AUTUMN
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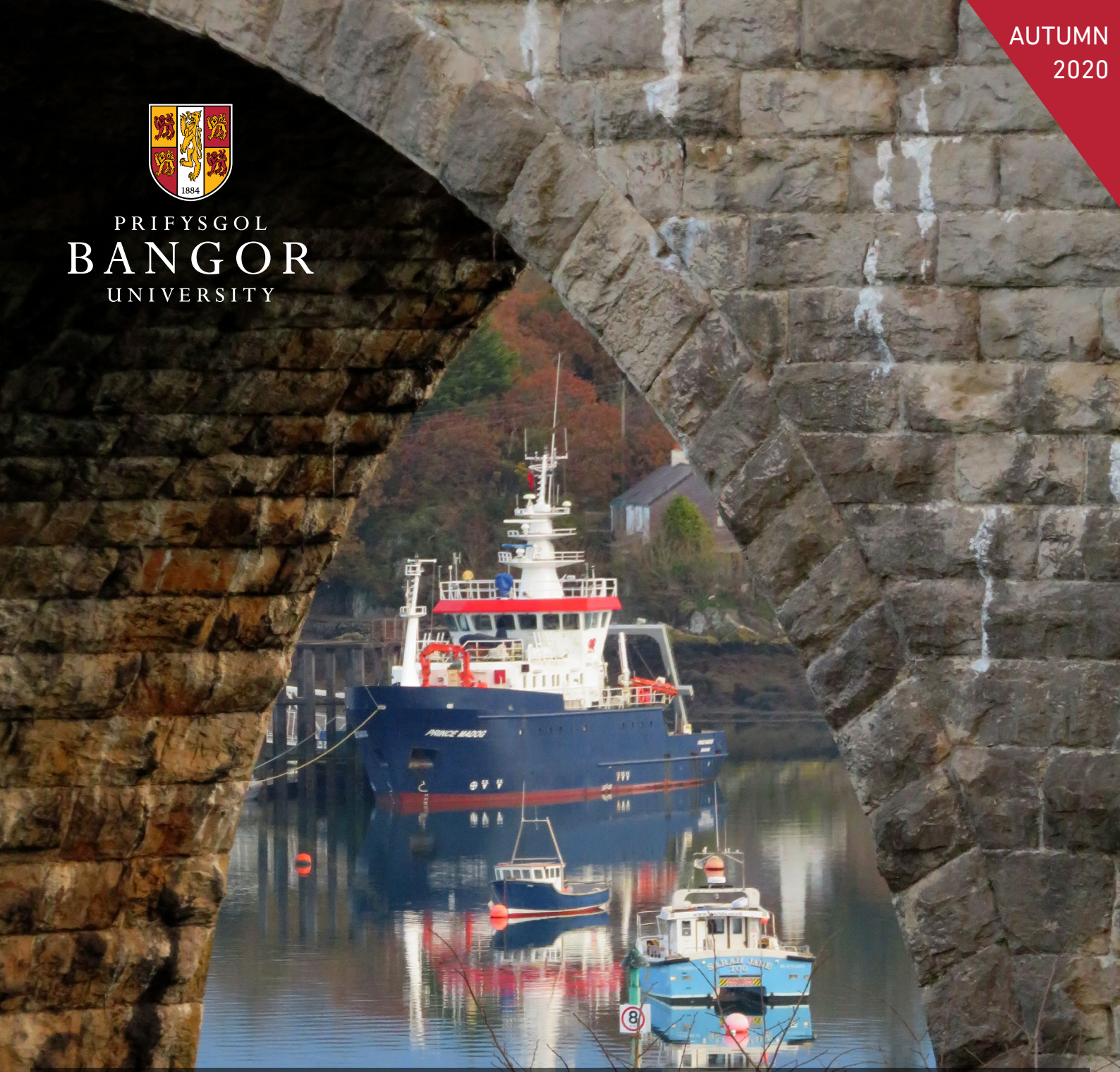

THE BRIDGE

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

THE BRIDGE
Autumn 2020

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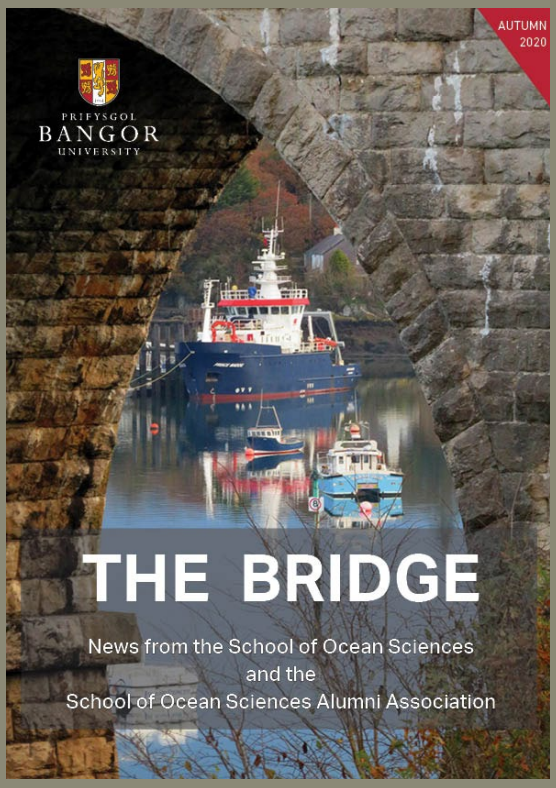

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Please send your School of Ocean Sciences news to:
l.haggett@bangor.ac.uk

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

This, and previous editions of *The Bridge* can be read online here.

TEF Gold
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2020/21 OPEN DAYS

Our next virtual open day is on 6th December, join us:
https://www.bangor.ac.uk/openday

INTRODUCTION

Welcome to this autumn's edition of *The Bridge*. As the COVID pandemic rolls on we have all had to change the way we are working. In ensuring the safety of our students and staff, we are striving to give our students the best experience of marine sciences possible in the circumstances. At the same time, we are also working hard on the national effort to beat this virus.

Whilst our working patterns might have changed the school continues to grow, with a record intake of undergraduate students this September together with a growth in postgraduate numbers. We are also pleased to report that these increases have happened alongside increasing levels of student satisfaction, as recorded by the National Student Survey.

In this edition of *The Bridge* we bring you updates on school news as well as news from our alumni. We are delighted to once again share and celebrate in the successes of our alumni and as you will see in the letter overleaf from School of Ocean Sciences Alumni Society's chair, Mick Cook, we hope to encourage our alumni to become more involved in helping shape the future careers of our current students.

Finally, whilst we fight the virus, we also face climate change and threats to the sustainability of our oceans. At the end of the newsletter we focus on highlights of the world leading SOS research within these areas published over the past 6 months.

Stay safe and I hope you enjoy this edition of *The Bridge*.

Best Wishes,

Tom Rippeth, Editor

ALUMNI CHAIR'S MESSAGE

"It seems like only yesterday that I wrote my last letter for *The Bridge* but what a lot has or has not happened since. We now have a good idea of the impact that COVID-19 has had and we do have some inkling about the impact it will have in the future. Further, here in the UK, Brexit looms."

"But no-one really knows what the future holds. Personally, I am not too phased by uncertainty and change but I know a lot of people are. I therefore hope you are all well and not struggling to badly with these issues. So, that is my last mention of the C or B word.

With everything that is happening in the world, the Alumni Association has taken a bit of a back seat over the past year or so. That said, I did take the opportunity to spend a few hours with the 'new' Head of School, John Turner, in early September when my wife, Christine, and I visited North Wales for a week. John and I had a very positive conversation about how the Alumni Association and The School of Ocean Sciences can collaborate in the future to support the School and aid its development. (You can read more about this under *Career Opportunities* a few pages further on.)

On a personal front, our visit to North Wales (something we have done annually for many years) was a momentous occasion in that Christine and I celebrated our 40th wedding anniversary with a meal at Harry's Bistro (a favourite of ours) at Henllys near Beaumaris. You may or may not know that we met in the coffee room at the School of Ocean Sciences (or Marine Sciences Laboratory as it was called then) in 1978. I had just begun my MSc in marine geophysics, geotechnics and oceanography. Christine was working as a Research Assistant for Dr Peter Spencer, having graduated from Bangor University in Marine Biology and Biochemistry in 1976. And the rest is history. Not only did I gain an MSc which led directly to a very fulfilling career in marine science but more importantly I gained a wife and a best friend with whom I have enjoyed the past 40+ years together.

Since semi-retiring in 2008, I have had held many positions and fulfilled many roles in a part-time capacity. One of the voluntary roles I hold is that of Council Member and Treasurer of the Society for Underwater Technology (SUT) – a multidisciplinary, international, learned Society with charitable status that brings together organisations and individuals with a common interest in underwater technology, ocean science and offshore engineering. At the heart of the SUT is a suite of Special Interest Groups (SIGs); one of which is the Offshore Site Investigation and Geotechnics (OSIG) which was formed 40+ years ago and comprises many Bangor SOS alumni including myself and Dei Huws, Senior Lecturer in Ocean Sciences at the SOS.

With the increasing importance of the environment in a burgeoning offshore development sector, we are in the process of setting up a Marine Environmental Science SIG. Should any staff, students or alumni be interested in joining this special interest group then please do not hesitate to contact me at mick@mickcook.com The intention is to hold an inaugural on-line meeting shortly where the remit of the SIG will be discussed. Early involvement will enable you to shape the group to the mutual benefit of its members.

Stay safe and keep well."

Mick Cook

Chairman – School of Ocean Sciences Alumni Association

FIGHTING THE COVID CRISIS

COVID has presented many challenges in the way we do things to ensure safety and social distancing.

To achieve this staff at the School of Ocean Sciences worked over the summer to develop a blended learning approach. Whilst lectures and tutorials have largely been moved online, we were determined that small group practical and fieldwork sessions should still take place where possible.

Students in the School of Ocean Sciences are experiencing small group, in-person practical sessions. All activities have been risk assessed and employ Covid-secure measures, including wearing face coverings, practicing good hand hygiene, and observing social distancing. These experiences are being replicated in the form of "virtual" laboratory sessions, which take the form of online resources that comprise a mixture of video, imagery, and text media, where students not able to attend on-campus sessions can still develop their skills and understanding in the absence of hands-on experience.

"*I took part in the practical at the School of Ocean Sciences. I was incredibly impressed at how organised the university had been to ensure we could be COVID safe and feel comfortable in our learning environment. It was fascinating to see the living organisms under the microscope, I found them so interesting and knew that I had chosen the correct degree. The experiment itself allowed me to learn to use a dissection microscope. Furthermore, I found the online resources incredibly useful as I was able to pause and look more closely at the structure of the organisms after I had left the lab.*" First year SOS student.

In addition, the School is using active digital design in their module Virtual Learning Experience to enhance students' online experience and the organisation of module content, using icons to visually signpost students to assessments and different modes of teaching delivery.

"All of these activities combined provide a holistic learning experience for all students, which takes into consideration their individual needs, their personal situation in relation to Covid, and their learning preferences."

Dr Laura Grange.

And a message from the Head of School

Staff in the School of Ocean Sciences have, since July, been doing a terrific job converting our teaching provision to one of 'blended learning'. This has mostly involved recording shorter, more focused lectures available from anywhere at any time through the Blackboard Ultra web based learning environment, and these are then accompanied by online tutorials, discussions and live group exercises during timetabled sessions.

Where possible, we have provided live interaction, and as Dr Laura Grange has explained, socially distanced practicals and fieldwork. Undertaking this work has been an enormous effort across the board from technical, administrative and academic staff, and I would like to thank all staff for their professional commitment and dedication getting to grips with new technologies and providing excellent materials for our students.

Although students have their preferences for different types of delivery, their feedback shows that this effort is recognised, and they are learning to study in new ways, which will continue to develop in Semester 2.

We all look forward to being back on campus, but there is little doubt that we will build on our new experiences to provide a modern, diverse, accessible teaching environment for the future.

So thank you all.'

Professor John Turner,
Head of School.

Sewage signals early warning of coronavirus outbreaks

A Bangor University led Welsh Government funded project, together with UK government-led project involving the School of Ocean Sciences and School of Natural Sciences, is successfully detecting traces of coronavirus in sewerage, providing an early warning for local outbreaks across the country and, as winter approaches, will share data with NHS Test and Trace.

The programmes are based on research pioneered at Bangor University and have now proven that fragments of genetic material from the virus can be detected in wastewater. This can then indicate where a local community or an institution is experiencing a spike in cases.

The results can provide local health professionals with a clearer picture of infection rates by identifying where there are high numbers, particularly for asymptomatic carriers and before people start showing symptoms. This will allow local authorities to take early action to slow the spread of the virus.

The data shared with NHS Test and Trace will be used to inform where new outbreaks may be happening as Influenza starts to increase in the Winter months. It means that public health professionals can speak directly to institutions where there may be spikes in infection. Those institutions can in turn can encourage people to get tested or take extra precautions.

At a UK level the project has already worked successfully in an area in the North West of England, where sewage sampling data showed a spike in coronavirus material despite relatively low numbers of people seeking tests. Testing has now been rolled out across more than 90 wastewater treatment sites in the UK, covering approximately 22% of the population in England, with plans to expand in the future.

In parallel, in Wales a pilot programme has been funded for an initial six months, where sampling began in the summer at a small number of water treatment plants, and is rapidly being expanded up to 20 treatment plants that cover approximately 75% of the Welsh population.

UK Environment Secretary George Eustice said: "*This is a significant step forward in giving us a clearer idea of infection rates both nationally and locally, particularly in areas where there may be large numbers of people who aren't showing any symptoms and therefore aren't seeking tests.*"

Professor Davey Jones, Professor of Soil & Environmental Science at Bangor University, said: "*We have been monitoring viruses like Norovirus and Hepatitis in human sewage for the last decade, as part of a programme to evaluate levels of these viruses in the community. We added COVID-19 to the surveillance list in March this year. "*

"*We showed that viral levels in wastewater mapped really well onto the success of lockdown measures in the first COVID-19 wave and to the emergence of the second wave. We are now using it to track the emergence and control of COVID-19 cases and working on new pilots to map the virus at both the local and the regional scale.*"

Dr Shelagh Malham of the School of Ocean Sciences added that "*Though increased monitoring we aim to not only detect COVID-19 in sewage but to start to survey for other pathogenic viruses such as influenza and Norovirus during the critical winter months. Going forward the legacy of wastewater surveillance could be understanding more the epidemiology of harmful bacteria and viruses circulating in the human population with targeted intervention where required. This would also lead to early detection of emerging pathogens*"

STEVE BACKSHALL'S FIRST LECTURE AT BANGOR

TV presenter and explorer, Steve Backshall, gave his first lecture as part of Bangor University's teaching team in October 2020.

The wildlife expert known for TV programmes such as Deadly 60, Expedition and Blue Planet Live shared his experiences with students from the School of Natural Sciences and the School of Ocean Science.

Due to Covid restrictions and being in quarantine after his latest expedition to Russia the lecture was delivered online, but the explorer emphasised more than once his desire to deliver lectures on campus as soon as restrictions are eased.

During the lecture, Steve explained more about his 20-plus years in wildlife and conservation media, and provided an insight into the lessons he'd learnt along the way as well as talking through behind-the-scenes footage of his many expeditions to places such as Bhutan, Borneo and Alaska.

Steve said, "*As a child, I remember being crushed that everything had already been explored. Turns out I was wrong - there are far flung places that haven't been explored. I would love to think that it would be one of you that would take over the mantle and be the next ones to explore these amazing places. I don't have many regrets, but not studying in Bangor is one of them and every time I come up to your place I think: what a wonderful place to study wildlife!*"

After the lecture, Steve answered all kinds of questions from students, from how to pursue a career in filming wildlife documentaries to advice on funding research and the media's power to affect change on issues such as deforestation and climate change.

Speaking after the lecture, Toby Carter, Environmental Conservation student said, "*It's a pretty big deal to have someone with Steve Backshall's credentials in working on wildlife programmes with broadcasters like the BBC, SKY and PSB come and speak directly to us, and offer really practical advice on pursuing careers in our chosen field. It's really inspiring and I'm looking forward to the next one, which is specifically on the nitty-gritty of careers in wildlife and conservation already!*"

Stevie Scanlan of the College of Environmental Sciences and Engineering added, "*What came through very strongly was Steve's passion for what he does, and the sense of camaraderie and friendship formed with the people he works with. I'm sure the way he described the experience of exploring the wild and witnessing something extraordinary that is still pristine will inspire many starting on their careers in environmental sciences.*"

Interested in studying natural sciences at Bangor?
Find out more here:

https://www.bangor.ac.uk/natural-sciences/index.php.en

CAREER OPPORTUNITIES

Developing career opportunities for Ocean Science students – your participation will make the difference.

Pre-COVID careers fair, our next one will probably be online.

The school has a strong tradition of both supporting student career development and of fulfilling the needs of the marine related industries. To this end we are currently developing a series of online talks from our alumni to help current students develop and assess their future career options.

Please contact us if you are willing to deliver such an online seminar (typically 30 minutes long, allowing for a Questions and Answer session afterwards). With the likely COVID-19 restrictions, our always well-attended annual careers fair in March will need to go online. We are looking for volunteers to talk about career opportunities with their companies, and/or their own career pathway. We seek to use pre-recorded short videos and live interactions online on March 10th.

We are also developing an "External Expert Board (EEB)". An important aim of the board will be to identify any gaps between graduate skills and what employers require, and to support the school in closing these gaps in our curriculum. The External Expert Board will also facilitate knowledge exchange and a strategic discussion between EEB members, academic staff and current students. By providing a direct line of sight between student experience and student career goals, we will improve student focus and consequent employment opportunities. The external board members will also benefit via raised awareness of their collaboration with the academic sector and networking opportunities with other institutions and companies. They will have the ability to influence graduate outcomes with relevant skills sets and work with students to undertake research projects of mutual interests.

And finally, we request your help to identify potential student placements of a duration between one month and one year.

If you can identify student placements, give a careers seminar, participate in the online careers fair or the External Expert Board, please contact Dr Katrien Van Landeghem (k.v.landeghem@bangor.ac.uk).

IN CONVERSATION - CARADOG (CRAG) JONES

(Marine Biology and Oceanography, 1995)

Everest summit

Always travel light

Rhwng Môr a Mynydd - Caradoc "Crag" Jones - Between the Mountains and the Sea

25 years ago, in 1995, Bangor University graduate Caradoc "Crag" Jones became the first Welsh mountaineer to reach the summit of Everest.

Originally from Pontrhydfendigaid in Ceredigion, Crag came to Bangor to study Marine Biology and Oceanography. During this time he was president of the UCNW (Bangor University) mountaineering club.

This year Crag was awarded the 2020 Morag Husband Campbell Medal for 'his contributions to fisheries management and scientific studies, and for championing adventure travel, exploration and mountaineering on South Georgia.'

We are delighted to be able to catch up with him about his varied career since graduating from Bangor.

Looking back on your past 40 years of adventures and work in fisheries science, Bangor University was clearly the right choice. At the time what made you choose Bangor? And who at Bangor inspired you moving forward?

I had a deferred unconditional offer to study ergonomics at Loughborough. However, In the intervening year my enthusiasm for climbing was rekindled. I had always

Hercules drop zone – fresh produce and mail was air-dropped.

Leaving Starbuck – after our successful first ascent in 2016.

been interested in earth and biological sciences. My brother-in-law was studying Oceanography at Bangor. Looking through his books and realizing I could combine it with the climbing on the doorstep it coalesced into a no-brainer. Four years with the sparkling mountains and coast of Snowdonia or the grey flat horizons of the Midlands? I could study and climb without the 200 mile weekend hitch-hikes that had plagued my teenage years in order to climb!

There was the slight technical problem of having no maths or chemistry and poor grades. This was creatively circumvented by the offer of an extra introductory year to get up to speed in these areas. Sinclair Buchan being such a nice guy in the interview clinched it. I never did master his specialist field of sediment mechanics which I always felt bad about! I did love sedimentology though and Colin Jago was inspiring. Following graduation in 1982 I went straight on to start a PhD in sedimentology at St Andrews. This was exchanged for a job in London as a plaster's labourer which is not a career move I would recommend. I kidded myself I was doing it to become a full time climber. In reality my heart was breaking trying to salvage a relationship that had become doomed entirely as a result of my abominable behaviour.

So you headed abroad, to Africa and then Peru and then on to the Falklands. What was the draw of the south?

First there was lots of plaster to be mixed, wounds to be healed and endless climbing weekends to every corner of Britain including Scotland in the winter. I teamed up with Mick Fowler to complete a new ice route up Kilimanjaro during his three week annual holiday. I realized I would never be so free so stayed on in Africa for six months. This included making the first solo ascent of the Diamond Couloir to the summit of Mt Kenya before hitching down across Africa to Namibia, then Cape Town.

After a good Alpine Season in 1985 I left with my girlfriend for the Andes. Climbed

Nordenskjold – a fur seal in front of South Georgia's second highest summit which we made the first ascent of in 2011.

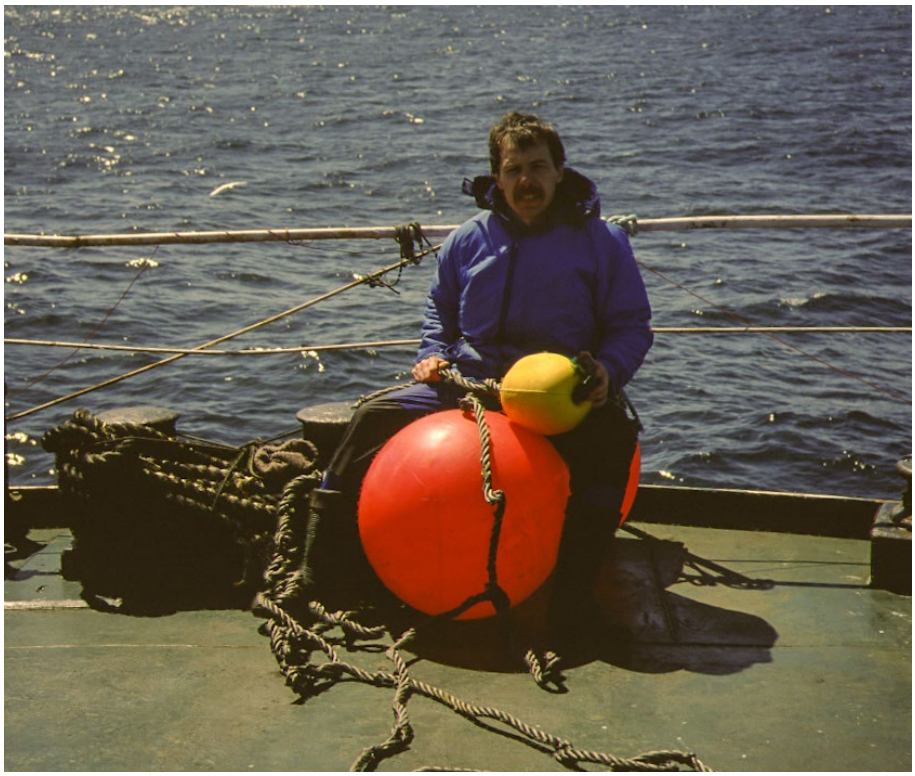
Stationed with the military garrison in 1990

a fair bit there, then ended up working as a reporter for the Lima Times which brought me back to the sea. The work included a 3-part series on Peruvian Fisheries including time at sea with their research institute. We eventually ended up in southern Chile. Naturally I thought I'd nip over to the Falklands to see an Islander, **John Barton**, who was a friend and contemporary from Marine Biology and Oceanography at Bangor. The whole Falklands War had happened during the run up to our finals. John, unsure if his family was safe out in the camp (countryside) had somehow maintained his focus to gain a first, which were very rare in those days.

The problem was that by 1987 Argentina was still not allowing vessels through its waters until the very first, the tiny MV Forest, was let through as a good-will gesture. We managed to hound the Captain, Roger Edwards, through his entire social calendar in Punta Arenas until he formally signed me on as a deckhand and Gillian as the cook to work our passages for the very rough return voyage.

When in the Falklands John explained they were desperate for fisheries observers in the newly established fishing zone so I signed on as the first. I was eventually sent back to the UK to recruit more, form a team and manage them. Several were press-ganged from Bangor - **Indrani Lutchman**, **Pete Larkins** and **Stephen Martin.** It was a wild time. We'd work at sea until we dropped and party the same during the runs ashore. One week you'd be on some horror show, a leaking Korean rust bucket, followed by a collectively depressed Polish trawler where even the cockroaches would try and jump ship, and then you would land up in the owner's suite on a Spanish super-trawler with your own rooms and valet service! All the time transferring via RIBS on the high seas via the patrol vessel.

After two years I returned to Britain thanks to MRAG (The Marine Resources Assessment Group) who sponsored my MSc in Biological Computation. I had become determined to master the data science that was at the heart of so much of



Designing and testing Albatross scarer on a long-liner

Everest approach

our work. Sir John Beddington the founder and head of MRAG was a unique character who had this knack of inspiring everyone's total dedication by trusting you completely. I've contracted to them for twenty years in total. John always allowed me the flexibility between contracts to continue climbing.

So as you were developing your career in fisheries conservation you continued your mountaineering exploits. At what point did you decide on tackling Everest?

An expedition I had led, to Mt Sarmiento in Tierra del Fuego, imploded leaving me a bit hacked off. We basically spent half the time in the company of fishing pirates from Punta Arenas. Great fun but no success. I had invited Henry Todd an old friend on that trip. Years later he returned the favour with a shot at Everest. The great thing was that he allowed us to attempt it in our own style which was to climb independently within his expedition – no guide or Sherpa help for the actual climbing. We intended to avoid using oxygen, got pinned down on our own in a storm for three days at the top camp and had to compromise on the oxygen front from an altitude of 8300m onwards.

In 1995 you became the first Welsh Climber to summit Everest. What were your thoughts on reaching the summit with the rest of the world stretched out beneath you?

It felt as if you could see the curvature of the earth. And it suddenly dawns on you how thin the atmosphere is, especially when you've climbed through it of your own accord. When you're on the ground, one assumes that there's this vast depth above you protecting the earth, but when you're up there, you realise that you're in an area that can't sustain life for very long. You really realise what a fragile balance life on Earth is.

Ice climb Wales - this was the first ascent of a new route 'Cryogenics' in the Rhinog range

Fisheries survey – Royal Bay, South Georgia during demersal stock survey

I am guessing it was a bit like the moment Astronauts first set foot on the moon and looked back on "the fragile" Earth, realising that it is our only life support machine and we must protect it.

In your role as vice president of the British Mountaineering Council you had specific interest in conservation. How well do you think we are balancing access to the high peaks with conservation of the unique environments and communities in these regions particularly with the increasing demands of high mountain tourism?

Commercialisation of mountaineering and other travel has created pressures as they have morphed into consumerist services. I doubt the environmental aspects are critical, notwithstanding the incessant air travel to get there in the first place. It does bring economic benefits and the cultural depredation would be happening anyway with rampant globalisation. At least there is some hope for positive support for rural communities, though at times I despair at the lack of interest visitors have in the people of the places they visit. They are not green desert recreational play-spaces. The main problem is ethical. People are not validly engaging with the challenge. They are not being inspired by their own curiosity, agreeing on objectives with friends, doing the research, preparation, jointly sharing the work, responsibility, decisions, failures and successes.

Instead they are just consuming whatever experience gets marketed to them. It's a shortcut to nothing. It's better to have a real adventure in your backyard.

Okovango- I have worked on inland artisanal fisheries

Tasmania looking south - after we ascended the 'Totem Pole'.

How did you become involved at South Georgia?

In 1990 John Beddington despatched me to South Georgia. He knew I'd be happy there. I was the first resident civilian since the conflict and my role was to begin to re-establish monitoring and control of shipping and fisheries. The coincidental collapse of the Soviet Union reduced the pressure from their large fleet down there, although not until after some hairy encounters arresting vessels etc. Those small beginnings have now grown into an exemplary regime that presides over a sustainable fishery which helps support the management of what David Attenborough recently termed an 'ecosystem in recovery'.

Because I also climbed there often, I eventually became the chair of an advisory panel the government uses to help manage visiting expeditions. There are debates as to what extent and forms of visitation should be restricted. There was never a native population to impinge upon, but how do you manage for the competing and shifting impacts of climate change, fisheries, fur-seal resurgence, rat and reindeer eradication on the biological treasures whilst people are clamouring to visit for many different reasons?

You are still active in rock climbing, winter mountaineering and expeditioning, with an impressive CV of climbs and summits, as far afield Greenland and Antarctica, as well as more locally. Over the past few decades what impacts has our changing climate on your expeditions?

If you dropped the Alps into a freezing ocean you have the picture of South Georgia. Over the years I have returned via long yacht passages and spent weeks on self-sustained ski traverses to reach and make the first ascents of some of the

islands highest summits. Places that twenty-five years ago would take us days to reach on foot can now be sailed to in open water because of the astounding rates of glacial recession. Once safe access routes have been transformed into dangerous ice-falls. Whales are returning at the same time as frantic research is being carried out to try and anticipate the likely impacts of global climate change on the biosphere.

Thank you for sharing the highlights of your amazing career. Looking back on all of your achievements, what advice would you give to our current students and recent graduates as they look forward to their careers?

Considering the mess my generation are handing on it might be a bit rich for me to be proffering advice! But for what it is worth, and based on what we learn from our mistakes then, keep your ears open for heartfelt guidance. Once people have lived long enough to raise kids to adulthood they really do know some things about life, its patterns and pitfalls.

Good advice is not trying to thwart your ambitions but tries to help you achieve them. Sometimes, someone can give you a hot tip when faced with difficult decisions. Think about what you love doing, what inspires you, what do you want from life. Information technology has freed us from some of the old constraints but you can't beat the interaction with problems and people to reach better solutions.

Make professional choices that align with your beliefs and lifestyle. It's probably not best to take a job in Birmingham if you love the sea AND the converse is equally important. Take chances, be cheeky, be honest, be kind. There are synergies. Someone once worried how Mawson the Australian scientist might cope with the tough psychology on an Antarctic expedition in the heroic age of early exploration, but it has been pointed out it was nothing compared to surviving the thuggery of academia! Hopefully its better these days?

Think of the utility of a piece of work before you commit to it and how effective is your solution in achieving its goals. Don't forget the commitment and resources that will be required to run and maintain the work in future. Understand the sociology of organizations and the psychology of the people working in them. From the most mundane to the most sophisticated it is often the same processes that are in play. Given where we are at though, many of these have to change.

Try and obtain that management understanding, support and commitment before you commence. Document everything well so that solutions and procedures can be understood and maintained in future. Plan your data requirements carefully, it costs to collect, manage and analyse it and maintain its quality. Are those costs worth the benefits you get from it. Before you start, look up the 'scientific method' understand Karl Popper and Kuhn and paradigm shifts. Make the effort to properly understand hypothesis formation and testing. You have to have the political commitment to make a real difference.

Cod end Falklands - research trawl from a goverment patrol vessel in Falkland waters.

You're going to study in Wales. Don't perpetuate the lamentable establishment ignorance and indifference towards this different place, its people, customs and language. We all like to champion cultural diversity. This is your chance to live it, cherish, nourish and sustain it. Take an interest, lend a hand and have a great time.

Ed in Bangor in 2005

CONGRATULATIONS TO PROFESSOR ED HILL CBE

(MSc Physical Oceanography, 1981 and PhD, 1985)

Congratulations to Ed Hill (who took his MSc and PhD here at Bangor and was also a lecturer in the late 1980s and 90s) on being awarded a CBE in the Queen's Birthday honours in recognition of his services to ocean and environmental sciences.

During his time at Bangor, Ed carried out fundamental research studying water circulation in continental shelf seas and was a chief scientist undertaking over 20 expeditions at sea. He was also instrumental in securing the funding for the building of the 'new' *Prince Madog* which was launched in 2001 and he holds an honorary fellowship here at Bangor University.

Ed Hill (front) and Oliver Hill – Blue Mountains Australia

Whilst many students and staff here in SOS are keen climbers, Ed Hill was always one to opt for 'less energetic' activities! However, as you will see from an article he has written for the Bridge, he has come to climbing late, with the strong encouragement from his two children!

Late Starter

"My rock climbing adventures began late in life, despite having spent many years at university close to two of Britain's climbing epicentres - the Peak District and Snowdonia. My two sons, Oliver and Patrick born when I was at Bangor and now in their late twenties are both excellent climbers, probably taking after their mother's late great uncle, Robert Caukwell who was described as one of the finest climbers of his generation and who climbed in East Africa.

Part way through their 18 month post-university climbing trip around the world in 2015, my wife Jacqueline and I joined them for several weeks in Australia - travelling all together up the east coast in a camper van. They had been saying for a while they intended to get me on a multi-pitch and we took a detour into the Blue Mountains in New South Wales. Those mountains are 'upside down' with extensive residential developments on the plateau at the top with the approach involving a scramble down into the forested wilderness below. Before I knew it, and with little prior experience, I was half way up a 700ft

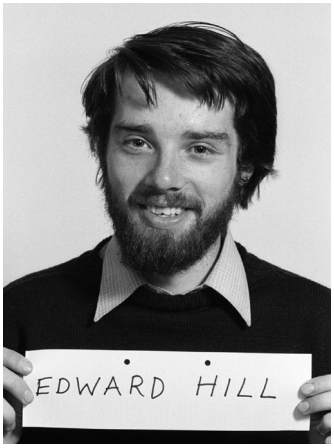
Ed and sons on top of the Old Man of Hoy

rock face (grade HS, pictured) wondering what I was doing there. Patrick led and Oliver was behind giving advice and instruction. I decided the key to success would be following orders and not looking down.

I think there was an ulterior motive on my sons' parts – their mother was none too taken with the idea of them climbing at all, especially having seen some of their pictures that had posed on Facebook. With my experiencing 'the buzz' on reaching the top, I said could see why they did it – and I supposed they figured they had an ally. "Well Dad", they said, "the main thing was you didn't freak out which is about the only thing that would have been really difficult to handle - so we've got a project for you when we get back home".

And so it was, in May 2016, I found myself on the ferry to the Orkney Islands and gulping with some trepidation at catching my first view of the Old Man of Hoy – the classic Scottish red sandstone sea stack rising 449ft high above the Atlantic. First climbed by Chris Bonington, Rusty Baillie and Tom Patey in 1966, it was also famously climbed again in 1967 when it was filmed live for the BBC, attracting 15 million viewers.

Ours was the original route. It was obvious aspects of the climb (grade E1) would be beyond my abilities and this would be an 'assisted climb'. Complete with an improvised harness, the plan



Ed in Bangor in 1981

was for me to jumar up the second pitch and I needed the jumar again for a section near the top– but otherwise I was able to climb most of it, albeit slowly.

At the top we were greeted and photographed by two German climbers who had taken a different route. The exploit featured in an article they wrote for UK Climbing entitled, 'A German Adventure on the Orkney Islands', "*one ropelength from the summit, we reached the party on the Original Route - two guys from Sheffield, who had eventually brought their father up onto the summit using every trick in the book over eight hours*" and an account of the abseil down we made with them on their ropes, "*the last 60 metres were overhanging and the father hung horizontally until banana-shaped in his harness construction. You didn't know whether to laugh or cry*".

And so in May of each of the succeeding years we drove to Scotland to take on two other classic sea stacks, First the 200 feet Old Man of Stoer and then the 213 feet Am Buachaille. Unlike the Old Man of Hoy which is connected to the mainland by a rubble causeway, the other two are true sea stacks cut off by the sea. The former can be crossed to by a Tyrolean rope traverse but there is no high connection point on the landward side for Am Buachaille so that approach means either a swim or, in our case, a swim by Patrick and an inflatable dinghy to carry the gear (and me). This was hauled across by rope to the rock platform surrounding the base of the stack and which is only exposed at low tide. Very good climbers can cross and then get up and down quickly enough before the platform is dangerously washed over by waves as the tide rises. With me in tow, that was never going to be an option. Instead, the gear and provisions was hauled up to a ledge about 50 feet up, anchored off, and then without hurry we climbed to the top and abseiled back down to the ledge to wait out the tide – just long enough for the waves to stop washing over the platform but soon enough for there to be enough light for the trek back up the cliffs on the other side.


Ed in Bangor in 1984

I have now retired from sea stack climbing (I think) but it's been great fun and the opportunity to spend time with my sons sharing in something they enjoy so much. It also dawned on me my sons might perhaps have other ulterior motives. I am reminded of the title of Tony Hawks's book 'Round Ireland with a Fridge' in which he hitchhiked with a fridge for a bet. Although, the climbs we did were not particularly special in terms of difficulty – doing it whilst hauling their slightly outsized old father up too is a feat that might perhaps win some peer recognition!

On a trip to their home in Sheffield, I was invited to a screening of the cult climbing film 'Hard Grit' about the pioneers of the classic gritstone routes of the Peak with some of them even in attendance. I knew I was over-dressed immediately because I was wearing a jacket. One of my sons introduced to a young climber called Lizzie who looked at me quizzically and said, "are you really Mr Hill?" to which, when I replied I was, she took hold of my hand and shaking it vigorously said, "Mr Hill, I've always wanted to meet you – you're a bloody legend around here!"

NEWS ROUNDUP

Despite the COVID lockdown, SOS once again see a big improvement in the National Student Survey (NSS) achieving a 72% response rate from graduating students. Our students placed the school no. 2 in the University for student satisfaction.

For the courses within Earth Sciences area the school achieved a 98% satisfaction rate (5th highest in the UK), whilst within the Ecology and Environmental Science subject area the school achieving a 93% satisfaction rate.

The marine renewable energy sector is an active area of research within the school and has been identified as vital to growing a sustainable economy in Wales.

We have been given a further boost with the awarding of an additional £1.5M of EU funding from the Welsh Government. This will extend research and innovation to support the development of marine renewable energy in Welsh waters through the SEACAMS 2 partnership. The extension to the SEACAMS2 partnership between Bangor University and Swansea University will enable research to continue until 2022.

Bangor University Professor of Conservation Science, **Julia Jones** featured in Sir David Attenborough's new documentary Extinction: The Facts.

The programme goes beyond the emotional to investigate what biodiversity loss and extinction mean - not just for the planet but for us as a species.

Commenting Professor **Julia Jones** said: "*I was delighted to be a small part of Extinction: The facts. The programme makers did a brilliant job of explaining just how bad things are for our planet's biodiversity, why this matters to each and every one of us, and what needs to change. The programme beautifully explains how interlinked our natural world is and that we are part of that system.*"

SOS Senior Tutor and Marine Biology lecturer Dr **Laura Grange** has been appointed to the role of Learning and Teaching Development Leader within Bangor University's Centre for the Enhancement of Learning and Teaching (CELT).

This position represents an exciting opportunity to take forward the University's commitment to the highest standards of learning, teaching, assessment and student support. This position will play a significant role in leading innovative projects to develop and support a high performing learning and teaching environment across the University.

Dr **Yueng Djern Lenn** has been appointed editor of the leading international oceanography journal, the American Meteorological Society's Journal of Physical Oceanography.

She has also been appointed chair of a new international Scientific Committee on Oceanic Research (SCOR) working group on ocean mixing. Yueng is also part of a recently funded £2.5 million NERC ArctiCONNECT Consortium which aims to investigate links between Arctic Sea ice retreat and UK weather severe weather. The other consortium partners are Oxford, Bristol and Exeter Universities and the National Oceanography Centre.

Our students have also been busy over the summer.

Recent MSc Marine Environmental Protection graduate **Bex Turner** started running during lockdown as a complete beginner, and ran 108 miles (the journey from Calais to London) through September to raise money for the British Red Cross!

Gem Simmons (BSc Marine Environmental Studies graduate) was involved in the rescue of a fin whale stranded in the Dee Estuary as a volunteer for British Divers Marine Life Rescue. Gem is currently studying for an MSc in conservation in the School of Natural Sciences.

Marine Biology and Oceanography student **Tom Williams** and his friends rescued an unconscious man from the sea at Llanelli.
Such quick thinking and heroic actions deserve huge praise! Tom describes events: "*We were just sitting on the beach when we saw this guy walking across the rocks. We thought it was a strange place to be walking, then all of a sudden he fell. I ran over to check if he was ok, and he was unconscious with his head in the water. I managed to lift him out and turn him onto his back so I could make sure he wasn't bleeding.*"

Second year Marine Biology student **Thea Moule** won a $4,400 scholarship to attend the Coral Reef Ecology course at the Bermuda Institute of Ocean Science this summer.

She also planned to work as a research assistant on Dr **James Waggitt**'s research cruise to Iceland. Unfortunately, both had to be cancelled due to COVID.

Bangor - the green university choice

With many young people wanting to reduce their environmental footprint, students looking for a 'green' university can be assured that if they choose Bangor, they will be studying at a university which is word-leading for its commitment to recycling and sustainability.

Not only was the University recently placed 7th in the world for recycling and sustainability, measured against the United Nations Sustainable Development Goals, Bangor is also ranked 10th in the world for its green credentials according to the Green Metric World University Rankings.

A NEW BOAT

Following a very generous donation from Prof Karin Lochte, (Honorary Fellow of Bangor University), the School now has a new small boat (a Pioneer Viking) which will replace the aluminium boat *Alwyn Mon*.

The boat is towable and will support local work. Karin has suggested the new boat be named *Mactra*, to complement *Mya* and *Macoma* (other boats in the SOS fleet).

Mactra stultorum - the "trough shell" - bivalve, widely distributed. A shallow but active burrower in sand or muddy sand.

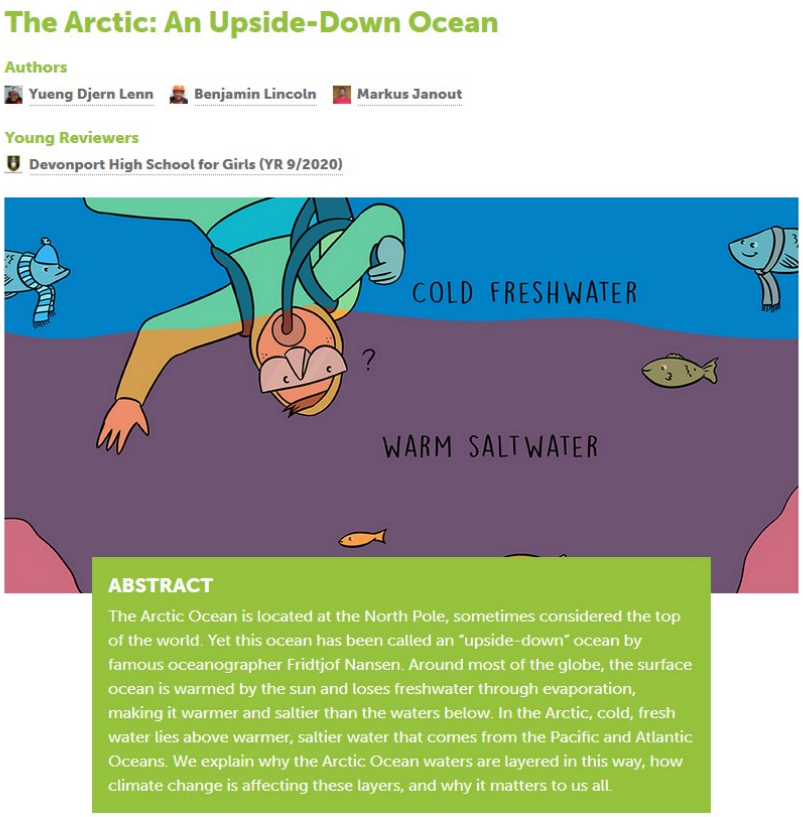
Focusing young minds

While scientists regularly publish papers on their research to inform the scientific community of their new discoveries, here in the School of Ocean Sciences we are also working hard to encourage youngsters to consider pursuing careers as scientists and engineers.

Dr Yueng Lenn leads these outreach activities which, in pre-COVID times, included visits to schools, and entertaining school groups as they visited the University. During the COVID lockdown she has also run "kitchen science" classes for local school children.

Her research specifically focuses on high latitude oceanography. She has visited Antarctica three times and the Arctic once and published several key papers focusing on these unique regions. Now with Ben Lincoln of the School of Ocean Sciences and Marcus Janout of the Alfred Wagner Institute she has published a paper specifically aimed at inspiring young minds about Polar Science.

You can download a copy of the paper here:



https://kids.frontiersin.org/article/10.3389/frym.2020.00105

Lenn Y, Lincoln B and Janout M (2020) The Arctic: An Upside-Down Ocean. Front. Young Minds. 8:105. doi: 10.3389/frym.2020.00105

PROMOTIONS AND AWARDS

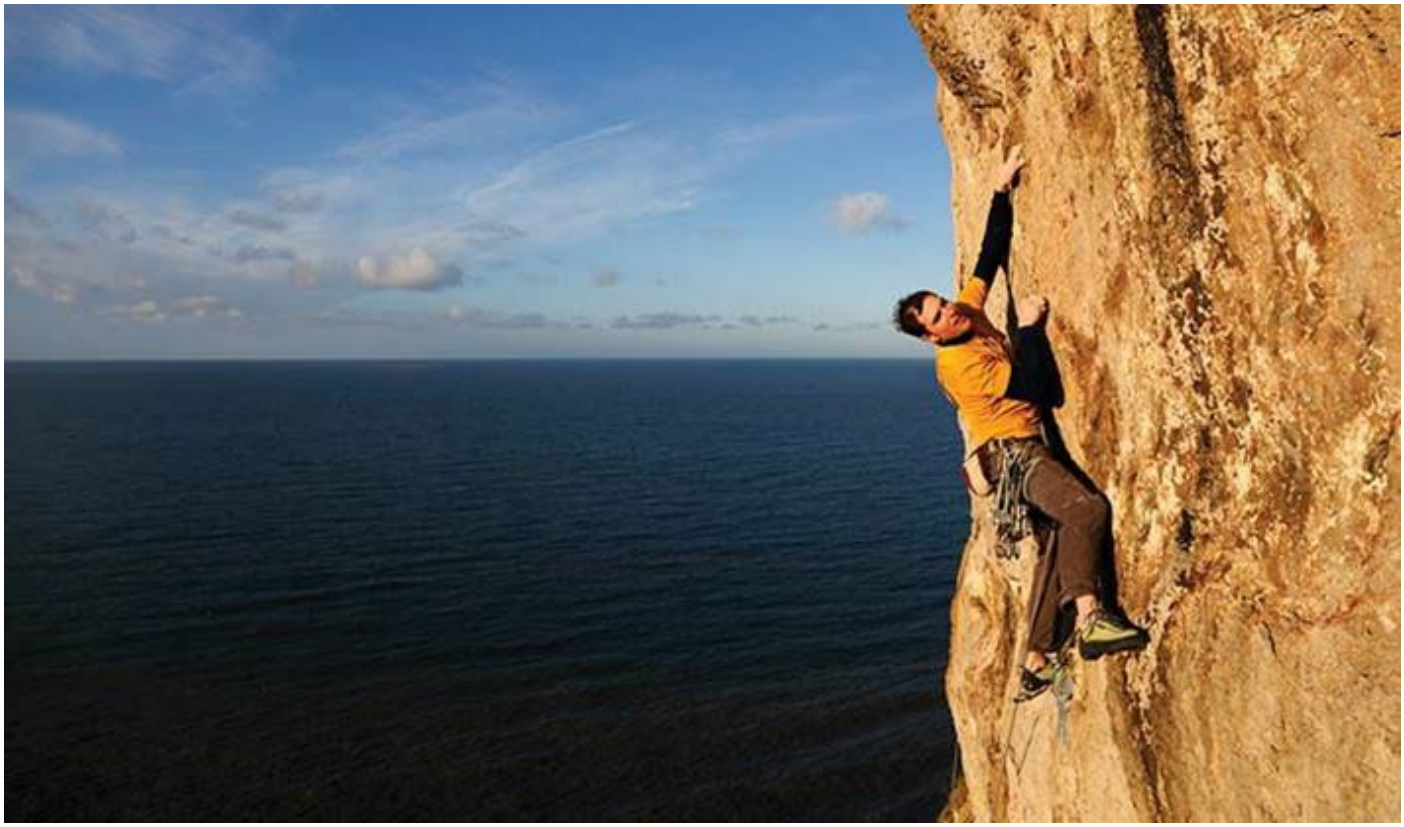
PETE ROBINS (Senior Lecturer)

Congratulations to physical oceanographer Pete Robins on his promotion to senior lecturer.

Pete first moved to Llanberis in the late 1990s driven by his interest in rock climbing. In 2019 Pete was described by Climber Magazine as: *"someone who has mastered all types of rock-climbing in the UK, having been brought up on the gritstone edges of the Peak District he has always had the technical and mental ability to deal with the bold arêtes and slabs associated with these areas"* and *"one of the leading bold trad climbers of his generation".* Pete used his spare time to undertake a BSc in Physical Oceanography and Maths here at Bangor, graduating in 2003. He then progressed to a PhD under the supervision of leading Applied Oceanographer and numerical modeller Professor Alan Elliott. Following several years as a postdoctoral researcher Pete was appointed a lecturer.

Pete's current research uses numerical models of estuaries to understand their sensitivity to complex interactions of rivers, tides, surges and sea-level rise, and how these interactions control coastal flooding, plastic dispersal, water quality and human health. He is also developing methods to characterise the bio-physical dispersal of larvae to help understand population dynamics and aid fishery and shellfishery management. He is also interested in characterising variabilities in tidal energy available for exploitation as a renewable electricity source.

Pete is also leading a recently funded £350K NERC grant which aims to improve forecasting of flooding and to identify vulnerable communities through downscaling of future climate change scenarios.



MARTIN SKOV (Reader)

Congratulations to Martin Skov on his Readership.

Martin graduated in Marine Biology at Bangor University in 1996, moving to Liverpool University to complete a PhD in mangrove ecology in 2001. As a postdoctoral researcher he undertook a two year research fellowship with Lisbon University in Portugal, studying crustacean recruitment dynamics, followed by research positions at Bangor and Southampton Universities. He returned to the School of Ocean Sciences as a Research Lectureship in 2009 progressing to a permanent lectureship and later a Senior Lectureship.

He is an experimental ecologist with particular interests in the ecological functioning and ecosystem services of coastal salt marshes, mangroves and seagrasses. His research focuses particularly on regulators of landscape-scale functioning, such as examining what determines the delivery of natural coastal protection and carbon sequestration by marshes and mangroves, as well and explaining and predicting long- and medium-term changes in marsh and mangrove area cover.

He also has a strong interest in the human interactions with coastal wetlands, including wellbeing associations and how ecosystem management impacts on ecosystem service delivery. Consequently, his work includes fundamental experimentation with ecosystem simulations in the field and hydrological flumes, use of historical data, records and systematic observations for understanding long-term processes in coastal systems.

Congratulations to EMILY CUNNINGHAM (Master of Marine Biology, 2012)

Bangor University Alumna recognised as a "30 under 30" global environmental leader

Alumna Emily Cunningham has been selected by The North American Association for Environmental Education (NAAEE) for its fifth round of 30 global leaders under the age of 30. Emily works tirelessly to inspire people about the wildlife in UK seas and encourage them to take action to protect it. To date she has secured £5.1m funding for marine and coastal projects in the UK. She is a Trustee of the Marine Conservation Society, the UK's leading marine charity.

Emily says "*My time at Bangor University was key to my career achievements. Before I arrived, I had no idea how amazing UK seas were, but through my studies and learning to scuba dive with the University Sub Aqua Club, my mind was well and truly blown! Since graduating, I've been driven to share this awe and inspire others to take action to protect our amazing marine wildlife. You can help by buying sustainable, locally-caught British seafood, avoiding single-use plastic and using environmentally-friendly washing and cleaning products.*"

Emily studied for a 4-year undergraduate-masters degree in marine biology at the School of Ocean Sciences between 2008 and 2012. After graduation, she went on to work monitoring sea turtles for the Ascension Island Government, develop pioneering projects for The Wildlife Trusts and lecture on an international marine ecology field course in Indonesia. She currently leads the work of the Local Government Association's Coastal Special Interest Group.

Emily is one of the 30 awardees who will join the global EE 30 Under 30 community of leaders and will receive ongoing support to expand their impact. Since 2016, NAAEE's EE 30 Under 30 program has recognized 150 individuals from 34 countries who are making a difference through environmental education. This program is made possible by Wells Fargo, the Global Environmental Education Partnership, and the U.S. Forest Service.

Follow Emily's adventures as a marine biologist on social media, search Marine Biology Life.

Facebook / Instagram / Twitter

Learn more about all of this year's winners on: naaee.org/ee30under30

IESTYN WOOLWAY (BSc Ocean Sciences, 2010; MSc Physical Oceanography, 2011)

Congratulations to SOS graduate Dr Iestyn Woolway on being awarded a prestigious early career NERC Independent Research Fellow.

Iestyn is based in the Department of Meteorology at Reading University and is a visiting lecturer here at the School of Ocean Sciences. During his fellowship he will be researching extreme weather and seasons and the impact of such events on the biodiversity and functioning of lakes

Iestyn is originally from Llanfrothen (near Penrhyndeudraeth) and played football for Porthmadog who, at the time, were in the League of Wales (but have since been relegated). He is also relative of the legendary Welsh Bard Hedd Wyn. He studied for a BSc in Ocean Sciences and an MSc in Physical Oceanography here in Bangor before moving on to UCL to undertake a PhD in Physical Limnology. Iestyn continues to collaborate with John Simpson, Martin Austin and Brian Scannell in studying mixing in lakes.

Iestyn has already published several high impact articles most recently including:

Woolway et al (2020). Global lake responses to climate change. Nature Reviews Earth & Environment, 1, 388-403.

Maberly et al inc. Woolway (2020). Global lake thermal regions shift under climate change. Nature Communications, 11, 1232.

BHAVANI NARAYANASWAMY (BSc Marine Biology and Oceangraphy, 1998)

Congratulations to Ocean Sciences graduate Bhavani Narayanaswamy on her promotion to Professor at the University of Highlands and Islands, in Scotland.

In recounting her career path as a marine scientist Bhavani tells us: "Even before I started my degree in Bangor, I wanted to research the deep sea. Studying for the Marine Biology and Oceanography degree reinforced this passion. The support and encouragement that I received from staff at the SOS with whom I came into contact is still really appreciated.

On leaving Bangor I was offered a PhD jointly with the University of Southampton and the Scottish Association for Marine Science, working with two of my deep-sea ecology heroes, Profs Paul Tyler and the late John Gage.

After gaining my PhD working for various companies before undertaking a Fellowship through the University of Massachusetts based in Woods Hole. I then returned to Oban as the Project coordinator for the European Census of Marine Life progressing to become a lecturer at SAMS-UHI and the head of SAMS Graduate School.

Again, I have been really lucky in that through work I have travelled the world, and undertaken research in both the Antarctic and Arctic as well as in the Atlantic and Indian Oceans. I am now combining my interest in deep-sea ecology with that of microplastics, an area I hope to work on more as time goes by."

KATE O'NEIL
(Marine Vertebrate Zoology, 2019)

Alumna's search for basking shark continues!

Kate O'Neil is a 2009 graduate from the School of Ocean Sciences and has spent her years since split between New Zealand and Scotland, where she now lives. After some initial excitement when she first moved to Edinburgh in 2017, in the form of wintering Humpback Whales in the Firth of Forth, things have been quieter on the scientific front and she's been focusing more on her jewellery business, which is also ocean-inspired.

With the madness of 2020 and having been city-bound since lockdown began in March, Kate assumed it would be a dull year for wildlife sightings. That was until she got a call about a basking shark just offshore and visible from an Edinburgh beach! Having been searching for these elusive giants since 2015, it seemed just too good to be true that one would appear right on her doorstep, and as it turned out, one had not. What was swimming around offshore did behave much like a basking shark, but had a tall, sickle-shaped dorsal fin with a serrated edge and blueish striations. Kate spent the afternoon photographing and videoing the mystery creature, and upon returning home consulted with other experts in the field. The sighting had in fact been a swordfish, a rare visitor to UK waters and a species recorded only a handful of times in Scotland, ever. So whilst her hunt for the basking shark continues, that's certainly an unusual species to tick off the bucket list!

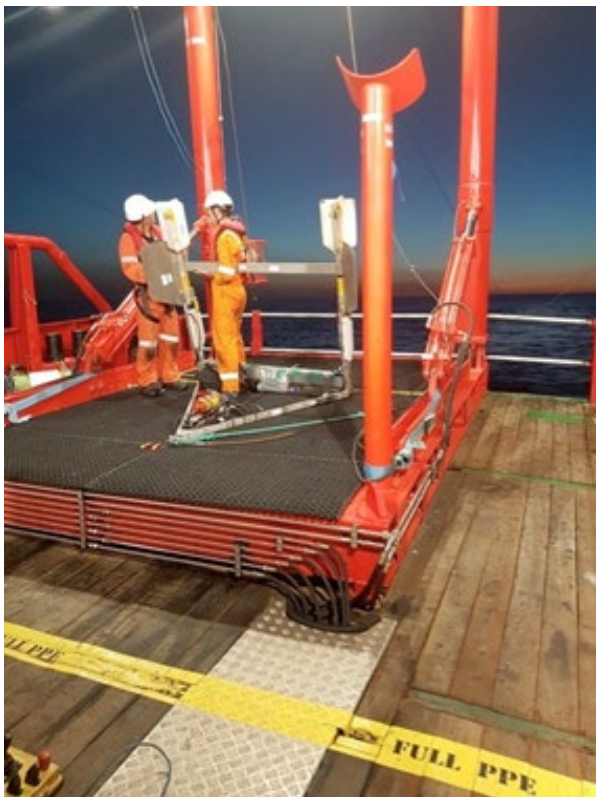
EMMA BAGNALL (Marine Biology, 2014)

"I have learnt what it is to be a part of real 'behind the scenes' conservation"

"I currently work as the Fisheries Officer for the Shark Trust. We are a small NGO part of a global movement in shark conservation. We provide a 'voice' for sharks, bridging the gap between research and policy.

My average day can include anything from picking apart fisheries legislation to documenting shark by-catch on fish markets, outreach events to conferences and stakeholder meetings... and of course a lot of report writing. There is little glamour or shark cuddling here. Over the last 18 months I have learnt what it is to be a part of real 'behind the scenes' conservation. I see how cutting-edge shark research and depressingly declining stock assessments are channelled into policy and implemented into industry. It is a slow game, requiring constant energy, accuracy and an extensive collaborative effort from people around the world.

So, I may no longer be diving with sharks on coral reefs in Madagascar like in my previous job. But, here, the bigger picture reward is even greater: Knowing that together, we are making a difference for sharks."



AMRO AL-ABBASI (Geological Oceanography BSc, 2018 & Applied Marine Geoscience MSc 2019)

"I wouldn't have been able to secure any job post-graduation if it wasn't for the education I received from my lecturers at SOS"

"I studied at Bangor University from 2015 until 2019 where I completed BSc in Geological Oceanography and an MSc in Applied Marine Geoscience.

Since graduating in September 2019 I worked for a geophysical company called Bibby Hydromap which unfortunately went into administration in April 2020. Unfortunately, COVID halted the whole marine geophysical survey industry until June and that's when I was fortunate enough to obtain a job as a Freelance Geophysicist with a company called GEOxyz for a survey job in northern France, off the coast of Bretagne. After spending two months onboard GEOxyz vessel Geo Ocean IV, I was offered a job within the company as a Geophysicist/Surveyor and started in October.

I wouldn't have been able to secure any job post-graduation if it wasn't for the education I received from my lecturers at SOS, such as Dei Huws, Katrien Van Landeghem, Jaco Baas and many more and I am very grateful to them all."

ABDULLAH AL-NAHDI (Marine Biology MSc, 2014)

Alumnus adapts to the COVID pandemic in Oman.

"Since completing my MSc in Bangor University in 2014, it would be an understatement to say that life has been pretty full on. I continued straight on with my studies, completing a PhD in Marine Biology in September 2017 at Swansea University. My PhD was on investigating the biology and management of commercial fisheries in Oman.

A few month after graduation, I became a Director of Marine Science and Fisheries Centre in Oman. Leading on work relating to: tropical fisheries; demersal, pelagic and crustacean; and project management works include stock assessment and modelling to update the management plan and implementing conservation policies in Sea of Oman and Arabian Sea fisheries. During my career, indeed, I have seen a growing development in the 'Impacts on the fisheries': the ecology and biology.

-

Like others nations, people in Oman were also affected by Pandemic COVID-19. In marine science and fisheries centre has also been impacted in multiple ways, from cancelation of laboratory work and field activities to suspension of onboard research along Omani coastline. However, from the early stage of pandemic, we adapted specific plans to deal with the ongoing difficulties and tackle similar future situations in fisheries sector. In this point of view, we have gathered information on the challenges, solutions and opportunities in the field of fisheries sector by (1) determining the relevant challenges caused by the pandemic, (2) providing appropriate immediate and short and long term solutions, (3) enhancement opportunities (promote development, innovation), and (4) creating online communication with stakeholders to make the available information and reorganization fisheries sector. With this, we implemented an effective strategy to resume work during this complicated period.

Meanwhile, we explored some of the ongoing problems and challenges faced due to the pandemic and proposed suitable actions to tackle them. Such as facilitating online regular meetings and home working, implementing tools to enable collaborative work during quarantine. Teams can use cloud tools to work on documents and data analysis. Health and safety protocols were also updated or restructured following current restrictions and precautions, especially for indoor activities and lab workspace. We also considered international collaboration with most relevant organisation such as FAO and CEFAS by providing online tools available to communicate and collaborate."

JAKE DAVIES
(Applied Marine Biology, 2018)

Shark challenge featured on BBC programme.

"It's been a busy summer for diving and I've been involved with some exciting dive jobs.

Earlier in September, I was featured on BBC's *The One Show* talking about British Sharks where I was set a challenge against a diver from Cornwall. A friendly competition between North Wales and Cornwall to see who could film as many sharks over a period of the week!

To watch the episode see iPlayer:

https://www.bbc.co.uk/iplayer/episode/m000mvdy/the-one-show-25092020

As a media diver and videographer (JDScuba) I will be releasing more media projects next year including a collaborative project showcasing Welsh diving and marine life."

ALICE NEWTON Marine Biology/ Oceanography, 1981 & Marine Biology MSc, 1987)

"Even COVID doesn't stop SOS alumni!"

"On Tuesday, 15th September 2020, in Sagres, SW Portugal John Icely and myself met up with Paulo Relvas to hand over a CTD for a cruise.

John and I had been "at home" since mid-March and only seen 10 people. Paulo was joined by Alexandra Cravo.

Meanwhile, a researcher from IPMA (fisheries institute) showed up in the port of Sagres on another mission. Despite the masks, Raquel said to me, "I think that you taught me". "Probably" I replied, " I have taught HUNDREDS of students in Portugal, in the past 37 years". "No" said Raquel, "in Menai Bridge"...

So there, at the SW tip of Portugal, by coincidence, in the middle of the COVID pandemic, were 5 Menai Bridge alumni researchers, all with PhDs from Aquaculture to Marine Zoology to Chemical and Physical Oceanography!"

The masked alumni, socially distanced:

From left to right: Paulo Relvas, Alexandra Cravo, Raquel Quintã, Alice Newton, John Icely

LYNN SORRENTINO (Marine Environmental Protection MSc, 2018)

"I work on a global programme to identify and abate marine plastic pollution"

"I graduated with an MSc in Marine Environmental Protection in 2018. I currently live in Switzerland.

I joined the International Union for the Conservation of Nature (IUCN) Global Marine and Polar Team in July 2020 and the project I am working on is called Marine Plastics and Coastal Communities (MARPLASTICCs - with 2 Cs, for coastal communities). This is a global programme operating in 5 countries to date: Kenya, Mozambique, South Africa, Thailand and Vietnam. The aim of the programme is to identify and abate marine plastic pollution. The webpage is https://www.iucn.org/theme/marine-and-polar/our-work/close-plastic-tap-programme/marplasticcs The most recent and most exciting part of this project was the launch, with the UN Environment Programme (UNEP) of a tool and set of guidance for solving the plastic crisis through hotspotting: a new guidance is now available for countries. More info on the tools and guidance for countries to use on solving their plastic pollution problem can be found here:

https://www.iucn.org/theme/marine-and-polar/our-work/close-plastic-tap-programme/marplasticcs/knowledge-products

IUCN is a membership Union composed of both government and civil society organisations. It harnesses the experience, resources and reach of its more than 1,400 Member organisations and the input of more than 17,000 experts. This diversity and vast expertise makes IUCN the global authority on the status of the natural world and the measures needed to safeguard it. The Global Marine and Polar Programme works to ensure that coastal, marine and polar ecosystems are restored and maintained, and that any use of their resources is sustainable and equitable, and also makes sure that the conservation of these ecosystems is integrated into national climate change mitigation and adaptation policies. More info:

https://www.iucn.org/theme/marine-and-polar

IUCN and all of our offices globally have been working diligently to do our best to keep the virus at bay and keep our staff, partners, and communities safe wherever they are around the globe. Some projects have been put on hold, some offices are fully work-at-home, and measures to keep offices clean have been implemented. The biggest challenge is that for now we have had to postpone the World Conservation Congress. More information on how IUCN is dealing with COVID-19, please see:

https://www.iucn.org/resources/covid-19-resources

I took this photo in Luzerne, Switzerland this spring before lockdown - the last real trip I was able to take - of the famous Luzerne wooden chapel bridge. More info: https://chapel-bridge.ch"

NORMA AFIATI BROTOHADIKUSUMO (Marine Biology MSc, 1990 & PhD, 1994)

"I still remember the feeling when I first took a deep breath of cool air in the morning mist in Menai."

"I was Prof. Raymond Seed and Prof. Chris Richardson's student in the SOS Menai Bridge for my masters and doctorate from 1989 and 1991-1994. I send my regards to both of them, also to Prof. Naylor, Prof. Andy Yule, Prof. Graham Walker, Prof. Ian Lucas, Prof. David Jones, Prof. Floodgate and Prof Kennedy. Sorry I forgot the name of others though I remember their faces and kindness!

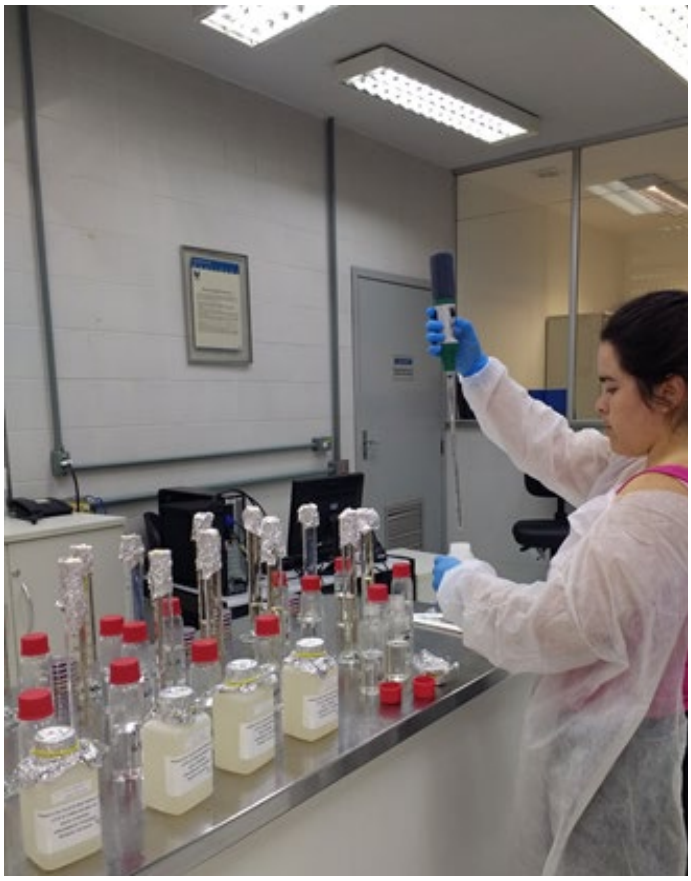
It was a really great time in my life. I still remember the feeling when I took a deep breath of cool air in the morning mist in Menai. Unfortunately for me, there was no snow in there. I love to visit Liverpool Arms, yet I know it is closed now. Prince Madog was the old one in that time, some years ago I saw her again in this magazine, she is now very beautiful.

Sometimes before retired, Chris and Carole had an opportunity to visit a place nearby I live, so we met and visit Jogjakarta.

Ever since, I have been back to the university that sent me to Menai, Diponegoro University in Semarang, the capital of Central Java. As a Biologist I was working at the Faculty of Medicine, but 5 years after my graduation the Senate positioned me in the Faculty of Fisheries and Marine Science where I belong to up to now.

Ten years ago I got my full professorship in Marine Biology and Ecology. I kept working with Moluska Bivalvia, and this last 5 years I have been focusing in Cephalopoda. I challenged myself to study a brand new subject - Biotechnology. At present I try to barcode cephalopods from Jawa island and some octopus sent to me from many places all over Indonesia. However, since I am a beginner, I do hope that somebody gets interested in what I have been trying to do and gives me a hand by joining my study or can provide some advice! Please get in touch if you can!"

Paula (right) with colleagues Letícia and Alan



PAULA BIROCCHI (Ocean Sciences, 2014)

Brazilian scholarship student made the most of her time at Bangor University

"I studied Ocean Sciences at Bangor University from July 2013 through July 2014 with the Brazilian scholarship, "Science without Borders". While doing undergraduate and graduate disciplines at the Ocean Sciences school, I have great memories of crossing the Menai Strait by bike every day. My mentor was Professor Mattias Green who provided me the opportunity to participate in an oceanographic cruise in Troon, Scotland and an internship to work with canyon data. Living in Bangor has provided me with many academic and personal experiences, and I am very grateful to all the people I lived with during this period. I took English classes with Professor Anthony Brooks (best English teacher I ever had), played volleyball with the University team, took Welsh classes, and participated in the British Tea Experience program where I met a great friend, Joan Beer. I cannot forget my Brazilian friends, Rayane, Pedro, and Ana Sílvia who were always there for me.

After living in Bangor, I returned to Brazil, where I completed my graduation and did a master's degree in Physical Oceanography. Today, I am in the second year of my doctorate also in Physical Oceanography at the Coastal Hydrodynamics Laboratory (LHiCo) at the University of São Paulo supervised by Professor Marcelo Dottori. I study hydrodynamics and pollution caused by bacteria in the Cananéia-Iguape estuary in the southern region of the state of São Paulo. Before the pandemic, I, Letícia and Alan carried out 3 field trips to measure currents, temperature, salinity, and collect water samples. The water samples had to be taken to São Paulo within 24 hours of collection for the bacteria to be analyzed in the laboratory. I can't wait for the pandemic to end so that field trips can happen again! For now, we are all working from home.

Here is an image of my bridge - the bridge in Valo Grande channel (Iguape, São Paulo state)."

LONG VU (Marine Biology MSc, 2017)

Studying the ecology of endangered fauna and flora in Vietnam.

"I have established a Not-for-profit research organization called the Center for Biodiversity conservation and Endangered Species (CBES) in Vietnam. CBES studies the ecology of endangered fauna and flora in the country to inform conservation. Under my leadership, the CBES team are currently working on three marine mammal focused projects, which study (1) the distribution and abundance of cetacean in Southwestern coast of Vietnam, (2) the population status and conservation of dugong (Dugong dugon) in Con Dao archipelago (Vietnam) and (3) the application of citizen science to monitor marine mammal stranding along Vietnamese coast. CBES have recently become partners of the Global Biodiversity Information Facility (GBIF) to fill the gaps of information on marine mammal occurrence in Vietnamese water.

Parallel to my position as the Director of CBES, I am also the founder of the consultant company named Conservation In Motion (CIM), a social enterprise which specialises in conducting environmental and social impact studies for renewable energy developments. CIM has been collaborating with various international corporations to address the impacts of multiple wind energy developments on seabirds and marine mammals in Vietnam. The core values of CIM include: Sciences and evidence, Biodiversity focus, Accountability, Innovations and Collaboration.

Research projects that I have been involved in:

The distribution and abundance of cetacean in Southwestern coast of Vietnam,

The population status and conservation of dugong (*Dugong dugon*) in Con Dao archipelago (Vietnam)

The application of citizen science to monitor marine mammal stranding along Vietnamese coast

Marine mammal and seabird baseline study for Hiep Thanh nearshore wind farm project, Ben Tre province, Vietnam (in collaboration with ERM Ltd.)

Marine mammal and seabird baseline study for Tra Vinh nearshore wind farm project, Tra Vinh province, Vietnam (in collaboration with ERM Ltd.)

Marine mammal and seabird baseline study for Phu Cuong-Mainstream wind farm project, Soc Trang province, Vietnam (in collaboration with ERM Ltd.)

Marine mammal and seabird baseline study for Thanh Hai nearshore wind farm project, Ben Tre province, Vietnam

Biodiversity baseline study for Hoa Dong onshore wind farm project, Soc Trang province, Vietnam (in collaboration with UPC Ltd.)

Biodiversity baseline study for Lac Hoa onshore wind farm project, Soc Trang province, Vietnam (in collaboration with UPC Ltd.)

The COVID-19 is well controlled in Vietnam. We have some short lock-down, but everything has already gone back to normal.

I really enjoyed my time in the Menai area, at the Bangor University's School of Ocean Sciences. I miss the breezing in the Menai Strait, something I haven't had for a while in the tropical weather of Vietnam!"

OLIVER THOMAS (Marine Biology, 2014)

"Working in my dream career in marine science"

"My three years at Bangor were extremely memorable and have catapulted me into my dream career in marine science. After graduation, I completed an MSc in Marine Resource Development and Protection at Heriot-Watt University in Edinburgh. I then worked as a Scientific Fisheries Observer for the Falkland Islands Government Fisheries Department. These were a whirlwind couple of years on the South Atlantic Ocean, witnessing fisheries management from the soaking decks of trawler and longliner fishing vessels. After that, I worked for a year as an Environment Officer for the Devon and Seven Inshore Fisheries Conservation Authority, a brilliant job that highlighted for me the complex and dynamic area of inshore fisheries management.

I have just started a PhD at Plymouth University and Plymouth Marine Laboratory, which involves researching the value of intertidal seagrass in Southwest England. This is an incredibly exciting chapter for me, as it is an opportunity to pursue my passion for coastal marine ecosystems. This passion first spawned in Bangor, while trudging round many shorelines, estuaries and saltmarshes, armed with a quadrat and a bucket!

The bridges behind me here are the Royal Albert Bridge and the Tamar Bridge, both iconic bridges in their own right, which connect Cornwall to Devon across the Tamar Estuary. It seems quite fitting to begin and end my higher education next to waterways, dominated by such spectacular and pioneering bridges, under whose shadows I have and will continue to sample under."

Twitter: @OllieThomas0

"Here is a photo of Natural Bridge which is located in North West Virginia near to the Blue Ridge Mountains. This is one of the locations within the state of Virginia that we have been able to visit. Made of bedrock marble carved by glacial meltwater some 13,000 years ago, the bridge straddles the Hudson brook and is a short hike on foot to view. Equally enjoyable is the James River nearby which we travelled by kayak down during the same visit in the summer. We hope to return there soon and if restrictions lift or a vaccine emerges we're optimistic we can expand our horizons to include some of the other fantastic natural sights in the US. "

NICHOLAS FOSTER (Marine Biology & Oceanography, 1991)

An update from an SOS Alumnus from North America

"I studied Marine Biology and Oceanography degree course at Bangor from 88-91. After graduating and completing an MSc in Underwater Technology from Cranfield, I joined the Royal Navy in 1995 qualifying as a Hydrography, Meteorology and Oceanography specialist. Despite being a specialist, I've enjoyed a very varied career in the Navy reaching the rank of Commander and serving in most warship types in the UK surface fleet.

In terms of achievements, the Royal Navy has provided me with a hugely rewarding career to date but some of the highlights have included :

Survey work in the Irish Sea, North Atlantic, Mediterranean and the Indian ocean;

Hunting for "*Red October*" in the North Atlantic;

Boarding and searching smuggling vessels in support of United Nation embargo's during the Gulf war;

Rescuing British civilians and military personnel from Tripoli in Aug 2014 as conflict threatened the city;

Conducting migrant patrols and ultimately rescuing approximately 10400 individuals at risk of drowning in the Mediterranean (over a 15 month period);

Commanding *HMS SCOTT*, the RN's only ocean survey vessel.

I am currently assigned to a NATO posting at the Strategic Allied Command Transformation (SACT) based in Norfolk, Virginia USA. Despite our shared language, the cultural differences between the UK and the USA and which in some cases extend within the country from state to state have also played out across the COVID crisis. As British nationals we are required to follow local civil and military guidance which for periods has restricted us to essential travel similar to the UK. That has prevented us traveling across this huge country to visit some of the incredibly diverse areas of natural beauty. This and the restrictions on international travel which have prevented visits back to the UK or being able to host family and friends here in Norfolk has been our largest impact."

"Also, here is an image "from the Bridge" of HMS SCOTT in the mid-Atlantic. I keep it above my desk to remind me of life before becoming tied to a desk job!"

JILL BROOKS (Marine Biology / Zoology, 2006)

Alumna receives Eugenie Clark Memorial Award for work with sharks

Jill Brooks, received her BSc from the School of Ocean Sciences 2006, and is currently a PhD Candidate in Fish Ecology at Carleton University, Ontario, Canada. Jill was recently awarded the Eugenie Clark Memorial Award from the American Elasmobranch Society. The award recognizes female early-career scientists who demonstrate uncommon perseverance, dedication and innovation in biological research and public outreach on elasmobranch fishes, such as sharks, rays, and skates.

Brooks, a student in Professor Steven Cooke's Fish Ecology and Conservation Physiology Laboratory, became interested in shark research while completing a two-month volunteer position at the Bimini Biological Field Station (BBFS) in the Bahamas in 2007 (after graduating from Bangor with a BSc in Marine Biology and Zoology in 06). After working in a variety of management positions at BBFS, she moved to Canada to pursue her Master's degree and PhD at Carleton.

Through her varied academic career, Brooks has taught undergraduate Environmental Science students at Carleton as a Contract Instructor, developed and organized activities related to shark science and conservation for schools, and communicated her shark research through magazine articles, blogs, social media, invited talks at museums, online programs, libraries, and university courses, all while conducting important research in the field. She is a Research Scientist with a US-based NGO, the American Shark Conservancy, and is co-leading a project assessing the post-release survival rates of the Great Hammerhead and the socioeconomic status of the shore based shark fishery in Florida, USA. Her PhD thesis work tracks wild fish using acoustic telemetry in the Laurentian Great Lakes to determine their responses to changes in temperature and dissolved oxygen levels.

Here are some photos of Jill's shark research and outreach efforts, including her measuring a lemon shark carcass that harvested in the commercial longline fishery in Florida, USA.

MEERA PATHMARAJAH-LAURIJSSEN (Marine Biology / Oceanography, 1980)

"I remember my years in Bangor fondly. It was sometimes fun to be the foreigner!"

"Graduating from Bangor in 1980 with a joint honours in Oceanography and Marine Biology, I felt the world was my oyster…. At the time I lived in Geneva. I hoped I would find a job quickly and had focused my efforts on physical oceanography – my first love, that Mr. Sinclair so rightly pointed out to me in my second year at Bangor. Not being overly keen on pure research it was disappointing, but perhaps not surprising, that I struggled to get employed. While my male peers found places in seabed research for minerals or on offshore rigs, for example, it was apparently not the thing for a woman. In hindsight perhaps understandably at that time.

What next? Well Geneva was apparently a good place to live. My university credits got me a place as an intern in the oceans division of a locally based United Nations programme less than a year after I graduated. My boss was a one of a kind virago of energy who taught me work ethic, responsibility and to remember to have play time too!! Apparently marine scientists like liquid in many other forms than sea water. He was the only person I ever met who could swallow kilos of cherries, pips and all. He believed in everyone having a chance, although I also met narrow-minded people, such as the gentleman (and I use the term loosely) who said he would never employ a woman since at some point he would have to give her maternity leave.…..

From oceans to the chemicals division I beavered away as an international civil servant for 12 years both in the oceans division and then the chemicals division. At that point, my family (yes I did get the maternity leave for my two kids) decided to leave Geneva. Responding to the needs of a demanding career, holding the reigns during my husband's travels as well as hosting for his demanding career left precious little time for anything else and we made the decision to down our income and up our family time by moving to Belgium for my husband's work.

Over the years, while I did not go back to working in an office full time, I consulted with the chemicals division that was my final employer. During my working career I was proud to have been a small cog in the wheel of developing international conventions initially on the protection of various marine and coastal areas around the world, thereafter on chemicals' conventions aimed at eliminating or restricting the production and use of persistent organic pollutants; promoting shared responsibility in relation to trade in hazardous chemicals; and what was for me the jewel in the crown, a convention to protect human health and the environment from man-made uses of mercury and its compounds. The Minamata tragedy had already captured my mind when I was a youngster; to be part of team looking for a solution to the adverse effects of that substance was very satisfying indeed. Anybody who knew me in Bangor would find it ironic that with my "love" of chemistry I would end up working in that domain for over 25 years. But then again I did not often need to demonstrate my chemical prowess, there being many amply more qualified than I during those years.

I remember my years in Bangor fondly. Luckily the mind only remembers the good times. It was sometimes fun to be the foreigner. I was asked whether I skied to school; why I wore the clothes I wore (no jeans…); why I spoke with an American accent; often had my initial shyness taken for snobbishness – Switzerland, you know. Those who know me now would not be able to picture a shy me.

I had come from a very protected family life. For four years I survived the crazy Welsh coastal weather; lived in jeans and desert boots; enjoyed – sometimes - our outdoor lab forays on Anglesey; did the "only girl on the Prince Madog" thing; insisted on doing economics in a spare hour and then had to sit through video tapes of the lecture (yes it did clash), alone (couldn't skip it, couldn't sleep); had an interesting trip to Sherkin Island where I dropped a filthy scalpel into my leg – still have the scar – and convinced myself I had lockjaw; made great friends from everywhere on the globe; learned to love nature. And never learned to love beer – although I did learn you do not go into a pub and ask for a tea.

Bangor now seems like a lifetime away although we have been to visit the city a couple of times. It certainly has changed from the small almost village like atmosphere it had to the university town it now is. I still have contact with some of my friends from that era but just as our generation now has time to start visiting each other, life has thrown us a curveball that must keep us grounded in more ways than one. We can only hope that we weather it out – as all those years ago I 'weathered' out the walk from Rathbone to lectures in Bangor or labs in Menai Bridge. It is true that your time in University educates you in more ways than one.

Photo courtesy of Lee Glasby

There are few bridges where I live, in a somewhat rural zone 25 kms south of Brussels. But there are many beautiful green areas with forests and country lanes down which to lose oneself on long walks. A very important benefit as we go through one of the toughest times of our generation, as demonstrated by this photo of an old bridge in glorious autumn colours in a wooded estate nearby."

RU MORRISON
(Marine Biology and Oceanography, 1993)

It is with great sadness we report that Ocean Sciences graduate Ru Morrison has passed away.

Photo: Angus Blackburn

"Ru studied Marine Biology and Oceanography gaining a first class honours degree in 1993. He then moved on to take a PhD in Physical Oceanography with Dave Bowers.

In 1999 he moved to US, taking up a position at the Woods Hole Oceanographic Institution before moving on to the University of New Hampshire. He then managed a very successful coastal observatory system covering the Northeastern seaboard of the US.

His contribution was recognised earlier this year when Senator Jean Shaheen of New Hampshire read a tribute to his service to ocean science into the Congressional Record.

Outside of oceanography Ru led a busy life with his wife Ann Michelle and children Alasdair and Marin. He inherited the title of Chief of the Clan Morrison and participated in annual gatherings in his kilt. Ru had many friends in oceanography and elsewhere, and will be greatly missed."

By Professor Jim O'Donnell, University of Connecticut (a friend, fellow Scotsman and collaborator).

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Senate

TRIBUTE TO DR. JOHN RUAIRIDH MORRISON

Mrs. SHAHEEN. Mr. President, I rise today to recognize Dr. John Ruairidh "Ru" Morrison, chief of Clan Morrison, as he steps down from his position as the founding executive director of the Northeast Regional Association of Coastal Ocean Observing Systems, NERACOOS. During his 10 years at NERACOOS, Dr. Morrison has been a visionary in the world of ocean observing for the people of New Hampshire, the Northeast, and this country. I know I speak for so many others when I say that we are deeply grateful and thank him for his service.

Originally from Scotland, Ru became a true advocate for New Hampshire when he began his position as an assistant research professor at the University of New Hampshire in 2003. During his tenure at UNH, Ru was an inspirational teacher whose work advanced the science of remote sensing. A primary focus of his efforts centered on building a better understanding of Great Bay, a resource that many in New Hampshire consider to be a cornerstone of our coastal environment.

When Ru transitioned to NERACOOS in 2009, he brought with him his extensive knowledge of marine science and technology, the coastal and ocean environment, and, most importantly, his collaborative nature, which was instrumental in establishing a successful regional ocean observing system. NERACOOS, 1 of 11 regional associations of the U.S. Integrated Ocean Observing System—IOOS—addresses the ocean monitoring and forecasting needs of the people of the Northeast.

As executive director of NERACOOS, Ru's charisma and outgoing nature, coupled with his ocean science expertise, allowed him to bring together scientists, resource managers, fishermen, NGOs, and the public into a system notable for its espirit de corps. My staff and I all have many fond memories of joining him for boat rides on Great Bay to get a firsthand look at NERACOOS's work on the estuary. Anyone who's worked with Ru can attest to his warmth, wit, and self-deprecating sense of humor, which made working with him and NERACOOS a real pleasure.

Over the past decade, Ru has grown the organization's prominence and expanded collaborations among its many users. Even more impactful, though, is a decade's worth of Ru's infectious enthusiasm, which invigorated the organization and its stakeholders alike. Under Ru's stewardship, NERACOOS became a morning ritual for fishermen preparing for their day at sea, and with the formation of the Northeast Coastal Acidification Network—NECAN—NERACOOS has become a national leader in facilitating regional responses to changing ocean chemistry.

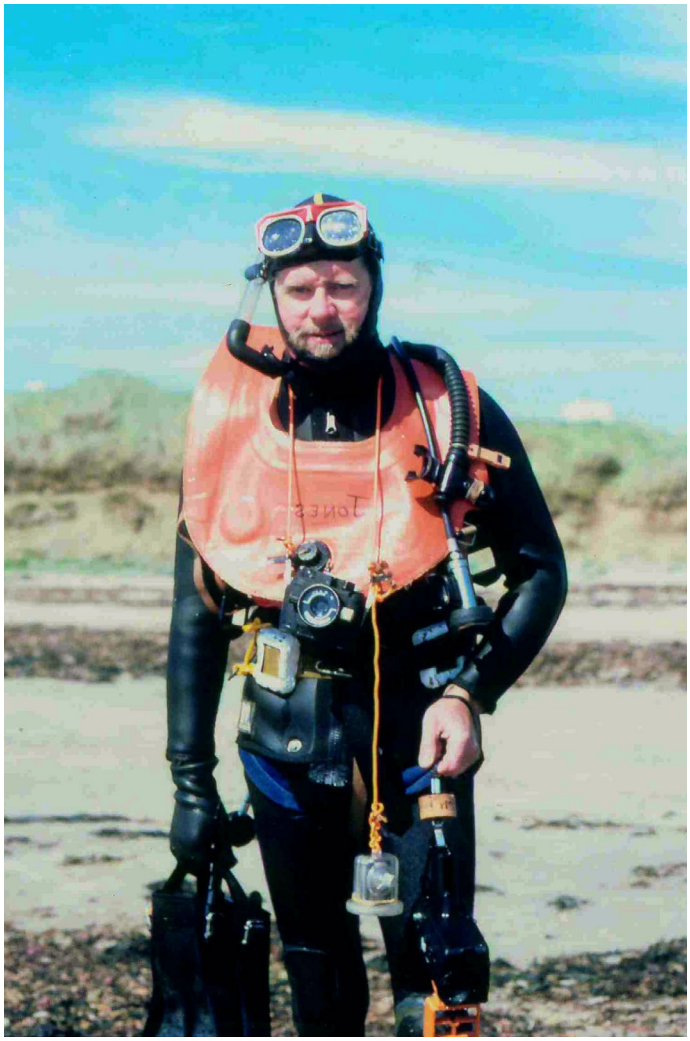
Ru's influence extends far beyond his backyard. He is the past chair of the IOOS Association; a member of the IOOS Federal Advisory Committee; councilor of the bi-national Gulf of Maine Council on the Marine Environment; board director of the Marine and Oceanography Technology Network; and science advisory board member for the Lake George Jefferson Project. I was pleased to invite him to Capitol Hill in 2016 to testify before the Senate Democratic Steering and Outreach Committee to share his expertise with Congress. I and my staff are greatly indebted to him for all of his advice and counsel over the years. It is truly difficult to overstate the breadth and significance of his service.

Ru would be the first to say that the foundation of his success is his family: his wife Ann Michelle and their children, Alistair and Marin. I know that everyone at NERACOOS and throughout the ocean observing community joins me in thanking Dr. Morrison and his family for his instrumental leadership and vision. We wish him all the best in retirement.

Ru, Thank you! Jeanne Shaheen

DR CECIL JONES

We regret to announce the death of Dr Cecil Jones. Cecil was a longstanding friend and contributor to the School of Ocean Sciences.



"Cecil was amongst the first intake to read Psychology at Bangor and after graduating, took on the role of lecturing in the subject for the Department of Extra Mural Studies. However, he always had a strong interest in Marine Science, and I first met him on one of his visits to Marine Laboratories in Menai Bridge in 1969.

He obtained his PhD in 1972 and soon after discovered the slate wreck at Pwll Fanogl in the Menai Strait. The excavation and mapping of this wreck formed the centre of diving activity for several years and won him a Duke of Edinburgh award, and Gold medal as leader of sub aqua groups monitoring the Menai Strait.

In the 1990's he received a research grant from the Pen-y-clip trust and established the Cemlyn Jones Studentship for studies in Marine Archaeology. In 1998 he finally joined the School of Ocean Sciences where he developed and established Marine Environmental History as a subject area.

To all who knew Cecil he was an inspiration with a total enthusiasm for his subject. He was a fund of local marine knowledge and his stories of the lost underwater settlements of the Llŷn peninsular are legendary.

We have all lost a great inspirational academic and friend who will be hard to replace."

Professor David Jones

"Cecil was a great communicator, very skilled at engaging with his audience. For many years he contributed evening lectures to students as part of the Marine Management module that was run over a weekend at Gregynog Hall in mid Wales, lectures that were full of interest and humour and equally enjoyed by students and staff.

His great passion was for Marine Archaeology – he was an experienced diver and he spent much of his life exploring the coastal waters around Anglesey where he made important archaeological discoveries. He and his team of enthusiasts established repeat video surveys of the seabed in several areas. This activity – collecting a time series of information – was unfashionable at the time but we can now appreciate its value when we are trying to assess ecosystem responses to environmental change. Cecil did this in his spare time without any financial support.

We currently have an ongoing project, funded by the Cemlyn Jones Trust, to digitise and catalogue his benthic survey video archive.

He was first and foremost an enthusiast. When Cecil knocked on your door, you knew that there was a high risk that you would be persuaded to help him in his latest schemes. It was also likely that you would agree to provide an evening course on marine biology, geology, or oceanography to the public in some remote part of North Wales – a decision you might regret as you drove through wind and rain on dark nights in February!"

Professor Colin Jago

OLE MIKKELSEN (Postdoc, Ocean Sciences, 2007)

"If you have purchased a LISST in the last six months, there is a very high chance that it was manufactured in a 2nd bedroom or the corner of a living room!"

"I completed a three-year postdoc on the MATSIS project with Colin Jago, Sarah Jones and Gay Mitchelson-Jacob in 2007. I then relocated to Washington (WA) state, USA where I had been offered a job with Sequoia Scientific, Inc. in Bellevue, just outside of Seattle. Sequoia manufactures the LISST series of laser particle size analysers, holographic cameras, and acoustic backscatter sensors, all for measuring suspended particle size, shape, and concentration, and water optical properties. I worked for Sequoia for six years, working my way up to become VP of Sales & Marketing. In late 2013 I left Sequoia to return to my native Denmark and work as a system sales manager for another underwater technology company, MacArtney Underwater Technology Group, in the Danish HQ.

Late 2018 I was headhunted back to Sequoia because the co-founder and President, Dr. Yogi Agrawal, was retiring. Since 1/1/2019 I have been back in WA as the President & CEO of Sequoia. Our customers are located all over the world and our instruments are used in applications as diverse as basic aquatic science studies (e.g. sediment transport, flocculation, marine optics, plankton studies) over environmental monitoring (harmful algal blooms, oil spill remediation) to a range of industrial applications such as ceramics, oil & gas drilling, stormwater monitoring, aquaculture food pellet design, enzyme production, hydropower, and much more.

As the President I am not involved in any research projects, but we have team members who are very active in obtaining funding for prototype development of new instrument designs. We are currently working on two externally funded research projects. One is for developing an instrumentation system that can monitor the environmental impact of deep-sea mining at a water depth of 6,000 m in real-time. So, a very practical application. The other is for developing an absorption sensor that can measure hyperspectral water absorption in-situ. This type of measurement is needed to improve our understanding of ocean biogeochemical cycling and to provide ground truth optical property data for future airborne and satellite ocean color missions, such as the Plankton, Aerosol, Cloud and ocean Ecosystem (PACE) Earth-observing satellite mission. So, an application much more catered towards the science market. We are also often working to optimize and improve our existing instrumentation offering. In the last year we have thus developed sensors specifically for oil spill research and remediation efforts (almost 10% of all scientific papers with LISST results are oil-spill based), and for harmful algal bloom monitoring and studies. We have also invented and introduced a method (patent pending) to combine acoustic and optical sensors in a manner that improves the accuracy of sediment concentration measurements with almost an order of magnitude compared to traditional sensors such as turbidity sensors and optical backscatter sensors.

When COVID-19 hit WA state hard in March, we were completely shut down for two weeks and didn't really move at all. We then started to let a couple of technicians come into the office and moved half the workshop home to the other technicians, so they could assemble instruments at home. If you have purchased a LISST in the last six months, there is a very high chance that it was manufactured in a 2nd bedroom or the corner of a living room with some of our technicians! The rest of us who work in admin, science, engineering, marketing, finance, HR and sales can work from home and we have been doing so since it all started. I do not anticipate us coming back to the office again in a 'normal' manner until perhaps sometime in Q1 2021, but more likely not until Q2, 2021. Fortunately we have good software systems that make it easy for us to collaborate internally, even if we are almost all working remotely all the time. We get together every Thursday at noon for a virtual lunch via Teams, and the managers update everybody else on what is going on. We also play trivia with a $50 prize for the winner, and two rounds of on-line bingo, with a $25 prize for each winner. Our VP Science & Technology, Dr. Wayne Slade, has taken home more than $600 in quiz and bingo winnings so far! "

"Here are pictures of two bridges. The first are the Lacey V. Murrow (right) and Homer M. Hadley (left) memorial bridges, which carries Interstate I-90 across Lake Washington from Seattle towards Bellevue (the skyscrapers in the distance). In normal times I would drive across twice a day to get to and from work."

"The other is the Salmon Bay Bridge, also known less poetically as Bridge No. 4, a bascule railroad bridge that I can also see from my rooftop. The bridge spans the Lake Washington Ship Canal and connects the railroad lines north of Seattle with the railroad lines south of Seattle. A very wide mix of freight and passenger trains pass over the bridge every day."

JONATHAN SAYER (Marine Biology / Oceanography, 2015)

Four Dive into a New Venture

Four SOS alumni are involved with the establishment and operation of a new company specialising in underwater research and development. Tritonia Scientific Ltd. (tritoniascientific.co.uk), based near Oban on the west coast of Scotland, was incorporated in 2018 and is co-owned and managed by Martin and Jane Sayer. Martin was a PhD student in the Animal Biology Group at Menai Bridge (1984-7) while Jane (née Beard) was a member of the inaugural MSc Marine Biology course (1985-6) before working with Peter Spencer on the Liverpool Bay water quality programme (1986-7).

Photo legend: *(L to R) Hugh, Jonathan, Jane and Martin photographed in the emergency recompression unit*

Martin and Jane set up the new company following the closure of the NERC National Facility for Scientific Diving (NFSD). Although primarily diving-based, Tritonia Scientific has expanded rapidly into areas of marine technology and marine-related aerial technology. A lot of the work involves surveying and monitoring underwater environments and marine structures, and most is based on the application of novel adaptations of emerging stereophotogrammety techniques and technologies. In the past two years, the team have undertaken commercial contracts that have involved quantifying biofouling on oil and gas platforms; structural surveys of harbours, piers and breakwaters; habitat mapping; and marine debris assessments.

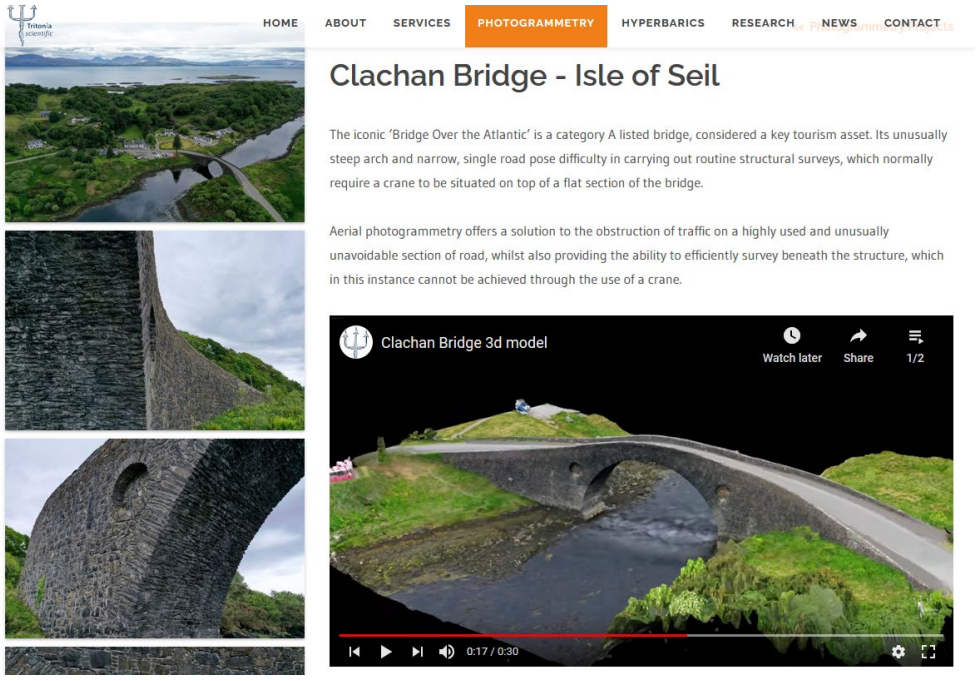
The company continues to provide diving support for academic partners and is currently collaborating on projects with researchers at the Marine Biological Association, University College London, British Antarctic Survey, Cefas, Natural History Museum, the Scottish Association for Marine Science, Scottish Natural Heritage and the Universities of Aberdeen, East Anglia, Stirling, Bristol and Newcastle. It also owns and manages the Oban hyperbaric recompression facility which is the only unit operating on the west coast of Scotland that provides NHS-funded emergency medical treatment for divers suffering from decompression illness.

Hugh Brown, who graduated from the SOS with a BSc in Marine Biology and Oceanography in 1996, transferred across from the NFSD with Martin in 2018. Hugh had previously worked for the University Marine Biological Station, Millport and the British Antarctic Survey before starting work for the NFSD in 2002. Hugh is the senior boat skipper at Tritonia and is a qualified diving supervisor. He is also one of the company's ROV pilots in addition to being a CAA-accredited commercial unmanned aircraft system (aerial drone) pilot.

In 2019, Jonathan Sayer joined the company as project manager. Jonathan also graduated from the Marine Biology and Oceanography BSc course (2015) before working in the Scottish aquaculture industry as an environmental scientist for over three years. As well as being one of the commercially qualified divers and boat skippers, Jonathan is responsible for Tritonia's quality management system and leads the current application for ISO9001 accreditation.

The group has maintained links with SOS over the years. The NFSD provided accurate and non-destructive diving-based sampling of shell material for the sclerochronology group lead by Chris Richardson and James Scourse and were also involved with supporting diving operations in the Chagos Archipelago that involved John Turner. The latter association continued with Tritonia Scientific and the two groups are involved in current proposals that should hopefully result in further collaboration for the next four years.

Tritonia Scientific undertook an aerial photogrammetry demonstration project on the iconic 'Bridge Over the Atlantic' on the Isle of Seil, just south of Oban. The structure is a category A listed bridge, considered a key tourism asset. Its unusually steep arch and narrow, single roadway posed difficulty in carrying out routine structural surveys. Tritonia Scientific modelled the bridge using aerial drone photography.



A video and interactive model of the survey can be found at:

https://tritoniascientific.co.uk/photogrammetry-projects/clachan-bridge

KEVIN DEEMING
(Physical Oceanography MSc, 1969)

The Bridges of France to see before you die.

"Bonjour from the northern Dordogne in France, where the food, wine, and climate are very pleasant. It is the walnut season and many kilos are being collected for friends back home in the UK.

I am one of the 1969 cohort of MSc physical Oceanographers – we few, we happy few, we band of brothers. I am not sure how many of us are still shuffling along this mortal coil. They were good days at Menai Bridge: the heady days of Crisp, Darbyshire, Taylor-Smith, Simpson, Buchan, Grove, Jones, Rees et.al. OK, I may be looking at things through rose-tinted glasses but I claim the privilege of old-age. In many ways, marine science was in its infancy. It never ceases to amaze me that the idea of plate tectonics was still then a hypothesis. However, the emergence of the offshore oil and gas industry was acting as a major catalyst for new thinking and technologies. In those days, 'The Labs' was the leading university marine research station in the UK.

My career was in commercial oceanography. I played a part in helping to develop several companies – the last one being Metoc plc. What am I most proud of? The way that we integrated all the marine disciplines to scope, investigate, obtain environmental and engineering permits, and then project manage the installation of many of the major electric power cables on the European continental shelf and elsewhere in the world. Getting the power to market for the green revolution was always crucial, and still is.

I have now been retired for nearly 10 years and spend half my time in leafy Surrey and, if I can, the other half in France. Which brings me to what I am really writing about: the bridges of France, which you should see before you die.

Rivers and straits have always been problematic for humankind. For centuries communication across them was by ferry or by fording them during dry periods. However, the construction of good wooden bridges, which could provide crossings in bad weather or flood, enabled commerce to flourish. Prosperity increased and city and town development followed. Over the years, the early wooden bridges gave way to the more durable stone and brick. Here in France there are some remarkable bridges remaining, which bear testimony to the brilliance of its engineers – all the way back to the Romans.

1 Pont Du Gard (100 AD)

Actually, this is not exactly a bridge but looks like one. It was built to carry water along the 50 kms Nimes aqueduct. It is France's third most visited attraction (after the Eiffel Tower and Mont St Michel). The Romans built this immense structure with local limestone. With three levels of arches it spans the River Gardon. It descends by 2.5 cm from end-to-end, providing a small incline for a gentle flow of water. It has stood for nearly 2000 years and is now a UNESCO heritage site.

2 Pont d'Avignon (1185 AD)

One of the most photographed bridges in France, it attracts 300,000 visitors a year. Yet, the paradox is that they cannot cross over it! It was built under the direction of St Bénézet, a shepherd, after he felt commanded by a vision from God to place a bridge across the River Rhone at Avignon. The locals were dismissive but, after many miracles – including the deaf and the blind being cured – they were convinced of his divine commission and helped him. Unfortunately, the bridge was abandoned in the 17th century as the arches tended to collapse each time the Rhone flooded. Only four arches – out of the original 22 arches -- and the gatehouse remain in place. The bridge was made famous in the 15th century by the song, 'Sur le Pont d'Avignon'.

3 Pont Valantré (1380 AD)

A splendid medieval fortified bridge, which crosses the River Lot at Cahors. Legend has it that construction took so long, the foreman signed a pact with the devil to help him finish it. Later, to save his soul, he tricked the devil out of the bargain. The furious devil sent one of his imps every night to loosen the last stone on the central tower so that the masons had to put it back every day. In the 19th century, when the bridge was being restored, a sculpture of an imp was placed on the central tower. Now the devil mistakenly thinks his work continues every day, when he checks the tower! Designed to be its own fortress, the three defensive towers never saw combat.

4 Pont Neuf (1607 AD)

Contrary to what its name, 'New Bridge', suggests, this is the oldest standing bridge across the River Seine in Paris. It stands at the downstream point of the Île de la Cité, the island in the middle of the river that was, circa 250 BC, the birthplace of Paris (Lutetia). The bridge links the island to the Right Bank (7 arches) and the Left Bank (5 arches). Before its construction Parisian bridges were mainly made of wood and covered with houses. Most of them collapsed. It was real change to have a bridge built in stone and without houses. Several French expressions have developed from the name: '*a Pont-Neuf*' is a person who speaks with *'a popular air'*; because it has been there so long '*to wear like a Pont-Neuf*' means to be *'indestructible and healthy'*; and as the first fries in Paris were sold on the bridge, *'Pont Neuf apples'* are a category of fries – those of 1cm square.

5 Viaduc de Garabit (1884 AD)

This was designed by Gustave Eiffel, the French civil engineer, famed for the Eiffel Tower. It is a railway arch bridge spanning the River Truyère in the Massif Central. Impressively, the actual deflection (load displacement) was measured at 8 mm – just as had been calculated by Eiffel. At 124 metres above the river, it was the highest bridge in the world at the time. Until 2009, two regular passenger trains crossed the viaduct: a Corail route from Clermont-Ferrand to Béziers. It was closed after cracks were discovered in a foundation. However, after safety checks, it re-opened and carries traffic with a speed limit of 10 km/hour.

6 Viaduc de Rochers Noir (1913 AD)

Much like our very own Menai Bridge, by the early 19th century the most cost-effective solution for road traffic and the burgeoning railway system at difficult locations was the suspension bridge. France became a world leader. But everything changed in 1850 when the Basse-Chaine suspension bridge in Angers collapsed into the River Maine, killing 226 of the 478 troops who were marching across it at the time. Corrosion was the problem. It put back the use of this technology in France for many years. However, new designs, developed in the 20th century have culminated in several successful suspension bridges. An example is the Black Rocks Viaduct spanning Luzège ravine in the Correze. It carried steam trains until 1959. Now forbidden to all traffic, there are plans to renovate it with lottery money.

7 Viaduc de Millau (2004 AD)

Which brings us to one of the newest and iconic suspension bridges in recent years. The Millau Viaduct spans the valley of the River Tarn. Before it was built, it could take motorists up to four hours to cross the valley in heavy traffic. Now it only takes five minutes. It carries over 5 million vehicles a year. British architect, Sir Norman Foster, and French engineer, Dr Michel Virlogeux, combined to design and construct the tallest bridge in the world. It is ranked as one of the great engineering achievements of modern times.

Another bridge perhaps?

Metaphorically speaking, the next big challenge is to rebuild the bridge across the Channel between the UK and France – and hence Europe. At present it is in suspension!!

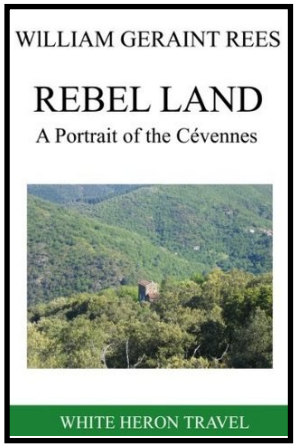
'*Bon chance'* or *'Fat chance"*? Only time will tell.

Meanwhile, stay well and keep dodging the ubiquitous coronavirus."

BILL REES
(Marine Biology, 1986)

"I'm still living mainly in the Cevennes (France) near to Le Vigan, which has a lovely bridge. Here is a photo of the bridge and an artist's impression of it.

Here is an excerpt from my book



Rebel Land: A Portrait of Cevennes:

'The home is near to *Le Vieux Pont*, a slender arched bridge built more than eight hundred years ago. A near perfect circle is formed by the arch and its reflection in the river, which Louis Agricol Montagné beautifully captured with watercolours in the manner reminiscent of the American Sublime School of painting. S.N.C.F. (national railways) made Montagné's work into a 1930s poster. Reprints of it are available from the Tourist Office (the former market hall) at the bargain price of six euros. Stand on the tall bridge, built to withstand spectacular floods. Then look down on the dark silhouettes of lolling and chubby (as in size, not metaphysical essence) chub. Much to the frustration of trout anglers, the chub are first to the fly, outcompeted only when screeching swifts arrive from Africa in May.'

This year I have written a book about playing competitive table tennis, which Parthian Press will be publishing next spring."

MANUEL NICOLAUS (Marine Biology / Zoology, 2006)

"Greetings from the most eastern point in Britain - mostly sunny Lowestoft!

I have been living here for the last 12 years and work for the Centre of Environment, Fisheries and Aquaculture Science (Cefas). In the picture you see me passing the bascule bridge and leaving Lowestoft harbour on board the RV Cefas Endeavour."

ANDY ATHERTON (Applied Marine Geoscience MSc, 2017)

"My bridge is the Buxin Bridge over the narrow straits separating Budai Island from Budai Township, southwest Taiwan.

The current in the straits is tidally influenced and changes direction dependant on the tidal height and time of day, very much like the tide in the Menai Strait.

I am currently in Taiwan as part of a team of 5/6 passive acoustic monitors (PAM) and noise monitors. We are observing the noise generated by piling operations for the Yunlin windfarm. The windfarm is being constructed on the edge of a reserve which is home to a variety of protected marine mammals including the Chinese white dolphin (Sousa chinensis) of which there are only 50 or so remaining."

MARK FLETCHER (Marine Biology / Oceanography, 2001 & Marine Env Protection MSc, 2002)

"I moved to Matsumoto, Japan 3 months ago from British Columbia with my wife.

We are currently picking grapes and apples in this rural area and are looking to buy and restore a traditional rural kominka house and would like to run an AirBnB farm restaurant. We are involved in voluntary community restoration of the rivers and local ricefield irrigation waterways which are everywhere.

Covid precautions are light here as it is a rural area with low numbers. People wear masks in public places, but no lockdowns."

"Here is a bridge to nearby Matsumoto castle which we visit regularly."

GUS JEANS
(MSc in Physical Oceanography, 1994 and PhD Internal Waves and Solitons,1998)

Following an MSc and PhD in Physical Oceanography at the School of Ocean Sciences, I moved on to the metocean industry.

I worked with Fugro for 15 years, gaining key skills and learning that a proven ability to deliver effective solutions to engineering clients is critical. Then 9 years ago I took the plunge and set up my own consultancy company, Oceanalysis Ltd. Having chosen a PhD topic on internal waves with clear industry applications, I have since worked on many related projects, establishing one of several niches of expertise. A type of high impact internal wave called a soliton is even at the core of my company logo.

Oceanalysis

I am the only employee in Oceanalysis, so administration is refreshingly simple and shareholder alignment perfect! But this brings challenges, with enormous fluctuations in workload and difficulty getting away from it all. But I find these are outweighed by many benefits. Years of working from home made it easier to adapt to Covid, which has accelerated trends for increased flexibility in the professional workplace. Covid has also accelerated the energy transition. Most of my work is now for offshore wind energy, one of the fastest growing industries in the world.

Large tides may have been a key factor in the evolution of bony fish and tetrapods

Pioneering research based on Hannah Bryne's (MSci Marine Biology and Oceanography) final year project has been published in Proceedings of the Royal Society A.

It investigates the role of ancient tides during the Late Silurian - Devonian periods (420 million years ago - 380 million years ago) in the evolution of bony fish and early tetrapods, the first vertebrate land-dwellers, a key stage of the evolution of life on Earth.

The research has been carried out by SOS's Professor Mattias Green together with Steve Balbus FRS (The Savilian Professor of Astronomy at the University of Oxford) and Per Ahlberg (the Professor of Evolutionary Organismal Biology of Uppsala University in Sweden) and led by PhD student Hannah Bryne (MSci Marine Biology and Oceanography and now a PhD student in Uppsala).

The research is the first to produce detailed numerical simulations to address the question of whether large tides occurred during this critical period. These are also the first calculations to relate tidal hydrodynamics to an evolutionary biological event.

The numerical simulations were computed using palaeogeographic reconstructions of the Earth's continents in an established state-of-the-art numerical tidal model. The simulation results show tidal variations in excess of four meters occurring around an area known as the South China block, which is the site of the origin and diversification of the earliest bony fish group, and has produced the earliest important fossils for this group. Geological evidence also points to tidal environments being closely associated with this class of fossils.

These first-of-their-kind results stimulate the need for more detailed tidal simulations of the ancient Earth. In particular, the researchers believe that the method used in this study can be used with a variety of palaeogeographic reconstructions at other time periods, to explore the tidal influence upon the origin and diversification of other early vertebrates, and perhaps the opposite as well: what might have been the role of tides in precipitating marine extinction events?

Citation: H. M. Byrne, J. A. M. Green, S. A. Balbus and P. E. Ahlberg (2020). Tides: a key environmental driver of osteichthyan evolution and the fish-tetrapod transition? Proceedings of the Royal Society A, https://doi.org/10.1098/rspa.2020.0355

Eds note: TV Scientist Brian Cox tweeted about this work and received 2.1K likes and 350 retreets within three hours of tweeting!

The Mauritius Oil Spill – how coral reefs, mangroves and seagrass could be affected

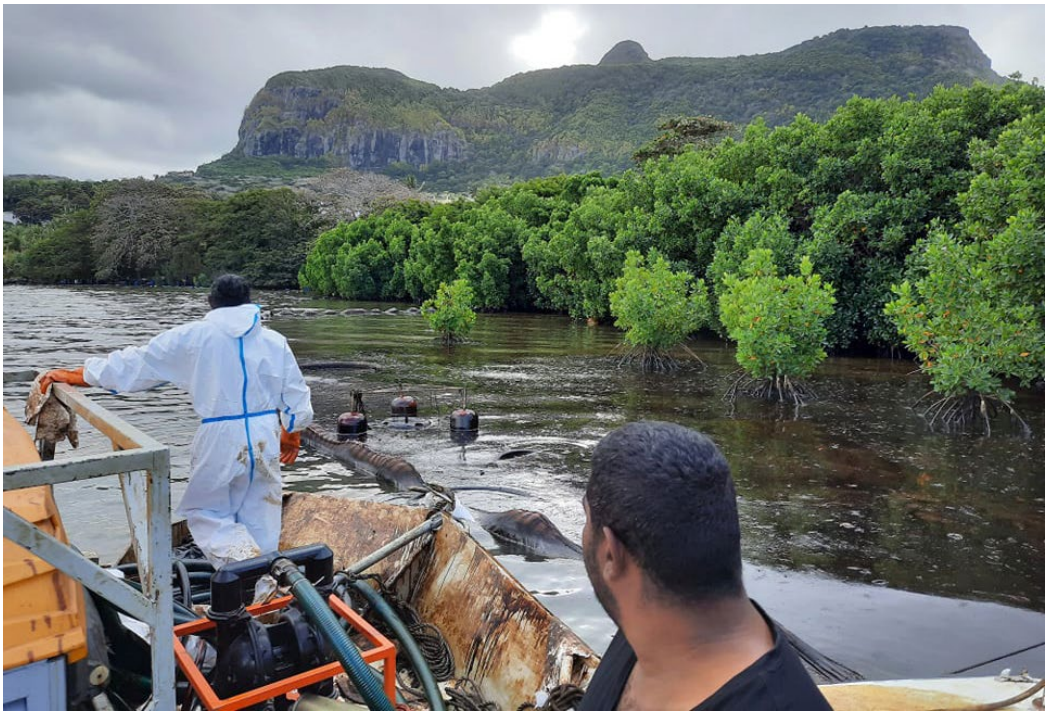
Sivajyodee Sannassy Pilly, PhD Candidate in Marine Ecology, Bangor University

Jyodee is from Mauritius, where she graduated with a BSc (Hons) in Marine Science and Technology. She then worked at the Mauritius Research council and Ministry of Environment for 2 years. In 2015, she was awarded the Chevening Scholarship and came to Bangor to undertake the MSc in Marine Environmental Protection at the at the School of Ocean Sciences. She then went back home and worked as a marine educator and coral reef restoration officer for the NGO, WiseOceans. She is now back in Bangor University pursuing a PhD, looking at the spatio-temporal variations and recovery of coral reef benthic communities in remote reefs.

Sometimes bad things happen in the worst possible places – like the MV Wakashio running aground on shallow reefs off the south-east coast of Mauritius on July 25.

The wreck of the bulk carrier ship began leaking oil in front of a nature reserve island (Ile aux Aigrettes), a couple of kilometres from a marine park (Blue Bay), and close to an internationally important wetland area (Pointe d'Esny Ramsar Site).

The MV Wakashio was carrying 4,000 tonnes of oil, which hardly compares to the 400,000 tonnes spilled in the Deepwater Horizon disaster of 2010. But it was the vessel's proximity to the globally recognised cluster of ecosystems in Mauritius that means this spill could have long lasting consequences.



Mauritius is a biodiversity hotspot and much of the island's unique wildlife depends on intricate connections between the reefs, lagoons, seagrass meadows and mangroves, so pollution in one habitat can have a devastating ripple effect.

With that in mind, what does the recent oil spill mean for the environment here?

What happens during an oil spill?

As soon as oil enters the ocean, lighter compounds in the fuel evaporate and the surrounding air can become toxic to wildlife and even harmful to human health. Oil slicks form on the sea surface and are carried away from the spill site.

When reefs and other habitats are nearby, it's this early window that is most crucial for preventing damage. Containing the spill with booms or collecting the oil while it is on the surface with skimmers can help stop it spreading.

As the lighter components of the oil evaporate, a heavy sludge forms and can be carried by the tide towards the coastline. Washed up, it effectively smothers any organism it touches, including corals, fish and seabirds, while toxic compounds accumulate in their tissues. Eventually, microbes will break down the remaining oil, but this may take many years.

Connections in coastal ecosystems

More than 500 metres of coral reef are thought to have been destroyed by the ship as it ran aground, but this is just the beginning.

As the oil sinks, it can cover more of the reef. Corals depend on sunlight for sustenance but they also eat floating microorganisms called zooplankton. Aside from clouding the water and reducing sunlight, oil pollution has been shown to kill zooplankton, while the toxic chemicals in crude oil weaken the ability of corals to photosynthesise. Deep water corals coated in oil experienced tissue swelling and ruptures.

In the years following an oil spill, growth and reproduction is reduced, leaving less live coral on reefs. In spite of this, coral reefs are resilient ecosystems and can recover to pre-disaster conditions over several decades, as long-term research following an oil spill in 1986 off the coast of Panama showed.

Key to that recovery are the efforts of local species. Parrotfish, for example, provide an essential service to reefs on the south-east coast of Mauritius by eating seaweeds that could otherwise choke and consume the coral when it's weakened by pollution. But they don't spend their whole lives doing this, they're born and raised in nearby mangroves and seagrass beds.

Mangrove forests are coastal wetlands comprised of a dense jumble of trees that thrive in salt water. Their tangled roots form almost impenetrable mazes that offer nursery habitats for parrotfish, snappers, jacks, barracudas and even sharks. Here, young reef fish can grow up safe beyond the reach of larger predators.

Seagrass form underwater plains of flowering plants. They are another kind of nursery refuge for ocean life, but, like mangroves, they struggle to recover from oil pollution. Both habitats tend to flourish where waves and tides are gentle. Sediment builds up around them and so does oil sludge.

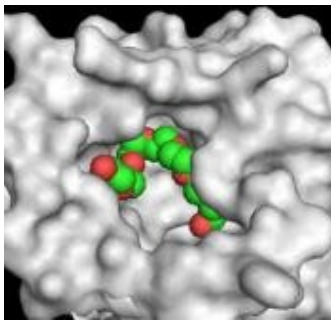
Aside from nurturing future generations of coral reef fish, mangroves and seagrass meadows trap material that runs off the land, providing clearer coastal waters over reefs. In turn, reefs absorb the energy of waves from the open ocean, protecting mangroves and beaches from erosion.

Marine life in places like Mauritius rely on all three ecosystems, and species often reside in one while feeding in another. This ensures a steady flow of nutrients between them. Seabirds nesting in mangroves feed on seagrass meadows and their organic waste is carried onto reefs where it nourishes organisms there.

These connections mean that if one ecosystem is damaged, the others are also affected. This ensures that the effects of oil spills are often more severe than they might first appear. Only by monitoring and protecting each of these ecosystems can there be any hope for long-term recovery in the region.

Published here: https://theconversation.com/mauritius-oil-spill-how-coral-reefs-mangroves-and-seagrass-could-be-affected-144954

Dr Christian Dunn *collecting fresh water to test for the presence of microplastics. "We want PRC Wales to be a true hub of knowledge for anyone, from our current and prospective students, to members of the public, businesses and policy makers."*



The resolved structure of an enzyme from a marine plastic degrading bacteria.

A new research centre to study the growing problem of plastic waste

A new research Centre has been established at Bangor University to study the growing problem of plastic. The Plastic Research Centre of Wales (PRC Wales) is the first of its kind in the country and brings together a wide variety of academics, students, organisations and industries.

Bangor University's former Pro-Vice Chancellor for Research and Impact, **Prof David Thomas**, brought together the group after realising many scientists in the university were already researching various aspects of plastic waste.

"*We felt it was time to add our considerable academic weight to the fight against plastic pollution*." said Prof Thomas.

"*We've brought together a great group of researchers from all across Bangor University, but the PRC Wales isn't just about research; everyone involved in the centre is passionate about tackling what David Attenborough describes as an "unfolding catastrophe"*.

The Centre has already been successful in winning a £1.5M NERC grant to examine how plastic waste impacts the marine environment, affecting communities who rely on the sea for their income.

The focus is the Philippines which has a severe plastic pollution problem that affects the tourism sector, a significant contributor to the country's development. Much of the problem can be traced to the disposal of single use plastics.

Although "*vast ocean garbage patches*" have been much publicised, this project will focus on the journey taken by plastics, and where along the coastal the plastics end up.

SOS **Prof. Simon Neill**, the project lead explains: "*We will focus on the Cebu Islands – the biggest marine protected area in the Philippines. Working with the University of San Carlos in the Philippines, Nanyang Technological University in Singapore, and Aquatera in Scotland, the project will develop a model that can be used to map how marine plastic litter is carried by wind, tides and ocean currents. The project will track plastics from their source to where they ultimately settle. It will also apply forensic techniques to track litter back to its origin.*

An innovation in the modelling is the inclusion of the physical processes which affect the condition of the plastic waste as it travels through the system, including changes due to exposure to UV light and mechanical degradation due to waves."

The centre is not only about identifying the problems, but also about finding solutions. Bangor' University's BioComposites Centre are also contributing through their work investigating alternatives to plastic packaging including most recently, working with willow.

The Plastic Research Centre of Wales (PRC Wales)

The Moon and stars are a compass for nocturnal animals but light pollution is leading them astray

Many nocturnal animal species use light from the moon and stars to migrate at night in search of food, shelter or mates. But in our recent study we uncovered how artificial light is disrupting these nightly migrations.

Electric lighting is transforming our world. Around 80% of the global population now lives in places where night skies are polluted with artificial light. A third of humanity can no longer see the Milky Way – the galaxy our solar system belongs to. But light at night has deeper effects. In humans, nocturnal light pollution has been linked to sleep disorders, depression, obesity and even some types of cancer.

Studies have shown that nocturnal animals modify their behaviour even with slight changes in night time light levels. Dung beetles become disoriented when navigating landscapes if light pollution prevents them from seeing the stars. Light can also change how species interact with each other. Insects such as moths are more vulnerable to being eaten by bats when light reduces how effective they are at evading predators.

Relatively little is known about how marine and coastal creatures cope. Clownfish exposed to light pollution fail to reproduce properly, as they need darkness for their eggs to hatch. Other fish stay active at night when there's too much light, emerging quicker from their hiding places during the day and increasing their exposure to predators. These effects have been observed under direct artificial light from coastal homes, promenades, boats and harbours, which might suggest the effects of light pollution on nocturnal ocean life are quite limited.

Except, when light from street lamps is emitted upwards, it's scattered in the atmosphere and reflected back to the ground. Anyone out in the countryside at night will notice this effect as a glow in the sky above a distant city or town. This form of light pollution is known as artificial skyglow, and it's about 100 times dimmer than that from direct lighting, but it is much more widespread. It's currently detectable above a quarter of the world's coastline, from where it can extend hundreds of kilometres out to sea.

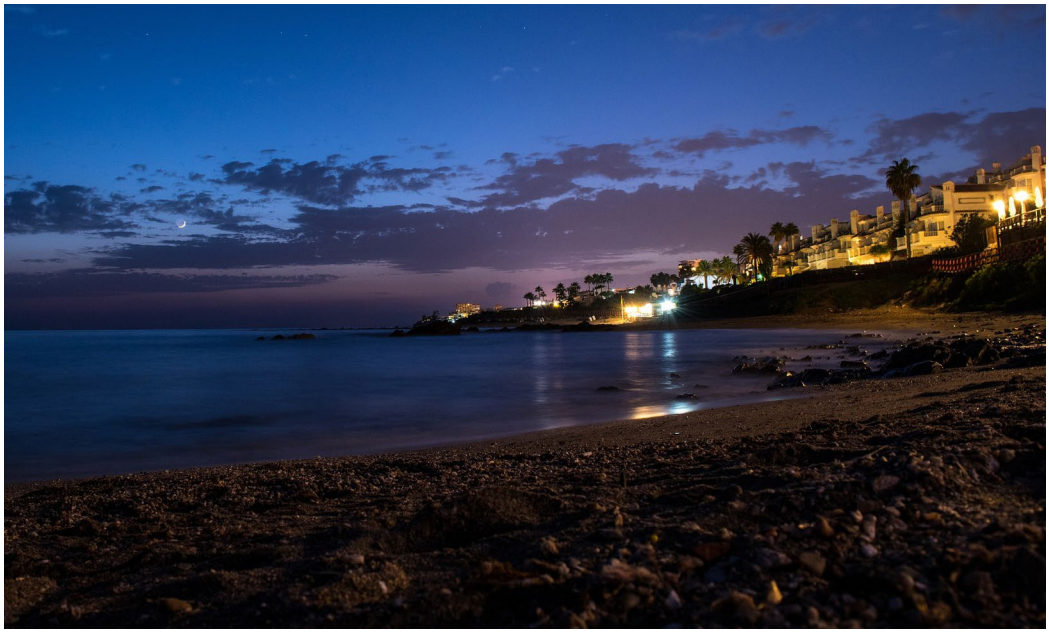
Humans aren't well adapted to seeing at night, which might make the effects of skyglow seem negligible. But many marine and coastal organisms are highly sensitive to low light. Skyglow could be changing the way they perceive the night sky, and ultimately affecting their lives.

Crustaceans in the spotlight

We tested this idea using the tiny sand hopper (*Talitrus saltator*), a coastal crustacean which is known to use the moon to guide its nightly foraging trips. Less than one inch long, sand hoppers are commonly found across Europe's sandy beaches and named for their ability to jump several inches in the air.

They bury in the sand during the day and emerge to feed on rotting seaweed at night. They play an important role in their ecosystem by breaking down and recycling nutrients from stranded algae. If you turn over washed up seaweed on an evening beach walk, you should have no trouble finding them.

In our study, we recreated the effects of artificial skyglow using a white LED light in a diffusing sphere that threw an even and dim layer of light over a beach across 19 nights between June and September 2019. During clear nights with a full moon, sand hoppers would naturally migrate towards the shore where they would encounter seaweed. Under our artificial skyglow, their movement was much more random. They migrated less often, missing out on feeding opportunities which, due to their role as recyclers, could have wider effects on the ecosystem.



Artificial skyglow changes the way sand hoppers use the moon to navigate. But since using the moon and stars as a compass is a common trait among a diverse range of sea and land animals, including seals, birds, reptiles, amphibians and insects, many more organisms are likely to be vulnerable to skyglow. And there's evidence that the Earth at night is getting brighter. From 2012 to 2016, scientists found that Earth's artificially lit outdoor areas increased by 2.2% each year.

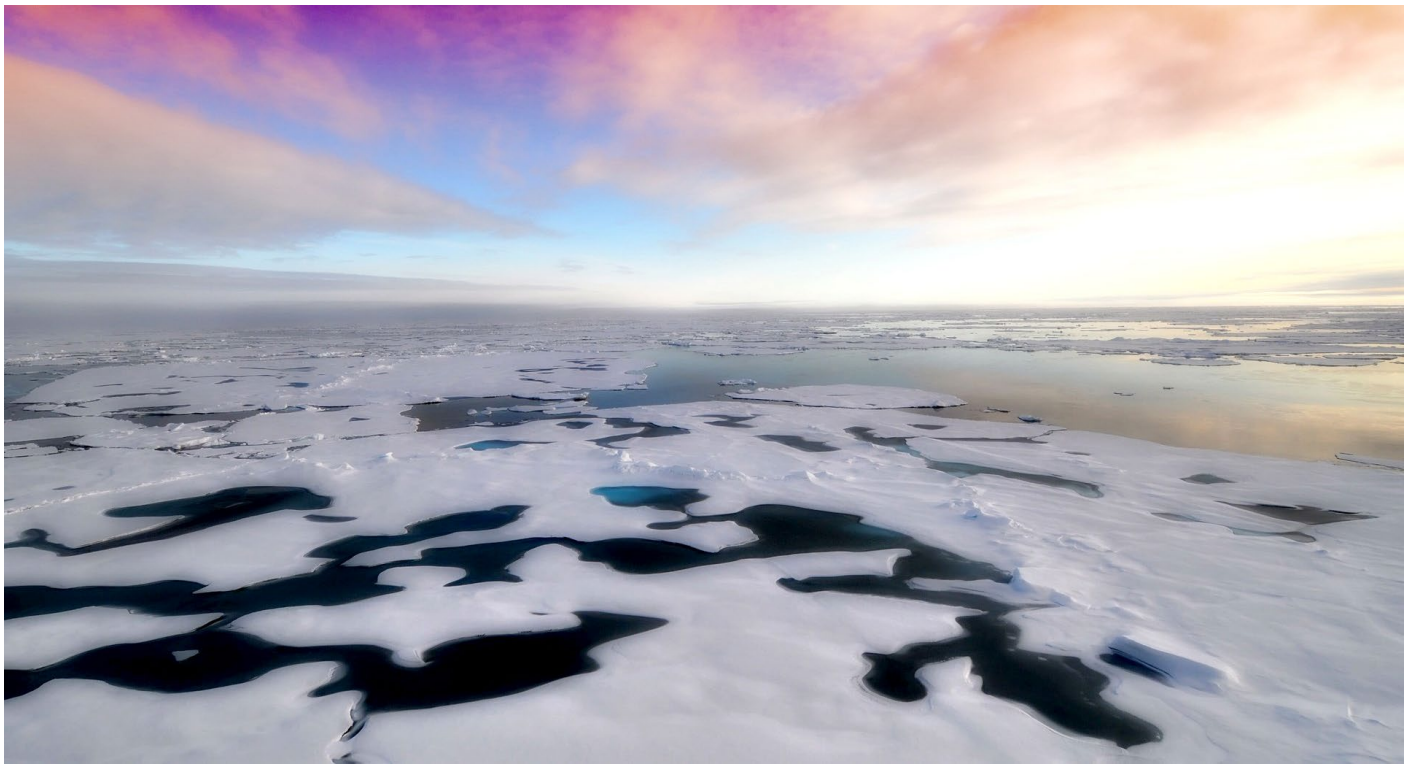
As researchers, we aim to unravel how light pollution is affecting coastal and marine ecosystems, by focusing on how it affects the development of different animals, interactions between species and even the effects at a molecular level. Only by understanding if, when and how light pollution affects nocturnal life can we find ways to mitigate the impact.

Article also published online:
https://theconversation.com/the-moon-and-stars-are-a-compass-for-nocturnal-animals-but-light-pollution-is-leading-them-astray-142301

This work was partly carried out by **Svenja Tidau**, an MSci student, under the supervision of **Stuart Jenkins** and Bangor alumni **Tom Davies**.

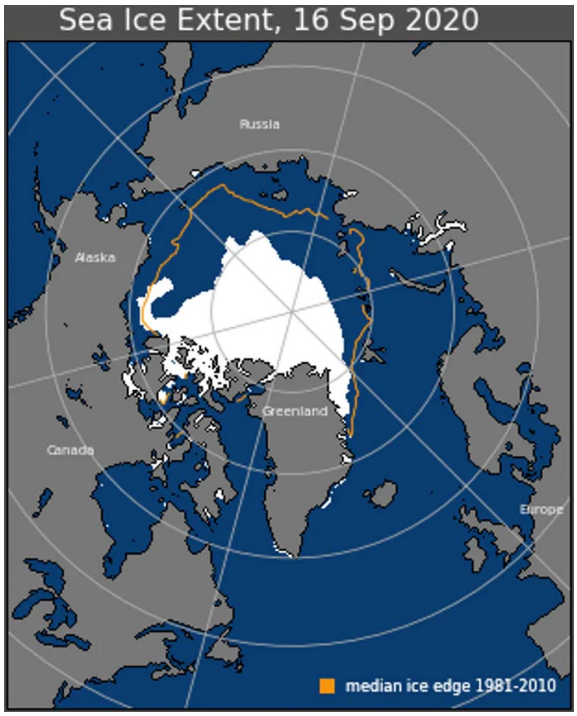
Citation: Daniela Torres, **Svenja Tidau**, **Stuart Jenkins** & Thomas Davies (2020). Artificial skyglow disrupts celestial migration at night. Current Biology, 30,12, PR696-R697. https://doi.org/10.1016/j.cub.2020.05.002

Arctic sea ice is being increasingly melted from below by warming Atlantic water



Each September, scientists like me look out for the point when the Arctic's meagre summer fizzles out and sea ice begins to grow once more. This point is known as the annual sea ice minimum extent. It has declined consistently over the past 15 years, and 2019 was the second lowest after 2012 in 42 years of continuous satellite records. This year's minimum is imminent, and there is already even less ice coverage than last year.

Below - Arctic sea ice today (white) is covering a much smaller area than in 1980-2010 (orange line). National Snow and Ice Data Center, University of Colorado, Boulder, CC BY-SA



What's causing this decline in minimum sea ice extent? The short answer is our changing climate. But the more specific answer is that Arctic sea ice is increasingly being thinned not just by warm air from above but by ever-warmer waters from below.

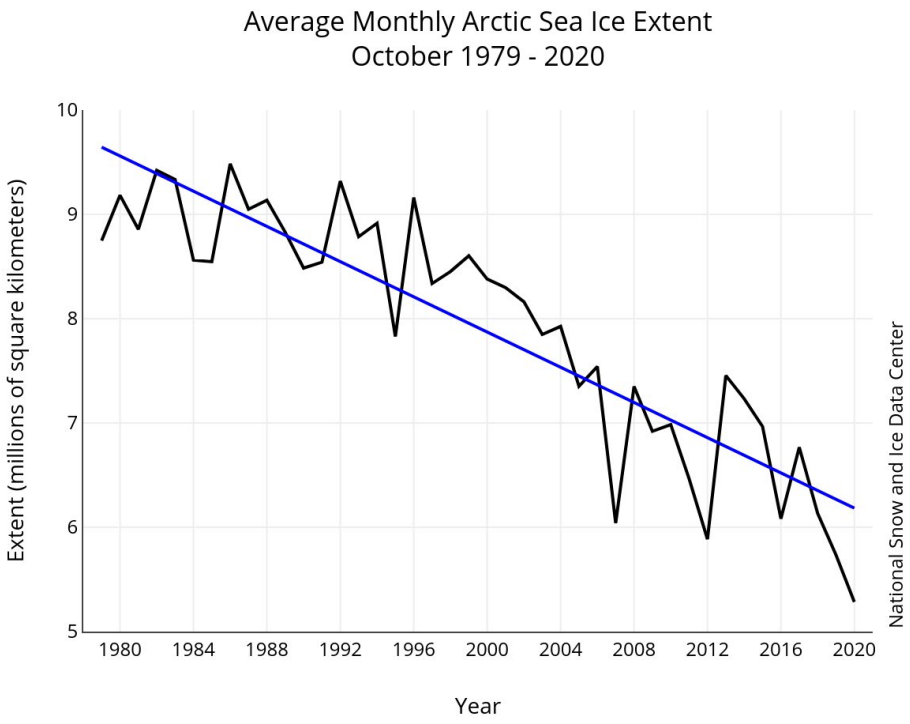
In fact, in a recently published scientific study my colleagues and I looked at why sea ice was melting in the eastern Arctic Ocean and showed that the influence of heat from the interior of the ocean has now overtaken the influence of the atmosphere.

While atmospheric heat is the dominant reason for melting in the summer, it has little influence during the cold dark polar winter. However, the ocean warms the ice from below year-round. Our new research shows that this influence has more than doubled over the past decade or so, and is now equivalent to the melting of nearly a metre thickness of sea ice each year (For comparison, at the North Pole the ocean is usually only covered by a couple metres of ice).

This warm water, sometimes referred to as the "heat blob", originates in the Atlantic and heads northwards via an extension of the Gulf Stream, entering the Arctic Ocean around Svalbard, an archipelago halfway between Norway and the North Pole. The blob has already resulted in the disappearance of winter sea ice off the northern coast of Norway and north-west Russia.

Further to the east, this warm water has been isolated from the sea surface, and so sea ice, by a layer of colder, fresher water. However, as the heat blob is getting warmer and moving closer to the surface its influence is now spreading eastwards through the Arctic.

Stop Press!
October 2020 sea ice extent
is the lowest on record



National Snow and Ice Data Center, University of Colorado, Boulder, CC BY-SA

In a second scientific paper we showed that currents in the upper Arctic ocean were increasing which, when combined with declining sea ice and the weakening of the boundaries between layers of warm and cold water, was potentially stirring more warm water from the heat blob towards the surface. The combined impact is a new back and forth relationship between sea ice and ocean heat which could lead to a new ocean climate state in the eastern Arctic Ocean.

All this may be feeding into ever more extreme climate change in the Arctic. Throughout summer 2020 the Siberian heatwave continually shattered temperature records, including eastern Arctic sea surface temperatures. And while sea ice reflects much of the sun's rays back into space, open water is dark and absorbs the sun's heat. So as the sea ice retreated the surface water is warmed, which in turned further warms the atmosphere above, quite apart from the influence of increasing greenhouse gases.

There is still much more to learn about the link between the eastwards spread of the influence of Atlantic heat, and the reduction in sea ice it brings, and knock on effects on severe weather at lower latitudes. But it is clear that the Arctic – already warming faster than anywhere else on Earth – could be in the process of transitioning to a "new" state.

Article also published online:
https://theconversation.com/arctic-sea-ice-is-being-increasingly-melted-from-below-by-warming-atlantic-water-144106

This work is part of an international collaboration involving Ocean Science's **Tom Rippeth**, **Yueng Lenn** and **Ben Lincoln**.

Citations:

Barton, B., **Lenn, Y-D.** & Lique, C. (2018). Observed atlantification of the Barents Sea causes the Polar Front to limit the expansion of winter sea ice. Journal of Physical Oceanography, 48 (8): 1849–1866.

Lenn, Y. D., Wiles, P. J., Torres-Valdes, S., Abrahamsen, E. P., **Rippeth, T. P.**, Simpson, J. H., Bacon, S., Laxon, S. W., Polyakov, I., Ivanov, V. & Kirillov, S. (2009). Vertical mixing at intermediate depths in the Arctic boundary current. Geophysical Research Letters, 36, p. L05601.

Polyakov, I., **Rippeth, T.**, Fer, I., Alkire, M., Baumann, T., Carmack, E., Ivanov, V., Janout, M. A., Padman, L., Pnyushkov, A. & Rember, R. (2020). Weakening of cold halocline layer exposes sea ice to oceanic heat in the eastern Arctic Ocean. Journal of Climate, 33(18), p. 8107-8123

Polyakov, I., **Rippeth, T.**, Fer, I., Baumann, T., Carmack, E., Ivanov, V., Janout, M. A., Padman, L., Pnyushkov, A. & Rember, R. (2020). Intensification of Near-Surface Currents and Shear in the Eastern Arctic Ocean: A More Dynamic Eastern Arctic Ocean. Geophysical Research Letters, 47(16), 2020GL089469

Climate change is impacting the spread of invasive animal species

Research by a team of experts from Bangor University, and the German Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) and University of Greifswald's Zoological Institute and Museum has revealed how climate change may be assisting the spread of invasive species.

Adult specimen of Hemigrapsus sanguineus.

(Photo credit: Alfred-Wegener-Institut / Uwe Nettelmann)

The results of their study which have just been released in the journal "Ecography" indicated considerable potential for the Asian shore crab to spread further north, along the coasts of Northern England and Norway.

According to **Dr Luis Giménez** of the School of Ocean Sciences:

"Our study confirms that, when it comes to predicting the climate-related spread of marine animals, we need to especially focus on the early stages of development, as they are critical for the settlement on new habitats and the establishment of new permanent populations."

Citation: Luis Giménez Michael Exton Franziska Spitzner Rebecca Meth Ursula Ecker Simon Jungblut Steffen Harzsch Reinhard Saborowski Gabriela Torres (2020). Exploring larval phenology as predictor for range expansion in an invasive species. Ecography, https://doi.org/10.1111/ecog.04725

How animals are coping with the global 'weirding' of the Earth's seasons

Yellow-bellied marmots are a North American species of ground squirrel.

Image by Martin Bächer, Pixabay.com

The UK's weather did a somersault in the first half of 2020, as the wettest February on record gave way to the sunniest spring. Climate change has warped the environmental conditions that might be considered normal, creating progressively weirder seasons that cause havoc for society. Longer, drier summers increase the risk of crop failure and fires, floods engulf homes, and less winter snowfall and earlier thaws threaten freshwater supplies.

But how do animals cope? Many species have evolved life cycles and strategies for coping with the seasons over millions of years, particularly those in temperate to arctic and alpine environments. Here, seasonal variability is large and predictable. Short and mild summers produce bursts of vegetation and food, the perfect time to give birth to young that can forage to develop their fitness. Long, harsh winters when food is scarce have shaped animals to largely depend on fat reserves for energy, and in extreme cases, to hibernate or migrate.

But as species come to inhabit seasons that no longer resemble those they evolved in, their chances of survival are governed less by their own careful adaptations, and more by the capricious weather. For species eking out an existence in seasonal climates, winter and summer produce distinct challenges of their own.

Climate change and seasonal survival

In new research, we explored how yellow-bellied marmots in the Colorado Rocky Mountains have responded to climate change. Since the 1970s, every marmot pup born at the study site has been marked, and its life followed year after year.

Marmots are large, burrowing ground squirrels, and they have a distinct seasonal life cycle, with a four-month period during the spring and summer when they're active and need to gain weight by foraging on plants, and an eight-month period of hibernation during autumn and winter. Marmots, like other burrowing and herbivorous mammals, help shape important habitats and serve as prey for many predators.

The study site on arrival – thick snow as far as the eye can see.

Photo by Line Cordes.

When I first arrived at the alpine field station in April, I was amazed by the thick layer of snow that reached the roofs of the small wooden cabins dotted around the town of Gothic, named after Gothic Mountain which looms above it. But spring set in and the snow melted, and by midsummer, wildflowers transformed the valley floor.

Climate records painted a gloomier picture, though. Over the past 40 years, winters have warmed by between two and four degrees Celsius on average, while annual snowfall has declined by three and a half metres. Summers have warmed by two degrees Celsius, lengthened by about 50 days and changed from predominantly wet to predominantly dry.

Summer is warmer, longer and earlier each year.

Photo by Line Cordes.

During this time, the chance of marmots surviving a summer has increased, but the chance of surviving the winter hibernation has decreased. The biggest changes in seasonal survival have been noted among younger age classes (the pups and one-year-olds).

We found that lower winter survival tended to be the result of conditions during the previous summer, when heat and drought likely reduced foraging conditions for marmots, leaving them in poor stead for hibernation.

A marmot pup

Image by Thierry Milherou, pixabay.com

Whether a marmot survived a summer depended on conditions in both seasons. Pups were more likely to survive the summer if it followed a winter with low snowfall. This was most likely because the mothers of these pups were in better condition as forage plants became available sooner after hibernation.

Unexpectedly, one-year-olds survived better when summers were longer and warmer. It may be that yearlings with their smaller body size are less prone to heat stress compared to adults. Nevertheless, we suspect that their resilience may not last as summers continue to warm and become drier.

Simply focusing on the survival of a species over the entire year may disguise these more dramatic seasonal responses to climate change, lulling us into a false sense of security. And contrasting seasonal responses don't necessarily cancel each other out. For the marmots, the net change over the year was negative for pups, positive for yearlings, while there was no change for adults.

The fact that climate change can result in beneficial conditions in one season, and difficult conditions in another has potentially wide-ranging consequences for the persistence of species occupying temperate to more extreme habitats, such as deserts, mountains and polar regions, where the most rapid changes in climate are being observed. Similar findings have emerged from other species around the world, from meerkats in the Kalahari Desert to bighorn sheep in the Canadian Rocky Mountains.

For wildlife living near the poles or near mountain tops, like marmots, there is nowhere to go when conditions slide further and further from optimal.

Article also published online:
https://theconversation.com/how-animals-are-coping-with-the-global-weirding-of-the-earths-seasons-140856

This work was led by **Line Cordes** of the School of Ocean Sciences.

Citation: **Line S. Cordes**, Daniel T. Blumstein, Kenneth B. Armitage, Paul J. CaraDonna, Dylan Z. Childs, Brian D. Gerber, Julien G. A. Martin, Madan K. Oli, and Arpat Ozgul (2020). Contrasting effects of climate change on seasonal survival of a hibernating mammal. Proceedings of the National Academy of Science, 117(30), 18119-18126.

Image by Julius Silver, pixabay.com

Review of accumulation of pollutants by sharks and their relatives

Peter Lawrence, a post-doc working on ECOSTRUCTURE, has helped aided develop a method for data collection to aid systemic reviews. He has applied this in a systematic review of literature on sharks, rays and skates and how they accumulate high concentrations of pollutants such as mercury and PCBs.

Sharks are commonly consumed around the world, for example within shark fin soup or in dietary supplements. Shark products are also to be found in beauty products and equally common in the food chain when they are mislabelled as fish, such as local fish and chip shops in the UK.

Shark meat is mislabelled across the world, and species that those commonly mislabelled include those with the highest concentrations of pollutants, such as scalloped and smooth hammerheads, short fin mako sharks, blue sharks and thresher sharks. The lead author Guuske Tiktak notes that the results "*indicate a risk to local fishing communities and international consumers of shark-based products, due to the widespread mislabelling of elasmobranch products*".

We have a relatively limited understanding of what effect pollutants have on shark populations, especially as they are highly mobile and thus difficult to monitor. It is important that we understand these risks as this in combination with threats from overfishing, habitat loss and climate change, could mean that we lose many already vulnerable shark species over time.

Guuske P.Tiktak, Demi Butcher, **Peter J. Lawrence**, John Norrey, Lee Bradley, Kirsty Shaw, Richard Preziosi and David Megson (2020). Are concentrations of pollutants in sharks, rays and skates (Elasmobranchii) a cause for concern? A systematic review. Marine Pollution Bulletin, 160, 111701.

We discovered a new species, but war means it may now remain hidden forever

The world has a new species. My colleagues and I were hugely excited to announce it but, alas, this stingray – a distant cousin of sharks – can't be claimed to be a particularly spectacular or awe-inspiring animal.

The male specimen discovered in the Natural History Museum, Vienna.

Photo: Alec Moore

It's small – about the size of an outstretched hand – and, as far as we know, plain, without distinctive markings. But what's special about this stingray is where it came from, how we came to discover it – and why we may never see it again.

"Discovery" might conjure up images of intrepid marine biologists finding this animal hidden in a remote cave, or while diving into the abyss in a submersible. In fact, many of the sharks and rays discovered in recent years have been found in fish markets. But not this one! We found it in a glass jar, on a shelf, in a museum, in the centre of Vienna.

The new species – to be known scientifically as *Hemitrygon yemenensis* – is, you've guessed it, from Yemen, on the Arabian Peninsula. And it comes with quite a story.

In 1902, an Austrian husband and wife team – Wilhelm and Marie Hein – were in the coastal town of Qishn, to study the unique Mehri language. While placed under house arrest by the local sheikh, the Heins busied themselves. Marie, in addition to providing medical treatment to locals, collected over 2,000 botanical and zoological specimens, which, fortunately for us, included two stingrays. These specimens – a male and a female – were preserved and brought back to the Natural History Museum in Vienna where they sat in a glass jar gathering dust for 115 years.

As part of my ongoing research work on the elasmobranchs (sharks and rays) of the Arabian region, I had been aware of the Heins – one of the other fish they brought back was a small shark, which turned out to be a story in itself. I had been combing through the museum's list of specimens from the Heins' expedition when I noticed a mysterious entry – to an old, now obsolete name for a stingray. Further investigation – and preliminary photographs kindly emailed by the museum staff – suggested these were something special we hadn't seen before, so I packed my bag and headed to Vienna.

The Natural History Museum, Vienna.

Photo: Alec Moore

On a chilly November morning, deep in the cavernous back rooms of the impressive old museum, the sealing wax on the jar was broken. As I gently drew out the stingrays – pale and shrivelled from a century in alcohol – I wondered if I was the first person to have handled them since the Heins bottled them on a hot, distant, sun-bleached beach so many years ago.

The painstaking work of measurements, observations and photographs then began – recording everything from the relative size and position of features like fins and gill slits, the shape and coverage of tooth-like "denticles" on the skin, to the angle the snout makes (the first time I had used a protractor since school).

Measuring the stingray specimen.

Photo: Alec Moore

Having this information allowed us to compare the Yemen specimens with known, closely related species – and pick out key features that, in combination, define the new species. This information is published in a "description", the scientific document (admittedly, a dry one) that officially names the new species and designates a single individual museum specimen as the "holotype" to which all future researchers should refer. The scientific name and description are also the fundamental building blocks underlying all species identification field guides that fishers, divers and scientists might use.

A mysterious creature

But what do we know about this species? Sadly, almost nothing – and chances are it will stay that way. Other than the two museum specimens collected over a century ago, the animal is completely unknown to science.

Small stingray species don't tend to swim far, and often have small geographic ranges as a result – so there is a chance H. yemenensis only occurs in Yemen. Yet research there is almost impossible due to a brutal ongoing war and humanitarian crisis, decades of previous conflict, and it being among the "least developed countries" for indicators like poverty, education and life expectancy.

The female specimen.

Photo: Alec Moore,

The intensive, unmanaged and unsustainable fisheries in these areas – often by foreign vessels – threaten not just unique marine species like our stingray, but the livelihoods of the fishing communities themselves. There is even a chance that our species may have become extinct before we realised it was a new species, like the "lost shark" found recently.

We can but hope that Yemen, and countries like it with rich biodiversity, has a brighter future. The formal name of our new species celebrates the country it was found in, but we have proposed the vernacular name "Heins' stingray" to acknowledge the role of Marie and Wilhelm in helping to document the riches – biological, linguistic and cultural – of this part of the world.

It seems remarkable that the only shark and ray specimens the Heins bought back turned out to be new species, especially as non-specialists with limited access to information. Sadly, Wilhelm died the year after the expedition, at the age of just 42. It is hoped that his stingray has not died out with him.

Alec Moore, Post-Doctoral Fisheries Scientist, School of Ocean Sciences

Article also published online:
https://theconversation.com/we-discovered-a-new-species-but-war-means-it-may-now-remain-hidden-forever-128746

Prehistoric communities off the coast of Britain embraced rising seas – what this means for today's island nations

Legend has it that the land of Lyonesse was engulfed by the sea in a single night during a dreadful storm. They say that this beautiful land, now lost to the seas, lay somewhere between Brittany and Cornwall, much like today's Isles of Scilly. The weave between legendary narrative and truth has always been challenging to unpick. In this case, the stories of Lyonesse and rising sea levels in south-west Britain are inseparably intertwined.

The legend of Lyonesse predates even King Arthur. It was the land of Tristan (who famously loved Iseult), son of noble King Rivalin, whose adventures were chronicled by Thomas of Britain, over 800 years ago. Now underwater, it is rumoured that fragments of masonry from Lyonesse litter the hauls of Cornish fishermen today:

Back to the sunset bound of Lyonesse –
A land of old upheaven from the abyss
By fire, to sink into the abyss again;
Where fragments of forgotten peoples dwealt …

Idylls of the King, Alfred Lord Tennyson (1859)

Back then, like now, the coastlines were being submerged by rising seas. If the poets are to be believed, this submergence was in the forefront of people's minds.

St Michael's Mount, a tidal island off Cornwall, also said to be near the legendary land of Lyonesse.

Image by Tim Hill, pixabay.com

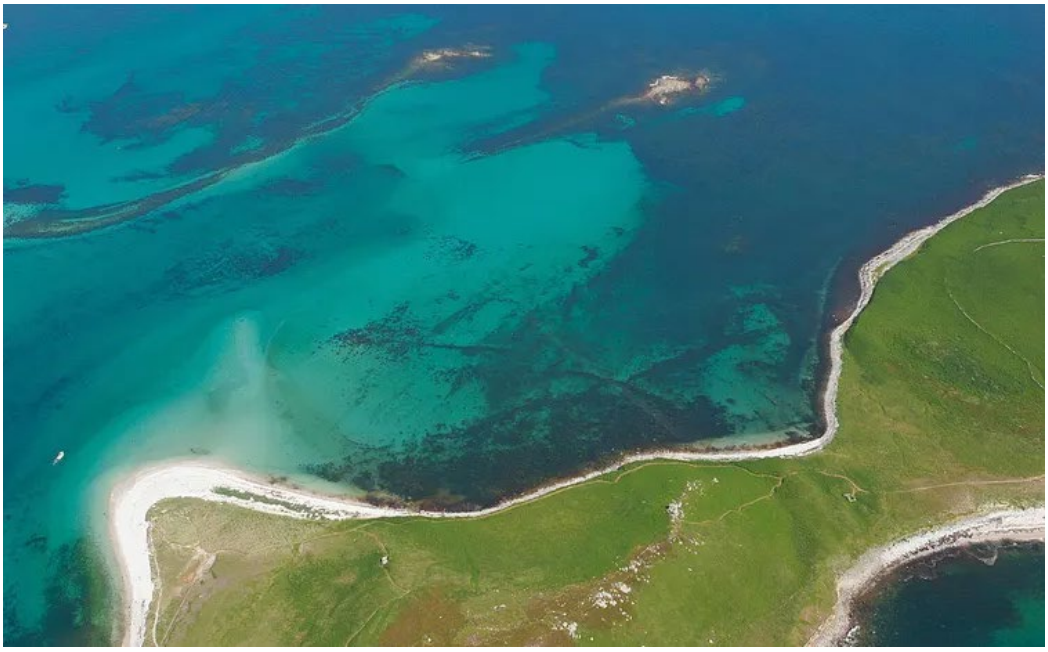
Yet the story of rising sea levels in south-west Britain, and of the prehistoric island communities that it affected, starts many millennia before the legends of Tristan and Arthur. Our newly published research sheds new light on the history of this corner of Britain and could explain how the legendary land of Lyonesse was lost to the seas. This research, which we carried out with an international team, used environmental data to reconstruct past sea levels and the wider landscape and archaeological data to explore the response of the island population to rising seas.

The findings from our research provide a stark (and timely) reminder of the effects sea-level rise can have on coastlines and communities. Importantly, we show that response plans must be designed with both local environments and local cultures in mind.

The Isles of Scilly

In the south-west corner of Britain, beyond Land's End, lie the Isles of Scilly – a beautiful, low-lying archipelago made up of over 50 islands and rocky islets. Surrounded by the English Channel, they are fewer than 50 km off the coast of Cornwall and host a population of a little over 2,000 people today. Scilly, now a popular tourist destination, is famed for its remarkable range of historic sites. Visitors have abundant opportunities for touring prehistoric monuments and heritage sites, as well as for island hopping and wildlife spotting.

The fragmented islands are separated by shallow, turquoise seas, fringed by white sandy beaches, unusual for coastal locations at this latitude. When kayaking the clear waters between the islets, it's possible to see long straight rock formations. These are not naturally formed – they are actually submerged stone walls and boundaries from times past, a reminder of the Scilly's tumultuous relationship with sea-level rise.



Submerged prehistoric field boundaries, Isles of Scilly.

© Historic England Archive

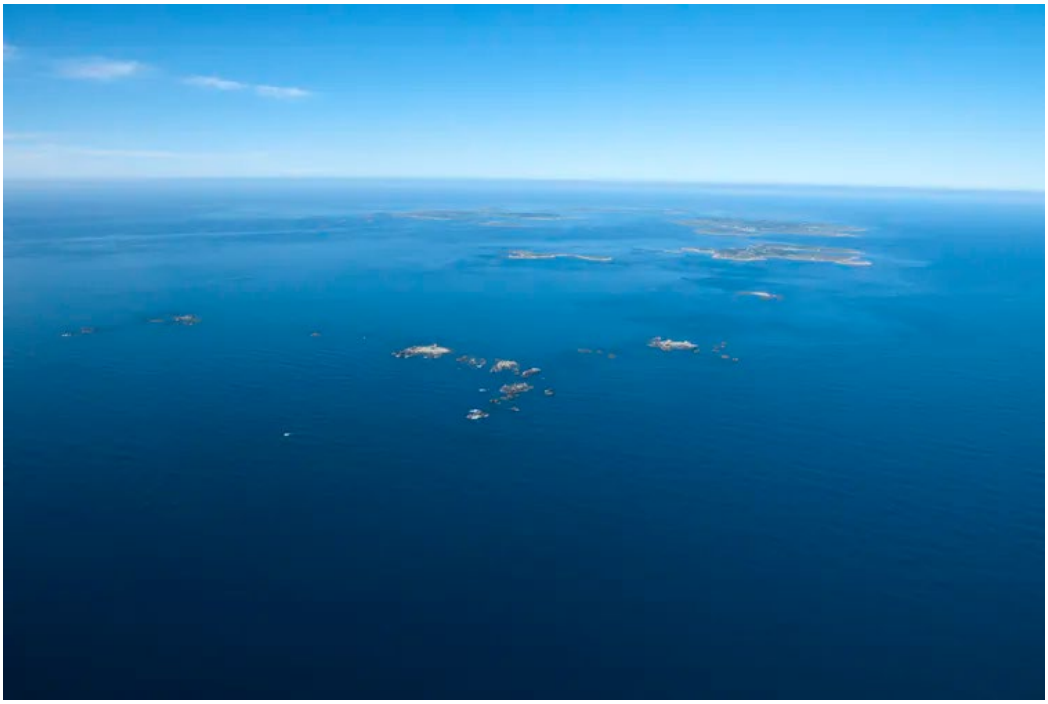
Rates of sea-level rise in the region are higher than anywhere else on the British Isles. As is the case across Britain (and indeed worldwide), sea-level rise will impact coastal communities on Scilly through increased flooding and coastal erosion caused by more frequent extreme water levels.

It should be unsurprising, then, to hear that the Isles of Scilly have not always looked as they do now. Our recently published data provides new insight into past sea levels, vegetation, and population changes on the islands for the past 12,000 years. The data allowed our team to develop maps of coastline changes, revealing unexpected relationships between sea-level rise, coastal change and the associated human response.

We found that major coastal flooding did not necessarily coincide with the highest rates of sea-level rise. One might expect such flooding to be followed swiftly by abandonment, but instead, we found that the population of the time embraced cultural and behavioural changes. Communities appeared to adapt modes of subsistence in a response to the coastal changes that were underway. It's clear that the ability to successfully respond to rising seas was centred around culture - being able and prepared to change behaviour. The importance of culture therefore must be recognised in the adaptation plans of today.

From island to archipelago

During the end of the last ice age, when south-east Britain was still connected to continental Europe, Scilly was not an island at all, but was joined to mainland Cornwall by a land bridge.

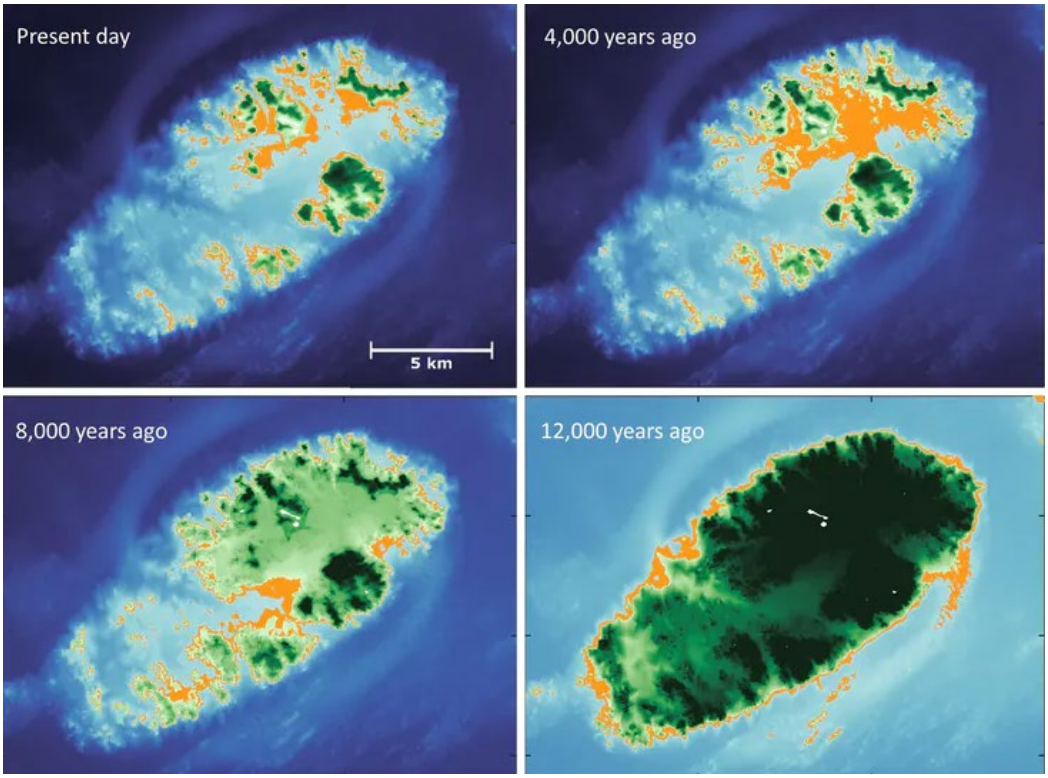


The Isles of Scilly.

© Historic England Archive,

Sea level around the world rose rapidly with the retreat of the major ice sheets in northern Europe and North America, following the end of the Last Glacial Maximum (around 21,000 years ago), the most recent period when global ice sheets were at their greatest extent.

During this time, the earliest modern humans were able to voyage across Europe with the last of the large ice-age mammals (woolly rhinos, mammoths and cave lions), unencumbered by expansive seaways. By 12,000 years ago, the Isles of Scilly were disconnected from mainland Britain by a seaway. One single large island, nearly 140 km² in size, it was getting rapidly smaller, engulfed by rising seas.



The Isles of Scilly – then and now. Showing land (green), water (blue, darker for deeper water) and the intertidal zone (orange).

We explored 12,000 years of past sea level and environmental changes, focusing on the Isles of Scilly as a groups of islands that have undergone expansive transformation due to flooding and coastal change. A sea-level reconstruction was developed from fossilised and submerged peat and salt-marsh deposits, which contained evidence of past sea levels from the microorganisms that inhabited the sediments. We used this record to recreate coastline changes, along with reconstructing the vegetation cover of the landscape as well as the population dynamics across Scilly and the wider region.

Relative sea level around Scilly was rising fast 12,000 years ago, a response to the melting of both local and far-field ice sheets. During the Last Glacial Maximum, a large ice sheet occupied Scotland, Ireland and much of northern Britain. When this melted, the land it occupied started to rebound – a great mass of ice had been lifted. This caused the land in the south to sink as the Earth's crust flexed back to its original position. This process is still ongoing today – the land in south-west Britain is currently sinking by around 1 mm each year (mm/yr) while Scotland continues to rise.

We found that a high rate of relative sea-level rise (nearly 3 mm/yr) continued around Scilly up until 4,000 years ago. At this point, the rate slowed down. Only the ice sheets over Greenland and Antarctica remained, and land subsidence in south-west Britain was lessening. Already, the one large island of Scilly had diminished in size, having lost 100 km² of land to the sea over the 8,000 years up until then.

But the island was still transforming. We found that even though the rate of relative sea-level rise decreased between 5,000 and 4,000 years ago (from nearly 3 mm/yr to less than 1 mm/yr), the land was still being inundated by the sea. This is because the coastline was low-lying, with much of the land area that remained only a few metres above sea level. As the sea level continued to rise, even at the modest rate of 1 mm/yr, dramatic coastal changes were taking place.

Land area was being lost at a rate of around 10,000 m² each year, equivalent to the area of a large international rugby stadium. About half of the lost land was turning into intertidal regions - the area of coastline which is intermittently flooded and exposed during the rising and falling of the tide. In fact, between 5,000 and 4,000 years ago, the amount of intertidal area across Scilly nearly doubled.

A view from Bryher, Isles of Scilly, today.

Photo by Annie Spratt/ Unsplash, FAL

Despite this large-scale coastal reorganisation of Scilly, the formation of widespread intertidal habitats means that the changes may not have been entirely negative for coastal communities.

Adapt and overcome

So were humans present on Scilly at this time? Hard archaeological evidence of permanent settlement is not fully apparent until after 4,500 years ago. But our new 12,000 year-long record of environmental change on Scilly reveals that oak woodland across Scilly was evident from 9,000 years ago, but abruptly vanishes 2,000 years later (7,000 years ago), which might suggest Mesolithic humans were clearing forest for hunting and resources. During the Neolithic (6,000 to 4,500 years ago), there is archaeological evidence of island visitors on Scilly from flint microliths, land disturbance and the arrival of grazing animals by the Late Neolithic.

Our research adds to the growing body of evidence for a permanent human presence on Scilly shortly after 4,500 years ago, right at the end of the Neolithic and at the beginning of the Early Bronze Age. It also tells us that during this time of rising seas, the available living space was being flooded and widespread coastal reorganisation was taking place year after year.

Research from other parts of the world (such as the Yangtze in east China) has shown how some Neolithic communities have been forced to flee sites of coastal inundation. It might be tempting, therefore, to think that the Neolithic population on Scilly was likewise compelled to relocate or even abandon the islands. Instead, after 4,500 years ago, there appears to have been an acceleration in human activity, evident from today's remaining archaeological sites, in particular the Early Bronze Age monuments.

The beginning of the Bronze Age in Britain was heralded 4,500 years ago. On Scilly, the Bronze Age is marked by an incredible abundance of material culture in the form of worked flints, pottery and vessels. Even more remarkable was the density of archaeological monuments. There are over 600 Bronze Age cairns, standing stones, entrance graves and other monuments across Scilly (not including some that may have been lost to the sea), which by then was a landmass of less than 30 km². Archaeology on Scilly during the Bronze Age is richer than at any other period through time.

Bronze Age entrance grave.

Cornwall Archaeological Unit, Cornwall Council

There was clearly a powerful drive for Bronze Age communities to remain on Scilly. This desire or need to stay is despite a backdrop of rising seas and rate of coastal change that would have been noticeable and impactful across human lifetimes. It suggests that cultural adaption, rather than physical flight, was the preferred solution for the inhabitants of the Isle of Scilly during this time.

We might never know why they remained. But it is likely that the development of expansive intertidal habitats offered opportunities for foraging, fishing and wildfowl hunting. Provided that the island inhabitants of the time were prepared to adapt the way they found food, these valuable food sources could have helped support growing human populations.

Evidence of land disturbance from the pollen and fire records, as well as the archaeological finds across the islands, show that local populations actively managed the landscape. Crops were being grown and animals were being kept. By adapting behaviours and exploiting new intertidal resources (such as collecting shellfish and other edibles), it is possible that the shrinking islands were able to support growing populations.

This demonstrates that rapid sea-level rise does not lead to uniform environmental change or a predictable human response. On Scilly, despite the changing coastlines, coastal communities seem to have flourished by adapting their behaviours. This highlights the importance of centring culture and society in discussions of coastal (and indeed wider climate change) adaptation.

Since the Bronze Age, both the amount of intertidal area and land area of Scilly has continued to dwindle. After millennia of modest rates of rise (around 1 mm/yr), sea levels around the Isles of Scilly are now rising rapidly once more, in line with rates of global mean sea-level rise.

This begs the question, what can we learn from the past, to protect our future?

Unprecedented sea-level rise

Many island nations are already adapting to – or fleeing from – the effects of climate change, including rising sea levels. Thousands of inhabitants of Pacific Islands such as Vanuatu, Tuvalu, Fiji and the Marshall Islands, have relocated to New Zealand for example, leaving their native islands, cultures and associated heritage.

The most recent estimate of global mean sea-level rise – the average rate by which sea level is rising across the entire globe – is 3.6 mm/yr. This is based on the average rate of rise between 2006 and 2015.

San Blas archipelago, Panama, one of Latin America's areas most affected by sea-level rise.

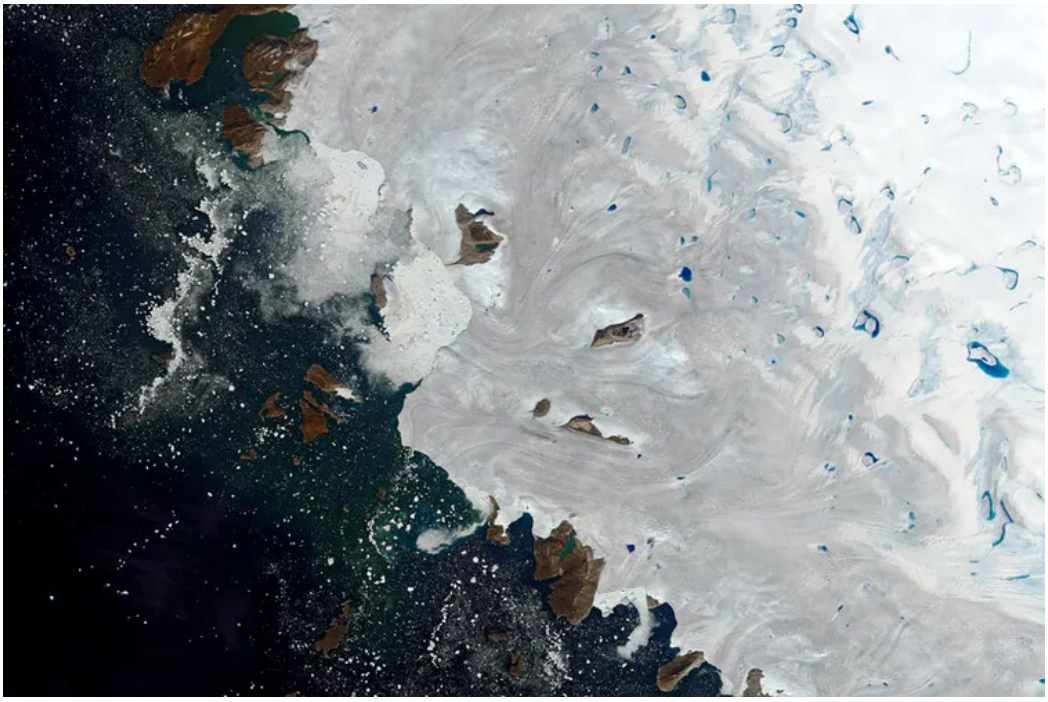
Photo by Benjamín Gremler on Unsplash

Perhaps this doesn't sound like much. To put it into context, this rate of global sea-level rise is unprecedented for at least 2,500 years. It's true (as many climate change deniers profess) that in the deep past (during the Pliocene, from 5.3 to 2.5 million years ago, for example) the Earth was warmer and the seas higher than at present. But what is so remarkable about present-day sea level is the exceptional rate of global sea-level rise that we're currently experiencing.

Even more concerning for many coastal communities is the fact that sea level is not actually level: changes are unique for each point in the world. Melting ice sheets, warming oceans, and alterations to the Earth's crust are among the processes which contribute to these complex patterns of change. In different places, these processes can either reduce the effects of global mean sea-level rise or exacerbate it.

As ice sheets melt, the world's oceans rise, but not uniformly. The oceans near melting ice sheets actually fall in level, because ice sheets exert a gravitational pull on the water surrounding it, and the pull diminishes as ice sheets lose mass. Conversely, this results in above-average sea-level rise in far-field regions, such as the tropics.

Global mean sea-level rise is an important concept. It tells us that the current overall rate of rise is unprecedented and alarming. Most important to coastal communities, though, is the rate of local sea-level rise: the change in sea level relative to their coast. It is the patterns of local change that will determine how quickly sea level will rise in a certain location and that threatens, costs, and overwhelms coastal communities.



Satellite image of meltwater streaming from the Greenland Ice Sheet into the Atlantic Ocean during a major melting event, July 2019.

NASA Earth Observatory/ EPA-EFE

Resistance and resilience

Today's coastal regions are densely populated, with an estimated 10% of the global population (around 600 million people) living fewer than 10 metres above sea level. Many huge cities around the world are highly vulnerable to sea-level rise, including Miami (US), Kolkata and Mumbai (India), Alexandria (Egypt) and Guangzhou (China). Millions of people are already facing the immediate threat of rising seas.

And the places that will be hit worst aren't always obvious: the case of Scilly illustrates this. The most drastic coastal flooding did not happen in response to the most rapid sea-level rise; it happened when a relatively slow rise inundated low-lying land. We must look not only to the places experiencing the highest rates of sea-level rise, but also to those low-lying areas undergoing dramatic coastal reorganisation resulting from a relatively small rise.

The research shows that rates of sea-level change, the reorganisation of the coastline, and the response of the local communities are all highly variable (and, potentially, unexpected) through time. In principle, the potential response options for modern communities to sea-level rise are equally variable. Options include hard engineering solutions, such as the defences built in Tokyo to keep flood waters out, or land reclamation – building seaward to reclaim land from rising waters.

In some instances, rising sea levels can be accommodated, for example by raising houses or diverting roads, or natural approaches can be employed, such as sand dune or mangrove restoration projects. And there persists an ever-increasing importance for well-designed early response systems and evacuation zones in response to the increased severity of storm surges.

Retreat – moving exposed people away from coastal flood zones – is the ultimate adaptation option. Theoretically, the above measures have the potential to be highly effective. But the reality is that the options available to small, often poor, coastal communities are far fewer.

Of course, the best thing to do would be to slow down the rate of global mean sea-level rise, which is a direct result of climate change. Until that becomes a reality, the next best way to protect the culture and heritage of island nations from further rising seas is to adapt. But at what cost? Rising oceans are, unfortunately, unavoidable and inevitable.

The right response is difficult to define. How do we measure the loss of languages and cultures? How a given community feels about migration is complex, driven by multiple individual, social, cultural, economic and political factors in addition to the environment. Understanding the societal and cultural perspectives of coastal populations will be critical for responding successfully to future sea-level rise. If it's not feasible or realistic to adapt, then what does the future really hold for today's native islanders?

It is perhaps unlikely that rising seas in the future will result in new intertidal landforms and resources capable of supporting growing populations, as may have been the case on the Isles of Scilly thousands of years ago. But the development of new wetland areas (for example, by allowing vegetated intertidal zones to progress inland as the seas rise) will be absolutely vital for maintaining biodiversity and ecosystem health, as well as for generating natural and cost-effective storm-defence systems.

More important is how local communities are woven into physical adaptation strategies. We must respect and protect coastal communities, cultures and heritage sites. Modern coastal communities are demonstrating incredible resistance and resilience to climate-driven relocation. These communities show us that societal and cultural perspectives are at the very heart of the response to rising sea levels, and our research indicates that this has been the case for millennia.

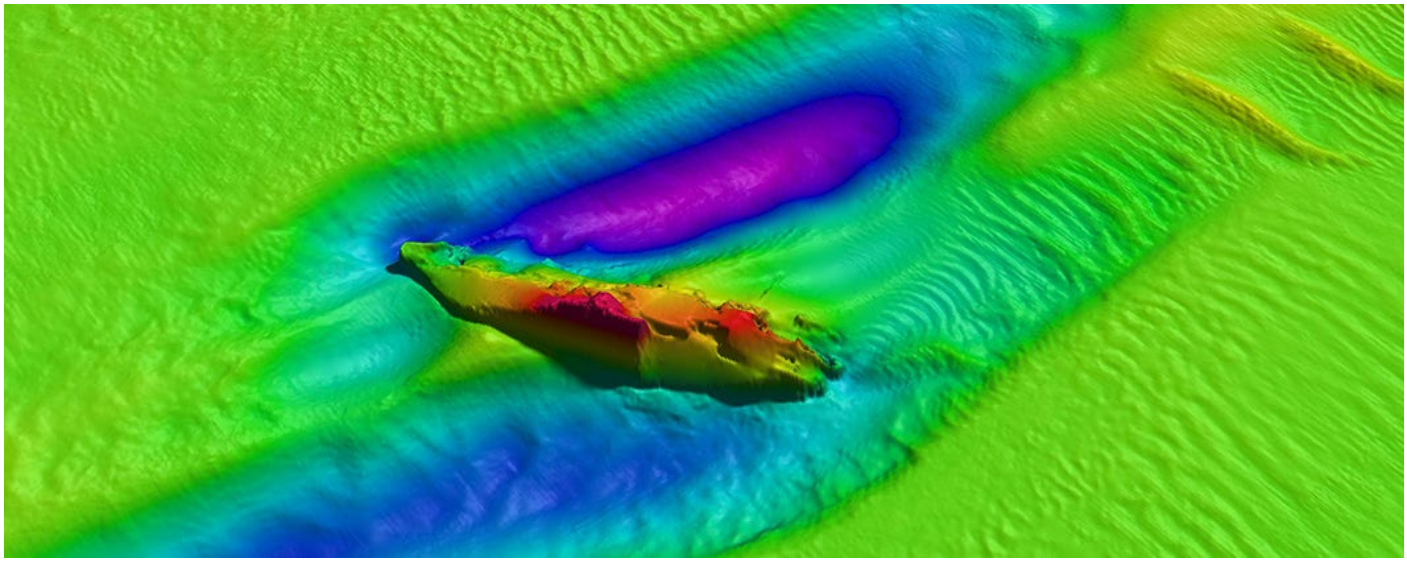
These societal and cultural perspectives will be critical for developing holistic and successful adaptive responses to climate change. Frontline coastal communities need to be heard.

Joint author **Sophie Ward** is a Research Fellow in Physical Oceanography at the School of Ocean Sciences.

Citation: Barnett, R., Charman, D. J., Johns, C., **Ward, S.**, Bevan, A., Bradley, S. L., Cambridge, K., Fyfe, R. M., Gehrels, W. R., Hatton, J., Khan, N. S., Marshall, P., Maezumi, S. Y., Mills, S., Mulville, J., Perez, M., Roberts, H. M., Scourse, J. (2020). Non-linear landscape and cultural response to sea-level riseD., SScience Advances. 6, 45, eabb6376

O Dan y Dŵr - Hidden Seascapes of Wales

O Dan y Dŵr - Beneath the Water, in English - is a project to share some of the unique and exciting insights into the marine environment off our coast which have been produced alongside research taking place at one of the UK's top Marine Sciences centres.



The SS Apapa was carrying passengers and cargo from Lagos, Nigeria to Liverpool when on the 28th November 1917 she was struck by two torpedoes fired from U-96 with the loss of seventy seven lives.

It allows members of the public to:

- Learn about new aspects of scientific research from the SEACAMS2 project at the School of Ocean Sciences.

- View exclusive images and innovative data obtained from our marine environment collected by scientists working on a range of innovative R&D projects supporting the marine renewable energy sector in Wales.

- Acoustic data, sonar and camera imagery show the effects of geological, biological and physical processes off the coast of Wales which due to fast tidal currents, relatively deep water and limited visibility have never been seen this way before.

- Understand how acoustic data, sonar and camera imagery show the effects of geological, biological and physical processes off the coast of Wales which due to fast tidal currents, relatively deep water and limited visibility have never been seen in this way before.

The featured 'false-colour' depth-based images have been generated by processing multibeam sonar data collected by a small team of Menai Bridge based scientists and technicians using the Research Vessel *Prince Madog* and inshore survey vessel *Macoma*.

Subjects range from man-made structures and underwater wrecks to natural features such as reefs and sandwaves.

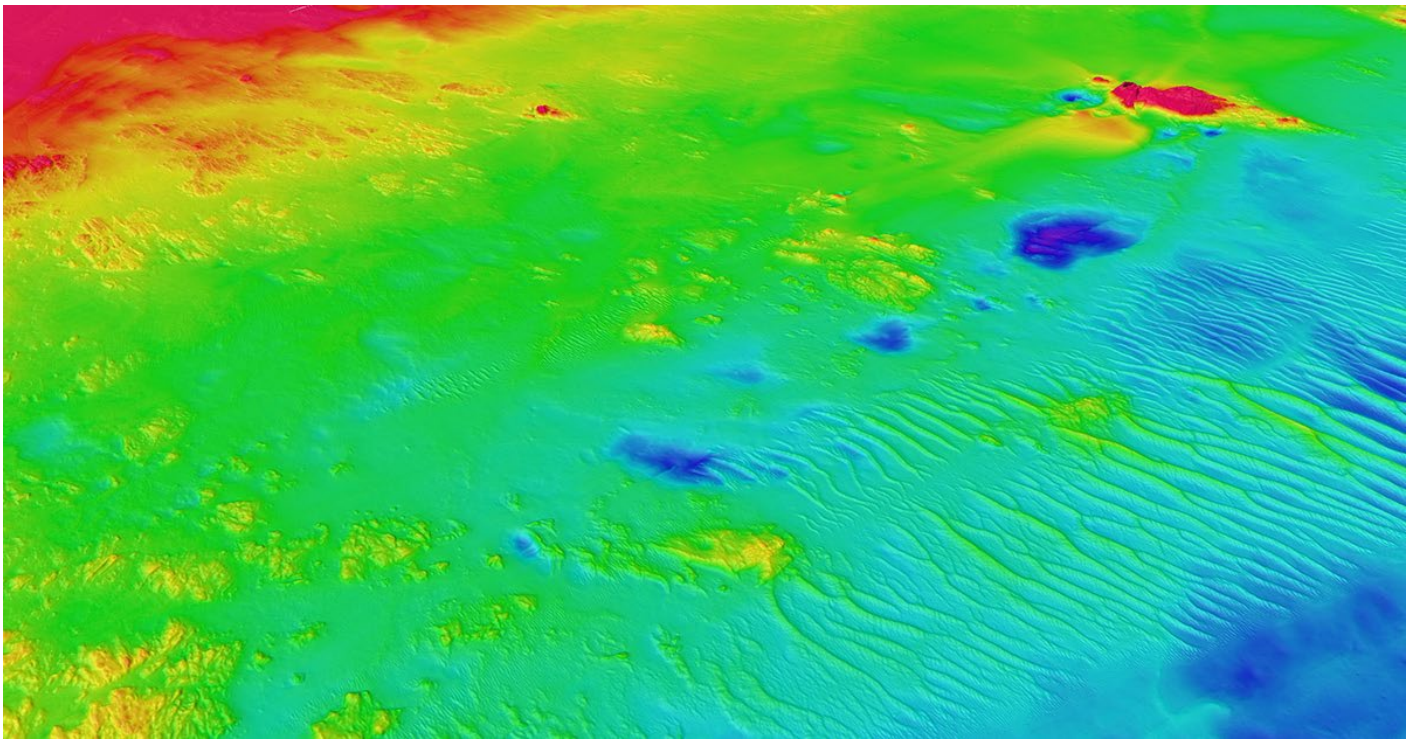
Project Team

Dr **Michael Roberts** (SEACAMS2 Geoscientist), Dr **Tim Whitton** (SEACAMS2 Ecologist), **Ben Powell** (Lead Sea-Going Technician), **Aled Owen** (Sea-Going Technician), **Steven Rowlands** (Multibeam Data Processor), **David Roberts** (Media Technician) and the Captain and Crew of the R.V. *Prince Madog*.

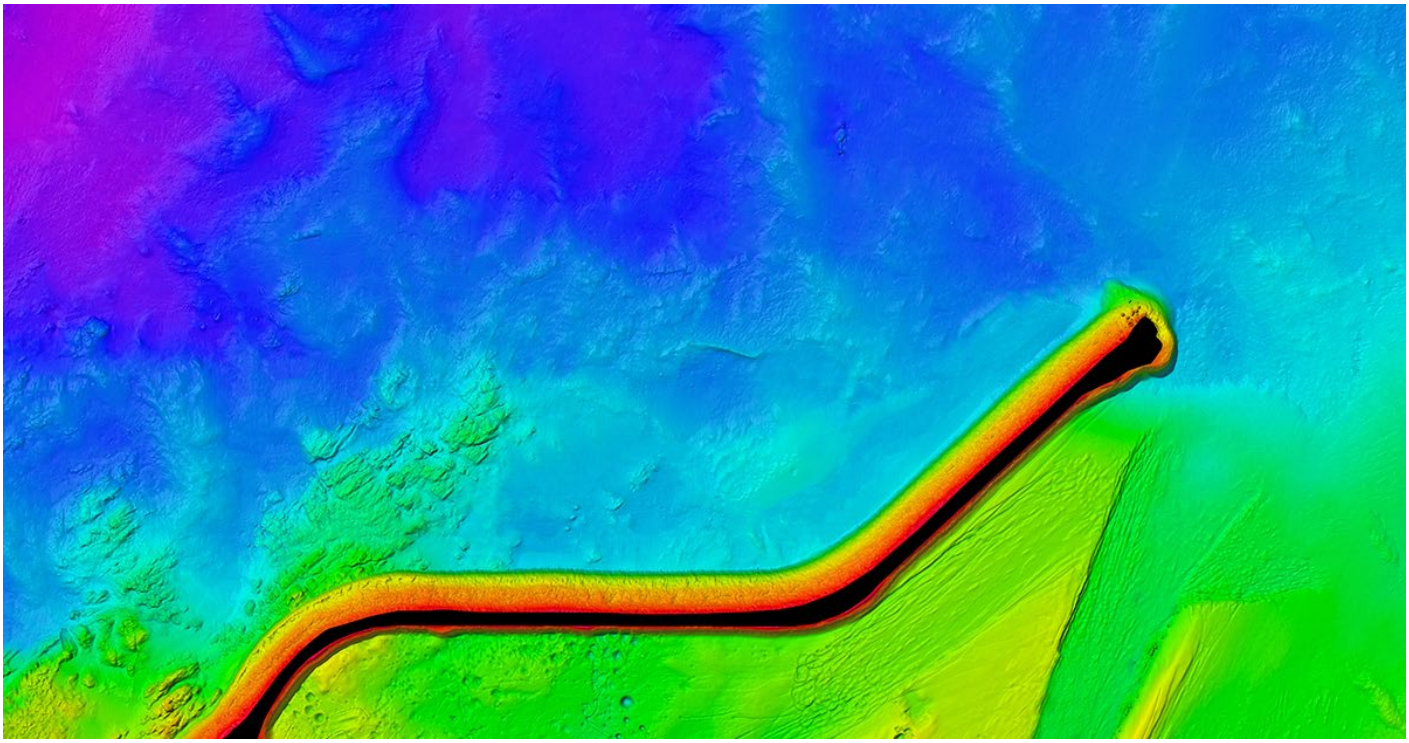
The website

http://www.seacams.ac.uk/seacams2/seascapes

New images are being added on a regular basis, so revisit regularly for the latest updates.



Seabed off Trearddur Bay, Anglesey. The red outcrop to the top right is Careg Hen ("Old Rock") underwater reef while mobile sandy sediments dominate the deeper areas located further offshore.



At 1.7miles, the Holyhead Breakwater located in northwest Anglesey is the longest structure of its kind in the UK. Average depths to the north of the breakwater are 5m greater than to the south, this is partly due to the natural slope of the seabed but also the increased rates of sediment deposition within the protected area.

RECENT PUBLICATIONS

Tides, the Moon and the Kaleidoscope of Ocean Mixing
Rippeth, T. & Green, M., 16 Nov 2020, Oceanography and Marine Biology: An Annual Review. Hawkins, S. J., Allcock, A. L., Bates, A. E., Evans, A. J., Firth, L. B., McQuaid, C. D., Russell, B. D., Smith, I. P., Swearer, S. E. & Todd, P. A. (eds.). Taylor & Francis, Vol. 58. p. 319-350

Factors affecting byssus attachment in juvenile scallops, Pecten maximus (L.)
Galley, T., Beaumont, A., Le Vay, L. & King, J., 15 Nov 2020, In : Aquaculture. 528, 735504.

Non-linear landscape and cultural response to sea-level rise
Barnett, R., Charman, D. J., Johns, C., Ward, S., Bevan, A., Bradley, S. L., Cambridge, K., Fyfe, R. M., Gehrels, W. R., Hatton, J., Khan, N. S., Marshall, P., Maezumi, S. Y., Mills, S., Mulville, J., Perez, M., Roberts, H. M., Scourse, J. D., Shepherd, F. & Stevens, T., 4 Nov 2020, In : Science Advances. 6, 45, eabb6376.

Weak tides during Cryogenian glaciations
Green, M., Davies, H., Duarte, J., Creveling, J. & Scotese, C., 3 Nov 2020, () In : Nature Communications.

Using structured eradication feasibility assessment to prioritize the management of new and emerging invasive alien species in Europe
Booy, O., Robinson, P. A., Moore, N., Ward, J., Roy, H. E., Adriaens, T., Shaw, R., van Valkenburg, J., Wyn, G., Bertolino, S., Blight, O., Branquart, E., Brundu, G., Caffrey, J., Capizzi, D., Casaer, J., De Clerck, O., Coughlan, N. E., Davis, E., Dick, J. T. A., Essl, F., Fried, G., Genovesi, P., Gonzalez-Moreno, P., Huysentruyt, F., Jenkins, S., Kerckhof, F., Frances, L. E., Nentwig, W., Newman, J., Rabitsch, W., Roy, S., Starfinger, U., Stebbing, P. D., Stuyck, J., Sutton-Croft, M., Tricario, E., Vanderhoven, S., Verreycken, H. & Mill, A. C., Nov 2020, In : Global Change Biology. 26, p. 6235-6250

New insights on the population genetic structure of the great scallop (Pecten maximus) in the English Channel coupling microsatellite data and demogenetic simulations.
Handal, W., Szostek, C., Hold, N., Andrello, M., Thiébaut, E., Ewan, H., Lefebvre, G., Elodie, B., Jolivet, A., Nicolle, A., Boyé, A., Foucher, E., Boudry, P. & Charrier, G., 31 Oct 2020, In : Aquatic Conservation: Marine and Freshwater Ecosystems. 30, 10, p. 1841-1853

Hydrocarbon-Degrading Bacteria Alcanivorax and Marinobacter Associated With Microalgae Pavlova lutheri and Nannochloropsis oculata
Chernikova, T., Bargiela, R., Toshchakov, S. V., Shivaraman, V., Lunev, E. A., Yakimov, M. M., Thomas, D. N. & Golyshin, P., 28 Oct 2020, In : Frontiers in Microbiology. 11, 572931.

Rapid gravity flow transformation revealed in a single climbing ripple
Baas, J. H., Best, J. & Peakall, J., 27 Oct 2020, () In : Geology.

Local human impacts disrupt relationships between benthic reef assemblages and environmental predictors
Ford, A., Jouffray, J-B., Norstrom, A. V., Moore, B., Nugues, M., Williams, G. J., Bejarano, S., Magron, F., Wild, C. & Ferse, S., 21 Oct 2020, In : Frontiers in Marine Science. 7, 571115.

Tides: A key driver of the evolution of terrestrial vertebrates?
Byrne, H. M., Green, J. A. M., Balbus, S. A. & Ahlberg, P. E., 21 Oct 2020, In : Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences.

Impact of Sediment Concentration on the Survival of Wastewater-Derived blaCTX-M-15-Producing E. coli, and the Implications for Dispersal into Estuarine Waters
Bashawri, Y. M. A., Robins, P., Jones, D. L., McDonald, J., Cooper, D. & Williams, P., 19 Oct 2020, In : International journal of environmental research and public health. 17, 20, 15 p., 7608.

Comparison of virus concentration methods for the RT-qPCR-based recovery of murine hepatitis virus, a surrogate for SARS-CoV-2 from untreated wastewater
Ahmed, W., Bertsch, P., Bivins, A., Bibby, K., Farkas, K., Gathercole, A., Haramoto, E., Gyawali, P., Korajkic, A., McMinn, B., Mueller, J., Simpson, S., Smith, W., Symonds, E., Thomas, K., Verhagen, R. & Kitajima, M., 15 Oct 2020, In : Science of the Total Environment. 739, 139960.

A review of a decade of lessons from one of the world's largest MPAs: conservation gains and key challenges
Hays, G. C., Koldewey, H., Meeuwig, J. J., Attrill, M. J., Barley, S., Bayley, D., . Benkwitt, C. E., Block, B., Schallert, R. J., Carlisle, A. B., Carr, P., Chapple, T. K., Collins, C., Diaz, C., Dunn, N., Dunbar, R. B., Eager, D. S., Engel, J., Embling, C. B., Esteban, N., Ferretti, F., Foster, N. L., Freeman, R., Gollock, M., Graham, N. A. J., Harris, J. L., Head, C. E. I., Hosegood, P., Howell, K. L., Hussey, N. E., Jacoby, D. M. P., Jones, R., Lange, I. D., Letessier, T. B., Levey, E., Lindhart, M., McDevitt-Irwin, J. M., Meekan, M. G., Micheli, F., Mogg, A., Mortimer, J. A., Mucciarone, D., Nicoll, M. A., Nuno, A., Perry, C. T., Sannassy Pilly, J., Preston, S. G., Rattray, A. J., Robinson, E., Roche, R., Schiele, M., Sheehan, E. V., Sheppard, A., Sheppard, C., Smith, A. L., Soule, B., Spalding, M., Stevens, G. M. W., Steyaert, M., Stiffel, S., Taylor, B., Tickler, D. M., Trevail, A. M., Trueba, P., Turner, J., Votier, S., Wilson, B., Williams, G., Williamson, B. J., Williamson, M. J., Wood, H. & Curnick, D. J., 14 Oct 2020, In : Marine Biology. 167, 11, 159.

Platelet ice, the Southern Ocean's hidden ice: a review
Hoppmann, M., Richter, M. E., Smith, I. J., Jendersie, S., Langhorne, P. J., Thomas, D. N. & Dieckmann, G. S., 12 Oct 2020, In : Annals of Glaciology.

Bardsey – an island in a strong tidal stream: Underestimating coastal tides due to unresolved topography
Green, M. & Pugh, D., 8 Oct 2020, () In : Ocean Science.

Comparing Water Level Estimation In Coastal And Shelf Seas From Satellite Altimetry And Numerical Models Rulent, J., Calafat, F., Banks, C., Bricheno, L., Gommenginger, C., Green, M., Haigh, I. D., Lewis, H. & Martin, A. C. H., 8 Oct 2020, () In : Frontiers in Marine Science.

Multi-century impacts of ice sheet retreat on sea level and ocean tides in Hudson Bay
Hayden, A-M., Gomez, N., Wilmes, S-B. & Green, M., 8 Oct 2020, () In : Journal of Geophysical Research: Oceans.

Mangrove carbon stocks and biomass partitioning in an extreme environment
Chatting, M., Le Vay, L., Walton, M., Skov, M., Kennedy, H., Wilson, S. & Al Maslamani, I., 5 Oct 2020, In : Estuarine, Coastal and Shelf Science. 244, 106940.

Climate driven benthic invertebrate activity and biogeochemical functioning across the Barents Sea Polar Front
Solan, M., Ward, E., Wood, C., Reed, A. J., Grange, L. & Godbold, J., 2 Oct 2020, In : Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences. 378, 2181, 20190365.

A Path to a Sustainable Trawl Fishery in Southeast Asia
Suuronen, P., Pitcher, C. R., McConnaughey, R. A., Kaiser, M., Hiddink, J. G. & Hilborn, R., 1 Oct 2020, In : Reviews in Fisheries Science & Aquaculture.. 28, 4, p. 499-517

Bed erosion during fast ice streaming regulated the retreat dynamics of the Irish Sea Ice Stream
Van Landeghem, K. & Chiverrell, R., 1 Oct 2020, In : Quaternary Science Reviews. 245, 106526.

Exploring larval phenology as predictor for range expansion in an invasive species
Gimenez Noya, L., Exton, M., Spitzner, F., Meth, R., Eckert, U., Jungblut, S., Harzsch, S., Saborowski, R. & Torres, G., Oct 2020, In : Ecography. 43, 10, p. 1423-1434

Formational history of the Wicklow Trough: a marine transgressed tunnel valley revealing ice flow velocity and retreat rates for the largest ice stream draining the late-Devensian British-Irish Ice Sheet
Coughlan, M., Tóth, Z., Van Landeghem, K., McCarron, S. & Wheeler, A. J., Oct 2020, In : Journal of Quaternary Science. 35, 7, p. 907-919

Interactions between sediment microbial ecology and physical dynamics drive heterogeneity in contextually similar depositional systems
Hope, J. A., Malarkey, J., Baas, J. H., Peakall, J., Parsons, D., Manning, A. J., Bass, S., Lichtman, I., Thorne, P., Ye, L. & Paterson, D. M., Oct 2020, In : Limnology and Oceanography. 65, 10, p. 2403-2419

Patterns of abundance across geographical ranges as a predictor for responses to climate change: evidence from UK rocky shores
Vye, S., Dickens, S., Adams, L. C., Bohn, K., Chenery, J., Dobson, N., Dunn, R. E., Earp, H., Evans, M., Foster, C., Grist, H., Holt, B., Hull, S., Jenkins, S., Lamont, P., Long, S., Mieszkowska, N., Millard, J., Morrall, Z., Pack, K., Parry-Wilson, H., Pocklington, J., Pottas, J., Richardson, L., Scott, A., Sugden, H., Watson, G., West, V., Winton, D., Delaney, J. & Burrows, M. T., Oct 2020, In : Diversity and Distributions. 26, 10, p. 1357-1365

The effects of trawling and primary production on size-structured food webs in seabed ecosystems
Howarth, L., Somerfield, P. J., Blanchard, J., Waggitt, J., Allender, S. & Hiddink, J. G., Oct 2020, In : Canadian Journal of Fisheries and Aquatic Sciences. 77, 10, p. 1659-1665

Wastewater and public health: the potential of wastewater surveillance for monitoring COVID-19
Farkas, K., Hillary, L., Malham, S., McDonald, J. & Jones, D. L., Oct 2020, In : Current Opinion in Environmental Science & Health. 17, p. 14-20 7 p.

Spatial scaling properties of coral reef benthic communities
Ford, H., Gove, J. M., Davies, A., Graham, N. A. J., Healey, J., Conklin, E. & Williams, G. J., 28 Sep 2020, () In : Ecography.

Modelling the linkage between coral assemblage structure and pattern of environmental forcing
Sandin, S. A., Eynaud, Y., Williams, G. J., Edwards, C. & McNamara, D., 21 Sep 2020, () In : Royal Society Open Science.

Climate change accelerates range expansion of the invasive non-native species, the Pacific oyster, Crassostrea gigas
King, N., Wilmes, S-B., Smyth, D., Tinker, J., Robins, P., Thorpe, J., Jones, L. & Malham, S., 19 Sep 2020, () In : ICES Journal of Marine Science.

Internal tide driven tracer transport across the continental slope
Spingys, C., Williams, R., Hopkins, J., Hall, R., Green, M. & Sharples, J., 17 Sep 2020, In : Journal of Geophysical Research: Oceans. 125, 9, e2019JC015530.

Weakening of cold halocline layer exposes sea ice to oceanic heat in the eastern Arctic Ocean
Polyakov, I., Rippeth, T., Fer, I., Alkire, M., Baumann, T., Carmack, E., Ivanov, V., Janout, M. A., Padman, L., Pnyushkov, A. & Rember, R., 15 Sep 2020, In : Journal of Climate. 33, 18, p. 8107-8123

Trawl fishing impacts on the status of seabed fauna in diverse regions of the globe
Mazor, T., Pitcher, C. R., Rochester, W., Kaiser, M., Hiddink, J. G., Jennings, S., Amoroso, R., McConnaughey, R. A., Rijnsdorp, A., Parma, A., Suuronen, P., Collie, J., Sciberras, M., Atkinson, L., Durholtz, D., Ellis, J., Bolam, S. G., Schratzberger, M., Couce, E., Eggleton, J., Garcia, C., Kainge, P., Paulus, S., Kathena, J. N., Gogina, M., van Denderen, P. D., Keller, A., Horness, B. & Hilborn, R., 14 Sep 2020, In : Fish and Fisheries.

Life Inside and Under Frozen Seawater
Thomas, D. N. & Kaartokallio, H., 9 Sep 2020, In : Frontiers for Young Minds.

Drivers of Sex-specific Trade-offs in the Macroalga Ascophyllum nodosum
Kurr, M. & Davies, A., 3 Sep 2020, In : Plant. 8, 3, p. 54-63

Calcareous defence structures of prey mediate the effects of predation and biotic resistance towards the tropics
Dias, G., Vieira, EA., Karythis, S., Jenkins, S., Griffith, K., Pestana, L. & Marques, A. C., 1 Sep 2020, In : Diversity and Distributions. 26, 9, p. 1198-1210

Hierarchical genetic structuring in the cool boreal kelp, Laminaria digitata: implications for conservation and management
King, N., McKeown, N., Smale, D., Bradbury, S., Stamp, T., Juterbock, A., Egilsdóttir, H., Groves, E. & Moore, P., 1 Sep 2020, In : ICES Journal of Marine Science. 77, 5, p. 1906–1913

Prey vulnerability and predation pressure influence predator induced changes in oxygen consumption and anti-predator behaviour
Karythis, S., Cornwell, T., Gimenez Noya, L., McCarthy, I., Whiteley, N. & Jenkins, S., 1 Sep 2020, In : Animal Behaviour. 167, p. 13-22

Different bottom trawl fisheries have a differential impact on the status of the North Sea seafloor habitats
Rijnsdorp, A. D., Hiddink, J. G., van Dendren, P. D., Hintzen, N. T., Eigaard, O. R., Valanko, S., Bastardie, F., Bolam, S. G., Boulcott, P., Egekvist, J., Garcia, C., van Hoey, G., Jonsson, P., Laffargue, P., Nielsen, J. R., Piet, G. J., Skold, M. & van Kooten, T., Sep 2020, In : ICES Journal of Marine Science. 77, 5, p. 1772-1786

Fine-scale seascape genomics of an exploited marine species, the common cockle Cerastoderma edule, using a multi-modelling approach
Coscia, I., Wilmes, S-B., Ironside, J. E., Goward Brown, A., O'Dea, E., Malham, S., McDevitt, AD. & Robins, P., Sep 2020, In : Evolutionary Applications. 13, 8, p. 1854-1867

Intensification of Near-Surface Currents and Shear in the Eastern Arctic Ocean: A More Dynamic Eastern Arctic Ocean
Polyakov, I., Rippeth, T., Fer, I., Baumann, T., Carmack, E., Ivanov, V., Janout, M. A., Padman, L., Pnyushkov, A. & Rember, R., 28 Aug 2020, In : Geophysical Research Letters. 47, 16, 2020GL089469.

Tidally-forced lee waves drive turbulent mixing along the Arctic Ocean margins
Fer, I., Koenig, Z., Koslov, I., Ostrowski, M., Rippeth, T., Padman, L., Bosse, A. & Kolas, E., 28 Aug 2020, In : Geophysical Research Letters. 47, 16, 2020GL088083R.

Numerical modelling of hydrodynamics and tidal energy extraction in the Alderney Race: a review
Thiebot, J., Coles, D., Bennis, A-C., Guillou, N., Neill, S., Guillou, S. & Piggott, M., 21 Aug 2020, In : Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences. 378, 2178, 20190498.

Spatio-temporal variability of tidal-stream energy in north-western Europe
Guillou, N., Neill, S. & Thiebot, J., 21 Aug 2020, In : Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences. 378, 2178, 20190493.

Viral indicators for tracking domestic wastewater contamination in the aquatic environment
Farkas, K., Walker, D., Adriaenssens, E., McDonald, J., Hillary, L., Malham, S. & Jones, D. L., 15 Aug 2020, In : Water Research. 181, 115926.

The spatial ecology of Rajidae from mark-recapture tagging and its implications for assessing fishery interactions and efficacy of Marine Protected Areas
Simpson, S., Humphries, N. E. & Sims, D. W., 1 Aug 2020, In : Fisheries Research. 228, 105569.

Emerging technologies for the rapid detection of enteric viruses in the aquatic environment
Farkas, K., Mannion, F., Hillary, L., Malham, S. & Walker, D., Aug 2020, In : Current Opinion in Environmental Science & Health. 16, p. 1-6

Exploring perceptions of marine biosecurity interventions: insights from the commercial marina sector
Vye, S., Wynne-Jones, S., Masterson Algar, P. & Jenkins, S., Aug 2020, In : Marine Policy. 118, 104027.

Mixed Sand—Mud Bedforms Produced by Transient Turbulent Flows in the Fringe of Submarine Fans: Indicators of Flow Transformation
Baker, M. L. & Baas, J. H., Aug 2020, In : Sedimentology. 67, 5, p. 2645-2671

On the interplay between horizontal resolution and wave drag and their effect on tidal baroclinic mode waves in realistic global ocean simulations
Buijsman, M. C., Stephenson, G. R., Ansong, J. K., Arbic, B. K., Green, M., Richman, J. G., Shriver, J. F., Vic, C., Wallcraft, A. & Zhao, Z., Aug 2020, In : Ocean Modelling. 152, 101656.

Temperature modulates compensatory responses to food limitation at metamorphosis in a marine invertebrate
Torres, G. & Gimenez Noya, L., Aug 2020, In : Functional Ecology. 34, 8, p. 1564-1576

Tidal range energy resource assessment of the Gulf of California, Mexico
Mejia-Olivares, C., Haigh, I. D., Angeloudis, A., Lewis, M. & Neill, S., Aug 2020, In : Renewable Energy. 155, p. 469-483

Water mass properties derived from satellite observations in the Barents Sea
Barton, B., Lique, C. & Lenn, Y-D., Aug 2020, In : Journal of Geophysical Research: Oceans. 125, 8, e2019JC015449.

Novel co-occurrence of functionally redundant consumers induced by range expansion alters community structure
Aguilera, M., Valdivia, N., Broitman, B., Jenkins, S. & Navarette, S., 30 Jul 2020, In : Ecology. e03150.

Contrasting effects of climate change on seasonal survival of a hibernating mammal
Cordes, L., Blumstein, D., Armitage, K., CaraDonna, P., Childs, D., Gerber, B., Martin, J., Oli, M. & Ozgul, A., 28 Jul 2020, In : PNAS. 117, 30, p. 18119-18126 8 p.

Summer and Winter Marine Heatwaves Favor an Invasive Over Native Seaweeds
Atkinson, J., King, N. G., Wilmes, S. B. & Moore, P. J., 17 Jul 2020, In : European Journal of Phycology. n/a, n/a

Possible control of acute outbreaks of a marine fungal pathogen by nominally herbivorous tropical reef fish
Neal, B., Honisch, B., Warrender, T., Williams, G. J., Work, T. & Price, N., 12 Jul 2020, In : Oecologia. 193, 3, p. 603-617

Multiple trait dimensions mediate stress gradient effects on plant biomass allocation, with implications for coastal ecosystem services
de Battisti, D., Fowler, M. S., Jenkins, S., Skov, M., Bouma, T. J., Neyland, P. J. & Griffin, J., Jul 2020, In : Journal of Ecology. 108, 4, p. 1227-1240

Tides on Other Earths: Implications for Exoplanet and Palaeo-Tidal Simulations
Blackledge, B., Green, M., Barnes, R. & Way, M., 28 Jun 2020, In : Geophysical Research Letters. 47, 12, e2019GL085746.

Maternal and cohort effects modulate offspring responses to multiple stressors
Torres, G., Thomas, D. N., Whiteley, N., Wilcockson, D. C. & Gimenez Noya, L., 24 Jun 2020, In : Proceedings of the Royal Society B: Biological Sciences. 287, 1929, 20200492.

The challenges of constraining shelf sea tidal models using seabed sediment grain size as a proxy for tidal currents
Ward, S., Scourse, J., Yokoyama, Y. & Neill, S., 24 Jun 2020, In : Continental Shelf Research. 205, 104165.

Artificial skyglow disrupts celestial migration at night
Torres, D., Tidau, S., Jenkins, S. & Davies, T., 22 Jun 2020, In : Current Biology. 30, 12, p. PR696-R697

An integrated process-based model of flutes and tool marks in deep-water environments: implications for palaeohydraulics, the Bouma sequence, and hybrid event beds
Peakall, J., Best, J., Baas, J. H., Hodgson, D. M., Clare, M. A., Talling, P. J., Dorrell, R. M. & Lee, D. R., Jun 2020, In : Sedimentology. 67, 4, p. 1601-1666

Localized outbreaks of coral disease on Arabian reefs are linked to extreme temperatures and environmental stressors
Aeby, G., Howells, E., Work, T., Abrego, D., Williams, G. J., Wedding, L., Caldwell, J., Moritsch, M. & Burt, J., Jun 2020, In : Coral Reefs. 39, 3, p. 829-846

Using vertebrate environmental DNA from seawater in biomonitoring of marine habitats
Sigsgaard, E. E., Torquato, F., Froslev, T., Moore, A., Sorensen, J., Range, P., Ben-Hamadou, R., Bach, S., Moller, P. R. & Thomsen, P., Jun 2020, In : Conservation Biology. 34, 3, p. 697-710 14 p.

Editorial: Structure, Functioning and Conservation of Coastal Vegetated Wetlands
Richir, J., Bouillon, S., Gobert, S., Skov, M. & Borges, A. V., 29 May 2020, In : Frontiers in Ecology and Evolution. 8, 4 p., 134.

Distribution modelling of the Eurasian Otter (Lutra lutra) on the Isle of Anglesey, Wales
Riley, T., Waggitt, J. & Davies, A., 28 May 2020, In : Journal of the International Otter Survival Fund. 6, p. 30-39

Final deglaciation of the Malin Sea through meltwater release and calving events
Tarlati, S., Benetti, S., Callard, S. L., Ó Cofaigh, C., Georgiopoulou, A., Edwards, R., Van Landeghem, K., Saher, M., Chiverrell, R., Fabel, D., Moreton, S., Morgan, S. & Clark, C., 6 May 2020, In : Scottish Journal of Geology.

Exceptionally low tide at Malltraeth Bay looking towards Llanddwyn Island and the mountains of Snowdonia.