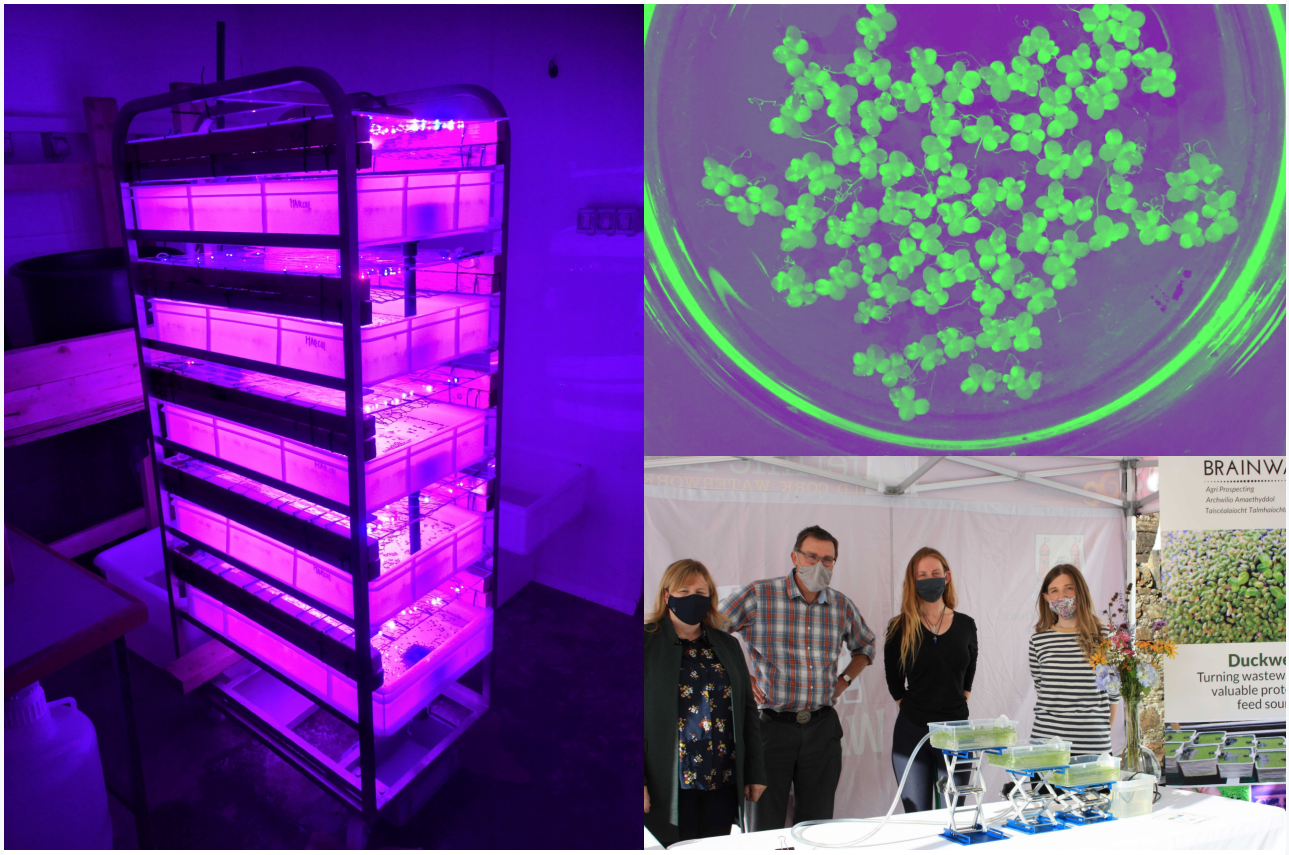
BRAINWAVES
Agri Prospecting
Archwilio Amaethyddol
Taiscéalaíocht Talmhaíochta

Newsletter 2

November 2021

Welcome to our second Newsletter!



Welcome to the second newsletter of the Brainwaves project. Here you'll find all the latest news and updates from the project activities. We'll keep you informed of our progress via newsletter twice a year.

Read on for more!

Project Partners

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh | School of Biological, Earth and Environmental Sciences

Environmental Research Institute

1872 Prifysgol Aberystwyth University

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European Regional Development Fund

Foreword

From Co-PI Dr. Dylan Gwynn Jones, Aberystywth University

We all know how overly dependent we are on fossil fuels for our lives, yet their burning has adverse consequences for our future climate. Many will instantly think about the impacts of transport and heating – but not about the food we eat. Some may not know that the inorganic fertilizers we use to grow crops and forages uses ~3% of global fossil fuels in the form of natural gas. We take nitrogen from the atmosphere and turn it into inorganic fertilizer via processes that are highly intensive in terms of energy use. Some might argue that half of us would not be here but for the Haber-Bosch process that exploits nitrogen from the atmosphere. However, we become addicted to producing inorganic nitrogen, and cheap fossil fuels have fed into this problem.

The pandemic has shaken the fossil fuel tree. Mismatches between fossil fuel supply and demand – plus commercial and international game playing and exchange rate fluctuations – has resulted in price volatility and even geo-political tensions founded on fossil fuel supply. The now rapidly rising fossil fuel costs are being passed on to farmers when they purchase inorganic fertilizer, then to retailers and ultimately the consumer – food inflation is something we must all accept, and this problem is a global one!

Brainwaves focuses on exploiting organic nitrogen sources, which, while not immune, could give farmers space against fossil fuel price volatility and could be the way forward in the future. If the price of fossil fuels increases, then so does fertilizer costs and animal feed. We are focused on two big goals – 1) sustainable high protein feed production and 2) cleaning the environment of nitrogenous waste. To meet these goals, we exploit farm waste that is high in nitrogen and phosphorus! We want to isolate the farming industry from reliance on fossil fuels and work with them to help sequester carbon and reduce environmental pollution.

Brainwaves might be green but is also very ripe for today and our shared tomorrow.

Interested in this exciting work? Please visit our website, follow us on Twitter, or contact Project Manager Anna Power at anna.power@ucc.ie

Indoor Systems

Work Package 3 involves the research and development of indoor duckweed growth systems. Principal Investigator Prof. Marcel Jansen and Postdoctoral Researcher Dr. Neil Coughlan have continued to lead this work at the School of BEES in UCC.

Since beginning this project, we have predominantly relied upon a laboratory-scale stacked system to assess duckweed growth, which was operated at a capacity of 125-litres. This system successfully allowed us to test the effect of basic growth conditions (e.g. water depth, flow rate), and gave us a keen

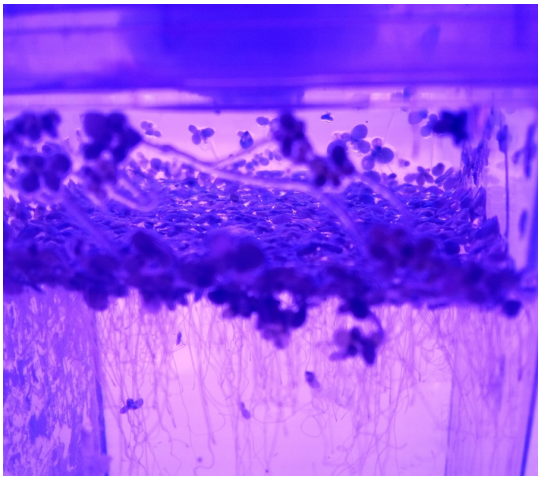
insight into duckweed biomass production, nutrient up-take rates, and plant health.

We are currently writing up the results of this work so we can share our data findings with all our stakeholders, the wider scientific community, and the public.

Since our previous Newsletter, to upscale from 125-litres, three new 500-litre re-circulatory systems have been constructed. Testing of their performance for maximised duckweed biomass production and water remediation is ongoing. One of these three systems has already produced exciting and informative data through a series of basic tests, and this gives us a further insight into the steps required to optimise indoor cultivation of duckweed.

Left: Two of our 500-litre re-circulatory systems for duckweed biomass production

It's not all physical labour though! We also conducted an extensive desk-based report to assess the knowledge gaps and potential best practice operational parameters of stacked systems for large-scale indoor duckweed cultivation. Now, using all three of our 500-litre systems, we can seek to address these identified knowledge gaps through further advanced testing activities. This includes experimenting with different LED lighting regimes, and exploring various sensor and harvesting technologies.



Right: Profile of duckweed plant growing on water surface

Outdoor Systems

Co-PI Dr. Dylan Gwynn-Jones and Postdoctoral Researcher Dr. Gruff Jones are leading the development of outdoor growth systems at Aberystwyth as part of Work Package 2.

Early 2021 saw work begin on the outdoor system, with a scoping study to compare options for design.

Based on the study conclusions, we constructed a system comprising a series of four connected duckweed growing tanks, a sump tank, and a prototype. Nutrient solution is pumped from the sump tank to the first duckweed growing tank, from where it trickles down the series of duckweed tanks by gravity, eventually making its way back into the sump tank.

Right: 80-litre systems in polytunnel at Aberystwyth's Botany Gardens, with duckweed cultures growing below

After testing the prototype, eight replicate 80-litre systems based on the original design were assembled in a polytunnel at our Botany Gardens in Aberystwyth. Having eight of these systems allows us to conduct replicated experiments. These systems are currently being trialed to assess the growth rate of the duckweed plant, as well as its capacity to uptake nitrogen and phosphorous from synthetic wastewater. We also monitor environmental conditions such as water temperature, air temperature, and light levels, in order to assess whether duckweed growth slows down in the polytunnel as we enter the chilly autumn and winter months.

Knowledge and experience we gained from testing the above experimental 80-litre systems provided a solid foundation for us to design a larger complimentary outdoor system (4000-litre), this time built using intermediate bulk containers (IBCs). This system will be used for testing the feasibility of scaling-up systems to more commercially viable sizes, with the intention that these can then be replicated on farms and by rural businesses. The IBC system will also be used for display purposes when site visits are permitted. We are currently busy assembling this system for preliminary tests this winter. Full steam ahead!

Below: Close up of the indoor system in operation

Get involved

Interested in this work? Brainwaves is now looking for SMEs, farmers, policymakers and others to become stakeholders in the project. Engineering, LED, water quality organisations and farmers can all play a part. Click below to learn more.

Become a stakeholder

A return to in-person events!

Above: Our stand and tabletop flow-through duckweed demonstration system at Culture Night 2021 in the Old Cork Waterworks

Culture Night 2021

After what felt like a lifetime in lockdown, we were thrilled to be able to safely participate in our first ever in-person event, with an outdoor stand for Culture Night at the Old Cork Waterworks Experience on September 17th. The autumn evening sun was shining, and we were delighted with the public engagement

and interesting questions posed which definitely kept our research scientists on their toes!

Above: Brainwaves researchers showing visitors how the tabletop flow-through demonstration system works

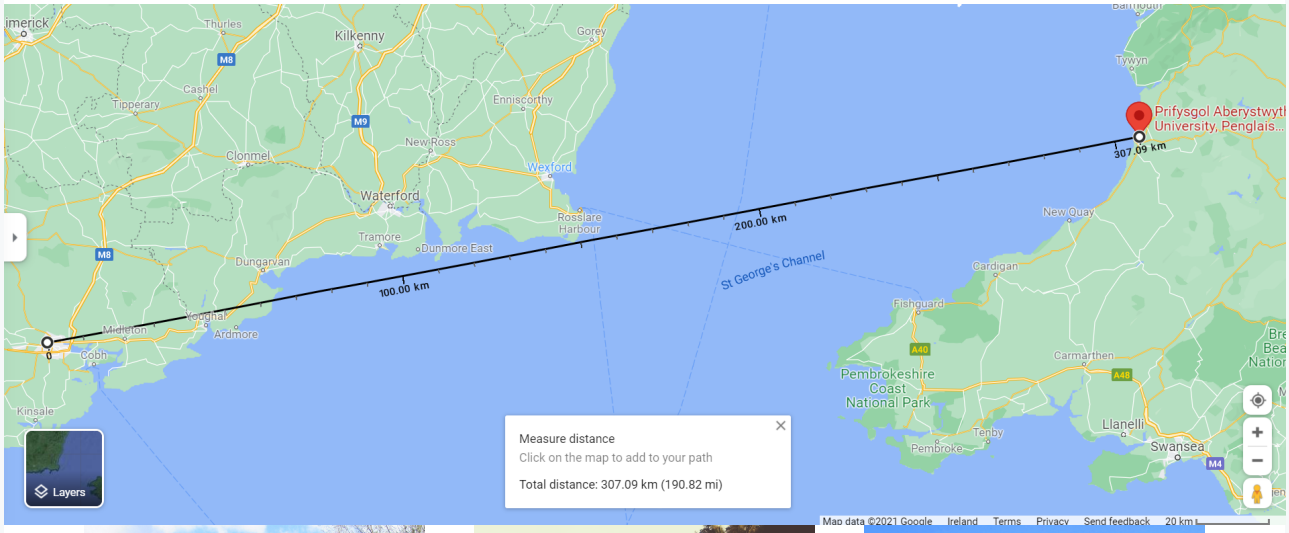
We displayed our miniature tabletop flow-through duckweed system, to give visitors an up-close view of how our larger scale systems work. The duckweed colouring pages and eco-friendly wheat straw recycled pens kept the kids busy!

Below: Prof Jansen and researcher Rachel O'Mahoney hyping up the benefits of duckweed on a sunny autumnal evening at the Old Waterworks

Stepping up for a Challenge

To encourage active habits and foster some healthy competition, our UCC team partook in a team head-to-head for the Walktober Step Challenge 2021. Over the course of 4 weeks in October our 5-person team managed to chalk up a whopping 1,038,483 steps/ 548.27 miles/ 882.35km!!! This distance is further than walking the return journey from UCC in Cork to Aberystwyth University to meet up with our cross-channel colleagues!!

Below: The straight-line distance from our lab in Cork to our colleagues in Aberystwyth is approx. 307km. Source: GoogleMaps



Mucking around at Mount Lucas duckweed fish farm

Social

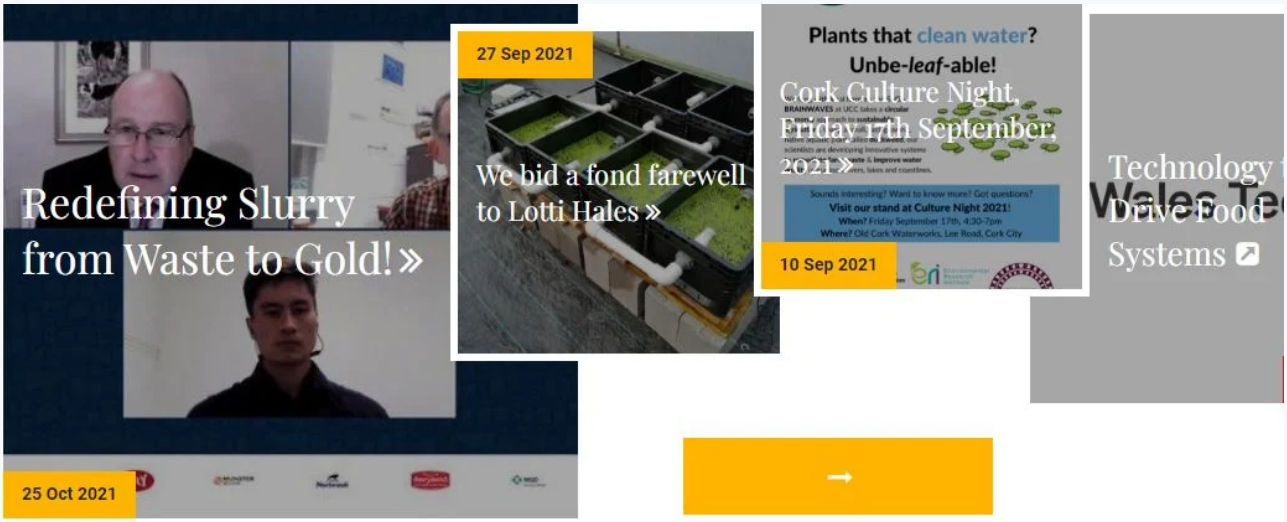
Join 337+ others and follow our journey on Twitter @BrainwavesEU. DMs are always open if you'd like to get in touch.

BRAINWAVES Project
@BrainwavesEU

'Can the duckweed plant be a sustainable alternative for imported soya?' ♻ #COP26 #EUIrelandWales #interreg https://t.co/ynqZDrBCtl

11:29 AM - Nov 10, 2021

4 See BrainwavesEU's other Tweets



Project Website

Find all your Brainwaves-related information and resources here.

Visit our website

Poem by Rachel O' Mahony

We'd like to leave you with an inspiring poem about the humble duckweed plant, written by Rachel O' Mahoney. Rachel joined the team as Research Assistant in October 2021.

Enjoy

I am native, I am wild

Upon the surface I live, with my root hair and small frond-like leaves,
Simple and unassuming, I ask for not too much,
-nitrogen, phosphorus and light.
Water you may deem dirty, to me is just quite right.

Farm effluents rich in nitrogen and phosphorus are good for me
but contrary for the streams, rivers, lakes and estuaries, you see
for this is where so, these surplus nutrients shall flow,
-freshwater eutrophication, ensuing aquatic ecosystem degradation.
Be that as it may, I thy duckweed can provide another way.

Pollution, contamination, environmental devastation.
'Oh Grandmother, what hope do we have now?'
'Oh young one, the Earth is older and wiser than I'.
'A native aquatic plant that can clean wastewater,
-sources of bacterial growth it shall rectify'.

Waste products of animal metabolism I can withstand.
I am fast-growing, the fastest in all the land.
Transforming excess nutrients into growth building blocks
as my amino acids weave and interlock.

Uptaking, converting - re-interpreting
all that you thought I could do.
Remediate I shall - altering thy water to a non-toxic state,
Providing an answer in this time and space
'Learn to listen child, listen to learn,
nature has the answers if we just gave it a turn'.

I, thy simple unassuming duckweed,
clean the water. Taking up the nutrients,
I leave no trace.
Here is your answer, scientist, young child,
to these Irish waters,
-I am native, I am wild.

Rachel O'Mahoney

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Brainwaves

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