



# MASTS ASM

## Reflections 2018

### LARGEST in UK



Professor David Paterson (St Andrews), Executive Director of MASTS, welcomed delegates to the largest meeting of its kind in the UK and the best attended ASM yet. The programme was he said “*the best we’ve ever had . It is pretty diverse and shows the range of science being done in Scotland and also includes work being done further afield as well, and I’m delighted to see so many people here.*” The success of ASM’s is that they don’t just attract academia; also taking part were speakers from government and industry, especially the oil and gas and Decom sector. MASTS itself is also expanding, “*since the last meeting we have welcomed BGS and JNCC as full members....it’s our ambition to have the most relevant people as members, and representing the marine community across Scotland.*”

Prof Paterson also mentioned the investment that marine science was attracting: The Lyell Centre at Heriot Watt, and the £16 million being invested at St Andrews these were recognition of the importance of Scottish marine science and international concern about global climate change and other issues. “*It’s our job to help respond to those challenges*”, he said, “*particularly for early career scientists. We have made a good job of giving you something to do in the future—perhaps not the best scenario that’s been left to you in order to sort out some of the problems that the increase in population and the requirement for resources has left us to deal with. It’s a challenge that we have to rise to and MASTS will try and help support.*” What is important about MASTS is that it promotes cooperation rather than competition among its members to attract large grants, to develop new areas of work and to promote the training of future scientists.



One of the biggest pieces of news since the last ASM is the announcement of the NERC-funded Doctoral Training Partnerships (DTPs); a subset of the MASTS community applied for a Scottish-based DTP. “*I can’t explain how delighted we were that we were able to bring this training package to Scotland. All round Scotland has done particularly well in the DTP round, with representation in four DTPs. There are only two new DTPs in this round and both are based in Scotland, and thanks to Dougie Spiers from Strathclyde and everyone involved in the application ,for their work on the SUPER DTP.*” Prof Paterson reminded delegates of the MASTS Graduate School as a means of getting the best possible training, and the opportunity for taking up internships which have

already aided career development for some young scientists., by giving them real work experience. Prof Paterson went on to thank IMarEST for sponsorship of the students’ presentation and poster prizes. Finally he highlighted the Brexit challenge but reminded the audience that: “*MASTS will remain engaged as members of the European Marine Board, the European Marine Biological Resource Centre, where we represent not just Scottish but UK science on those boards....we are trying to stay as involved as possible, and we want to continue that whatever the outcome of Brexit talks. Part of that is lobbying our own government to say that science and research from Europe and integration of that work is critical to the global problems we have. We need to stay closely linked.*” (SG&KB)





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## Reflections 2018

### Reporting the meeting

MASTS ASM just gets bigger and better. ASM 2018 continued the trend with 144 lecture and poster presentations, many more in the 9 parallel workshops and 15 exhibitors from science, industry and government. MASTS ASM *Reflections 2018* is a taster of what went on over the three days in the excellent Technology and Innovation Centre at the University of Strathclyde, Glasgow. The TIC is the perfect venue for what has become the largest meeting of its kind in the UK. As a showcase for Scottish Marine Science the ASM provides unique access to anyone-who-is-anyone in the field of marine science, as well as the opportunity to share science, swap ideas and make new contacts. A measure of its importance is demonstrated by the wide range of well-attended workshops, which the ASM now hosts. These workshops bring together even more delegates to discuss some of the most pressing issues facing the world ocean in general and Scottish seas in particular. As the ASM gets larger and covers more topics it becomes impossible to capture every aspect of every talk, presentation and workshop. But in an attempt to represent as much as we can the various strands of science that were discussed, a team of 'reporters' mixed with the crowds and attended talks. Joining Kelvin Boot were graduate students Allan Audsley (AA), Texa Sim (TS), Edward Bolger (EB), Soizic Garnier (SG) and Melinda Choua (MC). Some of them are registered for the MASTS Post Graduate Certificate and this experience will contribute to the PGC requirements, but mostly they all enjoyed meeting the presenters and trying their hands at being reporters. As well as writing for inclusion in *Reflections* they also recorded short vidcast interviews with some speakers, and these are available on the MASTS website. <https://www.masts.ac.uk/annual-science-meeting/2018-vidcasts/>. We hope you enjoy the fruits of their labours. Presentations represented in *Reflections* or on video can only be a taster of the breadth of marine science that was presented at ASM 2018, and to some extent mirrors our own preferences and biases, but nevertheless there is still a good cross section; the final programme and a complete collection of abstracts can be accessed on the MASTS website.

Allan Audsley interviewed:

**Charlotte Findlay** – Noise pollution from acoustic deterrent devices

**Kirsty Wright** – Interconnecting the North Sea: spatial planning

**Ina Lefering** – A new technique for measuring light absorption over large scales



Texa Sim interviewed:

**Daniel Johnstone** – Foraging behaviour, wind turbines and black guillemots

**Lola Paradinas** – Sampling microplastics along Scottish shores

**Mike Spain** – The Northern Lighthouse Board

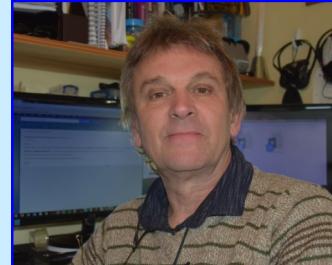


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## Reflections 2018

Kelvin Boot interviewed:

- Benjamin Williamson** – Using UAVs to measure animal distributions
- Christine Maggs** – What is JNCC?
- Lucy Mead** – Blue sharks challenges and conservation
- Colin Moffat** – A decade of opportunity for the marine environment
- Krista Crawley and Martin Laroche** – Canadian students visit MASTS
- Karen Seath** – A successful Decommissioning workshop
- Murray Roberts** – Decommissioning workshop: bringing scientists and industry together
- Lloyd Potts** – Can microbes help to breakdown pollutants in drill cuttings?
- James Thorburn** – Tope in Scottish waters



Soizic Garnier:

- Ana Rodrigues** – Restoration of a keystone species, the European Oyster
- Georgios Kazanidis** – Deep-sea sponges: distribution, variability and management
- Eben Wilson** – Sky , a mid-mass industrial drone for scientific missions



Melinda Choua interviewed:

- Adam Cooke** – The Marine Management Organisation
- Lonneke Goddijn** – Detecting microplastics with remote sensing



Edward Bolger interviewed:

- Kevin Scott** – Windfarms, EMFs and crustaceans
- Sonja Rueckert** – Gregarine apicomplexan parasites





## Everything you wanted to ask about JNCC

This year's invited speaker was Professor Christine Maggs, Chief Scientist at the Joint Nature Conservation Committee, which has recently become a member of the MASTS community. JNCC is an organisation that most people will have heard of but perhaps don't really know what it does so Prof Maggs began by outlining how JNCC fits into UK nature conservation and marine science in particular. JNCC, she said, was an arm's length body of the Defra group, tasked to provide impartial scientific authority through high-quality advice and practical solutions, which places nature at the heart of sustainable wealth and wellbeing. JNCC not only works across the entire UK but also in UK overseas territories and crown dependencies where, among other duties, it helps to protect significant biodiversity including 240 species at high risk of global extinction. In order to achieve its aims JNCC works closely with its Defra partners, academia, and NGOs. It is headquartered in Aberdeen where around 50 of its total of 200 staff are located. Prof Maggs went on to explain the key areas of interest that enabled JNCC to carry out its responsibilities. Big Data is very important now especially in relation to understanding UK biodiversity, which JNCC investigates with the Biological Records Centre at Centre for Ecology and Hydrology, using and developing cutting-edge model-



ling and reviewing annually methodologies. The approach is applied to fish stocks, invasive species and cetaceans; JNCC now has the largest database and maps of cetacean sightings in Europe. Prof Maggs illustrated JNCC's commitment to 'open data' by pointing out its research and monitoring of underwater noise. All aspects of noise pollution were the subject of JNCC's attention including: seabed exploration with explosives, other activities such as renewable energy installation, shipping and, although sensitive, the military. Earth Observation, using the Copernicus satellites, is a growing area and of particular value in helping to guide development and protection of biodiversity in the UK and in the overseas territories. JNCC is looking at natural capital through "a new lens", managing ecosystem services and 'selling'

the idea of conservation as having much broader value as an investment. In overseas territories, surveys carried out by JNCC showed how mangroves and coral reefs provided protection from tsunamis, thus justifying expenditure which would lead to better protection and enhanced tourism income, by preventing eutrophication and other damaging activities. Other activities include providing advice to offshore industries to enable marine spatial planning of activities and to minimise opportunities for damaging operations.

Prof Maggs also highlighted the need for accurate marine mapping and the need to speak the same language, and how modelling was helping to clarify many of the questions around decommissioning of redundant oil and gas platforms and infrastructure. The balance between exploiting kelp beds for bioproducts and retaining them for their ecological value is also a topic of interest to JNCC. Prof Maggs ended her presentation by drawing attention to the fact that JNCC was not a 'kit heavy' organisation and relied on working partnerships with those that ran research vessels, drones and other equipment. Innovation and integration were JNCC watchwords and she drew attention to the increasing use of environmental DNA and DNA meta-barcoding to speed up and reduce the expense of surveys and monitoring, especially in the benthic environment. Prof Maggs celebrated partnership working and, welcome comment for many of the audience, she mentioned that JNCC had vacancies and encouraged early career scientists to take a look at the website - <http://jncc.defra.gov.uk/>.

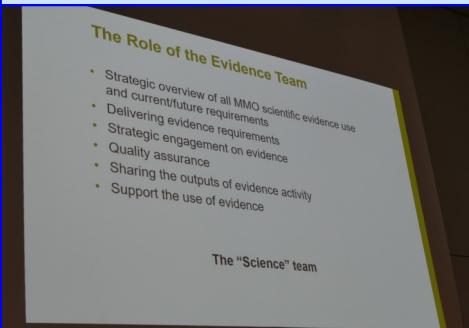
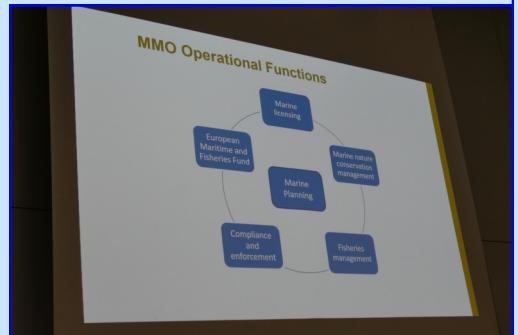




## Marine Science for Management – the MMO, a real opportunity for real impact



Adam Cook from the Marine Management Organization (MMO), reminded delegates that the MMO, operated in England, but with very strong ties across the border into Scotland, and as its name implies, manages the English marine area. With such a broad geographical area to manage, resulting in a wide range of work it collaborates with many other organisations to deliver its responsibilities. The MMO has 6 main functions but perhaps the best known is marine licensing, which covers everything from the impact of nuclear power in the marine environment to burials at sea. The conservation team carry out licensing for activities in MPAs and also wildlife, whereas the fisheries team look after English quotas, issue fisheries licences, and checks compliance, working with the enforcement team. MMO also monitors offshore developments to ensure that developers are honouring their obligations to the environment. MMO also administers a large fisheries fund which is used for port development, social benefits in communities, and environmental projects.



Of most relevance to the audience at MASTS ASM was the second half of the talk which dealt with evidence. There has been confusion as to what constitutes, it is not just compliance and prosecutions and for the MMO evidence underpins all decisions. The MMO definition, as Adam Cook made clear, is Science to support decisions, it could be environmental science, social research or economic analysis; it's three pillars and all are included". So another way of looking at the MMO Evidence Team is to think of it as the Science Team and probably the first point of contact for the MASTS community, it is responsible for gathering all of the evidence the MMO needs. So broad is the MMO remit that it is impossible to gather all of this evidence on its own and so it is keen to work with others which, as Adam stated presented a real opportunity for real impact, and "is the reason I am here today".

A key aim of the MMO is to find out where the gaps are and how requirements will be delivered, so there are a list of priorities and delivery plans. First it is essential to find what evidence exists, where it comes from and how it is applied. The MMO seeks knowledge exchange, collaborations, working in partnership and influencing to help target research that will have impact. Evidence requirements fit into three broad areas: describing the environment; interactions and integrated management, or what's the baseline, how do these things work together and what are the pressures on the environment and what do we do about it? The MMO has refined the questions down to 53 specific requirements prioritised and accompanied by a delivery plan. Adam encouraged the audience to check the work areas to see if they fitted with 'your research'. He also asked that anyone working in one of the topic areas of interest to the MMO should get in touch. If it is relevant it will be used and the bonus for researchers as that within a week or so the research can be cited in the MMO document, immediately providing evidence that the work was on a pathway to impact. The MMO, he concluded had large evidence needs and wanted to use the best and latest science, and it wanted to do so through collaboration. Let MMO know what you are doing and that will give immediate access to the operational teams, helping them to identify what they want, and feeding through to the wider Defra 'family'; and this can be at all levels from an MSc project through to a major research programme.





## Special Session - Marine Microplastics & Marine Litter

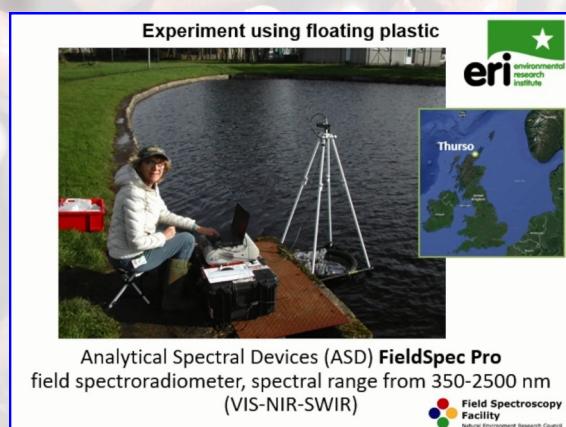
There is an increasing awareness in the general public about marine litter; along the coastal environment we can easily observe its impact, and nowadays many cleaning activities try to address this problem.

Sophie Green (Scottish Coastal Rubbish Aerial Photography – ‘SCRAPbook’) presented an interesting approach to mapping and help global understanding of coastal litter distribution and dynamics in Scotland. The project uses aerial images collected from light aircraft. This coastal monitoring is shared on Google Maps and is classified by volunteers to show where are the most beaches to clean.



Plastic is the dominant litter material in the marine environment. Through time, the large pieces of plastic degrade in smaller pieces that are called microplastic when they are smaller than 5 mm. Due to their reduced size, microplastics are found everywhere: in the water, the sediments and they are also ingested by marine organisms. Lola Paradines developed 3 cheap and simple protocols adapted for sampling these 3 different elements (water, sediments and mussels). Her work provides a new tool to quantify and understand microplastic pollution on coastlines.

But the coastal area reflect only a fraction of the marine litter problem and a large proportion is spread through the oceans. The work of Lonneke Goddijn-Murphy aims to detect buoyant plastics on the sea surface by using satellites, in the same way that we detect chlorophyll. Her research shows that it is possible to use spectral remote sensing algorithms to monitor plastic marine litter. This method should allow detection of large plastics that can then be removed, so preventing degradation into microplastics. The method can also detect the presence of microplastics in the surface layer, which is normally harder to observe due to its size and the fact that it is usually mixed deeper under the surface layer.



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Microplastics are also found within marine organisms as they can easily

be ingested. In urbanized areas, like the Thames estuary and the Fifth of Clyde, Alexandra McGowan showed that microplastic was present in 38% of the fishes. But even in remote area like Orkney islands, Angela Capper showed that it is common to find microplastic in fish guts. Finally Sarah Nelms highlighted the importance of studying marine mammals as key indicator of the ecosystem health as they can indirectly ingest plastic through their food-web. Plastic was detected in all the 50 examined animals. We know that the ingested plastic can have potential impacts on the health of low trophic organisms, reducing feeding capacity or lowering reproductive output, but we need to do more studies to understand how much it impacts higher trophic animals. The implications of microplastics research indicates that commercial fishery species may be contaminated with microplastics and the microplastic phenomenon is a worldwide problem. (SG)





## Special Session - Changing Arctic Ocean

The changing Arctic session presented an interesting update on the Scottish involvement towards researching the effects of climate change on the Arctic regions. Laura Hobbs and Sarah Reed presented our current understanding of how some important organisms at the base of food webs will be affected by changing sea ice conditions. The planktonic copepod species which are rich in fatty acids play an integral role in many arctic food webs, important for the transfer of energy. To survive the long polar nights during which time there is limited food, copepods enter a state of hibernation known as diapauses; a strategy that reduces copepods' its metabolism rates and lower predation rates. However, the changing arctic conditions mean they are having to adapt their overwintering strategies. The feeding time for copepods is very seasonal, with a very short time window for them to build their energy reserves. Missing this opportunity may result in a large decline of copepod populations which in turn will cascade up the food chain. In some regions there is an absence of diapauses, while some copepods may not enter diapauses. This may not be as detrimental as we once thought, showing that they have different strategies to adapt to uncertain food conditions. How changing life cycles of organisms, such as copepods, will need careful understanding and modelling to allow us to predict how it may effect arctic fisheries.

Prof Mike Heath (University of Strathclyde) discussed his involvement in the development of the MiMeMo project, modelling the microbe to megafaunal community responses to Arctic change. Since 1979, Arctic sea ice coverage has declined by 11% in winter and 37% in summer. This reduction allows additional light to reach the marine environment and an increase in primary productivity. The Barents Sea has experienced the greatest sea ice depletion within the Arctic, and as a result, ice cover no longer regulates the onset of the spring phytoplankton bloom. This area is experiencing 'atlantification', where the northern retreat of ice allows Atlantic waters to reach the Arctic Ocean. This in turn brings 'borealisation' of the Barents Sea, with Atlantic fish species spreading further north as Arctic species retreat. Mike asks how the potential increase of primary production may propagate up to the higher trophic levels, and if these processes can be modelled. Using the StrathE2E food web model, an extensive array of biological and environmental parameters were used to create a baseline sea ice extent model based on ice cover recorded during the 1980s, versus a model where no sea ice was present. Fishing yield curves were generated, and in the ice free model the Maximum Sustainable Yield (MSY) of demersal fish species was greater than that of pelagic species. Other outputs were mentioned, but ultimately the ice free model resulted in an increase of primary production and an enhancement of the benthic ecosystem rather than the pelagic ecosystem. An increase in primary production as sea ice extent decreases results in nothing to regulate or control the spring bloom of phytoplankton. We must begin to understand what effect this, along with the warming waters will have on arctic fisheries. Due to our lack in understanding it has been agreed that no arctic fisheries will be established for years to come, allowing for further research to be conducted first. Models help to show how primary production will change during ice and ice free conditions. These models have shown that more primary production also encourages an increase in benthic organisms. Such research will help form the future of arctic governance and ensure that we no longer over exploit a resource.

As the Arctic warms at twice the global average we will begin to see far more species like the copepods having to adapt their survival strategies. Although it is plain to see that changing sea ice conditions will affect the species that depend on it, the true consequence of this loss on ecosystem functions is poorly understood. Therefore to quantify this we must begin gathering data on how changes in migration patterns and behaviour of species is changing year to year. James Grecian presented his work towards understanding behaviour and migration of the harp seal. The harp seal are an integral part of the arctic ecosystem that depend on sea ice for raising their pups and as a feeding ground. Any impact on harp seal will effect not just the populations of its prey but also effect organisms further up the food chain such as orca and polar bear. This issue is they are difficult if not impossible to visually observe throughout the year, it would be entirely impractical. Therefore tagging harp seals and using models to predict movement and behaviour patterns is a crucial methodology that must be adapted. This session has shown the value in the current research into a changing Arctic that is being conducted; not only to understand how species are being effected now but allowing us to understand how these effects will continue to echo into the future. (AA&TS)



## A decade of opportunity a clarion call from Professor Colin Moffat

Opening his presentation by saying we need a step change in what we are doing, Professor Colin Moffat said that the Scottish Government were aware of this and had created the Post of Chief Scientific Officer, Marine, the post that Colin holds. This comes against a background of many years of trying to get marine onto the political agenda, not just in Scotland, and as Colin said: "today it's there, we are now seen by our political colleagues, by senior policy colleagues as fundamental to going forward in terms of delivery of an environment that means people in the future won't look back and say you guys contributed to the trashing of our environment". Colin thinks we are at a key transformational position in terms of decision time. For a long time people have been saying 'could we, may we, should we?' That has to end he said, we need to take action, quoting the words of Sir David Attenborough "We are at a unique stage in our history. Never before have we had such an awareness of what we are doing to the planet, and never before have we had the power to do something". Now we know what we are doing we have the responsibility to act, and we can do something now, ten years' time is probably too late. He used the example of breaking the 1.5°C barrier and that would have serious implications, demonstrating the point with a graph that showed the startling rise in CO<sub>2</sub> concentrations, 112ppm more than the maximum it has been for 800,000 years. By 2100 we might even reach 800ppm or more.

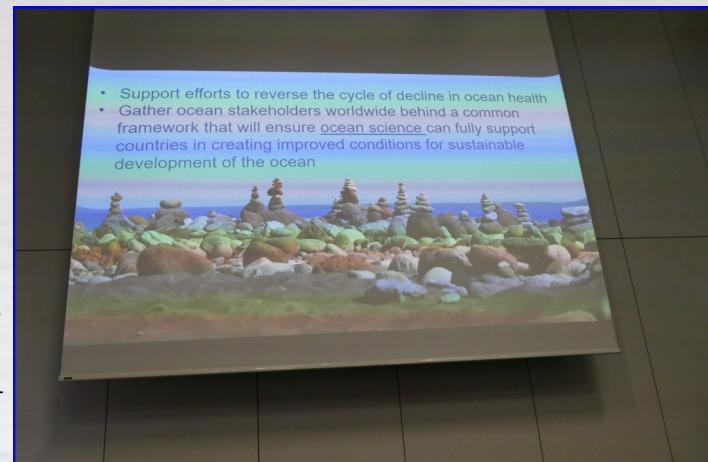
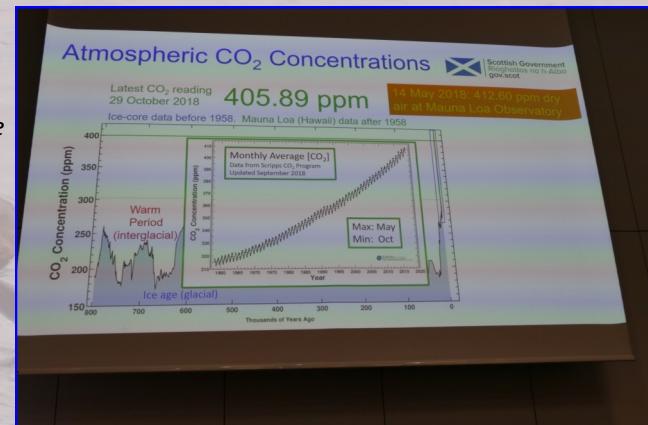
100ppm would normally be the difference between a warm period

and an ice age, so we are dealing with a scary increase. For our oceans it means temperature rise, rising sea levels and more acidic

seas with multiple changes taking place. But reports suggest we may be underestimating the figures, and what does that mean. Scientists have to get the figures right, do the communications and tell the story. But the ocean is also losing its breath, through de-oxygenation, this is often forgotten but to reduce it we have to reduce greenhouse gas emissions and reduce nutrient input, and that means changing and reducing agricultural practices. The OSPAR Assessment outlines what temperature rise means for marine biodiversity (see picture).



Colin brought things back home to Scotland by reminding delegates of the Scottish vision: 'clean, healthy, safe productive, biologically diverse marine and coastal environments, managed to meet the long-term needs of people and nature'. But all of us have to define what the words mean, he challenged everyone to sit down and write down what the key words mean, getting an understanding is fundamental. But we also want to use our seas in many, many ways and we see it as an infinite resource, we have to get the balance right. As scientists we need to work together to provide the best information to make things better.



# MASTS ASM

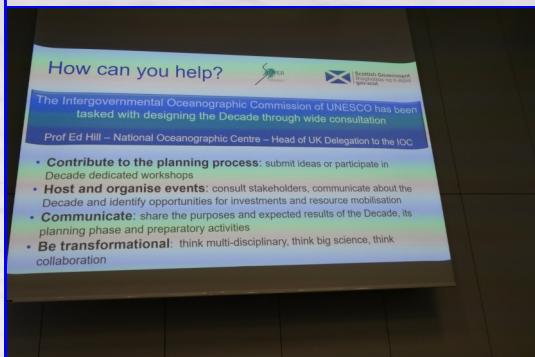
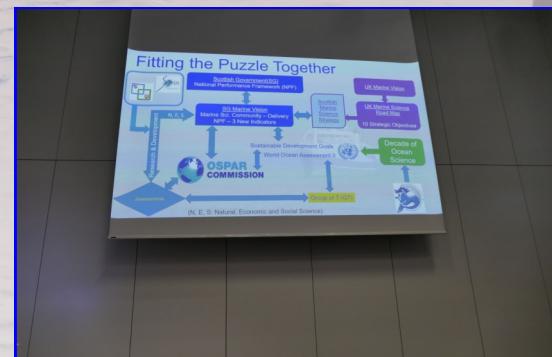
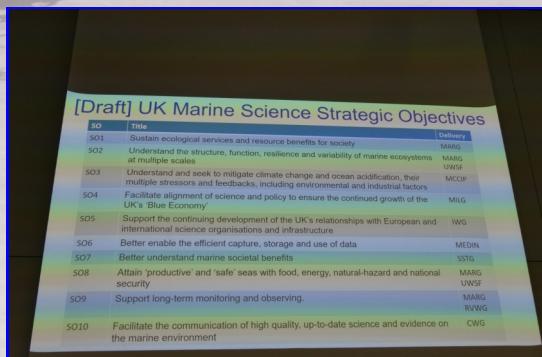
## Reflections 2018



The UN have announced that 2021-2030 will be the Decade of Ocean Science, this will provide the opportunity to leverage new money, to leverage new ways of working and make the transformational changes that are required to meet Sustainable Development Goals, but it is important we actually start now, because we want this to support the effort to reverse the cycle of decline in ocean health. *"Today we are starting on a road where we will see a difference, when seabirds are no longer in trouble, oceans are no longer running out of breath, and we are not saying that the pH is continuing to go down."* We need to gather stakeholders and colleagues together across the world, not just in Scotland, to ensure that ocean science can create improved conditions for sustainable development of the ocean. Colin pointed out that ocean science meant everyone

in the room. The idea of the Decade of Ocean Science will stimulate action in areas of critical importance for the planet, for people, for prosperity. As an example Colin mentioned the SUPER DTP as helping to make us transformational, an opportunity to get research and people together to make a difference. The idea is to go from gaps to action by improving scientific knowledge and capacity building, working with colleagues including in small island states and developing countries.

In 2020 World Oceans Assessment 2 will be published with the hope that it will be more accessible, that the public can use to discuss the ocean, not just scientists. Colin called for new partnerships to be developed to leverage new investment in marine research, telling the delegates that it will be their generation that will make those connections. We know about plastic in the deep ocean, Colin gave the example, but we need to know what its impact is and how we can reduce that impact, *"we have to go into top gear now"*.



In the UK the Marine Science Coordination Committee, with strong Scottish representation hopes that the UK Government, every department and every devolved administration, will sign up to the UK Marine Science Strategy Objectives, by working together we will be able to understand our marine environment better. It is hoped it will be accessible, captures



attention and is useable.

Colin ended his energetic and inspiring presentation with a rallying call for action, to gather evidence, communicate it to decision makers, and get message out to the public.

# MASTS ASM

## A chance to meet up with existing colleagues and make new friends

An important element of MASTS ASM is the opportunity to meet up with colleagues and friends, and not just in the formal sessions. Ample breaks gave everyone the chance to mingle over a coffee or lunch for a chat, discuss posters on display and meet exhibitors from science, industry and government. As always the Annual Dinner, followed by the now traditional ceilidh, proved ever popular.

Lunch and coffee breaks allowed plenty of time to catch up with speakers, view the posters, meet the 'stallholders' and discuss potential collaborations for the future.





The annual dinner : the perfect occasion to renew acquaintances and make new friends.



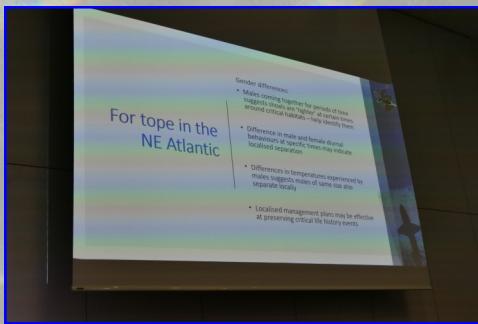


## Tags point to gender depth differences in tope

James Thorburn (St Andrews) introduced his work on tope sharks, a coastal species, widespread around the UK and globally except for the North West Atlantic, which occasionally strays into oceanic waters. James' research project involved tagging tope in SE Scotland. Much of the data for the project came from archival tags, which recorded depth and temperature, as well as pop-up satellite tags. Data comes from two studies: a shorter study where 43 tope were tagged, tags floating from the sharks to the surface to be retrieved by beachcombers. Longer term data was obtained from tags remaining on the sharks for up to 6 months, these were retrieved from fishermen and from beaches. Data shows that there were different patterns, showing sporadic movements at the beginning with more diagonal movements into shallower water over-



night, thought to be related to feeding behaviour or thermoregulation. Different depths that sharks visit is often due to gender and life history stages, with males and females occupying different depth habitats, perhaps due to different feeding requirements. Tope are opportunistic feeders but are attracted to mackerel migrations, for example. Geographically the sharks seemed to stay local around SE Scotland. The temperature data showed the two genders seeking different temperature habitats. The longer term data over 6 months show different depth behaviours, which may reflect different feeding behaviours with females moving down to the deep scattering layer while males may concentrate on feeding at the surface. Understanding more about the apparent different strategies by males and females might make one gender more prone to fisheries pressures, by depth and time of day. Tagging studies, show that animals are coming together, perhaps around feeding habitat, and this knowledge might help to introduce localised management strategies.



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## Flame shell bed formation

The flame-shell *L. hians* is an ecologically important bivalve, forming thick mats or 'tufs' that support a wide range of associated species. These highly diverse and productive flame-shell beds are deemed to be worthy of conservation, having been designated a Priority Marine Feature by Scottish Natural Heritage. Despite their recognised importance, Heriot Watt and SNH scientists have observed the decline of a key flame-shell bed at Port Appin in Loch Linnhebeen since observations began in 2011. Kieran aims to determine the significance of this decline, firstly by mapping the spatial extent of the remaining flame-shell bed and then implementing a monitoring programme to detect any changes over time.

Kieran recognises that in addition to quantifying the deterioration of this important biogenic reef, it is wise to adopt a forward-thinking approach to this problem, namely – conservation and recovery. To this end, he is conducting lab-based investigations of sexual maturation, gamete fertilization, larval swimming behaviour and substratum preferences for larval settlement. This work will provide much-needed data to feed into models of *L. hians* larval dispersal and settlement, which in turn will identify the flame-shell beds most at risk and help us to preserve these valuable habitats for many years to come. Kieran's well-presented and clearly laid-out e-poster featured the first known video footage of *L. hians* spawning activity and was a worthy winner of this year's Best Student poster prize, sponsored by IMarEST (see back page). (EB)





## Bringing back the oyster

Ana Rodruigues (Heriot Watt University) began her fascinating presentation with a stark reminder: a 19th century map displayed to the audience the historical extent of native European Oyster (*Ostrea edulis*) beds in the North Sea; They formed reefs over very large spatial scales, creating biodiversity hotspots and providing a cheap and abundant staple food-source to North Sea nations. Today, due to overfishing, the native oyster is rare and listed as threatened and declining by OSPAR.

Across Europe, there are now initiatives to restore these once-abundant native reefs, thereby achieving biodiversity goals and increasing ecosystem services and functioning. To achieve this, it is important to understand larval settlement behaviour, as free-swimming oyster larvae can delay settlement to the seafloor until they have 'decided' that the substrate is suitable for a successful adult life.

Ana's results show that the presence of biofilms and oysters of the same species, were the strongest drivers of larval settlement. This suggests that wild larvae are far more likely to settle on existing reefs – a challenge for those attempting to re-introduce oysters into areas where no reefs remain. It appears that the main challenge would be achieving a 'critical-mass' of reef which will provide a large enough target for planktonic larvae to successfully settle upon. This is by no means impossible but will require meaningful investment. The Dornoch Environmental Enhancement Project (DEEP), pioneered by Glenmorangie distillery in partnership with Heriot-Watt University and the Marine Conservation Society is an excellent example of the kind of committed, long-term and collaborative effort



## MASTS ASM

## Reflections 2018

## Magnificent animal under threat

Lucy Mead (Edinburgh) has been looking at the spatio-temporal distribution of the blue shark in the North Atlantic, analysing population structure, habitat preference and vulnerability to fishing pressures. In the North Atlantic in 2015 more than 42,000 tonnes of blue sharks were caught in pelagic long-line fisheries, up to 70% were discarded as bycatch; they are also targeted for 'finning'. Blue sharks are apex predators, so there is concern about what might happen, maybe distribution and behaviour changes, if they are removed in large numbers. Blue sharks are the most abundant and widespread species of shark globally but also vulnerable. They are highly migratory, capable of transatlantic migrations. Historically populations have been assumed to be stable, but they are the most exploited Atlantic shark, and they receive little protection throughout their range. Stock assessments are uncertain and inconsistent, and our knowledge of their lives is very limited. Lucy's research looked at population structure and migration of blue shark in UK waters and how they are coping against overfishing and possibly climate change, with a view to identifying priority areas in the North Atlantic where blue sharks are clustering in order to concentrate conservation measures. She used a tagging dataset of over 1000 records collected 1995-2016, from the Scottish Sea Angling Conservation Network. Anglers had caught, tagged and released the sharks around the UK, later to be captured again by recreational fishermen. Lucy presented some results as a series of maps, showing movements, distributions and 'hot spots'. Three main hotspots were identified: near the Mid-Atlantic Ridge, the Azores and the Bay of Biscay, these are consistent with what others have found. There were life stage differences with juveniles exclusively recaptured in mid-Atlantic, especially around the Azores, where they preferred shallower, cooler, more productive waters. Two intensive fishing areas overlapped with blue shark hotspots, near the mid-Atlantic Ridge and the Azores – where the juveniles are! There are implications for juvenile populations which are over-targeted by fisheries and potentially sensitive to changes brought about by global warming. In turn the success of juveniles determines the success of the population as a whole over the wider Atlantic. So there are also implications for policy and protection especially around the Azores, and along migration routes. This work highlights our lack of knowledge and the need for more research on this magnificent animal under threat.





# MASTS ASM

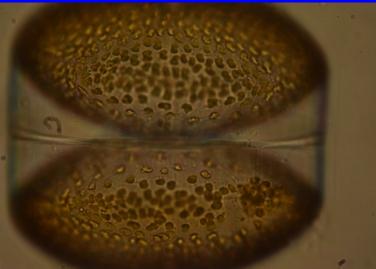
## Reflections 2018

### NorthSEE Project

Kirsty Wright introduced us to the work being produced through the NorthSEE EU-funded project to improve co-ordination of marine plans with all countries that have a stake in the North Sea. Within this project the leader of the Energy work package is Scotland, where there is increasing interest in generating energy from offshore wind. This growing interest in wind energy, brings the prospect of larger turbines and new growth with emergent tidal and wave energy. In the future it is clear that more area will be used throughout the North Sea as energy generation from wind meets demands. Not only will plans need to be made for the location of the turbines but we will need an awful lot of cables to transfer this power to shore as well. The logistical problem doesn't just end there; further considerations on land will be required to help distribute this energy across the country. We have to begin to consider how to tackle this spatial planning issue. To aid this understanding a virtual game was produced which can be used in workshops. The game allows plans for offshore wind to be investigated and then for us to be able to fast forward to the year 2030 to see the results of these plans. This game also uses many realistic environmental models in the background, so players must consider the impact of their decisions on the environment whilst attempting to meet current energy targets. This game will provide an accessible educational and stakeholder tool to communicate the importance of marine spatial planning. (AA)

### Interannual variations in the spring phytoplankton bloom in the Scottish North Sea

At the foundation of many marine food webs lies phytoplankton. Spring blooms of phytoplankton play a major role in the seasonal cycle of North Sea ecosystems, but as Ricardo González-Gil (University of Strathclyde) demonstrated in his talk, their timing and magnitude can vary greatly from one year to the next. Ricardo and team attempted to explain this variability by assessing the influence of *in situ* temperature, salinity and nutrients. Only winter phosphate was correlated with spring bloom size which was unexpected, since nitrogen is usually the main limiting nutrient for phytoplankton growth. For this reason, Ricardo suggested that winter phosphate levels and spring phytoplankton growth could both be directly controlled by, as yet, unstudied processes. I was



struck by how complex spring bloom prediction is; Ricardo pointed out that conditions which may be expected to lead to a large spring bloom (high light and nutrient availability) could be mitigated by intense micrograzer activity, leading to the question: what influences micrograzer activity? In future work, a model that includes solar radiation, phytoplankton biomass, nitrogen depletion, phytoplankton growth and grazing will be produced. It is hoped that this more complex model will allow for a greater disentangling of the factors influencing the spring blooms which underpin the ecosystem dynamics of the North Sea. If successful, it could be applied further afield, in other temperate and polar regions. (EB)

### Satellites and super swarms

Satellite ocean colour observations are widely used to study phytoplankton through chlorophyll detection. But what about zooplankton, can we use a similar approach? David McKee reported the occurrence of a super-swarm of the zooplankton *Calanus finmarchicus* in northern coastal water off Norway, using satellite Earth observation for the first time. So large and so dense are super swarms that the surface water is tinted pink and it is this colouration of the massive patches that run along the shelf that make them visible on satellite images. Usually such 'red tides' can be associated with harmful algae blooms. In order to prove its relation with zooplankton, he used *in-situ* observations from a sampling cruise. He showed that the presence of *Calanus finmarchicus* coincided with the red patches in the satellite images. These *in-situ* measurements were difficult to obtain because the sensors' sample volume were too small for easily detecting the one or two animals per litre of the super-swarm, and being active animals the copepods tend to swim to avoid the instruments. While the ability to detect and identify zooplankton from space is exciting it does raise new questions about how it may have the potential to influence the performance of the chlorophyll detection algorithm currently used in Marine Science, bringing new challenges to the marine optics community. (SG)



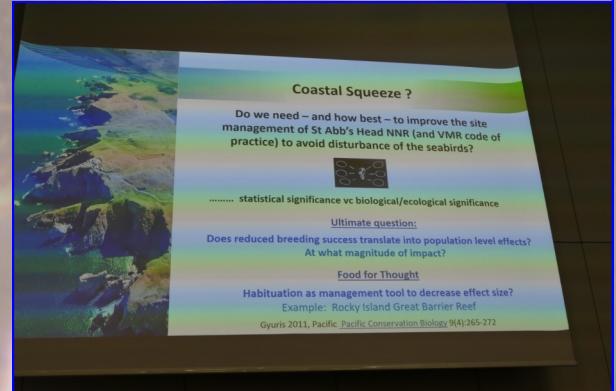
## Decrease in temperature, increase in mussel spawning

Blue mussel (*Mytilus edulis*) production is a major component of the UK aquaculture sector, and demand for this highly sustainable protein source is set to increase. Despite this, growth in mussel aquaculture lags behind other sectors. Currently, wild mussel larvae/spat are collected during the reproductive phase of wild populations, and this is then grown on to saleable size by mussel farming companies. Alessandro Laudicella (SAMS) explained how the availability of this larvae/spat is a major limiting factor in mussel production and argued that an industrial hatchery could provide a reliable, year-round supply of high-quality juveniles. Alessandro assessed the spawning competence, condition index, gonad histology and lipid biochemistry of adult broodstock mussels that were conditioned at lower temperatures. These mussels displayed greater spawning competence and condition index after 80 days of rearing compared to a standard temperature group. Gonad histology revealed that 80% of low-temperature broodstock were ready to spawn after 40 days, whereas that standard group was already showing evidence of spawning and redevelopment. If refined and applied to a hatchery setting, these promising results suggest that maintaining broodstock at lower temperatures could allow ripe mussels to be retained beyond the natural spawning period, thereby providing a steady supply of spat for on-growing that could unlock the true potential of this highly sustainable food source. (EB)



## Coastal squeeze, evidence for management?

St Abbs Head is an important seabird nesting site, which for most of the week remains relatively quiet and undisturbed but at weekends there are many activities going on, including walkers, kayaking, coasteering, all of which have the potential to disturb nesting birds such as kittiwake and guillemot during the breeding season, indeed the managers of the site, The national Trust have received comments about disturbance from concerned members of the public. Karen Diele (ENU&St Abbs Marine Station) wondered whether there was any scientific evidence to support or allay these concerns and perhaps change the way visitor activities around the site are managed. Working with multi-year data collected by MSc students to address the questions, she attempted to clarify how much this coastal squeeze was affecting the birds. One project looked at whether boating activity affected kittiwakes, so the decision was made to monitor nest data as well as people data. Nine plots each containing 12 nests at the eggs stage and chick stage were monitored once per week on Friday, Saturday or Sunday, the times of most visitors. Preliminary analysis showed that there was an interannual variation, probably due to multiple stressors acting together, but indications were that boat presence seemed to have a negative impact on nest success, while cliff top walkers didn't, although results were not always consistent. A second project looked at boating activities on 'loafing' (presumed resting behaviour) on guillemots. Two coves were monitored for boat presence and duration of stay, and the type and size of vessels and how the birds reacted. Overall the number of loafers was significantly lower when boats were present and there was evidence of some 'panic' when motorized vessels were present. Such explosive retreat is likely to carry a metabolic cost at a crucial time in the breeding cycle. But is there enough scientific evidence to suggest changes in the current management? Clearly there is some disturbance and this has highlighted the need to answer questions about whether reductions in breeding success actually translates into population level effects, and if it does how large is the impact? One possible mitigation might be gradual habituation, as has been tried on the Great Barrier Reef.





**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, The Changing Coast, Scottish Microplastic Research Group, Sustainable Aquaculture, MEDIN, Blue Carbon, Tidal Stream fieldwork, The Great Environment, SIFIDS, Flapper Skate/.

Decommissioning and wreck Removal workshop



Sustainable aquaculture workshop



Microplastics workshop



Biotime workshop

### Workshop—The changing coast : sharing knowledge and practice

The Coastal Forum and the Scottish Consortium for Rural Research held a one-day workshop during the MASTS ASM. The workshop brought together coastal scientists and rural researchers to provide an opportunity for new collaborations and partnerships. Coastal areas face complex challenges, this reflected by the breadth of workshop presentations ranging from Scotland's upland beef farmers to climate change impacts on Vietnam's vulnerable coastal communities. The final session was a lively discussion about a coastal observatory as a potential way to provide and share data on coastal environmental change. To view the presentations and learn more, please follow this link: <https://www.masts.ac.uk/annual-science-meeting/2018-workshops/the-changing-coast-sharing-knowledge-and-practice/>

Welcoming speakers and participants, Prof. Jim Hansom (GU) stressed that structuring the day into three sessions - 'processes', 'management' and 'future' – while necessary, was not intended to limit or restrict the exchange between disciplines. Indeed, sharing knowledge and practice between often disparate and distant disciplines is key to positioning society to cope with coastal change. The first session, Changes & Processes,



was opened by Prof. Stewart Angus (SNH), who questioned the evidence about whether sea level rise is the main cause of saltmarsh erosion - an idea at the heart of many coastal management policies. In reality, ground water forcing on the landward side of saltmarsh is a major driver in some marshes, whilst others can be seen to keep pace with relative sea level rise.



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Dr Dmitry Aleynik (SAMS) introduced the West Scottish Coastal Modelling System (WeStCOMS). This fine-scale mapping tool provides fantastic imagery that shows the detail of currents around Scotland's inland waters, an understanding that is becoming increasingly necessary in planning for marine economies, such as aquaculture and renewable energy development. Valuable insights from the social science community were

provided by Dr Leslie Mabon (RGU), on the impact of a rapidly changing climate to Vietnam's vulnerable coastal communities. He pointed out that while welcome, an ecosystem-based approach also needs to consider human wellbeing and social relations. Only by considering the human cost of climate change will culturally meaningful practices in marginalized societies be adopted and maintained. Prof. Robin Pakeman (JHI) wrapped up the first session by introducing a substantial data set that shows how Scotland's coastal vegetation has changed over three decades. Arable farming and nutrient enrichment have driven substantial, negative changes in the coastal vegetation of the East coast, sharply contrasting with the West coast, where traditional grazing on dune and machair habitats is helping to protect floral diversity.



## Changing Coast cont.....

The Management and Adaptation session began with an overview of the Humber flood and coast strategy. Dan Norman-dale (EA) summarised the Environment Agency's plans to align flood risk investment for infrastructure, with environmental improvements and economic growth. Given the size, complexity and importance of the Humber, many lessons were on offer for Scotland. Dr Andrew Rella followed this by demonstrating that innovative solutions in coastal defence are available using EConcrete® to help reduce the ecological footprint of ports and coastal protection schemes. Martin Laroche (UQAR) reflected on the Coastal and Riverside Area project in Quebec and Ontario, which is analysing the ability of adaptive governance to work with coastal municipalities to help overcome challenges, such as erosion and flooding.



Mairi MacArthur (GU) provided insights into the Hartlepool Headland project, describing how species abundance can be improved if construction materials are designed with increased surface roughness, allowing engineering structures to better match baseline biotope conditions for several key species.

Dr Alistair Rennie (SNH) opened the 'Way Forward' session and brought us up to speed with the Scottish Government project 'Dynamic Coast 1 & 2'. This path-breaking project has developed an online tool to identify past erosion and growth rates, and shows the potential future changes around Scotland's coastline that are key inputs to effective planning decisions. Phase 2 is developing this further

by developing 3D models to inform adaptation planning for coastal communities together with identifying whether certain levels of society will be more heavily impacted by coastal climate change than others. Prof David McCracken (SRUC) went on to provide greater understanding of the complex challenges facing livestock farming around coastal Scotland; with low productivity and falling profitability in sheep and beef farming, SRUC's Hill & Mountain Research Centre are helping to innovate and diversify into more sustainable and technology driven practices.

The GreenShores project was introduced by Dr Clare Maynard (Uni of St A), highlighting her work with community groups and schoolchildren to harvest, propagate and plant saltmarsh; in doing so increasing the flood and erosion resilience of valuable land. Clare went on to feature Ben Taylor's work, which has revealed that there may be substantial blue carbon benefits to saltmarsh restoration. Dr David Green (UoA) ended the session with an update on Unmanned Aerial Vehicles, a rapidly advancing field that is developing new and improved methods to monitor, map and model the coastal environment.

Eileen Bresnan outlined Marine Scotland's (MS) Coastal Observatory, established in 1997 to provide a baseline for monitoring inshore coastal waters and help track deviations from natural variability. This led to discussion about a wider type of Coastal Observatory to include a wide range of coastal issues beyond the MS Coastal Observatory. For example, Prof Stewart Angus argued there was an equally important need to monitor the terrestrial side of the coast. The coastline and its seaward and landward boundaries will change more than any other part of Scotland and an enhanced coastal observatory would build on the success of the Environmental Change Network and Dynamic Coast.





## Workshop—MASTS/SUT Decommissioning and Wreck Removal

When the oil and natural gas boom began in the 1960s, little attention was given to what would happen to the infrastructure when reservoirs ran dry. Now the chickens are coming home to roost and, in line with the OSPAR Convention, removal and return of the seabed to its former state is the rule. That's not easy but it is expensive with an estimated cost of £80 billion. The SUT/MASTS Decommissioning and Wreck Removal workshop is a regular fixture for stakeholders of all complexions to discuss the challenges. The Decom Workshop, built upon previous years by looking at recurring as well as new topics. The agenda included discussions about total removal and whether that remained the best option. Partial removal, rigs to reefs and whether more damage might be caused in removing than would occur if left largely in place, were up for debate. How removal might be done most effectively, and whether leaving cuttings piles to be 'digested' by microbes caused further discussion. Judging each installation on its merits seemed to be favoured by science, industry and regulators alike. Rigs as valuable habitats, and the need for sharing environmental observation data led to energetic conversation. Clearly all sides are prepared to discuss options and there is more common

ground than might be expected.

A report of the 6th Decommissioning and Wreck Removal Workshop, and results of the data sharing session will be posted on the MASTS, SUT and Decom North Sea websites.



Post-it sessions were used to gather comment and questions for later analysis

## Workshop – Conducting fieldwork in tidal streams

32 academics, technicians, technologists and marine renewable energy developers gathered for a workshop to discuss the challenges faced conducting fieldwork in energetic tidal stream sites. The workshop was part-funded by the Interreg Atlantic Area, ERDF-funded project MONITOR and came about through a collaboration between Marine Scotland Science and the SEACAMS2 project; it was hosted at the MASTS ASM 2018. Rory O'Hara Murray (Marine Scotland Science) began the day with a short presentation on the motivations behind the workshop: interest in tidal stream development; wide range of measurements and fieldwork practices; challenges of working in these environments; equipment loss and failures and the need to come together as a community to develop best practices.

There were six keynote presentations given at intervals throughout the day, which set the scene for the breakout sessions chaired by Beth Scott (Aberdeen University), Brian Sellar (Edinburgh University), Arne Vögler (UHI):

- Michael Togneri (Monitor, Swansea University) – Performing marine operations in strong current areas effectively – a case study
- Jason McIlvenny (Environmental Research Institute, UHI) - Mooring experiences in the Pentland Firth
- Benjamin Williamson (University of Highlands and Islands) - FLOWBEC and environmental monitoring
- Fraser Johnson (SIMEC Atlantis Energy) - Practical experience and learning of environmental monitoring in and around a tidal array
- Andy Shanks (EMEC) - The use of ROVs in strongly tidal sites: Planning bite-size operations
- Brian Sellar (Edinburgh University) - Acquisition of combined wave-current-turbulent flow data from energetic tidal sites as part of large Industrial-Academic projects: sensor configurations, data analysis and lessons-learned.





## Special Session - Multiple stressors, multiple challenges, multiple solutions

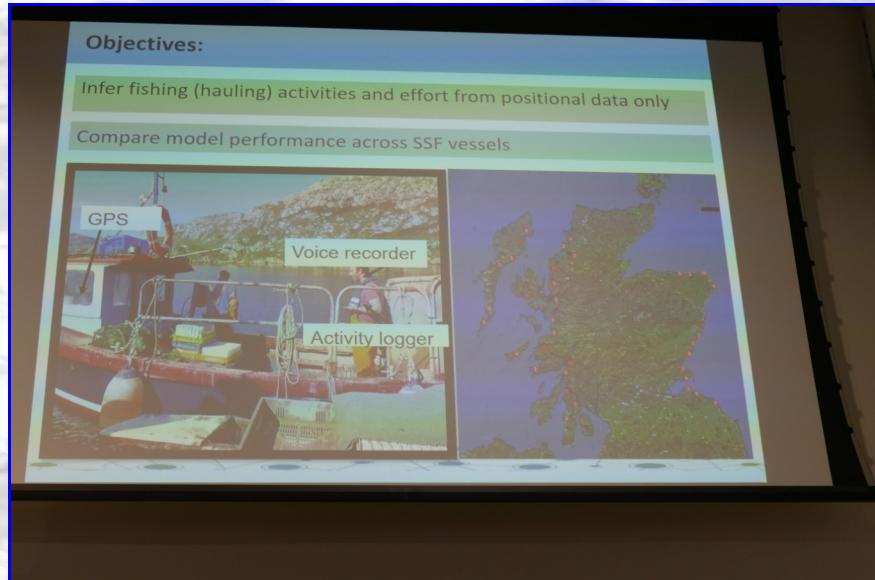
A well-attended multiple stressors forum, co-chaired by Drs. Karen Diele and Mark Hartl showcased some impressive multi-stressor research being conducted by MASTS institutions. The forum also identified some pressing challenges for the health and sustainability of marine ecosystems that are set to receive increasing pressures from a range of sources over the coming decades.

A highlight for me was a study by Alice Tagliati, Sebastian Hennige and Teresa Fernandes outlining the combined impacts of nanoparticle sunscreens and thermal stress on corals. Many sunscreens use titanium dioxide nanoparticles ( $n\text{TiO}_2$ ) as a UV filter; Tagliati et al. have shown these to cause stress in two coral species and in two species of the coral's symbiotic algae *Symbiodinium*. Surprisingly, sunscreen oil with no nanoparticles also caused stress – perhaps the oil carrier is the culprit rather than the nanoparticles themselves? This stress was enhanced in warmer temperatures (32°C vs. 26°C), which suggests that run-off of current sunscreen formulations could exacerbate coral bleaching events in our ever-warming oceans.

Following presentations of current research, Drs. Diele and Hartl highlighted the challenges of multi-stressor studies. Which stressors should we focus on, and in what combinations? The more stressors included in a study, the more environmentally relevant it will be, as stressors in our ocean never act in isolation and they can interact with each other in unexpected ways. However, each stressor included as a factor in experiments increases the size, costs and complexity of the research. Moving forward, different multi-stressor studies need to be brought together, combined into generalised predictive models that can then be provided to decision makers in government to affect meaningful changes in the way we impact our marine environment. The MASTS Stressors forum would welcome interested parties with modelling experience to collaborate with them in this endeavour, contact Dr. Hartl directly at [m.hartl@hw.ac.uk](mailto:m.hartl@hw.ac.uk). (EB)

## Small vessel activity tracking for management

One of the missing components of marine spatial planning is identifying the locations and intensity of small scale fishing activities, from the small scale fishing fleet. Tania Mendo (St Andrews) presented her work, undertaken as part of the SIFIDS project. The fleet of less than 12 metre vessels is mostly concerned with 'trap' fishing for lobsters, crabs and prawns. In Scotland these vessels amount to about 85% of the entire Scottish fleet. The project installed observers on cooperating vessels who used GPS tracking and voice recorders for ground truthing, alongside activity loggers and AIS data. The data gathered can determine, with the help of a Markov model, when a vessel is steaming, shooting and hauling, indeed all activities in the fishing grounds. The power of each vessel and its mean speeds, and its turning behaviour were the basis for identifying activities and for informing the model. In order to avoid overlap between vessels a vessel by vessel approach was adopted. The model results compared favourably with the actual observer data on location, activity and intensity. However with static gear there remain some challenges as number of creels, soak time are not easily obtained remotely. The conclusions are that using GPS data can identify areas being fished and with number of creels known, soak time can also be inferred and thus an estimate of fishing effort can be made. The project points to the potential of using positional or GPS data not only for compliance but also for management.





## POSTERS & TALKS MEAN PRIZES

This year's student prizes were sponsored by The Institute of Marine Engineering, Science and Technology and presented by IMarEST Fellow, Richard Wakefield. In addition to the 'liquid assets', they received at the ASM, the winning students have been invited to an IMarEST Branch meeting where they will receive their prizes and certificates.

### Best student talks:

**1st** – Todd Bond (University of Western Australia) "The influence of oil and gas infrastructure in Australian marine ecosystems: informing decommissioning decisions".



**2nd** – Anna Harte (Aberdeen University) "The development of clinical diets to treat farmed fish gill diseases".



### Best student e-posters:

**1st** – Kieran Tulbure (Heriot Watt) "The need for a greater understanding of life-style characteristics of *Limaria hians* and the mechanisms behind flame shell bed formation.



**2nd** – Daniella Hodgson (RHUL) "Ingestion and fragmentation of plastic carrier-bags by the amphipod *Orchestia gammarellus*: are there fitness impacts?