UNIVERSITY OF PORTSMOUTH

GB ROW CHALLENGE

ROW WITH A PURPOSE

GB ROW 2023
SCIENCE IMPACT REPORT

Left to right: Emma Wolstenholme (Skipper), Amy L Wood, Clair Fennessy, Sandra Gates, Maggie Hodge and Emma Haxell.

GB ROW 2023
SCIENCE IMPACT REPORT

The University of Portsmouth and GB Row Challenge partnership pairs science and sport.

In 2023, the endurance rowers of Team Ithaca battled winds and tides in a race around the British coastline. At the same time, they were gathering scientific data and samples including temperature, underwater sound, microplastics and biodiversity. Scientists at the University of Portsmouth have analysed and interpreted that data. This report presents our findings.

*Not only did Team Ithaca row 2,000 miles unsupported collecting a treasure trove of data – they also broke the **world record** for fastest female team. Congratulations Team Ithaca on your induction into the book of Guinness World Records.*

SCIENTIFIC DATA FROM THE 2023 GB ROW CHALLENGE RACE

Professor Fay Couceiro and Laura Fantuzzi

This report has been a team effort, and what a team. Professor Fay Couceiro led the science section of the partnership with Will de Laszlo leading the Challenge with Purpose.

Laura Fantuzzi analysed all 2023 samples and data. Anita Carey analysed 2022 microplastics samples. Dr James Trayford, Professor Andy Lundgren and Dr Ronaldas Macas guided sound analysis. Professor Alex Ford and Dr Kat Bruce helped with biodiversity and eDNA. Jon Churchill and Alex Mair provided vital engineering skills. Huge thanks are also due to the teams who collected the samples – and to the GB Row Challenge support team, especially Jim Bastin.

Find out where in the UK the water was warmest. Discover where we detected at-risk marine species. Listen to what we'd hear if a dolphin spoke to us underwater. And learn just how many microplastics might be in the sea near you...

BACKGROUND

GB Row Challenge began in 2005 as the ultimate rowing challenge, in which crews attempt to row continuously around the coastline of Great Britain - a distance of over 2,000 miles. This requires much more than just strength, stamina and endurance. To successfully circumnavigate Great Britain, teams need to understand navigation and the sea's tidal flow. Tactical ability, and the capability to make the most of weather and sea conditions, can be as important as the crew's rowing strength.

In 2022, GB Row Challenge teamed up with the University of Portsmouth, aiming to combine the physical challenge with a scientific purpose. Our team of scientists first needed to devise a sampling strategy that did not impact on the speed of the boat – we had to remember that the rowers are already taking on enough of a physical challenge!

We agreed to focus on three main areas: microplastics, underwater sound and biodiversity, as well as collecting data on temperature and salinity for environmental context. The aim is to collect these datasets for each GB Row Challenge event between 2022 through to 2026 and beyond. This will give us a great baseline for the entire UK and highlight any changes happening over that time.

This is the report for the 2023 GB Row Challenge. In 2023, one team of six women circumnavigated the UK coastline unsupported and collected these samples and data: Team Ithaca.

2023 TEMPERATURE REPORT

University of Portsmouth and GB Row

OCEAN TEMPERATURE

"GIVEN THE GREAT IMPLICATIONS OF A WARMING OCEAN TO A COUNTRY'S ENVIRONMENTAL, SOCIAL AND ECONOMIC SUCCESS, MONITORING SEA SURFACE TEMPERATURE IS OF UTMOST IMPORTANCE TO ANTICIPATE WHERE AND HOW WARMING OCCURS"

Laura Fantuzzi.

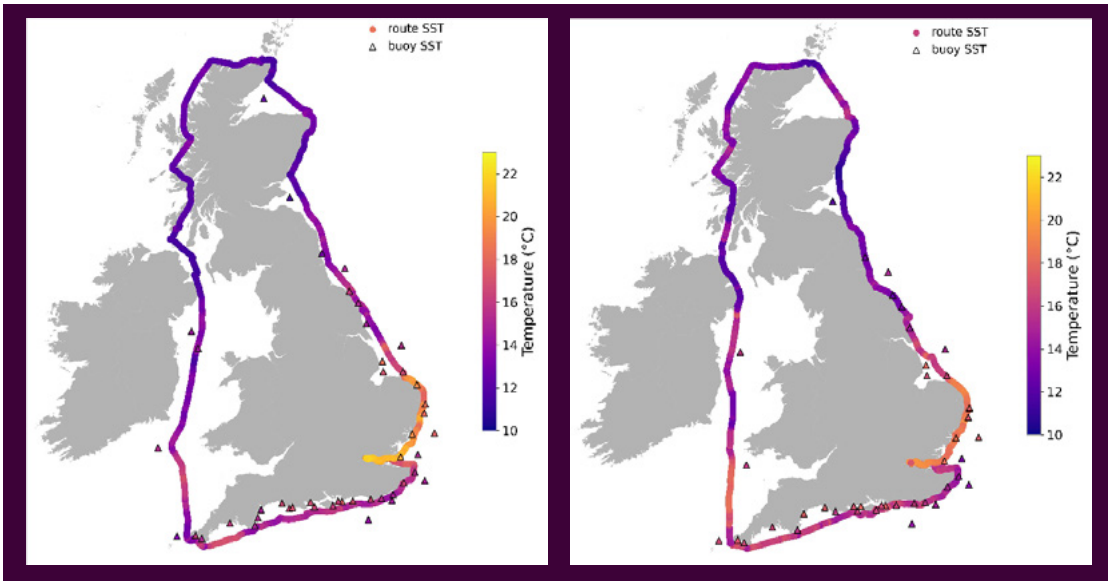
The long-term increase on sea surface temperature (SST) has already shown a global impact on ecosystems. Scientists have observed the spread of warm water species poleward, where waters have warmed enough to become habitable. A consequence of this is migrating commercial fish stocks, with impacts on local fisheries. Warming oceans also increase the rate of sea level rise, worsening coastal flooding and coastal erosion.

GB ROW & TEMPERATURE

GB ROW DATA FILLS GEOGRAPHICAL GAPS IN TEMPERATURE MONITORING

In areas not covered by oceanographic buoy monitoring, GB Row temperature data is the only in situ collected publicly available data for UK seas. In the figure below, triangles show the location of active temperature recording buoys in 2022 and 2023. GB Row routes intersect with some of these buoys, particularly along the south coast – however, there are many locations where monitoring is lacking and GB Row data is providing much needed coverage.

Having an in-situ reference dataset from static monitoring oceanographic buoys allows validation of GB Row data. For both 2022 and 2023, data from buoys <40 km away from the respective route are statistically well correlated and not significantly different from the corresponding GB Row data. This validation is important in ensuring that the GB Row data is accurate when looking at areas not regularly monitored, such as north and west coasts of Great Britain.



Temperature data collected by GB Row Challenge boats circumnavigating Great Britain in June/July 2022 and 2023, and temperature data from static oceanographic buoys.

INTER-ANNUAL COMPARISONS

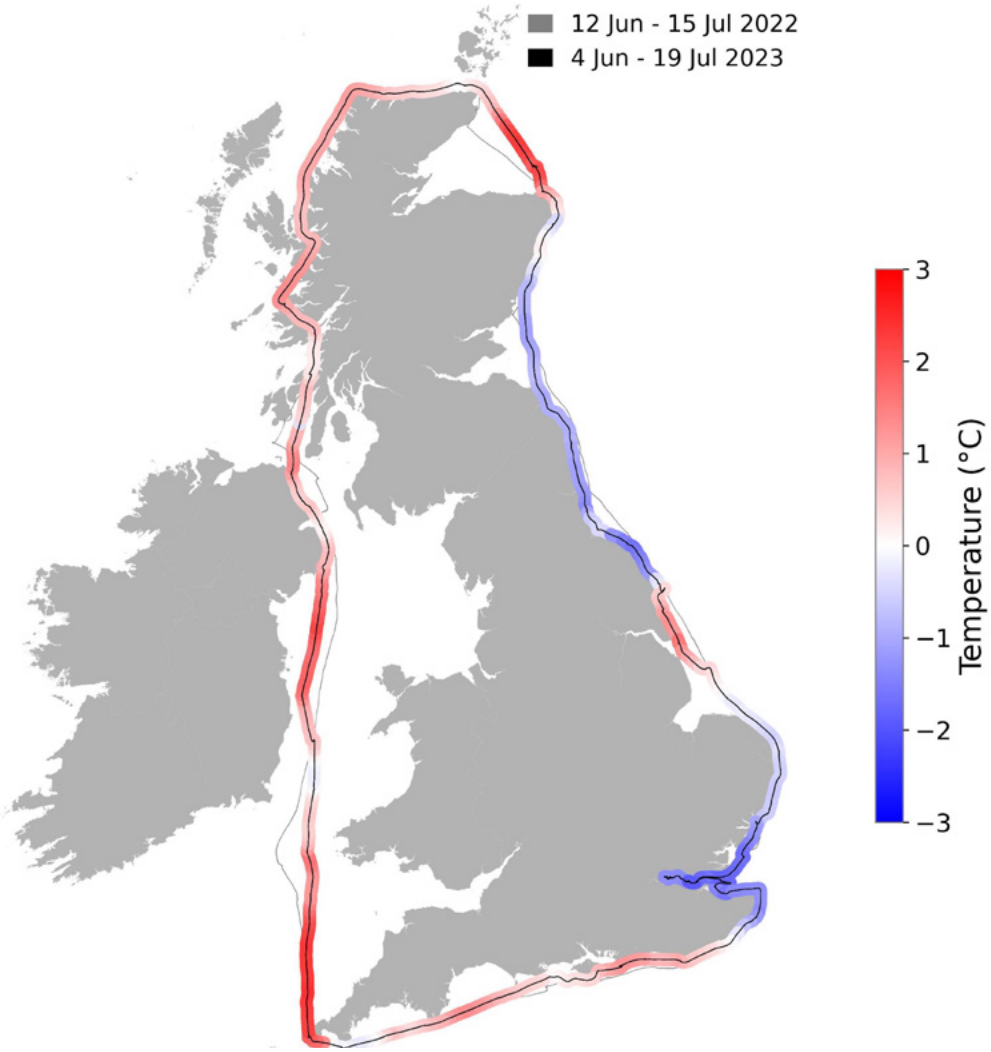
SUMMER UK COASTAL SEAS WERE, ON AVERAGE, 0.39ºC WARMER IN 2023 THAN IN 2022. LOCALLY THIS REACHED OVER 2ºC WARMER IN AREAS SUCH AS THE CELTIC AND IRISH SEAS, THE NORTHERN NORTH SEA AND AN AREA OFFSHORE OF THE HUMBER ESTUARY.

The magnitude of this warming is highly significant. A recent study calculated the decadal warming for the English Channel, finding a 0.35°C per decade increase in sea surface temperature, based on satellite and buoy data. GB Row data shows that this level of warming was achieved in just one year when comparing summer 2022 and 2023 temperatures. Two years of data is not enough to make long term predictions, therefore continued monitoring is essential, especially as the greatest temperature rises observed were in areas with little coverage by oceanographic buoys.

Alongside this warming in most of Great Britain's coastal waters, it is important to note that a few locations experienced a decline in summer sea surface temperature from 2022 to 2023, such as in the Thames Estuary both at the start and end of the monitoring, and around Kent in early June. The latter area had the most intense cooling, with surface waters in 2023 up to 1.9°C cooler than in 2022.

What does this mean?

These localised temperature changes, alongside generalised warming, are likely to impact ecosystems in the long term. The GB Row Challenge data collection project includes collection of eDNA samples, which will allow us to analyse temperature variations with biodiversity, a key factor in controlling species distribution.



Temperature differences between 2022 and 2023 GB Row Challenges. Red indicates warming and blue cooling.

MICROPLASTICS

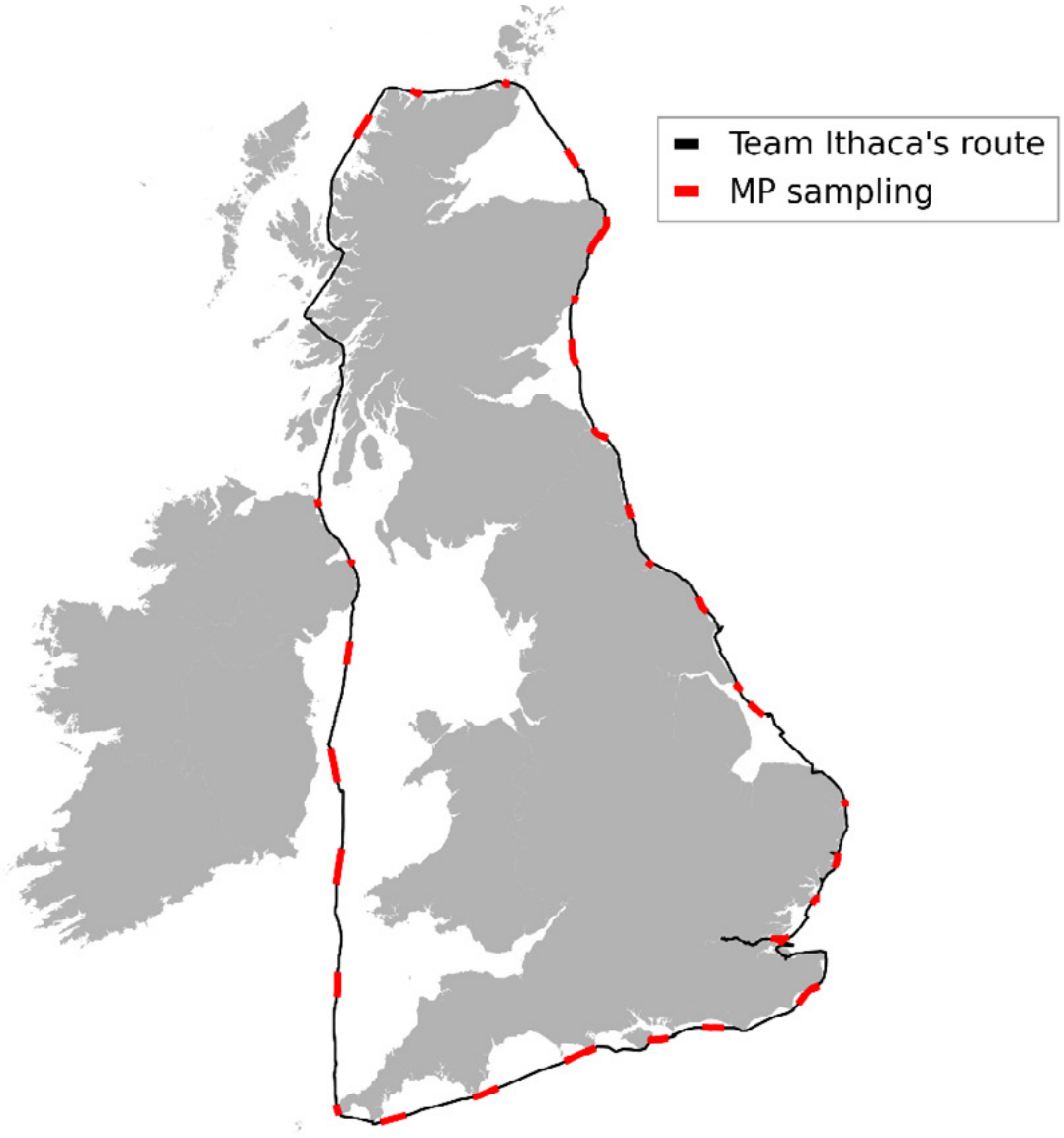
4,604L of sea water filtered over 340km of the 3,200km route in 2023

What are microplastics?

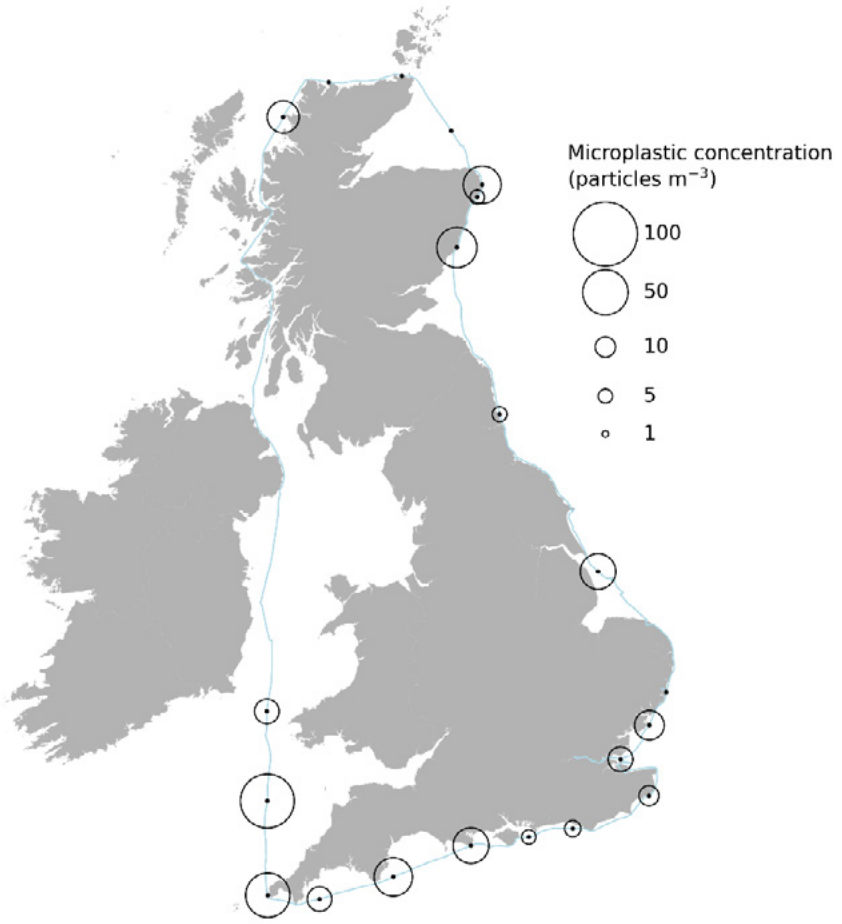
Microplastics are pieces of plastics smaller than 5mm. They may be plastics made that size on purpose (e.g. nurdles) or small pieces of plastic that have broken off from larger pieces (e.g. fragments or fibres). Scientists began to notice “small” plastics in the oceans almost 50 years ago. Since then, methods for detecting them have improved and studies have been conducted to determine if they are harmful. Most of these studies have taken place in sea animals and, unfortunately, the results are troubling. In many species, eating large numbers of microplastics has negative impacts ranging from reduced growth, to aberrant development, to cell toxicity.

What has changed since the 2022 impact report?

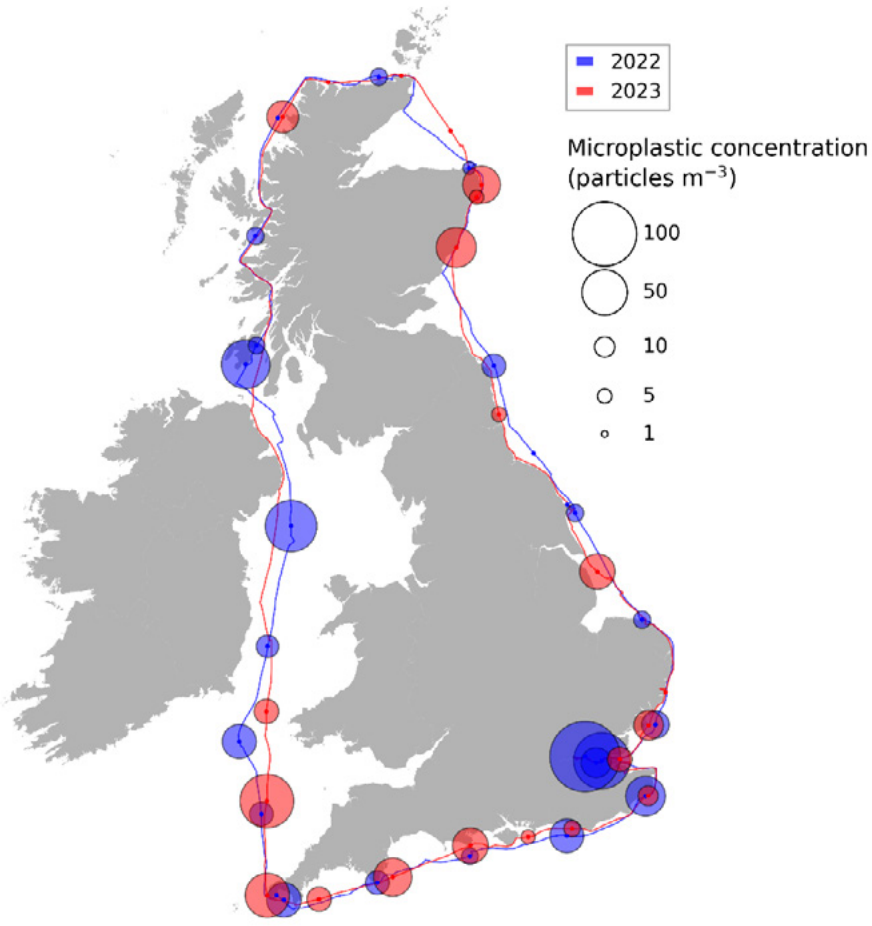
Samples were collected as described in the 2022 impact report with a slightly longer pump run time, to increase the volume of seawater filtered per sample. Briefly, sea water was pumped through a filter with a pore size of 0.04mm for 3.5 hours per day. The volume of water pumped was logged and the filters changed and stored each day. In 2023, an average of 154L was filtered for each sample and samples with less than 50L filtered were not analysed. Material collected on the filters was digested and density separated before analysis on by microRaman spectroscopy.



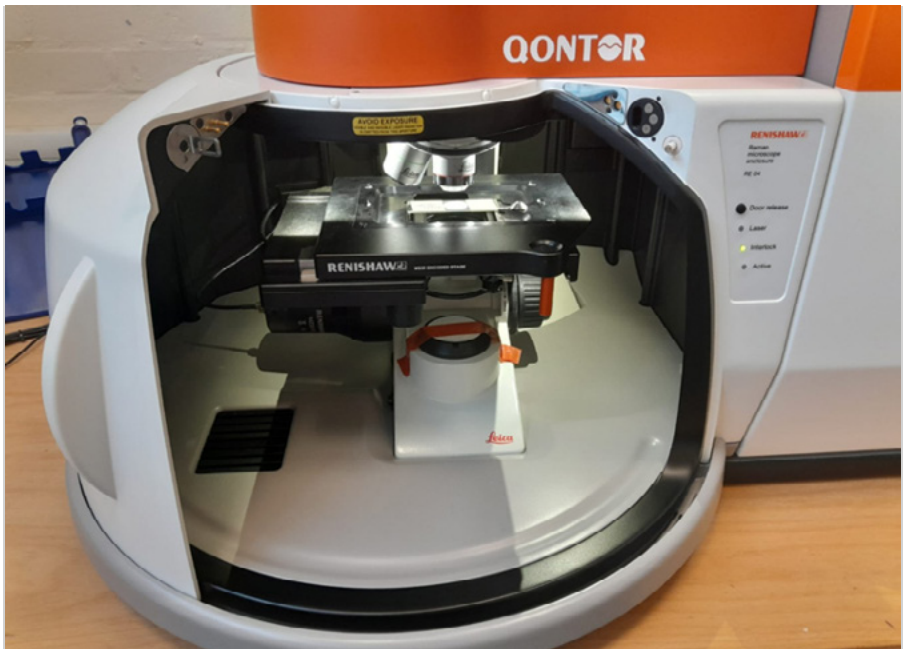
Team Ithaca route with locations of microplastic samples in red.



Microplastic concentrations in 2023.



Microplastic concentrations in 2022 and 2023.



microRaman.

We have analysed microplastics samples from 21 sites. The average number of microplastics collected in 2023 was 20 pieces per cubic metre of sea water (20 MP/m3) – this is the same as the average for 2022, despite distribution of microplastics changing between the two years.

We do not have data for the Thames estuary in 2023. The highest amount of microplastics, 70 MP/m3, was found in the Celtic Sea. This is again comparable to the greatest non-London concentration from 2022, of 65 MP/m3.

As in 2022, no microplastics larger than 40 micrometres were found in the samples from the northwest coast of Scotland in 2023.

One particularly surprising find was a fragment of Bakelite found just north of the Thames Estuary, close to Clacton-on-Sea. This is so surprising as Bakelite is the first entirely synthetic plastic sold in the early 1900s but few Bakelite products were sold after the 1950s. The Bakelite we found could possibly have been around for 100 years, really bringing into focus the longevity of plastics in the environment and reminding us yet again why we need to address the global plastic crisis and consider the long-term effects of microplastic pollution.

Bakelite microplastic found in the 2023 microplastics samples.

UNDERWATER SOUND

Why are we monitoring underwater sound?

Sound travels much further in water than in air. As it travels so well, sound is used by many marine species to communicate, hunt, find a mate and avoid predators. Probably the most famous example is dolphins using echolocation to navigate or find food, but many fish also use sound to communicate. Listening to these sounds underwater can help us determine where “noisy” species are in our waters.

It is not just animals making noise underwater. Humans create a lot of noise pollution through shipping, construction and operation of infrastructure like oil and gas platforms or windfarms, and our use of sonar (e.g. for military or surveying purposes). This can reduce animals’ ability to hear one another, leading to them getting lost or stranded, failing to find mates, or not hearing approaching predators. We hope that knowing, and monitoring, how noisy underwater locations are can help with introducing policy to reduce noisy human behaviour in protected locations, to reduce stress on the ecosystem.

What has changed since the 2022 impact report?

Methodological upgrade

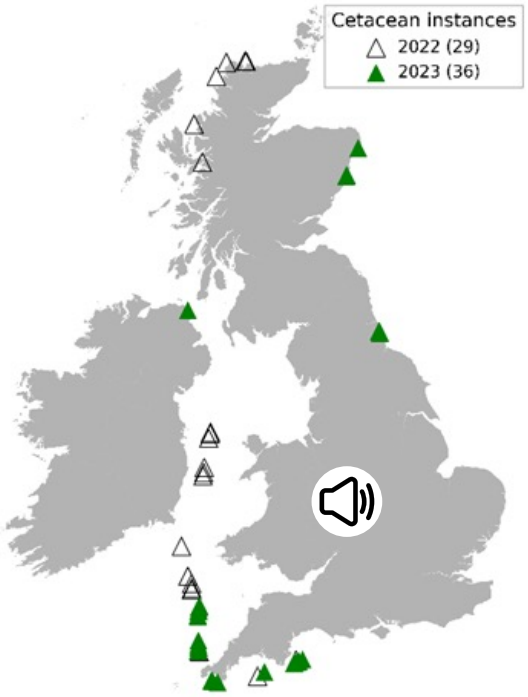
The same hydrophone system embedded in the rudder was used in 2023 as in 2022.

Image of the RS Aqua Porpoise hydrophone integrated with the rudder of a GB Row Challenge boat.

During the 2022 GB Row Challenge, the hydrophones had an extensive frequency range, recording from 150 Hz up to 192 kHz. To accommodate the available disk space for the duration of the challenge, the hydrophone was only recording half of the time.

In 2023 the decision was made to reduce the frequency range slightly from 150 Hz to 128 kHz, to allow continuous recording during the GB Row Challenge, maximizing the likelihood of bioacoustic detections, such as cetacean vocalizations. This resulted in a dataset size of 3 terabytes.

WHAT WE HEARD AND WHERE WE HEARD IT



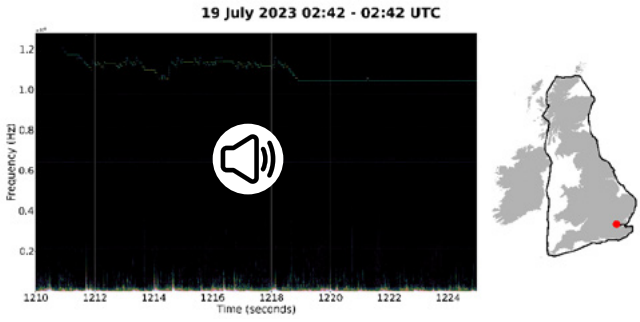
Locations of occurrences of vocalising cetaceans, in 2022 and 2023.

Locations of occurrences of boat engines, in 2022 vs 2023.

Cetacean and boat engine occurrences in 2023.

There was a clear contrast in the locations we heard cetacean and engine sounds in 2023.

As noted, it is not just boat engine noise we add to the marine environment. This is a visualisation and sound recording of an anthropogenic sound we heard with the hydrophone but is not heard by us above the water.



Visualisation and audio clip of the anthropogenic sound from an unidentified instrument. The audio clip has been processed to make the high frequency sound audible and clearer, including a 50% reduction in speed.

BIODIVERSITY

University of Portsmouth and GB Row Challenge on track to provide comprehensive eDNA biodiversity data for UK waters with NatureMetrics.

UK coverage of eDNA samples collected by GB Row Challenge in 2022 and 2023.

A key goal of our collaboration is to provide one of the most detailed baselines of British coastal biodiversity available for marine vertebrates (fish, mammals and birds) using environmental DNA (eDNA) analysis. The teams participating in the challenge collect samples as they circumnavigate the UK, rowing unassisted. Here you can see the location of the 143 samples collected and analysed so far, and some of the species detected during the 2023 challenge.
This data provides a unique look at the life beneath our waves.

GB ROW IMPROVES THE NUMBER OF SPECIES DETECTED IN EACH SAMPLE

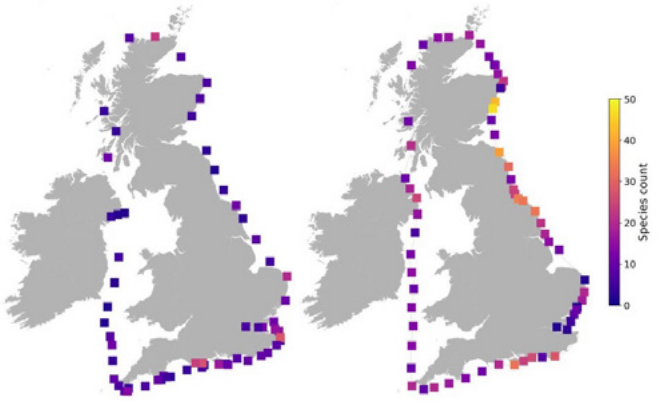
We detected 120 species in 2023 across 66 eDNA samples collected by GB Row Challenge. Only 82 species were found in 77 samples the previous year. This improvement in detection comes from changes in the way samples were collected.

For the first set of samples collected in 2022, rowers filtered eDNA from the water using a bucket and a syringe, pushing seawater through a filter by hand. This was found to be very time-consuming and difficult for the rowers and the level of human DNA contamination was found to be high.

In 2023, engineering partners at Harwin and Porvair worked hard to automate the process. They designed a peristaltic pump system located at the stern of the boat, that would pump seawater through a filter automatically twice daily. Rowers changed, preserved and stored the filter following each sampling event. This reduced the workload on the rowing team and the human DNA contamination. As a result, the DNA of more species could be found.

Due to the changes in sampling method, it is not currently possible to compare data directly between 2022 and 2023 for species richness (the number of species found at one location). We can, however, combine the datasets. The combined data gives exceptional spatial coverage around the UK – and there are still 2 years of the project left to go.

GB Row Challenge will continue to collect eDNA samples, and as the number of datasets increases, the University of Portsmouth will be able to determine if there are changes in species distributions and compositions over time. Combined with the temperature, microplastic and underwater noise data, also collected by GB Row Challenge, we hope to be able to determine current impacts of these parameters on UK coastal health.



Number of marine vertebrate species found at each sampling location for 2022 and 2023.

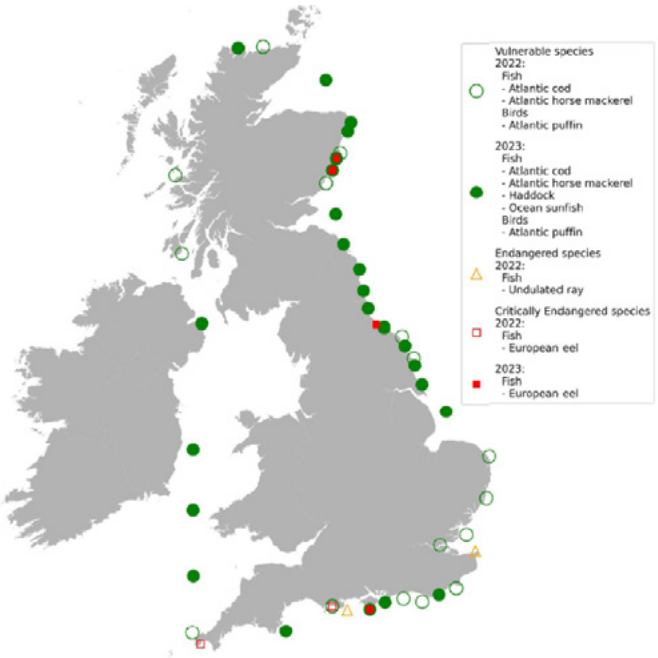
IMPORTANCE

At-risk species

We are in the midst of a global biodiversity crisis, both on land and in the oceans. From the data collected by GB Row Challenge in 2022 and 2023 alone, at risk species can be found all around our coastline. Protecting the health of our waters is therefore more crucial than ever.

It is also important to remember that not detecting a species' DNA in our sample does not mean that the species is not there, just that their DNA was not captured in the water we sampled.

There could be more rare species out there, but we haven't captured the eDNA – yet. This is why continuing datasets are so important.



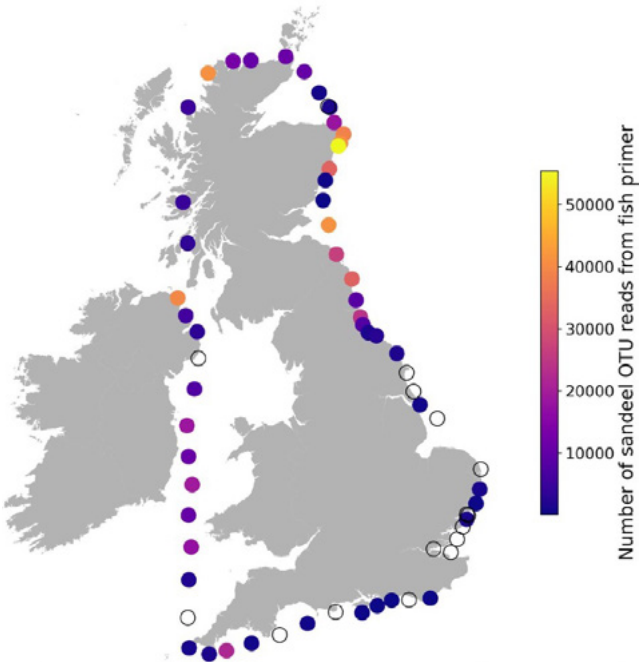
Locations of at-risk species detected in the eDNA collected during the 2022 and 2023 GB Row Challenges.

GOOD NEWS FOR SANDEELS, PUFFINS AND HARBOUR PORPOISES

Sandeels are a keystone species. These are species that can define an entire ecosystem, and their removal can lead to catastrophic failure. Many seabirds, such as puffins, are completely reliant on sandeels, and sandeels are an important part of the diet for many commercial fish and cetaceans.

Our eDNA data shows sandeels are still present around our coastline, but we know they are in severe decline due to climate change and overfishing. Harbour porpoise distribution closely mirrors sandeel habitat, and sea bird numbers and distributions have declined dramatically along with those of sandeels.

In January 2024, the UK government announced a ban on industrial sandeel fishing in all Scottish waters and the English North Sea (although this is being contested by the EU under the EU/UK Trade and Cooperation Agreement). With an increase in sandeel numbers on the horizon, we can look forward to monitoring the return and increased distribution of some of the iconic species that feed on them over the next few years.



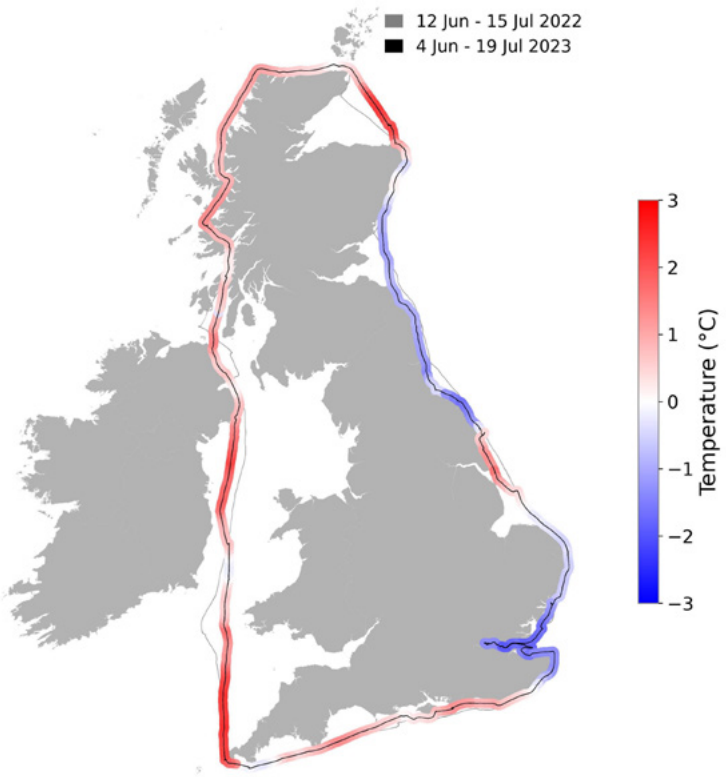
Quantity of sandeel DNA found in the 2023 GB Row eDNA samples. Empty circles indicate samples where no sandeel DNA was detected.

BRINGING IT ALL TOGETHER

The real strength of a project like this is how we combine these data sets going forward. The results you've seen so far are just the tip of the iceberg. We will be spending the next three years not only collecting more data but also combining the data sets.

Although no conclusive findings can be gained from the eDNA data as yet due to the changes in sampling methodology, Atlantic Cod DNA was found in multiple samples both years, but in quite different locations. These differences in distribution coincide with changes observed in the sea surface temperatures. As we establish baselines and expand the spatiotemporal coverage of eDNA samples, we will improve the knowledge of our seas and what is impacting them.

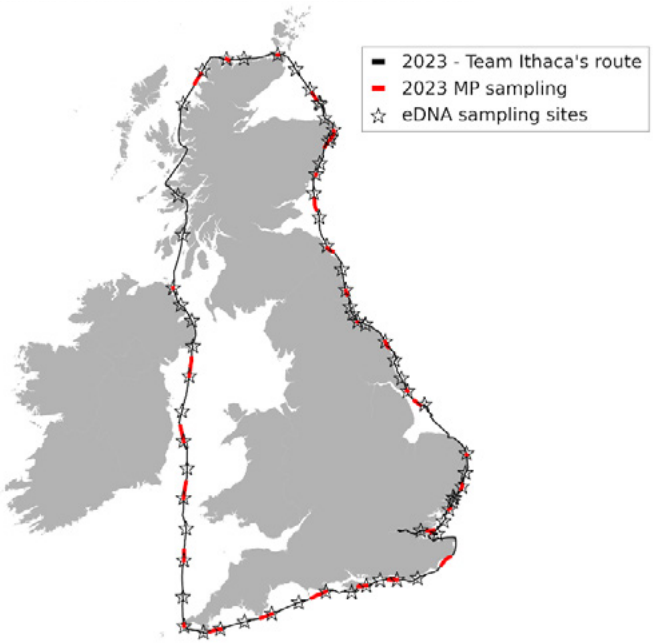
Atlantic Cod distributions in 2022 from eDNA.



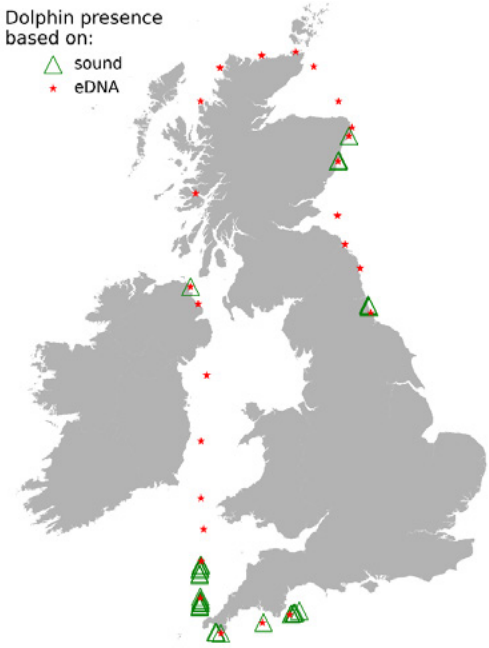
Atlantic Cod distributions in 2023 from eDNA.

Temperature differences between 2022 and 2023 GB Row Challenges. Red indicates warming and blue cooling.

Microplastic samples were taken in the same location as eDNA samples in 2023, which will allow us to compare microplastics concentrations and biodiversity.



Locations of eDNA and microplastics sampling sites over team Ithaca's route in 2023



eDNA and acoustic cetacean signals overlap in 2023

We are also investigating improving cetacean monitoring by combining two powerful techniques.

In 2023, all acoustic signals of cetaceans were matched by a cetacean DNA signature in the nearby water sample. This supports eDNA-based monitoring in confirming the vicinity (since high frequency sound is recorded – this requires the animal to be close to the hydrophone) and state (based on the acoustic signal produced – hunting, lone or in group, etc.) of the cetaceans. This is helpful because there is uncertainty around how eDNA travels in the marine environment, and the limitations as to what it can tell about the living organism.

On the other hand, not all eDNA signals were matched by an acoustic signal. This means animals were often silent; their presence and distribution cannot be reflected by acoustics-only monitoring. Combining eDNA and acoustic monitoring has the potential to be a very powerful approach to monitoring cetaceans and other vocal marine species.

We are delighted to announce that the Marine Data exchange will host all the data for The GB Row Challenge partnership.

THE CROWN ESTATE | Marine Data Exchange

The Marine Data Exchange (MDE), initiated by The Crown Estate, is the UK's trusted source of marine industry survey data, research, and evidence, making it freely accessible to help foster collaboration. Since 2013, The Crown Estate have continually invested in the MDE to remove barriers to data sharing, making it easier for others to find and access data. Their goal is to empower the nation to make evidence-based decisions and inspire everyone to shape the future of our seas through open and accessible data.

Data collected from The GB Row Challenge can be found on the Marine Data Exchange website.

This research is only possible thanks to the generosity of our community. Every donation of any size helps carry this work forward, tackle marine pollution and protect our seas. To support this vital work please visit The GB Row Challenge donation page hosted by the University of Portsmouth.

Donate to support
The GB Row Challenge today.

Every gift helps protect our oceans.

SPONSORS

A huge thank you to all the sponsors who have made this project possible:

Our Lead Engineering Technology Partner

HARWiN

Thank you to all the Team at Harwin who rose to the challenge to create a system that works in the harshest environments.

Environmental DNA Partner

NATURE METRICS
DNA-BASED MONITORING

Thank you to NatureMetrics for their time and expertise in the eDNA analysis.

Science and Innovation Partner

UNIVERSITY OF PORTSMOUTH

Thank you to the team of scientists at the University of Portsmouth for your support and guidance in order to create robust data sets.

Acoustics Partner

RS AQUA

Thank you to RS Aqua for the time devoted to designing the bespoke acoustic recording system for the GB Row Challenge boats.

Filtration Partner

porvair
filtration group

Thank you to Porvair Plc and especially to Jon Churchill for his tireless work and energy in leading the filtration project.

Corporate Partner

agathos

Thank you to Agathos for your support and belief, making this project a possibility.

Lead Corporate Sponsor for 2024

SIMPLY SUSTAINABLE®

In 2023 we welcomed Simply Sustainable as Lead Corporate Sponsor for 2024.

A BIG WELCOME TO THE SIMPLY SUSTAINABLE TEAM.

PHILANTHROPIC SUPPORT

GB ROW CHALLENGE
ANONYMOUS DONOR
THINK ABOUT DOING YOUR PART

Grateful Thank You to an Anonymous Donor

We would like to extend our heartfelt thanks to a generous anonymous donor for their incredible support of the GB Row Challenge and University of Portsmouth's pioneering environmental research.

Your contribution is making a real difference — helping us collect vital data on microplastics, eDNA, water temperature, and salinity from some of the most challenging waters around the UK. This research is driving forward our understanding of climate change and supporting world-class science at a time when it is urgently needed.

Your quiet generosity speaks volumes, and we hope your example inspires others to follow suit in backing this crucial work — for the health of our oceans and the future of our planet.

With sincere gratitude, **The GB Row Challenge Team and University of Portsmouth**

We are deeply grateful to the funders who have supported this work and made this research possible. Thank you to The Robert and MeiLi Hefner Foundation and the A.G. Leventis Foundation for your continued support, enabling this work to continue.

Robert & MeiLi Hefner FOUNDATION

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