



MASTS ASM—2017—Glasgow

Reflections

Largest in the UK

The Marine Alliance for Science and Technology for Scotland Annual Science Meeting took place in Glasgow at the University of Strathclyde's Technology and Innovation Centre. The MASTS ASM is now the largest gathering of marine scientists in the UK. Each year leading academics, innovative research students, representatives from government, NGOs and industry come together to share, collaborate and learn about the latest developments in Scotland's world leading marine science research. The annual event also attracts researchers from outside of Scotland, who are keen to work with Scottish colleagues and institutes on all aspects of the marine environment from the deep sea to the shallows of coasts and estuaries. This year more than 300 delegates had a choice of over 100 presentations and posters covering a wide range of marine



research including: how sound affects marine life; what we can expect from climate change; how we manage coastal areas; the threats of plastics in the sea; Scotland's world leading aquaculture industry; the challenges and opportunities that decommissioning oil and gas platforms might present; women in science and how Scotland's seas are being safeguarded.

"Scotland's seas are a rich resource, teeming with spectacular biodiversity while supporting a wide range of industries. Managing those seas for commerce and industry while ensuring they remain clean and healthy and continue to support wildlife is essential. Much of the marine research carried out in Scotland is geared towards understanding how the seas function and how we can use them in a sustainable manner. This meeting brings together Scotland's top-notch researchers to hear what their colleagues are discovering and to strengthen links for the benefit of Scotland's seas into the future", said Professor David Paterson, MASTS Executive Director.



Reporting the meeting

With more than 100 presentations and poster sessions, parallel workshop and break outs, the wide range of Scottish marine science was on show at MASTS ASM. In this document we provide a taster of some of the fascinating research that was presented and discussed. The reporting team was led by Kelvin Boot (MASTS) and three post graduate volunteer reporters, giving them an extra bit of experience in reporting marine science and interviewing techniques. Their initials follow the pieces they have written. Mairi MacArthur (Glasgow) - MM; Marzena Dziedzicka (Aberdeen) - MD; Hoa Nguyen (Strathclyde) - HN.



HN



MD



MM



Inevitably we could not get to every talk or workshop so within these pages is an overview, admittedly a bit selective, but we hope it gives a flavour of the incredible variety of topics covered over the few days of the ASM. Thanks to all the contributors who made time to speak to us and apologies to the many more we simply didn't have time to cover. We recorded some interviews and you can access these on the MASTS website, where there is also a complete programme with abstracts.





Invited Speaker—Conserving the deep

Dr Kerry Howell (Plymouth University) highlighted the necessity of modelling the distribution of vulnerable marine ecosystems. Examples included cold water coral and deep sea sponge aggregations, which are subject to increasing pressures from multiple stressors. With Japan's recent, rare and successful attempt of large-scale deep-sea mineral extraction, this industry's growing progress poses a new threat to the deep sea environment. Knowing the environmental conditions species prefer to live under means you can predict their distribution and habitat suitability, both habitat mapping and predictive distribution modelling have the potential to have a major role in the conservation of the deep sea. This has been used before in terrestrial modelling but the approach is new to the deep sea environment. (MM)



MASTS Women in Scottish Science Session

The gender gap in science is well documented. The session was a showcase of both the significance and variety of women's contributions to science, presented by women with a breadth of experience in marine science. Catherine Booth took us on a journey through time that shone the spotlight on women scientists of our past. Among them was the first female chair of King's College London in 1927, Doris Mackinnon, and Sheina Marshall - among the first of female fellows of the Royal Society of Edinburgh.

This segued to Raeanne Miller's (SAMS) story of her 21-day journey with 76 women on a ship in Antarctica. This was the largest non-scientific women's excursion to Antarctica. Its purpose was to equip a women with a science background to collaborate, lead, influence and contribute to policy decisions.

Meriwether Wilson (Edinburgh) concluded the talk with insights from her own highly varied career. Her talk asked us to consider how best to align the world views of conservation and development in a positive way for healthy marine ecosystems. (MM)



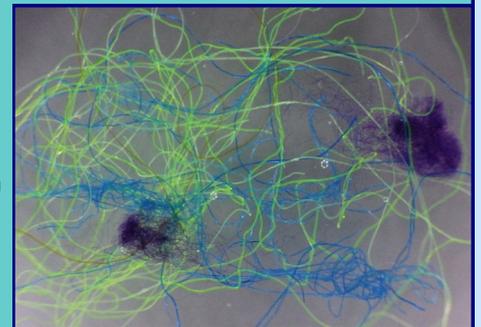
(L-R) Raeanne Miller, Meriwether Wilson, Bee Berx (Chair), Catherine Booth

Deep sea inverts ingest plastics

As problems with the widespread use of plastics continue Winnie Courtene-Jones' (SAMS) presentation shed some light onto the extent to which humans have impacted the marine environment. Despite the remoteness of the deep sea survey location, the levels of plastic found in examined species from this depth were comparable to species at the top of the water column and coastal species. In 240 litres of water collected at 2227m deep there were 71 fibres per m³, in the same range as surface water which had 2-100 fibres per m³. 87% of items ingested by invertebrates in the deep sea were shown to be fibres. This goes some way to accounting for the 'missing' plastic from the surface layers.



Greatest concentrations were found in the sea star *Hymenaster pellucidus*. Plastics are known to pass up food chains perhaps ultimately ending up in fish we might eat and so should be a cause of great concern ecologically and from a human health angle. (MM&KB)



Foraging porpoises and offshore wind

Porpoises are the commonest British marine mammal and are likely to coincide in areas suitable for marine energy installations, where there is potential for conflict. Using passive acoustic monitoring in the Moray Firth Laura Williamson examined spatio-temporal variation of harbour porpoise distribution. Harbour porpoises appeared to exhibit different behaviours and foraging strategies for different habitats. Patterns that showed seasonal shifts in distributions and foraging outside of high density areas have potential implications for MPAs, management approaches and the conservation of protected species where it is important to have a robust understanding of the distribution of populations. For example, knowing where porpoises will be at a given time will ensure offshore infrastructure is built at a suitable time of year to avoid or minimize effects on porpoises. (MM&(HN))



25 years of SNH challenges and achievements



The concepts and issues dealt with by SNH over the last 25 years have certainly evolved over time. Conversation has moved away from nature conservation and towards biodiversity. Similarly, the emphasis has shifted away from focusing on species and habitat towards ecosystem services and natural capital. Marine spatial planning has gained prominence and where we used to have a lack of relevant management legislation there is now a substantial planning and legal policy framework for the marine environment. David Donnan's talk set out how this evolution in our thinking will work with future challenges. Namely EU-Brexit talks cast a tall shadow of uncertainty over marine environmental legislation. This presents an opportunity for Scotland to put itself in a leading role for marine environmental management in the future. (MM)

Ecosystem services, conservation effortsand a wee dram!

William Sanderson talked us through the DEEP project, an environmental partnership between Heriot-Watt and whisky distillers The Glenmorangie Company. The project looks at evaluating the scope for enhancing biodiversity and improving water quality within the Dornoch Firth in order to support the marine environment and minimise any environmental impact from the distillery. 300 oysters over 2



experimental sites saw an 80% survival rate, the first time oysters have been in the Dornoch Firth for the last 100 years, leading to new futures for MPAs as this shows that there is the potential to restore habitats that have been long lost. (MM)



Tidal energy and sediment

Tidal energy produced by tidal turbines driven by fast-moving currents has potential for future electricity generation. However, Robert Wilson (University of Strathclyde) told us that tidal turbines may impact the marine environment by changing tidal height, which in turn might lead to a build up of mud on the seafloor, blocking up rivers, and eventually impacting organisms living there. It is thus important to know potential changes to the seafloor before deploying any tidal turbine. His research revealed that historically, water clarity declined massively in the North Sea in the 20th century and the impact of tidal energy on water clarity is predicted to be ten times lower than 20th century changes. He used project based models of turbidity and the Scottish shelf model for tides which provide tidal fields, to show how tidal energy extraction will change tides and sediment level. The research will provide information on scenario plans for building marine turbines, for example how the ocean bed will look if a number of turbines are built, and on managing the impacts of tidal turbines on the marine environment and local community while using this renewable energy. (MM&HN)



"It takes an ocean to feed a whale"

Neil Banas (University of Strathclyde) wants to know what is really going on at an important foraging site for Bowhead whales, especially adult females, preparing for pregnancy. At Disko Bay, Greenland, in the Arctic, Bowhead whales feed on tiny (1mm long) zooplankton, but the zooplankton population in the Arctic is changing very fast with global warming: warm water is coming in from the north Atlantic, the ice retreating, and the timing of the phytoplankton bloom is changing. Normally, a foraging hot spot for something as large as a whale species is thought of as having to be very productive: producing a lot of phytoplankton and zooplankton, in order to support predators and to export part of the biomass to the nearby sea. Is the effect local or does it work over large areas with changes in one place affecting whales in another? Neil's research aims to answer these questions and so far the indications are that in order to understand the impacts on the whale population we should be looking at a much larger scale. This requires a new way of looking at things, it appears that the productivity from other oceans is being transported, and delivered in concentrated form to the predators at Disko Bay. However, Disko Bay and perhaps other places in the Arctic might be the opposite of that. Where the productivity in other oceans get plenty and delivery it in concentrated form to their predators. As Neil puts it, "it takes an ocean to feed a whale", so we have to look much wider when it comes to trying to protect and conserve Arctic species. (HN)



Special Session Report — Circulation, dispersion and connectivity in Scottish Waters

Connectivity across Scottish Waters impacts on all aspects of the marine environment around the coastline. It can be observed and measured at all levels, from sea lice to Marine Protected Areas as a whole ecosystem. The assessment of circulation and dispersion can be measured in many ways, and the ones discussed during the session included experiments with tracers and drogues, measurements with high-frequency radar and current meters in areas of particular interest, as well as high-resolution glider observations. All methodologies aim to quantify the impact of wind, wave and tidal energy. Modelling of the many variables which change in time is a long and anisotropic process. The outputs however can be used to benefit many marine interest groups, such as aquaculture, where gathered information can help to define the spatial management units and their effectiveness for parasite control as well as to determine the best locations of new sites within the existing network. From the regulatory perspective the ability to model and predict or measure and define the mechanisms of dispersion is essential in the approval process for areas where discharges to the marine environment occur, such as sewage, industrial outfalls or fish farms. (MD)



(Liverpool) and Marine Scotland Science (MSS). Funded by the UK government through the Engineering and Physical Sciences Research Council (EPSRC) and established through the auspices of the Marine Alliance for Science and Technology for Scotland (MASTS), the research programme has been specifically designed to respond to questions posed by Marine Science Scotland that relate to marine planning for large scale arrays of renewable energy devices, the impacts of large scale energy extraction and how this can be differentiated from the effects of climate change. The objective was to determine ways in which marine spatial planning and policy development, can enable the maximum level of marine energy extraction, while minimizing environmental impacts and ensuring that these meet the legal criteria established by European law. The consortium has launched an EcoWatt2050 Project Summary 2017 booklet summarising the key findings for tidal and wave energy sites, expected to be available on MASTS website soon. (MD)

TeraWatt Position Papers can be viewed on MASTS website: http://www.masts.ac.uk/media/35656/position_papers_terawatt_e-book.pdf

Technology in Marine Science

As marine scientists we are very privileged to live in times where collecting crucial data doesn't necessarily mean we have to leave the comfort of our office. Of course, for many researchers a field trip is the essence of fun, but progress in technology available today for marine enthusiasts allows to explore the depths and widths of this incredible world to a detail that our predecessors couldn't dream about. Joanne Porter's (Heriot Watt) presentation looked at some of these technologies. With new survey methodologies such as Remotely Operated Vehicles (ROV), Autonomous Underwater Vehicles (AUV), tagging and sonar, amongst many more, data gathering is easier, faster and safer. Improved connectivity and wireless data streaming means that information comes with little delay and can be easily shared. Simple in operation, portable systems allow a scientist to share the task of data collection between each other or even with members of the public. The task left for a scientist is to decide which approach is the best for his or her study. It is important to keep up with most recent research technologies, but that should not stop anyone improving what is out there already or from developing bespoke systems to improve performance and save costs. (MD)



Special Session Report — EcoWatt 2050

A continuation from the TeraWatt project EcoWatt 2050 is in its final stages of delivering results of the 3-year study, analysis and modelling by the consortium members: Heriot-Watt University and the Universities of Edinburgh, Aberdeen, Strathclyde, Swansea and the Highlands and Islands, the National Oceanography Centre



Low drag sensor frame for high energy environments

Giuseppe Calise (University of Naples), is visiting Lews Castle College as a MASTS Fellow, he described the engineering challenge of designing a sensor frame that could be used in high energy environments, where low drag is a key factor. His approach was to use Computational Fluid Dynamics (CFD) methods, normally applied within aircraft and automotive industries, to design sea bottom sensor frames. Several shapes were tried to get the best design which would minimise the amount of ballast required to keep the sensor on station. First results from testing in the Pentland Firth are promising and the next step is to make several other deployments around the same area to ensure the sensor frame works in a variety of strong tide and current situations. Such a frame, which will enable the collection of high quality data, will be of interest to the wider scientific community and across the renewable energy sector. (MD&KB)



Cumulative effects

The key takeaway from the cumulative impacts session looks at avoiding the temptation to prioritise individual places, species or threats as this can end up being much less efficient in management. Our marine environment is not subject to a single stressor and Colin Moffat notes that “the unknown unknowns are some of the challenges we have to face”. Our marine systems are not experiencing single impacts and at the end of the day we must determine what we can actually do. We are not trying to manage the marine environment; we can only manage the human activities impacting on our systems. We have to think about the how and the why when we consider our actions in responding to change and management of our seas, and with approximately 18002 km of coastline in Scotland, there is a lot of sea, a lot of coast and a lot of happenings with Scotland’s marine aspirations to consider. Ultimately it’s not just about protecting specific habitats but the ecosystems they create. (MM)

Special Session Report—Marine Biogeochemistry

The full extent of climate change impacts and effects are still being discovered. In the Arctic, which is one of the most affected regions of the world, increasing temperatures and ocean acidification as a result of climate change are expected to alter the marine biogeochemical environment over the next century and consequently alter marine primary productivity in the region. Bonnie Lewis (University of Glasgow) notes that at the moment there is a limited understanding of how these impacts are going to affect productivity. However, as Greenland’s ice sheet is already decreasing at a rate of 269 Giga tonnes a year over the past 14 years, it is crucial that there is continued monitoring and management of sensitive ecosystems.



Nick Kamenos

Coastal ecosystems, such as saltmarsh and maerl beds, play a significant role in confronting climate change as they have the capacity to sequester large volumes of carbon. This session offered a valuable insight into the blue carbon storage potential of Scottish coastal ecosystems. Rebecca MacPhearson found that the inorganic carbon stored in a protected maerl bed within the Wyre Sound MPA was equivalent to a full year’s energy use for 154,015 homes. With 353 maerl beds in Scotland, it is critical that we understand how much carbon is stored in these habitats as their destruction could release substantial volumes of CO₂ in future.

Speaking about his recent work on quantifying the stock of carbon in the Eden estuary, Ben Taylor compared a natural saltmarsh with mudflats and a 10-year-old restored section of marsh. The results of this experiment are highly preliminary but they indicate that the restored marsh is storing more carbon than it did as a previously existing mudflat. In the ten years the restored marsh has been there (with total carbon storage corrected for area), restored areas appear to be functionally equivalent to natural marshes at storing carbon. It is likely that in ten years these restored areas will be as effective as natural marsh and will continue to accumulate over time. Carbon storage is an important ecosystem service and as such these habitats are of great conservation significance. Recordings of the presentations given at the Biogeochemistry Special Session are available on the MASTS YouTube channel (<https://www.youtube.com/channel/UCYyYvBMsAM2MEjshrMOsMtg>) and on MASTS website webinar page. (MM)



MASTS ASM

Mixing business with pleasure

Coffee, lunch and other breaks are an essential element of the MASTS ASM. Held at the University of Strathclyde's Technology and Innovation Centre, in Central Glasgow, the venue was not only conveniently placed for everyone, but the facilities, excellent catering and friendly, helpful staff ensured the ASM went smoothly and efficiently. Such a backdrop makes the perfect location for continued discussion, renewing old partnerships and evolving new collaborations.



Prof David Paterson, MASTS Exec Director and Annette Christie, Baillie of the City of Glasgow, who welcomed the ASM to Glasgow in the spectacular surroundings of the City Chambers. A delegation from India and South Africa, keen to make connections with Scottish marine science research joined delegates for early evening refreshments.



There was much to discuss and the breaks gave ample opportunity to continue questions and conversations. Delegates made good use of the time, meeting up with their colleagues, visiting the posters and mixing with a wide range of scientists from their own and other disciplines.



The ASM Dinner gave everyone an opportunity to enjoy good food, good company, great music and shake out any conference



A wide range of exhibits further demonstrated Scotland's world-class marine science



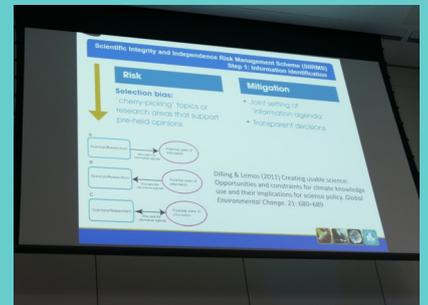


Reporting marine climate change impacts: lessons from the science-policy interface

Matt Frost (Marine Biological Association) introduced the latest Marine Climate Change Impacts Partnership (MCCIP) report card, which summarises changes over the last decade. We're experiencing a very interesting time in science, with the amount of marine science and climate change papers doubling every five years since the first UN report it is difficult to keep track of the sheer volume of data. MCCIP does a good job at summarising evidence and as the impacts of marine climate change are better studied than ever before, it is fundamental that integrity and independence are maintained with results and how these are relayed these to stakeholders and the public to best influence decision making. (MM).



Matt Frost went on to explain how the MCCIP report cards had established themselves over the decade as the succinct and accurate report of the state of climate change and our understanding of how it might progress and affect the natural world, with further impacts for goods and services applicable to humans. The MCCIP report card is now highly respected as a reliable source of high level information on climate change. He pointed out however that when you bring a group of like-minded individuals together there is a real opportunity for bias to creep in. This could be in the choice of science to include, or how that science is interpreted. MCCIP is very mindful of this and recognises that only if the report cards are seen to have high integrity, will they be trusted. MCCIP has thus adopted a mechanism designed to minimise any opportunities for a biased picture to emerge. Scientist and policy makers have worked together to set their agenda. In order to remove the possibility of scientific bias MCCIP has gathered expert opinion, it has taken a determined stance to cross-check and question each other stringently, above all looking behind the results to see what backs them up. This has encouraged a growing 'self-sceptical' community which is growing year-on-year. Following on from a series of videoed 'vox pops' reflecting the MCCIP report card a vigorous Q&A session ensued including a call for scientists to become more involved in spreading the message and becoming involved in solutions to climate change and related phenomena. (KB)



Harmful algal Blooms:

In the light of the uncertainty of the impacts of climate change, we are continuing to see the increased variability of the incidence of Harmful Algal Blooms (HABS) in UK waters. Eileen Bresnan told us that there is a data rich HABS community in the UK which has increased confidence into the complexity of the issues associated with our changing marine climate although there are still many unknowns as to how climate change impacts harmful algal blooms and how this feeds into our future prediction. HABS can be catastrophic, as seen with the 2016 bloom in Chilean waters that was likely triggered by a strong El Nino and resulted in 39 million salmon dead followed by another bloom with high shellfish mortality that subsequently led to social unrest and rioting. People believe these extreme events can reset ecosystems and trigger the breakdown of biogeographical barriers that impact the spread of HABS globally. Although the understanding of HABS has matured, the simple assumptions held 10/20 years ago have been replaced by a bigger understanding of how complex it is and the reluctance to be confident in ability to predict them. (MM)

Changing Distributions

Mike Burrows, another contributor to the 'Report Card' has been collating information on changing distributions of species. The MarClim database is a spatially extensive high intensity project that reviewed the geographical distribution of many species across 600-700 UK sites. There have been no real evident changes of the distributional ranges of intertidal species since 2000 but there appears to be changes in the relative abundance of cold and warm water species that follow trends in temperature. With these results, mortality events seem to coincide with temperature extremes and with the volume of community and abundance data it is possible to express the total range of temperatures species occupy and the weighted average of the collective affinity of that species over time. This data is important as we are faced with future climate change and changes to sea surface temperatures. (MM)





CCS Innovation

Marius Dewar (Heriot watt) is part of the STEMM-CCS project. As the effects from anthropogenic climate change becomes more pronounced and actions more urgent, it has been stated that the atmospheric concentration of CO2 must be kept below 350ppm. With fossil fuel usage continuing as renewable sources of energy largely remains in the developmental or marginal stages, carbon capture and storage looks to be a necessary short-term method to halt CO2 emissions. The risk of leakage from this method could cause more problems with sea level rise and ocean acidification than it solves. As such, the research presented in the CCS talk that looked at new acoustic techniques for the quantification of CO2 leakage, whether that's to do with the gas or any other fluids and also benthic images or seabed surveys, provides important details into how feasible CCS is. Biogeochemistry is considered (impact on the marine environment) and the study looks at what is already in the place and the impact cost from the leak occurring and detection models- where is best to put monitoring equipment and the best place to detect leakage. (MM)

DC cables and migratory and electro-sensitive species.

Zoë Hutchison, Cranfield University, is investigating how electromagnetic fields (EMF) from DC cables might influence migratory and electro-sensitive species. Migratory species are known to use the Earth's magnetic field for navigation while some species, sharks and rays, for example, are able to detect the electrical signals from hidden animals and so rely on an acute electro-sense to detect their prey. DC cables may cross the seabed for a range of uses, including as feeds to and from offshore energy devices and other seabed-based infrastructure. It is important to understand how migrating and electro-sensitive species are affected by the addition of artificial DC signals and alterations to local magnetic fields might impact on the lives of these creatures. This is a field that has been overlooked previously the two species that are the subject of her studies are the commercially important American Lobster and the Little Skate. Knowing how these animals react will be key to managing renewable energy installations in the future. (HN&KB)

Contourites.

Dorrik Stow, Heriot-Watt University, is studying deep sea sedimentology. There are several principal types of sediment in the deep sea created by different sediment pre-processes: **turbidites** from down-slope processes of materials from shallow water, **contourites** from long-slope processes moving sediment parallel to the contours, and pelagic or hemipelagic deposit by vertical settling sediments from the sea surface. The contourites deposits from bottom currents are significantly influenced by overall ocean circulation processes, which in turn are influenced by climate change in particular. So, by looking at contourites sediments from the past, we can decode the record of past climate and any signals of climate variation in the past. Improving our understanding of contourites would enhance our knowledge of the deep sea, climate science and the impacts of some bottom currents on the overall circulation pattern. In addition, it help determine which areas deep sea are suitable for ing infrastructure, internet and offshore energy installations, for example. (HN)



cur-tion would of the build-cables

Presentations and posters mean prizes

The MASTS ASM provides a forum for students to present their work to the wider Scottish marine science community, to share their thoughts and aspirations and to gain valuable, positive criticism and input from colleagues. The opportunity to present work and discuss and defend approaches, theories and results is an excellent rehearsal for a career in science. Questions from the audience following talks and the atmosphere during coffee breaks, when conversations continued and debate ensued provide a highly animated and audible testament to the quality of 'the next generation' of Scottish marine scientists. As always the standard of talks and poster presentations was excellent, so giving the judging panel the very hard task of choosing the 'winners'.



Johanne Vad (Heriot Watt) was judged to have given the best presentation— *Environmental Assessment of Deep-Water Sponge Grounds in relation to Oil and Gas Activities: a Faroe-Shetland case study.* Second place went to **Winnie Courtene-Jones** (SAMS) - *Microplastic pollution identified in deep-sea water and ingested by benthic invertebrates in the Rockall Trough, North Atlantic Ocean.*

In the poster section **Matthew Pace** (Glasgow) was awarded first prize for *Modelling the ecosystem consequences of demersal fishing gear impacts on soft sediment habitats.* **Afiq Fahmi** (Heriot Watt) gained second prize for his poster on—*Response to oil pollution by *Emiliania huxleyi* and its associated bacterial community under projected atmospheric CO2 conditions.*



Specialist workshops have become an essential part of the MASTS ASM, they enable a real cross-section of 'stakeholders' to get together to hear about the latest research and share ideas and approaches. This year was no exception with workshops on Decommissioning and Wreck Removal, Cumulative effects of multiple stressors, an update on EcoWatt2050 project, Scottish microplastic research Group, Sustainable Aquaculture, Biotime and MAREMAP

Decommissioning and wreck Removal workshop



Sustainable aquaculture workshop



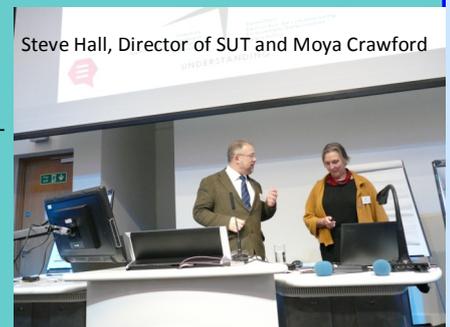
Biotime workshop



Microplastics workshop

Decommissioning and wreck removal workshop

The 'Decom' workshop is now firmly fixed in the ASM programme and attracts delegates across a wide range of stakeholder groups including many facets of the oil and gas sector, NGOs, government, regulators and marine science. Where once there may have been suspicion among the different groups there is now respect and cooperation in the face of the daunting and expensive task of decommissioning the platforms in the North Sea and beyond. The cost of decommissioning these platforms is likely to be anything between £40bn and £100bn an astounding figure that will be met by tax payers as well as the industry. Moya Crawford, one of the organisers of the joint MASTS SUT workshop, and Chair of the SUT International



Steve Hall, Director of SUT and Moya Crawford

Decommissioning and Salvage Committee, opened the meeting. She went on to point out that the challenge was about people working together bringing various expertises to the question from engineering, technology and biology, but also learning from colleagues across the oil and gas sector but also beyond into salvage.



Sally Rouse

Sally Rouse provided background about the legislation that insists that decom should take place, the OSPAR regulations are quite clear but there is a growing agreement that despite everything having to be removed, in many cases that might not be the best, safest and certainly not the cheapest way of doing things. A growing understanding from biologists is leading to the point of view that rigs can provide valuable habitat, increasing the diversity of what might previously have been relatively poor habitat. There is also evidence to suggest that the activity and disturbance surrounding removal might prove detrimental to existing marine life. Her work involves attempting to gain some idea of the relative importance that are put upon environmental interactions, with a view to building a better way of assessing rig decommissioning on a case by case basis.

Artificial reefs provide good examples of how artificial structures on the seabed can provide valuable habitat. Nigel James, Waves Group, talked about what was necessary before a reef could be created, including the various permissions, cleaning processes and monitoring, ending by saying that if done correctly there can be many benefits to wildlife, fishing, and diving, for example. Were there lessons here for decommissioned rigs?

Delegates also heard from the salvage sector, the insurance sector and case studies of placing artificial reefs in the US from Jim Elliot and some of the challenges in salvaging the Costa Concordia.

Other topics included discussions about the need from now on to design decommissioning in at the earliest stage of development of new structures, the potential for remote monitoring, safety aspects, but also the opportunities that decommissioning might bring: many of the technologies developed in the oil and gas sector can be applied to taking rigs apart in a safe manner, there is potential for job creation. What became obvious was that there is a need to continue the dialogue, to speak the same language, to work together and learn from wherever there is applicable knowledge.



New for this year were the breakout sessions that enabled delegates to gather in smaller groups to discuss some topics in more detail. The lively discussions that ensued were testament to the enthusiasm of the differing groups to listen and learn.



Aquaculture high on MASTS agenda

The aquaculture coverage was particularly strong in General Science Session 4, held on the afternoon of the 5th, which was chaired by Jimmy Turnbull from Stirling's Institute of Aquaculture. Talks included a summary of what is known about the exploitation of wild wrasse species in Scotland for use as cleanerfish in salmon farms, by Nabeil Salama of Marine Scotland Science; the results of a study on how environmental enrichment in hatcheries can influence the behavior of lumpfish larvae, by Bruce McAdam of Stirling's Institute of Aquaculture; and the development of a model means of predicting the prices for farmed salmon, by Simone Martino from SAMS.



Armin Sturm, from the Institute of Aquaculture presented his research into the genetic basis of drug resistance on *L. salmonis* – a study that could, in the long run, help lead to the creation of an effective vaccine that could be used on salmon against this perennial parasite; Ana Rodriguez, from Heriot Watt University, described a pioneering method for visualizing the movement of juvenile oysters that was as inventive as it was inexpensive; and Caroline Coccoli, from AZTI, explained how a spatial Bayesian belief network could be used to help relocate fishermen displaced by the establishment of an offshore shellfish growing installation in the Bay of Biscay.

On the following day a special workshop was dedicated to sustainable aquaculture, at which representatives from Aquaculture Research Collaborative Hub for the UK (ARCH-UK) discussed key research funding priorities. With an estimated £4 million of funding from NERC and BBSRC to apply for during 2018, they are keen to ensure the funds are allocated wisely and have set up Work Groups across eight priority areas to identify the most pressing priorities.

Although relatively new – ARCH-UK was established in March – the meeting was also a chance to showcase recent examples of inspirational research projects funded by the BBSRC aquaculture innovation that they would like to emulate. These included a project at Aberdeen University, led by Prof Sam Martin, which is using the gene editing tool CRISPR/Cas 9 to try and suppress the immune response of salmon cells in order to improve the possibility of culturing viruses in the laboratory. In the long-run this could lead to the culture of viruses – such as those causing CMS and HMSI – that have previously eluded scientists.



Another featured project, this time from Dr Ross Houston at the University of Edinburgh, explained how genetic markers had been identified to allow for the breeding of Pacific oysters (*Crassostrea gigas*) resistant to oyster herpes virus (OsHV-1). The final one, presented by Dr Jason Holland at the University of Aberdeen, related to a project led by Prof Pieter Van West which involves harnessing unique aspects of *Saprolegnia* biology to improve the protection provided by dip vaccinations. By combining a *Saprolegnia* gene along with the potential antigens it dramatically increased their absorption and therefore the possibility of greater protection.

The meeting also helped to highlight ARCH-UK's role in making recommendations to BBSRC/NERC about the current short and long-term research priorities for aquaculture and will be engaged

in supporting researchers to develop projects. The organization will also recommend funding models for the calls but it will be entirely up to BBSRC/NERC as to how they use these recommendations and formulate the call, which will be open to researchers across Britain. BBSRC/NERC will then deliver the call and allocate the funding using an independent panel of experts. Further details will be on the BBSRC/NERC webpages in the coming weeks.

The Special Session on Aquaculture was attended by Rob Fletcher from 'The Fish Site', where this article first appeared.

<https://thefishsite.com/articles/aquaculture-high-on-masts-agenda>

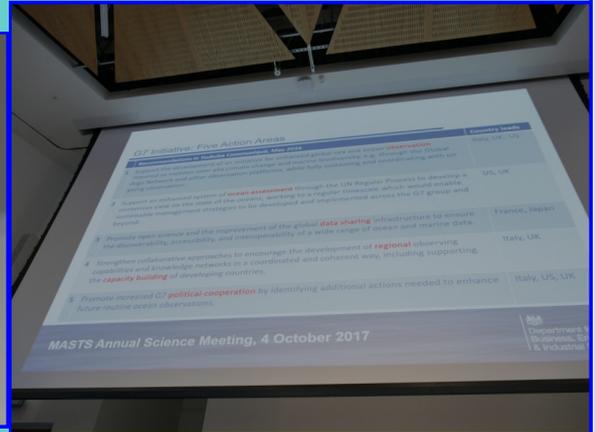


G7, BEIS and UK marine science

Claire Durkin (Head of Global Science, Innovation and Knowledge Economy, BEIS) gave some background to the government's and the G7's very positive attitude to marine science. She highlighted that the UK has much to offer globally and made a plea for the marine science community through MASTS to engage with government, advise on what was needed and make known what barriers there were. Working with government would make a real difference. Over the last few years the ocean has become of great interest to the G7 and there is a definite aim to create an ocean equivalent of the international cooperation that makes CERN such a success. She made a plea for more than just discussions and wanted to see a climate where actions were identified and acted upon. As far as global ocean observations are concerned the G7 had identified 5 key areas:

There were too many observations, they were too scattered and they were too slow – working together can improve this situation. Focus of observations should allow progress and quicker better assessment of the data was needed.

Data itself needs to be open and there should be more effort aimed at capacity building on a regional basis, Claire pinpointed small island states as being of particular interest, and mentioned the £1.5bn Global Challenges Research Fund and the Newton Fund as potential sources of research funding. Working with governments. Throughout her presentation Claire stressed the real need to work with government to identify challenges and opportunities. (KB)



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Ships of Opportunity

Lance Gregory, Operations Manager at Sir Alister Hardy Foundation for Ocean Science, outlined the support that the operation of the Continuous Plankton Recorder which has been collecting samples for decades and provides a unique comparable time series of data. But the CPR has moved with the times and now acts as a platform for other technologies, while the retained samples can now be re-appraised using new techniques, so providing a legacy. Microplastics is a good example, the CPR was collecting samples before plastic was widely used, and new DNA techniques can be applied to old samples, which will continue to have use as more ways of looking at



them are developed in years to come. This wealth of samples and data is entirely reliant upon a global network of volunteers across the entire shipping industry from crew, officers and captains, owners, charterers and agents, to port engineers and harbour masters – a chain of cooperation, a Navy of Volunteers. Deploying a CPR can be a very complex operation involving many people, and none of the ships are designed to carry and launch CPRs so it involves dedication and care from the volunteers.

Willie Wilson SAHFOS Director went on to explain how the CPR can provide a robust platform for other technologies, that will complement

the plankton data, so bring it up-to-date. PlankTag can beam back as soon as CPR surfaces. Developed by SMRU it can fit onto CPR, temperature, salinity temperature and fluorescence can also be measured and SAHFOS working on pCO2 sensors. CPR is perfect for ground-truthing satellite observations. Also looking at molecular data to identify microorganisms, especially those that do not survive entire from the CPR capture methods. The CPR is tested technology and a platform for the future, blending the old with the new to make better use of existing data while collecting a wider range of novel measurements. (KB)





Crab reports with phone APP

The mangrove crab provides food for thousands of people in Brazil, and at certain times of its life cycle is caught in huge numbers placing it at risk from over exploitation. The crabs which live much of the time in their burrows emerge to mate on the new and full moons, but which crabs emerge at which phase of the moon is not clear. Currently management regulations do not take into consideration that different populations choose one phase over the other, so such blanket rules are unfair and may not be very helpful and make any policing very difficult. Karen Diele and colleagues are working to get to the bottom of the mystery to understand which crabs prefer which moon phase. Working with the local fishers she is introducing a phone App that will enable them to record and report when the crabs emerge, so building a pattern that can be used for fair management, which will allow the fishers to continue to catch, but should lead to the population remaining sustainable.



Images courtesy Karen Diele

Fishing gear impacts on soft sediment habitats (e-poster)

Matthew Pace (Glasgow) is looking at how demersal fishing can affect the processes and functions, and hence the benefits and services ecosystems provide us. So does it matter for example when a muddy seabed, which may be extensive, is disturbed? Mud is a rich sediment and any disturbance could have impacts on the ecosystem as a whole. In general, demersal fishing could take one of three mechanistic impacts: physical disturbance of the habitat, mixing or re-suspension of sediment, and removal of biomass from the ecosystem. So, when any demersal gear is deployed, at least one of those impacts occurs. Previous studies on this issue have been taken at an ecological level but not on the ecosystem as a whole. So far, in Fifth of Clyde, the relationship between nutrient content and sediment characteristics matches quite well to other regions, but the Fifth of Clyde is distinct in rich nutrient input from the river and intense anthropogenic activities, such as aquaculture and shipping, for example and these also have to be considered by the researchers within their studies to fully estimate impacts caused on the entire ecosystem. (HN)

Scottish Coastal Observatory

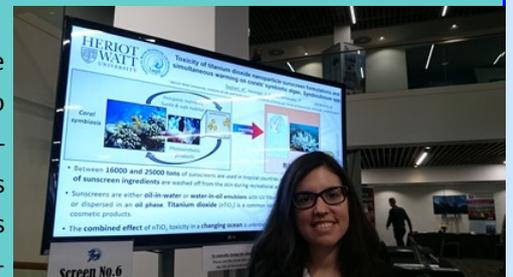
Eileen Bresnan, Marine Scotland Science, introduced the Scottish Coastal Observatory which has been measuring plankton in Scottish seas for 20 years providing a useful yardstick for comparing any changes in timing, extent and make-up of blooms. Scottish coasts are vast and varied and so the use of volunteers has greatly increased the coverage and frequency of recording. Such coverage has shown that the west coast is 1°C warmer than the east coast leading to an earlier blooming of diatoms. Scottish seas are also prone to harmful algal blooms and knowing when these are occurring enables an 'early warning' for aquaculture which can be badly affected by toxic plankton. Plankton are the base of most marine food chains and so understanding how they may be changing could prove valuable in managing our seas in a future facing change. (KB)



Sunscreens, nanoparticles and corals (e-poster)

A chemical filter used in sunscreen is thought to cause stress on coral reefs, and people who swim close to reefs are being advised not to use these products to avoid damage to the fragile coral ecosystems. However there has been little study carried out on the effects of the nanoparticles in the sunscreens and their effect on corals. What little has been learned appears to show that the nanoparticles do no harm to the coral animals and are safe to use. Alica Tagliati (Heriot Watt) is trying to establish the facts and determine whether the nanoparticle sunscreen causes stress on reefs and if it is safe to use.

The first step is looking at effects of nanoparticle sunscreen on corals' symbiotic algae. She has found that the oil used to dissolve or disperse nanoparticle into sunscreen has a much greater effect on the algae photosynthetic activity, growth rate and reactive oxygen species (ROS) production than the nanoparticles. This is important because the oil is used much more widely than just these sunscreens. Work continues to evaluate any potential effects on animals living in reefs. Preliminary finding suggests that looking for more friendly oil, plant derived oils for example, for use in sunscreens in particular or cosmetics in general might be necessary. (HN)





Kelvin Boot and PhD students Hoa Nguyen and Marzena Dziedzicka interviewed some of the speakers at the 2017 MASTS ASM. The recordings can be found on the MASTS website:

<http://www.masts.ac.uk/annual-science-meeting/2017-podcasts/>

And.....

<http://www.masts.ac.uk/annual-science-meeting/2017-vidcasts/>

Scottish Marine Science and Brexit— Professor David Paterson, MASTS Executive Director.

Scottish Marine Science Looking Forward—Professor Colin Moffat, Head of Science for Marine Scotland.

Scottish Coastal Observatory Volunteers—Eileen Bresnan, plankton ecologist at Marine Scotland Science.

Bioluminescence—Dr Jonathan Cohen, University of Delaware and MASTS Visiting Research Fellow at the Scottish Association for Marine Science.

MASTS Postgraduate Certificate in Researcher Professional Development for Marine Science and Technology - Dr Lois Calder, Dean of the MASTS Graduate School explains in more detail.

10 Years of the Marine Climate Change Impacts Partnership (MCCIP) - Dr Matt Frost, of the Marine Biological Association (UK).

Northern Lighthouse Board Supporting Marine Science—Mike Spain, Business Development Manager for the NLB.

Deep Sea Plastic Pollution—Post graduate researcher, Winnie Courtene-Jones, from the Scottish Association for Marine Science.

Offshore Energy and sediments—Robert Wilson talks to Hoa Nguyen.

Sunscreens and coral damage—Hoa Nguyen speaks to Alice Tagliati.

Porpoises and marine energy—Laura Williamson talks to Hoa Nguyen.

Contourites—Dorrik Stow talks with Hoa Nguyen.

Demersal fishing gear and sediments— Hoa Nguyen interviews Matthew Pace.

DC cables and migrating and electro-sensitive species—Hoa Nguyen talks to Zoë Huchison.

Bowhead whales, feeding hotspots and climate change—Hoa Nguyen talks to Neil Banas.

Sensor frames for high energy environments—Marzena Dziedzicka talks to Guiseppe Calise.