November 2024

Challenger Wave

Monthly newsletter of the Challenger Society for Marine Science (CSMS)

NEWS

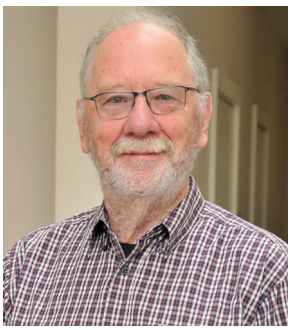
Time to notice 'invisible' plankton, say scientists

Microscopic plankton in the global ocean are crucial to supporting marine life and produce oxygen for the planet but are undervalued and poorly understood because of a lack of studies, according to a new report co-authored by a Scottish Association for Marine Science (SAMS) scientist. Professor Paul Tett is among the international experts who contributed to the Plankton Manifesto, which was unveiled during October's 79th session of the United Nations General Assembly in New York.

The report emphasises the critical role of plankton in addressing the global crises of climate change, pollution, and biodiversity loss. Plankton generate roughly half of the planet's oxygen and absorb vast amounts of carbon. Despite their immense importance, plankton are under threat and remain poorly understood. The Plankton Manifesto calls for immediate global recognition and action to protect these vital organisms.

Prof. Tett said the contribution of plankton to the global ecosystem was priceless, but if it were valued, it would be in the region of £101 billion per year in the UK alone. He explained: "If you take the amount of oxygen produced in one year in the UK's Exclusive Economic Zone and multiply that by the cost of making one kilogram of oxygen through an engineered method such as electrolysis, to obtain oxygen by splitting water into hydrogen and oxygen, then it is worth more than £100 billion per year on that basis alone. The problem plankton has is it is invisible to most people and its contribution to the planet goes unnoticed. A change in plankton populations could have implications for oxygen availability and food production that will affect every living thing on Earth. I say 'could', because we are not making enough measurements of the rate at which plankton produce organic matter and release oxygen. We rely heavily on remote sensing (satellites) which gives a view on the surface layer of the ocean but doesn't tell you what is going on beneath the sea surface."

The Plankton Manifesto calls for more public education on 'invisible plankton' and calls for a greater effort to understand the changes going on with plankton on a global scale. Prof. Tett's particular interest is how plankton populations are changing in UK waters, as even small changes have the potential to heavily impact the productivity of the seas and therefore the availability of fish. He added: "I hope this report encourages funders to continue helping us to monitor phytoplankton, especially around the UK. It is clear that there are changes here that are not necessarily good for fisheries.



Sampling by the UK's Continuous Plankton Recorder Survey has shown a decrease in zooplankton like krill and big copepods and those are things that herring and sand eel feed on. Meanwhile, there has been an increase in gelatinous plankton, which are not as good for fish, as they provide less energy. Observations by SAMS near Oban and the Scottish Government's Marine Directorate near Stonehaven have shown long-term changes in phytoplankton. We urgently need to understand what is going on with plankton populations. If climate change is the cause of these changes, then there is not much we can do at a national level but if it something else like over-fishing or pollution, for example, then we can do something about that."

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Antarctic krill can lock away similar levels of carbon as seagrass and mangroves

Small marine crustaceans are as valuable as key coastal habitats for storing carbon and should be similarly protected, according to new research. The study shows that a single species, Antarctic krill, store similar amounts of carbon to key 'blue carbon' habitats such as mangroves, salt-marshes and seagrasses. However, krill are also impacted by global heating and potential overfishing, so should be considered for similar protections as other important habitats, say the researchers. Krill are eaten by larger animals in the Southern Ocean around Antarctica such as whales, seals and penguins, but are also fished for food and fishing bait, and for use in aquaculture and dietary supplements.

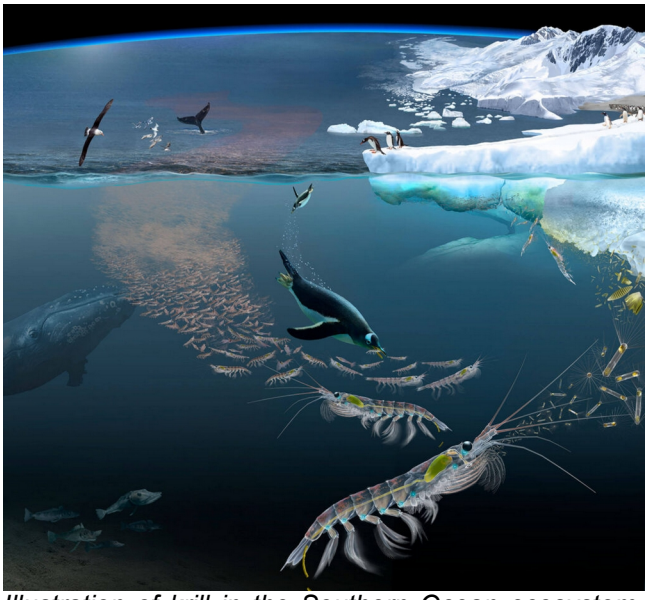

Illustration of krill in the Southern Ocean ecosystem. Artist: Glynn Gorick, reproduced from Hill et al. 2024 (https://doi.org/10.3389/fmars.2024.1307402)

Lead author Dr Emma Cavan, from the Department of Life Sciences at Imperial College

London, said: "For the past decade we have been piecing together the role krill have in carbon cycling, finally resulting in this amazing finding that krill, and their poo, store similar amounts of carbon as some coastal marine plants. I hope this means we can now work towards conserving krill and their valuable Southern Ocean ecosystem with the same gumption as we are seagrasses and mangroves."

Published in Nature Communications, the study was led by researchers from Imperial College London in collaboration with colleagues from the University of Exeter, the UK Centre for Ecology & Hydrology, the British Antarctic Survey, Plymouth Marine Laboratory and the Technical University of Denmark. Co-author Dr Simeon Hill, from the British Antarctic Survey, added: "This study shows how we as people are connected to a small creature in a remote location. We benefit from its actions in removing carbon but we also affect it through our own actions which drive climate change."

Marine life has an important role in locking carbon away from the atmosphere in ocean systems, and the term 'blue carbon' was coined over a decade ago to describe the important role of coastal marine plants in this process. However, the ocean has other ways to store carbon, away from the coasts, and one of these is through animals like krill. Krill are small (around 6cm) but extremely numerous crustaceans that live in the Antarctic seas. They eat phytoplankton, microscopic plants that take carbon out of the atmosphere as they perform photosynthesis. When krill poo or moult their exoskeletons, the carbon they have absorbed sinks into the deep sea where it can stay for a very long time.

The new study shows that Antarctic krill lock at least 20 million tonnes of carbon into the deep ocean annually, which equates to $4-46 billion of storage value, depending on the price of carbon. Co-author Prof. Angus Atkinson, Marine Ecologist at Plymouth Marine Laboratory, said: "Antarctic krill are well known for being at the centre of the unique Southern Ocean ecosystem and supporting an important fishery. But this study paints another picture of krill, on their key role in storing carbon".

The power of krill for storing carbon comes from their huge populations, forming swarms of up to 30 trillion individuals that produce showers of large, fast-sinking faecal pellets and other waste

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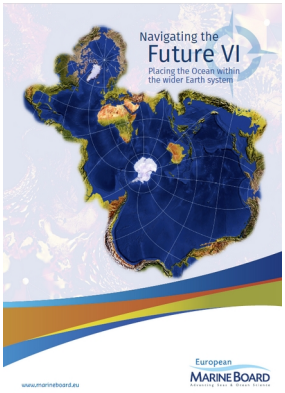
products. Co-author Dr Anna Belcher, based at the UK Centre for Ecology & Hydrology, added: "One of the amazing things about krill is that they form massive swarms, which can be over a kilometre in length. This drives a huge 'rain' of krill poo after feeding, making krill globally important for locking carbon away from the atmosphere. So, let's make sure we look after these amazing crustaceans"

The study also revealed that the depths that these waste products need to reach to remain stored away for at least 100 years were surprisingly shallow (average depth 381 metres), further enhancing their potential. In combination, these factors make the carbon storage from krill similar to that from coastal blue carbon plant stores. As Antarctic krill are being impacted by rapid polar climate change and targeted by an expanding fishery, the team say both krill populations and their habitat warrant protection to preserve this valuable carbon sink. Valuing this ecosystem in terms of carbon storage emphasises how crucial it is to meet climate goals and work towards including carbon in conservation policies.

Europe's leading ocean scientists launch advice for governments

Leading European ocean scientists, including Dr Katya Popova from the UK's National Oceanography Centre (NOC), have launched Navigating the Future VI (NFVI), providing governments, policymakers, and funders with robust, independent scientific advice, focusing on the critical role the ocean plays in the wider Earth system. Navigating the Future VI proposes the marine (natural and social) science research we need to help us address the challenges facing the planet, and with whom we need to collaborate to find solutions. This is a flagship publication of the European Marine Board, an independent non-governmental advisory body that represents more than 10,000 marine scientists across Europe.



"Protecting the Ocean so that it continues to protect us, covering all its extent from the coast to the deep sea, requires a multidisciplinary approach and appropriate governance. Navigating the Future VI, with its four outward-facing chapters linking to topics that any audience can identify with (People, Climate, Fresh Water, and Biodiversity), takes the next step towards these challenges and considers the role of the Ocean and marine science in the wider Earth system", says Dr Gilles Lericolais, Chair of the publication working group and Chair of the European Marine Board (2019-2024) in the foreword.

At important junctures for the UN Decade of Ocean Science for Sustainable Development (2021-2030) and the EU Mission: Restore our Ocean and waters (2021-2027), NFVI outlines key knowledge gaps, and research and policy recommendations to ensure we achieve the objectives of these important initiatives. It discusses how we can work together to manage our ocean interactions, what is needed to achieve an ocean that is no longer warming, how we can ensure that clean and safe waters are available to all communities, and how we can have a biodiverse ocean that continues to provide ecosystem services.

Drawing together messages from the four thematic chapters, the publication concludes that to ensure the Ocean continues to provide the services the Earth and society require, we need:

- Specific research on the impact of multiple stressors on the Ocean and its inhabitants;
- Substantial private Ocean finance for projects that are really sustainable, avoiding greenwashing;
- Sustained and long-term research funding;
- Sustained Ocean observations, open, accessible and digitised data, and their integration into Digital Twins of the Ocean;
- Increased technical and financial resources to meet the growing monitoring requirements;
- Harmonised governance, standards, policies and monitoring across the land-coastal-Ocean interface; and
- Scientists and policymakers who are trained to work in cross-, inter-, and trans-disciplinary ways, as well as trained specialists in critical fields.

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NFVI also takes an introspective look and recommends that the marine science community should operate more sustainably and equitably to lead by example. The publication has been a collaborative effort over two years starting in October 2022. The Working Group comprises 33 experts from 16 European countries, covering a wide range of marine natural and social science backgrounds and career levels.

Latest APPG for the Ocean meeting focuses on Blue Carbon financing in Parliament

The National Oceanography Centre (NOC) were delighted to recently attend the All Party Parliamentary Group for the Ocean's (APPG Ocean) meeting on Blue Carbon financing in Parliament. NOC's Dr Claire Evans presented to the APPG, which included cross-party Peers and MPs, on the role of blue carbon ecosystems, implementation of blue carbon projects and the need to prioritise conservation of existing ecosystems. Dr Evans was joined by Harry Wright from Bright Tide and Aisling McGarrigle from the Blue Marine Foundation, who also gave presentations on blue carbon ecosystems and financing.

After the presentations, there was a productive and interesting question and answer session between the speakers and parliamentarians on the legal, licensing and scientific barriers facing blue carbon projects in the UK. The NOC are delighted to support the APPG for the Ocean and continue working closely with parliamentarians and key stakeholders to support important conversations on the ocean, such as the role of blue carbon ecosystems.

Woods Hole Oceanographic Institution researchers use the sounds of healthy coral reefs to encourage growth of a new species of coral larvae

Coral reefs worldwide are in trouble. These ecosystems support a billion people and more than a quarter of marine species. Still, many have been damaged by unsustainable fishing and tourism, coastal construction, nutrient runoff, and climate change. Now, researchers have shown that broadcasting the sounds of healthy reefs is a way to encourage larval corals to repopulate degraded sites and help revitalize them. A recent study carried out by researchers at the Woods Hole Oceanographic Institution (WHOI) showed that golfball coral larvae can be encouraged to settle when they hear the sounds of a vibrant, healthy reef. This is the second coral species to demonstrate a responsiveness to sound, indicating that this technique has the potential to be a widely applicable tool for reef restoration.

"Acoustic enrichment is continuing to show promise as a technique in the field and in the lab to enhance coral settlement rates," said Nadège Aoki, a doctoral candidate at WHOI and first author of the recently published paper in *JASA Express Letters*. "There is a very limited pool of species that have had any kind of acoustic work done with them so far, and this is the second one where the corals have responded to replayed sound and settled."

During the larval stage of their life, corals drift or swim through the water looking for the right place to settle. To decide where they should attach to the seabed and mature into their stationary adult forms, coral larvae may rely on cues from chemicals, light, and as Aoki and her colleagues demonstrated previously and in this study, sounds. Healthy coral reefs echo with a chorus of purrs and grunts from fish feeding, looking for mates, or defending their territories, underscored by the persistent crackling of snapping shrimp. Damaged or degraded reefs are much quieter, and it appears that some coral larvae can tell the difference.

In July of 2022, Aoki and her colleagues collected larvae from *Favia fragum,* commonly

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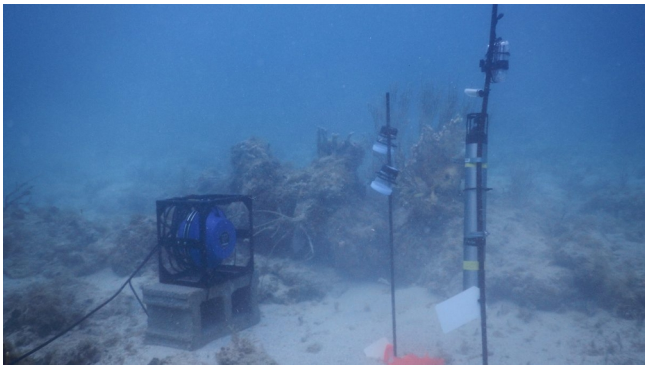
known as golfball coral, in the U.S. Virgin Islands. They divided the larvae into cups and set them up in two quiet, sandy bays off the southeastern coast of St. John; Great Lameshur Bay and Grootpan Bay. At Great Lameshur, the researchers placed the cups of larvae one meter away from a solar powered speaker playing sounds recorded at the nearby Tektite reef, which is considered relatively healthy and noisy. The researchers used the same setup in Grootpan Bay, but the speakers only played silence or sounds recorded in Grootpan.

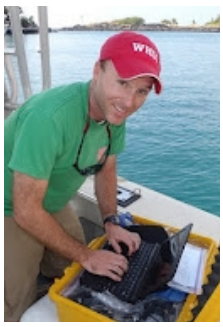


Using an underwater speaker system, researchers found that broadcasting the soundscape of a healthy reef at a degraded reef caused coral larvae to settle at significantly higher rates. (Photo by: Ciara Willis, ©Woods Hole Oceanographic Institution)

At each site, half of the larvae cups were in the water for 24 hours and half for 48 hours. After 24 hours, none of the larvae at the control site had settled to the bottom of their cups, but about 30% of the larvae hearing the sounds of a healthy reef had settled. After 48 hours, the settlement rates at both sites were much higher and roughly equivalent, around 73% at Great Lameshur and 85% at Grootpan.

The sample sizes at both time intervals were too small for the results to be statistically significant. However, the researchers also conducted a similar experiment in fiberglass aquarium tanks. In the tanks, they checked for larval settlement after 24 and 72 hours of sound exposure. Combining these results, they found that golfball coral larvae settled at significantly higher rates when exposed to the sounds of a healthy reef during their first 36 hours. After that window, the larvae settled at basically the same rate, regardless of what they were hearing. “Acoustic enrichment worked for 36 hours or so,” said Aran Mooney, a marine biologist at WHOI and senior author of the paper. “After that, they seem desperate to settle, and healthy cues become less important.”

“Golfball coral have a relatively short window of viability in their larval stage. They don’t have the resources to float around for weeks searching for the ideal spot; they want to settle in 8 to 36 hours after they are released into the water”, Mooney said. The researchers found that sound cues are most effective while the larvae have the resources to be picky once they run out of time, they’ll settle just about anywhere. “We’re getting at some of the nuances of coral biology,” Aoki said. “There’s a huge range of reproductive strategies that corals use and different species have different larval periods. We’re opening up this broad realm of questions about how responsiveness to sound will vary between species.”



The work also demonstrates that corals will respond to auditory cues even in tanks, where sound reflections, aerators, and water filters make the acoustics less than ideal. It can be tricky to get corals to reproduce and settle in tanks, sometimes taking months to get everything just right. Adding healthy reef sounds might facilitate that process in land-based nurseries. There isn’t likely to be a single solution that works for every coral species in every part of the world, but the researchers hope that acoustic enrichment, applied with an understanding of the local ecology and coral biology, will prove to be an effective tool for coral restoration.

“Finding a second species settling in response to sound shows that this isn’t just a one-off, and maybe we can really scale this up,” Mooney said. “But we can’t just throw a speaker over the side of a boat and think it’s going to work. We have to know the system and it has to be integrated with other conservation and restoration efforts.”. This research was supported by the Vere and Oceankind Foundations, the National Science Foundation, and WHOI’s Reef Solutions Initiative.

Seaweeds feeling the heat as ocean warms

As the seaweed farming industry in Europe expands, scientists have warned that seaweeds currently thriving in the cooler coastal waters of

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the north Atlantic could begin to vanish over the next 50 years. Climate change is expected to bring higher ocean temperatures, increased storms and unpredictable salinity fluctuations because of increased rainfall. Temperature has a major influence on seaweed growth and seaweed farms can be susceptible to storm damage. However, scientists say that sufficient investment in seaweed farming research and development could help safeguard the industry for decades to come.

In a recent paper published in Frontiers in Marine Science, researchers from the Scottish Association for Marine Science (SAMS), a partner of UHI, looked at five species of seaweed that are typically used in seaweed cultivation and modelled their success against projected climate change impacts. Using temperature models, they found that the North Atlantic is expected to see losses of some cold-affiliated species such as *Alaria esculenta* and *Laminaria digitata* by 2070.

Scientists have warned that seaweeds currently thriving in the cooler coastal waters of the north Atlantic could begin to vanish over the next 50 years

Lead author of the report, SAMS marine ecologist Dr Reina Veenhof, explained that seaweed, which absorbs carbon as it grows, is often seen as a small part of the solution to mitigating climate change, but is already beginning to feel the heat. She added: “Species such as *Alaria esculenta* and *Laminaria digitata* thrive in the relatively cool waters around the UK, northern France and the northern parts of North America but as ocean temperatures begin to rise, these seaweeds are growing outside of their ideal temperature range, resulting in poorer yield and even a loss of stock altogether. In the period we modelled, there seemed to be little temperature effect on seaweed grown in Scotland and similar northern latitudes, but these places will also experience more regular storms and see increased rainfall, which will challenge the conditions in which seaweed is grown.”

The paper also explored measures to better prepare the seaweed for a change in conditions and looked at the use of priming at the early gametophyte stage of seaweed cultivation. An often-used technique in agriculture, priming delivers a small dose of sub-lethal stress in early life stages (gametophytes), which can increase stress resilience later in life. This applies for all types of stress, but in the context of ocean change, thermal and salinity tolerance are particularly beneficial traits.

Dr Veenhof added: “A positive reason to grow seaweed is it is a form of aquaculture that needs no additives; it grows naturally using the nutrients in the water and sunlight. However, there is more work to be done in seaweed farming research and development to help prepare seaweed stocks for the changing environment. In Europe, we are well behind Asia in terms of developing these methods and the seaweed industry as a whole is a long way behind the research and development in the agriculture industry, for example. It will take a big effort, but I think with sufficient resources, we can safeguard a European seaweed industry for the longer term.”

New flagship report outlines Ocean Decade priorities to 2030

What action areas must the ocean community focus on to ensure a thriving ocean? What knowledge, capacity, and resources will drive the success of the Ocean Decade? The new report "Ambition, Action, Impact: the Ocean Decade Pathway to 2030 - Consolidated Outcomes of the Vision 2030 Process" identifies key priorities and transformative actions to achieve a successful Decade.

The Ocean Decade aims to transform the way that ocean science and knowledge is generated and used, and thus precipitate a shift from the ocean we have to the ocean we want by 2030. The Vision 2030 process, implemented over a twelve-month period leading up to the 2024

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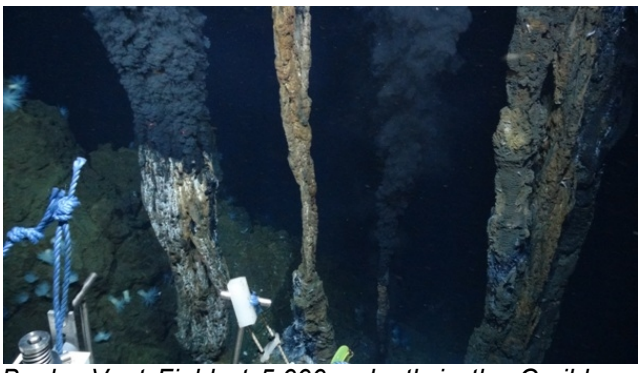
Ocean Decade Conference, was centered around the ten Ocean Decade Challenges, which represent the most immediate and pressing needs for ocean knowledge. Through this process, a tailored and specific end goal and associated milestones were established for each of these Challenges, ensuring the Decade's ongoing relevance and success.

To meet the strategic ambition of the Ocean Decade Challenges, the 'Ambition, Action, Impact' report outlines high-level priorities for ocean science, knowledge, capacity, resources, and infrastructure, as well as enabling conditions that must be established or strengthened in the coming years. These objectives will be at the heart of the Ocean Decade's engagement at the 2025 United Nations Ocean Conference in Nice, France, and pre-Conference Special Events, ensuring that all activities align with the strategic priorities outlined in the report. The Ocean Decade extends its heartfelt gratitude to the Vision 2030 Working Group members, the members of the Decade Advisory Board, and hundreds of contributors from all over the world for their invaluable inputs to this important Ocean Decade process.

How the UK stores marine rock samples, and how you can help

Marine rock samples collected by dredge or remotely operated vehicles (ROV) are an exceptional resource of immense scientific value which help inform geoscience research and contribute to the Natural Environment Research Council's (NERC) research areas including Earth resources, mantle and core processes, physics & chemistry of Earth materials and volcanic processes.



Beebe Vent Field at 5,000m depth in the Caribbean Sea. Image taken, February 2013, using the UK's remotely operated vehicle Isis, NERC, UK.

Currently, there is no repository for marine rock samples collected by UK Research and Innovation (UKRI) funded scientists and research ships so a Rock Store Working Group, involving the National Oceanography Centre (NOC), the British Geological Survey, the British Antarctic Survey and the Universities of Southampton, Strathclyde, Edinburgh and Manchester, is inviting the UK's marine science community to complete a survey which will help define the future requirements for marine dredge rock and ROV rock samples facilities. Results will be provided to the NOC Association of Marine Science National Capability Beneficiaries to consider next steps. The survey is open to UKRI-NERC funded scientists and the closing date for responses is 18 December 2024.

Call for Decade Actions number 08/2024 is open

This new Call for Decade Actions focuses on addressing some of the top priority needs from the Vision 2030 process, galvanising new contributions and new projects to support and strengthen existing Decade Actions and coordination structures. The priority focus areas for this Call for Decade Actions are:

- Coastal resilience
- Society's relationship with the ocean
- The link between ocean and human health

The UN Decade are holding two virtual Q&A sessions, both on the 29th November 2024:
07:30 – 08:30 UTC: Register here
13:30 – 14:30 UTC: Register here
More information here.

VIEWS

Might you be interested in joining the *Ocean Challenge* Editorial Board?

The Editorial Board has several vacant slots, and we are looking for people who are interested in the communication of marine science, and are happy to engage with a variety of marine science disciplines. Ideally, members of the Board come from a range of disciplines and from as wide a range of institutions as possible.

If you are interested, or think you could be, please contact the Editor, Angela Colling at

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AngelaMColling@gmail.com for more information.

Socio-oceanography Workshop sets sights on key climate and ocean challenges

The National Oceanography Centre (NOC) is calling on scientists and researchers to participate in its fourth annual Socio-Oceanography Workshop, hosted in collaboration with the Marine Social Science Network. This international event, set to take place at NOC's Southampton site 26th-28th February 2025, will gather experts across natural and social sciences to tackle the pressing issues linking people and the changing ocean.

This year's workshop will focus on four key themes, including the impact of climate change-driven shifts in marine species distribution and how these changes will affect the way the UK marine environment is perceived, valued, and managed. Other topics include integrating digital humans into environmental digital twins, addressing biases in research related to marine carbon dioxide removal, and exploring how local communities can engage in participatory environmental monitoring. Applications to take part in the event close on December 7th.

Co-convenor Dr Katya Popova, says, "These are issues that have both global and local relevance and cut across our traditional disciplines in the natural and social sciences. The Socio-Oceanography Workshop aims to bridge the gap, bringing those disciplines together. This is increasingly important in our complex and changing world where people and the environment cannot be considered in isolation. It's imperative that we work across disciplines to really understand the challenges we face and help find solutions to them."

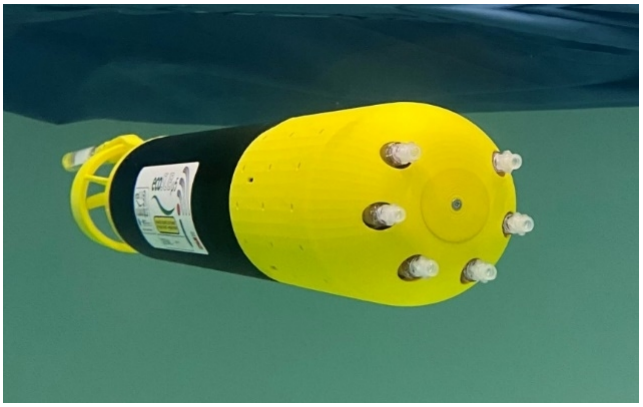
The workshop is limited to 50 people, with social sciences participants, in particular, being encouraged to apply, to help grow the number of specialists from this discipline engaging with socio-oceanography. Outputs from the workshop include research papers and funding proposals to help address the learnings, identified gaps and further knowledge.

"The first workshop helped to shape the concept of socio-oceanography, which was then published in Marine Frontiers, defining the new ways in which to conduct interdisciplinary research," says Dr Popova. "Last year's event then helped to drive international dialogue on issues such as marine plastics, with a paper in Nature Communications underpinning a key UN message on microplastics ahead of a major summit."

Outputs from this year's workshop, held in March, also continue with a recent publication addressing marine heatwaves, particularly in the UK where there is currently little awareness of their potential impacts, ecologically and societally. Find out more here.

The University of Southampton and ecoSUB Robotics Sign Licensing Agreement to Revolutionize Underwater Sampling Technology

On the 5th of November, the University of Southampton announced a groundbreaking licensing agreement with ecoSUB Robotics to bring an innovative underwater water sampler to market. Developed by researchers at the University of Southampton in collaboration with engineers from ecoSUB Robotics, this advanced water sampler is designed to facilitate autonomous collection of water samples, even at depths of up to 2,500 meters.



This versatile sampler, available in multiple configurations, can be seamlessly integrated with any of ecoSUB's autonomous underwater vehicles (AUVs). The new capability provides marine researchers, environmental agencies and others, with the unprecedented ability to collect water samples autonomously and, if necessary at depth, significantly expanding the scope of underwater exploration and analysis.

Traditional underwater data collection has relied heavily on sensors, which often have limitations when it comes to detecting specific water

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parameters such as DNA, RNA, heavy metals etc. The new sampler overcomes this limitation, enabling users to capture physical water samples for laboratory analysis. This development allows researchers to assess parameters that are currently inaccessible through standard sensor technology, providing a richer and more detailed picture of underwater environments. Dr. Adrian Nightingale, at the University of Southampton, commented on the significance of this achievement.

Terry Sloane, Managing Director at ecoSUB Robotics, highlighted the benefits of the sampler for the ecoSUB fleet, saying: “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. This partnership reinforces our commitment to providing cutting-edge, robust, and versatile AUV solutions. The unique ability of ecoSUB to dive vertically, presents researchers with a new way of obtaining water column data using a combination of traditional sensors as well as water samples.”

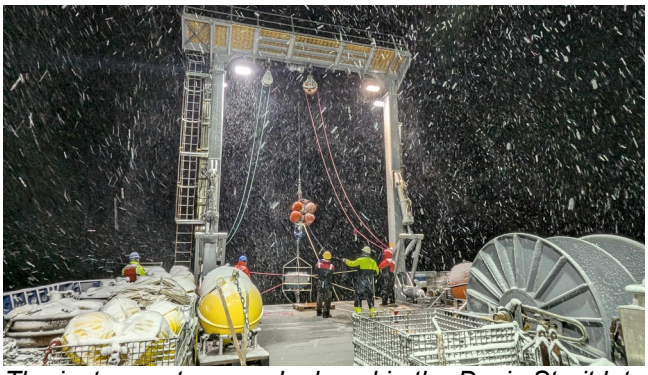
The sampler, opens new avenues for applications including environmental monitoring, marine biogeochemistry, oceanography, and offshore operations, where detailed water quality data is essential. In addition to providing this tool for the ecoSUB fleet, ecoSUB Robotics aims to continue its collaboration with the University of Southampton on future technologies that push the boundaries of what’s possible in autonomous underwater exploration. This collaboration underlines the University of Southampton and ecoSUB Robotics’ shared commitment to advancing technology and addressing critical challenges in marine science and industry. With this innovative water sampler, users worldwide can now access a deeper understanding of underwater environments.

SALTS

Tackling polar weather for BIOPOLE

The polar regions are an important source of nutrients into the wider ocean, where they support healthy marine life, including fisheries, and drawdown carbon dioxide from the atmosphere, slowing climate change effects. But we don’t know much about the processes that release nutrients from the polar regions or the current and future impact of climate change on them.

As part of an expedition on the US ship RV *Neil Armstrong*, which sailed out of Greenland earlier in October, National Oceanography Centre (NOC) scientists deployed monitoring equipment that will measure the nutrient content in some of the key waters flowing out of the Arctic, into the North Atlantic. The instruments were added to a mooring array that sits between Greenland and Baffin Island in Nunavut, Canada, and which is part of the Davis Strait Observing System, led by University of Washington.



The instruments were deployed in the Davis Strait late night on Monday (October 22), into Wednesday morning, including in a semi-blizzard.

The aim is to learn more about the role the polar regions play in delivering nutrients into the wider global ocean, and how they support healthy marine life, including fisheries. In particular, we want to understand how this will alter under the rapid climate change seen in the Arctic. The NOC involvement was as part of the BIOPOLE project, led by British Antarctic Survey. Together with data collected in the Arctic by NOC and other partners in BIOPOLE, this will help us understand the controls on nutrients being exported from the poles, how this might alter under climate change and the impacts this might have.

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This deployment follows a busy summer of NOC science and public engagement activities in the Arctic region. In August RRS *James Cook* embarked on an ambitious expedition from Greenland to Reykjavik, as part of the Resolving Biological carbon Export in the Labrador Sea (ReBELS) project. This kicked off a year of intensive study that will bring a new understanding of how much carbon is stored by the biological carbon pump in the Labrador Sea, a key region of carbon storage in the North Atlantic. As part of this mission, the ship will return to Nuuk in the summer of 2025.

Changes in the Arctic environment are already affecting our planet through sea-level rise, changes to our climate and weather patterns, and threats to our shared biodiversity. It's critical that we continue to gather crucial data and facilitate collaborative discussions to tackle challenging marine science problems.

Revolutionizing Biodiversity Monitoring: The Power of AI and New Technologies

Traditional methods of monitoring marine ecosystems and gathering data, while valuable, are increasingly challenged by the scale and complexity of the task at hand. Enter artificial intelligence (AI) and cutting-edge technologies, which are transforming our ability to observe, analyse, and, in turn, provide the evidence needed to better protect marine life.

Plymouth Marine Laboratory's (PML) new Automated in-situ Plankton Imaging and Classification System (APICS) project at the PML-led Western Channel Observatory (WCO) stands as a prime example. For decades, marine scientists have relied on ship-based sampling and light microscopy to study plankton communities. These methods have provided invaluable long-term datasets, such as the WCO's Station L4 time series, which has been running since the late 1980s. This has led to L4 becoming one of the longest-running, continuous plankton time-series in the world; and a key marine biodiversity reference site for studies (and evidence incorporated into key UN reports and recommendations) on both short and long-term environmental change.

However, traditional plankton sampling techniques come with significant drawbacks:

- Limited sampling frequency due to weather constraints and labour-intensive processes
- Potential damage to fragile organisms during collection and preservation
- Difficulty in accurately quantifying sample volumes
- Inability to observe real-time interactions between organisms

These limitations have left gaps in our understanding of plankton and marine ecosystems, particularly regarding short-term processes and subtle changes in biodiversity. Furthermore, there are challenges with regards to the availability of expertise in marine organism identification. APICS represents a paradigm shift in how we monitor marine biodiversity. By deploying the combined power of autonomous submersible camera units, the Imaging FlowCytobot (IFCB) and Moonpool Plankton Imager we can now capture vastly higher frequency, high-resolution images of plankton communities in their natural environment in real-time.

The advantages of this system are clear:

- Dramatically increased sampling frequency (up to 100-fold improvement e.g. from weekly to hourly)
- Ability to observe organisms in situ without disruption
- Precise quantification of sample volumes
- Real-time data processing using machine learning models
- Reduced carbon footprint compared with traditional sampling

Plankton images captured from the IFCB during testing at the marina.

This technological leap allows us to resolve processes that were previously invisible to traditional weekly sampling methods, such as bloom events, plankton community recovery after storms, and diurnal (daily) vertical migrations. The power of systems like APICS lies in their integration with artificial intelligence. Machine

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learning models, trained on vast datasets of labelled plankton images, can rapidly process and classify the continuous stream of data produced by the imaging systems. This real-time analysis opens up new possibilities for biodiversity monitoring:

- Early detection of harmful algal blooms (HABs)
- Rapid identification of invasive species
- Near-real-time tracking of changes in community composition
- Automated generation of biodiversity indicators/indexes.

By combining high-frequency sampling with AI-powered analysis, we can create a more responsive and comprehensive system for monitoring marine ecosystems. In addition, this enables far greater accessibility to scientists from different, broader or less specialised areas of research. The enhanced monitoring capabilities provided by AI and new technologies have far-reaching implications for conservation efforts and policy-making. With more accurate and timely data on plankton communities, which form the base of marine food webs and play crucial roles in oxygen production and carbon sequestration, decision-makers can:

- Respond more quickly to environmental threats
- Design more effective Marine Protected Areas (MPAs)
- Better assess the impacts of climate change on marine ecosystems
- Refine policies to support “clean, healthy, safe, productive and biologically diverse oceans and seas” (as outlined in the UK Marine Monitoring and Assessment Strategy (UKMMAS))

As we face unprecedented environmental challenges, the integration of AI and new technologies in biodiversity monitoring is unlocking huge potential. There are a multitude of potential applications for technologies such as APICS, for example we are already exploring its use for biodiversity monitoring as part of the UK expansion of offshore wind farms. The APICS project demonstrates the capacity for advanced technologies to revolutionize our understanding of marine ecosystems, the changes taking place within them, and the effect of human use of the Ocean, in turn enhancing our ability to make more informed and sustainable decisions.

CALENDAR

25th-28th November 2024: The 4th Mediterranean Geosciences Union Annual Meeting.

Barcelona, Spain

The 4th MedGU Annual Meeting will be held this year in-person and online. Visit our website (www.medgu.org) to learn more about the event. On this occasion, we are pleased to invite you to attend the conference and share/discuss your latest research findings. Your participation in-person or virtually will support MedGU’s mission of ensuring a sustainable future for humanity in the region and for the planet.

6th - 8th January 2025: 73rd Annual Meeting of the British Phycological Society

Hull, UK

Abstract submission and registration are now open at https://hull.brphycsoc.org/. We are very keen to welcome all phycologists to Hull as we approach the hundredth anniversary of marine science at this University. Thematic sessions cover advances in phytoplankton imaging and identification, current research in kelp, freshwater algae and eutrophication, and estuarine systems. The annual Irene Manton Prize will be awarded for best presentation by a PhD student. For more information, contact: bpshull2025@gmail.com.

26th-27th February 2025: The first OCEAN DECADE International Coastal Cities Conference

Qingdao, China

Coastal cities are among the fastest-growing human settlements in the world. They are on the frontline to benefit from the growth of a sustainable ocean economy, but also to face escalating threats from climate change, ocean pollution, and other environmental risks. The Ocean Decade presents a unique opportunity to harness ocean science and knowledge to address these challenges, enhance the resilience of coastal cities to global change, and improve the living conditions and well-being of their inhabitants. Happening ahead of the 2025 United Nations Ocean Conference, this event will accelerate the co-design of ocean science for the sustainable development of coastal cities. Join us to build a better ocean for better cities; Registration is open until 20th November 2024.

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26th-28th February 2025: 4th annual Socio-oceanography Workshop
Southampton, UK
The National Oceanography Centre (NOC) is calling on scientists and researchers to participate in its fourth annual Socio-Oceanography Workshop, hosted in collaboration with the Marine Social Science Network. This international event will gather experts across natural and social sciences to tackle the pressing issues linking people and the changing ocean.

This year's workshop will focus on four key themes, including the impact of climate change-driven shifts in marine species distribution and how these changes will affect the way the UK marine environment is perceived, valued, and managed. Other topics include integrating digital humans into environmental digital twins, addressing biases in research related to marine carbon dioxide removal, and exploring how local communities can engage in participatory environmental monitoring. Applications to take part in the event close on December 7th.

The workshop is limited to 50 people, with social sciences participants, in particular, being encouraged to apply, to help grow the number of specialists from this discipline engaging with socio-oceanography. Outputs from the workshop include research papers and funding proposals to help address the learnings, identified gaps and further knowledge.

Outputs from this year's workshop, held in March, continue with a recent publication addressing marine heatwaves, particularly in the UK where there is currently little awareness of their potential impacts, ecologically and societally. Find out more here.

11th-13th March 2025: The 4th Ocean Visions Biennial Summit.
Vancouver, Canada
We're thrilled to announce that the 4th Ocean Visions Biennial Summit 2025 will be held in March in Vancouver, Canada. This action-oriented event will bring together scientists, policymakers, innovators, funders, students, and others to explore solutions and strengthen partnerships to help restore our ocean and stabilize the climate. We invite you to be part of the movement. Join a multidisciplinary community focused on advancing solutions to the ocean's most pressing challenge, climate disruption.

Programming will be highly interactive and include ample opportunities for collaboration. Participants can look forward to:

- ***Sharing & Learning****:* Gain insights from inspiring keynote speakers and panel discussions on the forefront of ocean-climate research and innovation.
- ***Workshops****:* Dive deeper with fellow attendees on challenges and issues of mutual concern.
- ***Networking****:* Connect with leading experts, industry pioneers, and decision-makers shaping the future of ocean-climate health through time devoted to building and strengthening relationships.
- ***Collaborating****:* Forge partnerships and collaborations to accelerate the impact of your work in ocean-based climate solutions through interactive, action-oriented sessions and activities.

We're excited to announce that registration for the Ocean Visions Biennial Summit 2025 is now open. The Summit is designed to be highly interactive. A diverse set of session types and events will engage scientists, policymakers, innovators, funders, students, and others around innovative approaches and solutions to restore our ocean and stabilize the climate. The Summit will also help build and strengthen the multisector partnerships that are needed to make complex solutions real**.** Register Now and contribute to the Program.

Ocean Visions is seeking proposals for portions of the Summit's programming, which will include thematic sessions, focused workshops, plenaries, and idea pitches. If you have ideas for relevant and innovative content that could be featured, we ask that you submit idea by Friday, November 8th. We will review all submissions and share outcomes by mid-December.

The Summit is designed to welcome and engage a multidisciplinary community. The event will feature a mix of session types as well as ample opportunities to collaborate. Summit participants will share and discuss cutting-edge advancements in ocean sciences, engineering, policy, governance, and economics, and coordinate action on key priorities to advance innovative solutions for ocean-climate restoration. We invite you to be part of the movement. Help us advance solutions to the

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ocean's most pressing challenge – climate disruption.

27th April - 2nd May 2025: European Geophysical Union General Assembly.
Vienna, Austria
The EGU General Assembly 2025 brings together geoscientists from all over the world to one meeting covering all disciplines of the Earth, planetary, and space sciences. The EGU aims to provide a forum where scientists, especially early career researchers, can present their work and discuss their ideas with experts in all fields of geoscience.

The abstract submission deadline is **15th January 2025, 13:00 CET**. If you are looking for a head start the Provisional Programme is now online, though keep in mind that this list is not finalized until after the start of the Call for Abstracts. Prepare your calendar with all the EGU25 important dates by checking our Deadlines and Milestones page. Curious about who organizes the EGU25 General Assembly? Meet the Programme Committee.

4th-6th June 2025: The One Ocean Science Congress
Nice, France
The One Ocean Science Congress will feature a mix of plenary sessions, including opening and keynote speeches, alongside parallel oral and poster presentations. The One Ocean Science Congress is organised by CNRS and IFREMER and it is a special event of the 3rd United Nations Conference on the Ocean Endorsed by the United Nations Decade of Ocean Science for Sustainable Development. Please see more information on their website: https://one-ocean-science-2025.org/home.html

23rd-25th June 2025: Turbulence Grey Zone Workshop
Exeter, UK
Highlighting the opportunity to attend or participate in a workshop about advances in turbulence modelling/parametrisations, which is taking place at the University of Exeter next summer. Please see the link below for more information and the registration form:

Navigating the Turbulence Grey Zone in Numerical Weather Prediction: Modelling Challenges and Interdisciplinary Insights | Workshop of Turbulence Gray Zone in NWP in Exeter, UK, on 23-25 June 2025.

Turbulence parametrisation is a common challenge in the modelling of fluids, including Earth's ocean and atmosphere, so the conference aims to take an interdisciplinary approach.

The CSMS email address is challenger.society@gmail.com. Contributions for next month's edition of Challenger Wave should be sent to: john@myocean.co.uk by the 29th November.

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JOBS and OPPORTUNITIES

Five new research positions have been created at the Scottish Association form Marine Science (SAMS) in Oban as the institute responds to an urgent need to better understand ocean processes.

The ocean is critical to life on our blue planet and understanding how it is changing under the pressures of climate change, biodiversity loss and pollution has never been more important. In order to help us observe these changes, SAMS is expanding its science team and strengthening in specific areas. The institute is now recruiting two principal investigators and two senior post-doctoral positions in physical oceanography, as well as a senior post-doctoral position in marine biogeochemistry.

SAMS oceanographer Prof. Mark Inall said: "SAMS is a leading institute in ocean observations and is in a fantastic location on the west coast of Scotland to help understand major oceanographic changes in key regions, including the North Atlantic and the Arctic seas. Through our expertise and easy access to the open ocean, we've become a leader in ocean climate studies using large-scale mooring arrays and deploying autonomous underwater vehicles. Our glider programme has nearly 24/7 monitoring of the north-east Atlantic Ocean, which is crucial data to feed into climate models. Such is the pace and scale of climate change, we are seeing changes happening in increasingly shorter timescales, so now is the time to develop our capacity further. We're looking for ambitious and imaginative oceanographers who can help chart the direction of our research, ensuring we can answer the most pressing questions in ocean science."

From its Scottish Marine Robotics Facility, SAMS operates a fleet of gliders, as well as other autonomous underwater platforms. SAMS is also a leading partner in pan-Atlantic observation programmes, including OSNAP array, and is an important contributor to long-term Arctic observing via the SIOS programme. SAMS has a strong oceanographic heritage, dating back to its links with the Challenger Expedition and formation of the Extended Ellett Line. The Ellett Line is a standard hydrographic section between Scotland and Iceland designed to monitor critical ocean flows. It was started in 1975 by Dave Ellett, who was a physical oceanographer at SAMS. A partner of UHI (University of the Highlands and Islands), SAMS also offers a highly-rated BSc in Marine Science, which includes a pathway in Oceanography with Robotics. Find out more about the job opportunities at SAMS and apply for positions here.

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PhD opportunity in ocean carbon observing technologies at the National Oceanography Centre.

https://www.findaphd.com/phds/project/keeping-up-with-ocean-change-using-robots-to-push-the-envelope-in-ocean-carbon-observing/?p175586

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FMRI FUTURE MARINE RESEARCH INFRASTRUCTURE

UKRI Natural Environment Research Council

FMRI LEAD SCIENTIST OPPORTUNITY

Come and join the FMRI team and play a leading role in shaping the UK's future marine research capability.

We are looking for someone who can connect with scientists and engineers to help define the best strategies for exploiting new technologies. Someone who is excited about new opportunities for marine research and can think across the big challenges. Someone who can peer over the horizon and imagine a different way of doing things.

We will fund at least 50% of your time to work as part of the programme leadership team. In this role we will ask you to engage with the marine science community to understand their future requirements, bring that knowledge to bear on the decisions that we will make, and maintain that dialogue as we move forward.

For an informal discussion, please contact the team via: info@fmri.ac.uk

For more information or to apply, please visit: www.fmri.ac.uk/recruit/lead-scientist

Applications close: **28th November, 2024**

Head of Science, The Ocean Census

The Ocean Census is seeking a Head of Science to lead the mission to discover ocean life and to develop, manage and coordinate the international alliance of science partners participating in and contributing to the Census.

- Closing: EOB, Friday 29th November
- Full details: https://oceancensus.org/job-opportunity-head-of-science/

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There are jobs in the IMBeR newsletter

- Senior Research Associate (Fixed term for 18 months) - Marine Plankton Respiration, School of Environmental Sciences, University of East Anglia. Norwich, UK. Apply by **25 November 2024**.
- Postdoctoral Fellowship – Climate Change Impacts on Northwest Atlantic Marine Ecosystems & Fisheries, Memorial University, St. John's, Canada. Position will remain open until filled.
- 2024 NF-POGO Open Call for Shipboard Training Fellowships. Apply by **30 November 2024**.
- 2025 ITOPF R&D Award - Call for Tenders for Projects on Accidental Oil Spills In the Marine Environment. Apply by **30 November 2024**.
- Call for nominations for experts - The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Apply by **10 January 2025**.
- New EMFAF call for proposals for smart specialisation and regenerative ocean farming. Submit by **18 February 2025**.

More jobs and opportunities for ECRs, please sign up for IMECaN newsletter

If you would like to put some recruitment information in the IMBeR monthly newsletter, please contact us through imber@ecnu.edu.cn.

There are jobs in the MASTS newsletter

New vacancies:

- Assistant Scientist (Ecology) – SEPA – 27/11/24
- Volunteer Trustees – Young Sea Changers Scotland – 02/12/24
- Internship offer: International Policy Assistant – Ocean & Climate Flatform – 24/11/24
- Lecturer – University of Glasgow – 01/12/24

Still open vacancies:

- Marine Advocacy Manager – Yorkshire Wild life trust – 01/12/24
- Head of Enterprise and Commercial Services – SAMS – 05/01/25
- Post Doctoral Research Assistant – Ocean Science Consulting Limited (OSC) – 11/24
- Lead Scientist Opportunity – FMRI – 28/11/24
- Principal or Specialist Environmental Consultant – EIA – 24/11/24
- Research engineer – Post-doctoral Fellow – 30/11/24
- Science Officer – Irish Whale and Dolphin Group – 01/01/25
- Fisheries Research Assistant – UHI Shetland – 30/11/24

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