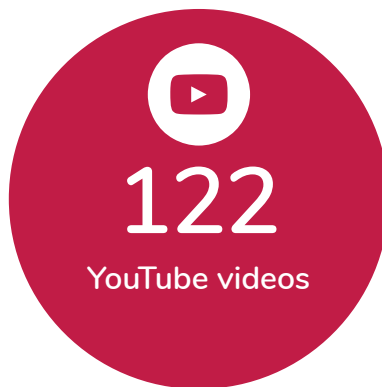
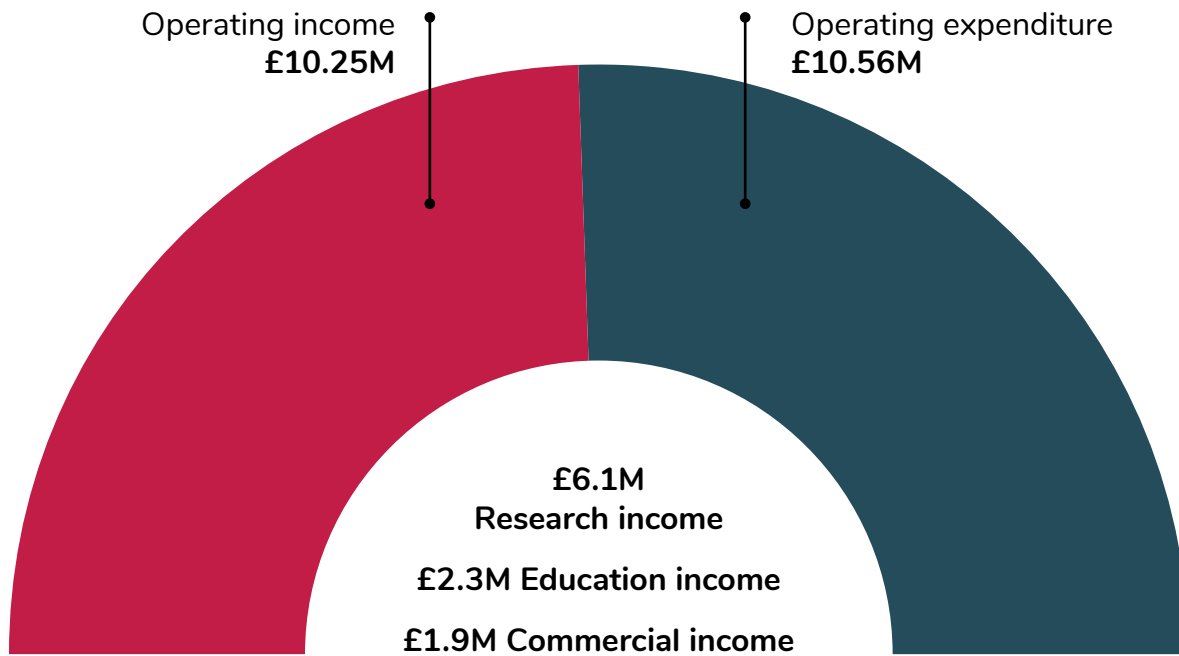
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VISITORS
to the Ocean
Explorer
Centre

At a Glance



Finance

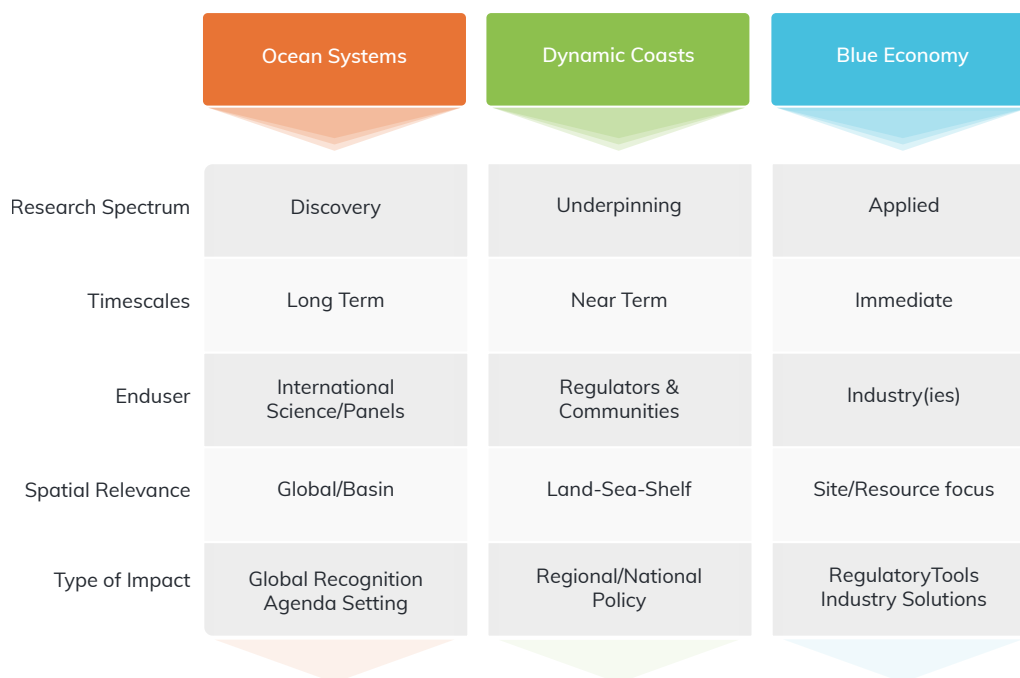


Research overview

In 2018 all SAMS research was restructured.

In 2017, at the senior management level, two Associate Directors were appointed to join Prof **Keith Davidson**, who had been Associate Director for Science and Education since 2015. Prof **Ben Wilson** took up the role of Associate Director for Science and Research and Prof **Michele Stanley** that of Associate Director for Science, Enterprise and Innovation. Between them the three Associate Directors manage all senior research staff and take responsibility for the science at SAMS with special focus related to academic research, education and innovation at the Executive Group.

To encourage multi-disciplinarity, innovation and team-working in our research and to dissuade fixed and closed groups, three research areas were set up in 2018. They are home to projects rather than to people. Since November 2018 a senior scientist and a dynamic early career researcher lead each research area. Together they organise and run regular meetings and distribute research-area related information about funding and fieldwork opportunities, conferences, new staff, students and projects and facilitate discussions about infrastructure and resource priorities, ethics, policy and scientific developments as well as research strategy and tactics.



The three research areas have collaborated with the Associate Director for Science and Research to develop a new research strategy for SAMS that is currently under consultation. They also organised a 'SAMS day' that brought staff from all areas of the organisation together for team-building, discussion, exploration, creativity and fun.

Drs **Mikey Ross** and **Neil Fraser** organised a weekly programme of lunchtime research seminars, inviting staff, students, fellows, members, tenants and visitors to share and discuss their research with the wider SAMS

community. Additionally training programmes for research staff and students offer internal opportunities to develop the skills researchers require to have a successful career including proposal writing, writing high impact papers, leadership, project and people management, and communication.

SAMS continues to quality control all research proposals that are submitted. This year the high quality of our proposals resulted in NERC lifting its proposal cap for SAMS that had allowed only one research proposal submission per standard grant round.



At SAMS there is a real mix of fundamental research in marine areas but also recognition of how that connects with industry, the environment and our communities. I was very interested to find that recognition here.

Prof Sheila Rowan MBE
Scotland's Chief Scientific Adviser

03

Ocean Systems Research

This research area explores the key processes that comprise the interconnected systems by which our oceans function. These processes range in scale from molecular to planetary and cover all scientific disciplines. Research topics include Arctic science, large-scale oceanography, climate change, ecosystem function and marine plastics.

*61 staff members and research students are interested in this research area, led by Prof **Finlo Cottier** and Dr **Raeanne Miller**.*



A decade of SAMS glider research

SAMS' first glider, *Talisker*, arrived at SAMS ten years ago as the UK's first robotic Seaglider. She has been busy monitoring the North East Atlantic since, travelling 11,500 km, spending 622 days at sea, recording 6,484 oceanographic profiles and braving force 10 storms and high seas to obtain measurements where oceanographers otherwise could not. Seagliders make cost-effective, long-term and long-distance observations down to 1,000 m. *Talisker* has since been joined by an entire fleet of gliders in our Scottish Marine Robotics Facility and has contributed to a host of research projects.

Shining a light on Arctic change

SAMS continued to focus on the Arctic region, leading two NERC-funded Changing Arctic Ocean projects.

For Arctic PRIZE our scientists and some of their ocean-going robots undertook three cruises to the Barents Sea in six months, spending 48 days at sea, covering 5,400 miles and reaching 83°N. The three cruises meant that environmental data about the ecosystem could be gathered in total darkness, under day-night light conditions, and in total daylight. The project was successful in measuring the beginning of the spring

bloom in the Arctic both in open water and below sea-ice to study the dynamic interactions between ice, nutrients and phytoplankton. An autonomous glider has continued measuring ocean temperature, salinity, oxygen and chlorophyll concentrations between the expeditions. This research is important if we want to predict the response of the Arctic ecosystem to decreasing sea-ice cover.

Dr **Laura Hobbs** studies the distribution and movement of zooplankton. Using populations collected in the High Arctic, she discovered that zooplankton does not display the typical diel vertical migration behaviour during the midnight sun and polar night. Somewhere between 81 and 89 degrees north, zooplankton appears to stop moving in unison to a daily solar cycle. Diel vertical migration was only observed in late February and August in High Arctic zooplankton.

Greenland ice sheets are melting even in winter

Giant warm waves were found to melt Greenland glaciers from below even in winter, contributing to rising global sea levels. Dr **Neil Fraser** developed computer simulations to study coastally trapped internal waves measuring up to 140 m from trough to crest and found that they are pushing relatively warm water up through Greenlandic fjords creating more wintertime melt than previously assumed. His study area was the Kangerdlugssuaq fjord, the drain for one of



PhD project focus

Sea Ice Retreat: using AUVs to measure the turbulent polar oceans

"I'm a NEXUSS funded PhD student working on turbulence data from the Barents Sea, near Svalbard, collected as part of the Arctic PRIZE project using a microstructure profiler. I have just finished my second year and I am currently looking at relationships between the turbulent mixing environment and the hydrography of the area and the sea ice extent during the cruises."

Jamie Rodgers

Greenland's major glaciers, and focused on 2012 events. An estimated 600 gigatonnes of meltwater flowed into the ocean that year.

A sea change in our view of overturning in the subpolar North Atlantic

Prof Stuart Cunningham, Prof Mark Inall and their teams contributed to a publication in *Science* that highlights the increasing influence of the Atlantic Meridional Overturning Circulation on global climate change.

Impacts of marine heatwaves

Prof Michael Burrows contributed to the first comprehensive analysis of marine heatwaves across the globe between 1982 and 2016 that was published in *Nature Communications*. On a local scale marine heatwaves may be caused by unusual changes in air temperature, winds or cloud cover or as a result of currents and mixing. On a larger scale climate change may become an important and worrying driver. A change in the baseline must be accommodated when predicting future marine heatwaves. Variability in ocean temperature is globally thought to remain relatively steady but high latitude regions may see a marked increase in temperature variability and experience more intense marine heatwaves. The impacts of marine heatwaves on marine life will be diverse and include migrations

and distribution shifts – with much research to follow from this seminal work.

Microplastics – a historic problem

PhD student **Winnie Courtene-Jones** delved into SAMS' archived Rockall Trough samples, collected during the Ellett Line expeditions, to assess the extent of microplastic ingestion in the stomachs of bottom-dwelling starfish and brittle stars between 1976 and 2015. She found traces of eight different types of plastic in nearly half the specimens living 2,000m and more below the surface. Surprisingly, she also found that the levels of ingestion were remarkably similar throughout that period. Microplastic pollution in our oceans is thus not a new problem and more long-term data is urgently needed to better understand its relevance.

Dr Bhavani Narayanaswamy contributed to a study of microplastics in deep-sea amphipods in six of the deepest marine ecosystems on Earth.

SAMS' capability to study marine microplastics was significantly enhanced by the generous philanthropic gift of a state-of-the-art instrument to analyse plastic particles.

Dynamic Coasts Research

This research area provides the underpinning biological, ecological and sociological knowledge to support the developing relationship between society and the sea.

64 staff members and research students are involved in this research area, led by **Dr Clive Fox** and **Dr Suzi Billing**.

Social licence research

Social licence is a concept that includes legal authorisations (such as planning permission) for development, and the informal consent by communities that, if absent, can result in well-organised opposition at local and national level. With increasing demand for space within our marine and coastal environments for conservation measures and marine related industries, there is a growing requirement for social licence for these activities in order to meet social sustainability goals. This is recognised by national, EU, and international research bodies and, in some cases, government agencies.

Over the past year, Dr **Suzi Billing** has led social licence research and commercial activities on two EU projects and two commercial projects. Two social licence related PhD projects started in the reporting year and are coming to the end of their first year. This research provides a real opportunity for a transdisciplinary approach to understanding the complexities of Blue Growth and sustainable marine management.

Sustainable livelihoods in the Western Indian Ocean

Over 100 million people in the Western Indian Ocean region live within 100 km of the coast with over 1 million working in the fisheries sector alone. Fisheries have been experiencing substantial reduction in recent years,

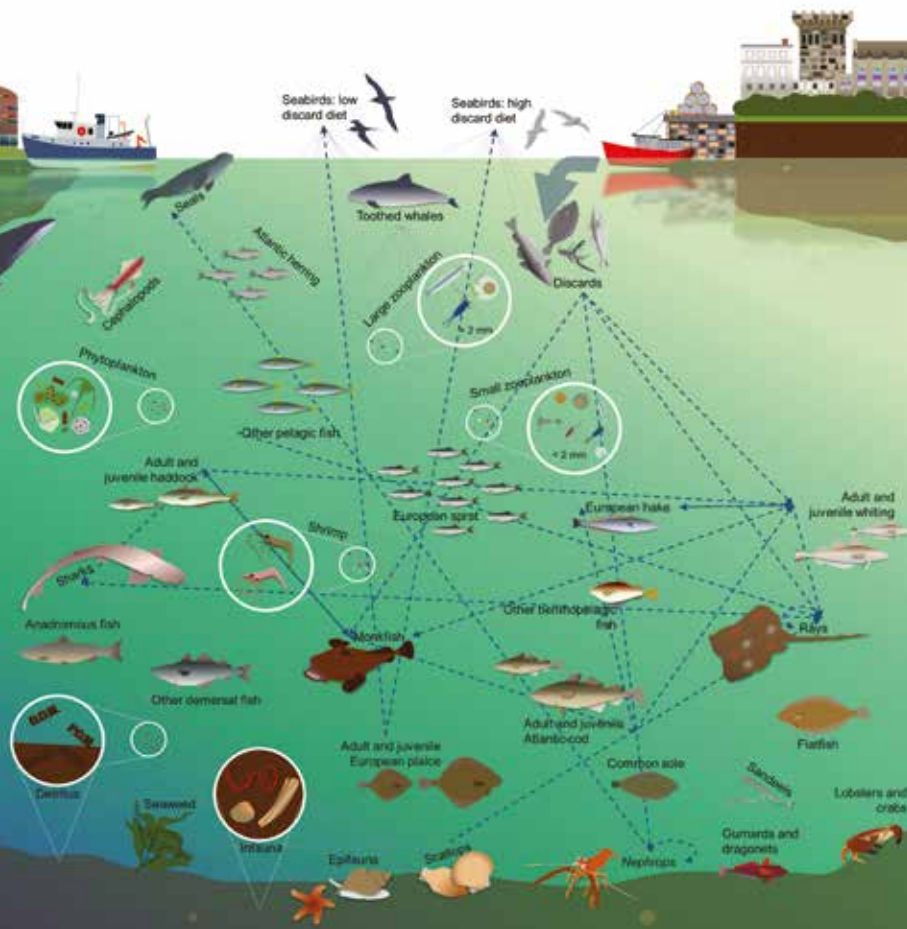
affecting food security and economic stability. The causes of the reductions are poorly understood with climate change, ecosystem variability, overfishing and degradation of key habitats all contributing to the decline.

The SOLSTICE project, led by the National Oceanography Centre and supported by the Global Challenges Research Fund, aims to build both fisheries management capacity and availability of reliable environmental and socio-economic information to support a sustainable use of marine resources in the Western Indian Ocean. At SAMS Dr **John Howe** and **Colin Abernethy** have been surveying the Mesali Island Marine Reserve near the island of Pemba using our AUV *Freya* to provide data that may enable the Zanzibar government to develop sustainable management plans for this marine reserve.

Skatespotter – a tool to conserve the flapper skate

The Loch Sunart to the Sound of Jura Marine Protected Area (MPA) is the largest conservation zone for the flapper skate (*Dipturus intermedius*). Once a common and widespread species, the flapper skate is now critically endangered with one of the largest remaining populations right on SAMS' doorstep. The MPA was initiated by calls from sea anglers who catch and release this large, long-lived fish. The sea anglers' support in collecting data to monitor the distribution and movements of flapper skates





PhD project focus

Modelling the Irish Sea food web

“For my PhD I worked with fishermen to devise a new way of assessing fish stocks in the Irish Sea. My Ecosim with Ecosim food web model considers data gathered from the fishing industry (scientific and fishers’ knowledge), environmental factors such as climate change, and how different conditions affect the food web in the Irish Sea. An International Council for the Exploration of the Seas (ICES) panel approved the model as a ‘key run’, meaning the model may be used to complement the existing single stock assessments that currently inform fishing quotas throughout Europe.”

Jacob Bentley

contributes to scientific knowledge and conservation.

As individual fish can be identified by the distinctive spot pattern on their backs, Dr **Steven Benjamins** from SAMS and colleagues from Scottish Natural Heritage have developed the online ‘Skatespotter’ photo-ID catalogue, containing >1,500 images of >800 individual skate taken by volunteers. This will help monitor individual movement patterns and changes in skate abundance. Anglers are encouraged to help monitor the population by uploading photographs to <https://skatespotter.sams.ac.uk>

In a related project, Dr **Clive Fox** has been developing baited camera landers to study the distribution of flapper skate in their deepwater environment.

Habitat mapping for MPAs

The Marine Protected Area Management and Monitoring (MarPAMM) project develops tools to enable the effective management of our growing MPA networks around the west coast of Scotland, Northern Ireland and the Republic of Ireland. It will also develop four regional and two site-specific management plans. Within a partnership of regulatory, academic and third sector organisations, Dr **Clive Fox**, Dr **John Howe** and **Colin Abernethy** from SAMS contribute information on the distribution of seabed species and bathymetry to produce habitat maps. They are also involved in trialling novel

MPA monitoring technologies using robotic surveying tools. Dr **Anuschka Miller** delivers the project communications and outreach and **Andy Crabb** supports the stakeholder engagement and dissemination with film footage.

Minke whales recorded off Scotland’s east coast

Minke whales are large and protected but their distribution and population sizes are hard to assess and monitor as they do not display and their sounds are difficult to pick up.

As part of the East Coast Marine Mammal Acoustic Study (ECOMMAS), marine mammal researchers for the first time recorded the sounds of Minke whales off the east coast of Scotland using an array of underwater sound recorders. The study had monitored bottlenose dolphins but SAMS scientist Dr **Denise Risch** used software to pick out the Minke whales’ underwater sounds from two years’ worth of recordings. The Minke whales’ low frequency calls had been difficult to record from moving platforms like boats and from near the shore while the static ECOMMAS array further from the shore allowed for their successful recording.

Many mysteries remain about this whale species, such as where they breed and the paths they use in their migrations. Dr Risch will use the same methodology to monitor Minke whales on the west coast of Scotland as part of the COMPASS project.

Blue Economy Research

This research area develops industry solutions and regulatory tools, channeling SAMS' expertise in fundamental and applied marine science to support commercial users of the marine environment to gain wealth from the oceans without degrading the very system we all depend on.

60 staff members and research students are involved in this research area, led by Dr Adam Hughes and Dr Sally Rouse.

Developing offshore aquaculture

The development of aquaculture in offshore environments offers a potential route for the sustainable expansion of the industry. More dispersive open environments offer the potential for larger farms with reduced interconnectivity and lower environmental impact. But these more exposed environments carry their own risks. The £1.1m three-year Off-Aqua project evaluates the environmental conditions required for successful offshore aquaculture sites. The project is led by Prof **Keith Davidson**. Physical oceanographers Drs **Max Holloway** and **Andrew Dale** contribute detailed physical observations at three contrasting potential sites for offshore aquaculture development. Drs **Tom Adams** and **Dmitry Aleynik** are using existing regional unstructured grid and new localised non-hydrostatic models to evaluate sea lice connectivity and harmful algal blooms (HABs) development in contrasting sites.

A consortium of engineers, environmental scientists and social scientists from the UK and China are collaborating to evaluate the feasibility of integrating marine renewable energy devices and aquaculture facilities into floating multi-purpose platforms (MPPs). The multidisciplinary team is presently progressing several focused studies on aspects of MPP design and impacts on surrounding ecosystems and communities. The team are exploring the overall feasibility of the MPP concept through two case studies, one focusing on small island communities in

China and one on remote aquaculture facilities in western Scotland. SAMS scientists Dr **Natalia Serpetti**, Dr **Steven Benjamins**, Dr **Adam Hughes** and Prof **Ben Wilson** are modelling and evaluating environmental impacts of these platforms and contributing to the Scottish case study.

Improving global seaweed aquaculture through collaborations

The £6m four-year Global Challenge Research Fund project GlobalSeaweedSTAR, led by Prof **Elizabeth Cottier-Cook**, works for the sustainable economic growth of the global seaweed farming industry. They do this through growing research and innovation capabilities of the developing nations that carry out 95% of the world's seaweed cultivation.

During the reporting year GlobalSeaweedSTAR launched a £200k travel grant scheme to build further collaborations and knowledge exchange between researchers and the industry. The scheme will in particular enable rapid reactivity to emerging crises such as disease outbreaks or invasions of non-native species in the seaweed farming industry.

For six months SAMS with its UK partners Cefas, the Overseas Development Institute and the Natural History Museum also hosted eleven early-career seaweed scientists from Tanzania, Indonesia and the Philippines. They learnt from UK researchers about seaweed-related topics such as movement of invasive species, the

genetic diversity of seaweeds, algal identification techniques as well as professional skills such as publishing, oral presentation and working with the media.

Algal research for policy making and biotech

Dr **Claire Gachon**'s group organised a week-long conference for around 160 scientists from around the world at SAMS in May 2018. Global experts shared and discussed their developing knowledge on algae, covering topics including microbiology, aquaculture, biofuels, algal disease, invasive algae and more. The event incorporated project meetings for GENIALG, GlobalSeaweedSTAR, ALFF and the annual Young Algaeneers Symposium.

Forecasting Harmful Algal Blooms

There is real appetite in Europe to increase aquaculture production and reduce pressures on wild fish stocks and seafood imports. The costs associated with HABs can, however, limit the further expansion of the industry.

The shellfish industry is particularly impacted by HAB events and scientists are therefore devising ways of providing more accurate forecasts to help shellfish producers.

One such project is PRIMROSE (Predicting the impact of regional scale events on the aquaculture sector) which aims to deliver improved forecasts of HABs, microbial risks and climate impacts in aquaculture locations the

length of Europe's Atlantic Arc from the Shetland Islands to the Canary Islands. It uses Sentinel 3 satellites to provide increased remote sensing resolution, as well as on-site sampling to develop early warning systems. Prof **Keith Davidson**, Dr **Callum Whyte**, Dr **Dmitry Aleynik** and **Steven Gontarek** contribute by developing a Scottish online risk assessment service for aquaculture and devising a 'toxin traffic light' method of risk assessment. Dr **Phil Anderson** is developing and evaluating the use of airborne drone technology for HAB remote sensing and water sample collection while **Euan Paterson** leads the project communication.

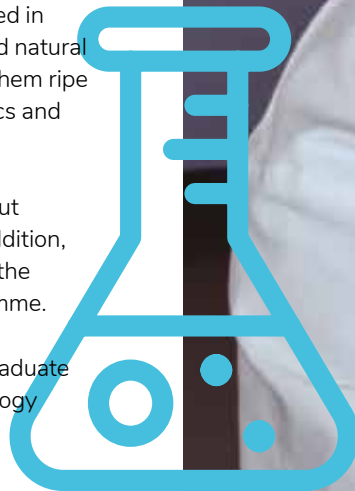
Blue biotechnology

Blue biotechnology is thriving at SAMS with cutting-edge research exploring the potential uses of bacteria, cyanobacteria, viruses, macro- and micro-algae. The cellular properties and the compounds synthesised by these powerful small organisms have importance in a range of industries including aquaculture, bioenergy, and other high-value markets.

For example, the three-year EU Horizons 2020 R&I funded ABACUS project aims to bring active ingredients derived from algae and cyanobacteria to market. These ingredients include volatile terpenes such as limonene and pinene that can be used in fragrances and carotenoids, which have vivid natural colours and antioxidant properties, making them ripe for use in food/feed, nutraceuticals, cosmetics and pharmaceuticals.

Biotechnology is a key component throughout the taught BSc Marine Science degree. In addition, SAMS annually hosts an elective module of the IBiolC Industrial Biotechnology MSc programme.

Furthermore, SAMS currently has 10 postgraduate research students involved in the biotechnology field.



PhD project focus

A century of changing toxic algae in Scottish coastal waters

"I am investigating the toxic bloom forming dinoflagellates *Alexandrium tamarensis* and *Lingulodinium polyedra*. As part of their sexual life cycles, these two species produce a resting stage that falls through

the water and accumulates on the seabed. Here they overwinter with minimal metabolic activity but when the growing season returns, they may germinate and inoculate the overlying waters with motile cells.

This allows the cycle to resume. I study the environmental variables that influence the frequency and intensity of *Alexandrium tamarensis* and *Lingulodinium polyedra* blooms by studying their cysts."

Cathy Winterton



SAMS infrastructure includes the Culture Collection of Algae and Protozoa (CCAP), which hosts more than 3,000 strains on site.

CCAP is a component of the UK's scientific infrastructure and is funded by the Natural Environment Research Council (NERC), part of UK Research and Innovation, as a national service culture collection, providing cultures (cyanobacterial, protistan, macro-algal), bioinformatic data, services and advice to the scientific community world-wide.
www.ccap.ac.uk



04

2018 Prizes

Johanna Fehling Memorial Prize:

PAUL DEES

*

SAMS Award for Overall
Achievement:

HANNA EWEN

*

SAMS Council Award for
Academic Excellence:

IVAN CAUTAIN

*

Tim Boyd Prize for
Oceanography:

JAMES COOGAN

*

Best ACES Dissertation:

NIKKO CABILLON

*

Best EMMS Dissertation:

KIRSTEN DINWOODIE

*

SAMS UHI undergraduate
student of the year:

**ENTIRE GRADUATING
COHORT OF 2018**



*Eleanor Wood with Michael Rayner, Dean of Research
at the University of the Highlands and Islands*

Education

Graduation 2018

This year's graduation marked the first award of a University of the Highlands and Islands research degree after the Privy Council had granted the university the power to award research degrees in June 2017: **Eleanor Wood** obtained a Master of Science by Research degree and graduated alongside 45 other graduates.

The keynote speaker at the graduation was Prof Stuart Monro, Scientific Director of the Scottish Consortium for Rural Research, who encouraged the students to "go out and use the knowledge and understanding you have gained at SAMS to steward this wonderful world."

"Studying at SAMS UHI has been of great benefit to me, as the institute is renowned for excellent research."

Eleanor Wood, MSc by Research graduate 2018



Bryden Centre summer school



2018 kicked off the Bryden Centre for Advanced Marine and Bio Energy Research, a €9.4 M cross-border collaboration on renewable energy research between the University of the Highlands and Islands and partners in Northern Ireland and the Republic of Ireland.

The programme aims to develop research and industry capacity in marine renewable energy across the region by supporting PhD studentships which are both academically rigorous and address pressing industry challenges. Four Bryden Centre PhD students are based at SAMS, working on projects including the recovery of flame shells following disturbance; community-scale tidal power generation; monitoring and detection of gadoid fish in marine renewable energy development areas; and the social acceptability of third generation marine biofuels.

In June 2019, SAMS-UHI hosted 32 PhD students at the Bryden Centre Summer School, involving businesses and enterprise organisations in six days of discussions, presentations, site visits, and interactive projects.

The Bryden Centre is named in honour of the late Prof Ian Bryden, a well-known figure in the marine renewable energy field and a former Vice Principal of Research at the University of the Highlands and Islands.



Education... continued

Taught Masters

Our Erasmus Joint Masters Degree in Aquaculture, Environment and Society was successful in winning a further four intakes of students with a total of 68 scholarships.

The leadership of the programme moved from SAMS to the University of Crete in preparation for Brexit while Radboud University joined the consortium. 11 students joined ACES in 2018, while there were 17 students in the second year of this truly innovative and international programme. In March, ACES student **Andrew Richardson** won the Lantra Scotland Higher Education Award at an awards' ceremony at the Hilton Hotel Dunblane. Lantra Scotland supports learners in the land-based, aquaculture and environmental sector.



One student studied the MRes in Algal Biotechnology, Ecology and Biology exploring microplastics.

Prof **Michele Stanley** leads an optional Blue Biotechnology module as part of the Industrial Biotechnology Innovation Centre Master in Biotechnology. Last year 14 students selected the module, which received positive feedback.

SAMS also provides two residential courses for IDCORE, a doctoral training programme for Engineering PhD students focusing on marine renewable devices. The Marine Renewables and Society course was for the first time led by Dr **Suzi Billing**. A proposal was submitted to ESPRC for a further five years' of funding for IDCORE.

Marine Science BSc

In the academic year 2018-19, SAMS had 118 students studying the 4-year full-time UHI undergraduate marine science programme.

These were made up of 78 Scottish students, 31 EU students and 8 students from the rest of the UK. Some changes were made to the programme: Science Communication was withdrawn as an optional module with the content integrated into other modules throughout the degree while Palaeoceanography was closed. Fisheries and Aquaculture were moved from third to fourth year. The course leader was **Dr John Howe**.

International exchanges are an important cultural and educational aspect of studying at SAMS UHI. In 2018/19 nine Erasmus students joined the programme for one or two semesters from the Universities of Konstanz, Zadar, Valencia, Alicante and an exchange student from Canada. In exchange six SAMS students studied at the University Centre in Svalbard and three spent a semester at the Van Hall Larenstein, University of Applied Sciences in the Netherlands. **Shona Magill** is the ERASMUS coordinator at SAMS.

The high quality of the programme was recognised by achieving 100% overall satisfaction in the National Student Survey for the second year running.



PhD students will increasingly gain doctorates from the University of the Highlands and Islands.



Postgraduate research

Our research student community consisted of 44 postgraduate students, 36 of which were registered with the University of the Highlands and Islands. Eight of these joined in the reporting year alongside one MRes student. Research topics cover the entire breadth of science at SAMS with funding hailing from doctoral training partnerships, the European Social Fund, Marie Curie and Interreg. Most SAMS PhD students in the

reporting year graduated with a University of Aberdeen degree as the validating university. In the future our PhD students will increasingly gain doctorates from the University of the Highlands and Islands. During the reporting period two doctoral training partnership applications ('SUPER; and 'E4') that included SAMS were approved, which may increase the number of PhD students further in the coming years.

The SAMS graduate school, led by Dr **Bhavani Narayanaswamy**, organised a comprehensive professional development portfolio that is also open to PostDocs and research staff. The programme included sessions on statistics, communication, management, proposal writing, teaching and general employability skills.



87% of SRSL customers
are repeat business.

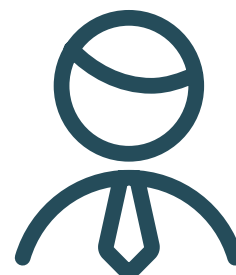
05

Enterprise and Innovation

SAMS Research Services Ltd (SRSL)

Enabling Productive Oceans

SAMS engages commercially with industry and organisations working in the marine environment through our wholly owned subsidiary and scientific consultancy, SRSL.



SRSL is integrated into SAMS but operates to commercial management standards. To deliver to the needs and expectations of its customers, SRSL operates and manages a Quality Management System that is compliant, and accredited, to SO9001 and ISO17025. This allows SRSL to continuously improve internal processes and procedures to meet the requirements of customers with consistency, quality of service, and efficiency of operation.

Value to society

Increasingly, SRSL operates at the interface between academia and business – the so-called innovation space – which is recognised as an important area to stimulate employment, new businesses and wealth generation.

Being integrated into SAMS, SRSL can leverage the expertise, skills and knowledge of world-leading scientists and the cutting-edge infrastructure of a research laboratory for the benefit of its customers for them to better carry out their business and reduce the conflicts between their business activities and the marine environment.

Value to SAMS

In the reporting year SRSL had a turnover of £1.44M allowing it to contribute £339k to SAMS and cover ca £500k of researcher salary costs..

Our activities in 2018-19

SRSL delivered 34 contracts in the reporting year, falling into the following priority areas of activity.

NewDEPOMOD

In the past year we have successfully commercialised our aquaculture modelling software NewDEPOMOD with annual licences sold in the UK, USA, Norway, Chile, Canada and Tasmania. The regulator in our immediate domestic market has adopted and specified its use and we are working with the regulators in our export markets.

Sea-lice modelling

For the SAMS-developed sea lice connectivity modelling, we have achieved a position where this modelling is now a Marine Scotland requirement in the aquaculture consenting process and we are delivering this service to Scottish fish farmers.

Seaweed hatchery success

In the past year we have increasingly commercialised our seaweed hatchery. We supply seaweed 'seed' to a growing number of seaweed farmers and have grown our customer base for the first time beyond the borders of Scotland.

Marine growth estimates

We have been delivering a marine growth assessment service to both the oil and gas decommissioning and marine renewables markets. Industry needs to monitor marine growth on installations as it affects performance both during the operational and the decommissioning phase. Monitoring marine growth type, mass, volume and surface roughness, industry requires accurate measurements as possible to inform engineering decisions, optimise cleaning regimes, inform lifting operations and organise disposal. SRSL has been using 3D photogrammetry to provide this information.

Sea ice monitoring

SIMBA is a product developed by polar scientists at SAMS to estimate the thickness and condition of sea ice. SRSL commercially builds SIMBA units for the polar ice research market. We are also exploring the potential of the technology for avalanche and flood forecasting, working with the support and endorsement of the Scottish Avalanche Information Service and SEPA.

Membership

SAMS Research Bursary

Microplastic fragments in Scottish coastal water

Recipient: **Solène Giraudeau-Potel**

Plastic pollution is a worldwide problem. Although research into this threat has been increasing substantially, many unknowns remain: dispersion, fate and toxicological impacts of microplastics are still obscure and answers are needed to initiate models for monitoring purposes and, most importantly, to inform policy makers. Yet not even all sources of this pollution are well described or recognised.

This project looks at toner material - an omitted source of microplastic - and estimates its impact. Over 250,000 tonnes are produced annually, which represents an important potential input of microplastics to the natural environment.

The £1,000 SAMS research bursary allowed Solène to visit the ACEMAC facility at the University of Aberdeen to run elemental analysis with a Scanning Electron Microscope coupled with Energy Dispersive X-Ray Spectroscopy (SEM-EDS). The results from this research, once fully analysed, will help identification purposes for the scientific community.

SAMS Honorary Fellows

Black, Prof Kenny
Brennan, Dr Ruth
Calderan, Susannah
Craig, Dr Clive
Day, Prof John

Duncan, Dr Katherine
Gary, Dr Stefan
Gordon, Dr John
Gowen, Dr Richard
Hatton, Prof Angela

Heymans, Prof Sheila
Jones, Dr Ken
Leakey, Dr Ray
Lewis, Prof Jane
McLeod, Dr Andrew

Meldrum, Prof David
Moore, Prof Geoff
Rice, Dr Jake
Sherwin, Prof Toby
Stahl, Dr Henrik


29th Annual Newth Lecture

The rise of ocean technologies

On 7 Dec 2018, **Steven Hall**, CEO of the Society for Underwater Technology, delivered our annual lecture on 'Blue Future: how new technology is going to change our relationship with the global ocean'. In a deeply thought-provoking lecture Steven highlighted the decisions humankind will need to make about the use of new technologies that allow us to use the marine environment at an increasingly large scale and in new ways.

The lecture was recorded and can be viewed at <https://www.youtube.com/watch?v=6zLNV7XOTLg>

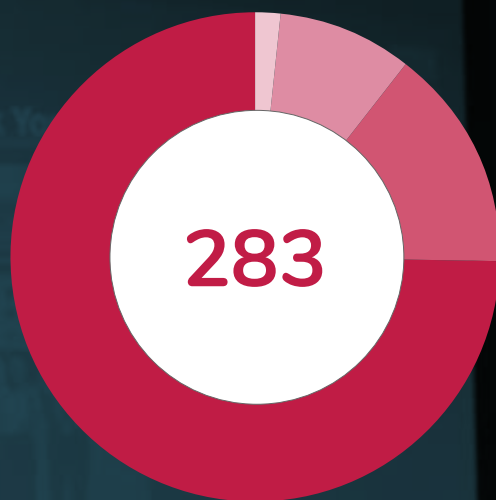
The lecture is named after a former SAMS President, the zoologist David R Newth, who was at the Association's helm from 1973-79.



Stephen Hall, CEO of the
Society for Underwater
Technology (SUT)



Current members



5

Honorary & Life

25

Corporate

42

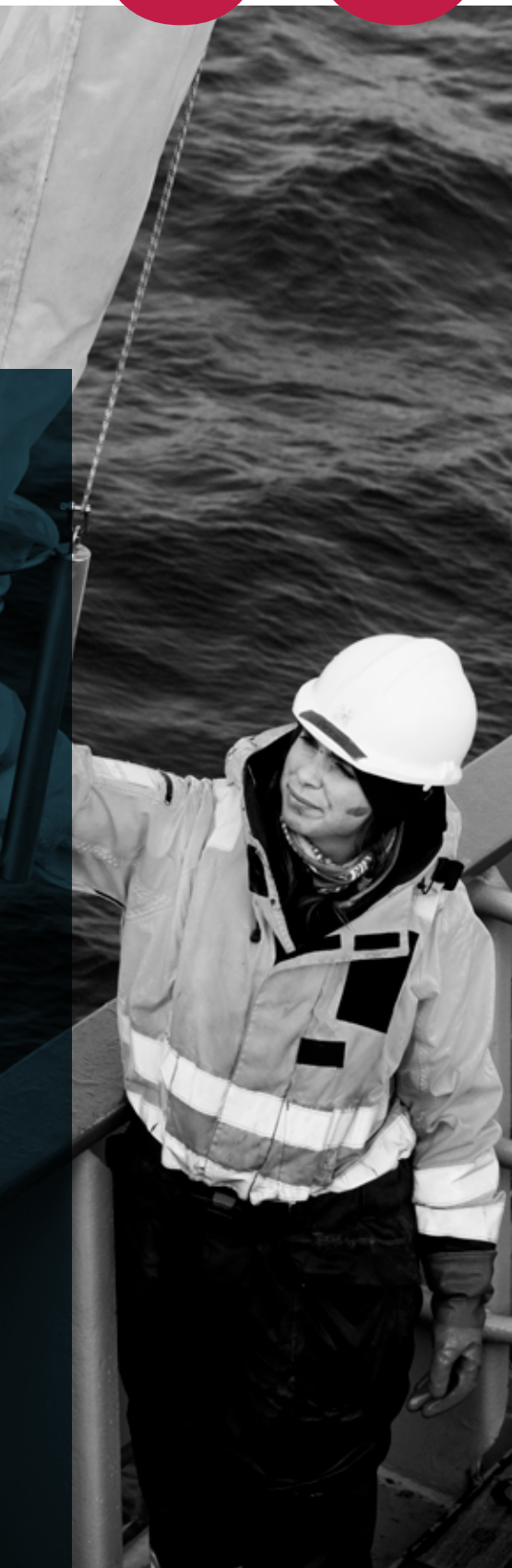
Students & unwaged

211

Ordinary

06

06



Prof Mark Inall



Prof Finlo Cottier, Prof Michele Stanley and Dr Claire Gachon

Our People

Academic promotions

The University of the Highlands and Islands awarded three new academic titles to SAMS researchers:

- **Finlo Cottier** was promoted to Professor. He is a physical oceanographer with expertise in Arctic climate change. At SAMS he leads our Ocean Systems research area. In 2015 the Arctic University of Norway had already appointed Finlo as an Adjunct Associate Professor in Polar Oceanography.
- **Michele Stanley** was promoted to Professor. She is an applied phycologist with expertise in biochemistry and molecular biology. At SAMS she acts as Associate Director for Science, Enterprise and Innovation and champions research that has societal and economic impact.
- Dr **Claire Gachon** was promoted to Reader (read Oban-Paris Express for information about her research.)

SAMS diversity

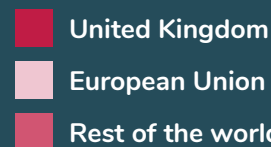


49.7%

Male

50.3%

Female



Advising the Scottish Government

On 1st January 2019 marine physicist Prof **Mark Inall** was appointed the only marine scientist on the 13-member Scottish Science Advisory Council. The SSAC is Scotland's highest level science advisory body, providing independent advice and recommendations on science strategy, policy and priorities.

In July 2018 Prof Inall gave evidence to the UK Commons Environmental Audit Committee inquiry into the changing Arctic.

Oban-Paris Express

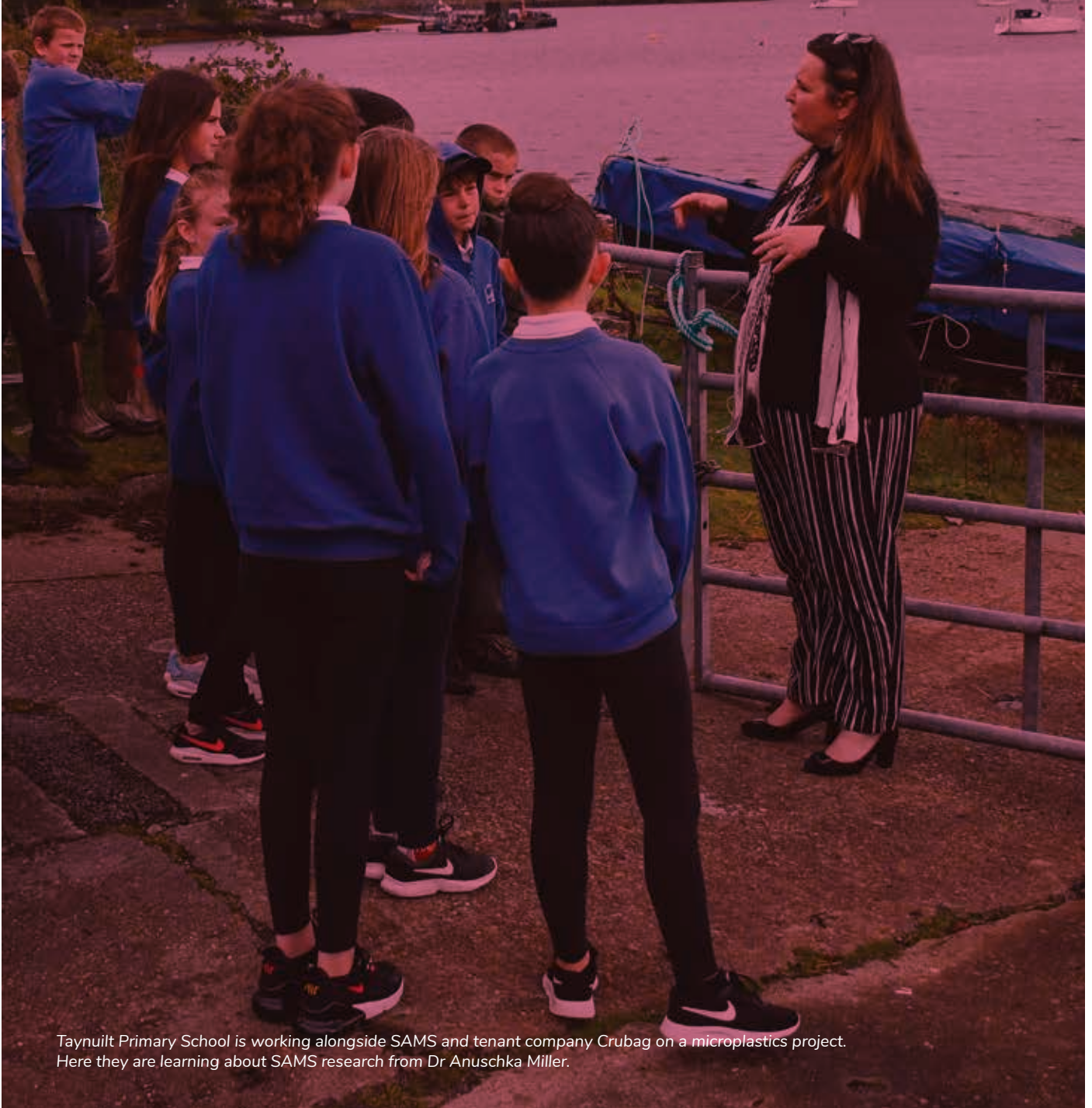
In her 11 years at SAMS, Dr **Claire Gachon** has developed a large and dynamic group of young researchers investigating the ecology, physiology and genomics of diseases in algae. Among her numerous outputs were the successful GlobalSeaweed project, the EU doctoral training project 'Algal microbiome – friends and foes' and SAMS' involvement in large EU infrastructure and networking programmes.

Her achievements were awarded with promotion to Reader during the reporting period. To keep her European networks active post-Brexit, she will be reducing her hours at SAMS to also act as co-director of the bioinformatics facility in the Natural History Museum in Paris. The Auld Alliance remains intact!



How inappropriate to call this planet Earth when it is quite clearly Ocean.

Arthur C Clarke



Taynult Primary School is working alongside SAMS and tenant company Crubag on a microplastics project. Here they are learning about SAMS research from Dr Anuschka Miller.

07

Public Engagement

Ocean Explorer Centre

Our Ocean Explorer visitor and outreach centre welcomed 4,474 visitors during the reporting period. **Helen McNeill**, **Elaine Mitchell** and helpers delivered 24 workshops in the OEC, reaching 539 pupils of mostly primary school age, covering topics including ocean plastics and pollution, Arctic exploration, the biology and uses of seaweed, the deep sea, ocean acidification and more. Additionally, we developed and delivered six events including a 'Sea Food for Christmas' event, where our aquaculture master students practised their engagement skills. We also regularly attend external events like Highland games with activity stands.

Future of our Seas

A particular public engagement highlight was the NERC-funded 'Future of Our Seas' project, led by Dr **Raeanne Miller**. Collaborating with eight partners from UK marine research, engagement, advocacy and environmental arts organisations, FOOS trained 24 marine scientists to engage people in vibrant, two-way conversations about the future of our seas. After two three-day-training programmes, one held in Plymouth and one in Oban, 16 novel activities were

developed by the participants with the support of 35 community partners. During West Highland Yachting Week on 30-31 July 2018 the project put on a public event at Station Square in Oban to allow the young scientists deliver their activities and learn from the live experience. One particularly successful activity exploring underwater soundscapes of the west coast of Scotland that was developed by SAMS PhD student **Charlotte Findlay** is currently being turned into a new display for the Ocean Explorer Centre by artist partners from the Templar Arts and Leisure Centre.

Capturing our Coast (CoCoast)

The reporting year saw the end of the three-year CoCoast project that between its eight partner organisations trained 3,000 citizen scientists to gather data about the species that live on the coasts around the UK. The volunteers surveyed more than 20,000 quadrats from 1,800 sites. SAMS hosted the only regional hub in Scotland and Dr **Hannah Grist**, **Peter Lamont** and Prof **Michael Burrows** provided training and volunteer events across Scotland.



Finance

2018/19 Financial Performance

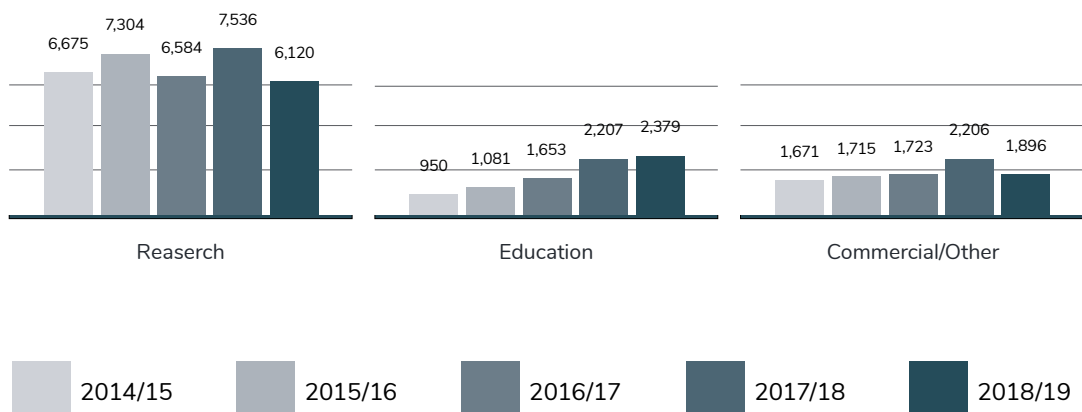
The SAMS group recorded a deficit of £2.205m in the reporting period. £1.3m of this was a pension deficit, leaving an operating deficit of £904k. This contrasts with a £833k operating surplus made the previous year.

Institutional Reform and Development Plan (IRDP)

SAMS is nearing completion of phase 1 of the IRDP: a programme of redundancies was completed to reduce the salary overhead and rebalance the science capabilities with availability of funding. The target of staff costs being no more than 60% of SAMS' total income was achieved for the reporting year.

We have also been developing and embedding a new financial and wider business management reporting system called Netsuite, and have been training all relevant staff in the use of Netsuite.

Income over five years



Financial Summary

	2018/19 £000	2017/18 £000	Change %
Operating Income	10,252	12,069	(15%)
Operating Expenditure excluding grant funded depreciation	(10,558)	(11,611)	(9%)
Operating Surplus/(Deficit) before exceptional item	(306)	458	
Other income	199	1,211	
Pension Deficit Obligation	(1,301)	198	
Depreciation funded by grants received in previous year	(797)	(836)	
Surplus/(Deficit) transferred to reserves	(2,205)	1,031	



Research

Income from research grants and contracts fell in the reporting year to the lowest level in the past five years.

NERC continues to be our most important research funder, responsible for nearly 45% of research income, although our income from NERC was also lower than in previous years.

EU grant income was particularly affected, and several Norwegian funded large projects (an 'other' funder) concluded in the past year without being immediately followed up with a new project.



Education

Education income has steadily grown for the past two decades and now accounts for 29% of SAMS' income, up from 18% last year. Undergraduate teaching generated £614k, PhD income £891k, and MRes brought in £410k with the remainder coming from short courses, fieldstation activities and more.



SRSL

SAMS Research Services Ltd (SRSL) had a successful year. With a turnover of £1.44M, SRSL contributed a profit of £382k to SAMS and 'bought' £500k of salary cost of SAMS researchers' time.

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Research publications

1st April 2018 to 31st March 2019

Peer-reviewed

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Baudron AR, **Serpetti N**, Fallon NG, **Heymans JJ**, Fernandes PG (Mar 2019) Can the common fisheries policy achieve good environmental status in exploited ecosystems: The west of Scotland demersal fisheries example. *Fisheries Research* 211: 217-230 <https://doi.org/10.1016/j.fishres.2018.10.024>

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Benjamins S, Dodd J, Thorburn J, Milway VA, Campbell R, Bailey DM (Jul 2018)

Evaluating the potential of photo-identification as a monitoring tool for flapper skate (*Dipturus intermedius*). *Aquatic Conservation: Marine and Freshwater Ecosystems* 28 (6) <https://doi.org/10.1002/aaq.2937>

Bentley J, Hines D, Borrett S, **Serpetti N**, **Fox C**, Reid DG, **Heymans JJ** (Mar 2019) Diet uncertainty analysis strengthens model-derived indicators of food web structure and function. *Ecological Indicators* 98: 239-250 <https://doi.org/10.1016/j.ecolind.2018.11.008>

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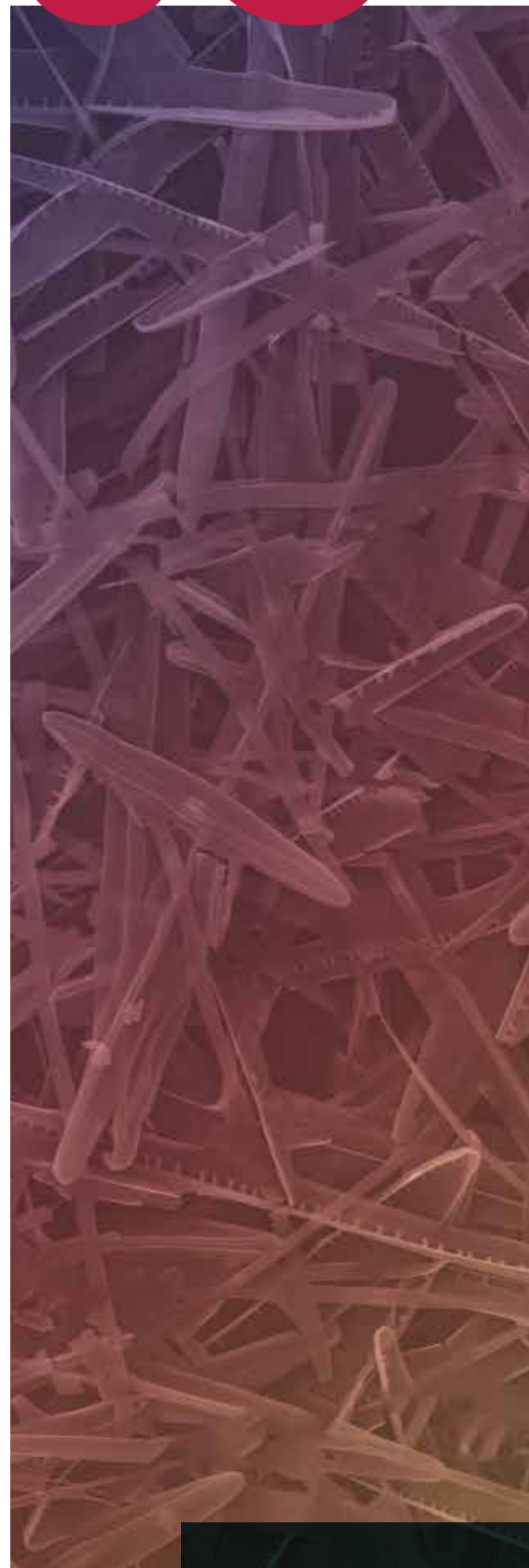
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In just one lunch break, a group of 40 SAMS staff, students and family members created this powerful message of support for the global climate strikes, out of nothing but seaweed, marine litter and enthusiasm.

Andy Crabb, SAMS Filmmaker

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1st April 2018 to 31st March 2019

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