



convex
**SEASCAPE
SURVEY**

Annual Report Year Three

APRIL 2024 – MARCH 2025

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Above: Antarctica Photo: Diego Rivera Rosas

FOREWORD

by **Stephen Catlin**

I write as David Attenborough's Ocean film is delivering perhaps his most powerful punch to date; 'After almost 100 years on the planet, I now understand the most important place on Earth is not on land, but at sea'.

We started Convex Seascape Survey three years ago, with a view that ocean based carbon was likely an important (and undervalued) factor in the carbon cycle and deserved materially deeper research. As we conclude this third year, the work undertaken by University of Exeter and partners in the project is now delivering the hard evidence the world needs to better understand quite how crucial – and complex – shelf sea carbon stores are.

We are immensely fortunate to have Professor Callum Roberts lead this ambitious project, orchestrating the integration of three distinct science workstreams and ensuring the engagement of the best subject experts. What is becoming increasingly clear is how interconnected the workstreams are; assessing the impact of trawling or other human disturbances on seabed carbon stores must inevitably consider the nature and origins of the carbon and the role of marine

life buried therein. Callum also takes time to ensure the important and evolving results of the project are well communicated by him and other CSS project scientists, presenting at ocean and climate related events throughout the year.

It has also been rewarding to see some of the project insights published in eight research papers over the course of the last year, covering topics such as drone imaging methodology, historical oyster reefs, and the air-sea exchange of carbon.

Our field expeditions, starting closer to home in the Scottish islands, have in the last year expanded to Hauraki Gulf in New Zealand, deepening our evidence base and understanding of seabed carbon origins. Still far afield, our project partners from KAUST have been to Antarctica, providing new insights into the carbon cycle and the effects industrial whaling might have had on ocean carbon uptake.

We are privileged to have a highly regarded advisory group chaired by Prof Michael Depledge, who meet twice annually to review the project's progress. Their insights and guidance are valuable both to Callum and the team leading the project but also to the Steering Committee. Our Steerco members also had the good fortune of participating in a whole project workshop on

site in Exeter in March 2025, listening to the scientists in the lab demonstrating their work and findings.

How we communicate the importance of seabed carbon is an important thread of this work and reaching new audiences is vital. Our partners in managing the project, Blue Marine Foundation are a tremendous force in their ability to raise awareness and convene engagement on this vital subject. We were especially thrilled to have multidisciplinary light artist Chris Levine create an original piece for CSS; his immersive laser piece '7.83 Hertz' was unveiled for World Ocean Day, in London in June 2024, highlighting the little known benthic zone, vitally important to our planet's health.

The impact on education continues to be a clear priority of the Project; the education stream has engaged over 750,000 learners in schools across the globe, building awareness of the role of the importance of the ocean to life on earth.

As we move into the fourth year of the Convex Seascape Survey, our efforts to research and raise awareness of this impactful area of the carbon cycle will undoubtedly bear further fruit. The increasing focus on how the world values nature and the role of robust data and science in underpinning

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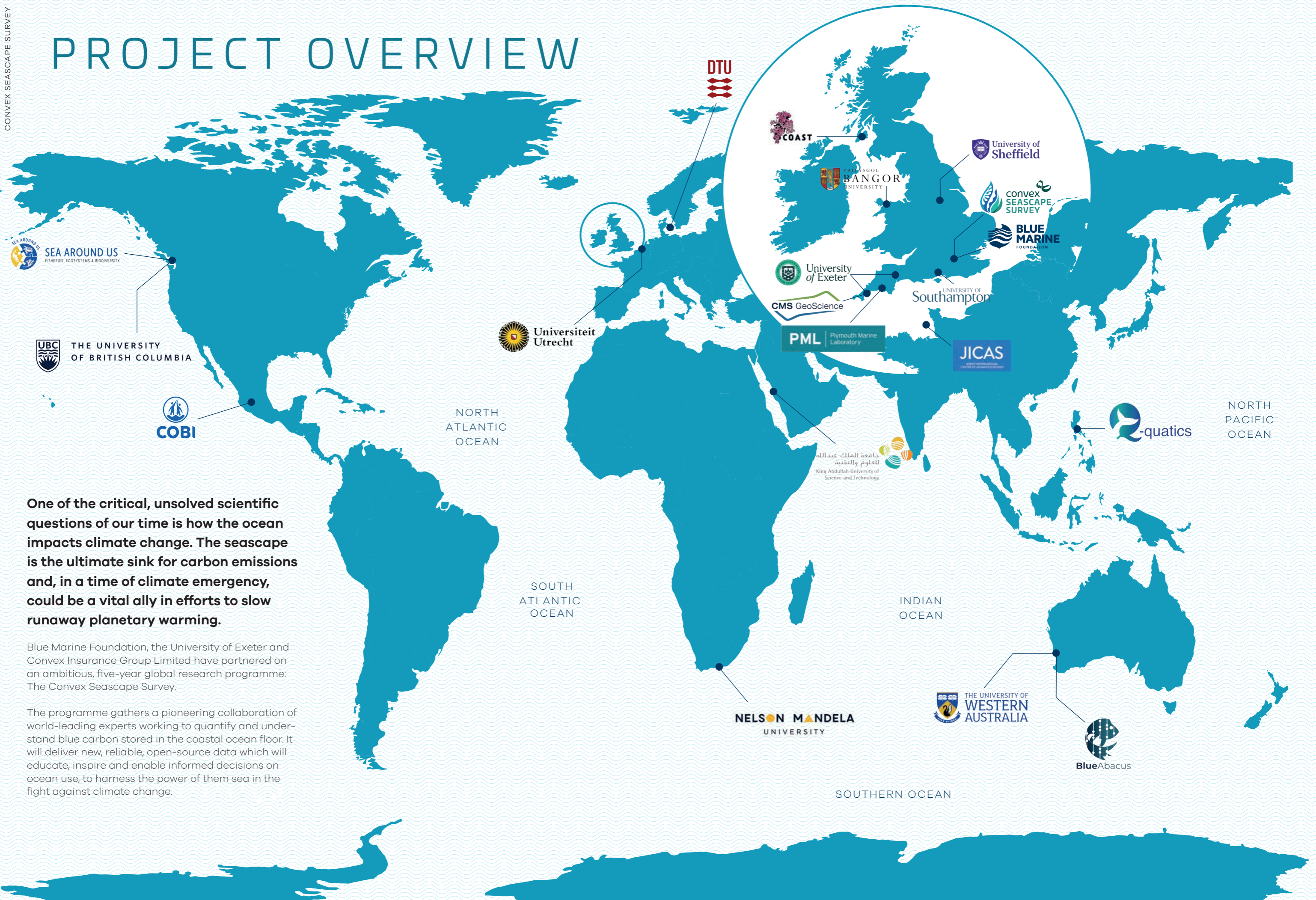
this, is increasingly the narrative at climate conventions. David Attenborough puts it very simply in his film, 'If we save the sea, we save our world'.

Thank you for your continued support and interest in our work.



Stephen Catlin, Executive Chairman
Convex Group Limited

PROJECT OVERVIEW



One of the critical, unsolved scientific questions of our time is how the ocean impacts climate change. The seascape is the ultimate sink for carbon emissions and, in a time of climate emergency, could be a vital ally in efforts to slow runaway planetary warming.

Blue Marine Foundation, the University of Exeter and Convex Insurance Group Limited have partnered on an ambitious, five-year global research programme: The Convex Seascape Survey.

The programme gathers a pioneering collaboration of world-leading experts working to quantify and understand blue carbon stored in the coastal ocean floor. It will deliver new, reliable, open-source data which will educate, inspire and enable informed decisions on ocean use, to harness the power of them sea in the fight against climate change.

KEY SCIENTIFIC QUESTIONS

OBJECTIVES WHAT WE WANT TO FIND OUT

Seascape carbon – where is it, how and when did it get there and where did it come from?

We will identify the origins of carbon on the world’s continental shelves and explore how it has accumulated and altered over time, discover where the biggest stores are found, molecularly fingerprint where they came from, and put the size of these carbon stores into context in the global carbon cycle.

The historical impact and spread of human influences on the seabed.

We will map the spread of multiple different human activities disturbing the seabed over two and a half centuries to the present day. By overlaying disturbance maps with our maps of the distribution of carbon in the seascape, and experimental measures of the consequences of bottom disturbance in the field and laboratory, we will identify historic and contemporary patterns of human influence on blue carbon and determine its vulnerability to loss and re-release to the ocean and atmosphere. We will thereby make quantitative links between human pressures on the seascape and their impact on carbon dioxide emissions and identify potential management options to slow climate change.

The role of life and biodiversity on seascape carbon stores and benefits of protection.

We will study and monitor the effects on wildlife and habitats of protection from seabed-disturbing human influences at multiple representative locations worldwide. We will measure how long it takes for carbon capture and burial to recover following protection and quantify the complementary benefits of protected areas to wildlife and people, in terms of ecosystem services, economic benefit and increased human wellbeing.

OUTCOMES WHAT WE ARE GOING TO ACHIEVE

We will gather, and make publicly accessible, high-quality data on seascape blue carbon. We will bring understanding and transparency to the capacity of the ocean as a carbon sink – which will support the vital value of a protected seascape and create a lasting legacy.

We will educate young people, the general public, governments and decision-makers in the UN climate change process and engage them in the immense value of a vibrant, living ocean.

We will develop a communication and education programme to raise global awareness and press coverage around this extraordinary story.

While this survey is all about the gathering of data, success could result in the proper integration of the ocean into political efforts to slow and stabilise climate change.

HOW IS THIS WORK UNIQUE?

At the outset of this project, we were aware of other nascent investigative work in the area of continental shelf sediment carbon, and we are delighted that interest in this topic has grown over the past three years. The interdisciplinary depth, global scale and broad scope of the Convex Seascape Survey places us in a unique position, and we’re proud to work closely with many partner organisations and scientists. In the past year, our team has to helped initiate one of two upcoming Natural Environment Research Council projects on sediment carbon and we hope to collaborate with researchers from both. www.ukri.org/councils/nerc/

WORK PROGRAMMES

WORK PROGRAMME ONE: THE WHERE, WHEN, HOW AND WHAT OF BLUE CARBON IN THE SEASCAPE

Understanding seabed carbon deposition and accumulation through history and into the future.

- Task 1.1:** Data mining and synthesis.
- Task 1.2:** Oceanographic modelling to predict carbon accumulation.
- Task 1.3:** Field research.
- Task 1.4:** Tracing the origins of blue carbon inputs to the seabed carbon sink.
- Task 1.5:** Placing sediment carbon into context of global carbon.

WORK PROGRAMME TWO: HUMAN INFLUENCES ON SEASCAPE CARBON

The recent period of human global influence and domination of the planet has come to be known as the Anthropocene. In programme two we will explore the Anthropocene Seabed, documenting how human influence has grown in the ocean and shaped the seascape.

- Task 2.1:** Historical development and spread of human influences on the seabed.
- Task 2.2:** Contemporary intensity and distribution of bottom disturbance by human activities.
- Task 2.3:** Where are the world’s remaining areas of pristine/intact seabed habitat?
- Tasks 2.4 – 2.6:** The importance of sediment carbon and the impact of seabed disturbance.
- Task 2.4:** Viewing the impact of seascape disturbance from space.
- Task 2.5:** Measuring the impact of trawling on sediment and animals from within the water.
- Task 2.6:** Quantifying the global impact of seascape disturbance on sedimentary and atmospheric carbon.

WORK PROGRAMME THREE: LIFE AND BIODIVERSITY EFFECTS ON BLUE CARBON CAPTURE AND BURIAL, AND BENEFITS OF PROTECTION

Understanding how seascape protection recovers wildlife, rebuilds habitats, restores their blue carbon values and delivers wider economic and wellbeing benefits to human society.

- Task 3.1:** Monitoring and measuring uptake of carbon by seabed habitats and recovery of carbon stocks after protection.
- Task 3.2:** Laboratory mesocosm experiments.
- Task 3.3:** Evaluating the co-benefits of seabed protection from human impacts on wildlife and ecosystem services.
- Task 3.4:** Economic values of protection.
- Task 3.5:** Measuring, monitoring and minimising the project’s carbon and environmental footprint.

WORK PROGRAMME FOUR: COMMUNICATIONS, EDUCATION AND OUTREACH

Communicating and helping the public visualise this project is key to its success. Work programme four will showcase scientific findings and project progress through media and live education outreach sessions.

- Task 4.1:** Development of communications plan and assets.
- Task 4.2:** Development and creation of digital platform.
- Task 4.3:** Deliver outreach.
- Task 4.4:** Secure exclusive programme media partners.
- Task 4.5:** Conduct press campaigns with announcements.
- Task 4.6:** Promote conclusive results to create a legacy.

UN SUSTAINABLE DEVELOPMENT GOALS (SDGs):

The project contributes to a broad range of the UN SDGs. Of these, we make the most substantive contribution towards realising the following seven:

1 NO POVERTY

2 ZERO HUNGER

3 GOOD HEALTH AND WELL-BEING

4 QUALITY EDUCATION

5 GENDER EQUALITY

6 CLEAN WATER AND SANITATION

7 AFFORDABLE AND CLEAN ENERGY

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

17 PARTNERSHIPS FOR THE GOALS

Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Goal 5. Achieve gender equality and empower all women and girls

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Goal 9.5 Enhance scientific research and 9.c Significantly increase access to information and communications technology

Goal 13. Take urgent action to combat climate change and its impacts

Goal 14. Life Below Water

Goal 17.6 Enhance NorthSouth, SouthSouth and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing

Hauraki Gulf New Zealand Photo: George Duffield

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TIMELINE OF PROGRESS
2024-2025

April
2024

- Interactive data tool PALTIDE published
- Project poster exhibited at UN Ocean Decade conference, Barcelona, Spain
- Press article in The Times
- Project presented at Blue Marine Foundation showcase event, London, UK
- Presentation at European Geosciences Union, Vienna, Austria

June
2024

- Fieldwork in Jersey
- 'Chris Levine art installation, 7.83 Hertz, unveiled
- Project-linked art workshop lead by Naomi Hart
- Presentation at the Oceans Past X conference, Exeter, UK
- Presentation at WGFTFB 2024 (Working Group on Fishing Technology and Fish Behaviour), Canada

September
2024

- Lair of the Sea Worm art exhibition, University of Exeter
- Project-linked art workshop lead by Naomi Hart
- New York Climate Week event

November
2024

- COP29, Baku, Azerbaijan
- Live Lesson: 'COP & Climate Science'
- PwC Insurance Summit, Bermuda
- Hauraki Gulf fieldwork, New Zealand
- Key stage 2 resources win Teach Award.
- New paper reanalyses ocean CO2 data
- Virtual presentation at the European Physical Oceanography and Shelf Sea Seminar Series

January
2025

- Antarctic fieldwork

March
2025

- Live Lesson: 'Can whales change the climate?'
- Live Lesson: 'CSI Seabed'
- Project communications away days, University of Exeter campuses
- UK Blue Carbon Forum online presentation
- New paper accepted on hydrodynamic tide models
- New paper accepted on variations in fishing gear
- New paper accepted on fish bioturbation

May
2024

- Media dinner, London, UK
- Presentations to the Convex board and Bermuda Underwater Exploration Institute
- Presentation at the European Space Agency Ocean Salinity Workshop in the Netherlands.

July
2024

- Team Science Discussion Days, Windsor, UK

August
2024

- Fieldwork in Jersey
- Guardian coverage about sea worms
- Convex Seascape Survey Advisory Group meeting

October
2024

- Academic writing workshop, Devon, UK
- Knowledge Exchange Awards
- Fishmongers Hall project showcase
- New European Oyster Reefs paper
- Guardian and BBC coverage for oyster reefs study
- New drone imaging methodology published

December
2024

- Hauraki Gulf fieldwork, New Zealand
- School workshops, West Bengal, India
- New paper on air-sea exchange

February
2025

- Project visit from Professor Gideon Henderson, Defra Chief Scientific Advisor
- Convex kids' day, London, UK
- Convex Seascape Survey Advisory Group meeting



EXECUTIVE SUMMARY

As the third year of the Convex Seascape Survey draws to a close, we're at an exciting intersection where model refinement, fieldwork, and data analyses continue apace, but we also begin to see the fruits of our labour as the first of our papers are published. These early manuscripts on drone imaging methodology, historical oyster reefs, and the air-sea exchange of carbon, set an exciting path for a flurry of burgeoning results in year four. As our research progresses, the survey's profile also grows, with frequent coverage in top-tier publications and over 750,000 learners engaging with our education programme to date, all building awareness of the ocean as our greatest climate ally.

Jersey **Photo:** Francesca Page

SCIENTIFIC MILESTONES

A further eight papers passed peer-review and were accepted for publication. And crucially, we shared our work more widely with academic peers and the wider blue carbon community with presentations at events like the European Geosciences Union General Assembly in Austria, the Ocean Decade Conference in Barcelona and the UK Blue Carbon Forum. Links with other experts working in this space have been strengthened to foster greater knowledge sharing and consensus-building in this emerging field of research. Members of our Scientific Advisory Group continue to validate the survey's direction and generously provide strategic guidance to help ensure the survey has the greatest possible impact.

Field expeditions to Jersey and New Zealand collected crucial data to support our investigations into the origins of the carbon in the seabed and the impact of human disturbance. Meanwhile, fieldwork in Antarctica sought to define the contribution of great whale populations on carbon sequestration in the ocean. Further fieldwork in Millport, Scotland, generated interesting results adding new information to what we understand about the role of benthic invertebrates in organic carbon movement within the seabed. Teams are now looking ahead to further exciting fieldwork campaigns in Canada, South Africa, Australia and Brazil.

NEW PUBLICATIONS THIS YEAR

Mara Fischer et al. 2025. <i>A functional assessment of fish as bioturbators and their vulnerability to local extinction</i> . Marine Environmental Research.	This paper highlights the significant and previously underappreciated role of fish as bioturbators in benthic ecosystems and presents the first systematic approach to assess fish bioturbation impact on the seabed based on ecological traits.
Sophie L. Ward et al. 2025. <i>The role of long-term hydrodynamic evolution in the accumulation and preservation of organic carbon-rich shelf sea deposits</i> . Journal of Geophysical Research: Oceans	This study examines how fine, muddy carbon-rich sediment deposits on the northwest European shelf seas may have formed over millennial timescales. These findings are crucial for informing strategies to manage and protect organic carbon stored in seabed sediments.
Mollie Rickwood et al. 2025. <i>Regional variation in active bottom-contacting gear footprints</i> . Fish and Fisheries.	This paper examines the global distribution of bottom contacting fishing gear parameters reported in the scientific literature and found there is little information for areas outside of Europe. This could be leading to under-estimates of global ‘swept area’ or seabed disturbance.
Hermann W. Bange et al. 2024. <i>Advances in understanding of air-sea exchange and cycling of greenhouse gases in the upper ocean</i> . Elementa: Science of the Anthropocene.	The air–sea exchange and oceanic cycling of greenhouse gases are fundamental in controlling the evolution of the Earth’s atmospheric chemistry and climate. This review paper calls for a comprehensive, coordinated and interdisciplinary approach to advancing this area of science.
Ruth H. Thurstan et al. 2024. <i>Records reveal the vast historical extent of European oyster reef ecosystems</i> . Nature Sustainability.	Using the IUCN Red List of Ecosystems Framework, this paper concludes the European native oyster reef ecosystem type is collapsed under three of five criteria and this assessment has important implications for conservation policy and future action.
Philine. S. E. zu Ermgassen et al. 2024. <i>European native oyster reef ecosystems are universally collapsed</i> . Conservation Letters.	The analysis in this paper collated >1,600 records published over 350 years and created an extraordinary map of historical oyster reef presence, demonstrating that these biogenic reef ecosystems once dominated European coastlines.
Daniel J. Ford et al. 2024. <i>A comprehensive analysis of air-sea CO2 flux uncertainties constructed from surface ocean data products</i> . Global Biogeochemical Cycles.	This paper describes a framework to calculate standard uncertainty budgets for air-sea CO2 flux data that considers all known sources of uncertainty. The results are a significant step forward in approaches for quantifying the ocean carbon sink.
Jennifer Watts et al. 2024. <i>Georectifying drone image data over water surfaces without fixed ground control: Methodology, uncertainty assessment and application over an estuarine environment</i> . Estuarine, Coastal and Shelf Science.	This paper presents an open-source workflow for georectifying drone image data. This novel method is suitable for use over water surfaces where there are no fixed points. Potential uses are widespread and include the evaluation of sediment disturbance via trawling activity.



Hauraki Gulf New Zealand Photo: George Duffield

“
This year we secured
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”

Alongside our scientific work, we continued to share the Convex Seascape Survey across multiple platforms and with varied audiences. This year we secured 144 press articles with an estimated reach of 629.4m people, and our work was featured in 20 national titles including the BBC, The Guardian and The Sunday Times. Taking a fresh approach to our social media channels, we’ve also grown followers across all platforms by 47%.

Some of this press coverage featured our artist collaborations, which bring the work of the survey to the attention of the wider public. This year, artist in residence, Naomi Hart, engaged nearly 59,000 people with her work inspired by the creatures residing in the benthic zone; while multidisciplinary light artist, Chris Levine, unveiled his immersive laser piece ‘783 Hertz’ for World Ocean Day in June.

Our education programme won the Best Free Primary Resource accolade for our Key Stage 2 resource pack at the Tech Primary Awards 2024 and our popular lives lessons attracted over 24,70 learners from 29 countries. We also adopted a new approach for our education programme, delivering continued professional development workshops for 76 teachers from 43 schools. These very well received sessions targeted primary schools identified as needing extra support with the science curriculum. They helped to build teacher knowledge and confidence, while also providing lesson ideas and resources.

The report that follows shows our progress across the major programme pillars in the third year of project delivery and describes our main objectives moving forward. We hope you enjoy reading about our quest to quantify seascape carbon in this pioneering five-year project.

IMPACT

SOCIAL MEDIA

1,290,296

REACH

797,462

VIEWS

47%

FOLLOWER
INCREASE

PR

144 ARTICLES

20

NATIONAL
TITLES

629.4m

TOTAL REACH

OUTREACH

ART 59,000 People

reached by artist
in residence
Naomi Hart

PRESENTATIONS, PANELS AND POSTER SESSIONS

OVER
23,500
ATTENDEES

Out of the Blue, UK | UN Ocean Decade Confernce, Spain | Media Dinner, UK | Bermuda Underwater Exploration Institute, Bermuda | NY Climate Week, USA | Fishmongers Hall, UK | PwC Insurance Summit, Bermuda | UK Blue Carbon Forum, UK | European Geosciences Union, Austria | Oceans Past X, UK | European Physical Oceanography and Shelf Sea Seminar Series, virtual | Dawin Global 200 voyage | European Space Agency Ocean Salinity Workshop, Netherlands | Working Group on Fishing Technology and Fish Behaviour (WGFTFB), Canada

EDUCATION

TOTAL POTENTIAL STUDENT REACH

729,858

76 teachers attended continued professional development training sessions.

29 NEW KEY STAGE 2-4
LESSONS CREATED

TESTIMONIALS

"It really cleared up my misconceptions around climate and has given me ideas about how to incorporate it into the curriculum"

Anonymous teacher CPD session feedback

"Fantastic, the doctors from Exeter University were amazing and so informative at just the right level for children."

Anonymous teacher live lesson feedback

3X LIVE
LESSONS

WATCHED BY

24,710

LEARNERS FROM
29 COUNTRIES

Australia, Belgium, Brazil, Canada, China, Egypt, Germany, Greece, Guernsey, India, Japan, Malawi, Malaysia, Mauritius, Mexico, Netherlands, New Zealand, Nigeria, Poland, Portugal, Qatar, Saudi Arabia, Spain, Switzerland, Turkey, Uganda, United Arab Emirates, United Kingdom, and the United States of America.



GRANT MANAGEMENT AND UNIVERSITY MANAGEMENT

Blue Marine Foundation is the grant recipient, with overall responsibility for ensuring the effective and timely delivery of the five-year programme and with ultimate responsibility for managing the budget. Blue Marine is well aligned with Convex Insurance, as an agile, effective and extremely well-regarded conservation organisation that is enviably globally networked. We have a great track record of delivering multi-partner projects of scale and especially of delivering public private partnerships. This is Blue's largest project to date, and it is our role to ensure real-world significance of the project and best reach of the data that we gather.

The University of Exeter, a member of the Russell Group of universities, has responsibility for overseeing the science and research function of the project. The Research Management Group, under the guidance of Professor Callum Roberts oversees the delivery of world-leading results and all coordination with the partners of the scientific consortium.

Photo: Matt Jarvis

ADVISORY BOARD REMIT AND MEMBERSHIP

Blue Marine manages an Advisory Group to provide strategic guidance over the lifetime of the Convex Seascape Survey. This includes members; authenticating the science, sharing their knowledge and networks, as well as providing advice to identify any gaps, shifts, new research, technologies or collaborations, that the research and project teams may need to consider.



Dr Trisha Atwood, Associate Professor at Utah State University and National Academies of Sciences Gulf Research. Early Career Fellow with expertise in quantifying marine sediment carbon



Professor Bill Austin, St Andrews University, Scotland, current chair of the Scottish Carbon Forum and lead of the UN's Global Ocean Decade Programme on Blue Carbon (GOBC)



Steve Crooks, Partner, Silvestrum Associates, experienced wetland scientist in the response of coastal wetland systems to human impacts and climate change and the translation of this into effective policy



Professor Michael Depledge (Chair) – expert in oceans and human health and government advisor on chemical pollution



Professor Hilary Kennedy, Biochemist and person responsible for getting coastal ecosystems recognised for their importance for storing carbon and mitigating climate change



Dr Ruth Parker, Centre for Environment, Fisheries and Aquaculture Science. Shelf sea biogeochemist and UK policy expert



Loreley Picourt, A strong advocate for multilateral cooperation, she works for a better integration of the ocean-climate-biodiversity nexus in decision making at the national and international levels



Dr Torsten Thiele, is an expert in sustainable blue finance and founder of Global Ocean Trust

ROLES AND RESPONSIBILITY

Responsibility	Blue Marine Foundation	University of Exeter	Convex Group Ltd	Consortium partners
FINANCE	Grant recipients: overall financial responsibility; overseeing research spend, delivering outreach package	Regrant from BMF for research elements; management of research partner budgets and equipment	Project supporter and oversight. Ensuring BMF is managing budget	Specific research task agreements
PROJECT	Overall responsibility for delivering the programme on time and on budget, managing Exeter	Overall Responsibility for delivery of scientific aims and objectives of the project, managing delivery partners, data collection, sample management	Overview project	Specific research tasks delivery
PROJECT	Reporting to Steering Committee; Managing Project Advisory Board	Reporting to BMF; Managing Research Management Group and consortium	Project overview; Chairing Steering Committee	Managing specific research staff in delivery of tasks
PROJECT	Ensuring project is represented on world stage e.g., COP, United Nations OceanClimate Platform	Ensuring results are represented on world stage; representing project to global research community	Identifying opportunities for project on world stage and B2B groups	Presenting specific research task results
DATA	Overall responsibility for data management and reach	Ensuring collection and quality of the data. Peer to peer dissemination	Identifying opportunities to share data	Collection, quality and dissemination of specific data relating to tasks
PROJECT	Horizon scanning research and policy opportunities	Horizon scanning research and policy opportunities	Horizon scanning business best practise opportunities	Connecting Project to existing networks
NETWORKS	Project overview forums e.g., United Nations (OcanClimate, GOBC, UK Blue Carbon Forum, Verra Ocean Forum, DEFRA Carbon Monitoring Project	Research networks and opportunities for collaboration such as Sea Around Us Project, University of Western Australia	Commercial and business networks such as marine underwriters	Specific research networks
OUTREACH	Overall responsibility for outreach with an ambition of 5m school children and billions of opportunities to see. Managing digital and education delivery partners. All press and media production	Delivering education and press content.	B2B and industry sector outreach. Additional opportunities such as Pacific Ocean Row	Additional outreach opportunities

Responsibility	Blue Marine Foundation	University of Exeter	Convex Group Ltd	Consortium partners
TECHNOLOGY	Tech partner scoping such as Moonshot, Google X, Tidal X	Consideration of application of new tech opportunities	Identification of tech opportunities for project team to scope	
PARTNERS	Scoping and relationship management of general project and commercial partners e.g., United Nations groups, Fugro, OceanX	Scoping and delivery of research and data collection specific partnerships e.g., Sea Around Us Project, OceanXplorer, Quest	Connecting project to existing networks and previous Catlin Research Projects and Convex affiliations e.g., Biological Institute of Ocean Science, Bermudan School Network, SeaView	Management of delivery specific project partners e.g.,research vessels, labs etc
CAPACITY BUILDING	Collaboration and best practise in blue carbon science, facilitating knowledge sharing and delivering workshop events	Representing project at research forums, peer to peer knowledge transfer Identifying Blue Carbon expertise in developing world, due diligence and delivery with local institution partners e.g., Nelson Mandela University, SA, CADICConicet, Argentina Training the next generation of blue carbon scientists in the UK and beyond	Blue carbon knowledge, blue economy expertise amongst networks.	Inputting expertise into Project planning and delivery thereby increasing seascape carbon expertise globally
EQUIPMENT	Identifying legacy opportunities	Procurement, storage and deployment of general project equipment e.g., carbon analyser, bioturbation tanks etc. Ensuring equipment use after the project	Identifying legacy opportunities	Design, procurement and deployment of specific project equipment e.g. trawl monitoring rig
SAMPLE COLLECTION	Identifying opportunities for collaboration and financial savings e.g. Fugro, OceanX	All sample handling, storage and logistics permits etc		Task specific sample management

WORK PACKAGE ONE:

Seascape carbon – where is it, how and when did it get there and where did it come from?

Workstream Objective: We will identify the origins of carbon on the world’s continental shelves and explore how it has accumulated and altered over time, discover where the biggest stores are found and put their size into context within the global carbon cycle.

Workstream Lead:
University of Exeter

Workstream timeline:
July 2022 – June 2027



Key achievements over the year

- In June 2024 through a collaboration with geotechnical company, CMS GeoScience, our team collected sediment cores from more than 60 locations throughout Jersey’s waters. Identifying the sources of blue carbon inputs to the seabed is vital, and to this end the team performed eDNA sequencing in-situ in a small dockside molecular laboratory. Our academics are now working on this material back in our carbon lab at Exeter University, to untangle environmental and anthropogenic influences on carbon burial.
- A new research paper has been accepted by the Journal of Geophysical Research: Oceans, which considers how fine, muddy carbon-rich sediment deposits on the northwest European shelf seas may have formed over millennial timescales. These findings are crucial for informing strategies to manage and protect organic carbon stored in seabed sediments.
- The reactivity of organic matter controls its degradation, preservation and burial in marine sediments. With advice from experts in our Advisory Group, the project now incorporates Thermogravimetric Analysis on sediment samples to capture this information.
- An expedition to The Hauraki Gulf in New Zealand resulted in the successful collection, shipping, and cold storage of 42 sediment cores to be analysed as part of investigations into the origins of the carbon in the seabed. There has been good progress so far in geochronology and biomolecular analyses of this material.
- A sampling campaign on the Antarctic shelf was completed by academics looking to identify the contribution of microalgae to carbon sequestration in the region as well as gain insight into the contribution of great whales to supporting the carbon cycle in the ocean.
- Using a groundbreaking observation-driven approach we have estimated annual cross-shelf carbon exchange, which has formed the basis of a new research paper currently being prepared for submission. The method has been applied to the northwest European shelf and the Mid Atlantic Bight, and this work represents a crucial step towards enabling regional and global carbon budgets to be better constrained.

Key challenges

Challenge	Mitigation
The proposal for sampling in Malaysian waters (Sunda shelf) was rejected by OceanX based on the work not fitting into pre-existing research permits.	Our team are exploring alternatives to access samples from the Sunda shelf or other geologically/ environmentally similar locations e.g. a submission has been made to the SeaKeepers DISCOVERY Yacht Program portal .
Legacy cores held in the Lamont Doherty repository were found to suffer from age-related degradation and were not useable for the intended analysis.	Instead, the team will use existing quantitative and qualitative grain size data (already collated) alongside the models developed as part of this workstream.
Obtaining reliable dating data for samples under the eDNA analysis protocol has been challenging. The University of Exeter internal facility does not currently have the expertise and external labs are expensive, with long waiting lists.	The ideal solution is to increase capacity at the internal facility. The team are looking into this and weighing it up against options for external lab services.



LOOKING AHEAD TO YEAR FOUR

- WP1.3** A Fladen Ground manuscript will shortly be submitted to the journal Marine Geology. Sediment samples have also been sourced from a mud basin on the north Icelandic Shelf for a new study investigating temporal variability in the accumulation rate of carbon, in relation to changing environmental conditions. And planning continues for a fieldwork visit to the Brazilian Shelf to collect cores for further similar investigations.

WP1.5 The cross-shelf flow methodology will be finalised, the manuscript circulated for broader co-author feedback, and the findings integrated into the regional carbon budgets.
- WP1.4** Researchers continue to process samples collected from Jersey, New Zealand and Antarctica to understand the biological inputs to seabed carbon across these regions. Key priorities will be to complete geochronological analyses, while refining microbial biomass methodologies. Planning will also continue for a potential polar region expedition and securing logistical support for this trip.

WP1.5 The Patagonian Shelf budget will be completed, providing proof of concept for further carbon budget models for other shelf seas. An abstract based on this work has been accepted for presentation at the European Space Agency Living Planet Symposium in June 2025.

WORK PACKAGE TWO:

The historical impact and spread of human influences on the seabed

Workstream Objective: We will uncover historic and contemporary patterns of human influence on shelf sea carbon and determine its vulnerability to re-release into the atmosphere as a consequence of disturbance by bottom-towed fishing.

Workstream Lead:
University of Exeter

Workstream timeline:
April 2022 – June 2027

Figure from published paper Rickwood et al 2025 Regional Variation in Active Bottom-Contacting Gear Footprints

Key achievements for the year

- A new research paper was accepted by the journal Fish and Fisheries which describes regional variation in active bottom-contacting gear footprints. These findings challenge the reliability of previous estimates of the global footprint of bottom trawling gears, thus highlighting the urgent need for improved availability of commercial data.
- Significant progress has been made developing a global database of trawling fleets which describe the number, type, size, and fishing power of bottom trawlers across the globe for the period up to 1950. This is being done to complement other data from the Sea Around Us database that covers the post-1950 period.
- A detailed case-study describing the origins, rise, and spread of bottom trawling in UK and Irish waters is being developed. The study gathers data from a series of historical government enquiries and accounts to describe the emergence of the bottom trawling industry.
- Data analysis is complete for a study investigating the effects of port dredging and seabed aggregate mining on carbon deposits in European waters.
- Academics have been granted access by Global Fishing Watch to use a preliminary version of their trawling dataset that disaggregates bottom and mid-water trawling, a crucial distinction for mapping seabed disturbance.
- Researchers successfully implemented the trawling disturbance component within a benthic-pelagic biogeochemical model. They are now adapting it for two locations on the northwestern European Shelf and preparing it for validation.
- New research paper 'Georectifying drone image data over water surfaces without fixed ground control: methodology, uncertainty assessment and application over an estuarine environment' was accepted by the journal Estuarine, Coastal and Shelf Science. The paper describes the method that we will next apply to drone footage to understand levels of sediment disturbance caused by trawling.

Key challenges

Challenge	Mitigation
Significant delays on the trawling experiment due to slow manufacturing of novel rig system, methodological challenges, issues working with trawlerman and vessel availability.	Working closely with partners to redesign the experiment and find solutions e.g. alternative vessel options.
The above challenge is having knock on effects on other workstreams e.g. testing drone sampling methodology to estimate sediment resuspension from aerial imagery is now also delayed as it relies on above trawl experiment.	A field plan and risk assessment has been completed for UK-based drone fieldwork, allowing for rapid mobilisation once timings are confirmed. There is also a contingency plan for a local experimental set-up if needed.
The fishing industry survey, distributed via the Working Group of Fish Behaviour and Fish Technology received few responses.	The team are redesigning the survey and finding ways to increase accessibility.
Obtaining historical trawl data from certain data-poor countries has proved challenging.	Established a Historical Trawling network with in-country collaborators and continued workshops will further facilitate collaboration.



LOOKING AHEAD TO YEAR FOUR

- 2.1

Data analysis and mapping continues for the study exploring the origins, rise and spread of the trawling industry in UK and Irish waters, with a draft research paper expected in the coming months. The preliminary findings will be presented at the One Ocean Science Congress in Nice on June 4th.
- 2.2

Academics will be preparing for our upcoming session at the Working Group on Fish Technology and Fish Behaviour (WGFTFB) annual meeting in Sicily (May 2025), investigating areas of uncertainty amongst global fishing gear parameters.
- 2.4

Remote sensing techniques will be deployed at the time of the below trawling experiment.
- 2.5

If challenges are resolved, sampling will take place in spring and early summer 2025 to collect data on the impacts of trawling on the seabed.
- 2.6

Finalising the improvements identified in the biogeochemical model to ensure the processes of interest are accurately represented, completing the parameter tuning framework, and adapting the model to the selected location.

WORK PACKAGE THREE:

The role of life and biodiversity on seascape carbon stores and benefits of ocean protection

Workstream Objective: We will measure how marine life influences carbon burial and storage, how long it takes for carbon uptake to recover when the seabed is protected and quantify the complementary benefits to wildlife and people.

Workstream Lead:
University of Exeter

Workstream timeline:
April 2022 – June 2027



Hauraki Gulf New Zealand Photo: Ben Sarten

Key achievements for the year

- Academics looking at carbon dynamics across a gradient of disturbance, across both pristine and damaged sites, successfully recovered cores from around Jersey's coastline, including via SCUBA diving. They also collected seabed video and image data, as well as infauna samples.
- The same team, collaborating with researchers in work package one, also completed a fieldwork campaign throughout the Hauraki Gulf in New Zealand where they gathered 46 well preserved sediment cores using an adapted miniature vibrocorer.
- Plans have been finalised for fieldwork in the Saguenay Fjord, Canada, to investigate how changes in biodiversity alter the cycling of nutrients and carbon in the seabed.
- Follow-up mesocosm experiments were conducted in Millport, Scotland, successfully tracking particulate organic carbon using a naturally occurring isotope of carbon (carbon-13) and producing 1500 samples to be analysed in the Mass spectrometry facility.
- Our partners at KAUST in Saudi Arabia have begun unravelling the role of great whales in ocean productivity and carbon sequestration, after a recent expedition to the Western Antarctic peninsula to collect a series of cores.



Hauraki Gulf New Zealand Photo: George Duffield

Key challenges

Challenge	Mitigation
Collecting samples in Jersey is challenging due to large tidal range and strong winds.	Worked with local partners on the ground (Government of Jersey Marine Resources) who aided in practical support and guidance.
The South Africa activity has been delayed by problems with team member health and visas.	New postdoc now appointed and we are in discussions to establish the most useful and feasible sampling plan for this region.
Obtaining permissions and permits for lots of different sampling techniques and collection of biological samples.	Working with local partners to access laboratories in country for sample processing and analysis e.g. New Zealand.

LOOKING AHEAD TO YEAR FOUR

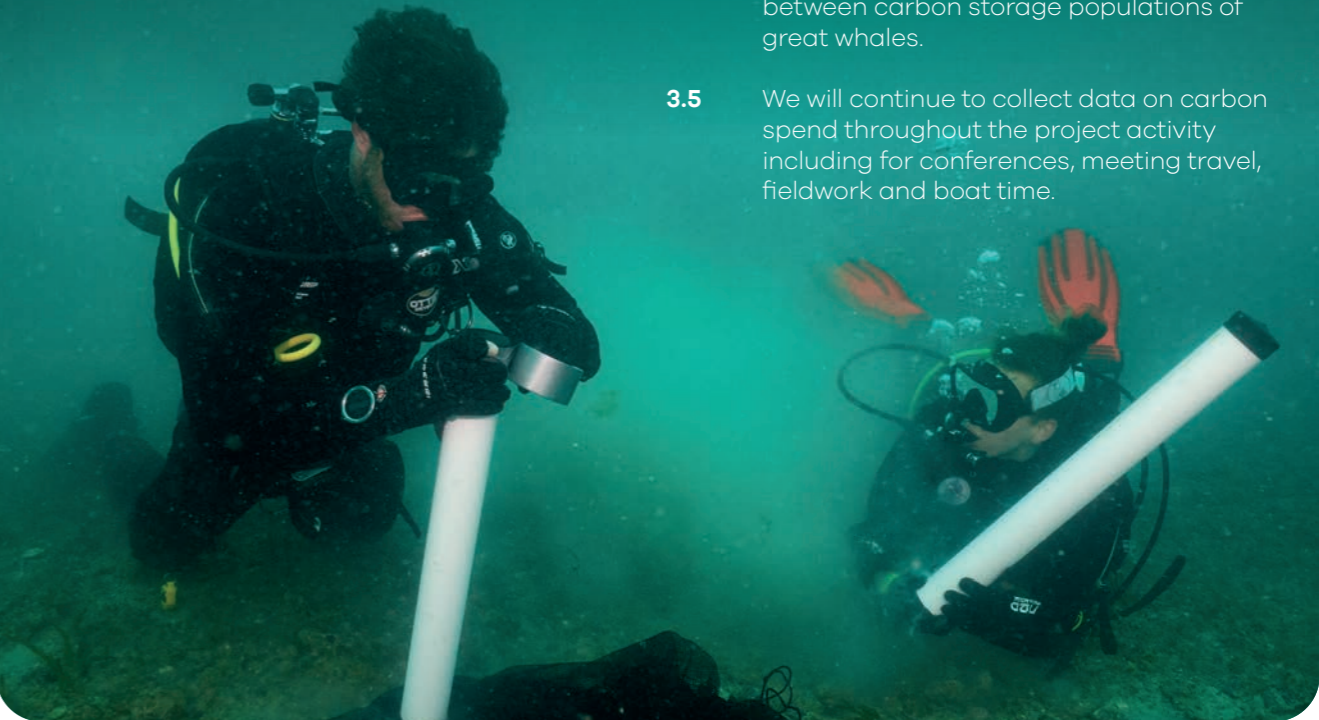
- 3.1** Processing ROV data collected from Jersey and New Zealand describing the differences in epifaunal communities across gradients of disturbance.

3.2 In August 2025 academics from the Universities of Exeter and Southampton will deploy to Saguenay Fjord, Canada, to collect benthic invertebrates using grab samples for mesocosm incubation in the lab.
- 3.3** Researchers are currently discussing more field sampling opportunities with a research group from the University of Western Australia. The idea is to evaluate the impact of de facto protection afforded by oil rigs in the East Indian Ocean.

3.3 At Nelson Mandela University our Postdoctoral researcher will be catching up on planned activity in South Africa now that he is in post. The KAUST team in Saudi Arabia will begin processing their sediment cores and exploring links between carbon storage populations of great whales.

3.5 We will continue to collect data on carbon spend throughout the project activity including for conferences, meeting travel, fieldwork and boat time.

Jersey Photo: Danny Copeland



WORK PACKAGE FOUR:

Communications, education and outreach

Workstream Objective: Working closely with Convex’s PR resources and Blue Marine’s own media connections, we will ensure global press and outreach opportunities are maximised around this exciting and inspiring project.

Workstream Lead:
Blue Marine Foundation

Workstream timeline:
April 2022 – June 2027

Key achievements for the year

- This year we shared our progress with over 23,000 people through presentations, panel events and posters, at events such as New York Climate Week, the UN Ocean Decade conference, the UK Blue Carbon Forum and the European Geosciences Union in Austria.
- Artist in residence Naomi Hart reached nearly 59,000 people with her work inspired by the Convex Seascape Survey and the underappreciated creatures residing in the benthic zone. She displayed her work at Exeter University, Falmouth Art gallery, Exeter’s Princesshay Shopping Centre and the Ocean Advocate Summit in Bristol, and her beautiful paintings of benthic invertebrates were featured in Oceanographic Magazine.
- Multidisciplinary light artist, Chris Levine, unveiled ‘7.83 Hertz’ for World Ocean Day in early June. The immersive piece uses patented ‘blipvert’, a laser line of light that allows images to be glimpsed in your peripheral vision, to submerge viewers in the benthic zone and its role in the health of our oceans.
- Our social media channels have gone from strength to strength this year, with followers across all channels growing by 47% and our reach increasing to 1,290,296 people. Our light-hearted but informative ‘how to use a vibrocorer’ reel was a surprise hit, receiving 60,957 views.
- Press coverage has been strong, with 144 articles securing a reach of 629.4m. Highlights included coverage of fish bioturbation in the BBC, pieces featuring Dr Ceri Lewis and her love of worms in The Guardian and The Sunday Times, and a stunning seven-page photo story covering our Jersey fieldwork in Oceanographic magazine.
- This year’s live lessons, delivered with our education partner EncounterEdu, were our most popular yet, attracting over 24,000 learners from 25 countries.



Artist Naomi Hart

Lessons focused on COP29 and how science and policy can work together to address climate change, the wonder of whales and their importance in the carbon cycle, and how eDNA analyses can help to inform blue carbon conservation strategies.

- We were thrilled to return to the Convex office in London to deliver a fun day of learning for more than sixty children, who discovered the role of whales in the ocean’s carbon cycle and carefully crafted their favourite species.
- Our Key Stage 2 Ocean Heroes resource, designed in collaboration with Encounter Edu, won Best Free Primary Resource at the Tech Primary Awards 2024.
- Working with the Primary Science Teaching Trust we have delivered continued professional development (CPD) workshops to 73 teachers from 43 primary schools identified as needing extra support with the science curriculum. We’re building teacher knowledge, providing lesson ideas, and supporting teachers to weave climate and ocean topics into the school day.

CONVEX SEASCAPE SURVEY MEDIA HIGHLIGHTS

144 ARTICLES with a reach of 629.4m



THE CRUCIAL ROLE OF COD AS ECOSYSTEM ENGINEERS

14 publications including BBC, Oceanographic, Daily Star

212m reach

DR CERI LEWIS IS OBSESSED WITH SEA WORMS

6 publications including The Guardian, Channel 4 & The Sunday Times

189m reach

GETTING TO THE CORE OF THE HAURAKI GULF

4 publications including New Zealand Herald

22.8m reach

SEABED SECRETS - JERSEY FIELDWORK

2 publications, Oceanographic Magazine & Vogue

10.6m reach

Key challenges

Challenge	Mitigation
The original budget did not include funds for attendance or sponsorship at global events such as COP or World Ocean Summit, nor did it allow for art-science collaborations.	New results have allowed academic teams to secure lots of conference opportunities this year without requiring sponsorship.

LOOKING AHEAD TO YEAR FOUR

- 4.1 We will continue to capture content showing our fieldwork in action, including upcoming work in Canada and Australia. As results emerge, we will present key methods and findings in easily digestible formats to facilitate understanding of our work.

4.3 Work will continue towards our goal of reaching five million students over the course of the project. Following the success of this year's CPD delivery, we will continue this programme as an effective and efficient way to grow our student reach and create long-lasting impact. We also look forward to broadcasting more live lessons in year four and delivering a new key stage one resource pack.
- 4.4 & 4.5 We will continue to work with our PR agency to ensure all opportunities are seized and the survey is covered by top tier media outlets. With the first published results now available, we will ensure these are disseminated widely.

4.6 With exciting results now emerging we have talks, poster presentations and panels planned at prestigious conferences in the coming year. These include the EGU Geoscience Conference, One Ocean Science Congress and the third UN Ocean conference. We will continue to identify further opportunities to share our findings.



The Lair of the Sea Worm
Photo Emily Appleton



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After living for nearly 100 years on
this planet, I now understand the
most important place on Earth is not
on land – but at sea...

If we save the sea, we save our world.

— SIR DAVID ATTENBOROUGH

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2025/26 OBJECTIVES

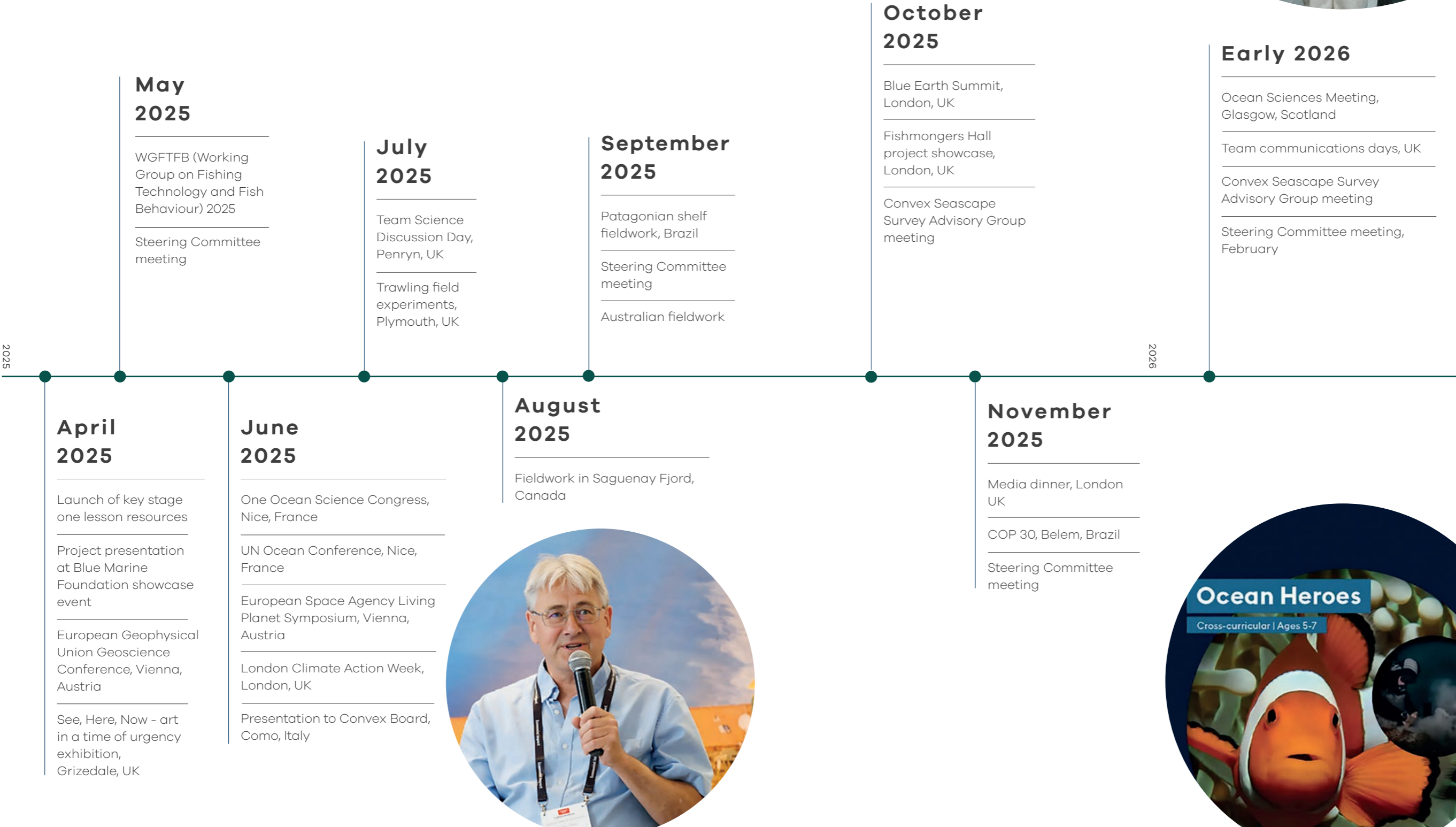
Support further presentation of the project on the global stage

Continued relationship building with overseas partners

Further fieldwork and data analyses across workstreams

Publication of project papers in top journals

Effective communication of new findings to varied audiences



PROGRESS TIMELINE

APPENDIX

WORK PACKAGE 1



Antarctica Photo: Diego Rivera Rosas

Task	Leads	Milestone				
		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Task 1.1: Data mining and synthesis - mapping of seabed topography, carbon accommodation space and prior sampling effort	<div><div></div> James Scourse</div> <div><div></div> Sophie Ward</div> <div><div></div> Sarah Bradley</div>					
Task 1.2: Oceanographic modelling to predict carbon accumulation - Hydrographic model development and application	<div><div></div> James Scourse</div> <div><div></div> Sophie Ward</div>					
Task 1.2: Oceanographic modelling to predict carbon accumulation - verification and refinement of hydrographic models of carbon burial based on field sample analyses	<div><div></div> James Scourse</div> <div><div></div> Sophie Ward</div>					
Task 1.2: Oceanographic modelling to predict carbon accumulation - projection of changes in carbon burial under future sea level rise	<div><div></div> James Scourse</div> <div><div></div> Sophie Ward</div>					
Task 1.3: Fieldwork - Identification of field sample sites and international project partners	<div><div></div> James Scourse</div> <div><div></div> Sophie Ward</div> <div><div></div> Sarah Bradley</div> <div><div></div> Zoe Roseby</div> <div><div></div> Torsa Sengupta</div>					
Task 1.3: Fieldwork – Collection of fresh core samples to verify insights from models and data mining, and resampling of previously collected cores kept in collections worldwide	<div><div></div> James Scourse</div> <div><div></div> Sophie Ward</div> <div><div></div> Sarah Bradley</div> <div><div></div> Zoe Roseby</div> <div><div></div> Torsa Sengupta</div>					
Task 1.4: Tracing the origins of blue carbon inputs to the seabed carbon sink - Analyses of samples for content and origin of buried carbon and testing.	<div><div></div> Dan Charman</div> <div><div></div> Rod Wilson</div> <div><div></div> Tom Roland</div> <div><div></div> Jack Middelburg</div> <div><div></div> Carlos Duarte</div>					
Task 1.5: Placing sediment carbon into context of global carbon - data mining to identify three shelf-seas to develop and apply an existing carbon budget model to	<div><div></div> Jamie Shutler</div>					
Task 1.5: Placing sediment carbon into context of global carbon - development of carbon budget models for the three identified shelf-seas	<div><div></div> Jamie Shutler</div>					

- University of Sheffield
- KAUST (King Abdullah University of Science and Technology)
- University of Southampton/NOC
- University of Utrecht
- Bangor University
- Plymouth Marine Laboratory
- University of Exeter

On track

Slow or delayed

Not yet started

Completed

Milestone/ Goal	Activities completed	Milestone changes			
Task 1.1: Data mining and synthesis- mapping of seabed topography, carbon accommodation space and prior sampling effort	Completed on schedule in September 2023.			Task 1.4: Tracing the origins of blue carbon inputs to the seabed carbon sink Analyses of samples for content and origin of buried carbon and testing	Researchers subsampled New Zealand cores, identified depths for radiocarbon (14C) dating, and planned geochronological strategy. eDNA subsampling was completed, and 210Pb dating is being trialled on samples from Jersey and New Zealand to refine methodology. Efforts to optimise microbial biomass methodology are ongoing and include exploring external labs for liquid Total Organic Carbon analysis. Fieldwork planning is also progressing, with a potential Arctic region expedition being explored, focusing on permafrost and coastal sediment interactions.
Task 1.2: Oceanographic modelling to predict carbon accumulation. Hydrographic model development and application	<p>The manuscript is titled: ‘The role of long-term hydrodynamic evolution in the accumulation and preservation of organic carbon-rich shelf sea deposits’ has been accepted for publication by the Journal of Geophysical Research: Oceans and is currently in production (Ward et al, 2025). The editor and reviewers were very complimentary, saying “this is a paleo-modelling work with important implications for blue carbon”.</p> <p>Sophie Ward has continued working on the hydrodynamic modelling of the Patagonia shelf. The outputs of the palaeotidal model have now been fully analysed. The model outputs are being compared with observed sediment data and the write-up is on-going.</p>			Task 1.5: Placing sediment carbon into context of global carbon. Data mining to identify three shelf seas to develop and apply an existing carbon budget model to	<p>Significant progress has been made on the carbon budgets for the North West European Shelf, the Mid-Atlantic Bight, and the Patagonian Shelf.</p> <p>An observation-based approach for estimating the cross-shelf exchange of carbon has been developed. These results represent the first fully open-source and observation driven approach to estimating annual cross-shelf exchange of carbon. This is a crucial step towards enabling regional and global carbon budgets to be better constrained.</p>
Task 1.3: Fieldwork <ul style="list-style-type: none">• Identification of field sample sites and international project partners• Collection of fresh core samples to verify insights from models and data mining, and resampling of previously collected cores kept in collections worldwide	<p>A manuscript ‘Evolution and vulnerability of blue carbon stocks in moribund mud basins: Fladen Ground, North Sea’ is going to be submitted to Marine Geology shortly. This work will also be presented in a poster session at the EGU2025 conference.</p> <p>Planning is underway for a fieldwork visit to the Brazilian Shelf, where researchers will collect cores to explore temporal variability in carbon accumulation rates, drivers of change and sources of organic matter. Sediment samples have also been sourced from a mud basin on the north Icelandic Shelf for similar analyses.</p> <p>Together, these three studies fill an important research gap, investigating the role of mud basins for the long-term storage of organic carbon on continental shelves. The geographic spread of case studies will provide insight into the factors that govern spatial variability in carbon burial and vulnerability.</p> <p>Sample sites and sediment cores have been identified for a new study, comparing methodologies for the analysis of organic matter reactivity.</p>				

WORK PACKAGE TWO

Task	Leads	Milestone				
		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Task 2.1: Historical development and spread of human influences on the seabed - scan of archives and other data sources for evidence of the spread of human influence on continental shelves	<ul style="list-style-type: none">Ruth ThurstanCallum RobertsJulie Hawkins					
Task 2.1: Historical development and spread of human influences on the seabed - collation of eye-witness evidence of the unimpacted state of the seabed	<ul style="list-style-type: none">Ruth ThurstanCallum RobertsJulie Hawkins					
Task 2.1: Historical development and spread of human influences on the seabed - evidence synthesis and mapping	<ul style="list-style-type: none">Ruth ThurstanCallum RobertsJulie Hawkins					
Task 2.2: Contemporary intensity and distribution of bottom disturbance by human activities - mapping and analyses of satellite data to determine patterns and intensity of fishing gear use and other forms of disturbance	<ul style="list-style-type: none">Kristian Metcalfe					
Task 2.2: Contemporary intensity and distribution of bottom disturbance by human activities - analyses and mapping of overlap in hotspots of vulnerable buried carbon (from Tasks 1.1-1.3) and human disturbance of the seabed	<ul style="list-style-type: none">Kristian Metcalfe					
Task 2.3: Where are the world’s remaining areas of pristine/intact seabed habitat? - design and application of a citizen science programme (Comms/ Outreach)	<ul style="list-style-type: none">Ruth ThurstanCallum RobertsJulie HawkinsBlue Marine					
Task 2.3: Where are the world’s remaining areas of pristine/intact seabed habitat? - identification and verification of seabed habitats in potentially unimpacted sites - with Blue Marine Outreach	<ul style="list-style-type: none">Ruth ThurstanCallum RobertsJulie Hawkins					
Task 2.4: Viewing the impact of seascape disturbance from space – collation, analysis, and mapping of satellite data on sediment disturbing human activities	<ul style="list-style-type: none">Jamie Shutler					

Task	Leads	Milestone				
		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Task 2.5: Measuring the impact of trawling on sediment and animals from within the water – deployment of a field experiment off Plymouth, UK, to determine the effects of trawling on sediment fauna and biogeochemistry	<ul style="list-style-type: none">Jamie ShutlerSarah BreimannVas KitidisKaren TaitTim Smyth					
Task 2.6: Quantifying the global impact of seascape disturbance on sedimentary and atmospheric carbon - Earth systems models developed to investigate carbon budget for continental shelves and explore role in climate change mitigation	<ul style="list-style-type: none">Tim LentonPaul HalloranRobert MarshJack Middelburg					

University of Sheffield

University of Utrecht

University of Exeter

KAUST (King Abdullah University of Science and Technology)

Bangor University

University of Southampton/NOC

Plymouth Marine Laboratory

Blue Marine

On track

Slow or delayed

Not yet started

Completed

Milestone/ Goal	Activities completed	Milestone changes
Task 2.1: Historical development and spread of human influences on the seabed. <ul style="list-style-type: none">• Scan of archives and other data sources for evidence of the spread of human influence on continental shelves• collation of eyewitness evidence of the unimpacted state of the seabed• seabed-evidence synthesis and mapping	<p>This study aims to describe global historical trawling fleet dynamics and their key trawling grounds in the pre-1950 period. Progress has been made in developing collaborations for data sharing with fisheries experts and historians.</p> <p>The manuscript ‘Estimating Historic Seabed Carbon Disturbance by Port Dredging and Aggregate Extraction in NW Europe’ has been submitted to Ocean Sustainability.</p> <p>Academics from this task have been sharing their research, with a recent presentation at the UK Blue Carbon Forum and up-coming plans for dissemination at the ICES Working Group on the Carbon Impacts of Fisheries (Copenhagen) and the One Ocean Science Congress (France).</p> <p>Work continues to apply spatial models to estimate fishing effort from catch data extracted from the University of British Columbia Sea Around Us database.</p>	
Task 2.2: Contemporary intensity and distribution of bottom disturbance by human activities <ul style="list-style-type: none">• mapping and analyses of satellite data to determine patterns and intensity of fishing gear use and other forms of disturbance• analyses and mapping of overlap in hotspots of vulnerable buried carbon (from Tasks 1.3) and human disturbance of the seabed	<p>A manuscript describing regional variation in active bottom-contacting gear footprints has been submitted to Fish and Fisheries.</p> <p>The Working Group on Fish Technology and Fish Behaviour annual meeting in Sicily (May 2025) accepted our focus session investigating areas of uncertainty amongst global fishing gear parameters.</p> <p>Academics working in this task have been granted access by Global Fishing Watch to use a preliminary version of their trawling dataset that disaggregates bottom and mid-water trawling. Academics have continued to work to remove glitches in this dataset and have produced initial maps of global bottom trawling effort by flag state.</p>	
Task 2.3: Where are the world’s remaining areas of pristine/intact seabed habitat? <ul style="list-style-type: none">• design and application of a citizen science programme (Comms/ Outreach)• identification and verification of seabed habitats in potentially unimpacted sites	<p>Despite the gradual pace of submissions, there has been significant progress in pinpointing future areas to study. Annabel Kemp has produced a comprehensive document outlining potential sampling areas for further investigation.</p>	<p>Despite our efforts we received few submissions to the citizen science portal. This may reflect the paucity of undisturbed soft sediment habitats and the difficulty of reaching people within offshore industries. However, the survey has been very widely publicised via this campaign, with well over 1.25m impressions and an above average click through rate of 12%.</p>

Milestone/ Goal	Activities completed	Milestone changes
Task 2.4: Viewing the impact of seascape disturbance from space – collation, analysis and mapping of satellite data on sediment disturbing human activities	<p>One academic has developed an airborne drone methodology capable of mapping surface sediment plumes and this is now planned to be deployed during the planned trawling experiment. The field plan and risk assessment are in place, allowing for rapid mobilisation once timing of the experiment is confirmed.</p>	
Task 2.5: Measuring the impact of trawling on sediment and animals from within the water <ul style="list-style-type: none">• deployment of a field experiment off Plymouth, UK, to determine the effects of trawling on sediment fauna and biogeochemistry• design of a simplified modular sampling programme to deploy internationally to measure effects of seabed disturbance on buried carbon• identification of international research sites and partners deployment and analyses of international field experiments	<p>There have been some challenges with this task pertaining to equipment manufacturing, methodological refinement and vessel availability and logistics. We are working with partners to find solutions and bring this task back on track.</p>	
Task 2.6: Quantifying the global impact of seascape disturbance on sedimentary and atmospheric carbon. Earth systems models developed to investigate carbon budget for continental shelves and explore role in climate change mitigation.	<p>The question this work addresses involves the interaction of various processes in the pelagic and benthic realms, with few existing models adequately capturing the coupling between these two domains. Therefore, the chosen model requires further development and adaptation to accurately represent key processes involved in the resuspension and remineralisation of organic matter.</p>	

WORK PACKAGE THREE

Task	Leads	Milestone				
		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Task 3.1: Monitoring and measuring uptake of carbon by seabed habitats and recovery of carbon stocks after protection - Identification of protected and control sites for field study, and of international research partners for collaboration (sites shared with Task 3.3)	<ul style="list-style-type: none">● Callum Roberts● Ceri Lewis● Julie Hawkins● Carlos Duarte					
Task 3.1: Monitoring and measuring uptake of carbon by seabed habitats and recovery of carbon stocks after protection - Design of modular sampling programme to evaluate the effects of protection on biota (sampling design shared with Task 3.3)	<ul style="list-style-type: none">● Callum Roberts● Ceri Lewis● Julie Hawkins● Carlos Duarte					
Task 3.1: Monitoring and measuring uptake of carbon by seabed habitats and recovery of carbon stocks after protection - Field research (sites shared with Task 3.3)	<ul style="list-style-type: none">● Callum Roberts● Ceri Lewis● Julie Hawkins● Carlos Duarte					
Task 3.2: Laboratory mesocosm experiments - Laboratory mesocosm measurements of the effects of seabed biota on carbon capture and burial	<ul style="list-style-type: none">● Ceri Lewis● Martin Solan● Jasmin Godbold● Technician					
Task 3.2: Laboratory mesocosm experiments - Laboratory mesocosm measurements of the effects of global change processes on seabed carbon capture and burial	<ul style="list-style-type: none">● Ceri Lewis● Martin Solan● Jasmin Godbold● Technician					
Task 3.3: Evaluating the co-benefits of seabed protection from human impacts on wildlife and ecosystem services - evaluating the co-benefits of seabed protection from human impacts on wildlife and ecosystem services	<ul style="list-style-type: none">● Ceri Lewis● Julie Hawkins● Carlos Duarte					
Task 3.4: Economic values of protection – economic cost-benefit analyses of change in ecosystem services under protected vs unprotected vs partially protected management regimes	<ul style="list-style-type: none">● Callum Roberts					
Task 3.5: Measuring, monitoring, and minimising the project’s carbon and environmental footprint	<ul style="list-style-type: none">● Jamie Shutler					
<div><div>● University of Sheffield</div><div>● KAUST (King Abdullah University of Science and Technology)</div><div>● University of Southampton/NOC</div><div>● University of Utrecht</div><div>● Bangor University</div><div>● Plymouth Marine Laboratory</div><div>● University of Exeter</div><div>● Blue Marine</div></div> <div><div>On track</div><div>Slow or delayed</div><div>Not yet started</div><div>Completed</div></div>						



Jersey Photo: Francesca Page

Milestone/ Goal	Activities completed
<p>Task 3.1: Identification of protected and control sites for field study, and of international research partners for collaboration (sites shared with Task 3.3)</p> <p>Design of modular sampling programme to evaluate the effects of protection on biota (sampling design shared with Task 3.3)</p>	<p>Academics completed overseas fieldwork campaigns in Jersey and New Zealand, collecting numerous cores from varied seabed environments. They will be investigating the impacts of trawling and uncovering the role of biodiversity in carbon burial. Collaborating with academics in Work Package 1, they will also use eDNA to examine how microbial biomass and fish communities change over time in response to seabed protection. Additionally, thermogravimetric analyses will reveal the vulnerability of carbon to remineralisation.</p> <p>The data produced from fieldwork in Arran (2023) is currently being used to develop a paper describing the changing ecological characteristics and sediment carbon content across a gradient of disturbance in a soft-sediment habitat.</p> <p>Academics are building out plans for more field sampling opportunities with a research group from the University of Western Australia. This study would look at the impact of de facto protection afforded by oil rigs in the East Indian Ocean.</p> <p>After a delayed start, there is now a full-time post doc in place in South Africa who is now getting on with feasibility assessments of different sampling campaign opportunities.</p>
<p>Task 3.2: Laboratory mesocosm experiments - Laboratory mesocosm measurements of the effects of seabed biota on carbon capture and burial</p> <p>Task 3.2: Laboratory mesocosm experiments - Laboratory mesocosm measurements of the effects of global change processes on seabed carbon capture and burial</p>	<p>A new analytical approach has been unlocked to facilitate the analyses of the data collected in Millport (2023). And the more recent trip to Millport in 2024 has generated interesting results adding new information to what we understand about particulate organic carbon movement within the mud driven by benthic invertebrates.</p> <p>Academics have been working on manuscripts, setting out their findings ready for review, they have also been carrying out follow-up experiments to investigate invertebrate interactions with particulate organic carbon. Currently, they have four papers in the pipeline.</p>
<p>Task 3.3: Evaluating the co-benefits of seabed protection from human impacts on wildlife and ecosystem services</p>	
<p>Task 3.5: Measuring, monitoring and minimising the project’s carbon and environmental footprint</p>	<p>The project team continue to collect information needed to monitor the project’s carbon and environmental footprint.</p> <p>Additionally, one academic completed a month-long research study aboard the RV James Cook to assess the carbon and environmental footprint of an oceanographic cruise—the first in-depth assessment of its kind within the Convex Seascape Survey. This work provides vital baseline data to inform future emission reduction strategies.</p>



Jersey Photo: Francesca Page

WORK PACKAGE FOUR

Task	Leads	Milestone				
		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Task 4.1: Development and design of communications plan, plus creation of media assets such as video, infographics, social media assets and creation of media pack.	<div><div></div> Jo Coumbe</div> <div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div> <div><div></div> Tim Bryant</div>					
Task 4.1: Secure and onboard PR Agency Greenhouse PR	<div><div></div> Jo Coumbe</div> <div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div> <div><div></div> Tim Bryant</div>					
Task 4.1: Deliver a comprehensive social media campaign	<div><div></div> Jo Coumbe</div> <div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div> <div><div></div> Tim Bryant</div>					
Task 4.2: Development and creation of digital platform	<div><div></div> Jo Coumbe</div> <div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div> <div><div></div> Unseen Studio</div>					
Task 4.2: Website Phase I	<div><div></div> Jo Coumbe</div> <div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div> <div><div></div> Unseen Studio</div>					
Task 4.2: Website Phase II	<div><div></div> Jo Coumbe</div> <div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div> <div><div></div> Unseen Studio</div>					
Task 4.2: Development of digital assets (AR WalkWithWhales and seascape carbon animation)	<div><div></div> Jo Coumbe</div> <div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div> <div><div></div> Unseen Studio</div>					
Task 4.3: Secure education partner, build educational materials and develop yearly outreach programme strategy	<div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div> <div><div></div> Anna Hughes</div> <div><div></div> EncounterEdu</div>					
Task 4.4: Secure exclusive programme media partners using Blue Marine's extensive media network, as well as enlisting celebrity ambassadors.	<div><div></div> Jo Coumbe</div> <div><div></div> Charles Clover</div> <div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div>					
Task 4.5: Conduct press campaigns with announcements matched to key Convex dates and global ocean events, minimum 1 x press releases per quarter	<div><div></div> Jo Coumbe</div> <div><div></div> Charles Clover</div> <div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div>					
Task 4.6: Promote conclusive results to create a legacy	<div><div></div> Jo Coumbe</div> <div><div></div> Jade Rolph</div> <div><div></div> Gail Fordham</div>					



Milestone/ Goal	Activities completed	Milestone changes
4.1: Design and development of communications plan	<p>The Prophets PR team work alongside the Blue Marine media team on an iterative on-going story matrix.</p> <p>Communications days at the University of Exeter Campus allowed colleagues to understand scientific progress and publication timelines and build forward communications plans accordingly.</p> <p>A bi-monthly e-newsletter was launched.</p> <p>Social media management moved in-house to Blue Marine Foundation. Followers across all channels growing by 47% and our reach increased to 1,290,296 people.</p>	<p>Original budget did not include funds for attendance or sponsorship at global events such as COP or World Ocean Summit, nor did it allow for art-science collaborations. The budget has been reprofiled to better accommodate these activities.</p>
4.1: Creation of media assets (incl. social media)	<p>We released a stunning new video showcasing the first two years of the survey, highlighting how we have explored the hidden depths of our oceans like never before.</p> <p>World-renowned light artist, Chris Levine, created artwork '783 Hertz' which plunges audiences into the benthic zone and it's role in the carbon cycle.</p> <p>Artist in residence, Naomi Hart, shared our passion for the ocean with nearly 59,000 people through her 'Seabed' textile piece and her paintings of benthic invertebrates.</p> <p>Working with talented photographer and journalist Francesca Page we captured astounding imagery of our Jersey fieldwork, with one image featuring in Vogue.</p>	
4.2: Creation of digital platform	<p>The second phase of our website launched, sharing more detail about research activity and progress to date. The new site hosts an open-source research portal where the our latest publications are freely accessible for the advancement of the global understanding of blue carbon and climate change.</p>	
4.3: Secure education partner, build educational materials and develop outreach programme strategy	<p>Total potential student reach is now 792,858.</p> <p>Working with EncounterEdu we delivered several in-person learner workshops as well as continued professional development training on the ocean and climate to 73 teachers from 43 schools.</p> <p>Three Live Lessons attracted a total audience of more than 24,710 students. The first focused on COP29 and climate change policy, while the second two aligned with British Science Week and discussed the 'whale pump' and eDNA.</p> <p>Our key stage 2 Ocean Heroes resource, designed in collaboration with Encounter Edu, won Best Free Primary Resource at the Tech Primary Awards 2024.</p> <p>We created 29 new lessons, including comprehensive key stage 2-4 resource packs.</p>	<p>Our plans originally focused on the delivery of student workshops, but we pivoted to concentrate on teacher CPD when an opportunity arose via the Primary Science Teaching Trust. We identified this as a more efficient and impactful way to reach more learners. We plan to continue this approach into project year four.</p>
4.4: Secure exclusive programme media partners using Blue Marine's extesive media network, as well as enlisting celebrity ambassadors	<p>An ocean influencer target list is compiled ready for outreach in years four and five.</p>	<p>We decided the concentrate on using online ocean influencers to support high-profile findings in the final two years of the project, rather than recruiting formal ambassadors.</p>
4.5: Conduct press campaigns with announcements matched to key Convex dates and global ocean events	<p>Press reach of 629.4m was achieved via 144 articles, including coverage from the BBC, The Guardian and The Sunday Times.</p>	





Photo: Hanley Spiers



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