WINTER
2021/22

THE BRIDGE

News from the
School of Ocean Sciences
and the
School of Ocean Sciences
Alumni Association

PRIFYSGOL
BANGOR
UNIVERSITY

CONTENTS

3 Message from the Chair of SOSA

4 COP26

8 Alumni Focus

11 School News

16 New Research Grants

19 The Wonders of the Celtic Deep

20 The Digital Twin Ocean

21 In Memoriam

23 Alumni News

26 Research and Impact Highlights

32 Publications

THE BRIDGE Winter 2021-22

Please send your School of Ocean Sciences news to:
sos-newsletter@bangor.ac.uk

Please send your School of Ocean Sciences Alumni Association (SOSA) news to:
l.haggett@bangor.ac.uk

Letter from the Editor

This newsletter comes to you as we approach the end of the first semester in which we have been able to begin a return to predominately face-to-face teaching as pandemic restrictions were gradually lifted, although at the time of writing it is not clear what impacts the spread of the new Omicron variant will have on our activities in the new year..

It also comes after the recent gathering of world leaders at COP26 in Glasgow to plan for the global transition to a more sustainable economy. The conference saw the growing recognition of the key role of the ocean in the climate and nature crises.

The key role of the ocean in achieving the energy transition is highlighted by Mick Cook of the SOS Alumni Association as are the employment opportunities arising from this major transition.

In this newsletter you can read about SOS staff, student and alumni contributions to and reflections of COP. You can also read about some of our recent research and impact highlights.

Best wishes,

Tom Rippeth, Editor

For more detail check out our past newletters:
https://www.bangor.ac.uk/oceansciences/newsletter.php.en

Cover photo: Plankton netting aboard the *Prince Madog* by Andrew Hodgson

MESSAGE FROM THE CHAIR OF SOSA

It is just a few months since I wrote my last Chairman's letter but, here in the south of England, things are, after many months impacted by the Pandemic, getting back to some sense of normality and many of the 'freedoms' we have missed are returning*. Indeed, I have begun to attend face-face meetings again and as mentioned in my previous letter, was even involved in organising and attending a face-face seminar at Newcastle Football Club entitled '*The Energy Transition – its impact on offshore site investigation*'. This event was successfully held in September under the auspices of the Society for Underwater Technology (SUT) and attracted some 100+ delegates.

All that said, my wife Christine and I have just spent 10 days in North Wales (part holiday/part business) and COVID precautions are still very much in evidence in that part of the world – suggesting we are far from being out the COVID fire yet.

As highlighted in my previous letter, I regret to report that little has happened on the School of Ocean Sciences Alumni Association front. However, as the Pandemic begins to subside, we are hopeful that we can begin preparations for a long overdue Alumni reunion. If you have any views on such an event, I would appreciate it if you would write to me at my e-mail address below, expressing your wants/desires or whatever. All feedback is gratefully received. But do not fear, such a reunion will not be happening anytime soon as such events take many months of planning to arrange and the earliest we are likely to hold such an event would be late 2022.

At the time of writing, COP 26, held in Glasgow, has just ended. Whilst it is difficult to evaluate what impact this will have on constraining climate change, what is very clear is that the move to decarbonise through the 'Energy Transition' will proceed apace in the next 2-3 decades. This transition will involve rapid divestment in coal (we hope), a gradual divestment in oil and gas when combined with technological advancements in 'Carbon Capture and Storage' (CCUS). I say 'gradual' because any thoughts of an abrupt change in the use of oil and gas would be catastrophic for day-day life as we know it today because we are not sufficiently advanced in the production of replacement technologies. Further, rapid advancements in offshore conventional and floating wind will ensue and these will be supported by nuclear (possibly micro-generation), solar and hydrogen as sources of electricity generation and for transport when combined with improvements in battery/electricity storage technology.

It is becoming increasingly apparent that to effect this 'Energy Transition', the marine environment will become an increasing focus for electricity generation and transmission. And marine scientists including geoscientists and environmental scientists will become more and more in demand. Alarmingly, the offshore industry is already short of these skills at today's level of activities; which are far below those forecast for the next 20-30 years.

In my part-time roles as non-executive director of several marine geoscience and environmental companies (including MarineSpace, Partrac, Alpine and Wessex Archaeology), I have witnessed first-hand the current shortage of such skills which, with everything that is planned, will only get worse if we do not begin to train and employ more marine scientists. Co-operation between government, universities and industry is required to ensure we take full advantage of this 'Energy Transition' leading to a sustainable and environmentally sensitive energy future.

Best wishes,

Mick Cook

Chairman School of Ocean Sciences Alumni Association (mick@mickcook.com)

* Ed: note this letter was composed before the spread of the Omicron variant here in the UK.

COP26
2021 United Nations Climate Change Conference

In the past few months the developing nature and climate emergencies have grabbed the headlines as never before, with the annual UN Climate Change Conference (COP26) taking place in Glasgow.

Whilst the outcome of the negotiations indicates that much work still needs to be done, particularly around reducing CO2 emissions, one take home message from this COP is the greater emphasis of the role of the Ocean in climate. This is reflected in the ocean being mentioned in the preamble of the Glasgow Pact and the recognition of marine ecosystems as "carbon sinks". This is widely seen as a major step forward and emphases the need to address ocean, climate and biodiversity issues together.

Ocean Sciences staff, students and alumni have all been involved in the COP processes, both inside and outside of the conference centre, including:

Dr Yueng-Djern Lenn who's work on the Atlantification of the Arctic Ocean which was live streamed on the first day of the conference as part of the presentation of the NERC Changing Arctic Ocean programme results.

Dr Gareth Williams joined an international panel to discuss The Future of Coral Reefs in a Warming World. The panel was chaired by TV Scientist Dr Helen Czerski and also included the UN Secretary General's Special Envoy for the Oceans, Ambassador Peter Thomson, Nature Conservancy's Kim Hum and Dr David Obura of Cordio East Africa.

Professor of Conservation **Julia Jones** was at the conference and welcomed the commitment by over 100 world leaders to halt and reverse deforestation by 2030 but stressed the need for commitments to be fair and just. She said: "I am cautiously impressed with how much attention is being paid to the question of fairly reducing tropical deforestation at COP26" but then went on to stress that "Only by finding ways for conservation to benefit those who live alongside forests can the world hope to keep those forests absorbing emissions for years to come."

Dr Martin Skov attended COP to help launch the new UK Blue Carbon Forum which aims to support and develop the UK's role in protecting its precious "blue carbon" habitats, vital to mitigate the effects of climate change.

The UK boasts an array of "blue carbon" habitats, that are known to draw in and store carbon. These habitats are diverse and complex, ranging from seagrass meadows and saltmarshes to, potentially one day, kelp and the seabed itself. As well as storing carbon and providing many other benefits, blue carbon habitats also boost biodiversity by providing shelter for young fish and benefit nearby coastal communities by buffering the coastline from storms.

Understanding and protecting these marine carbon sinks is crucial in the fight against the climate crisis, but often overlooked in climate discussions.

"Over three quarters of the UK is under the sea, yet carbon accounting stops on land, creating a substantial blind spot around the carbon storage potential of UK seas," said Dr Simon Walmsley, Chief Marine Advisor at WWF-UK and a co-host of the forum in the first year. "We are facing a climate emergency and the UK government must use every tool in the box to slash emissions and protect and restore nature. It's imperative that this includes action to assess, manage and protect the precious blue carbon locked away in UK seas, just as we do for vital carbon sinks on land, from forests to peatlands."

Bangor University has responded to the climate and nature emergencies by strategically combining its internationally leading research in the environmental sciences and electronic engineering to form one College to promote innovative, multidisciplinary research solutions to global environmental and energy challenges.

The College of Environmental Sciences and Engineering's research is marked by an interdisciplinary approach, which is vital to tackle the world's most pressing and complex challenges, including global environmental change, biodiversity loss, soil degradation, and unsustainable use of natural resources and energy. This is integrated with the College's research into renewable energy, the engineering of complex dynamic systems, optoelectronics and modelling to develop new technologies to address these, and a range of other societal and industrial needs. The College's approach to conservation research is also innovatively interdisciplinary. This work is underpinned by fundamental research in the biological, chemical and physical sciences of natural systems.

Reflections on COP26

Professor Ed Hill CBE (MSc and PhD, Physical Oceanography), Executive Director of the UK National Oceanography Centre gives his personal reflections on the recent COP meeting. Ed attended COP26 in Glasgow as head of the National Oceanography Centre's Observer Delegation.

"COP26 has had mixed reviews. For many it is a failure having not secured nationally defined contributions (NDC's) to emissions reductions sufficient at this stage to keep alive the Paris 1.5°C global mean temperature rise target. Other disappointments included watering down commitments to phase out coal burning; still not securing the $100billion a year climate finance needed to support transition and adaptation in developing countries; and the timeline for India's and China's targets for achieving 'net zero' remaining well beyond mid-century. Some go so far as to say the whole COP process is not working - securing only incremental changes, repeatedly kicking the can down the road to the next COP (to Egypt in this case) – that they are just 'blah, blah, blah'.

On the other hand, COP26 did see some important markers put down: coal is on the agenda with important commitments made even if not from the largest users. There were commitments on deforestation from significant countries including Brazil, albeit on slower timelines than hoped, and progress on technical issues relating to transborder emissions trading. Interestingly, there was also noticeable evidence of large corporations and private finance starting to mobilise in terms of using their purchasing and investment power in the key markets that will make a difference.

Secretary John Kerry US Special Envoy for Climate speaking at Ocean Action Day at COP26. Photo: Ed Hill

On the agenda too, as a UK COP26 Presidency priority, were 'nature-based solutions'. These are about protecting, restoring and enhancing natural carbon sinks like forests, coastal and other marine carbon sinks necessary for carbon dioxide removal from the atmosphere to compensate for the slower mid-century decarbonisation of some sectors. Indeed, alongside technological interventions like carbon capture utilisation & storage (CCUS), nature-based solutions are the 'net' in 'net zero'.

The ocean was still no means centre-stage at COP26 but, for the first time ever there was an Ocean Action Day led by the UK Presidency. It focussed particularly on the ocean-climate biodiversity nexus. Climate change is a major threat to marine biodiversity adding decisively to the cumulative other human pressures on marine ecosystems - pollution, habitat loss and over-exploitation. But protecting and restoring marine ecosystems systems has potential to deliver a 'triple win' - being good for nature, good for climate by increasing carbon sinks, and good for communities through enabling development of those sustainable 'blue economy' activities underpinned by the services of healthy ecosystems. During Ocean Action Day Secretary John Kerry, the US Special Envoy on Climate, powerfully reinforced this message saying, 'the ocean is not a separate thing - there is no solution to climate without it' and that 'climate action is ocean action and ocean action is climate action'. During COP26, there were specific announcements of ocean actions such as Columbia, Ecuador, Panama and Costa Rica collectively growing and connecting their marine protected areas.

Presently, only 3% of climate finance is directed towards nature-based solutions – and only a tiny fraction of that for marine nature-based solutions. However, there is evidence big private finance becoming increasingly interested in 'blue carbon' sinks as part of a carbon market that would allow some irreducible fossil fuel emissions to be offset against carbon taken up by natural sinks. However, carbon offsetting is an unregulated market and many organisations are making ambitious 'net zero' commitments perceiving this will be essential for them to maintain and grow their market share in line with demands form customers and influential stakeholders. This means many organisations are explicitly or implicitly committing to achieving a proportion of these carbon reductions by offsetting. Some organisations – including ones that ought to know better – are proposing explicitly or implicitly for offsetting to a ridiculously large proportions of their overall 'net zero' target. This is a contentious space, with some seeing it variously as distracting focus from fossil fuel emissions reductions, as just plain 'greenwashing' or as an essential ingredient in the mix to stabilise atmospheric CO2 concentrations and which may be one of the few market drives to attract the trillions of dollars of private finance necessary to reverse the decline and restore biodiversity and natural carbon sinks. Re-forestation and afforestation have limits because of competition for space on land.

Unsurprisingly, attention is turning to marine carbon sinks (blue carbon) like saltmarshes, seagrasses, and mangroves. However, the sizes of these reservoirs, their potential for expansion, and their rates of carbon sequestration are not well quantified or understood. Moreover, we cannot ignore the fact that it is not just humans now degrading biodiversity and carbon sinks - we

also have unleashed nature on this job too to work against us. Climate warming feedbacks are now taking their toll on terrestrial carbon sinks from forests to tundra, and probably reducing the uptake efficiency of major ocean carbon sinks like the Southern Ocean – with warming effects possibly tipping some of these systems from sinks to sources. Climate warming and continuing human activity could well be degrading natural terrestrial and marine carbon sinks faster than they are being restored regardless of whether carbon sink restoration is used to offset emissions.

The next step after COP26 is the COP15 of the Convention on Biological Diversity in 2022. Here the ocean promises to be more centre-stage than in the climate COP. For example, the UK in alliance with other countries will be strongly promoting the target of protecting 30% of the Ocean by 2030. The ocean has traditionally been seen has a 'climate victim' which it is - through devastating impacts on marine life. The ocean is also a 'climate threat' to people due to sea level rise, more extreme ocean-heat fuelled weather, and the potential author of dangerous tipping posts in the climate system. But the ocean also offers 'climate solutions' too. Protecting and restoring marine ecosystems and associated carbon sinks is one of them and the High Level Panel on the Sustainable Ocean Economy estimated key elements of the blue economy could contribute up to 20% of the emissions reductions needed to achieve the 1.5°C Paris target - offshore renewables, greening shipping, sourcing sustainable food from the sea, and restoring coastal marine ecosystems. COP26 put down some markers in seeing the ocean as more than a victim and a threat and towards being a solution. Sound marine science operating to high standards of integrity will be vital to sift out the viable from the unworkable, the delusional and downright disreputable as it is drawn ever closer into the centre of the quest for solutions at the climate biodiversity nexus where it should be."

Professor Hilary Kennedy, marine biogeochemist and IPCC lead author gives her reflections:

"In 2010 at COP16 Blue Carbon was presented for the first time as a nature based solution (NbS) to climate change, and was largely met by indifference by the delegates. So when COP26, took place in Glasgow, it was interesting to reflect on how far, if at all, the pendulum had swung towards the recognition of these ecosystems and their inclusion in current policy.

Since 2010, mangroves, seagrass meadows and tidal marshes have been deemed to meet the criteria as "actionable" in climate mitigation policy and are already recognized for their climate mitigation value by the Intergovernmental Panel on Climate Change (IPCC). They are additionally included in some countries' Nationally Determined Contributions (NDCs), national Green House Gas (GHG) Inventories, and other climate mitigation measures. So, the pendulum has swung, but there is still a long way to go as evidenced by the side events at COP26, where their role in mitigating climate change has still to be advocated and the implementation of actions (including carbon credits) to effect any change are still in their infancy.

The joint statement by more than 130 countries to halt and reverse deforestation and land degradation by the end of the decade, should be of benefit to Blue Carbon Ecosystems (BCE) and other aspects related to the protection and restoration of BCE were also being brought forward at COP 26. Adaptation began to be considered as of equal importance to mitigation, the imperative of recognising and respecting indigenous peoples' rights was endorsed and the value of biodiversity and the co-benefits that these BCE bestow acknowledged.

COP 26 did not just showcase the established BCE, but introduced the delegates to emerging BCE, such as macroalgae (including kelp and seaweed farms), coastal mudflats and marine sediments and currently there is a lot of interest around the management of bottom trawling to reduce carbon dioxide emissions. However, there are currently significant scientific uncertainties around the pathways and quantities of carbon sequestered and stored in these emerging BCE and emissions resulting from their disturbance. Until these BCE become "actionable", climate policy actions, to manage destructive activities, while not requiring carbon accounting, such as inclusion in a country's NDCs, may be the only avenue for their protection."

Reflections on speaking at Bangor's Day of Climate Action during COP26

By Nia Heulwen Jones (a PhD student in Physical Oceanography, SOS)

As a PhD student studying plastic pollution, I often get asked "why concentrate on a problem like plastic pollution when a much larger environmental disaster looms like climate change?'.

To answer this question, we published a review paper led by fellow SOS PhD Student, **Helen Ford**, on the 'Fundamental links between climate change and marine plastic pollution' ahead of the international climate conference, COP26. We highlighted that the sources of many growing environmental crises are very similar, the overconsumption of Earth's finite resources.

On November 6th 2021, over 250 events took place to mark the Global Day of Action for Climate Justice while world leaders were meeting in Glasgow. There was a great turnout in Bangor that day (despite the typically Welsh weather!) with people from across the political spectrum, academics, racial justice groups and youth activists marching from the pier to the clock tower to demand action on climate change. I was honoured to be invited to speak to the crowd on plastic pollution, climate change and the importance of centring environmental and climate justice within our actions. Time will tell whether governments live up to the pledges made at COP26, and hopefully realise much more is needed to limit warming in line with the Paris Agreement. We all, however, have our part to play in a fairer, more sustainable world and I hope we can all continue to demand action from those in charge but also pull up chairs to the table for those who have been historically excluded from discussions.

ALUMNI FOCUS

In conversation with Zaha Waheed (BSc Marine Biology & Oceanography, 1996)

Marine Biology & Oceanography graduate Ms **Zaha Waheed** was appointed as the Minister at the President's Office of the Government of the Maldives in May of this year.

She had previously served the government in several key positions. Most recently, she served as the Minister of Fisheries, Marine Resources and Agriculture, from November 2018 until May 2021.

We are delighted that she has been able to find time to chat to two of her class mates from the class of '96, **Martin Skov** (now a Reader in the School of Ocean Sciences) and **Karen Tuson** (now a project manager within the School of Ocean Sciences Marine Centre Wales) about her career to date.

1. Wales is a long way from the Maldives, approximately 5500 miles, and a very different climate. Why did you choose to study at Bangor?

I had the opportunity to further my academic career under the UK-Overseas Development Administration Scholarship, and I was deeply committed to studying Oceanography and Marine Biology. The University of Southampton and Bangor University were the few places that offered a strong education in the field that I was interested in. Upon further research into the universities and their respective location, I was enthralled by the environment that North Wales, Bangor offered. Furthermore, the course that was offered embodied the modules that I believed were useful for advancing my career, and what I felt was very necessary for my country.

2. When you think back on your time in Bangor, what memories stand out?

Without a doubt, the most memorable moments of my time in Bangor were surrounding myself with the scenic environment. The Maldives, with its tropical climate and beautiful islands, is very different world to that of Bangor. The coastline in Bangor is unique to what I had previously experienced, and Bangor itself is dotted with intriguing historical and memorable landmarks which makes it ideal for exploration.

It was wonderful to be part of a very diverse community of many international students in a varied age group. Even though I attended Bangor University as a mature student and after starting my career in the Maldives, I enjoyed having a full student life. The faculty was nothing short of wonder and knowledge, and it was easy to motivate myself to do my best in my studies.

3. After graduating you returned to the Maldives. Did you know what career path you wanted to pursue at that time?

I had already started my career in the Marine Research Section of the Ministry of Fisheries and Agriculture of the Maldives and had been working in this particular field soon after finishing high school. This is where my passion laid and the experience in this field is what led me to pursue my education in this field. After I returned to the Maldives, I saw lots of potential in the research field, to apply the knowledge I gained from Bangor University.

I quickly delved into my job as a Research Officer focussed on Research on Tuna Stock Assessment, and Bait Fisheries in 1996 and then advanced to Senior Research Officer in 2000. This was part of a research conducted by the Marine Research Centre. Further on, in July 2006, upon the request from the government, I was transferred into the policy sector, to contribute my knowledge and experience in developing policies in the marine sector. I was given the task of heading the Policy, Planning and Coordination Services of the Ministry of Fisheries, Agriculture & Marine Resources.

4. The Boxing Day tsunami in 2004 devastated coastal areas of eight countries within and surrounding the Indian Ocean, including the Maldives. Many people lost their lives and survivors in affected areas found themselves displaced. You choose to help out in the period after. Could you:

- *Tell us about your work at the National Disaster Management Centre (NDMC)*
- *Your work must have included some heart-rending experiences. Do you think this gave you an insight into the community needs? Was this good training for your time as the Fisheries Minister?*

The Boxing Day tsunami in 2004 was indeed devastating to the Maldives and other countries in the Indian Ocean. In the aftermath of the tsunami, I was involved at the Emergency Operational Centre in gathering information about the extent of the damages caused to the islands and the numbers displaced. In order to do so, the first few days, I travelled with technical teams to closely examine the islands and meet the communities and experienced first-hand, the damage caused by the tsunami.

I worked as the Deputy Head of the "Managing of Internally Displaced Populations (MIDP Unit)", at the National Disaster Management Center from March 2005. As the Maldives has never experienced having internally displaced people prior to the Boxing Day Tsunami, nor a national tragedy of this scale, the assistance and guidance provided by the United Nations Office for the Co-ordination of Humanitarian Affairs (OCHA) was integral for us to learn and absorb information quickly in order to respond to the needs of the Maldivian communities. I am glad and very honoured that I was able to work during such an important, albeit tragic, time to assure that the needs of these displaced communities were met and contribute towards placing all of them in permanent homes within a period of 10 years.

During my portfolio as the Minister for Fisheries, Marine Resources and Agriculture, I was tasked with assessing the community to advance the sectors under the Ministry's mandate, and to ensure the development of these sectors as well. I do believe that my time at the NDMC had allowed me more insight into the communities' needs, as well as enhanced my capability to be prepared during unpredictable situations.

5. What interested you most about entering into government?

I have always been interested in the field of Research and Marine Biology, and during this period the government offered a lot of opportunities in these fields. I have also always been eager to contribute my part in the sustainable development of the fisheries sector of the Maldives, and in order to do so I believe it is important to be part of the policy changes to ensure that we leave a better and brighter future for the upcoming generation.

6. To many, it's difficult to imagine, what it was like being a Fisheries Minister. What was a typical day like for you?

My portfolio during my time as the Minister was quite broad as I was tasked with not only the Fisheries sector, but also the Marine Resources and Agriculture sectors as well. Our main priorities were diversifying into the aquaculture sector, promoting sustainable fisheries, and working towards marine spatial planning, enhancing the agriculture sector in order to secure livelihoods and food security. Therefore, a typical day would encompass different meetings and lots of reading in order to ensure that these priorities take place, as well as ensuring that the public is aware of the importance of the priorities that we are trying so diligently to achieve.

Sustainable development of small island states like the Maldives will never be realised unless we make meaningful progress in the fight against climate change and environmental degradation. It is essential that we prioritise the precautionary approach and ecosystem based management in our efforts. This is why Maldives has remained committed as one of the few nations in the world that has a strict policy on the prohibition of all forms of net fishing. We continue to maintain the one-by-one method of fishing, making our tuna fisheries one of the most sustainable in the world.

In highly uncertain and unprecedented times of rapid climate change, planning is essential for our future and the well-being of our communities. This is why this government is committed to making marine spatial planning a priority, and gives emphasis to a process that is inclusive, holistic, and most importantly, sustainable. By making smart choices and planning wisely, we give our businesses and other resource user's tools to thrive while protecting the long-term health of our marine ecosystems. It gives us the opportunity to more effectively advance economic and conservation goals through sound ocean management.

We are designing and adopting a nation-wide Marine Spatial Plan, which will include the protection of 20% of our oceans, in line with this government's commitments. The programme will help us organise the use of our ocean spaces, and will be crucial when striving to meet our needs without impeding the needs of the future generation. It charts a path to better decision-making through science and data sharing, and it ensures that we maintain a strong economy, while meeting our conservation goals. I have no doubt that the environmental and economic rewards of this will be realised for generations to come.

Maldives, like many other countries in the world, is battling the effects of the COVID-19 pandemic. The economy was severely impacted with the closure of the tourism sector, and travel and exportation restrictions had drastically diminished our food security. It had become startlingly clear that Maldives needed to diversify its economy and invest into the fisheries and agriculture sector in order to minimise the impact to our food supply chain. We developed measures to facilitate fish export and increase local agriculture production. Agricultural schemes were established to promote commercial farming, and urban gardening programs were introduced to build the capacity of farming communities and revive production of traditional crops. While fish and fishery products are the number one export of the country, the travel ban hindered the fish export to the main markets in the European Union. In order to address this issue, various loan schemes to businesses and relief packages were initiated to mitigate the impacts to different sectors.

7. Do you have to be made of extra sturdy material to enter, as a woman, into the field of fisheries management that is traditionally dominated by men?

There is a strong belief, even currently, that this is a masculine industry. The ocean is perceived to be a harsh and unforgiving entity, which may be the reason why this belief is still prevalent. In the Maldives, barriers to girls' and women participation in this field has not been due to resources or academic requirements. It is attributed to the shared beliefs within the community, which is why women who enter into the field of fisheries management must be made of extra sturdy material to advance their careers. However, having said that, I think we have come a long way, and compared to when I first joined the field, the presumption that ocean governance, fisheries management and marine research is more suited to boys and men have changed considerably.

8. All over the world there is a drive to encourage more women into leading roles in science. Do you have any advice to offer young and aspirational women in science?

Women in science are not always given the prevalence they deserve, even though there are many who have shown strength, perseverance, and passion. It is up to the women who are in this field, to help one another to fight for a place in the table and to ensure that our voices are heard. This is imperative for us to create equal opportunities for both men and women to thrive.

9. Your son also chose to study at Bangor University. Has he been inspired by his mother?

Our family has always been environmentally conscious, and a passion for the ocean definitely runs in our blood. Even at a young age, my son enjoyed many sea-related exploits, such as snorkelling, diving, fishing etc. This has cemented his passion for Environmental Management, however choosing to study at Bangor was a happy coincidence since I had given him free reign in his university search. My son chose Bangor primarily, after looking at other universities, location, due to the field of study and curriculum offered by the university.

10. Thank you for sharing an insight into your amazing career. Looking back on all of your achievements, what advice would you give to our current students and recent graduates as they start their careers?

My advice to current students and recent graduates would be to stay focused in pursuing their academic career and to always strive for the best possible outcome. Follow your dreams and passion. It is also important for all of us to learn how to cope with failure and disappointment, to learn and grow instead of giving up.

SCHOOL NEWS

Steve Backshall visits Bangor

There was a rockstar reception from the students at Bangor University as Steve Backshall took a face-to-face open-air questions and answers session in the main quadrangle of Top College in a damp evening in October.

The session was attended by over a thousand students who were clearly inspired, having grown up watching programmes such as Deadly 60, to pursue studies in natural and oceans sciences here at Bangor. As part of the Bangor teaching team, Steve is sharing his vast experience of the natural world and TV production with students.

Steve Backshall introduced by Christian Dunn, a wetlands expert in the School of Natural Sciences

New MSc Studentships

We are delighted to report that Alumnus **Professor Craig Kensler** (1961-65) has generously agreed to fund the tuition fees for two studentships for MSc taught degrees and the tuition and lab fees for two MSc research degree studentships in each of the next two years.

These will be called the Professor Craig Kensler MSc Studentships in Marine Science and will be awarded competitively, boosting our PGT and MSc by Research community.

Craig came to Menai Bridge from the USA to join the Marine Biological Station at Westbury Mount in order to undertake a PhD with Professor Dennis Crisp. He recalls at that time there were no one-year MSc degree programmes!

Craig met fellow student Gwyneth (nee Roberts) in Menai Bridge and they married in 1965. Craig's work as a fisheries biologist took he and Gwyneth all over the world, but they have stayed great friends of Bangor and the School. Gwyneth served on the University Court whilst a Denbighshire Councillor.

These studentships will provide excellent opportunities for eight postgraduates to build careers in marine science. **Professor John Turner** will coordinate the studentships with support from **Dr Ian McCarthy** (PGT) and **Dr Line Cordes** (PGR.

Multi-Million Pound Initiative Advances Sustainable Management of UK Marine Resources

We are delighted to report that the School of Ocean Sciences is part of a consortium of industry, government, non-governmental organisations and universities which have joined forces for a major new initiative aimed at sustainability managing the UK's coasts and seas.

The Centre for Doctoral Training in Sustainable Management of UK Marine Resources (SuMMeR CDT) aims to deliver the next generation of researchers, solution providers and practitioners who will sustainably manage our marine resources.
Supported by £2.2million in funding from NERC, the Natural Environment Research Council, part of UK Research and Innovation, the Centre will train almost 50 interdisciplinary PhD students over the next seven years.
Based at locations across England, Scotland, Wales and Northern Ireland, they will focus on subjects ranging from marine and social sciences to law, health, education and economics. Together they will cover existing and emerging topics of local, national and global importance, from enabling biodiversity gains and delivering Net Zero, to enhancing coastal protection and supporting coastal communities, and from pioneering marine technology to fostering a sustainable marine economy.

Commenting **Professor John Turner**, Head of School of Ocean Sciences said:

"*We will provide postgraduate training to build a strong community of transdisciplinary researchers, equipped with skills crossing the interfaces between marine environmental science and other disciplines such as economics, social science, law and policy, engineering and renewable energy, psychology and public health. These talented researchers will work with partner organisations to investigate the significant challenges from biodiversity loss to climate change to create urgently needed sustainable solutions to manage the UK's marine environment.*"

In the News

Media appearances by our staff and students over the past few months

Gareth Williams joined SOS alumni **Nicola Foster**, together with evolutionary expert Steve Jones (UCL) and host Melvyn Bragg, on Radio 4's In Our Time to talk about the simple animals which informed Charles Darwin's first book and form the reefs now threatened by climate change.

Listen now via BBC (52mins)

Dei Huws and **Nia Jones** appeared on the last episode of S4C's Cynefin where they discussed the geology and biology of Afon Menai (the Menai Strait).

Margo Saher was interviewed by S4C news about the scientific value of Lleiniog beach and the potential impact of a planning application for increased sea defences nearby.

Sophie Ward and **Tom Rippeth** were interviewed ahead of COP26 for S4C and BBC Welsh news respectively.

Alumni help with Student Careers Advice

We were pleased to welcome back the SOS Alumni Chair **Mick Cook** to Bangor to talk to our students about their future career options in the marine sciences.

Mick is a marine geophysicist by background having graduated with an MSc in Physical Oceanography from Bangor in 1979.

He began his career working internationally for a US seismic contractor before joining a small technical consultancy, Hydrosearch. Over the next 20 years, Mick played a central role in growing Hydrosearch into one of the largest geosciences consultancies in the international energy sector.

Hydrosearch was acquired by the RPS Group in 2003 and Mick was appointed Managing Director – Operations, RPS Energy. During the ensuing five years RPS Energy grew significantly into a business with revenues approaching £200m and strong profit margins. Since 2009, MCL has provided advisory services to a range of clients and Mick has held a number of non-executive Director and board advisory roles with clients.

Mick is one of a number of alumni who sits on the recently established School of Ocean Sciences External Expert Board, led by **Dr Katrien van Landeghem**, which works with the school in development of our curriculum, ensuring alignment of skills acquired with skills needed and linking graduates from the past and the future to develop a strong and diverse SOS network to support our students.

Top of the form in the National Student Survey - NSS

Ocean Sciences once again achieved some high scores in the annual National Student Survey (NSS).

The NSS gathers students' opinions on the quality of their courses which helps to inform prospective students' choices as well as providing data to supports universities and colleges in improving the student experience.

In the Earth Science category, which covers the majority of the undergraduate degree courses offered by the School of Ocean Sciences, Bangor University was rated no. 2 out of 33 Universities UK wide and achieved a student satisfaction rate of 98%.

discoveruni.gov.uk/course-details/10007857/BSC_OS/Full-time

Congratulations

Congratulations to **Dr Yueng-Djern Lenn** on winning the "Hydrogen Zone" award for her work in inspiring the next generation of scientists through her STEM Outreach work!

The Hydrogen Zone is part of I'm a Scientist, Get me out of here. Over the summer it enabled school students to connect virtually with working scientists from across the global including weekly 'after-school' chats with the aim of getting more children interested in studying science.

Yueng leads on STEM activities within the School of Ocean Sciences.

New Glaciation teaching recourse highlighting Snowdonia's unique environment

Bangor University have a recently released a new teaching tool aimed at helping school children appreciate the evidence for past ice ages.

Physical Geography lecture **Dr Lynda Yorke** teamed up with Time for Geography and others to show how the landscapes of the UK, and in particular Snowdonia, are a legacy of glacial conditions that last came and went tens of thousands of years ago.

The video can be viewed at: https://timeforgeography.co.uk/videos_list/glaciation/evidence-uk-glaciation-deglaciation/

This is one of a series of videos produced in collaboration with Time for Geography, including one of tsunamis and another on tides and our climate.

A Model *Prince Madog*

As mentioned in our last newsletter, to celebrate the 20th anniversary of the launch of the "new" *Prince Madog*, **Tim Whitton** developed a cut-out model of the *Madog* in kit form.

The model is now available. You can build your own accurate paper model of the *Prince Madog* in 1/250 scale from the kit. All you need is a craft knife (or scalpel from your student dissection kit), a metal ruler, PVA glue and some patience.

https://www.papershipwright.co.uk/product/rv-prince-madog/

The model kit was designed by David Hathaway who runs www.papershipwright.co.uk, with images and technical details to help in the design provided by Tim, and is constructed from 2 sheets of A4 card.

Towards the development of a sustainable trade in live coral reef fish

An estimated 20 to 27 million coral reef fish enter the global aquarium trade each year, the majority of which are collected from the wild.

The development of breeding and larval rearing protocols and technology is essential to increase both the number and availability of sustainably bred fish to the industry.

Researchers from Bangor University School of Ocean Sciences have teamed up with ZSL (Zoological Society London), The Deep and SEA LIFE on an innovative and exciting research project to improve our understanding of the reproductive biology and life cycle of coral reef fishes. The goal of the SustaiNable Aquariums project (SNAP), which is part-funded by the European Regional Development Fund through the Welsh Government's SMARTExpertise programme, is to develop protocols and technology for breeding and rearing desirable species of coral reef fish, thereby reducing pressure on wild populations and coral reef ecosystems.

As **Dr Tom Galley**, part of the research team at Bangor University explained:

"Aquacultured coral reef fish raised in hatcheries are widely recognised as having advantages over their wild collected counterparts, such as being pre-adapted to life in an aquarium. However, completing the life cycle of many of these species in a hatchery setting is a particularly challenging and a lengthy process."

Marine Biology student Bradley England gaining work experience working on the SNAP project

Eggs from broodstock maintained in a bespoke culture facility at the School of Ocean Sciences, supplement those collected from display aquariums at eleven partner sites across the UK. These are transported to Menai Bridge where efforts are made to rear their larvae. To date, the project has produced and returned over 750 fish (from three species) to be displayed at partner aquariums, while significant progress has been made towards the rearing of several others.

Dr Nick Jones, also part of the research team explained:

"The difficulty in rearing the majority of coral reef fish lies in the small size of their delicate larvae, a limited understanding of appropriate larval rearing environments, plus the need to offer suitably sized and nutritious food items. These are issues we hope to resolve during the project."

Projects like SNAP advance aquaculture techniques and further our understanding of the reproductive biology of coral reef fishes, while highlighting the collective awareness that aquariums have an important role to play in the future of conserving our oceans.

NEW RESEARCH GRANTS

The impact of the physical environment on the foraging energetics of shearwaters and the consequences for breeding success

We are delighted to report that **Dr Line Cordes** has been awarded a NERC Standard Grant together with co-investigators **Dr Charles Bishop**, **Dr Peter Robins**, **Dr James Waggitt** (BU) and Prof Paul Fernandes (University of Aberdeen) in collaboration with the Bardsey Bird and Field Observatory, Manx Wildlife Trust, and the Met Office.

The project will look at the distribution and availability of food in the marine environment is highly variable over space and time. This creates significant challenges for marine top predators, including seabirds and marine mammals, as they must deploy an efficient movement strategy in their search for food, while navigating an ever-changing landscape of winds, waves and ocean currents. However, oceanographic features such as tidal mixing fronts enhance productivity, which in turn attracts pelagic and demersal fish. Thus, there is a strong linkage between the dynamic physical environment and the predictability of prey assemblages.

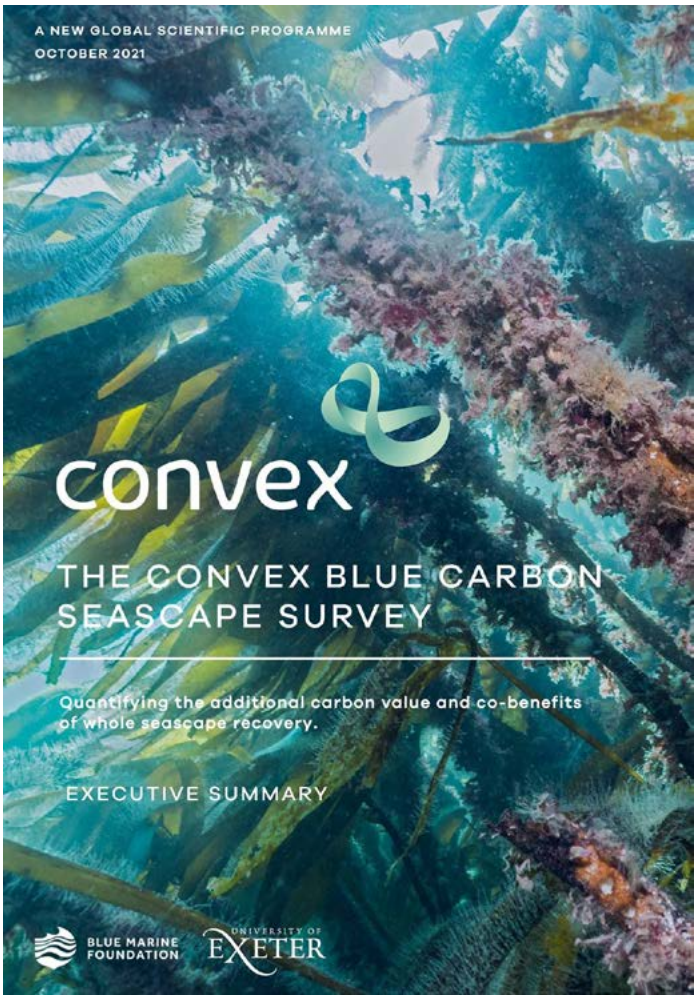
For breeding seabirds, their fine-scale movement decisions are typically constrained by the location of terrestrial colonies. This forces them to regularly navigate the variable wind and wave landscape between the terrestrial colony and the preferred offshore foraging areas, often separated by tens to hundreds of kilometres. In doing so they must constantly adapt their behaviour with consequences for route choice, energetic costs, and chick provisioning.

Our model system involves tagging Manx shearwaters (GPS & accelerometer) breeding on two colonies within the Irish Sea, which overlap in their use of a dynamic tidal mixing front known to aggregate prey but operating from opposite sides of the same windscape. This multidisciplinary project will determine the association and interaction between wind, oceanographic features and prey availability, and how this influences the energy landscape of Manx shearwaters. Using projected changes to the ocean windscape, ocean warming and stratification, we will model the consequences of continued climate change on shearwater movement costs and foraging success. The predicted reduction in the windscape and increased stratification could have disparate effects on the energy budget of [illegible] research is critical if we are to understand

One of the shearwaters tagged as part of the National Geographic project this summer.

The Convex Blue Carbon Seascape Survey

Ocean Sciences researchers are among world-class ocean and blue carbon scientists contributing to a newly announced multi-million-dollar partnership between the insurance group, Convex Group Limited (Convex), the Blue Marine Foundation (BLUE), a charity dedicated to restoring the ocean to health, led by the University of Exeter.



The ambitious five-year programme is the largest attempt to date to build a greater understanding of the properties and capabilities of the ocean and its continental shelves in the earth's carbon cycle. It represents an urgent effort to slow climate change.

The Bangor contribution is led by **Dr Sophie Ward** who said: "This is a really bold and ambitious global research programme, involving a team of fantastic ocean and blue carbon scientists, and I'm thrilled to be a part of it. We urgently need to better understand seabed carbon stores on a global scale since the oceans play such an important role in the Earth's carbon cycle. Until now, little has been known about the full capacity of coastal waters and continental shelves to store carbon. This research will be a real game-changer in understanding how the oceans can contribute to solving the climate crisis.

Teaming up with Brazil to tackle world problems

Bangor University is at the forefront of collaborative working across scientific disciplines to resolve major health and environment issues, and in merging healthcare, the arts and the environment.

They hope that bringing experts from different subject areas together using different approaches and techniques will be key in developing new solutions to challenges under global agendas such as OneHealth, Agenda 2030 and the UN Ocean Decade.

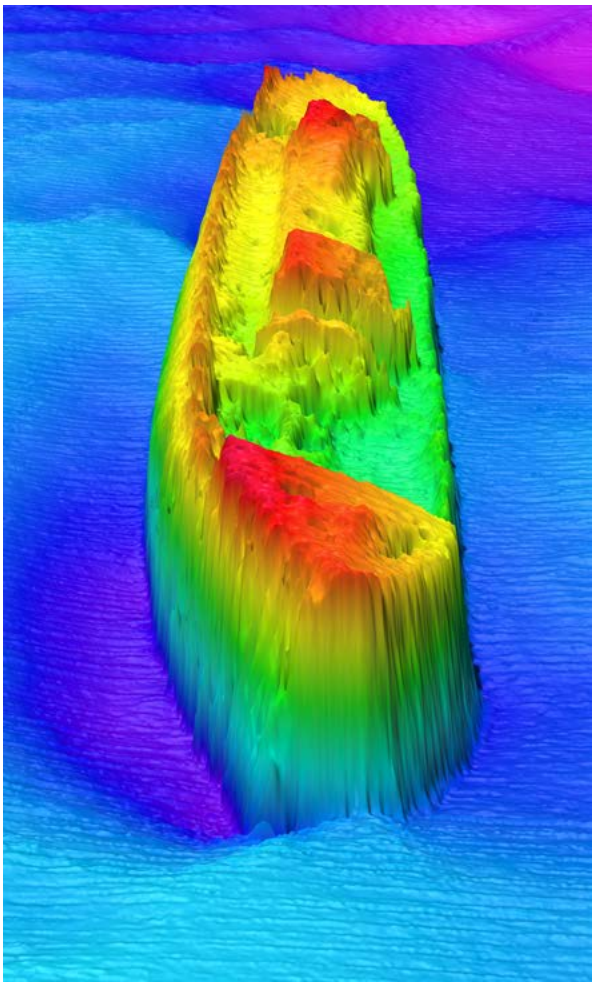
Dr Patricia Masterson-Algar of the BU School of Health Sciences, who is leading this initiative in collaboration with Dr Ronaldo Christofoletti from the Federal University of São Paulo (UNIFESP) explains:

"This work shows that researchers and policymakers from different countries working in different fields can find common ground under the premise that human health and wellbeing is influenced by nature and the environment.

Professor Stuart Jenkins of the School of Ocean Sciences has worked on ocean research with colleagues in UNIFESP and is delighted to see the partnership expand to fit the WHO OneHealth global agenda.

"I have been working with Brazilian colleagues for a number of years, but instead of sharing ideas with other marine biologists, it was great to see the benefits of working with health and behavioural scientists. It is clear that through working across disciplines we can change behaviours, which will ultimately benefit both society and the environment"

Towards a National Collection - £14.5m awarded to transform online exploration of UK's culture and heritage collections through harnessing innovative AI



Bangor University is to take part in one of five major projects receiving between them, £14.5m from Arts and Humanities Research Council (AHRC).

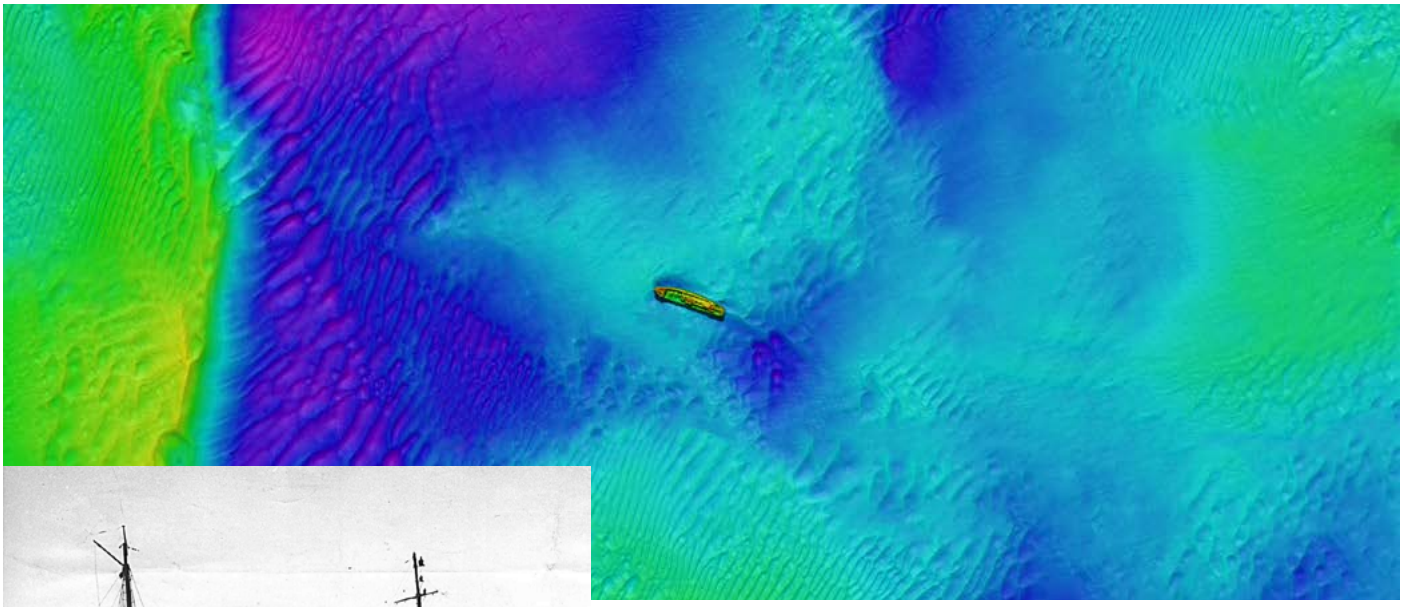
Towards a National Collection, a five-year research programme, will show how thousands of disparate collections could be explored by public audiences and academic researchers in the future.

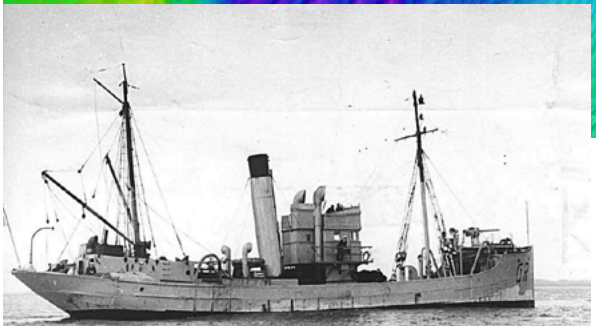
The School of Ocean Sciences will be making a significant contribution to the project: Unpath'd Waters: Marine and Maritime Collections in the UK. Over the years the University's research vessel, Prince Madog has been instrumental in mapping the seabed around the Irish sea, and by using one of the most advanced high-resolution multibeam sonar systems available, has been revealing the location and identity of 100's of shipwrecks, many of which were casualties from U-boat activity during both World Wars.

Commenting **Dr Michael Roberts** who will lead the project at the School of Ocean Sciences said:

"Having access to a unique resource such as the Prince Madog, its survey systems and our highly skilled support staff, together with the ability to re-interrogate existing data for an entirely different purpose, provides the School of Ocean Sciences with a unique opportunity to work with a diverse group of internationally renowned UK institutions and researchers working in the arts and humanities sector.

Being part of this exciting cross-disciplinary initiative will provide us with a new platform to demonstrate how our marine data can benefit wider UK and international audiences and provide a valuable legacy for future generations".





Fishing vessel Cartagena lost in 1928

THE WONDERS OF THE CELTIC DEEP

This autumn saw the release of a speculator new BBC nature documentary The Wonders of the Celtic Deep which explored the nature and wildlife of the Welsh coast.

Those watching will have seen many familiar Ocean Science fieldwork sites, which is perhaps not a surprise given one of the programme's researchers is SOS graduate **Jake Smallbone** (MSc Marine Biology 2019)

All episodes available on BBC IPlayer

The final episode focuses on the biggest marine environmental challenges today and efforts being made to conserve this unique environment. These featured and interview with a local fisherman who is collaborating with the School of Ocean Sciences to preserve local lobster stocks in Welsh water.

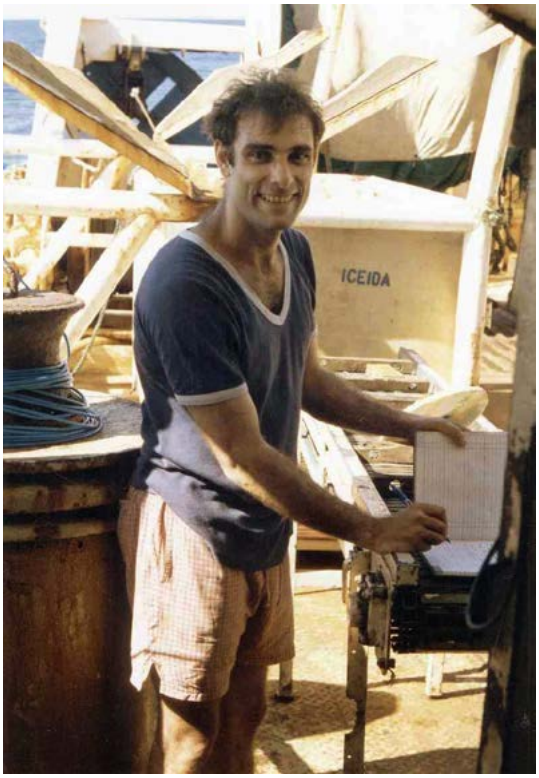
It also included interviews with several alumni about their ongoing conservation work around the coast of Wales. These included **Frankie Hobo** (MSc MEP) who talked about her work breeding sea horses in captivity and her ambition to re- introduce native sea horses back to our local seas. It also featured was an interview with **Jake Davies** (BSc Applied Marine Biology, 2018) on his work research into sharks in Welsh waters, which included 'first time' video footage of a rare Angel shark filmed in Welsh waters. The programme also spoke to **Gem Simmonds** (BSc MES 2016, MSc Conservation and Land Management 2021) on her work with British Divers Marine Rescue in saving stranded marine mammals, and to **Richard Unsworth** (MSc MEP, 2001) about his sea grass restoration project.

Second year coastal processes field study this autumn at Penrhos beach, Llanddwyn, Anglesey - the start of a long term monitoring campaign.

First year marine biology fieldtrip this autumn - digging, sifting and sampling at Aberffraw beach, Anglesey

THE DIGITAL TWIN OCEAN

The idea of the Digital Twin of the Ocean is to generate knowledge which can empower citizens, governments and industries by providing them with the capacity to inform their decisions.



John collecting data in Mozambique whilst an MSc in Ocean Sciences

To help us further understand this important developing concept we have invited SOS Physical Oceanography graduate **Dr John Siddorn,** who has recently moved from the Met Office to take up a new role at the UK's National Oceanography centre, to tell us about his new job:

"*Having recently started a new role as Associate Director for the Digital Ocean, it was great to be asked to write a few words for the Bridge on what that really means. What is meant by the Digital Ocean, and what am I am being brought in to do at the National Oceanography Centre?*

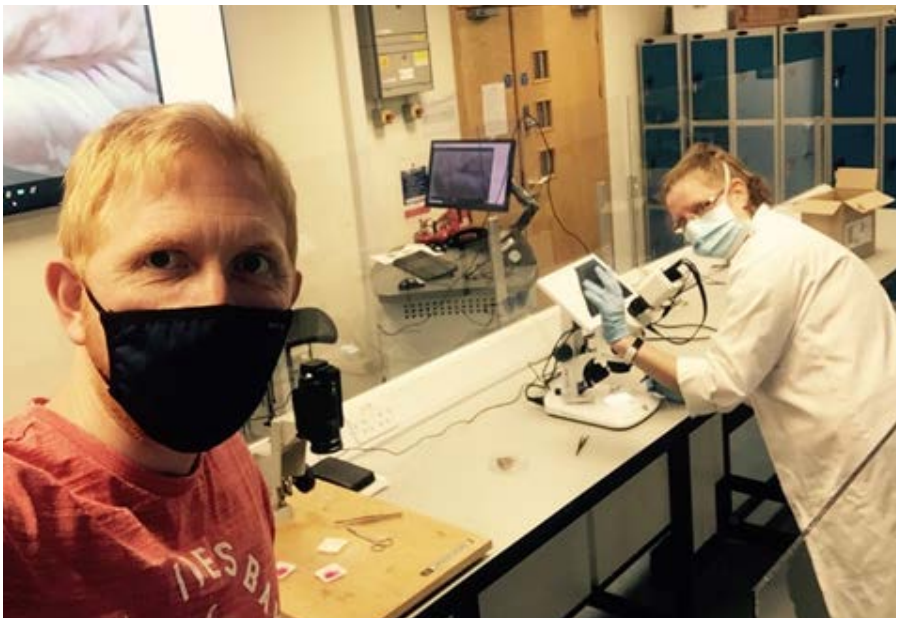
When I introduce this topic I often use the words of Pierre Simon de Laplace who, a long time before big data or even the concept of digital, said:

"An intelligence … would be able to comprehend in one single formula the motions of the largest bodies as well as the lightest atoms in the world, provided that its intellect were sufficiently powerful to subject all data to analysis; to it nothing would be uncertain, the future as well as the past would be present to its eyes."

There are two elements to that statement that are fundamental to the idea of a digital ocean – data and analysis. The ocean is a remote and challenging environment and so as oceanographers we are used to working in a data sparse environment. Where we do have observations it is incumbent on us to make the very best use of them we can, and the phrase "collect once, use often" has come to be used a lot around marine data. Unfortunately, the history of ocean data collection means that much of what we have has been collected by individual researchers and is hidden on hard drives and old floppy disks, or worse. A few months ago, I received a message from Dave Bowers asking me if I could provide him with the data from a cruise we were on off the coast of Mozambique. Unfortunately, and embarrassingly for me, I now have no idea where that data is (it was a long time ago!). Making sure the data we do collect is managed effectively, making it available, and reusable to others (following appropriate embargos if needed), is a fundamental aim of the digital ocean ambition.*

But the ambition is much broader than simply curating data for prosperity. With increasing numbers of autonomous vehicles, novel approaches to remote data collection from the likes of subsea cables and the prospect of citizen science data collection allied to the already large amounts of data we produce from satellites and modelling, oceanography is increasingly going to be in a position to benefit from big data approaches. If we can't make use of our data effectively our science won't make the progress we would like. So, the bigger ambition encompassed by the term Digital Ocean is to put in place the building blocks to make sure that we can uncover the secrets of the ocean through our data – making sure the big data revolution doesn't pass us by."

IN MEMORIAM



Julie Helen Wright

Julie joined the School as a mature student in 2012 to study Marine Biology after a career in nursing and, following a course change to MSci Marine Biology, completed her studies in 2016 with a First Class degree.

This was no surprise for her enthusiasm and motivation meant that she had first class marks in each year of study. Julie's project involved analysing the relationship between corals and disease prevalence in the absence of anthropogenic pressures using video data captured from the uninhabited Chagos Archipelago. While reefs were her second passion, sharks were her first and she did not hide the fact that she undertook this project because she knew that sharks criss-crossed our video transect lines!

Julie demonstrated in many practicals, bringing her curiosity and enthusiasm to each. However, it was the shark practicals that she loved and continued to contribute to each year.

Julie obtained summer placement funding to design a shark sensory ecology practical for the third-year Shark Ecology module. As part of this, Julie made a highly instructive video of the dissection which was invaluable for online teaching and in reality it was Julie, not the module organiser, that led the practical session on the day!

Julie planned to do a PhD on sharks in local waters and continued to work as a nurse to help fund the project.

It is with great sadness that she passed away unexpectedly at her home in Menai Bridge. Julie leaves behind three adult daughters, two of whom have recently visited to the School to donate Julie's shark books in her memory. We will all miss Julie's infectious enthusiasm and dedication and incredible interest in sharks.

John Turner, Gareth Williams, Charlotte Colvin

Bernie collecting field data at Ynysoedd Duon on Anglesey back in the early 70s.

Bernie McConnell remembered

We are saddened to learn of the death of Bernie McConnell (BSc Marine Biology, 1971-75).

After graduation Bernie undertook a PhD in seal ecology at St Andrew's University, where he remained for the rest of career becoming deputy director of the Sea Mammal Research Unit (SMRU) within the School of Biology, University of St Andrews. During this time he published many important papers the on the movement and behaviour of marine mammals – from the Antarctic to the Arctic.

On LinkedIn he described his influences as including Jacques Cousteau and Jethro Tull, and his other interests including renovating of old wooden fishing boats and singing sea shanties.

Sheila Burnell remembers Bernie as a colleague in the Marine Science Laboratories Coastal Surveillance Unit:

"*Bernie was great fun to work with in the Coastal Surveillance Unit from 1975-78. Every month we visited eight sites around Anglesey, riding round in the Unit's red Ford Escort estate which Bernie loved driving, especially round the Moelfre roundabout! On the shores we crawled down the transects, Bernie's voice constantly uttering Fucus, Fucus, Ascophyllum while I counted the barnacles etc. We often stopped at our favourite ice cream shop in Amlwch on the way home. It was a sad day for us, but great for him, when he left to join the Sea Mammal Research Unit.*"

Ed Hill adds: "*I was so sorry and shocked to learn of Bernie's unexpected death. I knew Bernie for many years and we had both studied at the Marine Science Laboratories in Menai Bridge and so had many common roots. Bernie was a larger than life figure and a great enthusiast for all he did and a huge asset to the Sea Mammal Research Unit. He was extremely able, ingenious and entrepreneurial in the technology developed for sea mammal tagging. We used to frequently run into each other at meetings and I shall very much miss him and his great company. My condolences to all his colleagues at Sea Mammal Research Unit who will feel the loss of his infectious enthusiasm and larger than life personality.*"

Matthew Davison (BSc Marine Biology/ Zoology, 2005)

We recently receved the sad news that Matthew has passed away at the age of 37.

He had not been unwell, it came as a very sudden shock to his family and friends. He was part of a swimming club, and he had gone on Sunday evening to swim as usual, and sadly passed away during his set. The cause is as yet unknown.

Matthew always spoke very fondly of his time at Bangor, and has continued to enjoy regular work in Marine Ecology throughout his career.

Matthew appeared in *The Bridge* in March,2019:

"*I graduated from Bangor University in 2005 with a degree in Marine Biology and Zoology. Since that time, I have worked throughout the UK and abroad as an aquatic ecologist in the commercial sector. Three years ago I was invited to join Carcinus Limited as Director / Principal Ecologist.*"

ALUMNI NEWS

Stephan Hays (Physical Oceanography / Maths, 1975)

An early lesson in Marine Survey work (aka Murphy's Law)

"These events occurred in 1975 on my first oceanographic survey job, after completing my oceanography degree at Menai Bridge. Whether my boss (Kevin Deeming, the MD of Marine Investigations and Services Ltd in Bangor) would have taken me on, if he had known what a naïve noviciate in nautical matters I was is a moot point. Perhaps it was my conscientiousness. The job was a preliminary survey of water movements for the disposal of ballast water from the Sullom Voe Oil Terminal, which was to service the burgeoning oil industry in the North Sea.

Our survey ship was a fishing boat converted by a wealthy butcher into a 'gin' palace, the MFV Dunedin (it still had a net hauler). It was his pride and joy. The Skipper was the butcher's son Finlay. The Mate was Brian with his partner, Judith, as chief cook and bottle washer. The surveyors were mostly me and the team leader a merchant navy captain, Simon. At the time Sullom Voe was a wild area of a few isolated houses and one pub at Graven, Garth Voe. So, we had to be fairly self-contained. We were based at the pier at Graven.

MFV Dunedin, with central wheelhouse. With the mid-night on the horizon???

Part way through the survey and after a bread-and-butter pudding with added organic spots of a blue-green hue we decided it was high time we topped up the supplies. The Skipper and the Mate's partner would travel to Lerwick for fresh food. In the meantime, we could continue working doing some drogue tracking off Calbeck Ness. It was agreed that someone would go and pick them up in the vessel's tender (a dory) at 1pm.

When the time came, we were just northwest of Calback Ness and I was nominated to pick them up. The mate checked the tender out and off I went. After rounding Calback Ness I was making good progress down Sullom Voe. The sea was short and choppy. I wasn't going very fast, as it was the first time I had ever been in charge of a vessel so took it steady. The dory kept bouncing off the top of 60cm waves. Then I heard the outboard (40hp) sounding not right. I turned around to see what was happening only to see it bounce off the transom and head to the seabed – 40m below!! I grabbed what I could, a fuel line and loose rope, but to no avail.

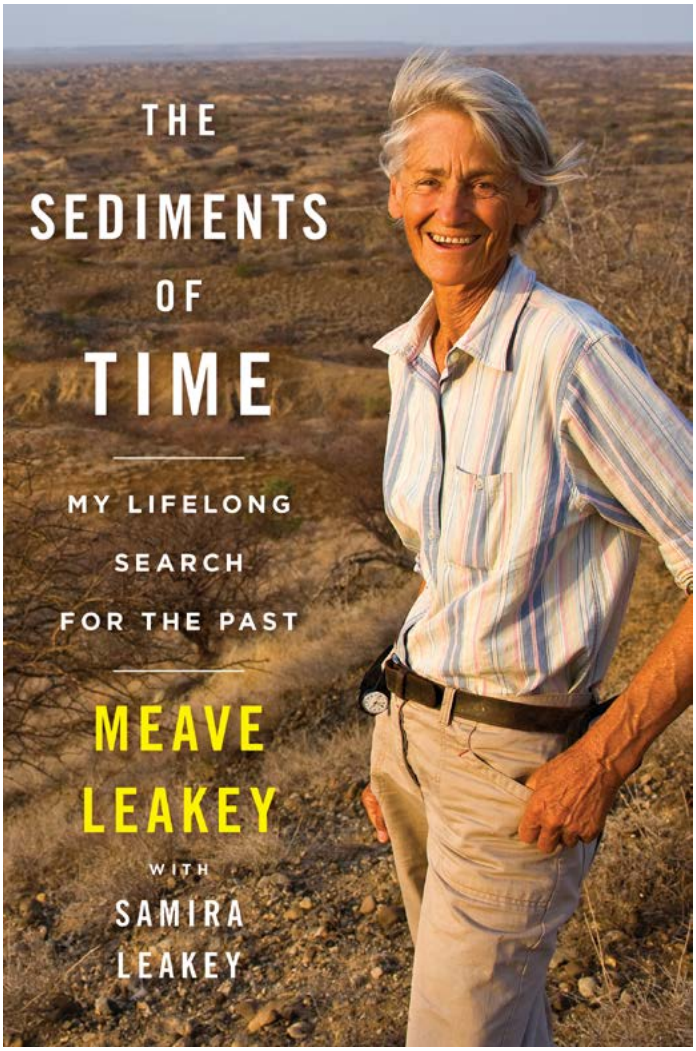
I was now half way down Sullom Voe (1 on the map) with no means of communication and no life jacket. Life Jackets were not de rigueur then. Fortunately, there were a couple of oars. I tried to row but I had some difficulty, so I ended up using one oar, kneeling on the foredeck and sculling to the shore. After about 20mins I got to the beach and tied up the boat, I didn't want to lose that too. I walked up to the top of the hill (30m) of Calback Ness. I took off my orange waterproofs started to shout and frantically wave them to the boat about a three quarters of a mile away. Eventually, I was spotted, and the vessel came towards me. Simon came to fetch me from the shore in an inflatable, now christened the tender to the tender to Dunedin.

We now had to gather up the drogues and go and get the Skipper. We sailed to the opposite shore which was quite steep and the drogues were very close in. Brian was carefully inching the boat forward. I was on the foredeck waiting to pick up the drogue. Simon was aft dealing with the dinghy. After we had gone astern, I heard this laughter coming from the front area of the boat and below deck level. Peering over the side there was Simon in the inflatable. I was puzzled as to how he had got there. Whilst Simon had been manoeuvring the dinghy the aft handrail gave way. As he started to fall, he shouted "don't come astern". Brian only heard "come astern". He thought the vessel was al the dinghy which of course then shot past the front of the bo worried. He drove around to the bottom of Orka Voe (it hadn' on the rocks (2). He was now really worried.

The rest of the day passed by without any further incident. We picked up the rest of the drogues and sailed to Garths Voe. I had tried to take a bearing on where the outboard had gone down. Brian later dived to see if he could find it. It was deep so he had limited time down there. He never did find it. I not sure what happened in the end, but I think the boat's owner eventually accepted liability. It was a difficult experience but as Shakespeare said: "All's Well that Ends Well"."

Me in the Dory with spare 10hp engine.

Meave Leakey (nee: Epps) (Marine Biology and Zoology)



Since graduating from Bangor Meave has spent many years in the hot, arid sands of northern Kenya as a palaontologist working to uncover the story of human evolution.

She has recently published a new memoir together with her daughter Samira covering her fascinating journey: The Sediments of Time: My Lifelong Search for the Past.

On the *East African* website, recalling her journey Meave recalls that after graduation she "could not get employment because of her gender. According to the men running the marine expeditions, there were no facilities on board ships for women."

"*A job advert in 1965 in The Times listed a research position at the Tigoni Primate Research Centre in Kenya. One of the interviewers turned out to be palaeo-anthropologist Louis Leakey. Meave took over running the centre in 1969, the same year she met her future husband Richard Leakey. They married quietly in 1970 and among her fondest memories are field research excursions with Richard before his varied interests took him into other endeavours.*"

To find out more you can get a copy of Meave's book

The Sediments of Time: My Lifelong Search for the Past

ISBN: 0358206677 (ISBN13: 9780358206675)

https://www.amazon.co.uk/Sediments-Time-Lifelong-Search-Past/dp/0358206677

Jake Davies (BSc Applied Marine Biology, 2018)

"I recently became the first to person to film the Critically Endangered Angelshark off the UK which was off the Welsh coast.

The footage was shared globally from a range of media outlets and news stories. You can view it here:

https://www.youtube.com/watch?v=jN_1t_Pdlo8

https://www.bbc.co.uk/news/av/uk-wales-58479544

I was again featured on S4C's 'Heno' where I took the presenter, ex-Welsh footballer Owain Tudor Jones, to explore the seagrass meadow in Porthdinllaen:

https://www.youtube.com/watch?v=H9JJe8u0kPM

I was part of the dive team for filming BBC Wales Wonders of the Celtic Deep as well as featured footage in episode 2 and I was also an interview in episode 4 talking about the use of Baited Cameras to study Welsh marine life and the use of social media to explore below the waves."

Jack Walker (MSci Physical Oceanography, 2017)

Jack now works as a Marine Environmental Consultant and reflects on how his time at Bangor helped him achieve this career:

"Studying Physical Oceanography at Bangor really was a great mix of outdoor learning and cutting edge scientific research, with lecturers and staff contributing to the very forefront of research. The facilities the School of Ocean Sciences in Menai Bridge offers are stunning, with a brilliant research institution in a fantastic place on the Menai Straits. Learning in such a unique school really captured my imagination and motivated me on my course.

I now work as a Marine Environmental Consultant for the world's largest sustainability consultancy. This involves impact assessment, site selection and more general research projects in the offshore marine industry including offshore wind, subsea cables, energy exploration and marine transport. I look forward to playing a role in the UK's transition to offshore wind, meeting our renewable targets.

I look back on my time in Bangor and at the School of Ocean Sciences with great fondness, it's only now that I can truly appreciate the skills I developed there that have really set me up to handle the work I do now, I will always look forward to passing through and visiting North Wales."

Sam Hartharn-Evans (BSc Marine Biology and Oceanography, 2018; MSc Physical Oceanography; 2019)

Congratulations to Sam on being awarded a 2021 *Virtual Outstanding Student and PhD candidate Presentation* (vOSPP) Award by the European Geophysical Union.

Sam is now PhD Researcher in Applied Mathematics at Newcastle University and is interested in describing and understanding how sea ice and the oceans interact. Funded by Natural Environment Research Council through the ONE Planet Doctoral Training Programme. His PhD thesis title is 'Internal Solitary Waves in Ice-Covered Waters'.

He is also a founding member of the Youth4Ocean forum promoting a youth voice for ocean literacy.

RESEARCH AND IMPACT HIGHLIGHTS

A Turbulent Ice-Age Ocean

New Research by School of Oceans Sciences **Dr Sophie Wilmes** and **Prof Mattias Green** in collaboration with scientists from Oregon State University has shown that tides and tidal mixing were stronger during the ice age (Last Glacial Maximum).

During the peak of the last ice age, global temperatures were around 6°C colder than at present, and more areas of the Northern Hemisphere continents were covered in large ice sheets. The water for the ice came from the oceans, meaning that sea levels were around 120 m lower. This resulted in much larger tides throughout the Atlantic Ocean.

Scientists have previously proposed that there was less mixing between layers of water, and that this held carbon in a more stagnant deep ocean, keeping it out of the atmosphere. Lower concentrations of atmospheric carbon dioxide, a greenhouse gas, contributed to the chilly climate at this time. However, this hypothesis does not account for changes in the tides. In the present-day ocean, tides create mixing, or 'turbulence' that mixes surface and deep waters and sustains the global deep ocean overturning circulation which, in turn, influences our global climate and weather systems.

The new research has shown that turbulence driven by the tides was increased during the peak of the last ice age, therefore challenging the general consensus of a quieter deep ocean at that time. The researchers compared climate model simulations to carbon isotope data from sediment cores and concluded that stronger tides and more turbulent mixing would have been required to create the data recorded in the sediment.

Dr Sophie Wilmes, an expert in Earth system dynamics at Bangor University and lead author of the study, comments:

"*These results are really exciting as they provide evidence that the tides and tidal mixing were different from present during the Last Glacial Maximum. As tidally driven ocean mixing is one of the main energy sources sustaining the global ocean circulation a key determinate of our climate, this means that studies of past climate must take into account changes in the tides.*"

Reference: Wilmes, S-B., Green, M. & Schmittner, A. (2021).Enhanced vertical mixing in the glacial ocean inferred from sedimentary carbon isotopes. Communications Earth and Environment. 2, 166.

Large Tusks Trump Body Size in Male Hippo Contests

Original research notebooks compiled in the 1960s have provided a vital and rare source of information about the evolutionary biology of the hippopotamus.

Hippos are charismatic species, but remarkably understudied due to their semi-aquatic lifestyle and aggressive behaviour. Identification of individuals is also very challenging.

Detailed measurements originally collected in Uganda by Prof. Richard Laws in the 1960s, have enabled **Dr Graeme Shannon**, **Dr Line Cordes** and colleagues at Bangor University to explore sex differences in body size of this megaherbivore (species weighing in excess of 1000 kg) for the first time.

Despite expecting to find that the data would reflect the general trend within hoofed mammals (ungulates) of males being significantly larger than females, the analysis revealed that the adult male hippos were on average only 5% larger than adult females. This is approximately a 60 Kg difference – which is fairly limited in a species where adults commonly weigh >1500 kg or the size of a family car.

Photo: Graeme Shannon

However, the findings revealed that male hippos had significantly larger weapons (head, jaw and tusk size). Specifically, male hippos had jaws 44% heavier and canines that were almost twice the size of those from adult females, the study revealed.

The evolutionary pressure generated by intense competition for access to breeding females has generally led to larger male body and weapon size in many ungulate species. For example, male African Elephants, also classed as megaherbivores, can weigh twice as much as a fully-grown female. They use their larger body size to assert dominance and intimidate their rivals.

Male hippos however, commonly signal their dominance by yawning and displaying the gape of their jaws and the size of their tusks (occasionally using them to deadly effect). Analysis of the unique dataset, revealing larger head, jaw and tusk size reflected the importance of this display, particularly given that their bodies are usually submerged underwater out of sight.

Dr Line Cordes, a population ecologist in the School of Ocean Sciences who led the data analysis, reveals that: "*On acquiring the notebooks, we immediately realised that they contained a gold mine of detailed information on the biology of this enigmatic species, with all the measurements neatly handwritten and recorded in imperial units*".

Reference: Graeme Shannon, Phoebe Sadler, Joanna Smith, Eleanor Roylance-Casson and Line S. Cordes (2021). Contrasting selection pressure on body and weapon size in a polygynous megaherbivore. Biology Letters, 17(10), 20210368.

Connecting plastic pollution and climate change

A new study by **Helen Ford**, **Nia Jones** and **Dr Gareth Williams** at the School of Ocean Sciences in collaboration with the Zoological Society of London has revealed fundamental links between the global climate crisis and plastic pollution, including extreme weather worsening the distribution of microplastics into pristine and remote areas.

The ocean, its ecosystems and species are commonly the focus of plastic pollution research or climate change research; however, the compounding impact of how they act together is often overlooked.

The study is the first of its kind to collated evidence that the global issues of marine plastic pollution and climate change exacerbate one another, creating a dangerous cycle, implying that the two issues must be tackled in unison.

The team identified three significant ways that the climate crisis and plastic pollution – a significant driver of marine biodiversity loss - are connected, with the first being how plastic contributes to global greenhouse gases (GHGs) throughout its life cycle, from production through to disposal. The second demonstrates how extreme weather, like floods and typhoons associated with climate change will disperse and worsen plastic pollution. With plastic pollution and the effects of climate change being major issues for our ocean, seas, and rivers, the third point examines the marine species and ecosystems that are particularly vulnerable to both.

Plastic pollution is having a devastating impact on marine biodiversity – from individual animals mistakenly ingesting plastic bags to entire habitats polluted with microplastics. Mainly sourced from fossil fuels, and with global demand set to rise, the production of plastic is predicted to emit more than 56 billion Mt of carbon dioxide in GHGs between 2015 – 2020, which is 10 – 13 % of the entire remaining carbon budget.

Climate change is already causing more extreme weather events including storms and flooding which increases the dispersal of mismanaged waste between land and sea. In addition, sea ice is a major trap for microplastics which will be released into the ocean as the ice melts due to warming.

Public awareness and media coverage of both issues has risen exponentially over the years, but studies show that they are often approached as separate, even competing issues. Professor Heather Koldewey, Senior Technical Specialist at ZSL and the senior author on the paper says that integrated solutions to mitigate against both crises are possible and must be considered.

Professor Koldewey said: "*Climate change is undoubtedly one of the most critical global threats of our time. Plastic pollution is also having a global impact; from the top of Mount Everest to the deepest parts of our ocean. Both are having a detrimental effect on ocean biodiversity; with climate change heating ocean temperatures and bleaching coral reefs, to plastic damaging habitats and causing fatalities among marine species. The compounding impact of both crises just exacerbates the problem. It's not a case of debating which issue is most important, it's recognising that the two crises are interconnected and require joint solutions.*"

The study demonstrates how vulnerable species and habitats which are impacted by, and can have an impact on climate change, are also threatened by plastic pollution, such as sea turtles and corals. It says that further research is needed to determine these links, their roles in our natural environment, and how both issues interact to negatively impact ecosystems.

Professor Koldewey added: "*The biggest shift will be moving away from wasteful single-use plastic and from a linear to circular economy that reduces the demand for damaging fossil fuels.*"

Helen Ford, a PhD student at Bangor University who led the study said: "*As coral reefs are the focus of my research, I am reminded daily of how vulnerable these marine ecosystems are to climate change. I have seen how even the most remote coral reefs are experiencing widespread coral death through global warming-caused mass bleaching. Plastic pollution is yet another threat to these stressed ecosystems.*

Our study shows that changes are already occurring from both plastic pollution and climate change that are affecting marine organisms across marine ecosystems and food webs, from the smallest plankton to the largest whale. We need to understand how these threats to ocean life will interact as they build and encourage policy-makers to act to address these global threats."

The recognition that global environmental crises are intrinsically linked is increasing. A recent ZSL-led study which was also co-authored by Professor Koldewey, stressed that both the climate change and biodiversity crises must be tackled in unison to avoid falling short on solutions, and suggests ways in which several Nature-based Solutions could address both.

Ford, H. V., Jones, NH, Davies, A. J., Godley, B. J., Jambeck, J. R., Napper, I. E., Suckling, C. C., Williams, G. J., Woodall, L. & Koldewey, H. J. (2021). The fundamental links between climate change and marine plastic pollution. Science of the Total Environment. 806, Pt 1, 150392.

New Research Shows That Tiny Zooplankton Can Stir Up Turbulent Eddies Leading To Mixing In Lakes

Lakes are usually pictured as tranquil environments, largely uninfluenced by the enormous tidal power which drives the oceans. But the surface winds that act upon lakes can significantly alter the environment in which many lake species thrive – particularly during summer.

Recent research by **John H. Simpson, Iestyn Woolway, Brian Scannell, Martin Austin, Ben Powell** and Stephen Maberly suggests another factor might play a significant role in mixing up a lake's water: the movement of the animals that live in it, including microscopic zooplankton. This sheds light on how even the tiniest of organisms can contribute to the physical processes that make lake and ocean environments so extraordinary.

We already knew winds could induce water movement that extends throughout the full depth of a lake, commonly referred to as the "water column". Mixing between surface and deep waters is essential for maintaining a healthy lake ecosystem.

This mixing drives the exchange of oxygen from the lake surface to the bottom layer, reducing production of the potent greenhouse gas methane in the sediment on the floor of the lake. Mixing can also allow nutrients, which are essential for species like phytoplankton living near the lake's surface, to be transported upwards.

Yet in the most tranquil waters of a lake – near the bed – scientists have for a while suspected that animal life may contribute to lake mixing. By moving their fins, antennae or legs, swimming organisms can generate a variety of movements which combine to form eddies – dynamic circular currents of water – in a process known as "biogenic mixing". Although studies of ocean environments have suggested how this might happen, mainly through lab experiments or using numerical simulations, evidence of this process in lakes is limited.

Our study of Windermere, a large lake in Cumbria's Lake District National Park, found evidence of significant and persistent biogenic mixing in lakes. This suggests that previous studies may have missed a critical mixing process in lake ecosystems, with implications for our understanding of how they respond to environmental change.

To study this phenomenon, we used acoustic Doppler profilers (ADCPs). These instruments send out sound waves which are reflected back by suspended particles, such as zooplankton, in the water column. The wavelength of the returning sound differs from that of the outgoing signal, which allows us to measure the velocity of the water. Once we know the velocity at different positions in the water column, we can estimate the amount of mixing that takes place.

Our Doppler profilers, which were recording both water current velocities and the movement made by organisms swimming through the water column, indicated that mixing produced by swimming organisms is strongest near the bottom of the lake.

The mixing we observed occurred in a regular 24-hour period, which was quietest close to midnight. This suggested that high concentrations of organisms were moving vertically from deep water up towards the lake surface during the hours of darkness, before returning to deeper water before dawn where they stayed during daylight hours. This is known as "Diel vertical migration", and is a characteristic behaviour of zooplankton.

We also detected a smaller mixing process taking place at the thermocline. This is a region within lakes and oceans where warmer surface waters and cooler bottom waters are separated during summer. As the sun heats the lake surface, cooler waters (which are denser) sink to the depths of the lake, resulting in a layered water column of varying temperatures.

The thermocline is somewhat of a haven for aquatic organisms, allowing them access to both the warm well-oxygenated water above and the cool nutrient-rich water below, while also providing a potential escape from predators often present in well-lit surface layers.

Our data indicated that the peak in mixing at the thermocline – around midnight – was the opposite of the peak observed near the lake bed. That's because this region is where many of the upward swimming organisms come from the deeper regions to feed at night.

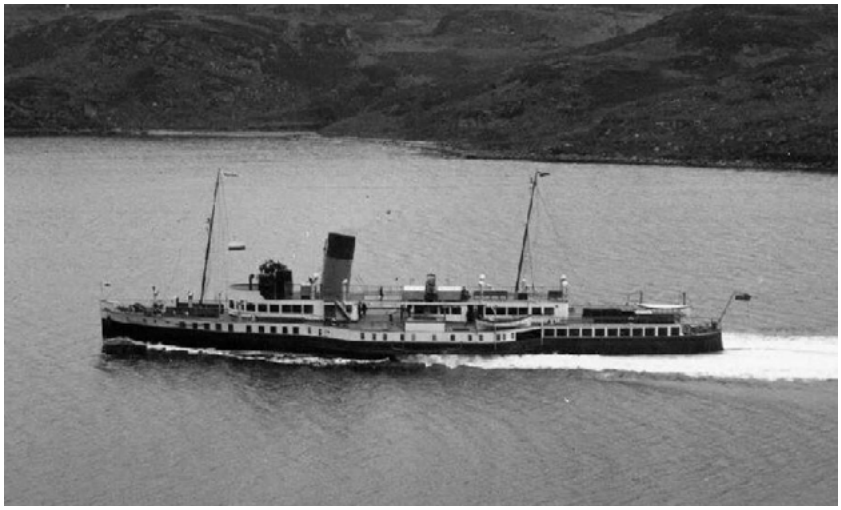
The implications of these findings are yet to be explored in detail. But it looks like understanding mixing processes could help us prevent algal blooms like those currently threatening Lake Windermere from developing, as these can be driven by weak mixing during summer that leaves sewage trapped in layers of the lake.

Reproduced from the Conversation

Reference: Simpson, J.H., Woolway, R. I., Scannell, B., Austin, M., Powell, B. & Maberly, S. C. (2021). The annual cycle of energy input, modal excitation and physical plus biogenic turbulent dissipation in a temperate lake. Water Resources Research, 57(6), 2020WR029441.

Discovery Of The Minesweeper HMS *Mercury*

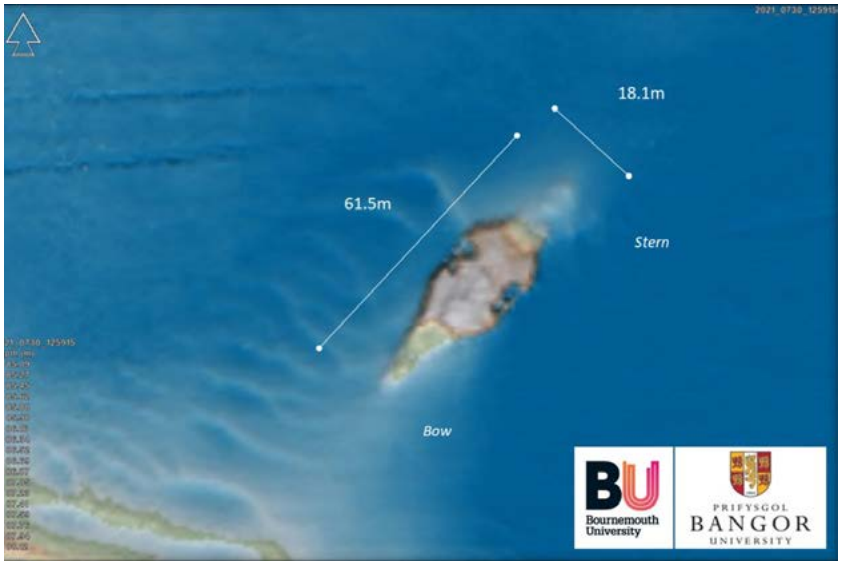
A shipwreck in the middle of the Southern Irish Sea, previously thought to be that of a submarine, has now been identified as the minesweeper, HMS *Mercury*.



The discovery has been made as part of a joint project between Maritime Archaeologists at Bournemouth University and scientists at Bangor University's School of Ocean Sciences, who have been combining marine archives with high-resolution multibeam sonar data to try and identify many of the unknown wreck sites located off our coast.

Originally built as a Clyde-based ferry, HMS *Mercury* was requisitioned by the Admiralty in 1939 to serve as minesweeper. It sank in 1940 after being damaged by a mine that it was attempting to clear and was reported lost off Southern Ireland.

Commenting, **Dr Michael Roberts** of the School of Ocean Sciences, who led the multibeam surveys, said:



"*Having access to our research vessel Prince Madog and use of one of the most advanced multibeam sonar systems available has enabled us to very efficiently and accurately survey almost every wreck site in the central Irish Sea. Obtaining high-resolution sonar data from all these sites has been crucial to the research process and we hope this work and collaboration with Bournemouth demonstrates the importance of having these valuable assets available to us here at Bangor. These sunken vessels represent the sacrifices and efforts of citizens who were the 'key' and 'essential' workers of their time and it's important that the final resting place of the vessels they were associated with are identified before it's too late. We hope to secure additional funding to expand on this work and examine wrecks in other UK coastal regions before their remnants become unidentifiable due to degradation through natural marine processes.*"

All Coral Reefs in the Western Indian Ocean At High Risk of Collapse Within 50 Years

A new assessment of the coral reefs of the Western Indian Ocean shows that they are all at high risk of collapse within the next five decades. Ocean warming and overfishing were identified as the main threats.

The new study by an international team of authors including Ocean Science's Ronan Roche was published in the Nature Sustainability. In the study the coral reefs of ten countries in the Western Indian Ocean were split into 11 sub-regions, and assessed using the criteria of the IUCN Red List of Ecosystems, a framework developed by the International Union for Conservation of Nature (IUCN) to assess how close ecosystems are to collapse. Reefs in all sub-regions were found to be at high risk of complete ecosystem collapse and irreversible damage.

"*We've known for some time that coral reefs are in decline, but now we know more precisely to what degree, and why,*" said lead author Dr David Obura, Founding Director at Coastal Oceans Research and Development in the Indian Ocean (CORDIO East Africa) and Chair of the IUCN SSC Corals Specialist Group. "*This assessment reaffirms the urgency of the interlinked climate and biodiversity crises addressed by COP26 last month in Glasgow, and COP15 in a few months in Kunming. We need to take decisive action to address both global threats to corals from climate change, and local ones, such as overfishing.*"

Ronan Roche, a research fellow at Bangor University's Centre for Applied Marine Sciences, a co-author, analysed fish abundance *data within the Red List of Ecosystems framework. Dr Roche said: "This research provides a strong basis for management action to reduce coral reef vulnerability across the Western Indian Ocean, by integrating long-term ecological datasets in an accessible framework."*

The study authors analysed data ranging as far back as 35 years as well as sea surface temperature projections 50 years into the future. Their study area included the east coast of continental Africa from Kenya to South Africa and east to the island states of Seychelles and Mauritius. In total, it comprised around 5% of the world's coral reefs. The work was led by researchers from CORDIO East Africa and involved contributions from researchers across nine Western Indian Ocean countries and from more than 35 institutions.

Paper: Obura, D., Gudka, M., Samoilys, M. et al. (2021). Vulnerability to collapse of coral reef ecosystems in the Western Indian Ocean. Nature Sustainability, https://doi.org/10.1038/s41893-021-00817-0

PUBLICATIONS
(July - December 2021)

Ontogeny of osmoregulation of the Asian shore crab Hemigrapsus sanguineus at an invaded site of Europe
Torres, G., Charmantier, G. & Gimenez Noya, L., 2 Dec 2021, In : Conservation physiology.

Combined control of bottom and turbidity currents on the origin and evolution of channel systems, examples from the Porcupine Seabight.
Verweirder, L., Van Rooij, D., White, M., Van Landeghem, K., Bossée, K. & Georgiopoulou, A., 1 Dec 2021, In : Marine Geology. 442, 106639.

Protection outcomes for fish trophic groups across a range of management regimes
Osuka, K. E., Stewart, B. D., Samoilys, M. A., Roche, R., Turner, J. & McClean, C., 1 Dec 2021, In : Marine Pollution Bulletin. 173 , Part A, 113010.

Genetic diversity and relatedness in aquaculture and marina populations of the invasive tunicate Didemnum vexillum in the British Isles.
Prentice, M. B., Vye, S., Jenkins, S., Shaw, P. W. & Ironside, J. E., Dec 2021, In : Biological Invasions. 23, 12, p. 3613-3624

Wave exposure shapes reef community composition and recovery trajectories at a remote coral atoll
Lange, I. D., Benkwitt, C. E., McDevitt-Irwin, J. M., Tietjen, K. L., Taylor, B., Chinkin, M., Gunn, R. L., Palmisciano, M., Steyaert, M., Wilson, B., East, H. K., Turner, J., Graham, N. A. J. & Perry, C. T., Dec 2021, In : Coral Reefs. 40, 6, p. 1819-1829 11 p.

A review of the UK and British Channel Islands practical tidal stream energy resource
Coles, D., Angeloudis, A., Greaves, D., Hastie, G., Lewis, M., Mackie, L., McNaughton, J., Miles, J., Neill, S., Piggott, M., Risch, D., Scott, B., Sparling, C., Stallard, T., Thies, P., Walker, S., White, D., Willden, R. & Williamson, B. J., 24 Nov 2021, In : Proceedings of the Royal Society A . 477, 2255, 20210469.

Current- and Wave-Generated Bedforms on Mixed Sand–Clay Intertidal Flats: A New Bedform Phase Diagram and Implications for Bed Roughness and Preservation Potential
Baas, J., Malarkey, J., Lichtman, I. D., Amoudry, L. O., Thorne, P., Hope, J. A., Peakall, J., Paterson, D. M., Bass, S., Cooke, R. D., Manning, A. J., Parsons, D. & Ye, L., 3 Nov 2021, In : Frontiers Earth Science. 9, 747567.

A new seabed mobility index for the Irish Sea: Modelling seabed shear stress and classifying sediment mobilisation to help predict erosion, deposition, and sediment distribution.
Coughlan, M., Guerrini, M., Creane, S., O'Shea, M., Ward, S., Van Landeghem, K., Murphy, J. & Doherty, P., 1 Nov 2021, In : Continental Shelf Research. 229, 104574.

Coastal sand dunes: storms and (over-)stabilisation
Austin, M. & Walker-Springett, G., 1 Nov 2021, Geography Review, 35, 2, p. 8-13 6 p.

A review of tidal energy - Resource, feedbacks, and environmental interactions
Neill, S., Haas, K., Thiebot, J. & Yang, Z., Nov 2021, In : Journal of Renewable and Sustainable Energy. 13, 6, 17 p., 062702.

Unravelling facilitation among introduced species, a mechanistic approach
Pereyra, P. J., de la Barra, P., Saad, J. F., Gastaldi, M., Arcángel, A. E., Rodríguez, E. A., González, R. & Narvarte, M., Nov 2021, In : Biological Invasions. 23, 11, p. 3483-3496 14 p.

Using bio-physical modelling and population genetics for conservation and management of an exploited species, Pecten maximus L.
Hold, N., Robins, P., Szostek, C., Lambert, G., Lincoln, H., Le Vay, L., Bell, E. & Kaiser, M., Nov 2021, In : Fisheries Oceanography. 30, 6, p. 740-756 17 p.

Contrasting selection pressure on body and weapon size in a polygynous megaherbivore
Shannon, G., Sadler, P., Smith, J., Roylance-Casson, E. & Cordes, L., 31 Oct 2021, In : Biology Letters. 17, 10

Contrasting offspring responses to variation in salinity and temperature among populations of a coastal crab: A maladaptive ecological surprise?
Šargač, Z., Gimenez, L., Harzsch, S., Krieger, J., Fjordside, K. & Torres, G., 28 Oct 2021, In : Marine Ecology Progress Series. 677, p. 51-65 15 p.

Salinity Gradient Power
Withers, T. & Neill, S., 20 Oct 2021, Earth Systems and Environmental Sciences. 2nd ed. Elsevier Press

Saltmarsh resilience to periodic shifts in tidal channels
Ladd, C. J. T., Duggan Edwards, M., Pages, J. F. & Skov, M., 20 Oct 2021, In : Frontiers in Marine Science. 8, 13 p., 757715.

Quantification of blue carbon pathways contributing to negative feedback on climate change following glacier retreat in West Antarctic fjords
Zwerschke, N., Sands, C. J., Roman-Gonzalez, A., Barnes, D. K. A., Guzzi, A., Jenkins, S., Muñoz-Ramírez, C. & Scourse, J., 17 Oct 2021, In : Global Change Biology. 1 p.

Temporal and spatial infection patterns of the rhizocephalan parasite Parasacculina leptodiae (Guérin-Ganivet, 1911) in the crab Leptodius exaratus along the shores of Kuwait
Al-Wazzan, Z., Waser, A. M., Glenner, H., Gimenez Noya, L. & Thieltges, D. W., 14 Oct 2021, () In : Marine Biodiversity.

Sole marks reveal deep-marine depositional process and environment: implications for flow transformation and hybrid event bed models
Baas, J., Tracey, N. D. & Peakall, J., 4 Oct 2021, In : Journal of Sedimentary Research. 91, 9, p. 986–1009

Bayesian network modelling provides spatial and temporal understanding of ecosystem dynamics within shallow shelf seas
Trifonova, N., Scott, B., De Dominicis, M., Waggitt, J. & Wolf, J., 1 Oct 2021, In : Ecological Indicators. 129, 107997, 107997.

Boom not bust: Cooperative management as a mechanism for improving the commercial efficiency and environmental outcomes of regional scallop fisheries
Bloor, I., Duncan, P. F., Dignan, S., Emmerson, J., Beard, D., Gell, F. R., McHarg, K. & Kaiser, M. J., 1 Oct 2021, In : Marine Policy. 132, 104649.

Measurement and prediction of bottom boundary layer hydrodynamics under modulated oscillatory flows
O'Donoghue, T., Davies, A. G., Bhawanin, M. & Van Der A, D. A., 1 Oct 2021, In : Coastal Engineering. 169, 103954, 19 p., 103954.

Vulnerability of Temperate Mesophotic Ecosystems (TMEs) to environmental impacts: Rapid ecosystem changes at Lough Hyne Marine Nature Reserve, Ireland
Micaroni, V., McAllen, R., Turner, J., Strano, F., Morrow, C., Picton, B., Harman, L. & Bell, J. J., 1 Oct 2021, In : Science of the Total Environment. 789, 147708.

A state-space approach to understand responses of organisms, populations and communities to multiple environmental drivers
Gimenez Noya, L., Chaterjee, A. & Torres, G., 30 Sep 2021, In : Communications Biology. 4, 1142.

Stacking Ensemble Learning in Deep Domain Adaptation for Ophthalmic Image Classification
Madadi, Y., Seydi, V., Sun, J., Chaum, E. & Yousefi2, S., 27 Sep 2021.

Biogeochemical consequences of a changing Arctic shelf seafloor ecosystem
Marz, C., Freitas, F., Faust, J., Godbold, J., Henley, S., Tessin, A., Arndt, S., Barnes, D., Grange, L., Gray, N., Head, I., Hendry, K., Hilton, R., Reed, A., Rhul, S., Solan, M., Souster, T., Stevenson, M., Tait, K. & Widdicombe, S., 22 Sep 2021, () In : AMBIO.

Multiyear trend in reproduction underpins interannual variation in gametogenic development of an Antarctic urchin.
De Leij, R., Peck, L. S. & Grange, L., 22 Sep 2021, In : Scientific Reports. 11, 1, 18868.

The fundamental links between climate change and marine plastic pollution
Ford, H. V., Davies, A. J., Godley, B. J., Jambeck, J. R., Napper, I. E., Suckling, C. C., Williams, G. J., Woodall, L. & Koldewey, H. J., 17 Sep 2021, In : Science of the Total Environment. 806, Pt 1, 150392.

Long-term Earth-Moon evolution with high-level orbit and ocean tide models
Daher, H., Arbic, B. K., Williams, J. G., Ansong, J. K., Boggs, D. H., Müller, M., Schindelegger, M., Adcroft, A. J., Austermann, J., Cornuelle, B. D., Crawford, E. B., Fringer, O. B., Lau, H., Lock, S. J., Maloof, A. C., Menemenlis, D., Mitrovica, J. X., Green, M. & Huber, M., 15 Sep 2021, In : Journal of Geophysical Research: Planets.

Tracing the fate of wastewater viruses reveals catchment-scale virome diversity and connectivity
Adriaenssens, E. M., Farkas, K., McDonald, J. E., Jones, D. L., Allison, H. E. & McCarthy, A. J., 15 Sep 2021, In : Water Research. 203

Ocean Renewable Energy Test Centers
Marti, V., Culina, J. & Neill, S., 9 Sep 2021, Earth Systems and Environmental Sciences. 2nd ed.

Noisy waters can influence young-of-year lobsters' substrate choice and their antipredatory responses
Leiva, L., Scholz, S., Giménez, L., Boersma, M., Torres, G., Krone, R. & Tremblay, N., 7 Sep 2021, In : Environmental Pollution. 291, 1 p., 118108.

Medium-term variability of the UK's combined tidal energy resource for a net-zero carbon grid
Todeschini, G., Coles, D., Lewis, M., Popov, I., Angeloudis, A., Fairley, I., Johnson, F., Williams, A. J., Robins, P. & Masters, I., 6 Sep 2021, In : Energy. 238, 121990.

Marine artificial light at night: An empirical and technical guide
Tidau, S., Smyth, T., McKee, D., Wiedenmann, J., D'Angelo, C., Wilcockson, D., Ellison, A., Grimmer, A., Jenkins, S., Widdicombe, S., de Moura Queiros, A., Talbot, E., Wright, A. & Davies, T., Sep 2021, In : Methods in Ecology and Evolution. 12, 9, p. 1588-1601

Precision and cost-effectiveness of bioindicators to estimate nutrient regimes on coral reefs
Vaughan, E. J., Wynn, P. M., Wilson, S. K., Williams, G. J., Barker, P. A. & Graham, N. A. J., Sep 2021, In : Marine Pollution Bulletin. 170, 112606.

Enhanced vertical mixing in the glacial ocean inferred from sedimentary carbon isotopes
Wilmes, S-B., Green, M. & Schmittner, A., 18 Aug 2021, In : Communications Earth and Environment. 2, 166.

Intermediate ice scour disturbance is key to maintaining a peak in biodiversity within the shallows of the Western Antarctic Peninsula
Robinson, B., Barnes, D., Grange, L. & Morley, S., 18 Aug 2021, In : Scientific Reports. 11, 1, 16712.

Middle Ordovician Upwelling-Related Ironstone of North Wales: Coated Grains, Ocean Chemistry, and Biological Evolution
Dunn, S. K., Pufahl, P. K., Murphy, J. B. & Lokier, S., 18 Aug 2021, In : Frontiers Earth Science. 9

Compound flooding: Dependence at sub-daily scales between extreme storm surge and fluvial flow
Robins, P., Lewis, M., Elnahrawi, M., Lyddon, C., Dickson, N. & Coulthard, T., 16 Aug 2021, In : Frontiers. 7, 727294.

Sustainable fishing can lead to improvements in marine ecosystem status: an ensemble-model forecast of the North Sea ecosystem
Spence, M., Griffiths, C., Waggitt, J., Bannister, H., Thorpe, R., Rossberg, A. & Lynam, C., 14 Aug 2021, () In : Marine Ecology Progress Series.

Global riverine theoretical hydrokinetic resource assessment
Ridgill, M., Neill, S., Lewis, M., Robins, P. & Patil, S., 1 Aug 2021, In : Renewable Energy. 174, p. 654-665

Multi-scale assessment of distribution and density of procellariiform seabirds within the Northern Antarctic Peninsula marine ecosystem
Warwick-Evans, V., Santora, J., Waggitt, J. & Trathan, P., 1 Aug 2021, In : ICES Journal of Marine Science. 78, 4, p. 1324-1339

Coral reef resilience differs among islands within the Gulf of Mannar, southeast India following successive coral bleaching events
Diraviya Raj, K., Aeby, G., Mathews, G., Williams, G. J., Caldwell, J., Laju, R. L., Selva Bharath, M., Dinesh Kumar, P., Arasamuthu, A., Gladwin Gnana Asir, N., Wedding, L., Davies, A., Moritsch, M. & Patterson Edward, J. K., Aug 2021, In : Coral Reefs. 40, 4, p. 1029-1044

Quantifying upwelling in tropical shallow waters: a novel method using a temperature stratification index
Guillaume-Castel, R., Williams, G. J., Rogers, J. S., Gove, J. M. & Green, M., Aug 2021, In : Limnology and Oceanography: Methods. 19, 8, p. 566-577 10499.

Shelf Seas Baroclinic Energy Loss: Pycnocline Mixing and Bottom Boundary Layer Dissipation
Inall, M. E., Toberman, M., Polton, J., Palmer, M. R., Green, M. & Rippeth, T., Aug 2021, In : Journal of Geophysical Research: Oceans. 126, 8, e2020JC016528.

Shell growth and age determined from annual lines in the southern warm-water limpet Patella depressa at its poleward geographic boundaries
Orostica Vega, M., Richardson, C., Estrella Martinez, J., Jenkins, S. & Hawkins, S. J., 30 Jul 2021, In : Journal of the Marine Biological Association of the United Kingdom. 101, 4, p. 707-716