



# MASTS ASM—2019—Glasgow

## Reflections

### BOLD SCIENCE to meet GRAND CHALLENGES

The 9th MASTS Annual Science Meeting kicked off 2nd October 2019, returning to the excellent conference venue at Strathclyde University's Technology and Innovation Centre, in the heart of Glasgow.

MASTS Executive Director, Professor David Paterson, welcomed around 400 delegates to three days of 140 presentations and e-posters during the plenary sessions and 10 specialist workshops which have become an intrinsic part of the ASM offering. As always the intervals provided further opportunities to visit the e-posters, discuss topics in more detail, meet up with existing colleagues and make new partnerships.

The theme of this year's ASM was about being **bold** to **meet** global **challenges**. The opening session certainly spoke of bold feats, from the challenges of marine planning and spatial management to exploring the depths of our oceans with the Five Deeps expedition. The session began with Professor David Paterson and a success story, MASTS and its Graduate School. MASTS has been operating as a diverse network bringing researchers, government and industry together across Scotland for nearly 10 years with current funding until 2022. At the ASM we saw 22 new SUPER doctoral students join the graduate school which focuses on developing doctoral students with two major MASTS events each year and workshops throughout the year. The past 2 years has seen MASTS go global and the beginning of several new working groups focusing on dynamic themes which meet the needs of now. So far MASTS has demonstrated "Investment in research collaboration pays off" fostering a collaborative research ethos and therefore developing a strong research culture across Scotland, opening up opportunities for both early career researchers and established groups working in Scotland. (HL&KB)



### Reflections Reporters

Helping out Kelvin Boot (KB) at the ASM were Hannah Lee (HL) and James Rimmer (JR), Grad Students also working toward their Post Grad Certificates in Researcher Professional Development for Marine Science and Technology (MASTS PG CERT). James and Hannah have written articles and taken photos for *Reflections*, as well as carrying out video interviews of some of the key speakers at ASM 2019.

MASTS ASM vidcasts can be viewed at:

<https://www.masts.ac.uk/annual-science-meeting/2019-vidcasts/>

We cannot cover every talk, abstracts are available on the MASTS website



## Marine Spatial Planning in the 21st century: Scottish innovation and the role of science

The challenge: managing our coastal waters. The solution: future thinking and working with the community. Tim Stojanovic, Rachel Shucksmith and Chris Leakey (MASTS Marine Planning & Governance Forum) delivered an engaging triple act as they opened this year's ASM. The aim was to raise awareness of the forum which they represent while also highlighting the process of marine planning from the perspective of the planner, the academic and the officer. More than 70 countries around the globe are undertaking marine spatial planning as our oceans and in particular, our coasts get busier each year. Highlighted was the importance of good communication and even better evidence. Well established management comes from communicating with key stakeholders and utilising available evidence to make informed decisions and balance social, environmental and economic needs. The other side of the coin to planning well for the now is planning for the future and identifying what would make a plan climate resilient through collaboration between research and policy. (HR)



Using multiple datasets we are:

- Using coastal and sediment bathymetry to map the geomorphology
- Analyzing satellite imagery for correlation over water depths, areas, (there are a lot of coastal canyons for the UK)
- Analyzing satellite imagery for PIV and cores for analysis of depositional environments (across through time)
- Working cross-disciplines for links to habitats and ocean protection
- Feeding into ASM planning (review e.g. South Landbank beach and golfcourse)



Heather Stewart (BGS) discussed research into the geomorphology of subduction trenches. Previously unknown topography was revealed and should be of use in understanding geohazards associated with trenches, including the identification of 'landslides' that caused tsunamis. (KB)

Reykjanes: A proxy for modern SMS

GEOMAR

- A unique small-fractured subaerial-dominated geothermal energy system
- Subside-rich scales deposited in managed production pipes display trace elements associated with high-temperature hydrothermal fluids
- Represent local metal contents of deep, primary high-temperature hydrothermal fluids
- Samples from surface pipes and also downhole production pipes (P94-10)



HELMHOLTZ

Hannah Grant (BGS) used the Reykjanes geothermal system as a proxy for investigating the presence of minerals in the sub-seafloor. (KB)

## 5 Deeps Expedition



Dr Alan Jamieson (Newcastle University) described his involvement in the 5 Deeps Expedition, a world first manned expedition to each of the 5 ocean's deepest points. Alan began by explaining how expeditions funded by the super-wealthy can offer opportunities to engage in science which would normally be far beyond the budget or ability for a normal university or research institution to undertake, however the science must be balanced against other commercial interests such as film making and the publicising of such expeditions. Scientific side-objectives included investigating deep sea ecology, genetics, habitat type/structure, and anthropogenic impacts. Indeed, the expedition found plastic debris and each of the dive locations. The technology used in this expedition was described as being significantly advanced from previous expeditions, including the 2012 James Cameron expedition, with the ability to film the manned submersible with deployed landers. Alan also explained how artificial intelligence is being used to help research efforts, by cutting out hours of footage of empty water. This particular funding model is only likely to be successful where exciting, expensive projects can capture the attention of the super-wealthy and news headlines, rather than low-cost (even costing several hundred thousand pounds) research projects. Alan was also able to show footage captured during the expedition, which is not yet publicly available. (JR)

## Blue carbon and blue mussels

Hannah Lee (Heriot-Watt University) introduced the concept of Blue Carbon - carbon stored in the marine environment for the medium to long term, preventing it from contributing to climate change in the form of carbon dioxide. Whilst a range of coastal habitats, such as seagrass beds and mangroves, are increasingly recognised for their role in carbon storage, little quantification has been made of bivalve bed storage. Bivalve reefs are recognised to offer other ecosystem services, such as improving water quality and reducing turbidity, and thus are increasingly recognised as a target for restoration at their historic sites. Quantifying the associated carbon sequestration in the restored reefs will contribute to a broader assessment of the importance of Blue Carbon storage, and help to produce a 'carbon map' of our marine environment. (JR)



## Avoiding wasted data

Charlotte Myskin-Hymas (British Oceanographic Data Centre) spoke about improving access to UK marine data through the use of MEDIN - the Marine Environmental Data and Information Network. As well as improving data access, the goal of MEDIN is to avoid wasting data and improve efficiency by avoiding doubling up on research effort. The partner network includes research institutions, government departments and private companies, and currently includes over 14,000 data sets accessed through a searchable portal. MEDIN workshops are regularly held around the UK, including on the Friday of the MASTS ASM, to encourage understanding of the system and to train users in proper data entry for quality and consistency purposes. Systems are also in development to more rapidly automate and process data to be compliant with the MEDIN standards. (JR)



## Modelling sea-floor litter

Kelly McIntosh (Marine Scotland Science) explained how statistical modelling is being used to investigate the distribution of marine sea-floor litter around Scotland. Specific focus was given to plastic, as a persistent, identifiable and entirely anthropogenic form of litter. Data was gathered from marine research vessels, such as those carried out as part of IBTS (International Bottom Trawl Survey). Using generalised additive modelling techniques (GAMs), a flexible modelling technique which allows for the description of complex, non-linear relationships between predictor variables and responses (in this case, litter presence/absence). Modelling reveals spatial distribution patterns of marine litter, indicating the greatest densities of litter in Scottish waters were located in the North Sea, and lowest off the West coast. Kelly also found that there appeared to be a small, but statistically significant, decrease in litter over time - however, she acknowledges that litter (plastic use) reduction may not be the driving factor explaining this observation. It may instead be the case that litter has been redistributed over time during the course of the surveys, emphasising the need for continued monitoring efforts. (JR)

Johanne Vad (Edinburgh) used benthic landers and rope dredges to sample the sponge beds of the Davis Strait. The research showed that the beds have a much higher biodiversity than previously thought. The data can populate biomass prediction models so aiding future management strategies. (KB)



## **Aquaculture at ASM 2019**

**Aquaculture is an important and growing industry in Scotland but as it expands it needs more space and there are always the challenges of environmental cleanliness and the spectre of sea lice infestations to face, set against increasing water temperatures due to climate change. The MASTS community of researchers continues to investigate these issues and what they mean for future Scottish aquaculture. Many talks touched on aquaculture, here are some of them. (KB)**

### **Triple act! A story of salmon and sea lice**

Though Tom Adams (SAMS), Phil Gillibrand (MOWI) and Berit Rabe (MSS) delivered independent talks, a story of salmon and sea lice connected the three speakers. Tom began the session identifying the challenges faced when a new farm is proposed, in particular he discussed the emerging challenges for OFF-AQUA or offshore aquaculture developments. The benefits of this include greater flushing and therefore a predicted reduction of localised impacts. Tom continued to explain the need for finer scale models along the west coast of Scotland which could predict dispersal of effect with this increase in circulation. Phil Gillibrand continued along the theme discussing not only how to predict disease and parasite dispersal but how to manage it. Integrated into these models was the 25 year climate flow model which encompasses wind, temperature and salinity changes, enabling workers to identify how this may affect farm connectivity. Finally, Berit Rabe demonstrated how this work could be scaled from a regional to national scale by enabling connectivity between the submodels and large model domain through an integrated mesh. As with the previous two speakers this work feeds into management strategies, informing the scale at which management may be necessary. All of this work was underpinned by the Scottish Shelf Model and associated sub models, data from which is directly available from Marine Scotland Science. (HL)

### **Making a noise about oysters**

Heading into his third year of his PhD Ed Bolger spent a considerable period of the summer of 2019 working with the Danish Shellfish Centre to investigate the effects of underwater noise on oyster larvae settlement. As blue growth takes place our oceans are becoming noisier with 100x increase in low frequency noise as a result of commercial shipping alone, as a result, noise is now described as 'a marine pollutant'. The effects of noise on animal physiology and behaviour is a constantly expanding field of research and for Ed the focus is on invertebrates, which account for 60% of the biomass in our oceans. The work presented this week by Ed focused on whether the presence of elevated noise levels disrupts settlement cues for oyster larvae and in turn survival. This has particular relevance to bivalve restoration programmes which are gaining momentum across Europe, as over 100 years ago native oyster populations were decimated by overfishing and disease. Projects restoring oysters in the present day have many factors to consider, with the potential of noise pollution being one of them. (HL)

## Changing seas

While sea lice might be a very obvious threat to the economics of salmon farms, climate change is never far from the horizon and this may be more so with offshore farms. Using the coast of Norway, which has a thirteen degree latitudinal range and hence provides good data on performance of fish in different climates, Bruce McAdam of the University of Stirling set out to use this to test what might happen as sea temperatures rise. He used Intergovernmental Panel on Climate Change (IPCC) predicted scenarios as the basis for computer modelling future impacts on salmon farms. The results showed that it was not so much gradual temperature rise that might cause difficulties but rather the frequency of extremes, the breaches of the threshold. It should be noted that there was much variation between locations of farms and how they are managed, those in the south and those which keep fish at sea longer are likely to be more prone to climate change impacts.

Another effect of rising carbon dioxide levels is ocean acidification, which has been shown to affect the ability of shell-bearing animals to grow or maintain their shells. This has obvious consequences for aquaculture, so research by Susan Fitzer of the University of Stirling should be of interest. Working with other scientists in Australia on the Sydney rock oyster, she found that selective breeding of the oysters, for fast growth and disease resistance can alter the way they obtain and use calcium carbonate (calcite) in building their shells. While impactful ocean acidification might not be imminent in Scottish waters, the risks will rise as climate change effects are felt. This research demonstrates that careful selection for resilience might prove to be an effective strategy for shellfish survival and aquaculture continuity. (KB)

## Women in Scottish Aquaculture—specialist workshop

Speakers from WiSA, Women in Scottish Aquaculture, introduced this growing collaborative network aimed at supporting women entering and developing careers in aquaculture. WiSA officially launched at the Scottish Aquaculture Innovation Centre (SAIC) in March 2019, to address the fact that currently women are significantly and disproportionately underrepresented in this profession. However there is evidence that this situation is starting to change, and WiSA is working to encourage women to enter at all levels of the industry. WiSA encourages membership of both men and women, in order to build a supportive network and help to promote access to the diversity of careers in an industry which pays better than the national average. WiSA can be followed on Twitter with the hashtag: #diversitymakesuswisa, or on Instagram @womeninscottishaqua. (JR)

## 15 years of SARF

Anton Edwards (Scottish Aquaculture Research Forum – SARF) in a talk entitled ‘Growing fish and research together’ gave an entertaining retrospective about how SARF had been born from a need to provide scientific underpinning for a then fledgling industry. The unique structure of SARF which included in its Board, representation from a wide range of stakeholders often with opposing views, ensured that a considered approach to providing the science behind the product could be achieved. Funded jointly by the Scottish Government and industry partners, SARF was able to provide small grants for specific research projects which targeted areas of concern for the industry – the sea lice problem, for example, was the subject of many bids and projects. After 15 years SARF has reached a natural end point and the need for larger, better funded projects is now being catered for by the Scottish Aquaculture Innovation Centre (SAIC). (KB)

# West Scotland Coastal Ocean Modelling System WeStCOMS

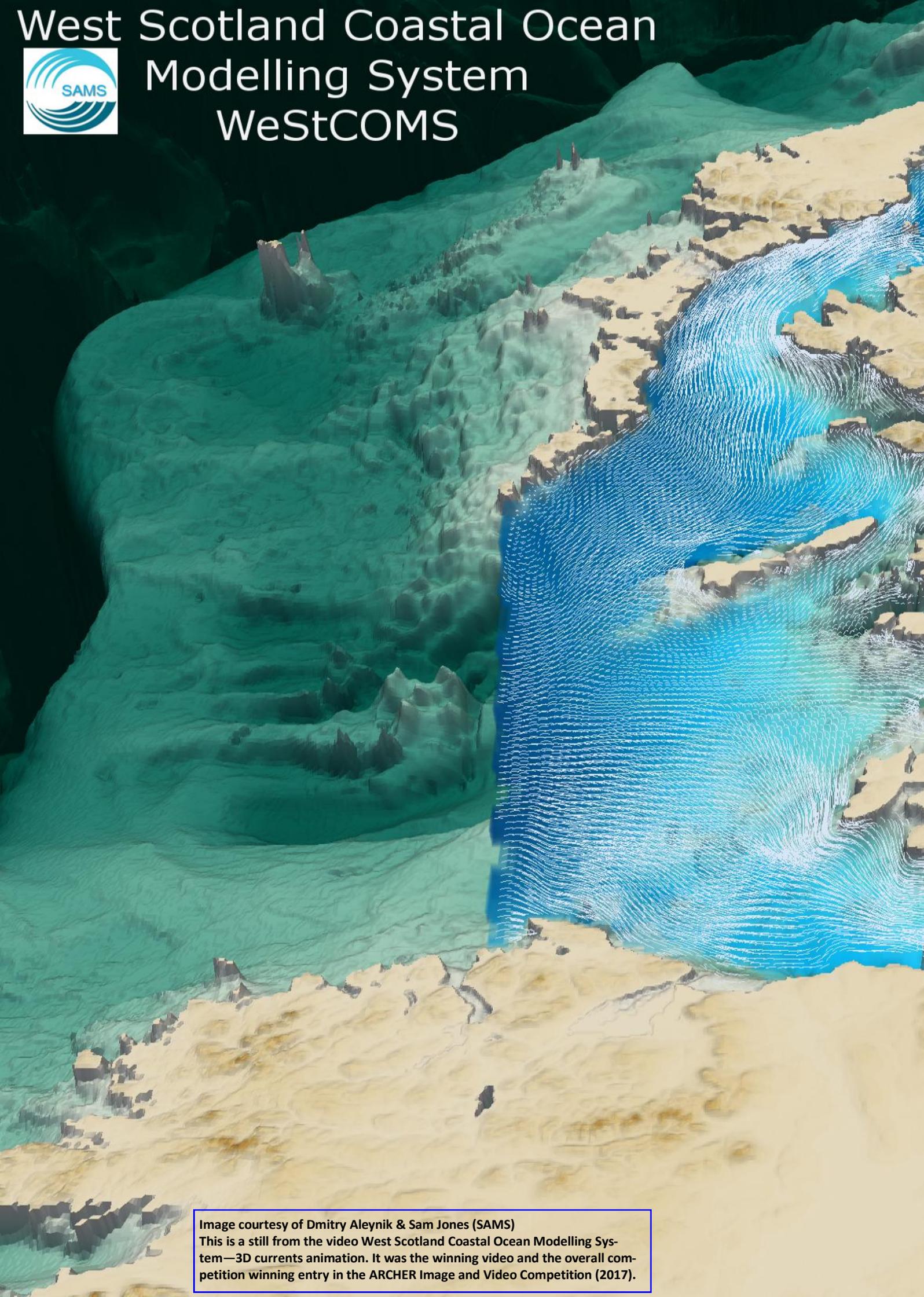
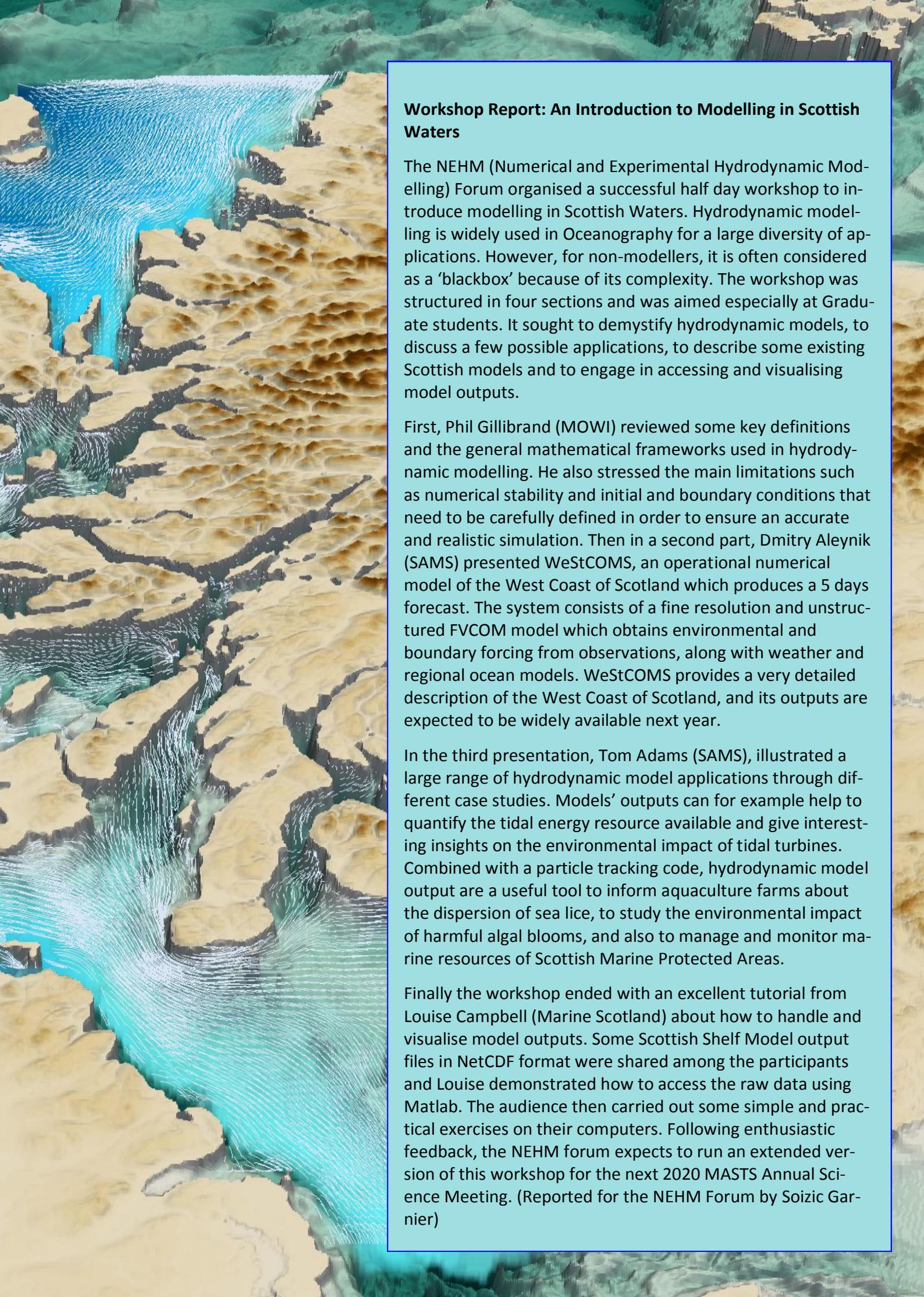


Image courtesy of Dmitry Aleynik & Sam Jones (SAMS)  
This is a still from the video West Scotland Coastal Ocean Modelling System—3D currents animation. It was the winning video and the overall competition winning entry in the ARCHER Image and Video Competition (2017).



## Workshop Report: An Introduction to Modelling in Scottish Waters

The NEHM (Numerical and Experimental Hydrodynamic Modelling) Forum organised a successful half day workshop to introduce modelling in Scottish Waters. Hydrodynamic modelling is widely used in Oceanography for a large diversity of applications. However, for non-modellers, it is often considered as a 'blackbox' because of its complexity. The workshop was structured in four sections and was aimed especially at Graduate students. It sought to demystify hydrodynamic models, to discuss a few possible applications, to describe some existing Scottish models and to engage in accessing and visualising model outputs.

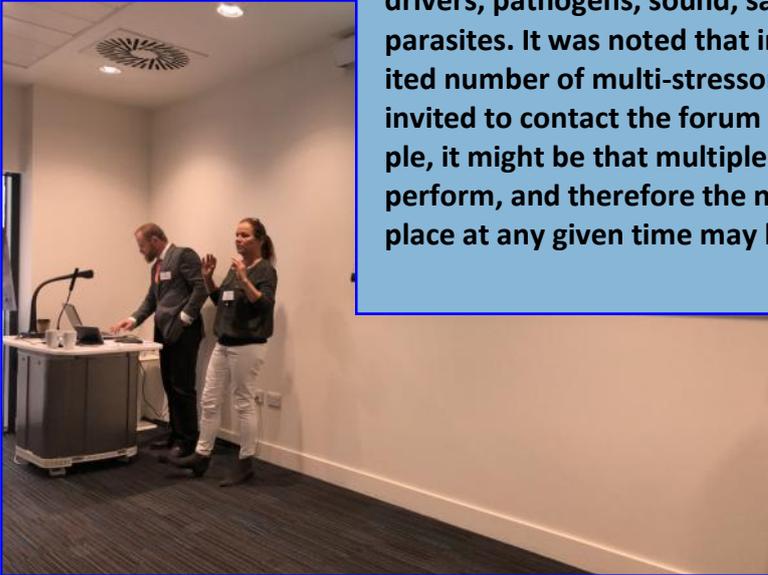
First, Phil Gillibrand (MOWI) reviewed some key definitions and the general mathematical frameworks used in hydrodynamic modelling. He also stressed the main limitations such as numerical stability and initial and boundary conditions that need to be carefully defined in order to ensure an accurate and realistic simulation. Then in a second part, Dmitry Aleynik (SAMS) presented WeStCOMS, an operational numerical model of the West Coast of Scotland which produces a 5 days forecast. The system consists of a fine resolution and unstructured FVCOM model which obtains environmental and boundary forcing from observations, along with weather and regional ocean models. WeStCOMS provides a very detailed description of the West Coast of Scotland, and its outputs are expected to be widely available next year.

In the third presentation, Tom Adams (SAMS), illustrated a large range of hydrodynamic model applications through different case studies. Models' outputs can for example help to quantify the tidal energy resource available and give interesting insights on the environmental impact of tidal turbines. Combined with a particle tracking code, hydrodynamic model output are a useful tool to inform aquaculture farms about the dispersion of sea lice, to study the environmental impact of harmful algal blooms, and also to manage and monitor marine resources of Scottish Marine Protected Areas.

Finally the workshop ended with an excellent tutorial from Louise Campbell (Marine Scotland) about how to handle and visualise model outputs. Some Scottish Shelf Model output files in NetCDF format were shared among the participants and Louise demonstrated how to access the raw data using Matlab. The audience then carried out some simple and practical exercises on their computers. Following enthusiastic feedback, the NEHM forum expects to run an extended version of this workshop for the next 2020 MASTS Annual Science Meeting. (Reported for the NEHM Forum by Soizic Garnier)

## Special Session - "Multiple Stressors"

This session was chaired by Mark Hartl and Karen Diele, who introduced the session with a quick brainstorm of the range of stressors participants are working on in their research, with examples including climate change related drivers, pathogens, sound, salinity, predation, competition, biotoxins and parasites. It was noted that in this year's forum there were a relatively limited number of multi-stressor submissions from speakers, and the room was invited to contact the forum subsequently to propose suggestions. For example, it might be that multiple stressor work is still logistically challenging to perform, and therefore the number of active experimental projects taking place at any given time may be limited. (JR)



## Microbes and multiple stressors

Sinead Collins (Edinburgh) discussed multiple stressor impacts in the context of microbial responses, as well as discussing experimental design approaches to investigating this topic. Sinead noted that it is effectively impossible to meaningfully interpret interaction levels above perhaps 3 or 4, and therefore we shouldn't really be attempting to do so. Moreover fully factorial designs in studies with several factors and levels, in which everything is combined with everything, rapidly result in unrealistically large experimental designs, which require ludicrously amounts of space to even set up. However, the use of a collapsed experimental design can help with this problem, by focusing only on the interactions and combinations which you actually care about testing. Sinead's group has created an online facility and guide for best practice in experiments in ocean research called 'Meddle', available at [meddle-scor149.org](http://meddle-scor149.org). (JR)



### **Impact of anthropogenic noise on invertebrates**

Invertebrates probably do not 'hear' sound *per se* in the same way as we as humans understand it, but certainly are capable of detecting the pressure wave component of sound, and therefore sound has the potential to impact them. Craig Stenton (Edinburgh Napier) is particularly focussed on embryos rather than adults, due to advantages in space and numbers (being far smaller than adults), as well as being transparent and therefore easier to visually inspect for physiological stress impacts. Craig highlighted some of the difficulties he has encountered in working with sound - for example, the difficulty in replicating accurately anthropogenic sounds using a speaker. Actual marine pile driving, for example, has a different sound profile to that of a playback of the recorded activity. Additionally, it is very difficult in an experimental system to emit sound evenly when played from a speaker, as there can be edge effects from the sides of a vessel causing unexpected internal echoes. In a multiple stressor context, Craig is investigating how sound interacts non-additively with other stressors. (JR)

### **Sunscreen, coral and toxicology**

Sebastian Hennige (Edinburgh) spoke on behalf of Alice Tagliati about the impacts of sunscreen, used in enormous volumes in tropical and subtropical regions, on corals, due to its potential to act as a toxicological stressor in a warming ocean. It is already known that certain organic-based sunscreens are considered to be a risk to the health of corals, and indeed some countries have already banned their use if an individual intends to enter the water (though sewage may also act as a transport vector). However, inorganic-based products (for example based on titanium dioxide) have been less studied. A custom sunscreen was developed in order for the researchers to know precisely which chemicals they were using (and at what ratio they were at), which was experimentally combined with warming ocean conditions to investigate impacts both on adult corals and on their gametes/larvae. Coral health was measured with the Fv/FM parameter, which is indicative of stress in photosynthesising species. This work is ongoing, but shows negative impacts of the stressors on photosynthetic yields. (JR)

### **Multiple stressors and marine mammals**

Peter Tyack (USTAN) told us that marine mammals are exposed to a range of different anthropogenic impacts, including collisions with vessels, exposure to sonar, entanglement with fishing gear, changes in prey distribution/availability, and climate change. We need to acknowledge that the cumulative risks to these animals cannot be predicted from an understanding of the single stressor effects or single studies, as stressor interactions may be synergistic (greater than the sum of the individual stressors) at one level, but additive or antagonistic (less than the sum) at another. Moreover, compared to other systems it is even harder to evaluate these impacts as it is very difficult (or indeed impossible) to experimentally manipulate stressor conditions. Tagging offers the opportunity to measure both the position of animals and dose (e.g. of sound) of particular stressors an animal is exposed to. In conjunction with knowledge of other environmental parameters, it is therefore possible to examine the impacts of stressors which overlap in time and space. However, as much as we may learn about physiological and behavioural responses of organisms, it is important to keep in mind that above all managers need ecosystem-level responses in order to properly undertake marine planning. (JR)

# e-Poster sessions



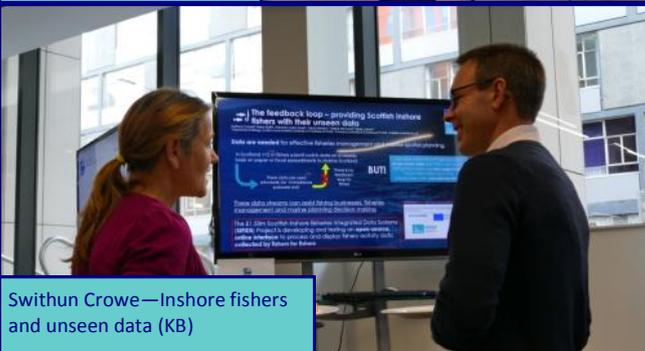
Erica Chapman—temporal and spatial variability in oysters (KB)



Aresenio Hilinganye—Artisanal seafood in Angola (KB)



Cornelia Simon-Nutbrown—Maerl distribution (KB)



Swithun Crowe—Inshore fishers and unseen data (KB)



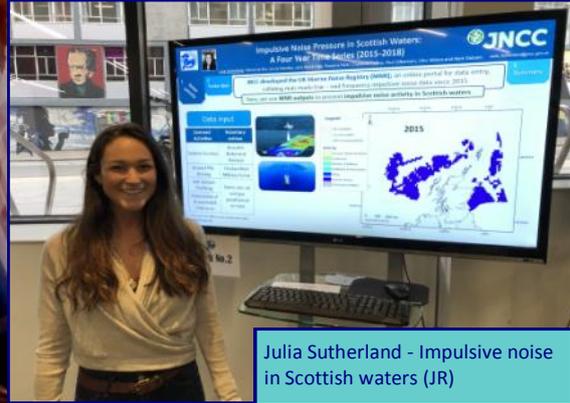
James Rimmer—Multiple stressors and mudflats (KB)



Robert Eisler—Blue carbon and limpets (KB)



Alan Audsley - Seabed pockmarks (HL)



Julia Sutherland - Impulsive noise in Scottish waters (JR)



Susan Fitzer - oysters and biomineralisation (HL)



Simone Riegler - The perception and value of Scottish saltmarshes (HL)

E-poster sessions have become an intrinsic part of the MASTS ASM. Researchers get to discuss how their projects are progressing and meet potential collaborators.

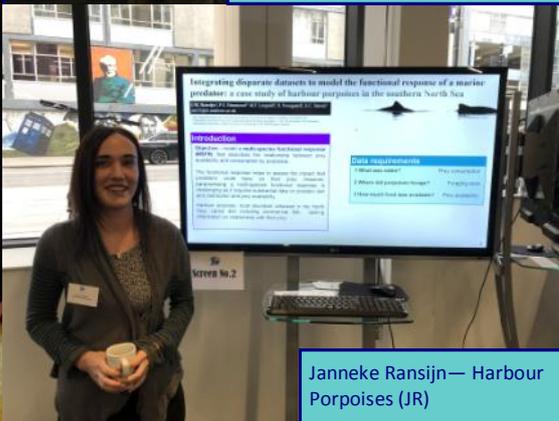
# e-Poster sessions



Melissa Costaglio-Ray Seabird use of tidal environments (HL)



Marie Porter - Seasonally resolved slope current, gliders (HL)



Janneke Ransijn— Harbour Porpoises (JR)



Heather Runnacles-Goodridge TBT and dogwhelks (JR)



Jason Cleland—Epibenthic megafauna in the Davis Strait (KB)



John Phelan—modelling salmon lice around salmon farms (KB)



Catherine Tait— an Ocean Energy impact Monitoring System (KB)



Rebekah Wood— microplastics ingestion in and *Crangon crangon* (KB)



Rene Swift— Low-cost data collection from small-scale fisheries (KB)



The Hoochie Coochie Band entertained delegates as they enjoyed a hot buffet and wine reception during E-poster session 3. (KB)

Across the two days of the meeting 30 e-posters were displayed to delegates. Project scientists were on-hand to answer questions and provide more detail.

## MASTS VIDCASTS

In addition to joining Kelvin Boot in reporting on the 2019 MASTS ASM in the pages of this edition of *Reflections*, student reporters Hannah Lee and James Rimmer also practiced their interviewing skills by recording short pieces with some of the many speakers from the ASM. Full recordings can be accessed at <https://www.masts.ac.uk/annual-science-meeting/2019-vidcasts/>

### James Rimmer interviewed:

**We all need to be bolder!** James Rimmer spoke with Colin Moffat, Chief Scientific Advisor (Marine) for Scottish Government. Colin gave a rousing final talk at the 2019 ASM, culminating in a call to action for all of us to be BOLDER!

**Blue carbon.** James Rimmer spoke to MASTS student, Hannah Lee (Heriot Watt University) about blue carbon in bivalve habitats.

**Flapper Skate.** James Rimmer spoke with MASTS Grad School student, Edward Lavender (St Andrews University) about his work studying the movement and ecology of Flapper Skate. Edward won the prize for best student talk given at the ASM.

**Marine mammals and noise.** Ewan Edwards, a MASTS Graduate School alumnus, now working for Marine Scotland Science talks about monitoring marine mammals and noise in the west of Scotland using underwater listening devices.



### Hannah Lee interviewed:

**Marine Climate Change.** In the spring of 2019, Scotland's first Minister declared a "climate change emergency". Hannah recorded an interview with Bee Berx, Climate Change Science Lead at Marine Scotland Science.



**Mudflats & multiple stressors.** Hannah Lee spoke to MASTS Grad School student, James Rimmer (St Andrews University) about his e-poster and work looking at the effects of multiple stressors on intertidal mudflats.

**European oyster.** Hannah Lee spoke with Erica Chapman from St Abbs Marine Station about the spatial variability of native European oyster in Loch Ryan.

**Women in Scottish Aquaculture.** Hannah Lee talks to Rob McLean (Aquaculture Policy Manager at Scottish Government) about the careers in aquaculture talk he was delivering at the Women in Scottish Aquaculture (WISA) initiative.

**Are there enough fish in the sea?** Anneli Lofsted (University of Aberdeen) spoke to Hannah Lee about her talk "European fish availability and nutritional aspirations: are there enough fish in the sea?"

**Territorial user rights fisheries.** Hannah Lee talks to Prof Michel Kaiser (Heriot Watt University), about territorial user rights fisheries.

**Blue Carbon Audit.** Dr Joanne Porter from Heriot Watt University talks about the Blue Carbon Audit of Orkney Waters.

## **Kelvin Boot interviewed:**

**MASTS looking forward.** Professor David Paterson (MASTS Executive Director), discusses the 2019 Annual Science Meeting and is looking forward to hosting the 10th ASM in 2020.

**The Five Deeps.** Alan Jamieson spoke about his involvement in the Five Deeps exhibition, which gave him a unique opportunity to study the oceans' greatest depths, with all the weird and wonderful organisms that live down there. Before moving to Newcastle University, Alan was a MASTS lecturer, so we were delighted to welcome him back to provide an ASM plenary talk.

**Marine Invasive Species.** Kelvin Boot spoke with MASTS ASM plenary Speaker, Prof Sergej Olenin (Klaipeda University, Lithuania), about the precautionary approach that he thinks should be applied to invasive species.

**Maerl.** Kelvin Boot recorded an interview with Connie Simon-Nutbrown (Heriot Watt University and runner-up of the best student e-poster prize) about her work developing a model to predict the distribution of maerl, a coralline alga that not only provides valuable habitat but also sequesters blue carbon.

**Marine Spatial Planning.** Kelvin Boot interviewed Chris Leakey who had co-delivered a talk about marine spatial planning in the 21st Century, illustrating Scottish innovation and the role of science.

**Scottish Seabird Centre.** Charlotte Foster joined the ASM as an exhibitor and spoke with Kelvin Boot about her experience at the MASTS ASM

**Decom Workshop.** David Paterson reflects on the annual MASTS/SUT workshop.

**Decom workshop industry perspective.** Moya Crawford is one of the organising committee for the MASTS/SUT ASM workshop. She shared her impressions of the workshop with Kelvin Boot.

**Pipelines and artificial reefs.** Kelvin Boot interviews Michael Redford from SAMS about his work looking into the option of leaving pipeline protection materials in place as artificial reefs.

**Learning from each other.** Prof Mike Elliot from Hull University is a regular speaker at the MASTS/SUT workshop. He summed up the workshop for Kelvin Boot and reflected how the Decom stakeholders were now listening to and learning from each other.

**Decom and the circular economy.** Charlotte Stamper from Zero Waste Scotland spoke with Kelvin Boot about decommissioning challenges and the circular economy.



## Special Session on “Marine Biogeochemistry”

This special session, Chaired by Nick Kamenos, Heidi Burdett and Seb Hennige covered a wide range of topics including: seagrass and carbon sequestration, analysing a decadal trend in biological activity in the North Sea, modelling the effects of Water Framework Directive nutrient reductions on the eutrophication status of the North Sea, and ocean acidification and coral reefs. Three talks in particular caught the attention of Hannah Lee.



Matthew Grey (Marine Science Scotland), addresses a full audience at the biogeochem session.

## Biochemical time series

Annual survey cruises provide us with an excellent opportunity to gather long term data sets, though these cruises can be constrained to a single season for various reasons such as weather and boat schedules. Dr Clare Johnson (SAMS) presented an overview of the OSNAP array which monitors the overturning circulation within the North Atlantic. As part of this array SAMS deployed three moorings into the Rockall Trough as part of ATLAS and AtlantOS. Sensors were deployed at 70, 1000 and 16,000 metres and collected data on current speeds, dissolved inorganic nutrient levels, dissolved oxygen and pH. When compared with annual cruises the data collected by these moorings will begin to allow researchers to identify interannual variability and assess mixing of waters across distance and depths. (HL)



## Carbon breakdown in coralline beds

Understanding blue carbon stores isn't just about understanding what is there but also how it got there and the rates at which the carbon is broken down. Second year PhD student Kelly James (Glasgow) presented work to the biogeochemistry forum investigating the rate at which carbon with labile and refractory properties breaks down in the presence of coralline algae. Substituting green tea and rooibos tea to represent labile and refractory carbon material respectively, Kelly demonstrated how by measuring bacterial oxygen consumption rate of decomposition could be assumed. This work feeds into Kelly's PhD during which she is looking at maerl beds as blue carbon stores and the effects of a changing world on these habitats. (HL)

## Decaying kelp and blue carbon

Kelp forests in Scottish waters provide habitat for many iconic marine species and through the year, as the kelp cycles through growth and shedding of blades, 44% of the alga becomes detritus. Alasdair O'Dell (SAMS) presented his ongoing research which aims to understand how kelp detritus is exported after shedding. Different parts of the kelp structure were incubated in sealed vessels and water samples were collected to determine levels of dissolved inorganic carbon production and therefore determine rates of decomposition. This work and other topics which Alasdair's PhD focuses on feed into the work by the Scottish Blue Carbon Forum and their aims to quantify blue carbon accretion and export rates around Scotland. (HL)



Drs Nick Kamenos and Heidi Burdett, along with Dr Seb Hennige, chaired the biogeochem session



## Monitoring marine mammals and noise

Ewan Edwards (Marine Scotland Science) spoke about noise in the marine environment, which can be broken down into three main categories:

- Geophony - non-biological sounds, such as rain on the sea surface, shifting sediments, or waves
- Biophony - biological sounds, such as bivalves opening and closing, fish feeding on a reef, and marine mammal vocalisations
- Anthropophony - human-created sounds, such as shipping, sonar and pile-driving

### Geophony      Biophony      Anthropophony

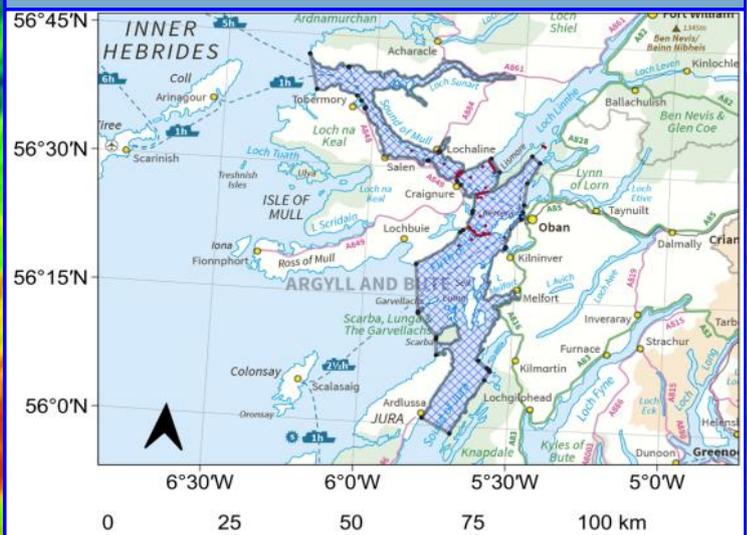


Passive acoustic monitoring - a system used to listen to marine noise and record it - can be used to spatially map the distribution and nature of sounds occurring in the marine environment. The COMPASS (Collaborative Oceanography and Monitoring for Protected Areas and Species) is a 5-year project which uses passive acoustic monitoring techniques at 6 locations in Scotland, through the establishment of oceanographic and acoustic moorings. There is a lot of data coming in to Marine Scotland through such projects, and there will be opportunities for future student projects to analyse it. Passive Acoustic Monitoring data is important in helping to define and monitor marine spatial planning efforts, such as Scotland's network of Marine Protected Areas, and can help with the conservation of a range of species - from noisy cetaceans, to tagged salmon. (JR)

## Passive acoustic monitoring of skate movements

Continuing with the theme of passive acoustic monitoring, Ed Lavender (University of St Andrews) gave a detailed technical account on the use of this technique to monitor flapper skate in the Loch Sunart to the Sound of Jura Nature Conservation Marine Protected Area (MPA).

As part of the monitoring programme on the skate, Marine Scotland Science and Scottish Natural Heritage used a series of acoustic receivers (underwater hydrophones) in the MPA in order to detect acoustically tagged skate moving within range of the receivers. Approximately 50 receivers were used in an array throughout the MPA, however due to its size, 720 sq km, some of the area was not covered by the array. Skate were tagged with both acoustic tags, which communicate with the hydrophones to record presence, and archival tags, which recorded



depth and temperature every 2 minutes. Ed is working on developing methods to predict the position of animals when they were beyond the range of the acoustic receivers by using the archival data. This approach only works due to the uneven depth profile of the benthic habitat in which the skate are found, and their demersal lifestyle causing the animal's own depth profile to be closely associated with the actual bathymetry. Indeed, it has been speculated that the skate may 'walk' on the seabed using their wings to maximise locomotory energy efficiency. The goal of the broader flapper skate project is to better understand the habitat use of the skate within the MPA, and passive acoustic monitoring is an effective tool in investigating this. (JR)

## Special Session on “The Future of Scottish Fisheries in a Changing World “

Fisheries is very important to the Scottish economy but is also culturally important and has the potential to impact upon the marine environment and the ecosystems it holds. Getting a better understanding of the future of Scottish fishing as the world changes is essential for planning and management into the decades ahead. We may not know what that future is at the moment but as Dr Tara Marshall (University of Aberdeen) said in her opening remarks of this special session “ we can be certain that it is going to be very different from what we are experiencing today”. This special session contained 8 talks ranging from territorial rights and developing participatory approaches to management through data self-sampling and the Scottish Inshore Fisheries Integrated Data System, to environmental impacts and gear selection, what dictates whether small scale fishers go to sea, and even whether we have enough fish to meet our dietary requirements. (KB)

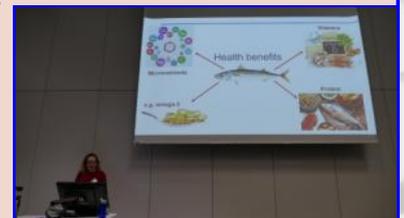
### Getting territorial

Professor Michel Kaiser (Heriot-Watt University), got the session off to a topical start discussing greater use of territorial fisheries in management in the UK, specifically for sedentary species like *Nephrops* or scallops. Prof Kaiser illustrated the principle with a case study of the scallop dredged fishery in the Isle of Man which to date has been subject to little management, not much science and patchy stock-assessment, so over-exploitation remains a possibility. Scallop dredging is also known to have the most impact of all towed-gear fishing and this is of concern to the sustainability of the scallops as well as other seabed life. About ten years ago a fisheries and conservation zone was implemented; some areas are set aside for sea-grass beds, maerl beds or horse mussel reefs but there is a designated fishery management zone. The Manx Fish Producers Association was given the lease to fish the area for scallops, but with conditions that the fishermen had to participate in scientific survey and quota setting, effectively taking responsibility for how they would fish the zone. Because of the quota that limits how much can be fished, the fishermen were encouraged to fish the high density scallop areas, fishing became more efficient and less damaging. GPS recorders showed that the actual area that was fished was minute with 96% of the potential fishing area, not being fished at all. Compared to the rest of the Isle of Man scallop fishery that is not managed as part of this regime, the carbon footprint is less, catch per unit effort is better and in the wider context of food production the energy return on investment is better than livestock farming. This work demonstrates that in the real world, if the management is right to create the right conditions wild capture fisheries, even if using environmentally disturbing fishing gears, like scallop dredges, can be managed effectively to improve profitability, reduce time at sea and lessen the environmental footprint on the seabed. (KB)



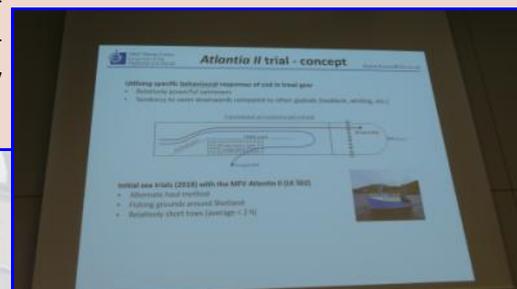
### Is there enough fish?

From the community which bring the fish in, to fish consumption at an international scale Anneli Lofstedt (University of Aberdeen) began by outlining why fish is a great food source. Guidelines suggest we should consume two portions of fish a week; as well as protein, fishy diets are rich in omega 3 and important micronutrients. However, Annelis PhD poses the question; to meet this guideline - is there enough fish in the sea? Anneli's talk demonstrated how both guidelines and traditional diets vary across Europe as does fishing effort. As a result some countries consume more than the guideline while others considerably less. )! Two points come from this research being carried out by Anneli Lofstedt and colleagues at the University of Aberdeen: sustainable fish production is likely to be even more important in future and there is a need for changes in cultural consumption trends, we should be encouraging a broader species range, as well as a greater awareness of how much fish we should be eating, all tempered with how much fish is available. (HL)



## Fisheries - adapting for change

To adapt for change we must be bold and innovative. Yolanda Arjana (JNCC) continued a theme of expanding the focus from a local to a European scale highlighting directives which commit governing bodies to considering ways in which by adapting bottom trawling gear ecosystem impacts can be reduced. In particular, the work presented by Yolanda looked to produce evidence to support adaptive strategies by identifying the key data which is needed to assess the impacts of fishing gear. This includes understanding both the way in which gear interacts with the seabed and the vulnerability of ecosystems to a given interaction. From this understanding of gear adaption begins a cycle of improving fishing practices and understanding impact to better improve practices, all of which is underpinned by understanding the ecology of target species and the engineering of the gear. In-keeping with this theme and moving from the sea bed to mid water Dr Shaun Fraser (UHI) presented the testing of innovative fishing gear with the aim of bycatch reduction. The construction of this gear utilised knowledge of the behaviour of both the target and bycatch species to maximise yield and minimise bycatch. Shaun demonstrated how different adaptations influenced the catch in different ways which was accompanied by footage from inside the trawl. (HL)



## SIFIDS summary

Mark James (MASTS) drew together the nine work packages that came out of the Scottish Inshore Fisheries Integrated Data System (SIFIDS), which set out to develop a series of prototype processes and systems designed to improve data collection in inshore fisheries. SIFIDS was mostly concerned with static gear fisheries for crabs, lobster and langoustine but also included some other sectors such as scallop diving, dredging and fixed net fisheries. (KB)

For more information about SIFIDS visit:

<https://www.masts.ac.uk/research/emff-sifids-project/>



## What stops fishing?

Small scale fishing can be a precarious occupation and many factors influence whether a fisherman goes to sea to make money or stays ashore and misses opportunities to earn income. Janneke Ransijn (USTAN) and colleagues interviewed 105 lobster and crab fishers from 42 ports around Scotland, to better understand their fishing behaviour, as part of the Scottish Inshore Fisheries Integrated Data System (SIFIDS) project. This project wanted to learn more about where and when fisheries activity was taking place and what the drivers were that determined that activity. 95.2% of respondents cited bad weather as the most important driver for stopping fishing, but there are other factors that dictate the probability of going fishing on any given day. Low catch rate was the second most important reason for not venturing out to fish, according to more than a third of those interviewed; around a third also gave vessel problems and personal problems as reasons for staying ashore. Seasonality and sale price of catch were also deemed of importance, while only 1% reported ground closures as a reason for not fishing. Still in its early stages the project's data is being used to populate computer models that should help to predict the likely behaviour of the fisheries as a whole as well as that of individuals, under different, future economic, environmental and ecosystem scenarios. An increase in stormy weather due to climate change, for example, will clearly impact the number of fishing days. This work provides a baseline to understanding vulnerable communities which are reliant on their catch. Identifying these drivers is particularly important with changing oceans as a result of climate change. (KB&HL)

# Scotland, the Climate Emergency and a Call-to-Arms

## Climate Emergency

At this year's ASM the theme of climate change and specifically Blue Carbon has been high on the agenda. Dr Bill Turrell (MSS) began by setting the Scottish scene with regards to the first declaration of a climate emergency and proceeded to detail how research in Scotland aims to address the goal of becoming 'Net zero' by 2045. Bill spoke not only of ongoing research to offset carbon but also to reduce carbon output. For example, extensive work has been done looking into carbon capture and storage, including aiming to understand the effects of the process on ecosystems if gas escapes. Identifying the need for such evidence led into identifying work which is needed to underpin environmental impact assessments as we continue to expand renewable energy developments in Scotland's sea area. Following this Bill highlighted the work of the Scottish Blue Carbon Forum (SBCF), with many of the PhD researcher members presenting their work at this year's ASM. The ongoing work by this group looks to identify blue carbon stores as well as develop the understanding of accretion rates of carbon in these stores. Bill finished his talk with a request for us all to be 'carbon conscious' and consider our carbon footprint and how it can be mitigated by for example considering greener energy, food and travel options. (HL)

## Climate research

Bee Berx is Marine Scotland Science's new Climate Change lead, she reminded us how the climate had changed over the millennia since the last Ice Age to the inception of the Industrial Era, resulting in rising temperatures, gradual ocean acidification, sea level rise and oxygen depletion. Such pressures, not least on society, need to be addressed; there has never been a more pressing time for climate change research. Scotland is leading the way by declaring a Climate Emergency, a Bill which is set to become law and underpinning that a Climate Change Plan, setting out adaptation and mitigation plans and policies; Bee went on to highlight the need for science to support these initiatives. Audience participation then took the form of getting everyone to stand up, and only sit down if they agreed with certain statements, beginning with 'climate change is not really a problem' - nobody sat down, by the time she got to 'climate change is an immediate and urgent problem' - nobody remained standing. The response was different in wider Scottish society where about two thirds would agree with the last statement, but that is a dramatic increase on just a few years ago. Science she pointed out, has long time series but should be honest about natural variability; continued scientific monitoring is essential. Other research areas include offshore renewables, fisheries and aquaculture, especially in the light of an impending nine billion global population. The Scottish Government has plans for a Centre for Scottish Aquatic Climate Change Studies to coordinate climate studies in Scotland. Bee also called for the setting up of a MASTS Forum to bring together the excellent research already being carried out in Scotland, as well as making firmer links with the other 'pools' in Scotland such as SAGES, ETP and SRPe. (KB)

## BE BOLD!

Closing the MASTS ASM, Professor Colin Moffat (Marine Scotland) spoke about being bold. In particular are we being bold enough to tackle the biggest danger to our planet, climate change. Highlighting how every talks starts by speaking about what the ocean gives us but not what we give to it. At current rates, within 10 years the damage the population of Earth is doing becomes irreversible, yet CO<sub>2</sub> emissions are still accelerating. As scientists we have a crucial part to play but we have to be bold:

**Our** response has to be courageous, immediate and influential.

**We** must break down the barriers between the social, economic and natural sciences more rapidly than is happening at the moment.

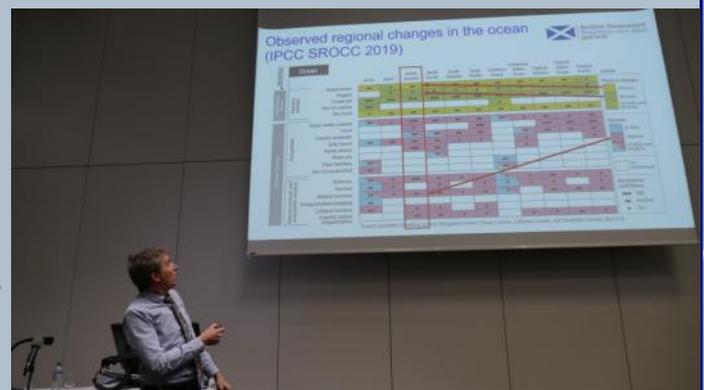
**We** need to grasp open access to our data and encourage even closer collaborations than have developed in the past.

**We** must maintain, and in some cases develop, critical time series, focusing on what is needed.

**We** need to be less precious about research versus monitoring, academic science versus government science.

**We** must ensure that we transform the data we have into digestible information such that decision makers are fully informed and the wider public are supported to make the required changes – tell a story.

Colin's talk was a call-to-arms, to educate both ourselves and those around us. To in fact make the world ocean literate and share a Scone! SCONE being **S**eeking out data on response to stressors; **C**hallenging everything we learn; **O**bserving the reactions of people and the ocean to research and change; **N**etworking with a diverse spectrum of people and finally **E**ntertaining and educating – sharing your research at a level everyone can access so we can work towards appropriately responding to the current climate emergency we are experiencing. Colin closed the conference leaving all in attendance with food for thought on how, in the next year can we be bold enough to react to the current challenges we face. (HL&KB)



## An ocean-literate person

- Understands the Essential Principles and Fundamental Concepts about the ocean
- Can communicate about the ocean in a meaningful way
- Is able to make informed and responsible decisions regarding the ocean and its resources



## The SCONE process

- S**eek responses to ocean pressures/stressors and management actions
- C**hallenge constructively, continuously and with candour
- O**bserve the ocean, people, actions, reactions and the clock
- N**etwork across many fora, ages ...
- E**ntertain and tell the story that restores planet Earth



© John Baxter

## A different perspective on 'invasives'

This year we were treated to a stimulating talk from Professor Sergej Olenin (Klaipeda University, Lithuania), who gave us a different perspective on the question of 'invasive' species, and left many re-evaluating their opinions. There are many pathways for aquatic species to move (and potentially 'invade') to new systems as a result of human activities; in ballast water, biofouling of shipping, aquaculture etc. Species are moving, however the traditional invasion paradigm may need reconsidering in a changing world. Sergej outlined how this paradigm has evolved over the last few decades, with the terms 'biological invasion' first being used in 1981, and biosecurity appearing in the literature in 1987. Whilst this anthropogenic facilitation of invasion is now much better understood, there is still much uncertainty in this field - are so-called 'alien' species really alien, or simply previously undetected? Much is unknown about the ecological status of these species and it is nearly impossible to predict their impacts on a new system *a priori*, therefore it may not be possible to produce a meaningful risk assessment (though machine learning may offer a solution to processing the vast array of parameters associated with biological invasions).



We have always considered non-natives in a negative light, Sergej outlined some of the problems with this approach. For example, it does not account for the differences in impacts caused by invasive species (species are not all equal), or even potential benefits either to society or in the form of ecosystem functions. For example, King Crab is invasive to Norway and is associated with great ecological damage, yet it also offers a harvestable source of food. Strong language and often militaristic metaphors, such as 'enemies' and 'army' are used to describe these distribution shifts in the mass media, however Sergej suggests an alternative approach of assessing organisms on a case-by-case basis on their environmental economic and human health impacts rather than their simply alien or native status. Unlike climate change, for example, where we can measure a whole series of physical parameters, with 'invasives' there are many unknowns. Sergej notes that wiping out an aquatic species is rarely practical (or even possible), therefore attempting to do so may not be economically sensible. Instead, perhaps we should consider controlling an invasion, or even commercially exploiting it, in a fashion which is sensitive to both its scale and impact. Sergej notes that it still remains best to take a precautionary approach, through clean ballast water, clearing biofouling from ships' hulls or from decommissioned structures like oil and gas rigs, and taking quarantine precautions with aquaculture facilities. (JR&KB)

## Decommissioning and Wreck Removal Workshop

Ninety delegates from across the Decommissioning community gathered for the annual Decommissioning and Wreck Removal Workshop at the MASTS ASM 2019. Once again we were treated to fascinating presentations from almost 30 speakers, vigorous and healthy discussions and plenty of opportunity to swap ideas and opinions, to renew old and make new contacts. Working together and sharing data was an underlying thread of a very successful workshop, as highlighted in Moya Crawford's introduction as she encouraged people to be provocative as we went forward. Stephen Thompson (Arden Global) looked at the global 'Decom' market, pointing out that it was very complex and dynamic, adding that 'best practice' was still evolving. As he said most forecast for the future end up in 'Room 101'. He also drew attention to the fact that re-selling some equipment is very difficult as it has little residual value.

Knowing what you are removing when 'jackets' are being dismantled is paramount for Peter Oliver (Chevron) who cantered through the various survey and data collection methods available, including divers, seabed samples and ROV footage, he was enthusiastic about the possibilities brought by Stereo ROV. Estimates can be made, for example, of the amount of fish inhabiting the subsurface structures and he illustrated this with a valuation of \$7000 per 'jacket'. DNA is also an exciting field which allows the whole community to be identified, again showing an ecological value.

## DECOM continued.....

Other speakers went into the important details of the need for clear and consistent Decom agreements, the UK Regulatory Hub and the world-leading National Decommissioning Centre in Aberdeen. The NDC has a PhD –based research programme and is driven by industry and its needs and includes a compelling simulator which enables visualisation in a highly realistic manner. The first session of the workshop ended with everyone being encouraged to get out their mobile phones to take part in a live, interactive quiz which delved into aspects of the relationship between marine science and the ‘Decom’ industry; results are still being analysed but there were calls for the need for a common language including agreed terminology, and understanding of cultural differences.



The second session dealt with inputs and impacts of retaining or removing marine infrastructure. Mike Elliot (University of Hull) followed a theme of “how do we look after the natural stuff, how do we deliver the human stuff”, it is a question of costs and benefits., risk assessment and management. Mike gave us the ‘10 Tenets of sustainable management for decommissioning’: ecologically sustainable, technologically feasible, economically viable, socially desirable/tolerable, legally permissible, administratively achievable, politically expedient, ethically defensible, culturally inclusive and effectively communicable. Yolanda Arjona (JNCC) outlined one such challenge, the use of explosive pointing out the threats to all marine life, not just cetaceans. There were, however, pre-activity mitigations that could be used to mitigate effects : including acoustic deterrents, noise abatement through the use of bubble screens resonators and coffer dams, and soft starts, introducing gradually to allow wildlife to move away. Jon Miller later brought the question of dumped explosives and chemicals from shipwrecks to the fore with a sobering talk, which he opened with the words “If you go down to the beach today, you’re sure of a big surprise”, a reference to the dangers of shells, grenades and other ordnance being cast ashore for wrecks. He gave an overview of some of the attempts to remove this ordnance since World War II, but there is still a lot out there. Moya Crawford then discussed the apparent contradiction in the law where sunken Naval vessels are often seen as cultural heritage to be preserved in situ, oil and gas infrastructure has to be removed.

Data, as always, was a key topic , with calls for more cooperation and sharing between academia and industry, not least to populate dta visualisation. There were some stunning illustrations of how virtual reality and visualisation tools can be brought to bear on developing wreck removal procedures and predicting almost-real scenarios before work begins, particularly pertinent to safety aspects..Pierre Major ( Offshore Simulator Centre) highlighted the value of animations in training, while Mark Lawrence ((Waves Grp) gave us the sequence for success as: visualise-understand-communicate. Recycling and re-use were also put forward as ways to approach Decom with talks on mattress recycling for use as artificial reefs (Michael Radford, & Elise Depauw, SAMS), and the need to apply the circular economy principle (Charlotte Stamper, Zero Waste Scotland).

Summing up the workshop, Moya Crawford (SUT Decom and Salvage Committee) observed:

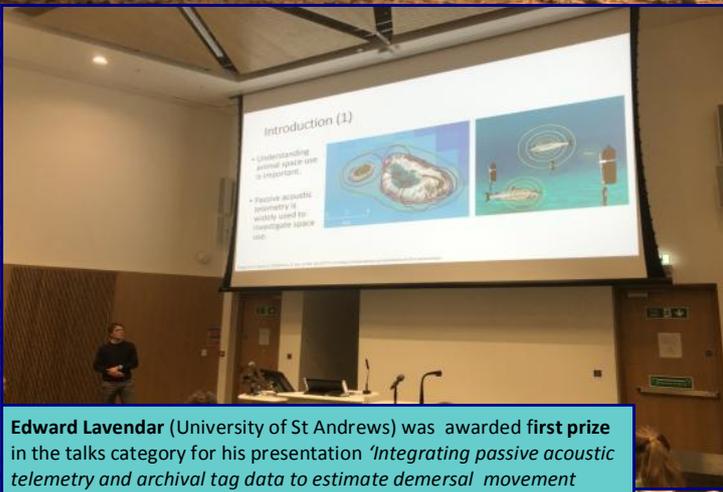
*“This meeting aimed to unlock opportunities, share experiences and expertise and influence decisions around the challenges decommissioning and salvage are facing now and in future. Judging by the interactions and knowledge sharing between the various groups in the room, I am certain that we have taken more steps to achieve this”.*



Richard Heard ended the meeting with an update on the INSITE Project 2019



Panel discussions allowed for more detailed questioning of speakers and more consideration of topics



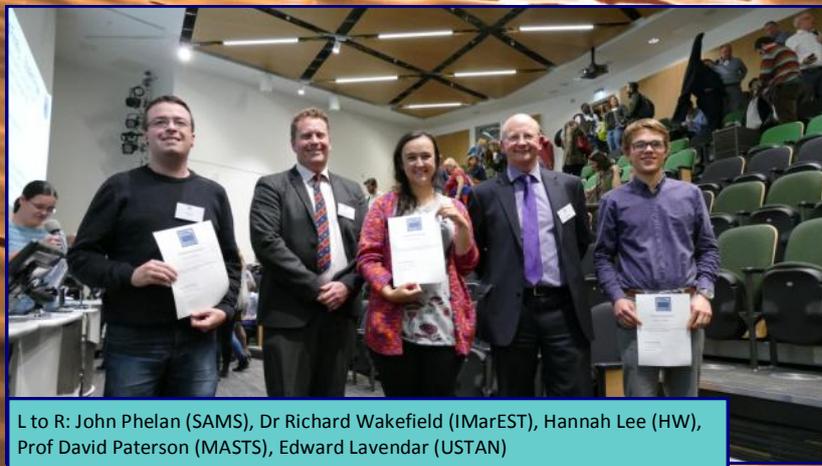
**Edward Lavendar** (University of St Andrews) was awarded **first prize** in the talks category for his presentation *'Integrating passive acoustic telemetry and archival tag data to estimate demersal movement pathways at high resolution'*.



**Second prize** went to **Hannah Lee** (Heriot-Watt University) for her talk *'Towards an understanding of the role of blue mussel beds in carbon cycling'*.

**Presentation and e-poster prize winners**

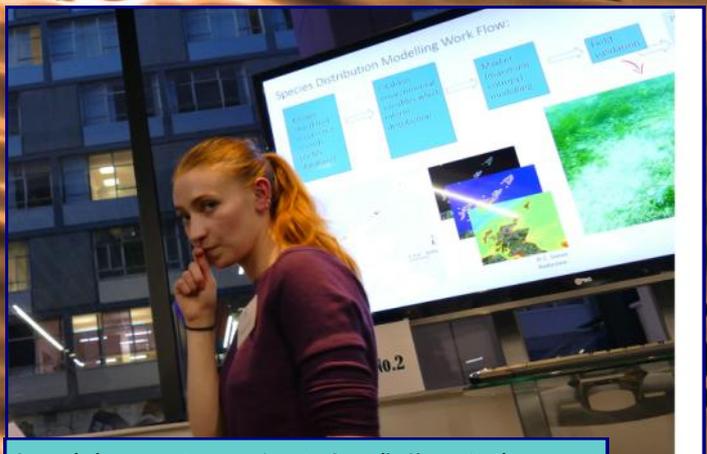
Dr Richard Wakefield from the Institute of Marine Engineering, Science and Technology (IMarEST) gave a brief overview of the IMarEST and its specialist groups, pointing out the synergies with MASTS. The relationship between the two organisations grows in strength each year and once again IMarEST has generously sponsored the prizes for best student talks and e-posters. Richard and the judges had to choose from around 100 talks and 30 e-posters, all of a very high standard, reflecting the quality of the MASTS community.



L to R: John Phelan (SAMS), Dr Richard Wakefield (IMarEST), Hannah Lee (HW), Prof David Paterson (MASTS), Edward Lavendar (USTAN)



**First prize** in the e-poster category was given to **John Phelan** (Scottish Association for Marine Science) for his poster *'Modelling and forecasting of Lepeophtheirus salmonis around Scottish salmon farms'*.



**Second place** e-poster was given to **Cornelia Simon-Nutbrown** (Heriot-Watt) for her poster explaining *'Using species distribution modelling to further the understanding of Maerl bed distribution around Scotland'*.