Welcome to the winter edition of the Marine Science newsletter

It is a new year and we are rapidly heading towards a new semester. Our new students are now settling in and those towards the end of their studies are busy working on their research projects and getting ready to start their careers in the Marine sector. There has been lots of good news regarding new research grants and some fascinating new papers published by our post-graduate researchers and academic staff.

We hope you enjoy this latest snapshot of the activities of the University of Plymouth Marine Science community.

Tim Scott
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Front cover: Marine Science students preparing to measure surf zone currents and waves at Sunday’s River beach in South Africa.

Contents page: The stunning setting of the Marine Science student field trip to the Isles of Scilly.
The Marine Science group at Plymouth University comprises world-leading researchers addressing a wide range of issues in the marine environment, including ocean mixing, marine renewable energy, storm impacts, coastal erosion, ocean exploration, inshore fisheries management and marine conservation. This provides an exciting academic environment for all our students with opportunities for fascinating research dissertation topics.

We offer a range of thought-provoking and challenging courses at BSc and MSc level that address all aspects of marine science, with a particular emphasis on application of scientific principles to the study of natural systems. Our three three-year BSc programmes: Ocean Exploration and Surveying, Oceanography and Coastal Processes, and Ocean Science and Marine Conservation, run alongside a four-year MSci programme in Ocean Science. These programmes deal with conventional topics such as oceanography and ocean exploration, but also address current issues such as coastal processes and management, the impacts of climate change and human interactions with the marine environment.

Our suite of Masters' programmes (MSc Applied Marine Science, MSc Hydrography, MSc Marine Renewable Energy and MSc Marine Conservation) go from strength to strength with over 60 students this year, making for a lively marine postgraduate community. This fits very nicely in Plymouth where the other marine laboratories (including the Plymouth Marine Laboratory and the Marine Biological Association) offer a range of excellent opportunities for students to develop their skills and knowledge.

Dr Jill Schwarz, Admissions Tutor (Marine Sciences), said:

“Checking through applications is always interesting - the personal statements our prospective students write are full of passion and remind me why we're here! Meanwhile, our new first years will be starting their second semester at the end of the month, so there's plenty to do with planning fieldwork, formulating assessments and kicking off our new journal for postgraduate students' work. The January UCAS deadline has crept up on me this year as I've been distracted with research, but it's been great to see several of our 2018 graduates publishing their dissertations in the Plymouth Student Scientist journal. If you're wondering what goes into a dissertation, you can take a look at http://bcur.org/journals/index.php/TPSS.

As always, if you're considering applying to start a Bachelor's degree next year and are wondering about what our programmes involve, please come along and meet us and - more importantly - our current students at our open and applicant days. Talking to us about what we do day to day, seeing the research facilities available to you and getting a feel for life in Plymouth could really help you to decide whether one of our marine science programmes would suit you.”

Dr Gillian Glegg, Associate Head of School (Marine Sciences), said:

“Well, at this time of the year, just after Christmas our thoughts turn to ... the Bahamas! Some of our third year students are in the Bahamas on their residential field trip – lucky things. The other third year students went on their residential field trips to either the Scilly Isles or South Africa in September last year but the Bahamas' trip has to be in January to avoid the hurricanes. I received an email today from Dr Simon Ingram, programme leader for Ocean Science and Marine Conservation saying it was hot and sunny and they could not wait to get out on the water!

We are already half way through the year and starting to plan for next year. Our new boat RV Wavedancer is arriving this week to join the RV Falcon Spirit and the other boats at the marine station – this will be a great addition to our fleet. I am really looking forward to using it when I take the second year students out sampling later in the year. Before then I had better get back to my marking and stop wondering why I didn't get to go to the Bahamas!”
South West Evening Meeting
Advances in Marine Measurements

The Society for Underwater Technology held their first south west evening meeting in Plymouth on November. The meeting was a great success with five excellent speakers and 63 attendees from across the UK and Europe, many of whom were Plymouth alumni. The meeting was chaired by Dr. Edward Steele of the Met Office and an alumnus of the University.

The first speaker was Claire Cardy, a Director of Nortek UK and an oceanographer who had studied at the National Oceanographic Centre in Southampton before a career in metocean engineering and hydrodynamic modelling. Claire talked about the Acoustic Doppler Current Profilers (ADCPs) that Nortek supply in the UK and Ireland, which are of an advanced design and used to measure currents and waves in a variety of applications. Claire is also a strong supporter of SUT+, the group founded to address the needs of younger engineers and scientists within the SUT.

The next speaker was Dr. Tim Scott, Lecturer in Ocean Exploration at the University of Plymouth and an expert on coastal erosion and geophysics. He enthralled the audience with the story of the development of commercial drones that can provide very detailed measurements of coastal conditions and dynamic measurement of sand deposition following storms. It was a fine example of how science can be fun at the beach.

More fun at the beach with our next speaker, Dr. Bob Brewin of the Plymouth Marine Laboratory, who talked about remote satellite sensing of marine biogeochemistry. The sensors are mounted upon kayaks and surfboards using a “Smart Fin” and collect real time data from pleasurable activity. The result is a massive database of measurements of water quality and coastal conditions.

Dr. George Graham of the Marine Biological Association (MBA) told us about the devices towed behind marine vessels to monitor the impact of climate change on marine plankton and the health of our oceans. Their machine learning algorithms allow much more detailed and speedy assessment of results, leading to a greater understanding of the marine environment.

Finally, Alexander Steele of Fugro Vision Technology Group and another alumnus of Plymouth University, told us about their subsea augmented reality system as applied to ROV intervention in oil and gas and renewable energy projects worldwide. The images he was able to project in the lecture theatre were truly remarkable and give us all hope for the future direction of AI technology development. The meeting was very interesting, the networking was excellent, and we now know all there is to know about the fun of science, at the beach and beyond.

Brian Green B.Sc. FSUT
Honorary Secretary SUT SW | SUTSouthWest@sut.org
New MSc in Marine Conservation open for applications

The latest exciting addition to the School of Biological and Marine Sciences degree portfolio, our pioneering new MSc focuses on Marine Conservation in Practice in order to deliver highly skilled graduates to work within this sector. In order to achieve this, we have partnered with a suite of leading external organisations who will directly input to the course, including government agencies such as Defra, MMO, Natural England and local Inshore Fisheries and Conservation Agencies, leading NGOs like the Marine Conservation Society, Shark Trust and WWF plus international organisations such as Fauna and Flora International and the UNEP World Conservation Monitoring Centre. This will enable students on the course to follow either a policy (e.g. looking to work in a marine management organisation) or advocacy (working for a charity or NGO) path through the degree, depending on their interests.

Whilst the students on the course will benefit from the expertise of the UK’s largest Marine Conservation Research Group, providing the background in natural and social sciences, our partners will input through workshops across the course in order to provide an understanding of the practical issues and hurdles those working directly within marine conservation face, and the solutions they are devising. This will mean direct experience of tools required to make a difference, such as ocean literacy, science communication, behaviour change and fundraising, as well as the science, policies and management methods employed by conservation organisations. Students can put these skills into practice by working directly with one of our course partners for their MSc Marine Conservation project.

Our first cohort of future Ocean Guardians will start in September 2019, with applications for the course currently open – the closing date to apply for a place on this competitive course is 9th May 2019. Full details can be found on the programme website: https://www.plymouth.ac.uk/courses/postgraduate/msc-marine-conservation

Prof Martin Attrill
Programme Leader
Dr Abigail McQuatters-Gollop was awarded a £190,000 grant from the European Maritime and Fisheries Fund for the project **ICEGRAPH: Increasing Confidence in Evaluation Good Environmental Status for Regional Assessments of Pelagic Habitats.**

McQuatters-Gollop is the project PI and project partners include the Environment Agency, the Marine Biological Association (MBA), Plymouth Marine Lab (PML), and Centre for Fisheries and Aquaculture Science (Cefas). ICEGRAPH will increase the scientific understanding of the drivers of change in pelagic biodiversity, expanding our ability to manage human pressures, such as fishing and nutrients, which have negative impacts on the marine environment. Project results will directly support UK and wider EU decision-making about managing marine biodiversity.

McQuatters-Gollop is the chair of the scientific OSPAR (Northeast Atlantic) and UK Pelagic Habitats Expert Groups which work closely with UK and EU policy makers to develop and monitor marine biodiversity indicators in an effort to achieve Good Environmental Status for UK and Northeast Atlantic marine waters. In 2017, McQuatters-Gollop led the first ever, regional assessment of pelagic habitat biodiversity which was published through OSPAR and which the UK will report to the European Commission in 2019 in fulfilment of the EU Marine Strategy Framework Directive.

In October 2018, a stark report suggested that current methods being used to protect England’s coastal communities are ‘not fit for purpose’. The Committee on Climate Change’s Managing the coast in a changing climate report showed that between 2005 and 2014, over 15,000 new buildings were built in coastal areas at significant risk of coastal flooding and/or erosion. However, if the government meets its ambitious targets, up to 90,000 homes built in the next five years might be in areas of significant annual flood risk from all sources of flooding, including coastal flooding. Practically every winter we are reminded of how dynamic our coastline is and many of us see at very close quarters how vulnerable many communities in the UK are to coastal flooding and erosion. But, by the time summer arrives, the need for a wide and deep debate as to how we deal with rising sea levels and potential future increases in maritime storminess around the UK coastline evaporates.

Our approach to coastal management issues is to react to failures of coastal defences, either natural or man-made, rather than proactively working towards future-proofing our coastline. Much of the UK coastline is already eroding, as testified by the dominance of coastal cliff scenery. But coastal erosion and flooding, and consequent damage to infrastructure, disruption of services and modifications to the coastal landscape will become more common over the next century due to climate change. Specifically, rising sea levels will increase the probability of extreme coastal water levels and this could be exacerbated by potentially larger and more frequent extreme waves due to changes to the wave climate. At the same time, our coastal zone is far from natural with numerous cliff-top properties and extensive development at the back of beaches, on top of dunes and in low-lying coastal valleys. It is obvious that coastal communities are facing significant future challenges.

Much existing coastal development took place when our understanding of coastal dynamics was limited and when climate change, and its consequences for the coast, was not yet a reality. That development is already under threat, and the scale of the threat will only increase. Dealing with this issue requires a balanced consideration of the various adaptation strategies, ranging from ‘hard’ coastal protection such as sea walls, to more sustainable solutions such as supplementing the amount of sand and gravel on our beaches, and managed realignment. There will always be locations where only hard coastal defences will do. But if we wish to avoid piling ever-increasing costs – in both financial and environmental terms – on future generations, we need a more sophisticated, integrated discussion of zoning (to avoid building in high-risk zones).

It may be stating the obvious, but a relatively easy win is to avoid more development in the dynamic coastal zone, unless it is absolutely essential. The concept of Coastal Change Management Areas (CCMAs) can play a key role here. The National Planning Policy Framework (NPPF) requires councils to identify CCMAs where rates of shoreline change are expected to be significant over the next 100 years, taking account of climate change. The first local plan to make use of CCMAs to inform coastal planning is in Cornwall, where the Newquay Neighbourhood Plan (NNP) is currently under consultation. The NNP recommends that proposals for development in CCMAs should only be supported where they are for “small, temporary structures that will not add to the erosion risk”, and rules out residential development. Proposals for redevelopment, enlargement or extension of existing buildings that fall within the exclusion zone, and proposals to change the use of existing buildings into residential usage, will not be supported either. In the NNP, the landward limit of CCMAs represents the estimated 100-year erosion line with an additional buffer of 10 metres. Another 2m buffer zone is added if the coastal path is located within the CCMA. Continued investment into the coastal zone will reduce the natural capability of the coast to respond to hazards, while at the same time passing the financial burden of protecting such coastal development onto future generation.

In order to future-proof our dynamic coast, we need to implement an appropriate buffer zone to inform coastal planning decisions, and these buffer zones will need to be site-specific and science-based. They would also require regular updating in light of new data, understanding and predictions of climate change and its consequences.

The Committee on Climate Change’s report has demonstrated the scale of future potential problems, and our own research heavily supports their findings. By implementing a CCMA-informed policy that is consistent on a national scale, potentially with the policy outlined in the NNP as a blueprint, we can better protect our coastlines now and for future generations.

Gerd Masselink, Professor in Coastal Geomorphology, University of Plymouth
co-authored by
Tom Spencer, Professor of Coastal Dynamics at the University of Cambridge

Find out more and download the report: https://www.theccc.org.uk/publication/managing-the-coast-in-a-changing-climate/
Find out more about the Coastal Processes Research Group at Plymouth: www.coastalprocesses.org
OSPAR is the cooperative mechanism for marine environmental management in the Northeast Atlantic, to which the UK is one of 15 contracting parties. OSPAR is collaboratively implementing ecosystem-based management in the Northeast Atlantic to meet the EU Marine Strategy Framework Directive (MSFD) requirements to achieve Good Environmental Status (GES) of European seas by 2020.

As part of this process, OSPAR has developed three policy-approved, plankton biodiversity indicators for pelagic habitats in the Northeast Atlantic region. These indicators are assessed against targets representing the MSFD’s objective of Good Environmental Status. Plankton are particularly well suited as indicators of environmental change in pelagic habitats due to their rapid response to changes in climate, hydrology and water quality. They are also fundamental to the marine food web and perform a number of ecological functions, such as the cycling of carbon and key nutrients.

Governance of the Arctic is complex (Figure 1) and although OSPAR is also responsible for achieving GES in the Arctic Ocean, regional plankton biodiversity indicators do not exist. Fortunately, current Northeast Atlantic pelagic habitat indicators are ecologically applicable to the Arctic. This transferability is primarily due to the flexibility of the plankton lifeforms and biodiversity indices indicators that allow selection of regionally-relevant lifeform pairs or species for assessment. However, current national plankton monitoring programmes in the Arctic are insufficient to support the implementation of these indicators. Additional regionally-specific indicators, such as for sympagic (ice-dwelling) phytoplankton and sea-ice biota, are worthy of consideration although they do not exist for Northeast Atlantic waters. Budgetary constraints and a corresponding lack of year-round sampling and long-term datasets were found to be the key limitations in the implementation of OSPAR’s Northeast Atlantic plankton indicators for establishing GES in the Arctic Ocean. Implementing an Arctic-wide plankton monitoring programme would be a significant step towards the assessment of GES for this unique and vulnerable ecosystem.


Figure 1: Horrendogram illustrating international, multilateral, bilateral and national policy and cooperation influencing EBM strategies and management in the Arctic. Abbreviations: EU, Int. Mar. Pol. = EU Integrated Maritime Policy, NOR-RUSS Comm On Env. Protects = Norwegian-Russian Commission on Environmental Protection.
Prior to the introduction of the Deposit of Poisonous Waste Act (1972) and Control of Pollution Act (1974), waste material from landfill sites was commonly disposed of in low-lying coastal zones. This often proved to be a cost effective method to discard waste material at a time when there was a general lack of knowledge and awareness surrounding the risks this presented to the environment.

An example of such a site is the Blaxton Meadow impoundment (see Figure 1) that was reclaimed from the Plym Estuary in the mid-1800s to create additional land on the Saltram Estate. The impounded area was designed to be used for recreational purposes and was infilled over what was previously a stretch of mudflats. The embankment that separates the impounded area from the estuary is beginning to erode, and with rising sea-levels imminent as a result of climate change, management of the site is necessary.

A study conducted in 2017 revealed high levels of metalliferous contaminants in the sediment, which prompted this research (an MRes dissertation) to further investigate the extent of contamination and quantify the risk posed to the adjacent estuarine system. Sediment cores were obtained from Blaxton Meadow on a very snowy day in early 2018 (see Figure 1 and 3) and analysed using Quantitative X-Ray Fluorescence (Q-XRF) to determine concentrations of selected elements (manganese Mn, iron Fe, rubidium Rb, copper Cu, zinc Zn, arsenic As, lead Pb, tin Sn, tungsten W) and geochronology was established using gamma spectroscopy.

Using results from the current study alongside those from 2017 allowed for a comprehensive assessment of the study site (see Figure 2 for As and Pb concentration profiles). The concentration profiles revealed distinct layers within the meadow as a result of infilling during construction. These layers consisted of a surface layer (~ 5 cm), a mid-layer (~5–30 cm) and a deeper layer (> 30 cm) where significant enrichment was particularly apparent in the deeper sediment layers. Elemental concentrations were compared with Canadian Sediment Quality Guidelines (CSQG) which revealed a substantial level of contamination from both As and Pb.

Original documentation outlining the construction of Blaxton impoundment indicates that the sediment used for infill was taken from external sources, and given the level of contamination presented by the results it is conceivable that a portion of it was sourced from local mine waste material. Since the sediment would have been transported in loads and deposited across the impounded area, this explains the apparent layers exhibited by the concentration profiles.

The results ultimately signified contamination within the meadow, and in consideration of the risks proposed, suitable management options for the site were suggested. The most suitable management approaches included a hold-the-line or managed retreat with an emphasis on strengthening flood defences. Blaxton Meadow is one of many other such contaminated coastal sites within the UK that is facing risks of flooding from rising sea levels. Long-term management options and implementation of appropriate flood defences in low-lying coastal zones is gaining increased focus as coasts are required to adapt to the inevitable changes they face going forward.
RIP CURRENT RESEARCH
Investigating headland rip currents

CMAR (Coastal Marine Applied Research, coastal consultancy at University of Plymouth) were recently asked to support the University of Bordeaux (METHYS team) and SIAME Laboratory in undertaking a field study investigating headland rip current flows under energetic surf conditions. The site was located in the French Basque Country at the southern end of Anglet beach where rip current circulations and headland flows have previously been observed from remote video images.

The experiment involved the measurement and mapping of the nearshore current circulation and headland flows under a range of wave conditions. CMAR provided six GPS drifters which have been previously developed by the University of Plymouth and tested for the measurement of surf zone flows. Partially submerged, the drifters are specifically designed to track surface currents and move through breaking waves without “surfing” shoreward. The drifters represent the latest version which builds on previous designs to provide a real-time telemetered feed of the drifter location to a shore station. The GPS drifters log their position at 2.5Hz which is stored locally on an SD card and also transmitted to a shore station where the data can be visualised to aid in the deployment strategy.

A maximum of six GPS drifters were deployed on the 16, 17, 18, 19, 22 and 23 October from the southern end of Anglet beach (Chambre D’Amour). Deployment methods varied from beach seeding by hand, surfzone seeding by hand (swimming the drifter into position), surfzone seeding by jet ski, offshore seeding by jet ski, offshore seeding by boat and offshore seeding by hand (swimmer seeding drifter). All drifter deployments and drifter recoveries were logged manually by a shore team to aid post-processing. A range of behaviours was observed after a successful few days drifting in what were challenging conditions with large surf.

The drifter experiments were supported by the very experienced lifeguard team at Anglet, without whom the experiment would not have been possible. These experiments represented the first time to our knowledge that rip current drifter experiments have been successfully conducted in 3-4 m surf!

Tim Poate, Senior Investigator, CMAR
For more information on the Coastal Marine Applied Research (CMAR) consultancy, run by the Coastal Processes Research Group at Plymouth go to: https://www.plymouth.ac.uk/research/cmar

Above left: (left to right) Dr Tim Poate (CMAR) and Dr Jak McCarroll (CRPG) after a punishing day in the surf. Above right: Research team from University of Plymouth and Bordeaux. Left: Snapshots from the rip current experiment, illustrating the challenging nature of the headland environment and the optimum deployment technique for the quick in-and-out deployments! Figure shows example drifter tracks for one day when all the drifters exited the surf zone around the headland!
It’s been a good 2018 at the Marine Station with students surfing in Newquay, learning field skills on Falcon Spirit, investigating the foreshore, building ADCP bedframes, and enjoying being out on Plymouth Sound all from our waterfront location by the National Marine Aquarium.

The Marine Station is in the Plymouth Herald. Award winning nature camera man Doug Anderson (Blue Planet) said “the Marine Station is an unrivalled place to learn and by the time students leave, they undoubtedly have the education and experience to succeed in the wider world”.

**Nature cameraman Doug hails marine science team**

A huge congratulations to our Director, Professor Richard Thompson DBE, receiving two #NERCimpact awards for the extensive work on microplastics alongside colleagues at @UniofExeter @PlymouthMarine @PlymUni

Cracking day on the reef with @MarineSciPlym Ocean Science and Marine Conservation field course! @DrSimonIngram

Very exciting day first in lab for grain size analysis of our Antarctic @exps34 samples! @PlymUni @EarthSciPlymUni @MarineSciPlym

New paper on Depth of Closure by PhD student Mouser Nithifah is now out and freely downloadable from Marine Geology. @austenstevens01/1xZbMyOmlvdr22: Paper investigates the concept for embayed, exposed and marginal shelf settings. @jpu_cpg @PlymUnResearch

A sunny day for multi-platform #UAV surveying at Looe this week, flying the @SeafloorEyeLabs, Exo, @SeaGlioba Phantom4Pro and Mavic Air. Comparing methods and collecting data for @MarineSciPlym and @PlymGeo student projects on seagrass beds and land slips.

UAV observations of rip current circulation and surf development during recent South Africa @MarineSciPlym student field trip indicates important role of rip rip current recruitment in primary productivity in surf zone @PlymUni @jpu_cpg

Wavewarden safely tucked up after her trip home. Apart from a few minor nags I couldn’t be more pleased - she will be a fine addition to our fleet 😊