University of Southampton

DEPTH & DISCOVERY

Producing knowledge through research

SOUTHAMPTON MARINE & MARITIME INSTITUTE

WELCOME

It is a great pleasure to provide this introduction to the Southampton Marine and Maritime Institute Report. The University of Southampton is world-renowned for its strength in interdisciplinary and mission-orientated research. At the heart of this, are our four University Strategic Interdisciplinary Research Institutes, including SMMI, which bring together researchers from across the University, and beyond, to allow them to develop new partnerships and deliver outcomes and impact beyond anything they could achieve on their own.

In the case of SMMI, this allows us to provide insights and solutions to the challenges of the changing climate and maritime environment as well as addressing the critical need to decarbonize maritime trade and transport. The combination of science and engineering with law, politics and other social sciences allows us to provide input to policy makers, while the inclusion of arts and humanities input has resulted in compelling public engagement activities, including our contributions to the spectacular Whales exhibition in Winchester Cathedral (page 43).

I am very grateful to Professor Fraser Sturt, the new director of SMMI and to Professor Damon Teagle, his long-serving predecessor for their excellent leadership of this important activity, together with the core team and the wider SMMI community. As you read through this report I am sure that you will be impressed by the quality of the activities it presents and share my gratitude to those who have contributed.

Professor S. Mark Spearing
Vice-President, Research and Enterprise

The world's oceans and seas are foundational to life on Earth. They regulate climate, sustain ecosystems, and connect societies through food, energy, trade, and culture. As pressures on marine space and resources intensify, how we use, govern, and care for the seas will shape the sustainability, equity, and resilience of future generations.

Southampton Marine and Maritime Institute exists to advance the interdisciplinary research, education, and innovation needed to meet these global challenges. In doing so, SMMI directly supports the University of Southampton's strategic mission to generate and share knowledge that addresses the most pressing challenges facing society, creating global impact. Through collaboration across disciplines, sectors, and borders, our Institute enables scientific insight, engineering solutions, policy frameworks, and societal perspectives that both respond to current needs and anticipate future risks and opportunities.

The quality and breadth of our work are reflected in distinctions such as hosting the Regius Professorship in Ocean Science, a Royal Academy of Engineering Chair in Emerging Technology for Ocean Engineering, the Shell Professorship of Ship Safety and Efficiency, and the Centre for Green Maritime Innovation. In recent years, our researchers have advanced understanding of global seafloor biodiversity, explored future fuels for maritime transport, developed pathways for renewable energy generation, and contributed to the discovery of the world's oldest intact shipwrecks.

It is a privilege to work with such a committed and diverse community. The work showcased in this report demonstrates the impact that can be achieved through sustained interdisciplinary collaboration, and the vital role SMMI will continue to play in supporting the University's mission and in working with partners to shape a sustainable marine and maritime future.

Professor Fraser Sturt
Director, Southampton Marine and Maritime Institute

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ADDRESSING GLOBAL MARINE AND MARITIME CHALLENGES

Southampton Marine and Maritime Institute (SMMI) works with partner organisations to tackle global marine and maritime challenges.

From developing green technologies to influencing government policy, our experts from across the University of Southampton are working to deepen knowledge of the ocean and develop just, sustainable solutions to the challenges it faces.

OUR MISSION

Our core mission is to increase knowledge and awareness of the oceans and to develop just solutions to marine and maritime grand challenges from local to global scales.

SMMI is a gateway that connects marine and maritime industries, policy makers and other groups to research, innovation, and education within the University of Southampton.

WHAT WE DO

We are a unique, internationally recognised centre of excellence for research, innovation, and education. Our large community of more than 400 experts are addressing present day and future challenges around the natural ocean environment and human use of seas. As well as educating the next generation of leaders, we are also generating new collaborations, knowledge and ideas for businesses, governments and organisations to develop wide-ranging solutions to these issues.

Since its launch in March 2012, SMMI has flourished; producing world-class research and attracting new researchers and collaborations to the University. We have supported scholars looking at topics from colonialism and opera, to underwater distributed optical fibre networks. Within the SMMI we have people who are passionate about research, and who can offer unique insights, across a surprisingly diverse cross section of the University.

For more than a decade we have been connecting our experts in ocean science, engineering, maritime law, medicine, archaeology and many other disciplines with partners from industry, government, and other external stakeholders.

Our interdisciplinarity and the bridging of disciplinary boundaries enables us to address complex global challenges together.

OUR NETWORKS

THE CENTRE FOR GREEN MARITIME INNOVATION

The Centre for Green Maritime Innovation (cGMI) is a major industry-backed initiative led by the University aiming to address the UK's urgent need for maritime decarbonisation through collaboration, innovation, technical de-risking and skills development.

The cGMI is a proposed national centre to unite and promote the maritime sector, accelerate the development and integration of clean technologies, and deliver the jobs, skills and growth needed across the UK.

Aligning with the University's strengths in research and business collaboration, cGMI would fill a critical gap in the UK's innovation landscape by providing the infrastructure, expertise and coordination needed to test and de-risk sustainable maritime technologies at scale and in representative environments, in one of the UK's most significant port cities and premier maritime business clusters.

INTERNATIONAL MARITIME FUTURE TECHNOLOGIES INNOVATION CENTRE

The International Maritime Future Technologies Innovation Centre, is a new centre which will focus on developing and testing zero-carbon and intelligent-ship technologies, building on joint research into fleet decarbonisation models.

The Centre is a joint collaboration led by Lloyd's Register (LR), with COSCO Shipping Group, Shanghai Jiao Tong University and the University of Southampton.

The new virtual centre aims to advance research and development in low- and zero-carbon maritime technologies, intelligent ship systems and digital innovation.

The Centre will serve as a global platform for collaboration between industry and academia, supporting the sector's transition towards a smarter and more sustainable future. It will focus on translating research into practical, scalable solutions for deployment across global fleets.

MARITIME SOLENT

Maritime Solent is an organisation which offers advice, international access, and all-important connections to the Solent maritime cluster.

Through strong ties with HM Government, Maritime Solent nurtures maritime success in the region. It also champions Solent success worldwide. Leading by example with representation at maritime events and trade missions, and enabling partners to target growth.

The Maritime Solent network has diverse, world-leading capability across Ports and Shipping, Maritime Defence, Training, Academia and Research, Shipbuilding, Leisure Marine, Heritage and Tourism, Professional Services and Regulation.

Through powerful partnerships and a diverse network of collaborators, SMMI is driving collective action to deliver real-world impact.

Centre for Green Maritime Innovation (cGMI)

EngineeringX

Lloyd's Register Foundation

Royal Academy of Engineering

CYPRUS MARINE & MARITIME INSTITUTE

EMREA
European Ocean Research and Education Alliance

MARITIME UK SOLENT

SMMI TEAM

PROFESSOR FRASER STURT
SMMI DIRECTOR
PROFESSOR OF ARCHAEOLOGY

Southampton alumni Professor Fraser Sturt has been involved in SMMI since it began, as Deputy Director for 7 years, taking on the Directorship in 2025. He brings a key understanding of the importance of the arts and humanities to the Institute.

"Culture shapes everything we do, from how we understand the world around us, to how we evaluate information and make decisions. Research in the arts, humanities and social sciences give unique perspectives on this which are fundamental to our knowledge of the past and present, as well as plans for the future," he said.

PROFESSOR SUSAN GOURVENEC
SMMI DEPUTY DIRECTOR
PROFESSOR OF OFFSHORE GEOTECHNICAL ENGINEERING

Professor Susan Gourvenec was drawn to the University of Southampton by SMMI when she was looking to relocate from Australia. "Bringing together diverse disciplinary, geographical and cross-sector perspectives is essential to create equitable and workable solutions to complex challenges. I have been an advocate and practitioner of multi- and interdisciplinary working throughout my career," she said.

PROFESSOR JULIAN LEYLAND
SMMI DEPUTY DIRECTOR
PROFESSOR OF PHYSICAL GEOGRAPHY

Julian joined SMMI as a Deputy Director in late 2025 with a key aim in mind, "I am keen to lead the work on consolidating and amplifying the institutes and Southampton's coastal agenda.

"By embedding research excellence within regional governance and innovation frameworks, the goal is to position both SMMI and the wider Solent area as leaders in coastal resilience, sustainable maritime futures and evidence-led environmental management."

PROFESSOR BLAIR THORNTON
SMMI DEPUTY DIRECTOR
PROFESSOR OF MARINE AUTONOMY, SCHOOL OF ENGINEERING

Joining SMMI at the same time as Julian in 2025, Professor Blair Thornton looks forward to giving back to the University's marine and maritime community.

"I first joined Southampton's marine and maritime community in 1999 as an undergraduate in naval architecture, later completing a PhD in underwater robotics. After 14 years at the University of Tokyo, I returned to Southampton under an SMMI funded post. Being part of SMMI has been a big part of my career, and I have benefitted immensely from the mentorship and opportunities it has brought me. It has helped me broaden my perspectives across research, education and enterprise and I believe I am a better Engineer for it.

SMMI IS SUPPORTED BY A DEDICATED TEAM OF SPECIALISTS

SUE BRINDLE
INSTITUTE COORDINATION MANAGER

Sue drives forward the activities, events, and impact of SMMI community, working closely with the Special Interest Groups, providing coordination and management support, and overseeing all funding opportunities and studentships.

WASSIM DBOUK
RESEARCH FELLOW

Wassim works at the intersection of maritime law and ocean policy, conducting research across the marine and maritime space on how legal and governance frameworks can support a just and sustainable transition for the ocean economy, coastal communities, and all those whose livelihoods depend on the sea. He works to translate diverse expertise into policy-relevant outputs and to build relationships with key decision makers.

LOUISE PAYNE
MARKETING AND COMMUNICATIONS MANAGER

Louise works with SMMI to promote and amplify the opportunities, projects, networks and events it undertakes to academic colleagues and wider external stakeholders and partners. Her work across all the University interdisciplinary research institutes brings together and elevates the world leading strength we have in interdisciplinarity.

CARIN REISINGER
COLLABORATION & SCIENTIFIC COMMUNICATIONS MANAGER

Carin works to build relationships, advance strategic engagement, and connect marine and maritime expertise across the University with partners, networks, and opportunities. She develops targeted communications that showcase our research and strengthen SMMI's reach and impact.

PROFESSOR DAMON TEAGLE
OUTGOING SMMI DIRECTOR
PROFESSOR OF GEOCHEMISTRY, OCEAN AND EARTH SCIENCE

After seven years as Director of SMMI, Professor Damon Teagle stepped down from the role in August 2025.

As he says farewell to the leadership role to pursue new challenges, we look at how things have changed under his tenure, what has been achieved and his hopes for SMMI's future.

Damon not only held the Director post, he was also Deputy Director for five years and prior to the formation of the formal interdisciplinary research institutes, he was involved in marine and maritime research.

He said: "The biggest change since I became involved with SMMI is that the University now recognises and proudly promotes our distinctive strengths in ocean-facing research, education and knowledge exchange.

"Our world-leading research isn't an inevitable consequence of being hosted in a major port city in a region with hundreds of miles of coastline. But it is a happy coincidence, the broad spectrum of leading marine and maritime expertise at the University of Southampton and its depth, distinguishes us from other major UK research-intensive universities.

"Our region has strong marine and maritime activities and SMMI has played an important role in building links with local industry, government and society. However, there is still much to be done and I look forward to seeing Fraser steer the ship in that endeavour. Here in the Solent region we have one of the globe's great concentrations of marine and maritime science, technology, industry, education, training and knowledge, and I am confident SMMI will continue to shout loudly nationally and internationally about that critical mass of expertise."

SPECIAL INTEREST GROUPS

SMMI has an established and active community of Special Interest Groups (SIGs) that bring together colleagues to address key challenges.

Led by mid- to early-career researchers, the SIGs create collaborative opportunities for experts working on related projects to pursue new research avenues and exchange knowledge. They encourage academics from different disciplines to work together on interdisciplinary research that is exploring solutions to today's global challenges.

This means that the resulting research communities are in a strategically stronger position to respond to significant multi and interdisciplinary grant applications when a funding call is announced.

Since their creation, SMMI SIGs have undertaken activities to bring colleagues together to explore research opportunities and ideas, including workshops, lectures, sandpits and writing retreats.

This year, they held a coastal nature-based solutions stakeholder engagement event in collaboration with the Sustainability and Resilience Institute and the Future Towns Innovation Hub and have been preparing funding bids across the sector.

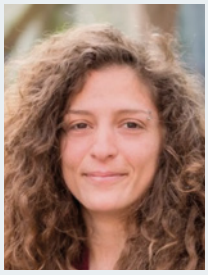
SMMI is continually looking for new areas of special interest as different challenges and specialisms arise. We are keen to hear from anyone who is interested in establishing or joining a SIG.

Special Interest Groups

Dr Sien van der Plank
Lecturer, Geography and Environmental Science

Freya Palmer
PhD Student, School of Engineering

Dr Alexandra Karamitrou
Lecturer in Archaeology and AI, Archaeology



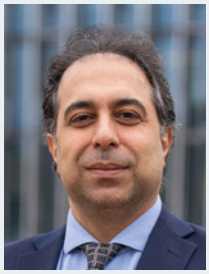
Dr Crystal El Safadi
Associate Professor Maritime Archaeology, Archaeology

Avanthika Kamath
PhD Student, School of Engineering

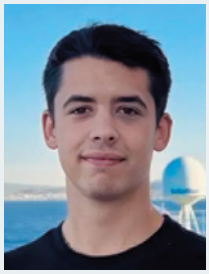
Imali Manikarachchige
PhD Student, School of Engineering

Dr Philip Leadbitter
Research Fellow, Chemistry & Chemical Engineering

Dr Hugo Putuhena
Research Fellow in Offshore Renewable Energy, School of Engineering



Capt Dr Seyedvahid Vakili
Research Fellow, School of Engineering



Panos Manias
SMMI-CMMI Marine and Maritime Senior Research Assistant, School of Engineering

COASTAL COMMUNITIES

Focusing on bringing together researchers and non-academic stakeholders to tackle challenges facing coastal communities such as the health impacts of air pollution to the social effects of climate change-driven coastal change.

"Coastal communities face a complex range of opportunities and challenges in the twenty-first century, locally to Southampton, around the UK, and worldwide. The Coastal Communities research group brings together academic, practice, community, and policy experts across economic, social, health, and environmental realms to collaboratively work toward sustainable solutions."

Dr Sien van der Plank
Freya Palmer
Avanthika Kamath
Imali Manikarachchi

DIGITAL OCEANS

Exploring advancements and exchanges expertise in digital technology in the marine space in areas such as artificial intelligence, data infrastructure and management, ocean mapping, simulation and developing digital twins.

"Digital Oceans is driving a transformative shift in marine research by harnessing AI, advanced data infrastructure, and ocean-mapping technologies to produce insights that were previously out of reach. The development of this research theme reflects Southampton's drive to lead in digitally enabled ocean science, bringing together interdisciplinary expertise and targeted investment to transform how we survey, monitor, understand, and manage the marine environment."

Dr Alexandra Karamitrou
Crystal El Safadi
Philip Leadbitter
Hugo Putuhena

MARINE DECARBONISATION

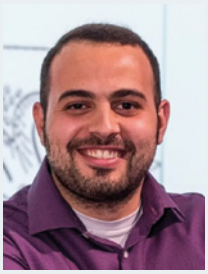
Driving positive change and shaping a more sustainable and prosperous future in shipping through collaboration and innovation. Their multi-faceted approach encompasses environmental responsibility, regulatory compliance, economic benefits, international collaboration, and alignment with national commitments.

"The global maritime sector is entering a decisive decade of transformation toward clean, smart, and sustainable operations. The establishment of the Maritime Decarbonisation SIG at Southampton reflects our growing leadership in advancing zero- and near-zero emission technologies, fostering cross-disciplinary research, and driving real-world impact through collaboration with industry, policymakers, and international partners."

Capt Dr Seyedvahid Vakili
Mr Panos Manias

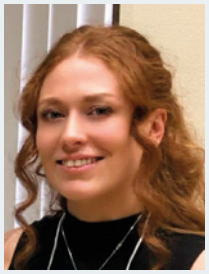
Dr Luke Myers
Associate Professor, School of Engineering

Dr Wassim Dbouk
Research Fellow, SMMI



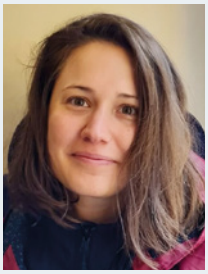
Dr Hachem Kassem
Lecturer, Ocean and Earth Science

Dr Vicky Dominguez Almela
Lecturer, Geography and Environmental Science



Dr Amber Jones
Senior Research Assistant, Ocean and Earth Science

Dr Dina Lupin
Associate Professor, Southampton Law School



Dr Giulia Champion
Lecturer, English

NATURE-BASED OCEAN SOLUTIONS

Addressing societal, economic, environmental and engineering challenges through effective nature-based ocean solutions. They aim to protect, sustainably manage, and restore natural or modified ecosystems to alleviate coastal and marine hazards such as coastal flooding and erosion, habitat degradation and biodiversity loss, and changing ocean biochemistry.

"Nature-based solutions are gaining traction within adaptive policies and interventions to address marine and climate-mediated challenges. The Nature-based Ocean Solutions SIG brings together researchers and stakeholders across disciplines with a shared commitment to deliver robust, nature-positive outcomes and enhanced societal, economic and environmental resilience through impactful, evidence-based ocean solutions."

Dr Hachem Kassem
Dr Vicky Dominguez Almela

OCEAN ENERGY

Addressing energy challenges to unlock the potential of ocean renewable energy and help achieve net zero goals worldwide. Topics of interest are centred around technological, environmental, societal, financial, and policy challenges related to the harvesting of renewable energies, the storage and transformation of offshore energy, and the sustainable decommissioning of oil and gas infrastructures.

Dr Luke Myers
Dr Wassim Dbouk
Dr Amber Jones

OCEAN JUSTICE

Sitting at the intersection of ocean studies and the concepts of global and environmental justice, they are exploring what the ocean brings to the meaning of justice, the presence and representation of the ocean in courts and law, and how we can unlearn and decolonise our engagement with the ocean.

"Centring justice in ocean research is critical at a time of intersecting social, political, economic and environmental crises, which threaten the ocean and all of the human and more-than-human communities that rely on it. The Ocean Justice SIG is an interdisciplinary research community who bring together scholars and non-academics across fields and disciplines to think and act together Ocean Justice, in its many and broadest definitions. The group organises reading group sessions, work-in-progress events, writing retreats, talks and lends its space to its members to propose events and formats for discussion and coming together; all are welcome."

Dr Dina Lupin
Dr Giulia Champion

RESEARCH PROJECTS

REGENERATING BONES WITH REEF CORALS

Interdisciplinary research led by SMMI member Professor Jörg Wiedenmann is exploring the use of reef corals in bone regeneration.

Professor Jörg Wiedenmann

Jörg, from Southampton's Coral Reef Laboratory, is working with colleagues in Ocean and Earth Science, Medicine and with the Institute for Life Sciences to investigate how the physical properties of reef coral skeletons can be manipulated to produce the best specimens for us in bone regeneration.

He said: "We found that the growth of hard corals is strongly influenced by the levels of nutrients in the water and the density and microstructure of the coral skeleton changes as we manipulate the water's nutrient levels. This enables us to customise the make-up of the coral skeletons for applications in medical research."

Sometimes parts of bones need to be replaced due to accidents, diseases or surgery. If a gap is over a certain size, then the bone won't regenerate naturally and needs to be bridged. Ideally a material needs to be used that will subsequently allow the regeneration of the natural bone material.

Jörg said: "Coral skeletons are well suited for this as they have a porous structure like natural bone, they are very hard yet still have a degree of flexibility. Bone cells need to be able to migrate into the pores of the replacement material and we can now deliberately manipulate the size and shape of these pores to find the ideal structure.

"At Southampton, we are in a unique position where we have researchers working on corals and researchers working on bone regeneration. This provided a great opportunity to drive this research forward.

"We are also proud of the totally sustainable environment that we have created at Southampton. We can grow corals in-house, so we don't need to take them from the field where they are a threatened species. The capacity to simulate different nutrient environments for long term experiments sets us apart from other coral reef research groups across the globe."

The research has shown that the coral skeleton can be manipulated to make it more advantageous to bone regeneration applications and that aquarium-grown coral skeletons can be used as potential bone regeneration material.

Experimental aquarium of the Coral Reef Laboratory University of Southampton

Credit: Wiedenmann D'Angelo

INVESTIGATING POWERING FUTURE SHIPS BY WIND

SMMI has been a key collaborator in the Winds of Change project that is investigating the potential of wind power in decarbonising the UK and global maritime sector.

The Pacific Grebe at sea during trials

SMMI has been a key collaborator in the Winds of Change project that is investigating the potential of wind power in decarbonising the UK and global maritime sector.

The project was funded by the UK Government to explore the use of the FastRig wing-sails when retrofitted to vessels. The FastRig wing-sails were developed by UK company Smart Green Shipping.

SMMI members Dr Joseph Banks, lecturer in Ship Science and Maritime Engineering and Professor Dominic Hudson, Shell Professor in Ship Efficiency, have been leading the Southampton research that has included testing the sails and vessel performance in the University's wind tunnel towing tank, creating new software to accurately predict how modern vessels fitted with the sails perform on the ocean, and to help with the installation and sea-trial testing of the FastRig on a commercial vessel – the MV Pacific Grebe.

Joseph said: "Ships powered by wind are obviously nothing new – but almost every large vessel operating today is powered by fossil fuels, leaving a lasting mark on the environment. While new wind-assist technologies are being developed, many are not ready for market and their predicted fuel savings have not been independently verified at sea.

"With this innovative project, the technology can be retrofitted to pre-existing vessels to quickly reduce emissions from the existing ships and help create quieter, emission-free ships in the future that do no harm to ocean environments and improve air quality in ports towns and cities.

"Our team of researchers investigated the complex interactions between the wing-sails and the ship hydrodynamics enabling accurate predictions of vessel performance that are being compared to a demonstration vessel. This required innovative numerical simulations backed up by experiments conducted in our 138-metre Boldrewood towing tank and RJ Mitchell wind tunnel."

Dr Joseph Banks

The MV Pacific Grebe, fitted with the wing-sail, paid a visit to Southampton to showcase the technology to industry guests, collaborators, researchers and public figures.

Di Gilpin, CEO and Founder of Smart Green Shipping, said: "Wind is clean and cheap. Once the technology is installed, the ship gets access to wind to power the ship, which reduces the need for whatever other fuel type is being used to drive the ship, ultimately cutting emissions."

Joseph said that the support from the SMMI has been vital in combining two distinctive areas in maritime research – ship efficiency and performance and sailing performance and prediction.

Find out more about maritime decarbonisation.

EMERGING TECHNOLOGIES FOR INTELLIGENT RESILIENT OCEAN ENGINEERING

SMMI Deputy Director, Professor Susan Gourvenec, holds a prestigious Royal Academy of Engineering Chair in Emerging Technologies for her vision for Intelligent and Resilient Ocean Engineering.

Susan leads the Centre of Excellence for Intelligent & Resilient Ocean Engineering (IROE) driving activities to create a step change in ocean engineering design to support responsible, sustainable and economic use of ocean resources.

IROE's activities address technology gaps at each stage of the engineered life cycle of ocean structures, from characterising and forecasting ocean and seafloor behaviour, to the design and operation of novel platforms for ocean facilities.

The activities of the Chair in Emerging Technologies for Intelligent & Resilient Ocean Engineering reach beyond engineering solutions, engaging with the public and policy makers to raise awareness of ocean engineering and guide policy for future use of our oceans.

Find out more about IROE's research and activities visit:
www.southampton.ac.uk/iroe

IROE team ready to welcome the public to the annual Southampton Science and Engineering Festival (SOTSEF)

SUBSEA ROBOTICS AID RENEWABLE ENERGY PLANNING

As the UK moves towards its 2050 Net Zero target, its offshore wind capacity is expected to increase tenfold. How this expansion impacts marine ecosystems in relation to other human-made pressures is still largely unknown.

The Natural Environment Research Council (NERC) funded Benthic-Offshore Wind Interactions project, or BOWIE for short, aims to address this information deficit, by better understanding how offshore wind infrastructure interacts with the marine environment.

In Autumn 2025, a team led by SMMI Deputy Director, Professor Blair Thornton and Dr Emma Curtis (Maritime Engineering), deployed the autonomous underwater robot SMARTY200 to survey the Gwynt y Môr wind farm in North Wales.

Gwynt y Môr is a 576-megawatt offshore wind farm located in the Irish Sea. Commissioned in June 2015, it has 160 wind turbines which produce enough clean energy a year to power 467,000 households, cutting 1.7 million tonnes of CO_2 emissions a year.

All the offshore wind turbines at Gwynt y Môr are fixed-bottom turbines that have foundations which are large-diameter steel piles driven into the seabed, either with or without protection from erosion in the form of a ring of large boulders surrounding the foundation.

SMARTY200 was sent to capture visual images of the seafloor around several turbines, to establish what kinds of marine life are present, and how they change with distance and direction from the turbines.

Emma, who was chief scientist on the survey, said, "We captured more than 25,000 images over a total of five dives, which provided us with visuals of a range of seafloor habitat types and organisms, including sea stars, anemones, crabs and flatfish.

"We can now attribute these images back to where they appear on the seafloor and with careful analysis, provide insight into the interaction of seafloor ecosystems with offshore wind infrastructure.

AUV on water surface

Emma Curtis

"Importantly, this insight will feed back into the BOWIE project, moving us closer to an improved understanding on how we can better develop the UK's renewable energy landscape whilst preserving our important marine environment."

As we continue to see big changes to our climate and to life on our planet, moving to renewable energy, including offshore wind, remains a priority and can play a major role in cutting the emissions contributing to climate change, however we don't yet fully know how this transition will affect marine biodiversity which is why projects like BOWIE are so important.

As the UK leads the way in delivering offshore wind energy, SMMI and the Southampton community is committed to understanding how these efforts impact the natural environment, enabling better informed planning and management.

BOWIE is part of the Ecological Consequences of Offshore Wind research programme (ECOWind), which is supported by Defra and funded by The Crown Estate's Offshore Wind Evidence and Change Programme (OWEC), The Crown Estate Scotland (CES) and NERC.

All ECOWind projects aim to fill the knowledge gaps critical to making sustainable marine spatial planning decisions whilst increasing the UK's renewable energy capacity.

Special thanks to RWE Renewables UK and Briggs Marine for supporting the survey, and BOWIE team members, including Sam Simmons, Dr Hugo Putuhena, Professor Susan Gourvenec, Professor Paul White, Dr George Callender, Professor Jasmine Godbold, Professor Martin Solan, Professor Justin Dix and Dr Krysia Mazik from the University of Hull.

PATHWAYS TO A BLUE ECONOMY: SOUTHAMPTON RESEARCHERS OUTLINE ROUTES TO A SUSTAINABLE OCEAN FUTURE

A new paper from SMMI warns that the ocean economy remains "grey, not blue" – and that only decisive, system-wide change can secure a thriving ocean and stable climate for future generations.

A new paper from the SMMI warns that the ocean economy remains "grey, not blue" – and that only decisive, system-wide change can secure a thriving ocean and stable climate for future generations.

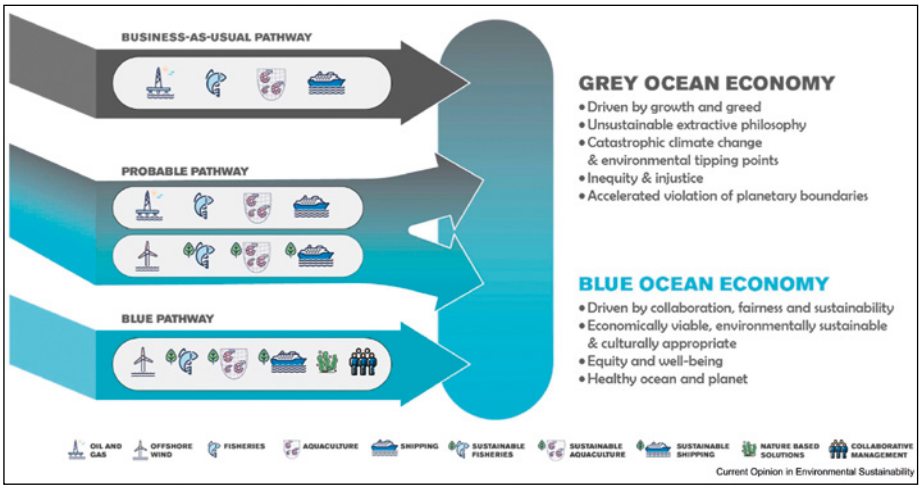
Published in *Current Opinion in Environmental Sustainability*, Pathways to a Blue Economy is authored by SMMI leadership past and present; Professor Susan Gourvenec, Professor Fraser Sturt, Professor Damon Teagle and SMMI Research Fellow Dr Wassim Dbouk, and it defines three possible futures for the ocean economy: business-as-usual, probable, and blue.

The authors conclude that current trends fall far short of global sustainability and decarbonisation targets, and that a proactive "blue shift" built on collaboration, fairness, and sustainability is urgently needed.

"The ocean is our lifeline – feeding billions, powering economies, and sustaining the climate. Yet investments still flow into harmful practices," said Susan. "A thriving blue economy isn't just possible – it's essential. The choices we make today will shape the ocean's future – and our own."

This paper offers a roadmap to transition from extractive, carbon-heavy practices towards ocean use that supports both planetary health and economic resilience.

It also builds on the team's earlier contribution to the UK Ministry of Defence's Global Strategic Trends: Out to 2055 (GST 7), for which they authored a report *From Grey to Blue: An Ocean Economy fit for the Future*, detailed on page 48.



Pathways to a Blue Economy

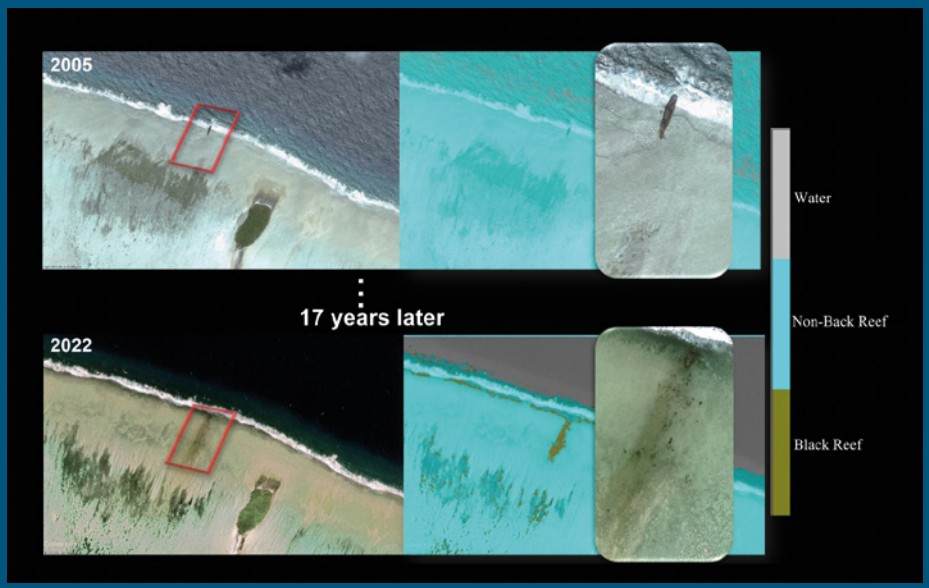
AI FOR SHIPWRECK MAPPING

A new project led by SMMI member and SIG lead for Digital Oceans Dr Alexandra Karamitrou, Lecturer in Archaeology and AI, is set to transform how we uncover and protect shipwrecks hidden beneath our oceans.

The project, *Deep Data, Fragile Seas: AI for Shipwreck Mapping and Environmental Safeguarding*, uses open access remote sensing data ranging from satellite imagery to environmental surveys, combined with artificial intelligence and high-performance computing, to create transparent, reproducible workflows capable of detecting wrecks and assessing their environmental risks.

Alexandra explains, "By harmonising archival records with geospatial datasets, the project will not only enrich our understanding of maritime heritage but also provide practical tools for conservation and environmental safeguarding.

"What makes this initiative especially exciting is its adaptability. The AI models trained to identify shipwrecks can also be applied to other marine hazards, such as abandoned oil and gas platforms or pollution hotspots. With the blend of cutting edge technology and cultural heritage, we aim to safeguard the past while tackling urgent challenges of the present, offering benefits for researchers, heritage organisations, environmental agencies, policymakers, educators, and coastal communities worldwide."



This image illustrates findings from previous research on shipwreck impacts at Kwajalein Reef Atoll. The left column shows Google Earth images from 2005 and 2022, with the wreck site marked inside a red rectangle. The right column presents segmented outputs after the application of a trained AI model. The khaki indicates areas classified by the algorithm as "black reef", light blue represents the remaining reef, and grey denotes water. The comparison reveals how, over 17 years, the vessel's body fragmented and dispersed, leaving behind a trail of ecological change. This study formed part of a wider project that uses open access remote sensing data, artificial intelligence, and high performance computing to detect shipwrecks and assess their environmental risks (Karamitrou et al., 2023).

Karamitrou, A., Sturt, F. and Bogiatzis, P., 2023. Identification of black reef shipwreck sites using AI and satellite multispectral imagery. Remote Sensing, 15(8), p.2030.

NEW FINDINGS REVEAL NEW GUINEANS AND ABORIGINAL AUSTRALIANS DESCEND FROM TWO GROUPS OF PEOPLE WHO ARRIVED CA. 60,000 YEARS AGO

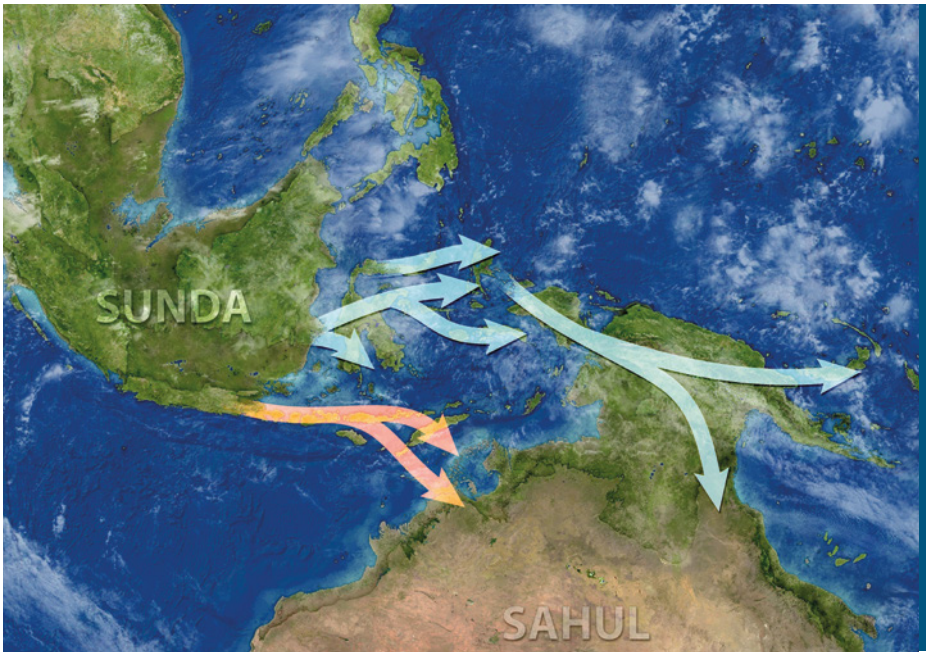
The first settlement of New Guinea and Australia by modern humans took place some 60,000 years ago, according to new findings of a major research collaboration between the University of Southampton and the University of Huddersfield.

Led by Professor Helen Farr, an expert in maritime archaeology, and an SMMI member who came to the university in 2009 on an SMMI Lectureship, the genetic research reveals two distinct groups of settlers dispersed into the region from different parts of what is now South East Asia.

Helen explains, "Our study, which has been published in the journal Science Advances, is a collaboration between archaeogeneticists, archaeologists, earth scientists and oceanographers. It clarifies the much debated who, where and when of this early maritime migration."

The work was funded by a European Research Council grant to Helen and the University of Southampton's Centre for Maritime Archaeology, with the archaeogenetics team led by Professor Martin Richards at the University of Huddersfield's Archaeogenetics Research Group. The interdisciplinary team also included colleagues at the University of Minho in Portugal, at La Trobe University in Australia, and the University of Oxford.

"During the last Ice Age, when sea levels were much lower than they are today, New Guinea and Australia were part of a single landmass, known as Sahul. There has been a long-running discussion about both the timing of the first settlement of Sahul and the routes by which people first travelled to the ancient super-continent," explains Helen.



Check out Helen's podcast, Before Us, a deep dive into big issues in archaeology and human evolution. Helen and Dr Erich Fisher take a look into the origins and development of Maritime Adaptations, tracing humanity's journey from the earliest interests in aquatic resources to the global expansion of modern humans via oceans, coastlines, and waterways.

Professor Helen Farr

Professor Martin Richards

"It is widely known that the ancestors of Indigenous New Guineans, Australians and Torres Strait Islanders have inhabited Sahul for tens of thousands of years, with many Aboriginal Australians understanding that they have always been 'on country'. However, for western scientists and archaeologists, the details of global dispersals have remained somewhat controversial.

"There are two views on the timing of the settlement – the 'long chronology', suggesting that the first settlement goes back to around 60,000 years and the 'short chronology', which argues for a first landfall around 45,000 to 50,000 years," she said.

Helen and the team analysed almost 2,500 mtDNA genomes from Indigenous Australian, Torres Strait Islanders, New Guineans, and people from the western Pacific and Southeast Asia. They used these to build a genealogical tree and looked at the way the lineages in the tree were distributed from one population to the next. As all DNA changes gradually over time, they used the amount of change in the lineages – known as the 'molecular clock' – to date lineages from each region.

Their findings showed that the most ancient lineages seen either in Aboriginal Australians, New Guineans, or both, but nowhere else, dated to around 60,000 years, coming down firmly in support of the long chronology.

The ancestry of the most ancient lineages could be traced back to Southeast Asia. But the team also found that while the majority traced back to more northerly parts of Southeast Asia – northern Indonesia and the Philippines – a significant minority traced to more southerly parts – southern Indonesia, Malaysia and Indochina. This suggested there were at least two distinct dispersal routes into Sahul with lineages from both routes dated to around the same arrival time.

Helen said, "This is a great story that helps refine our understanding of human origins, maritime mobility and early seafaring narratives. It reflects the really deep heritage that Indigenous communities have in this region and the skills and technology of these early voyagers."

Professor Martin Richards said: "We feel that this is strong support for the long chronology. Still, estimates based on the molecular clock can always be challenged, and the mitochondrial DNA is only one line of descent. We are currently analysing hundreds of whole human genome sequences – 3 billion bases each, compared to 16,000 – to test our results against the many thousands of other lines of descent throughout the human genome.

"In the future there will be further archaeological discoveries, and we can also hope that ancient DNA might be recovered from key remains, so we can more directly test these models and distinguish between them."

Thanks to the wider team at Southampton involved in the project including Professor Robert Marsh, Professor Ivan Haigh, Professor Justin Dix and Dr Kiki Kuijjer who successfully completed her SMMI funded PhD with the team.

HIGHER EDUCATION INNOVATION FUND (HEIF)

As part of our ongoing commitment to fostering innovation and growth within our community, an annual allocation of funding from HEIF is given to the University by Research England to support knowledge exchange activities.

The allocation to SMMI is open to our members to apply for, in support of small-scale projects. These grants are designed to enable individuals and teams to explore new ideas, develop pilot initiatives, and build capacity.

Projects are expected to address immediate challenges, particularly nature-based and engineering-based solutions to climate change and decarbonisation, while also responding to business needs.

We ask that applicants demonstrate interdisciplinary approaches and clear engagement in knowledge exchange activities with business, industry, and external stakeholders, including local government, the public sector, or charitable organisations.

The long-term aim behind this funding is to enable these initial initiatives to grow into larger research opportunities and impactful collaborations, to contribute to sustained impact and advancement in different fields and the strengthening of our broader mission.

The following pages highlight successful projects that showcase how initial funding has acted as a catalyst for further development, leading to continued work and notable achievements.

ROBOTIC MONITORING OF SUBSEA COMMUNICATION CABLES

Autonomous Underwater Vehicles (AUVs) equipped with cameras, lasers and real-time intelligence are being developed to help monitor subsea communication cables, thanks to HEIF funding from SMMI.

Professor Blair Thornton

Globally we rely on a network of more than 500 subsea cables that total 1.4 million km and transmit over 95 percent of data. In shallow coastal areas, cables are buried to reduce accidental damage, however, the majority of cables are in deep water where they lay exposed on the seafloor far from shore.

Every year between 200 and 300 cable faults occur, with 80 percent caused by activities such as fishing and anchoring. Natural hazards account for most of the rest. Currently robotic vehicles inspect these cables, but these need to be piloted by human operators.

The HEIF funding has enabled SMMI Deputy Director, Professor Blair Thornton and his team to develop an autonomous robotic inspection vehicle that automatically detects cables, images them and reports potential threats to cable integrity before they cause damage. This is quicker and cheaper than using the remotely operated vehicles.

Since the HEIF funding, Blair's research team, has received further funding and carried out successful field demonstrations inspecting actual seafloor communication cables.

Blair said: "The HEIF funding brought together academics from diverse fields, enabling a focused effort on understanding the core challenges of robotic cable surveys. Building on this foundation, our team has secured external funding and successfully developed and demonstrated the necessary technology to address these challenges."

SAMPLING TREE BARK TO SHED LIGHT ON SHIPPING EMISSIONS

SMMI researchers have been sampling tree bark across Southampton to help understand and map the spread of shipping emissions.

Professor Matt Loxham from the Faculty of Medicine and Dr Nat Easton who is a Specialist Policy Officer for the Faculty of Environmental and Life Sciences, led the project to identify the spatial distribution of shipping emissions across the city to generate evidence on the extent of emissions spread, and potential exposure, to contribute to better informed policy decisions on pollution mitigation steps.

The team collected and characterised tree bark samples containing trapped particle matter (PM) that can show up to eight years of pollution accumulation.

Nat said: "We used the broad distribution of trees across the city to assess quantitatively how the shipping tracers vary spatially across Southampton and beyond.

"The focus of the work was to understand the spread of shipping emissions, but this technique also yields quantitative data on the spread of other pollution sources, enabling hot spot identification and material to be stored to be used in future studies at the University."

The project was originally in collaboration with Southampton City Council who provided maps of trees and permission to perform the sampling of surface tree bark. The sampling did not damage the trees.

However, its scope ended up being widened to include Southampton Science Park, at Chilworth, and Eastleigh Borough Council.

Southampton is the busiest cruise port in the UK and one of the busiest cargo ports, but the study findings may also apply to other ports.

Matt said: "The results of the tree bark study have been very interesting and show a clear trend which we are now using as preliminary data in grant proposals to further investigate using biomonitoring to assess air pollution."

Professor Matt Loxham

Dr Nat Easton

The project culminated in a knowledge exchange workshop between researchers from across the University and delegates from local authorities where future collaborative opportunities were discussed. A keynote speech was also given by Southampton's Professor Sir Stephen Holgate who is the UKRI Clean Air Champion. The workshop has also led to related work being taken forwards in collaboration with neighbouring local authorities. The work has been presented at major conferences and invited seminars, where it has garnered significant interest.

Matt added: "SMMI funding enabled Nat to undertake the significant amount of field- and laboratory- based experimental work to develop and characterise the novel use of tree bark biosampling. Not only has it led to tangible results and new evidence for grant applications, but it has also further expanded Nat's already impressive interdisciplinary skillset, which will make her highly competitive for her own independent Fellowship funding in the future.

"This is not the first time that the SMMI has supported our work – two BBSRC Fellowships, an AXA Research Fellowship and three PhD studentships (totalling around £1.7 million, with a further £1.7 million-worth of bids under review) are directly attributable to initial work that has been enabled by the generous and longstanding support we have received from the SMMI.

"Not only has SMMI enabled our work through financial means, but its interdisciplinary ethos and events have provided networking opportunities to develop our scientific ideas from conception through to execution and impact.

"Alongside her current research role, Nat is also acting as the UKRI Clean Air Knowledge Exchange Impact Fellow, a position she gained in no small part due to the opportunities facilitated by SMMI support that also included a prior internship with the Maritime and Coastguard Agency."

Matt and Nat plan to use some of the techniques from this project if a Leverhulme Trust application is successful to develop new models to analyse and predict the contribution of shipping emissions to air quality across Southampton.

INNOVATIVE TECHNOLOGY GOES FROM STUDENT PROJECT TO MARKET

Pump priming funding by SMMI has led to a student group project being developed into a field-tested viable product that has been licensed to local company ecoSUB Robotics.

The initial student project designed a water sampler to be used on small autonomous underwater vehicles (AUVs). The results of the project, including a working prototype, were so good that the project was awarded SMMI HEIF funding, along with a smaller grant from the Southampton Enterprise Development Fund to drive the project towards commercialisation.

SMMI funding enabled the team to create additional copies of the sampler and field-trial them in the Solent with support from ecoSUB Robotics. The field trials demonstrated that the sampler could be seamlessly integrated with ecoSUB's vehicles and perform in a representative real-world environment.

The technology will significantly expand the scope of underwater exploration and analysis by enabling marine researchers, environmental agencies and others to collect water samples autonomously and at depth.

Sam Simmons with AUV

Equipping water samplers on automated sea-going vehicles allows more water samples to be taken over a greater area at a lower cost compared to traditional manual sampling from research ships. Before this work, no water samplers have been available for smaller autonomous vehicles such as those made by ecoSUB.

SMMI member Dr Adrian Nightingale said: "Our collaboration with ecoSUB Robotics has been instrumental in bringing this advanced sampler to market. This is a significant step forward for marine science, as it provides a practical and scalable new solution for water sampling at depth and inhospitable environments."

Terry Sloane, ecoSUB Robotics' Managing Director, added: "The water sampler is a welcome addition to our ecoSUB vehicles, increasing their functionality for a wider range of underwater data collection missions. With this tool, we can support our customers in gathering critical data in ways that were previously not possible."

The sampler opens new avenues for applications including environmental monitoring, marine biogeochemistry, oceanography, and offshore operations, where detailed water quality data is essential. ecoSUB Robotics and the University aim to continue their collaboration on future technologies that push the boundaries of what's possible in autonomous water exploration.

HELPING MANAGE THE ADVERSE EFFECTS OF SARGASSUM INFLUXES

The influx of sargassum along the Caribbean coast of Mexico is being addressed through the innovative linking of technology and citizen sciences, thanks to HEIF funding from SMMI.

The influx of sargassum along the Caribbean coast of Mexico is being addressed through the innovative linking of technology and citizen sciences, thanks to HEIF funding from SMMI.

When a huge mass of sargassum seaweed washes up on the coastline it can damage the local economy in minutes. Boats are trapped, fishing nets are clogged, and beaches are inaccessible, affecting important industries such as tourism.

SMMI HEIF funding is enabling the SarTECH project to better understand and manage the adverse environmental and socio-economic impact induced by these sargassum influxes.

The project, led by SMMI member Dr Victoria Dominguez Almela, has made substantial progress and has exceeded its initial objectives by expanding its scope to also include deployments in Jamaica and Ghana.

So far, they have successfully installed seven low-cost fixed cameras across these regions. Controlled by raspberry pi computers, the cameras capture hourly images that are transformed into accurate bird's-eye views through specialised algorithms.

Vicky said: "This data enables the precise tracking and quantification of sargassum, laying the foundation for a future sargassum early warning system in Mexico.

The team also partnered with local schools, communities and regional experts to develop other ways to monitor near shore sargassum.

Dr Vicky Dominguez Almela

These included:

- Introducing fixed-point monitoring stations where members of the general public can take pictures to capture and upload sargassum imagery
- Developing curriculum-aligned educational materials that aim to foster an intrinsic community connection and sense of caring among students towards their environmental surroundings
- Organising workshops to share skills on sargassum monitoring with the community

The project has laid the groundwork for future initiatives, including establishing a Seaweed School and Community Network that will promote educational activities and interactions between students in different countries, and a series of events to measure the impact of the research.

Dr Oscar Frausto (University of Quintana Roo), teaching school students about the problems and potential benefits of pelagic sargassum on their local beach in Cozumel (Mexico).

EVENTS

SMMI SPONSORS REGIUS PROFESSOR LECTURE

SMMI sponsored the Regius Professor of Ocean Sciences Annual Lecture at the National Oceanography Centre Southampton (NOCS).

Professor Alberto Naveira Garabato

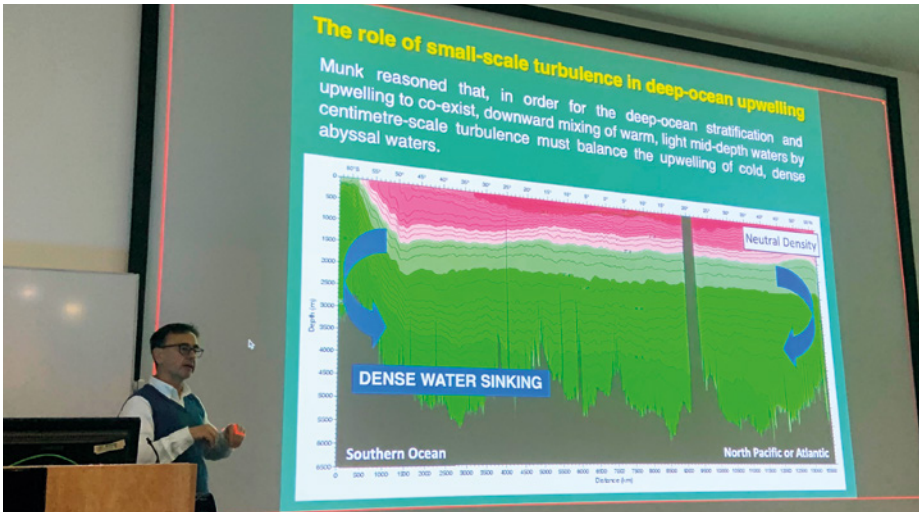
Regius Professor of Ocean Sciences Alberto Naveira Garabato, of Ocean and Earth Science, gave the lecture entitled Rewriting the Tale of Deep-Ocean Upwelling. The event was part of the flagship Earth and Ocean Science lecture series at NOCS.

Alberto is the second Southampton Regius Professor of Ocean Sciences, taking over from Emeritus Professor Harry Bryden FRS in 2023. Regius Professorships are an ancient tradition of royal patronage and the Regius Chair in Ocean Sciences was awarded in 2016 by Her Majesty the Queen as part of her 90th Birthday celebrations, to acknowledge the University's distinctive and broad excellence in ocean-facing research.

Alberto is an internationally recognised oceanographer and a University of Southampton alumnus who returned to the University in 2005. His research has been globally recognised and he received the Philip Leverhulme Prize in 2010, a Royal Society Wolfson Research Merit Award in 2014, the Challenger Medal of the Challenger Society for Marine Science in 2020 and the European Geoscience Union Nansen Medal in 2023.

In his lecture, Alberto interrogated the fundamental, yet poorly understood, process of ocean upwelling. This is the idea that dense, cold waters sink in the oceans and that is intuitive, but the mechanisms by which deep waters return to the surface remains poorly explained. Alberto explored recent theoretical investigations that have developed an alternative view of the role of mixing in sustaining deep-ocean upwelling. In this new view, upwelling is driven by highly localised turbulence within layers near the seafloor, known collectively as the bottom boundary layer. He discussed testing this new view and figuring out how it works.

The lecture was attended by Southampton colleagues, members of the British Antarctic Survey, staff from the National Oceanography Centre, and academic collaborators of Alberto from the Universities of Cambridge, Liverpool, and Exeter.



Professor Alberto Naveira Garabato delivers University of Southampton Regius Professor in Ocean Sciences Annual Lecture

VISIT BY WORLD-RENOWNED CLIMATE SCIENTIST PROFESSOR MICHAEL MANN

The University of Southampton had the honour of welcoming Professor Michael Mann – one of the world's most influential climate scientists – for a two-day visit and public lecture series sponsored by SMMI.

Best known for the iconic "hockey stick" graph that first captured global attention in 1998, Professor Mann is the Presidential Distinguished Professor of Earth & Environmental Science at the University of Pennsylvania, a lead author in multiple IPCC reports, and co-recipient of the 2007 Nobel Peace Prize. His visit drew full lecture theatres and galvanised conversations across the university community about the climate crisis – and what can still be done to prevent its worst effects.

In his first talk, Beyond the Hockey Stick, Michael revisited the groundbreaking climate reconstruction that revealed the unprecedented pace of recent global warming. "The blade, if you will, is even sharper," he noted, reflecting on the updated versions of the graph. "We have continued to warm by about 0.3°C per decade. The latest versions communicate even greater urgency when it comes to acting on the climate crisis."

But urgency doesn't mean despair. In his second lecture, Science Under Siege, Michael explored the rise of climate denial, anti-science ideologies, and misinformation amplified through AI and social media echo chambers. Yet, his message remained empowering: "There is urgency, but also agency." He emphasised that agency lies in our ability to vote, support science-based policy, engage people in everyday conversations, and take collective action through the choices we make and the communities we build.

Throughout his visit, Michael was introduced to a range of research teams and facilities that exemplify Southampton's leadership in interdisciplinary climate, sustainability, and ocean science. His tour included the National Oceanography Centre's Marine Autonomous Robotic Systems group, and the University of Southampton's Maritime Robotics Lab, Boldrewood Wave and Towing Tank, the Winds of Change project, Southampton Geospatial and the School of Ocean and Earth Science.

Reflecting on his time at Southampton, Michael said: "It's been a great experience to be here and talk with students and researchers about the really important climate and sustainability research that's going on here." He praised the university's interdisciplinary strength and the collaborative environment fostered by SMMI.

See more about Michael's visit here

From left:
Professor Susan Gourvenec,
Professor Gavin Foster,
Professor Michael Mann,
Professor Damon Teagle,
Professor Fraser Sturt

CELEBRATING WOMEN'S CONTRIBUTIONS TO MARITIME SAFETY

SMMI hosted a special panel event featuring three University of Southampton experts working towards safer futures in maritime.

> "The maritime industry is experiencing a technological (r)evolution and now, more than ever, we need to work together to ensure that the progress we've made on gender equity across the sector continues into the future."
>
> **Dhwani Oakley**

The event was held to celebrate women in the industry, highlight the work they do, and promote discussion around gender imbalances and how these can be addressed.

The panel brought together leading voices from different disciplines and career stages, working in various aspects of maritime safety. They shared about their research and work, as well as the route they took to get to where they are, including challenges and opportunities they faced being women in a male-dominated field.

On the panel were Dhwani Oakley, PhD Student in Maritime Engineering; Dr Alexandra Karamitrou, Lecturer in Archaeology and AI; and Dr Johanna Hjalmarsson, Associate Professor in Maritime Law. Each speaker brought a unique perspective, sharing valuable insights from their experience and contributions to the sector. Chairing the panel was Professor Susan Gourvenec, SMMI Deputy Director.

The audience of students and academics responded enthusiastically to the panellists' excellent and varied presentations. The Q&A session opened the floor to a meaningful and thought-provoking discussion, both with regards to the panellists' research and technical insights with regards to women in maritime and their experience as women making their way in their respective fields.

DHWANI OAKLEY
PHD STUDENT IN MARITIME ENGINEERING

Dhwani Oakley's research focuses on the application of ergonomics and human factors in ship design. Dhwani emphasised the importance of human-centred design (HCD) in the present day and for the future.

"The maritime industry is experiencing a technological (r)evolution and now, more than ever, we need to work together to ensure that the progress we've made on gender equity across the sector continues into the future." shared Dhwani.

"As innovations in autonomy, digitalisation, connectivity, and smart shipping continue to rapidly develop, transforming the world and the way we work, it will be increasingly important to ensure that our future legislation, regulations and standards, which govern the design and operation of ships and shipboard equipment, consider diverse perspectives and recognise the specific challenges women face both at sea and on shore."

DR ALEXANDRA KARAMITROU
LECTURER IN ARCHAEOLOGY AND AI

As part of her research, Dr Alexandra Karamitrou works to achieve safer decommissioning of offshore infrastructure and ships: establishing a global baseline and raising awareness to help deliver safety improvements. Decommissioning of offshore assets refers to the process of safely and responsibly removing offshore structures such as ships, oil and gas platforms, or wind turbines at the end of their operational life.

"In the domain of decommissioning, my role is to harness the power of artificial intelligence, orchestrating the seamless retirement of offshore assets with precision, efficiency, and environmental mindfulness, paving the way for a safer, smarter, and more sustainable maritime industry."

When offshore assets reach the end of their use life, instead of ending in qualified decommissioning facilities they often end up in yards in developing countries. Decommissioning in such places thrives from low-cost labour, relaxed environmental laws and non-existent worker health and safety regulations. These factors contribute to the risks involved in shipbreaking, which, according to the International Labour Organisation, is one of the most dangerous jobs in the world.

To address some of these challenges, Alexandra and colleagues are working to improve transparency around decommissioning, developing models to detect and map platforms globally and to predict when ships will reach the end of their life. By making these data publicly available, the team are facilitating responsible and sustainable decommissioning practices, and ultimately benefiting the wider industry, the environment, and the health of the workers involved in these operations.

DR JOHANNA HJALMARSSON
ASSOCIATE PROFESSOR IN MARITIME LAW

Doctor Johanna Hjalmarsson discussed her contributions to safer maritime futures through legal frameworks and policy research. With a background that includes a law degree from Stockholm University, experience as a junior judge, and roles at international organizations, Johanna has a rich expertise in maritime law. She emphasized the critical role of the United Nations Convention on the Law of the Sea (UNCLOS) and conventions like SOLAS and the Collision Regulations in setting safety standards.

Johanna highlighted the enforcement role of flag and port state control, classification societies, and marine insurers in ensuring compliance. She also discussed legal responses to maritime incidents, underscoring the importance of a robust legal framework.

"There is a lot to celebrate in the increased opportunities and achievements of women in the sector" reflected Johanna. "Going forward, we can continue to work on ship and equipment design, working conditions and law, rules and standards that are inclusive and supportive of all those wanting to work in the maritime industry."

Johanna's work exemplifies how legal expertise and inclusive policies can enhance maritime safety and support the growing role of women in the industry.

Wolfson Unit engineer Magnus Gregory paddles to victory in the Seawork Cardboard Boat regatta.

Photo: Seawork

CARDBOARD, COLLABORATION AND CAREERS: SEAWORK 2025

Our university's marine and maritime community attended Seawork 2025, showcasing a mix of research, education and consultancy opportunities – and taking home wins in engineering innovation and cardboard boat racing.

Seawork, Europe's largest commercial marine and workboat exhibition, was held on the city's waterfront at Mayflower Park. This year's event saw teams from Maritime Engineering, the Wolfson Unit, the Marine Technology Education Consortium and the Centre for Green Maritime Innovation representing the University of Southampton at our stand which was coordinated by SMMI.

Future Seawork Awards

Ship Science student Robin Stein won first prize at the Future Seawork Awards, which recognises emerging talent in the commercial marine sector. His prize-winning project, *The Assessment of a Reconfigurable Mould Tool for the Production of Foils* explores how sustainable, adaptable composite tooling could reduce waste and costs in marine manufacturing. Supervised by Dr James Blake, Associate Professor in Sustainable Composites and High Performance Marine Vehicles, Robin's work was praised by judges for its "clear potential to impact future design processes in the commercial marine industry."

Alumni Event

The Maritime Engineering (Ship Science) group hosted an alumni networking event. Former students from across the years now working in the industry gathered to reconnect and explore new opportunities for collaboration. "It was fantastic to catch up with 'shippies' old and new," one attendee noted, "and to see where the next generation is heading."

Cardboard Boat Regatta

The Wolfson Unit's Magnus Gregory took to the water and took victory in the Seawork Cardboard Boat Race. His vessel was "equal parts sturdy cardboard and hydrodynamic weapon."

"We could have run CFD simulations and done tank testing," Magnus joked, "but opted instead for three rolls of duct tape, a dream, and some core stability exercises." The resulting boat not only remained afloat but surged past the competition.

Spectators – including a group of University of Southampton Maritime Engineering alumni – cheered Magnus on as he crossed the finish line.

Student Robin Stein receives his Future Seawork award from Professor Alan Murphy for his innovative composite tooling project

MARITIME RESEARCH, SKILLS AND SOLUTIONS AT LONDON INTERNATIONAL SHIPPING WEEK 2025

From fuel discussions to wind propulsion demonstrations, maritime training showcases and Clean Maritime Day exhibitions, University of Southampton and SMMI colleagues took part in a diverse programme of activity at London International Shipping Week (LISW).

Colleagues represented the University, sharing research and building connections across the maritime community. Their presence throughout the week reflected the University's growing role in shaping sustainable shipping, from advancing technical innovation to contributing to national and international policy discussions.

Activities and involvement from colleagues included:

- Professor Alan Murphy delivered a keynote at Powering Maritime Innovation: Towards a UK Research Roadmap
- Alan also gave closing remarks as MarRI-UK Academic Chair, stressing the role of international collaboration in supporting the transition to net-zero shipping
- Professor Mark Spearing, Vice-President of Research and Enterprise, represented the University at the Investment Reception hosted by His Majesty's Government
- Panos Manias represented SMMI at MarRI-UK's event on hydrogen as a clean maritime fuel
- Panos also joined industry and policy leaders at the ShipZERO30 – HyWindships conference at the International Maritime Organization (IMO)
- Panos and Professor Stephen Turnock represented the University at the Maritime Innovation Networking event hosted by ACUA Ocean in partnership with the University of Southampton and MarRI-UK
- Professor Dominic Hudson and Dr Joseph Banks attended the Wind Propulsion Session hosted by the Royal Institution of Naval Architects and the International Windship Association
- SMMI engineers and collaborators showcased the Winds of Change project at Innovate UK's Clean Maritime Day, as part of the Smart Green Shipping exhibition

Professor Alan Murphy delivers a keynote at MarRI-UK's research roadmap event

OCEAN BUSINESS 2025: SHOWCASING EXPERTISE, TRAINING, AND THE FUTURE OF OCEAN TECHNOLOGY

Held dockside at the National Oceanography Centre, Ocean Business 2025 brought together global leaders in ocean technology for three days of exhibitions, demonstrations, and networking.

SMMI coordinates the University of Southampton's stand and presence at this important event.

Over three days, we engaged with professionals from industry, academia, trusts, and organisations, building new relationships and reconnecting with familiar faces from across the university and our wider network. Our stand served as a hub for discussions on marine technology, sustainable innovation, and opportunities in education and interdisciplinary research, reinforcing the university's role as a leader in the field.

Top: Ocean Business 2025 at the National Oceanography Centre, Southampton
Above: Dockside demonstrations featuring Rad Propulsion and Sonardyne watercraft

COMMUNITY ENGAGEMENT

SHOWCASING RESEARCH AT THE SOUTHAMPTON INTERNATIONAL BOAT SHOW

Pioneering marine and maritime research from across the University of Southampton was showcased at the Southampton International Boat Show in September 2024.

More than 7,500 visitors were welcomed at the University stand, where they had opportunities to discover more about the real-world impact of Southampton's research through a range of interactive exhibits. They could also hop onboard the University's research vessel Callista in the marina.

The stand was coordinated by SMMI with the School of Ocean and Earth Science, and SMMI members from across the University were on hand throughout to engage visitors with the interactive displays. These included:

Dive into the Deep

Professor Blair Thornton's team showcased an ocean-going robotic submersible that is capable diving to 200m to undertake laser scans and photography of the seafloor. This enables researchers to develop detailed maps and gather high-resolution imagery of the ocean floor.

Winds of Change

Dr Joseph Banks and team invited visitors to learn about wind-assisted shipping technologies and try their hand at trimming a model ship's wing-sail in a wind tunnel simulation. The model simulated a real-life project that Joseph and his team are working on, in partnership with Smart Green Shipping, where a retractable 20 metre-high FastRig wing-sail has been fitted to a commercial ship for testing.

Tales of Discovery

Dr Michael Grant and Dr Felix Pedrotti offered visitors a glimpse aboard a 'Digital Twin' of the UK's first Royal Research Ship, the RRS Discovery through VR headsets. The highly accurate 3D representation of the ship gave participants a chance to explore the historic vessel and learn about its groundbreaking expeditions in Antarctic waters.

Can Fossils Foretell Our Future

Dr Richard Stockey and Dr Alison Cribb led a team of palaeobiologists who showed visitors how studying fossils of woolly mammoths and ichthyosaurs can reveal insights about long-term climate changes and the future of our planet.

Seagrass the Superpower

Dr Hachem Kassem and colleagues demonstrated their wave tank that simulates coastal flooding and storm conditions. By adjusting the structures and elements in the Lego town and coastline, visitors could see how natural flood defences, like seagrass meadows, worked to prevent flooding and storm damage.

> "My students enjoyed the trip to the University of Southampton stall; they liked the VR experience and asked some great questions about what they had seen. The students helping on the stall were fab at answering the students questions no matter how strange they were. The stall had a great balance between the virtual elements and the physical models explaining the work of the university."
>
> **Oasis Academy Sholing**

SMMI whales and ocean-related research exhibition

WHALES AT WINCHESTER CATHEDRAL

Visitors to Winchester Cathedral were invited to find out more about the far-reaching impact of these majestic sea-creatures thanks to an SMMI sponsored art installation and exhibition.

Three monumental sperm whale sculptures by artist Tessa Campbell Fraser were suspended in the cathedral's nave, and SMMI created an exhibition area in the North Transept that showcased Southampton's whale and ocean-related research. There were also a series of whale-themed events to complement both.

The exhibition provided an interactive hub where visitors could engage with pioneering research on whales and the oceans across multiple disciplines. Thousands of visitors ventured through this space throughout the duration of *Whales*, discovering the innovations and insights by our experts in marine science, the arts, law, archaeology, and even fashion.

One of the themed events was an immersive evening hosted by SMMI in partnership with the Southampton Institute for Arts and Humanities. *Ocean Giants: Whales and the Worlds They Shape* was an evening of thought-provoking talks and performances exploring the diverse worlds created by whales and the far-reaching impact they have on the planet.

The evening featured talks and performances by experts from Law, Ocean and Earth Science and Humanities. Dr Dina Lupin explored the legal role of whales in human society, Professor Jon Copley talked in depth about the unique ecosystems formed by whale carcasses on the ocean floor and Dr Ryan Reisinger spoke about the connective role of whale migratory movements on ecosystems and humans.

The evening included a thought-provoking original composition by University of Southampton musicians, led by Dr Drew Crawford and Dr Benjamin Oliver, alongside a literary exploration with Professor Will May and Professor Philip Hoare.

SMMI Director, Professor Damon Teagle said: "We were truly delighted to support the *Whales* art installation. *Whales* are the giants of our oceans that play extraordinary roles in shaping the world's ecosystems, cultures and even legal landscapes.

We were excited to complement the art installation and exhibition space with an entertaining evening of marine science, deep sea exploration and environmental law enhanced through original music, literature and poetry in the magnificent setting of Winchester Cathedral.

It provided a wonderful and atmospheric occasion to showcase the University's distinctive expertise in addressing the major challenges confronting our oceans and environment."

COWES WEEK 2025

A team from the University of Southampton, led by SMMI, joined thousands of sailing enthusiasts on the Isle of Wight at the world-famous Cowes Week regatta.

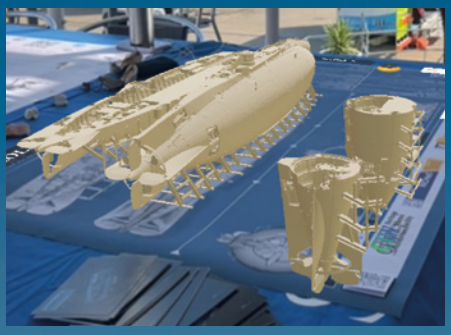
SMMI coordinated a showcase, supported by Maritime Archaeology, the School of Ocean and Earth Science, and the University's Public Engagement with Research unit (PERu).

On show at the stand was the augmented reality experience developed by researchers Dr Felix Pedrotti and Dr Stephanie Blankshein, showcasing HMS Holland 1, Britain's first commissioned submarine. Using 3D scans and historical data, the team brought the vessel to life as part of the AHRC-funded Unpath'd Waters project.

Our researchers were warmly welcomed by partners at the Royal Navy's recruitment stand on the parade. A few from the University team joined a tour of HMS Tyne, one of the Navy's Offshore Patrol Vessels, and learned more about how the Navy engages with schools and universities to encourage STEM participation and career pathways.

There was also plenty of sailing to enjoy! This year featured University of Southampton colleagues past and present on the water. Among those racing were Dr Joseph Banks and Dr Penny Jeffcoate from Maritime Engineering, crewing Nightjar, along with Head of Industry Relations Rosemary Nunn and several of our students and alumni.

Carin Reisinger, Felix Pedrotti, and Kara Goodland aboard HMS Tyne



HMS Holland 1 AR experience

SOTSEF 2025

SOUTHAMPTON SCIENCE AND ENGINEERING FESTIVAL 2025

At the University of Southampton's annual Science and Engineering Day, SMMI helped to celebrate innovation and discovery, with marine and maritime research showcased across both Boldrewood and Highfield Campuses.

At the University of Southampton's annual Science and Engineering Day, SMMI helped to celebrate innovation and discovery, with marine and maritime research showcased across both Boldrewood and Highfield Campuses.

Hosted as part of the Southampton Science and Engineering Festival (SOTSEF), the event invites families and members of the public to campus for a day of hands-on exploration and activities run by our researchers and students.

SMMI partnered with Maritime Engineering who opened up the doors to the Towing Tank for visitors to learn about the science and engineering of ships. There were demonstrations of offshore engineering, visualisations of water flow around different vessel shapes that visitors could cut out, and a paper boat building challenge to see whose design could hold the most golf balls.

The SMMI team invited guests on a journey with whales using a bespoke app created by artist Julian Stadon and gaming technician Ross Popovs from Winchester School of Art. Based on the WWF Protecting Blue Corridors report, the app let visitors explore global whale migration routes, discover facts about humpback, sperm, and blue whales, and they could take home a postcard of their favourite!

The Intelligent & Resilient Ocean Engineering team engaged visitors with interactive demonstrations on offshore wind energy. Attendees explored how wind turbines generate electricity and stay anchored in diverse seabed conditions, gaining hands-on experience by installing model foundations and testing different anchoring methods.

Beyond Boldrewood, the festival featured an array of marine-themed activities. 'Taking the Ocean's Temperature' explored ocean science and climate solutions, while marine palaeobiology and climate modelling used fossils and ancient-ocean reconstructions as an 'ocean time machine'. Meanwhile, team 'Fish on a Chip' showcased innovative ways to monitor water quality using biosensors, offering a glimpse into the future of environmental monitoring.

POLICY IMPACT

SMMI continues to work to help bridge the gap between research and policy as a key part of its mission. With support from SMMI Policy Officer and Public Policy Southampton (PPS), over the past year the Institute has strengthened its outreach, engagement, and connectivity with UK policy audiences, further enhancing University of Southampton's visibility as a powerhouse for marine and maritime research.

Evidence-based policymaking in marine and maritime fields is essential. Over the course of 2025, SMMI coordinated more than nine contributions to public consultations, calls for evidence, and parliamentary inquiries. From input into the Department for Transport's call for evidence on Net Zero Ports, to Defra's consultations on offshore wind environmental compensatory measures and the establishment of the Marine Recovery Fund, the breadth of expertise and insight SMMI members can offer is far reaching.

The institute fed into the All Party Parliamentary Groups for the Ocean inquiry into Sustainable Ocean Policy and mobilised its research community on key marine and maritime policy developments, enabling a strategic supply of science-based evidence to the UK Parliament and Government departments.

To mark the Day of the Seafarer, Professor Stephen Turnock briefed members of the House of Commons Transport Committee on the National Policy Statement on Ports and shared perspectives on the maritime sector's contribution to growth, decarbonisation and competitiveness.

In June, the university convened a high-profile parliamentary reception in Westminster on maritime decarbonisation. With support from Darren Paffey MP and Lord Willetts, Professor Dominic Hudson presented the Centre for Green Maritime Innovation (cGMI) to a large audience of key

policy and industry stakeholders, read more on page 52.

Over the summer, Professor Dame Angela McLean, Government Chief Scientific Adviser, visited the University. As part of the PPS Annual Lecture, SMMI supported the visit with an informative tour of the Boldrewood Towing Tank for conventional ship model testing and aerospace, energy and transport applications.

SMMI showcased our maritime engineering expertise at the UK SHORE Clean Maritime Day in September and has been a key partner supporting the Maritime and Coastguard Agency in the development and publication of their Areas of Research Interest (ARIs), delivered through a Public Policy Southampton-brokered policy placement and formal reference to our MoU with the Agency.

SMMI has brokered meetings with Foreign, Commonwealth and Development Office officials, including those working on critical minerals. To mark UNESCO's 80th anniversary, SMMI contacted over 30 MPs to promote University heritage research and advocate for ratification of the 2001 Convention on the Protection of the Underwater Cultural Heritage, see more on page 50.

SMMI will continue translating evidence into clear, actionable insights that strengthen policy impact, into 2026 and beyond. We will carry on working at bridging the gap between research and policy to ensure that informed decisions drive meaningful change.

PREDICTING THE FUTURE OF THE OCEAN ECONOMY

SMMI was invited to help shape the Ocean's Chapter of the most recent Global Strategic Trends (GST): Out to 2055.

GST is published every five years by the UK Ministry of Defence Futures Team, the Development, Concepts and Doctrine Centre (DCDC), and offers foresight analysis and forecast potential trends that shape and inform the future strategic context.

GST has historically considered land-based regions across the world, focussing on geopolitical, societal, technical, economic and environmental drivers for change, their uncertainties and strategic implications. GST portrays a future strategic context for those involved in developing long-term plans, strategies, policies and capabilities in the Ministry of Defence, the wider government, and the UK's allies and partners.

For the first time, the seventh edition of the publication included the role of shared spaces including Oceans, the Poles, and Space.

SMMI were approached to lead a report "Blue Economy in the Future: Context, outlook, uncertainties, shocks and strategic implications" to shape the Ocean chapter.

The report presents a current snapshot of the ocean economy alongside potential scenarios of the future ocean economy, and pathways for its transition from grey to blue, with a view to 2055, considering the incoming possibilities and threats of the future facing the ocean, regarding economy, society and the environment.

Professor Susan Gourvenec, SMMI Deputy Director, who led the report said: "The diverse, multi-disciplinary expertise across SMMI made us very well-placed as experts to be able to look at the research into the technical, environmental, geopolitical, justice, economic and societal trends, and to identify where there were conflicts or tension in the literature.

SMMI published a report based on their GST work called *From Grey to Blue: An Ocean Economy fit for the Future*.

And more recently a new research paper from the team has been published which builds on the GST report, read more about Pathways to a Blue Economy on page 22.

"The diverse, multi-disciplinary expertise across SMMI made us very well-placed as experts to be able to look at the research into the technical, environmental, geopolitical, justice, economic and societal trends, and to identify where there were conflicts or tension in the literature."

Professor Susan Gourvenec

DEBATING THE HIGH SEAS TREATY

An event to mark the first comprehensive analysis of the 2023 High Seas Treaty, funded by the Gard/Institute for Maritime Law (IML) fund, organised by the Institute of Maritime Law and SMMI, with tailored support from Public Policy|Southampton was held at the National Oceanography Centre Southampton (NOCS).

The one-day debate and panel event aimed to analyse the impact of the 2023 High Seas Treaty with the view of identifying possible obstacles in terms of implementation and suggest the way forward. The Treaty contains many ambiguities, none more so than the applicability of the 'common heritage' and 'freedom of the seas' principles.

The event brought together diverse and global perspectives to identify obstacles and suggest ways forward on the Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (BBNJ).

The BBNJ Agreement has been celebrated as great progress for the conservation and protection of ocean biodiversity. This event encouraged panel members to be honest and provocative in their appraisal of the possible gaps, ambiguities and loopholes that exist in the BBNJ text.

IML Director Professor Andrea Lista said: "Critical discourse and exploring the implications and applications of the High Seas Treaty is the first step on the road to addressing its inherent challenges and getting people involved in ratifying it."

Discussions covered a range of interest areas and addressed areas of contention, including:

- The principles of 'common heritage' and 'freedom of the seas'
- The use of the name 'High Seas Treaty'
- Sharing of Marine Genetic Resources and monetary benefits
- Areas Beyond National Jurisdiction extent and coverage
- The lack of focus on Biodiversity Loss

Critical discourse and exploring the implications and applications of the High Seas Treaty is the first step on the road to addressing its inherent challenges and getting people involved in ratifying it."

Professor Andrea Lista

UNESCO AND THE UNIVERSITY OF SOUTHAMPTON'S EXCELLENCE IN MARITIME HERITAGE

The Centre for Maritime Archaeology at the University of Southampton is a world leader in Maritime and Underwater Archaeology and represents the UK as a founding Member and former Chair of the UNESCO UNITWIN (the abbreviation for University Twinning and Networking Programme) Network for Underwater Archaeology.

UNESCO, is the United Nations Educational, Scientific and Cultural Organisation, a specialised agency dedicated to strengthening our shared humanity through the promotion of education, science, culture, and communication.

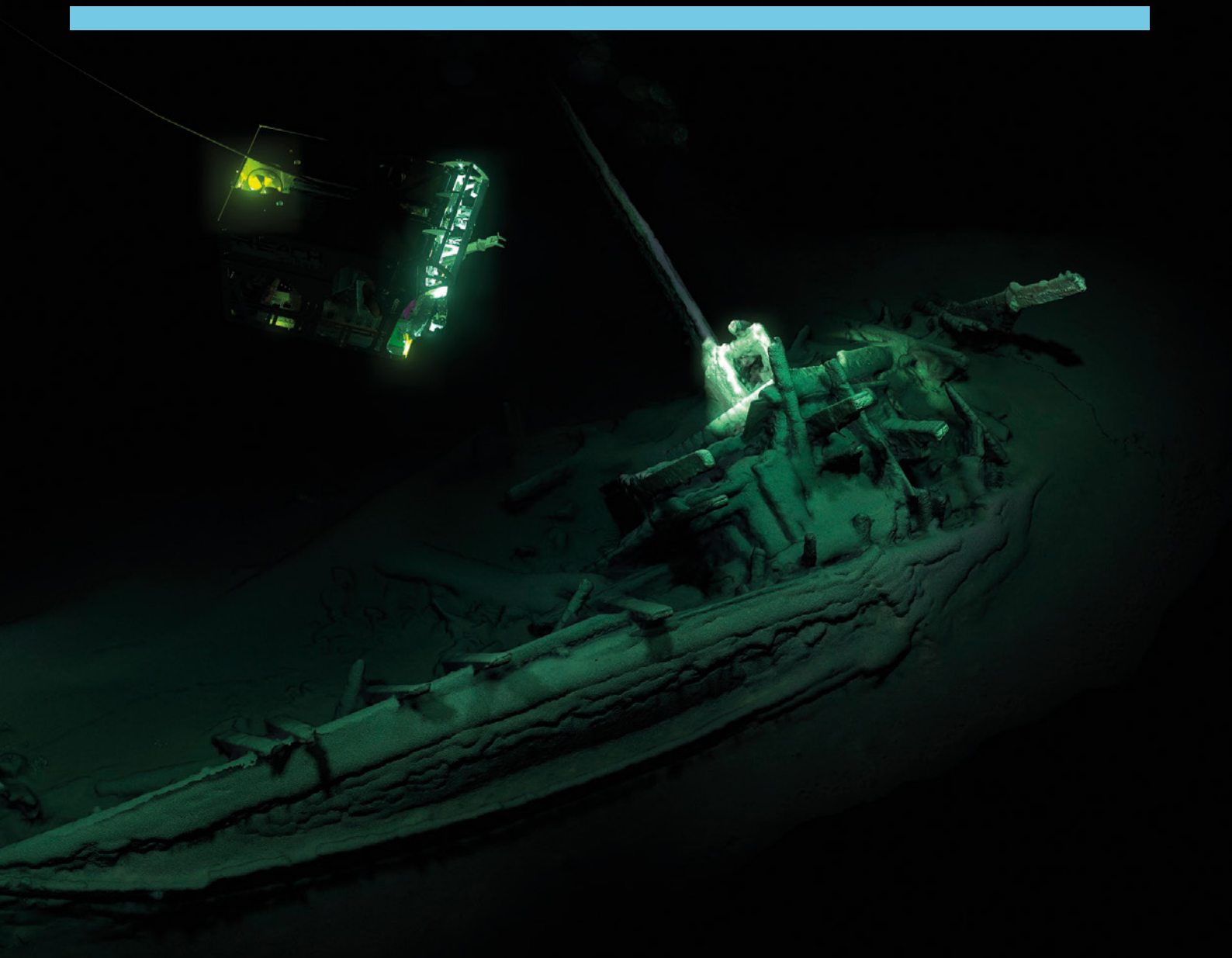
Our maritime archaeologists, many of whom are SMMI members, have worked closely with UNESCO to set the standards of best practice to safeguard underwater heritage and to disseminate our findings to the public. As an island nation, we have a long heritage of maritime activity: migration, fishing, naval and merchant maritime histories.

Through close work with UNESCO, the University of Southampton has led the conversation surrounding the protection of coastal and underwater heritage, ocean security and sustainability. Ratification of the 2001 Convention is the next step in moving forward with UK's leadership in ocean science and literacy.

"Being the national lead for our UNITWIN Network within the UK National Commission has enabled me to advise on policy and work with other UNESCO Chairs across the country" says Professor Helen Farr. "It is a great way of amplifying the interdisciplinary work we do here at the University and advocating for the importance of studying and protecting our maritime cultural heritage."

A few examples of the major Maritime Archaeology projects that SMMI members have led across the globe, include:

- **Black Sea MAP**, the largest maritime archaeological project to have been conducted since the raising of the Mary Rose. This collaboration between UK, Bulgarian, Swedish and US institutions deployed cutting-edge technologies to transform our knowledge of sea-level change and seafaring, including identification of 65 new shipwrecks including the oldest intact wreck ever found, an Ancient Greek sailed galley



Black Sea Map:
3D Image of Ancient Greek shipwreck

Image Credit:
Rodrigo Pacheco Ruiz

from the classical era (c. 2500 years old). This project also included an education outreach programme using maritime science and archaeology to support STEM education to over 22,000 schools across England.

- **The MarEA project** is documenting endangered maritime heritage across the Middle East and North Africa. The project works with local communities and partner organisations, using satellite and remote sensing data to create new, openly accessible datasets in order to record cultural heritage and aid coastal decision making and planning for the future.

- **Unpath'd Waters:** Working with colleagues from across all four home nations, the University of Southampton developed AI tools to link and unlock hidden details held by each devolved body. The results allowed a first view of our shared maritime past, enabling new insights into change through time, guiding how we manage maritime space for future planning, offshore development, marine renewables and environmental sustainability. See page 23 for more on this project.

"Our work follows Best Practice and implements the UNESCO 2001 Convention on Underwater Cultural Heritage, addressing many of the concerns raised in the parliamentary debate surrounding protection of heritage sites and the challenges that are faced today," said Helen.

"Whilst there are still legislative and administrative complexities with UK ratification, we believe that it still provides the best opportunity to safeguard our maritime heritage. Here at Southampton, we are well placed to work with interdisciplinary academics, industry and community stakeholders to learn about, communicate and protect our maritime and coastal heritage."

DECARBONISING SHIPPING DISCUSSED AT THE HOUSE OF COMMONS

The University of Southampton held a high-level event at the House of Commons to explore UK leadership of the challenge of decarbonising shipping, a major source of global greenhouse gas emissions, by 2050.

The session was convened by the Centre for Green Maritime Innovation (cGMI) – a major industry-backed initiative led by the University aiming to address the UK's urgent need for maritime decarbonisation through collaboration, innovation, technical de-risking and skills development.

Bringing together leaders from government, small and large industry, researchers and a number of SMMI members, the event highlighted the need to prioritise maritime decarbonisation in discussions around the UK's transport and net zero priorities. It introduced the cGMI as a proposed national centre to unite and promote the maritime sector, accelerate the development and integration of clean technologies, and deliver the jobs, skills and growth needed across the UK.

Hosted by Darren Paffey (Labour MP for Southampton Itchen) the event featured a wide range of perspectives from national policymakers, major operators, academic experts and SME innovators, who together set out the challenges and opportunities facing maritime decarbonisation in the UK– and the role the cGMI could play in enabling long-term change.

Professor Dominic Hudson, who has led the development of the cGMI, explained how 18 months of engagement with industry, regulators, and ports across the UK has shaped the centre's vision and scope. He described the complex decisions facing maritime businesses – particularly SMEs – when investing in future fuels and technologies.

Professor Dominic Hudson

Darren Paffey MP hosts the parliamentary event in support of the cGMI

"The UK has no such facility operating at a mid-to-high Technology Readiness Level, and at the scale required across the whole of the maritime sector," said Professor Hudson. The proposed cGMI would accelerate the safe deployment of new technologies, support skills development, and enable system-wide integration. "Our analysis shows a new national centre will help the UK stay at the forefront of the global maritime sector through a time of rapid change. There is an opportunity to drive exports, high skills jobs and regional and national growth, through the de-risking and proving of UK-developed and manufactured advanced components, systems and vessels."

LLOYD'S REGISTER FOUNDATION FORESIGHT REVIEW ON NATURE POSITIVE ENGINEERING

SMMI Deputy Director, Professor Susan Gourvenec, and SMMI SIG Champion Dr Hachem Kasem acted as Technical Advisors for the Lloyd's Register Foundation Foresight Review on Nature Positive Engineering.

The review explores Nature-Positive Engineering across offshore renewables, ports and coastal protection, offering insights to guide safe, scalable adoption and action.

The review identifies ten guiding principles to support NPE implementation:

1. Foster a mutually enhancing Human-Nature relationship
2. Take a whole lifecycle approach to ecological impacts
3. Deliver measurable nature improvements
4. Recognise interconnectedness across scales and timeframes
5. Co-develop solutions with communities and Indigenous Peoples
6. Design multifunctional, regenerative systems
7. Manage complex risks and trade-offs
8. Address the climate-nature-health nexus through adaptive management
9. Foster interdisciplinary collaboration
10. Anticipate and manage potential unintended consequences

Three key recommendations are made to accelerate the implementation of NPE to help protect, restore and enhance our natural ecosystems:

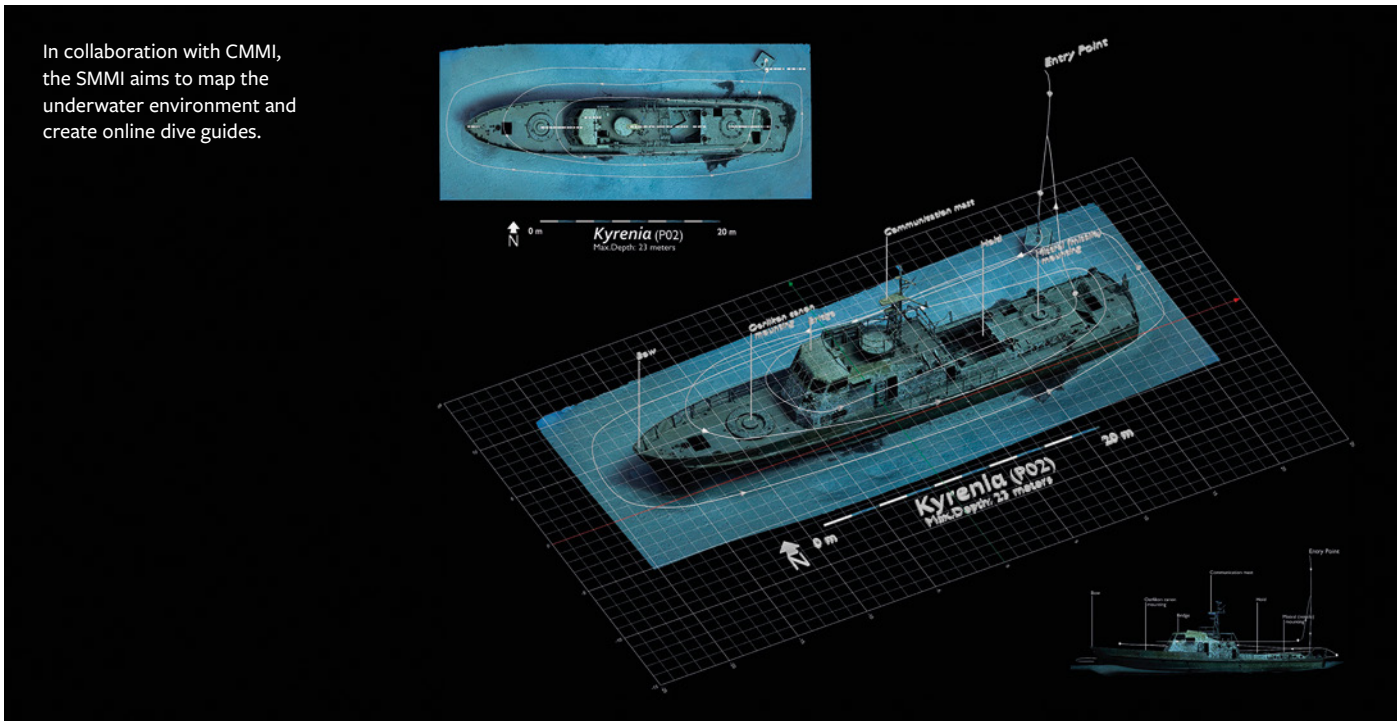
1. Create an enabling environment, including policies that leverage technology for integrated planning, embed biodiversity outcomes in permitting and procurement, and align finance with natural capital risk frameworks.
2. Building technical capacity through guidance to implement NPE across the lifecycle, a toolkit to design for interconnected climate-nature-health risks, standardised biodiversity metrics, case study research, and integrating NPE into education and professional development.
3. Advocacy and partnerships, establishing a global engineering NPE alliance and community of practice for knowledge sharing and policy influence, alongside targeted communications to policymakers, investors, and communities showcasing examples of successful NPE implementation.

You can download the full report here :
www.lrfoundation.org.uk/publications/foresight-review-of-nature-positive-engineering

INTERNATIONAL IMPACT

CELEBRATING CYPRIOT COLLABORATION

Members of SMMI have been strengthening their international collaboration with Cyprus Marine and Maritime Institute (CMMI) when they joined forces for a series of impactful events.



In collaboration with CMMI, the SMMI aims to map the underwater environment and create online dive guides.

During a visit to Cyprus, the team explored seafloor research, investigated cutting-edge marine technology and looked at sustainable development initiatives. It was the latest in a history of collaboration and partnership between SMMI and the CMMI.

SMMI is an advanced partner of the CMMI and is responsible for supporting the CMMI's research activity, infrastructure development and training as part of the Marine and Maritime Research, Innovation, Technology Centre of Excellence (MaRITeC-X) project funded by the EU Horizon 2020 programme.

During the visit several SMMI members delivered a successful two-day United Nations Decade of the Oceans accredited short course Seafloor Exploration and Characterisation for Infrastructure, Heritage and Marine Planning that attracted participants from a range of backgrounds and nationalities.

Course leader Professor David White said: "Characterisation of the seafloor is critical to a sustainable future, to support the urgent expansion of offshore wind energy and meet net zero goals. The seafloor, however, can also host fragile ecosystems and cultural heritage that require mapping, monitoring and management."

The course drew on expertise from across SMMI to provide a holistic multi-disciplinary perspective. Informal lectures were combined with hands-on practical activities with participants gaining skills in the latest analysis tools and working with real data from offshore projects.

Participants also got the chance to enjoy virtual trips to the seafloor via augmented reality, to observe some of the 40 shipwrecks from the Cyprus coast that have been surveyed using photogrammetry by the SMMI-CMMI team.

The final evening of the course saw people from across the Cypriot marine and maritime community join the Mayor of Larnaca and Southampton alumnus Andreas Vyras to listen to a lecture by SMMI Professor Blair Thornton about his experience of more than 500 days at sea using marine robots to survey the ocean floor.

The CMMI has grown from one employee to 50 employees over the last four years and celebrated their achievement by giving the SMMI team a ride on their new 9-metre battery-powered vessel – the Zero Emissions Sea Transporter (ZEST) – that was developed with support from SMMI researcher Panos Manias.

The visit also included research meetings with the Cyprus Department for Antiquities and a round table with the Chief Scientist of Cyprus Demetris Skourides.

RAISING WRECKS THROUGH DIGITAL MODELLING

Innovative 3D-modelling developed at Southampton is helping to shed light on the lives of heroic Antarctic explorers, protect endangered coral, improve the safety of wreck diving and monitor the condition of marinas.

SMMI member Dr Felix Pedrotti specialises in creating 'digital twins' – 3D-models of real-life objects – and is combining this with his background in archaeology to help uncover some of the mysteries of the deep.

He said: "Our research enables 3D-modelling of objects or environments under the sea usually created by photogrammetry (taking photographs from multiple perspectives) or via laser-scanning. We can then recreate these real-life objects or environments on the surface.

"By digitally bringing this underwater archaeology to the surface, we can perform tests and take measurements that allow us to understand the scale of the site and begin reconstructing the past."

Felix's skills are already being used by SMMI partners Cyprus Marine and Maritime Institute (CMMI) to improve the safety of diving tourism in Cyprus by creating 3D models of wrecks popular with divers.

He said: "Giving divers models of the wrecks can help them visualise the various routes and their suitability for different skill levels. Every year unfortunately, some shipwrecks in Cyprus hit the news because of accidents, but when divers can plan more accurately or see which areas to avoid, it safeguards against that."

Felix is also helping CMMI marine biology researchers monitor the health of the endangered coral species Cladocora caespitosa. These corals build large structures that support wider biodiversity and accurately assessing these structural changes is essential for effective conservation. 3D-modelling of the coral is a more accurate and less costly method.

RRS Discovery and its museum are located in Dundee and tell a unique story of Antarctic exploration.

Large parts of the hull of RRS Discovery are currently being restored and conserved.

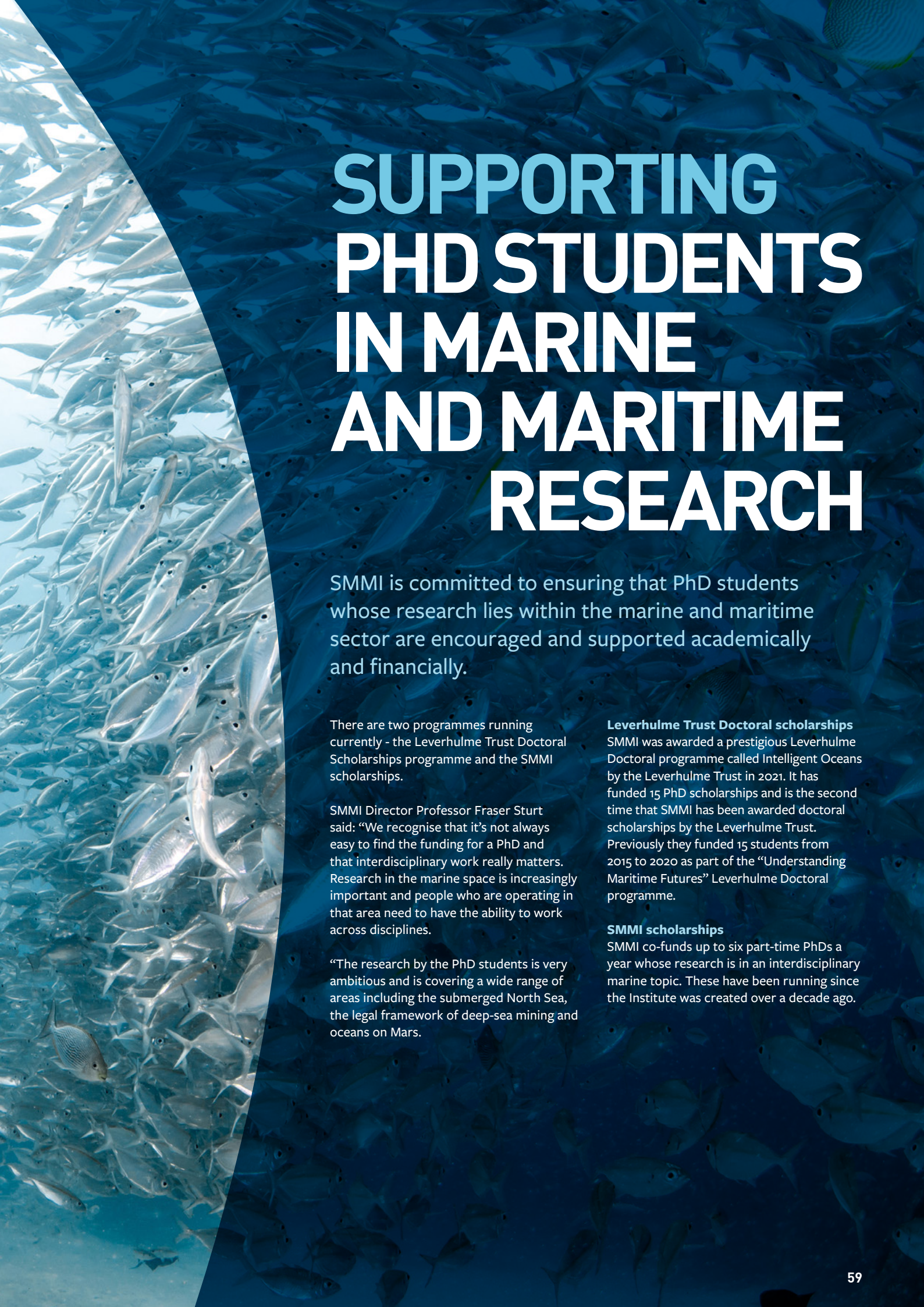
A team of CMMI robotic engineers is also using the technology to monitor the condition of marinas and other infrastructure, removing the need to send human divers down into busy shipping environments.

Felix has also created a detailed digital twin of the RRS Discovery – the historic research vessel that first carried Robert Falcon Scott and Ernest Shackleton to Antarctica.

The digital recreation provides unprecedented insights into the ship's construction and daily life on board and is informing vital restoration work on the vessel.

Felix said: "With the rise of new technologies, such as laser scanners and Unmanned Autonomous Vehicles, we can now create highly accurate digital twins. These digital replicas offer invaluable insights into the RRS Discovery, including its structures and layouts.

"SMMI has provided financial support for this project, enabling the funding of an internship to assess and evaluate the data. They have also facilitated public engagement by developing a range of augmented reality and virtual reality experiences that we showcased at the Southampton International Boat Show."



SUPPORTING PHD STUDENTS IN MARINE AND MARITIME RESEARCH

SMMI is committed to ensuring that PhD students whose research lies within the marine and maritime sector are encouraged and supported academically and financially.

There are two programmes running currently - the Leverhulme Trust Doctoral Scholarships programme and the SMMI scholarships.

SMMI Director Professor Fraser Sturt said: "We recognise that it's not always easy to find the funding for a PhD and that interdisciplinary work really matters. Research in the marine space is increasingly important and people who are operating in that area need to have the ability to work across disciplines.

"The research by the PhD students is very ambitious and is covering a wide range of areas including the submerged North Sea, the legal framework of deep-sea mining and oceans on Mars.

Leverhulme Trust Doctoral scholarships
SMMI was awarded a prestigious Leverhulme Doctoral programme called Intelligent Oceans by the Leverhulme Trust in 2021. It has funded 15 PhD scholarships and is the second time that SMMI has been awarded doctoral scholarships by the Leverhulme Trust. Previously they funded 15 students from 2015 to 2020 as part of the "Understanding Maritime Futures" Leverhulme Doctoral programme.

SMMI scholarships
SMMI co-funds up to six part-time PhDs a year whose research is in an interdisciplinary marine topic. These have been running since the Institute was created over a decade ago.

Spotlight on students

MOLLY PHILLIPS
SMMI SCHOLAR

Molly is applying her marine biogeochemistry background to her PhD, designing, assembling and testing a high-frequency sensor that measures the alkalinity of the oceans in fast-changing areas.

Alkalinity in the ocean gives it the capacity to buffer against acidification caused by the increasing atmospheric CO_2 input.

She said: "It is essential we understand the spatial and temporal variation of marine CO_2 so that we can predict the effects of ocean acidification on marine ecosystems."

Molly's PhD scholarship is supported by both SMMI and Engineering, without which she could not carry out her research, and brings together research from several schools at Southampton.

She added: "This project brings together technology from the droplet microfluidics sensor that was pioneered by Dr Adrian Nightingale and the innovative alkalinity sensor developed by Dr Allison Schaap.

"My droplet sensor aims to address the limitations of continuous sensors, by increasing the measurement frequency and accuracy over large ranges of alkalinity. It was tested on board a research vessel in Spring 2025, measuring how the uptake of atmospheric CO_2 is affecting carbon capture in the ocean."

Molly says that supporting interdisciplinary research is important as researchers with different backgrounds can bring new perspectives and solutions. She hopes to continue a career as an academic once she completes her PhD and disseminate her work to different age groups and audiences.

Molly has won a plethora of awards and accolades because of her PhD, these include:

- Challenger Society Conference – Molly won the Norman Heaps Prize for Best Talk.
- SMMI and Leverhulme Poster Presentations – Molly received a Best Poster Prize for her poster *Autonomous Droplet Microfluidic Sensor for Highly Variable Ocean Alkalinity.*
- Maritime Technology Postgraduate Conference – Molly was Awarded Best Poster, judged by industry experts.
- Advances in Marine Biogeochemistry Challenger Society Special Interest Group – Molly presented a poster and won ECR poster competition.

NINA HALTON-HERNANDEZ
INTELLIGENT OCEANS SCHOLAR

When Nina heard about the Leverhulme Trust Intelligent Oceans scholarships being offered by SMMI it immediately caught her attention.

"It fitted my research interests perfectly, so I applied and haven't looked back," she said.

Nina, whose PhD research is titled *Imagining and Imaging Coastal Change – Communicating the Climate Crisis Through Documentary Style*, is at the intersection of environmental communication and documentary aesthetics.

Nina says that the scholarship has been an invaluable source of support giving her the time and resources to develop her research skills and writing. Her PhD has deepened her understanding of how documentaries are representing coastal issues and the relationship between environmentalism, politics and aesthetics."

She said: "Whilst more opportunities are arising for interdisciplinary researchers, there are still difficulties in finding opportunities. To tackle the complexity of the climate crisis, interdisciplinary perspectives are crucial. We must explore the relationships between the scientific and cultural implications of environmental issues to understand and solve them."

In the future, Nina is keen to continue in an academic career and hopes to expand on her research on coastal areas.

ALEJANDRO LIMPO GONZALEZ
INTELLIGENT OCEANS SCHOLAR

Alejandro heard about the Intelligent Oceans scholarship when he was working as a research assistant and thought it was an excellent opportunity to develop his research interests in ocean sensing.

His PhD is exploring sensing from an anthropologist's point of view, investigating how the ocean overlaps with people, disciplines and institutions.

He said: "I am looking at sea surfaces across security institutions, the water column in the measurement of carbon transport and deep seabed mapping of mineral resources. Looking at these three spaces as seascapes of ocean sensing, helps to challenge prevailing ideas about human vision reaching into every inch of the globe.

Alejandro says the scholarship has been vital in enabling his PhD research. He said: "Intelligent Oceans has shaped a highly collaborative, supportive community of PhD students and I feel fortunate to be surrounded by such inspiring researchers and exceptional people. Through this network, I have also met other researchers and institutions that have led to collaborations that not only advance our research but also challenge our assumptions.

"The financial support from the scholarship has also been crucial. It has enabled trips to research institutions such as the International Seabed Authority in Kingston, Jamaica, and I have also been able to expand my professional network at conferences and scientific meetings. These opportunities have been essential for building connections, disseminating research, exchanging new ideas, and developing parallel projects."

In the future, Alejandro aspires to continue researching the ocean and the infrastructures, technologies and knowledge networks that emerge to understand and govern it.

DR SIEN VAN DER PLANK
SMMI MEMBER AND FORMER SMMI LEVERHULME TRUST SCHOLAR

Since completing her SMMI Understanding Maritime Futures Leverhulme Trust scholarship Sien has gone on to become Senior Research Fellow in Geography and Environment at Southampton and remains an active member of SMMI. She is continuing the research started in her PhD investigating how communities around the world are adapting to their changing coastlines.

Sien said: "I stayed at Southampton to work because of the amazing opportunities at this university to develop, learn and expand my research expertise. It offers huge support for early career researchers to become independent academics, and there is a lot of encouragement for cross-faculty collaborations.

"The key highlight of my career so far has been working with young people across the UK, Ghana and Mexico to co-develop learning about changing seaweeds on our shorelines.

"I have been a postdoctoral researcher on projects examining adaptations to extreme seaweed influxes across the Tropical Atlantic, to how people working in the marine environment in England's southwest have adapted to change over their lives. I am currently completing my Anniversary Fellowship at Southampton that examines how connecting communities worldwide may enhance adaptive capacity, as well as critically analyses the need, opportunities and challenges of larger scale 'transformational' adaptations.

"The interdisciplinary nature of my PhD meant that I am confident and able to collaborate with researchers and partners across a wide range of disciplines and interests, developing exciting and innovative ways of working and communicating research."

Sien says the scholarship provided the funding and training to complete her interdisciplinary PhD studying coastal flooding from multiple academic perspectives that bridged geography, law and engineering. It explored how we could better prepare for coastal flood risk in England across national policy, local management and household level adaptations.

INTERNATIONAL VISIT

During their scholarships, both Nina and Alejandro spent some time at the Penn Centre for Science, Sustainability and the Media at the University of Philadelphia.

Nina said: "The centre's director Michael Mann is a well-known climate scientist with an interest in journalism and media, so it was really interesting to learn from him as someone who is promoting environmental interdisciplinarity. The trip was very fulfilling and I came away with a new network of researchers interested in the ocean, environment and media."

Alejandro said "This was an incredible experience to get a glimpse of how US institutions conduct interdisciplinary research on the environment. It was also a lesson on the importance of building partnerships to ensure that this research continues."

3-MINUTE THESIS SHOWCASE: A CELEBRATION OF RESEARCH FROM SMMI AND LEVERHULME SPONSORED STUDENTS

Our event showcased the talent of our PhD students, who each delivered a compelling three-minute presentation on their research and the challenges they are tackling.

The event was a reminder of the depth and diversity of student research across disciplines. Each talk was a standout example of how complex ideas can be communicated with clarity, creativity, and confidence, and the engaging Q&A session that followed provided thoughtful discussion for staff and students alike.

Congratulations to all participants for their inspiring work and captivating the audience.

Hear more from some of our PhD students on the Leverhulme Trust Understanding Maritime Futures Doctoral Scholarships programme.

DECARBONISING THE MARINE INDUSTRY

SMMI member and PhD student Panos Manias is exploring a holistic assessment of hydrogen use in marine shipping as part of a wider SMMI focus on the decarbonisation of the marine industry to meet the International Maritime Organisation's target of reaching Net Zero by, or around, 2050.

Recently Panos has been part of a team that has been exploring a 'wind to wake' approach examining the total renewable energy contribution for competing future low-carbon approaches for powering ships.

The team investigated a range of alternative fuels, alongside new powertrain solutions, to test the lowest emission solutions, that require the least amount of renewable energy from fuel production to the voyage itself.

Panos used a dynamic voyage simulation tool to estimate the emissions, as well as fuel used, by a cruise ship, a research survey vessel, a container ship and a large multi-fuel liquified natural gas (LNG) carrier. He investigated the alternative ship power systems using various carbon-based fuels, together with ammonia and hydrogen, using either conventional engines or fuel cells.

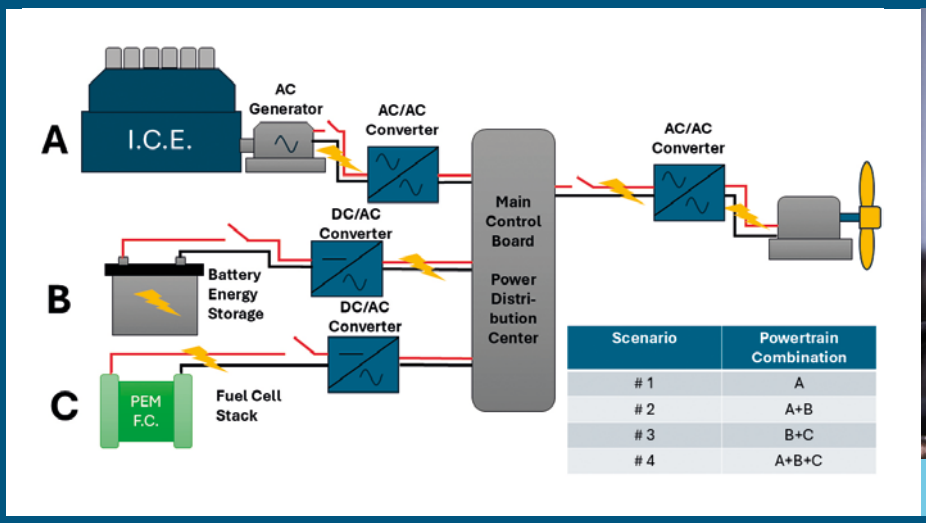
Panos said: "Although some alternative fuels may theoretically appear as zero emission, our full life-cycle energy feasibility studies challenge this.

"Through taking a wind to wake approach, scenarios involving both ammonia and methanol require higher energy in their production compared to liquid hydrogen, while crucial steps such as carbon recycling and fossil fuel dependence are brought to light."

The research showed results that were consistent across the wide range of ship types. They revealed that for all voyage and fuel scenarios, the combination of hydrogen and fuel cells used 30 percent less renewable energy than ammonia, and 26 percent less than methanol when used in combination with a fuel cell and battery hybrid powertrain.

They also showed that hydrogen only emits steam whereas the other fuel scenarios still emit greenhouse gases.

Panos added: "These results support the expectation that this significant energy saving will drive the industry to adopt hydrogen as its fuel of the future with the additional benefits of zero greenhouse gas and other air pollutant emissions."



Scenario	Powertrain Combination
# 1	A
# 2	A+B
# 3	B+C
# 4	A+B+C

Powertrain illustration

Panos Manias

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Southampton Marine and Maritime Institute (SMMI) is a community of experts from across the University of Southampton and beyond that works to address challenges around the natural ocean environment and human use of the seas. Working in partnership with external stakeholders, we generate new collaborations, knowledge and ideas for businesses, governments, and organisations to develop wide-ranging solutions to ocean challenges.

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