ECOSTRUCTURE

Climate Change Adaptation through Ecologically-Sensitive Coastal Infrastructure

Newsletter No. 4 | December 2020

Above: a scenic rocky shore in Wales, captured by Project Coordinator Joe Ironside.

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In This Issue

Happy Holidays!

This year has been a challenging one. Alongside pandemic worries and juggling working from home with family life, the first lockdown in spring pulled many of us away from the field and lab. In what was to be the start of a busy fieldwork season, we found ourselves wondering when and if we'd be able to continue with our carefully-laid plans.

But we rallied. We spent our time in lockdown learning new modelling techniques, soliciting valuable community feedback though surveys, analysing data, writing publications, and communicating project outputs in new ways. By August, we had researchers out in the field again installing eco-engineering experiments in the final window of summer. We reached new heights in project communication, hitting over 1,000 followers on social media and making it to the final round of the .eu Web Awards (wish us luck!). We received hundreds of responses to surveys that sought to gain diverse perspectives on some of our artificial habitat installations and address our knowledge gaps in understanding perceptions of how we view biodiversity on coastal structures. And despite lockdowns and travel restrictions, our community of citizen scientists continues to

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EU Funds: Ireland Wales Programme 2014-2020

Tionól Réigiúnach an Deiscirt Southern Regional Assembly

Cláir Chistí Eorpacha Struchtúrtha agus Infheistíochta na hÉireann 2014–2020

Cómhaoinithe ag Rialtas na hÉireann agus ag an Aontas Eorpach

Llywodraeth Cymru Welsh Government

Cronfa Datblygu Rhanbarthol Ewrop European Regional Development Fund

Happy Holidays

continued

to provide us with valuable data on seashore snails and stories about coastal structures via our online Ecostructure Observatory platform.

Above all, we emerged with an even stronger belief in the importance of nature for well-being and coastal protection. From the seashore to the lab, we continue to test and explore how coastal communities can adapt to climate change while making our shores more supportive of native biodiversity. As we head into 2021, we're pleased to start work on three new Work Packages thanks to an 18-month project extension.

Wishing you good health and a happy new year,

The Ecostructure Team

Awards Season

We're excited to announce that Ecostructure has been nominated for the .eu Web Awards and is a finalist in the 'Better World' category! You can watch the awards ceremony from your home as it will stream live from Pisa, Italy on 16 December at 8:30 CET (including a performance by Sting!). A huge thank you to everyone who voted for us. Fingers crossed!

To learn more, visit the .eu Web Awards website at webawards.eurid.eu.

Participate in Our Research!

Visit the **Ecostructure Observatory**, our citizen science mapping platform, to contribute observations of your local sealife and coastal structures to help our research.

www.observatory.ecostructureproject.eu

Share Your Stories about Coastal Structures

Coastal structures such as seawalls, piers & lighthouses are part of our cultural heritage and link to our maritime past. We are really interested to know more about what these structures mean for people and communities. Submit stories or facts about coastal structures you're familiar with to the Observatory.

Seashore Snail Survey

Have you seen a dogwhelk, purple topshell or toothed topshell on the East coast of Ireland or Wales? We want to know about it! We need citizen scientists in Ireland and Wales to explore their local rocky shores and coastal defences, recording dog whelks, toothed topshells and purple topshells. Count how many you find and take a few pictures then add them to the Observatory so that our experts can confirm your species identification.

On the Ecostructure website, you can find resources to support your seashore snail search, including an ID guide & videos. We're particularly interested in snails found on coastal structures in northern Wales and in eastern Ireland between Dublin and Wexford.

Welcome New Staff!

María

María Troya

MaREI, University College Cork

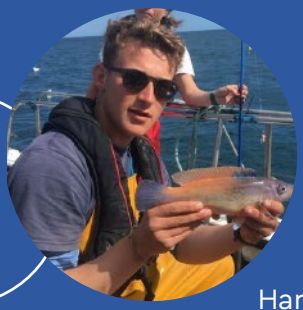
Maria will be part of the team looking to upscale and translate eco-engineering research developed in the earlier stages of the project. Maria will be conducting a comparative analysis of the coastal and marine regulatory framework in Ireland & Wales to determine best practices for incorporating coastal ecoengineering into policy.

Morag

Morag Taite

Aberystwyth University

Morag will be undertaking DNA barcoding non-native marine species of the Irish Sea. This will assist with the identification of the eDNA samples previously completed by Laura Gargan by providing comparative sequences. Morag has just finished her PhD on the evolution of cephalopods at the National University of Ireland, Galway.



Harry

Harry Thatcher

Aberystwyth University

Harry has re-joined the marine ecology team at Aberystwyth University having held a short-term role back in 2018. Harry will be investigating lobster habitat preference and use of offshore windfarms. He will use a combination of behavioural trials and intertidal surveys to design and test habitat units, before deploying them for field testing. He will also be using acoustic telemetry to investigate the behaviour and fine-scale movement patterns of lobster, crab, and potentially cod within the footprint of windfarms.

Liz

Liz Morris-Web

Bangor University

Liz joins the Non-native Species & Biosecurity team at Bangor University bringing extensive experience working with the public sector and citizen science projects. Liz will continue the research of Siobhan Vye, the results of which identified a need for biosecurity interventions which better incorporate the needs and understanding of stakeholders. Liz will be developing biosecurity devices, protocols and educational best practise for ports, marinas and recreational boaters.

New Fact Sheet on Invasive Species

The introduction, establishment, and spread of non-native species presents one of the biggest threats to biodiversity globally. Invasive species can spread to the point that they threaten the survival of native wildlife or damage the environment, economy, or human health. We've created a fact sheet about what we're researching and what you can do to prevent their spread. You're welcome to print this fact sheet for your students, business, or organisation – find it on our website under 'Multimedia'.

Research Updates

Above: one of our bolt-on rockpools provides shelter to intertidal life in Ireland. Photo by Paul Brooks.

Installing a SLOSS-style experiment on a seawall at Milford Haven, Wales. Photo by Ally Evans.

Two months later, the wall-mounted rockpools at Milford Haven have been colonised by Ulva and grey topshells. Photo by Joe Ironside.

Eco-engineering Fieldwork

Update from Ally Evans, Aberystwyth University

Our natural topography habitat units have been in the sea for over a year and we've been excited to watch them get colonised. A range of marine life is using the different microhabitats provided by the units. Snails and fish are using mini rock pools forming in depressions, limpets are taking refuge in the shady channels between ridges, and canopy seaweeds are taking hold on the rough surfaces. It's too soon to report final outcomes from this work, but we are in the process of publishing the underlying design approach in a journal article.

We've also found some interesting results from our ongoing work with drill-cored rock pools around Wales. In wave-sheltered conditions, they seem to provide useful nursery habitats for juvenile periwinkles, but are less diverse than they are in wave-exposed conditions.

Our coralline algae transplantation trials are ongoing. We are looking into the potential of transplanting this important foundation species into artificial rock pools to make them function more like natural rock pools.

Our main focus now is on completing the Conservation Evidence synopsis to help communicate the evidence base underpinning all the different methods of eco-engineering artificial structures in the marine environment.

Milford Haven Experiment

At the end of the summer, Aberystwyth researchers installed a new wall-mounted rock pool experiment at Milford Haven with units manufactured by engineers from University College Dublin. The Port of Milford Haven supported this Ecostructure work as part of their environmental vision to promote biodiversity in the Milford Haven waterway, so many thanks to them and the Abcas rope access team for helping us get this up and running. We will be collecting data over the coming years to find out how the size and configuration of bolt-on rock

Milford Haven Experiment, cont'd

pools can affect biodiversity on seawalls. As expected, opportunistic green Ulva has been first to arrive, but we're also seeing quite a few grey topshells (*Steromphala cineraria*)!

Grey topshells are normally found in damp places at low shore, often under cobbles – not on plain seawalls at mid-shore level. They are important grazers in intertidal systems, so it appears that the pools may already be helping to extend the vertical range of lower shore species there.

Raising Lobsters

With hatcheries shut due to COVID-19, Harry Thatcher has set up a small-scale lobster hatchery in the Aberystwyth labs and is now the proud parent of a lot of larval lobsters. The juvenile lobsters are transported to holding tanks until they reach the early benthic phase, at which point our researchers will run habitat choice experiments to determine their preferred habitats. These experiments will inform the design of eco-engineered habitat units that can be deployed within the footprint of renewable energy devices (such as offshore wind turbines) or artificial structures (e.g. seawalls, breakwaters).

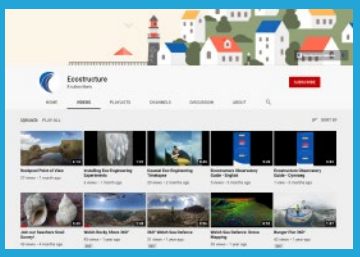
The Journey from Survey to Modelling

Update from Peter Lawrence, Bangor University

2020 started with a productive meeting that enabled some great WP2 conversations with the help of the Ecostructure Steering Committee. As a result, we were able to refine the likely variables and data sources that affect biodiversity of our coastline and importantly also envision how that data could be presented. Prior to this meeting, Peter worked with researchers in Spain to extract and understand the typical environmental characteristics of Ecostructure study locations. This was reinforced by work from Brian Thompson, Ally Evans, and Paul Brooks and enabled completion of the dataset that was to be used to model WP2 seascape-scale data.

At the end of the summer we conducted fieldwork towards the development of a rapid method of assessing the habitat mosaic of rocky shore habitats and how they compare with artificial

Ecostructure Videos



On our website or YouTube channel you can find videos of our researchers in the field explaining our activities, showing you how to identify seashore snails, and taking you above and below the water with scenic footage of the Irish Sea.

Above: Photos by Harry Thatcher show just how much the juvenile lobsters have grown over the past few months.

Journey from Survey to Modelling, cont'd

structures, which will be presented for discussion in early January. Peter has also completed a first manuscript indicating a scale-specific and notable disparity in the surface complexity of natural and artificial surfaces.

Seascape Genetics

Update from Melanie Prentice, Aberystwyth University

We're currently in the process of publishing results of the genetic diversity and population structure of *Didemnum vexillum* (Carpet Sea Squirt) in the UK and Ireland, and are nearing completion of a publication comparing population structure of a direct developing (*Nucella lapillus*) and larval dispersing (*Steromphala umbilicalis*) species. This work uses genetic datasets and oceanographic modelling from the Bangor team to compare connectivity of populations within the Irish sea and assess how reproductive strategy influences connectivity and adaptation in these two similarly-distributed gastropods.

We are also in the process of analysing data from the experimental evolution study we conducted with the biosecurity team at Bangor. We're comparing the genetic and physiological responses of *D. vexillum* to marine heatwaves between high and low invasive populations. We have processed the samples from the experiment and are currently analysing the data. We've also finished field and lab work for a project that will look for genetic signatures of adaptation at several range margins of the expanding marine gastropod the common topshell (*Phorcus lineatus*).

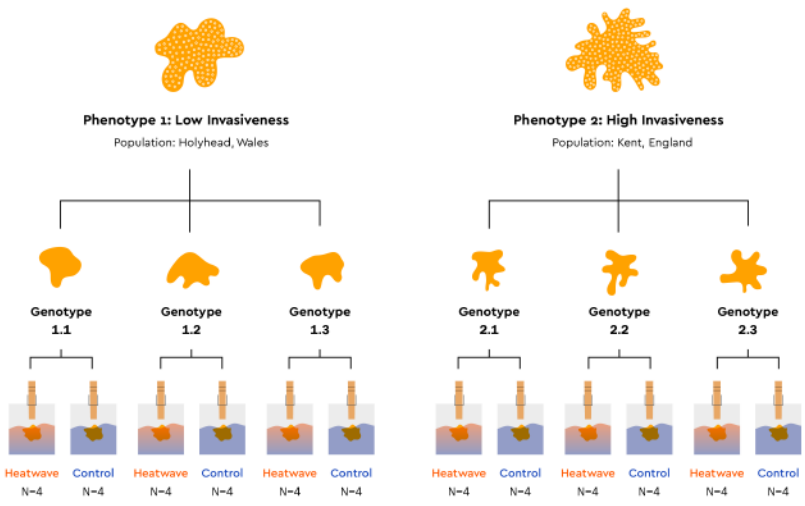


Figure showing the comparison of the genetic and physiological responses of D. vexillum to marine heatwaves between high and low invasive populations. Figure by Amy Dozier.

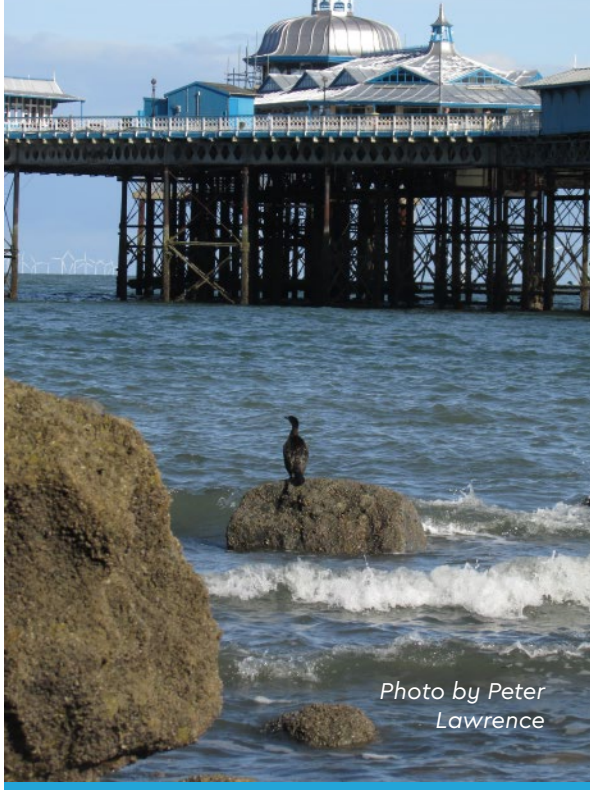


Photo by Peter Lawrence

Presentations

JANUARY

Coastal Futures: Ally Evans presented "Promoting biodiversity on marine artificial structures: building the evidence for marine planning"

FEBRUARY

Ally Evans, Paul Brooks, and Ecostructure Steering Committee member Louise Firth contributed to the CIRIA Webinar "Coastal Eco-Engineering: Boosting Britain's Biodiversity"

MAY

EGU General Assembly: Md Salauddin presented "Extreme wave overtopping at ecologically modified sea defences"

OCTOBER

International Conference on Coastal Engineering (vICCE): Md Salauddin presented "Distribution of Individual Overtopping Volumes on A Sloping Structure with a Permeable Foreshore"

DECEMBER

CommOCEAN: Sonya Agnew presented "The ECOSTRUCTURE Observatory – a novel online citizen science mapping tool to engage coastal communities" and Amy Dozier presented "The Value of Visual Science Communication in the Ecostructure Project."

Above left: an experimental tile deployed to measure biomass, diversity, and ecosystem functions on a variety of stones of different complexity. Above right: Complexity drives different animal and seaweed communities as part of our ecosystem function tile experiment. Photos by Tom Fairchild.

Biophysical Modelling

Update from Sophie Ward, Bangor University

The biophysical modellers continue to develop tools for improved larval dispersal modelling, with specific application to the Irish Sea. Our work on high resolution particle tracking has generated some interesting results regarding the difference in dispersal of larvae released in the coastal zone, when simulated using hydrodynamic models of relatively coarse and fine resolution. Overall, we find that the high-resolution models are more dispersive, i.e. get larvae offshore quicker than the lower resolution models. We think that not all of the smaller-scale coastal currents are being fully-resolved. This has implications for the connectivity of coastal species.

Work on the Rapid Response Tool for dispersal of marine non-native species is well underway. A comprehensive suite of scenarios have been simulated and are due to be worked into a user-friendly format (GUI) shortly. The various simulations consider particles released at different water depths, as well as seasonal variability.

We have also been working with Melanie Prentice on understanding connectivity within the Irish Sea, as part of the Seascape Genetics study. A particle tracking model has been run for the entire Irish Sea with 450 "spawning sites" around the coast, which includes Melanie's data collection sites from 2018/19. Theoretical larvae have been released from these sites and the dispersal pattern is being quantified to better understand background connectivity within the Irish Sea, and for consideration of multi-year spread between specific sites of interest.

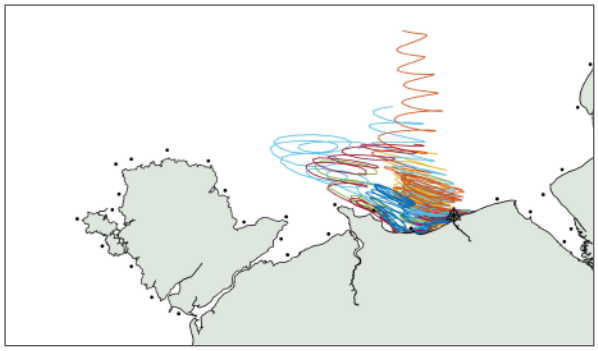


Figure shows example dispersal (after 10 days) of particles released from three sites of interest on the N Wales coast as part of the Seascape Genetics work. Figure by Sophie Ward.

Recent Publications

Jackson, T.U., Williams, G.J., Walker-Springett, G., and Davies, A.J. (2020) Three-dimensional digital mapping of ecosystems: a new era in spatial ecology. *Proceedings of the Royal Society B: Biological Sciences* 287.

O'Shaughnessy, K.A., Hawkins, S.J., Evans, A.J. et al. (2019) Design catalogue for eco-engineering of coastal artificial structures: a multifunctional approach for stakeholders and end-users. *Urban Ecosystems* 23, 431–443.

Above: Paul Brooks captured this photo of an Irish Sea rockpool, where you can find myriad organisms such as barnacles, limpets, topshells, anemones, and even dogwhelk eggs.

Conservation Evidence

Conservation Evidence is a free, online resource designed to support decisions about how to maintain and restore global biodiversity. It provides summaries of evidence from the scientific literature about the effects of conservation actions. Ecostructure researchers Ally Evans and Pippa Moore, along with Ecostructure Steering Committee member Louise Firth, are currently producing a synopsis on enhancing biodiversity on marine artificial structures that will contribute to this respected resource.

www.conservationevidence.com

Ecosystem Functions and Services

Update from Tom Fairchild, Swansea University

WP2 has been undertaking experiments looking at primary productivity and nutrient uptake between algal species and observational studies looking at epiphytes and habitat creation by algae for animals. This year, we also conducted an image-based survey to fill the gap in our knowledge around biodiversity on artificial structures and how it changes our perceptions of the structures. WP2 has also been working on creating a predictive model to understand how biodiversity enhancement might change key ecosystem processes that benefit humans.

Ecostructure has a wide range of resources available on our website. Visit www.ecostructureproject.eu to take a look.

What's Next?

We're pleased to announce that we've been awarded an additional €1.61m in funding from the ERDF Ireland Wales Cooperation Programme 2014-2020 to continue our research. The additional funding will allow us to conduct larger-scale trials of some of our nature-based interventions, moving us further toward implementation at a commercial scale. In addition, the extra funding will enable us to extend our work from the intertidal zone into the subtidal, allowing us to work around offshore structures and involve some new collaborating partners. Take a look at the new Work Packages that form part of Phase II on the following page.

WP 7: Upscaling and Translation of Coastal Eco-engineering

Lead: Ruth Callaway, Swansea University

WP7 will look at upscaling and translating concepts, models and prototypes developed in Phase 1 of the project. This will involve delving deeper into some areas from the perspectives of both top-down drivers such as law and policy and bottom-up drivers such as stakeholder perception. Key activities will include working with commercial partners to upscale eco-engineering designs, reviewing policy and legislation on both sides of the Irish Sea, working more with decision makers around new developments and assessing cultural values of artificial structures.

WP 8: Habitat Creation by Offshore Renewable Energy Developments

Lead: Joe Ironside, Aberystwyth University

WP8 will address further knowledge gaps around native and non-native species (NNS). Surveys will be undertaken to determine the biodiversity of native and NNS on artificial structures in the subtidal zone. A database of DNA barcodes for NNS will be developed and we will investigate the use of environmental DNA techniques as a tool for early detection of NNS. Building on earlier work, particle tracking tools will be developed to look at predicting impacts of existing and planned offshore renewable developments on range expansions of native and non-native species.

WP 9: Artificial Habitats for Commercially-Valuable Species

Lead: Pippa Moore

WP9 will investigate the potential importance of offshore renewable energy structures to commercially important species. A combination of laboratory and field trials will examine behavior and habitat preferences of lobster and brown crab. This will involve designing and building habitat units of differing shapes and sizes and acoustic telemetry will be used to tag and track individuals in situ. We will also investigate the potential for eco-engineering to enhance the recreational value of coastal structures such as seawalls, harbor walls and jetties, through making structures more attractive to fish species targeted by recreational anglers.

Above: Melanie Prentice sampling topshells in Wales.

Ecostructure on ITV Cymru Wales!

Catch a glimpse of one of our latest bolt-on rock pool experiments in the Port of Milford Haven on the ITV Cymru Wales, Coast & Country programme (Series 8, Episode 4) on the ITV Wales website.

In the episode, Jonathan Monk – Environmental Manager at the Port of Milford Haven and member of the Ecostructure Steering Committee – discusses the value of these experiments to "one of the most important and diverse Marine Protected Areas in the UK."

We can't wait to share more of our research with you next year.

See you in 2021!

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