



MARINE ECO ENGINEERING NEWS

SPRING 2022





PROVIDED BY SEASEARCH EAST. PHOTOGRAPHED OFF THE EAST COAST OF ENGLAND.

EDITORS NOTE:

Marine Eco Engineering news is formulated for our partnerships and collaborations. We view this publication as an opportunity to hear from our partners, associates and interesting research to forge new collaboration opportunities and strengthen existing connections.

In this first spring 2022 issue there is much to report regarding team evolution, product development and project involvement.

COLOPHON:

Publication: Marine Eco Engineering News

Front cover: Provided by SeaSearch East-photographed off the east of England.

Production: Exo Engineering Int. Ltd.

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THE LAUNCH OF EXO ENGINEERING

Introducing Exo Engineering Int. Ltd. , the new sister company of Exo Environmental. Since 2014, Exo Environmental has been developing a range of low carbon, environmentally friendly products that protect coastal and marine infrastructure whilst achieving biodiversity net gain. Products range from Eco-Reef scour protection and Eco-Rock Armour coastal defences to Piling Habitats for waterfront infrastructure.

Exo has developed two unique technologies that are utilised by the product range.

Geoblock® technology incorporates up to 90% waste and recycled materials into concrete-like products achieving 17% carbon savings compared to conventional concrete.

This approach is vital to achieve a circular economy, reducing waste and carbon emissions.

Greening the Grey® technology is used to produce unique macro and micro surface textures that encourage biocolonisation on hard, grey infrastructure. Greening the Grey® aims to turn hard infrastructure such as concrete rock armour, breakwaters and quay walls into thriving habitats for a diverse range of organisms.

Until now these technologies and nature based solutions have been developed by Exo Environmental alongside its environmental consultancy services, on which it has built its reputation among partners and clients. Exo Engineering will take over the development and manufacture of these innovative products with renewed focus on collaboration, commercialisation, scaling up production and targeting new markets.





AN INTRODUCTION TO THE TEAM



The team at Exo Engineering boasts a wealth of experience in ecological engineering design innovation, concrete chemistry, and environmental research. We asked each team member about their role, what they are most excited about for the future of Exo Engineering, and what they see as the opportunities and challenges ahead. More members of the team will feature in future publications.

WILLIAM COULET

William founded Exo Environmental in 2014 and is the director of both Exo Environmental and the newly founded Exo Engineering. He has previous experience working on innovative and ground-breaking projects from previous positions during his career. As director William coordinates the day to day running and the strategic direction of the company. Over time he has built an impressive network of partners and collaborators and sees collaboration being key to Exo Engineering moving forward,



“collaborative projects are of great interest to us, we love to explore opportunities with other SME’s, universities, offshore developers and coastal managers.” Through collaboration some of the challenges in the eco engineering field can be addressed. For example, William sees issues in clarifying and improving how biodiversity net gain metrics can be used in intertidal and marine environments, as well as issues arising during decommissioning of offshore infrastructure. Through communication with different stakeholders William is optimistic that these challenges can be overcome.

DAVID MIKO

David has worked at Exo for 5 years and has a background in chemistry having completed chemistry (MSc) at the University of East Anglia. David realised that he wanted to apply his skills in the environment sector and has been key to the development of Geoblock® technology where his knowledge of sediment stabilisation has been vital.



David is aware of challenges that come from traditional engineering mindsets that neglect environmental considerations in infrastructure project decisions but believes we are at a turning point with regards to the uptake of eco engineering concepts,

“We are at a really interesting crossroad with Exo Engineering, as the potential for full scale coastal defence blocks is just a few months away from reality, something that felt infinitely far away mere 3 years ago. This is especially exciting to see as there is clearly so much appetite for these innovative solutions in marine infrastructure amongst the biggest players in the field of offshore wind, shipping and fishing industries”.



ECO-ROCK ARMOUR: BIOCOLONISATION IN PROGRESS

Exo Engineering's Eco-Rock armour incorporates Greening the Grey® technology, facilitating biocolonisation and boosting biodiversity in the intertidal zone. In 2020, 32 of Our Eco-Rock Armour units were deployed in collaboration with the Environment Agency at Moverons Farm Brightlingsea, Essex. After one season of growth, Eco-Rock Armour had been colonised by initial pioneer biofilms, facilitating growth of higher trophic macrophytes such as Enteromorpha (Green filamentous algae).

The heterogenous surface textures encouraged the colonisation of crustaceans and molluscs such as periwinkle gastropods sheltering in the ledges and crevices of our design.

In comparison to adjacent homogenous rock armour the contrast in diversity is stark, with only filamentous Enteromorpha present on these traditional erosion control units, with a dearth of higher trophic organisms. Further monitoring of these Eco Rock Armour units will continue to understand the successional process that are taking place.

Eco-Rock armour is currently being intensively studied to understand the design's positive impact on biodiversity. In 2020, 12 Eco-Rock Armour Blocks were deployed in Cornwall in collaboration with the Environment Agency as part of the SARCC (Sustainable And Resilient Coastal Cities) project which will be studied and monitored until Autumn 2022.

Bio-colonisation of pioneer floral biofilms and later higher trophic organisms is well underway.

Species that have been observed on these units include filamentous algae (Enteromorpha), Periwinkles (Littorina saxatilis) and Bladder wrack sea-weed (Fucus vesiculosus). At the conclusion of the monitoring in autumn this year a comprehensive survey will take place to give a full understanding of the species colonising these Eco-Rock Armour units.



SCALING UP

All of Exo Engineering's products such as Eco-Rock Armour are fully scalable and can be made bespoke to specific project requirements.

The Eco Rock Armour units currently used in the trials in Essex and Cornwall weigh 70kg. Now these units have been made at more than 10 times this size, tipping the scales at 750kg. They will be scaled up further still to 4.8 tonnes for a trial of 25 units with the Environment Agency in Cornwall. This project will trial a variety of Eco Block designs of which Eco Rock armour is one. Eco-Rock Armour units made for this project will utilise Geoblock® technology, using local quarrying by-products in production to reduce carbon emissions and forging a circular economy.

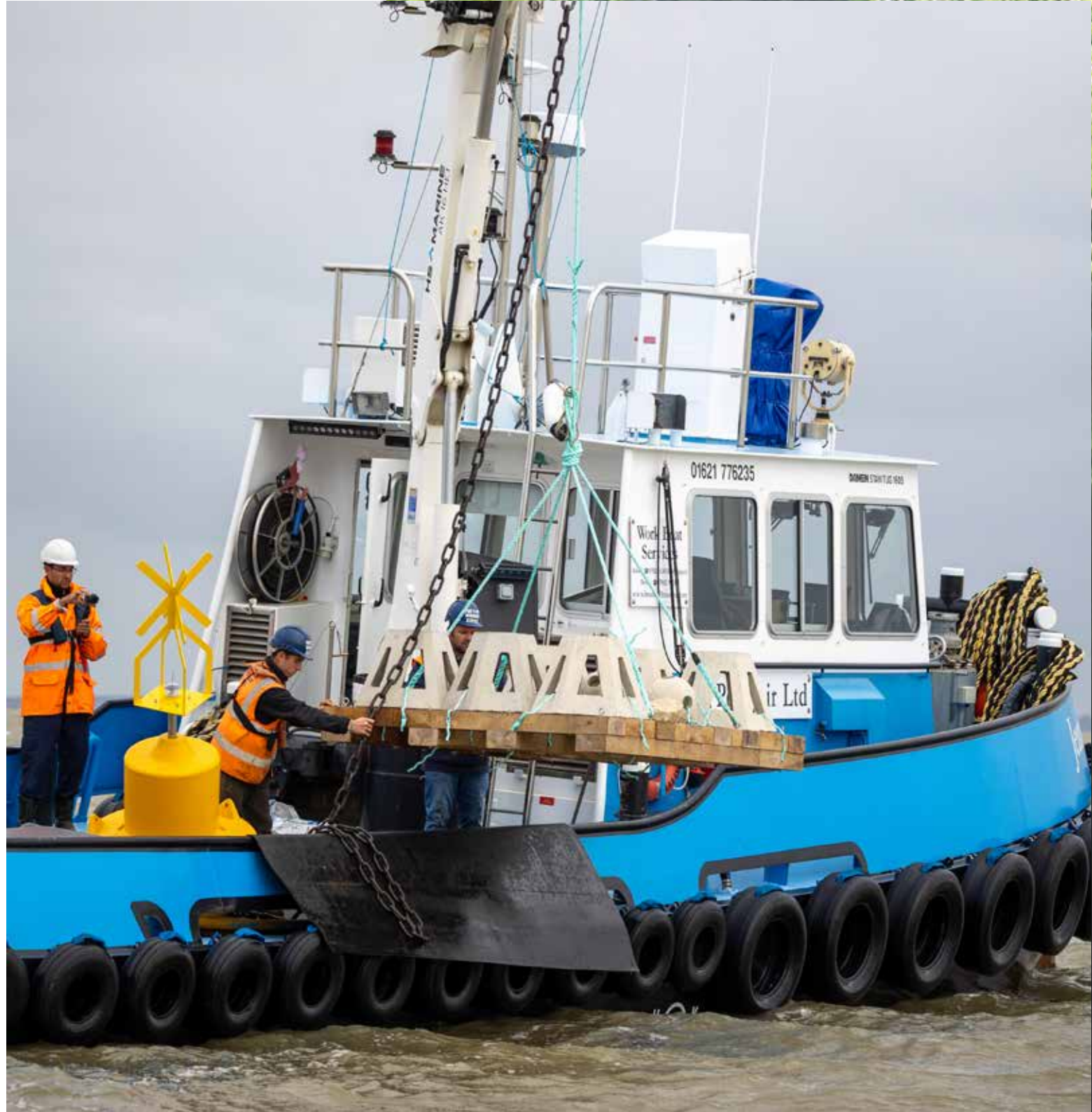


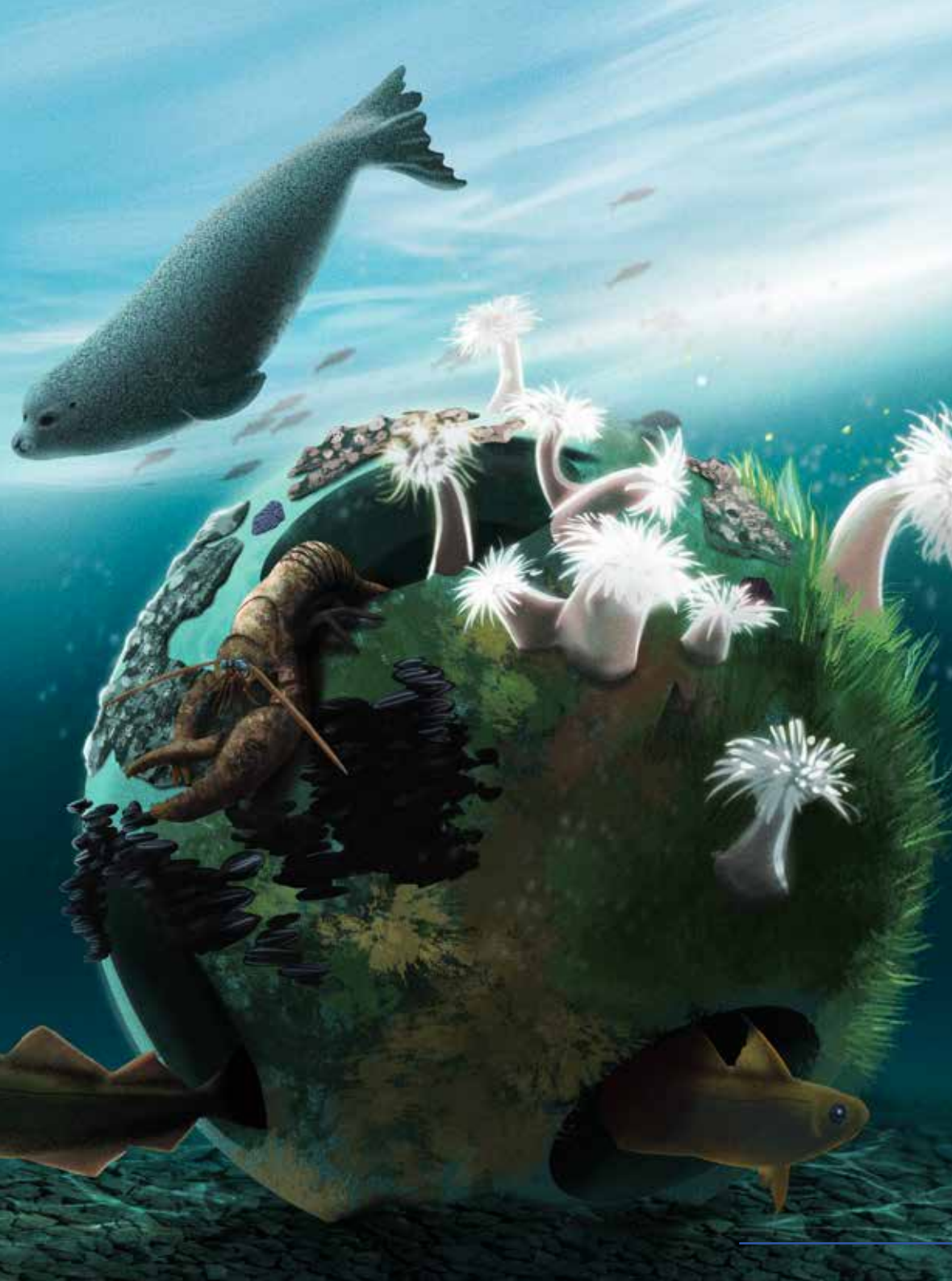
ECO-REEFS: THE ROUTE TO MASS DEPLOYMENT

Exo Engineering's Eco-Reefs are specifically developed to provide scour protection for offshore infrastructure whilst providing enhanced habitats. The habitats created by Eco-Reefs are designed to cater for important species such as juvenile cod, haddock, and crustaceans as well as allowing for algae and reef building species to become established.

Lab flume experiments with the university of Southampton have shown that Eco-Reefs are effective at providing scour protection.

Following the lab experiments, Eco-Reef units have been deployed in the Crouch Estuary in Essex. These are currently being monitored to assess the biocolonisation potential of these units. Exo Engineering is building on this success to make Eco-Reef products ready for commercial scale manufacture and mass deployment by focusing on improved strength of the design as well as efficient, scaled-up manufacturing methods.





OWGP PROJECT NEWS

A key potential market for Eco-Reef products is the offshore wind industry. **Exo Engineering has been building up its knowledge of the offshore wind industry with support from the Offshore Wind Growth Partnership (OWGP)** in the form of the Wind Expert Support Toolkit (WEST). This has helped to understand the requirements of key players in this offshore market. Consequently, the design, applications and deployment of Exo Engineering's Eco Reef scour protection are being tailored towards the needs of these players such as contractors and regulators.

In addition to the WEST programme, Exo Engineering has also applied to receive OWGP Development Grant funding for an ambitious project to scale up production and deployment of Eco-Reef scour protection units. This project aims to establish pilot studies examining how Eco-Reef units can be manufactured, transported and deployed using conventional methods such as conveyor belts, fall pipes and flat top barges. In addition the project will monitor the biocolonisation of Eco-Reef Units to quantify their potential to provide biodiversity net gain for offshore wind infrastructure. **This project concept has proved popular with stakeholders in the offshore wind industry** with Exo receiving letters of support from the following organisations: University of Southampton, University of Essex, UEA, MKEN, The Rich North Sea project, Bournemouth University, Deme, Vattenfall, Orsted and Scottish Power.

Exo Engineering is pleased to announce that this application has been successful, and this project will be going ahead, starting in July 2022. Now the project has been given the go ahead, the hard preparation work starts to hit the ground running come July. Exo Engineering are engaging with partner windfarm contractors Jan de Nul and Deme, operating in the North Sea to establish the project pilot sites. Preparations for scaling up Eco -Reef production is already well underway with new components in the manufacturing process being developed to improve strength and accelerate manufacturing. The successful completion of this project will result in a fully operational port side facility, with industrial scale manufacturing and site transport that is suited for conventional vessels. This would include investment into UK port side infrastructure as well as employment and training of a workforce leading to further growth and the development of new products.

DE RIJKE NOORDZEE: THE RICH NORTH SEA

Exo Engineering is always looking to reach out to exciting research projects to establish learning and collaboration opportunities for the mutual benefit of the organisations involved. De Rijke Noordzee (The Rich North Sea) is one such project. They have kindly contributed an article explaining their research into artificial reefs in the North Sea.

A healthy North Sea: source of renewable energy, rich in nature, and full of life. The program The Rich North Sea is based on an insight that is as simple as it is effective: **offshore wind farms can act as nurseries for underwater nature. To realise this, we use the unique conditions that wind farms provide for underwater nature.**

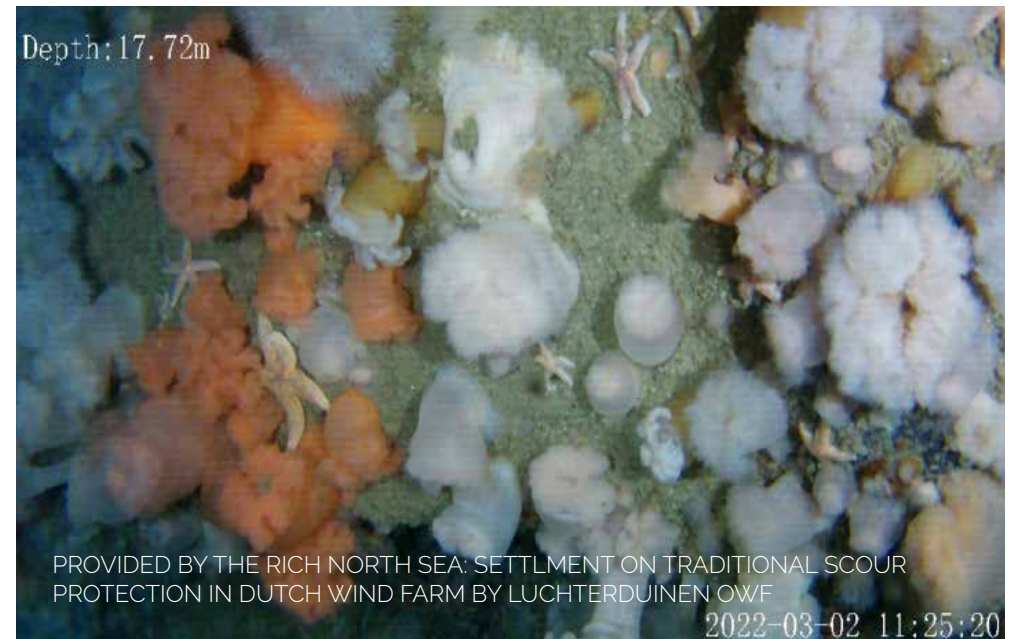
In Dutch wind farms it is not allowed to carry out seabed disturbing activities. By installing artificial reefs and releasing oysters, we accelerate and strengthen the development of nature within wind farms.

The Rich North Sea is a 4-year programme under The North Sea Foundation and the Dutch Nature & Environment foundation which focuses on nature enhancement in offshore wind farms. The Rich North Sea currently has five nature enhancement projects in different offshore wind farms in the Netherlands, it's involved in a breeding line for European flat oyster, it's making use of an offshore test site for nature enhancement methods and is working on an open source online toolbox for presenting all the results of the programme.

Next to this, The rich North Sea has partnered with several different organisations on (research) projects concerning nature enhancement and offshore wind.

The aim of the programme is to learn about nature enhancement in offshore windfarms and implementing nature enhancement in legislation to be a standard part of new renewable energy projects.

By placing structures in an offshore environment, an 'artificial reef effect' can occur: species benefitting from hard surfaces for attachment, shelter or food can be found on or near the foundation of the monopile and the scour protection of a windmill. This effect can be enhanced by enlarging the beneficial properties of these anthropogenic structures, for example by creating even more shelter and settlement opportunities...





PROVIDED BY THE RICH NORTH SEA: OYSTER CAGES ON CONCRETE, ROUGHLY 8 MONTHS AFTER DEPLOYMENT BY BLAUW WIND OWF

...through the placement of artificial reefs, designed for creating and sustaining a reef habitat. The Rich North Sea is experimenting with different types of artificial reefs and has so far seen positive results; colonization is fast and many species make use of artificial reefs once placed. However, colonization goes through different phases and can take up to a decade or longer, making it sometimes difficult to predict long-term effects.

Deployment of artificial reefs can be expensive as well as difficult in the current regulatory framework. For a more nature inclusive design of windfarms, upscaling on production, installation and monitoring is needed. Artificial reefs can help in creating a more nature-inclusive design of offshore wind farms, for example by replacing traditional scour protection or by additions to the monopile or foundation design.

By upscaling, costs will go down and benefits will go up. The Rich North Sea is advocating for more obligations of nature inclusive designs and other forms of nature enhancement in and outside of offshore wind farms.

By partnering with offshore developers and contractors, as well as wind farm owners and creating pilot projects, research experiments and monitoring, knowledge on best-practices is gained while also gaining experience in practical operations. As the offshore wind industry is growing at an unprecedented rate, we need to step up on nature protection, conservation, restoration and active nature enhancement, both within and outside of offshore wind farms, to create a resilient ecosystem and guarantee sustainable use of the North Sea. First steps are being taken but speeding up this process is crucial if we want to change the policy landscape in time and create a net zero or net gain effect for nature.



Credit of Rich North Sea.

SEASEARCH EAST: LIFE UNDER THE WAVES

Understanding life under the waves is important for Exo Engineering to be able to design products that target specific species to create thriving ecosystems. It is vital that the colonisation these products are monitored once they are deployed to fully appreciate their potential to enhance biodiversity. Exo Engineering has reached out to sea search east to discuss their expertise in capturing underwater footage in the off the east coast of England.

1. Please introduce Sea Search East: who you are, how long have you been diving, what do you do, where do you dive?

Seasearch East is our part of the national Seasearch project which helps volunteer divers record the marine environment around the UK's coast. The data is to government standards and has helped inform many conservation and environmental initiatives. There's a real shortage of knowledge about our seas and volunteers can make a huge impact when it comes to shedding light on local conditions (whether they're divers, snorkellers or shoreline observers).

The team at Seasearch East consist of a microbiologist and video engineer (both lapsed really) who started diving in 1998 and got rather obsessed with underwater wildlife. We dive around the UK but concentrate on the East Anglian coast - coordinating Seasearch East.

2. What kind of ecosystems, habitats and species can be seen off the east coast of England?

The UK's east coast is badly under recorded and that might give an impression that its dull and 'fair game' for industrial use but it includes plenty of important habitats - which is why it used to be a huge fishing ground before overfishing collapsed the industry. We have the expected moving seabeds of sand, gravel and mud which are all actually important for wildlife as well as some jewels like the North Norfolk chalk reef which is spectacular habitat and would be a huge attraction on land.

In summer clear, warm water allows divers to see beautiful chalk features and seaweed gardens which are home to hundreds of species.

3. What problems do you see with artificial structures in coastal and marine settings at the moment?

Human interventions are rarely sensitive or even aware of their marine implications. Just because animals may colonise debris doesn't mean that any old materials are beneficial. We've seen so much bare rubbish that highlights that you must not just dump anything in the sea. Tyre reefs, old gun emplacements, and fishing debris cannot rival natural habitats; some stay permanently bare after dumping while others leech chemicals and shed particles into the food chain for decades.



PROVIDED BY SEASEARCH EAST



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4. Do you feel that there are opportunities in the North Sea or off the east coast of England to improve habitat provision or protect habitats that are under threat?

With the constant demands on the North Sea there is a real need to think holistically and make sure that any developments aim for zero impact and ideally positive influence. That can be a combination of new opportunities in previously degraded areas, protection of sensitive natural features by new installations or wider aims like energy dissipation offshore from fragile coasts. There's even scope for new ways to help the public appreciate their coast by enabling sustainable access - the equivalent of paths through marshes and woods which protect the natural while bring visitors closer to nature.

5. And finally, what are your thoughts on Exo Engineering's work?

We're intrigued by Exo's developments; they try to address some of our reservations about typical coast works and we can see they could moderate the impact of the hard features that industries demand.

We hope to see how these work in place - underwater - and longer term it would be great if their technologies might help the recovery of areas which have been lost to wildlife through human expansion.



Photographs provided by SeaSearch East:

All species seen in these photos can be found in the North Sea, photographed off the east coast of England.

FURTHER DEVELOPMENTS TO LOOK OUT FOR

Exo Engineering has developed habitat enhancing products for sheet piles and vertical seawalls. These units are in the process of being deployed in Hamble Harbour, Southampton.

We have successfully applied to be part of Innovate UK EDGE GBIP (Global Business Innovation Programme) in Taiwan and Canada. In June Exo will take part in a weeklong trip to Nova Scotia forge new relationships and research collaborations in new markets to drive the innovation of our Eco-Reef products to target application in offshore industries.

Eco-Reefs units deployed in the river crouch will be revisited in the summer to monitor the biocolonisation that has taken place.

A NOTE OF THANKS TO OUR PARTNERS AND COLLABORATORS

There are exciting times ahead for Exo Engineering. We recognise the important role of all past and current collaborators, partners and clients who have helped us get to where we are today. We are extremely grateful for all these contributions and look forward to forging stronger relationships with new and existing partners in the future as Exo Engineering grows.

If you have any ideas for collaborations or contributions to make regarding the future of Exo Engineering, please do not hesitate to get in contact with us.





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