



Welcome to our latest Newsletter!



Project Partners



School of
Biological, Earth and
Environmental Sciences



**Funded by the European Regional Development Fund through the Ireland Wales
Cooperation Programme**



Foreword

From Co-Principal Investigator Dr Dylan Gwynn Jones

"Water, water everywhere but not a drop to drink"

As Autumn draws to a close, the trees are losing their leaves and the spectacular autumn colours, which followed the very dry summer, are beginning to fade. Our Duckweed here is still growing strong but this will inevitably slow as we enter this shoulder of the growing season, due to colder temperature and reduced light. We are looking at ways of extending the growing season and convincing our Duckweed to keep on growing into the winter. However, what we must inevitably limit is the input of any energy due to the ongoing crisis.

This time in our lives highlights how important it is to embrace low carbon approaches for growing plants that we use for food or essential substrates. The outdoor growing season is over and horticultural growers are relying on Polytunnels to extend their season. After that, they will then move to heated and lit glasshouses for growing produce and this where their challenge begins. For the consumer over winter it is a balance of either buying local food produced using fossil fuels or imported food that also demand the use of fossil fuels for transport. We also eat imported food crops that were grown via fossil fuels.



The situation reminds me of Coleridge's Rime of the Ancient Mariner "Water, water and not a drop to drink!". Here in west Wales, there are energy sources everywhere but we just cannot access enough of them. The wind in them hills, the tides and those sparkling dendritic streams that now awaken as the autumn comes. The same is true for Ireland, we are truly blessed yet we have for too long ignored the future and held on to a past of fossil fuels.

In a crisis, we must embrace opportunity and support new ways to enable low carbon, renewable local food production. Whilst we await this much needed green revolution, we must all possibly consider eating more seasonal produce and of course must have zero waste kitchens, just like our grandparents did! Energy consumption in the home will also be a significant challenge and worry

to us all this winter. Amongst all this doom and gloom, we must try to identify at least some positives to keep us going. By reducing energy use and food waste today, we are doing our bit to safeguard a better environment for future generations. Also, we are all now being forced to think greener and learn new low carbon ways of living. Clearly, this will not be a global phenomena and ignorance might prevail elsewhere. However, we need to be entirely optimistic and see this time as an opportunity. Also, putting pressure on our governments to invest into renewable locally sourced energy. Ireland and Wales are truly blessed in this respect and must believe that our journey a greener future has already began.

Taking to the big screen for RTE 1's Ten Things to Know About



Above & Below: Video production with the RTE team underway in the Cooperage Building at UCC

We were delighted to see the project featured recently in the new series of popular science-based TV show, [10 Things to Know About](#). Broadcast on RTE 1 on Monday evenings starting November 2022, the latest episodes bring some of the amazing developments in scientific research happening across Ireland to a national audience.

Presenter Kathriona Devereux and her team spoke with Professor Marcel Jansen on the development of wastewater remediation systems using duckweed plants, uses for the plant biomass, and how this research feeds into

the wider movement towards embedding circular economy processes into production systems in Ireland.

Brainwaves features in Episode 4 - 'Circular Economy', aired on RTE 1 on Monday December 5th, 8.30pm. It can also be found [here](#) on the RTE Player.



Dairy farm waste trials



Above and Below Left and Right: Collecting the yard-washing samples at dairy farms around Cork

This summer saw an exciting development into a new phase of the project, as we began testing our duckweed remediation systems with waste collected from working dairy farms around the Cork region.



The team at UCC led by Principal Investigator Prof Marcel Jansen have been testing a scaled-up version of the previous basic system, to assess both duckweed growth and wastewater cleaning capacity, this time using waste media sourced from a variety of different farms. In total, 15 tanks each containing 500 litres of test wastewater media were used. In this experiment, the wastewaters selected for testing were 'yard-washings'. Yard-washings are produced by dairy farmers following the hosing down and cleaning of the dairy parlour and nearby holding areas after cows have been milked.

In many ways, yard-washings can be considered a very dilute slurry, with high levels of nutrients that should, in theory, be able to support duckweed plant growth. Here, the work was conducted in an outdoor setting over the summer months, to take advantage of the best growing window for duckweed under natural temperature and light conditions.

Preliminary results from the chemical analysis done indicate that the varied composition of yard washings from different farms led to observable differences in the growth rates of duckweed on the wastewater. These findings are an important stepping stone in the progression of these systems from a controlled laboratory to a real-life farm setting, where conditions are likely to be more varied and unpredictable.

This work has been the focus of Postdoctoral Researcher Dr Neil Coughlan, with support from Research Assistants Rachel O'Mahoney and Cian Redmond. In fact, Cian has now moved from his Assistant role with Brainwaves to begin his own PhD research at UCC on the new DuckFeed project. Funded by DAFM, this project will focus on the further development of large-scale outdoor duckweed cultivation in Ireland, this time with an increased focus on maximising the protein production aspect of the system. His work will further build on the know-how developed on Brainwaves' systems over the last six months, and is an excellent example of the 'building block' nature of the scientific research process.



Our outdoor work has continued to be underpinned by laboratory-based assessments led by Rachel, which over the last six months have focused on making minor chemical amendments to waste streams, including dairy parlour

yard-washings and filtered swine effluents. The aim of these activities is to further identify and maximise opportunities for enhanced duckweed growth, water cleaning, and overall system performance.

Below: 500 litre IBC tanks used for growing duckweed on dairy farm yard-washings

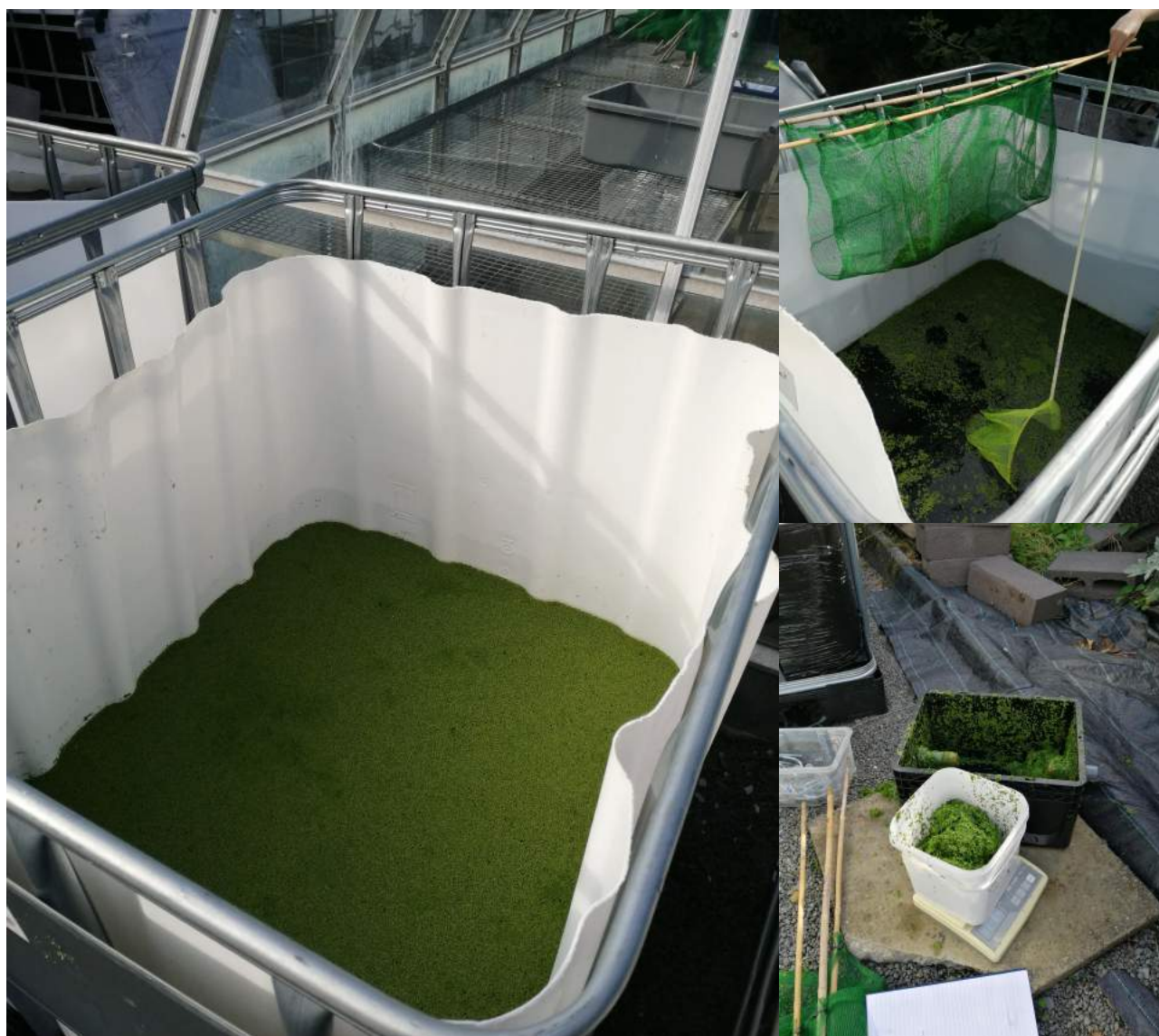


In Wales, work has continued over the past six months at Aberystwyth University on developing outdoor duckweed growing systems. During the spring, duckweed was grown on anaerobically digested cattle slurry in our polytunnel (left). These 70 litre systems allow for multiple replicated experiments, which are used to yield more reliable results. Ultimately, the research team found that the duckweed grew well, rapidly utilising the nutrients in the medium.



As the days got warmer over the summer and into autumn, work shifted to growing duckweed fully outdoors. A trial was set up at our test site in the University's Botany Gardens, where duckweed was grown on cattle slurry in larger IBCs (intermediate bulk containers), building on previous work conducted in the laboratory at a scale more relevant to industry. Weekly measurements allowed researchers to assess how various factors influenced duckweed's growth and its ability to clean the wastewater.

Below clockwise from left: A thick layer of duckweed growth. Harvesting the duckweed. Weighing biomass yield



Meanwhile in Ireland, indoor system work has been progressed by building on research findings presented in the last Newsletter. Over the past six months, we have continued to test the capacity of our three 500 litre indoor recirculatory systems. In this case, we decided to further explore some existing knowledge gaps through advanced testing activities, especially focusing on LED lighting regimes. Findings indicate that optimising LED lighting regimes promotes plant growth and reduces energy costs in the system. We also undertook assessments of robotic harvesting technology, which includes the development and refinement of a mechanised harvesting arm to scoop up duckweed biomass.

As part of the development of the indoor systems, Prof Jansen and Dr Coughlan, along with UCC Research Assistants Rachel O'Mahoney and Roger Ahern have recently published new research concerning the operation of multi-layered indoor duckweed growth systems. In particular, this research investigated the combined effect flow rates and water depth on duckweed growth within an indoor system. The research was published in the academic journal *Plants* and you can read it here:

Coughlan, N.E., Walsh, É., Ahern, R., Burnell, G., O'Mahoney, R., Kuehnhold, H., Jansen, M.A.K. (2022). Flow Rate and Water Depth Alters Biomass Production and Phytoremediation Capacity of *Lemna minor*. *Plants* 11, 2170. <https://doi.org/10.3390/plants11162170>

In addition, we are currently preparing the results of other basic testing of our duckweed bioreactor parameters, such as nutrient diffusion within the liquid growth medium as it circulates through the system. These results are also planned for publication in an appropriate peer-reviewed journal. This data will also inform how indoor duckweed systems are constructed and managed. Our results will continue to considerably advance the development and optimisation of industrial large-scale indoor (multi-layered, stacked) systems, as well as outdoor systems (pond, lagoon, canal) for duckweed-based remediation and mitigation of high nutrient wastewaters.

Welsh Government visit UCC



Above: UCC's historic Quadrangle lit up in Welsh colours for the visit

Founded in 2021, the Ireland-Wales Forum is a bilateral event held each year between the governments of Ireland and Wales to promote knowledge sharing and cooperation on both sides of the Irish Sea. As part of this Forum, Brainwaves participated in a research project showcase organised at UCC in October, with Welsh First Minister Mark Drakeford and Minister for Rural Affairs Lesley Griffiths in attendance.

We were delighted at the opportunity to be part of an interesting policy-led event, and were particularly grateful to Minister Griffiths for her time and interest in the project, and for her insights on the potential for furthering duckweed research applications. Diolch!

More information about the Ireland Wales Forum is available [here](#).

Below: Welsh Rural Affairs Minister Lesley Griffiths discussing duckweed research with Prof Marcel Jansen. Below, bottom: Project Manager Anna Power at the Brainwaves stand



Simple ideas can lead to inspiring research

‘Our research addresses some of the most urgent challenges in farming and resource management today’

– Prof Marcel Jansen

In a [recent article](#) for Irish science and technology magazine Silicon Republic, Prof Marcel Jansen explains how he was first inspired to investigate the potential of duckweed when cleaning out his pond. He explains how the Brainwaves project centres around a circular economy approach to agriculture. That means existing plant nutrients are retained in production systems as long as possible, being reused rather than being discarded.

Cork Carnival of Science 2022: Back with a Bang!



Above: Various images of the Brainwaves stand on Exploration Avenue. Top Right: Brainwaves staff members Rachel, Neil & Niamh. Bottom Centre: Prof Marcel Jansen speaking with An Taoiseach Micheál Martin, who visited our stand.

After a Covid-induced 2-year absence, the [Cork Carnival of Science](#) came back with a bang this summer. Our project team was delighted to showcase Brainwaves at the science-filled spectacular, held at Fitzgerald's Park in Cork on June 11th and 12th.

An incredible 25,000 people visited this STEM wonderland over the weekend, according to organiser estimates. We were truly blown away by the numbers of people who stopped by our stand to speak with us and learn about the potential of duckweeds for our environment. As a bonus, we were delighted to see An Taoiseach Micheál Martin and Lord Mayor of Cork City Colm Kelleher taking time to visit our stand to discuss the potential of duckweed for Irish agriculture.

The Royal Welsh Show 2022: Turning the heat up!



Above: Brainwaves Team Dylan, Lesley, Gruff & Abby in Aberystwyth University enjoying the summer sunshine at the Royal Welsh Show 2022

The [Royal Welsh Show](#) came back with a sizzle this year taking place during the hottest days ever recorded in Wales! Our project team was delighted to showcase Brainwaves on the 18th & 19th July with a stand outside the Aberystwyth University Education Pavilion - in the shade, thankfully!

We enjoyed two days of fascinating chats about the wonders of duckweed, our circular economy work, the concept of duckweed-based remediation systems and more.

Open Lab Night at Culture Night 2022

Once again, we were pleased to participate in the wonderful event that is Culture Night, this time hosting an interactive stand at the [Explore Climate Change and Biodiversity](#) themed open night held in UCC's School of Biological, Earth and Environmental Sciences for [Culture Night 2022](#). It was inspiring to see the engagement and interest in the project from all those who stopped by

and chatting with our research scientists. Many thanks to the organisers for opening a door into the fascinating world of biological sciences for people of all ages!



International Duckweed Research Steering Committee

DUCKWEED FORUM



The 5th International Steering Committee on Duckweed Research and Applications Members

- Chair: Prof. Eric Lam, Rutgers, The State University of NJ, New Brunswick, USA, eric.lam@rutgers.edu
- PD Dr. Klaus-J. Appenroth, Friedrich-Schiller-University of Jena, Germany, klaus.appenroth@uni-jena.de
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- Prof. Marcel A.M. Jansen, University College Cork, Cork, Ireland, M.Jansen@ucc.ie
- Dr. Talip Shoham, Green Chain Ltd., Tel Aviv, Israel, talip@greenchain.co.il



Photo credit: Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK) Gatersleben, Germany

UCC and Irish research received a boost recently, with the news that Prof Marcel Jansen was elected to a 2-year term on the International Steering Committee on Duckweed Research and Applications (ISCDDA). This places Ireland firmly at the forefront of international duckweed research, alongside representation by leading scientists from Germany India, Israel, and the USA.

Since its establishment in 2013, the Committee has been the guiding force for facilitating and championing the exciting new developments happening within the international duckweed research community. The Committee organises the world's leading international duckweed research conference, [ICDDA](#), every 2 years. It also produces a biannual newsletter, all volumes of which are available online [here](#). Congratulations Marcel!

Welsh Brainwaves team visit Ireland

Some of the Brainwaves team from Aberystwyth University in Wales were pleased to visit the project's Irish research facilities in Cork over the summer - the first such visit possible since before the Covid-19 pandemic.



Above, L-R: Team members Rachel O' Mahoney & Cian Redmond (UCC) and Lesley Langstaff & Gruff Jones (AU).

Postdoctoral Researcher Gruff Jones and Local Project Manager Lesley Langstaff had a busy few days with management meetings, laboratory tours to see the duckweed growing indoors and outdoors - and they even had time to climb Cork's iconic [Shandon Bells and Tower](#).

Meet our new Postdoctoral Researcher!

To help expedite the research and development work at UCC, Dr Merve Sasmaz Kislioglu from Turkey, has recently joined our Cork-based team. Supporting the project in multiple ways, Dr Sasmaz Kislioglu will initially focus on the further development LED lighting regimes within the stacked indoor system, with a view to optimising duckweed growth and remediation capacity with the lowest associated lighting energy requirement. She will also be contributing to report writing and publication activity. Welcome to the Brainwaves Team Merve!

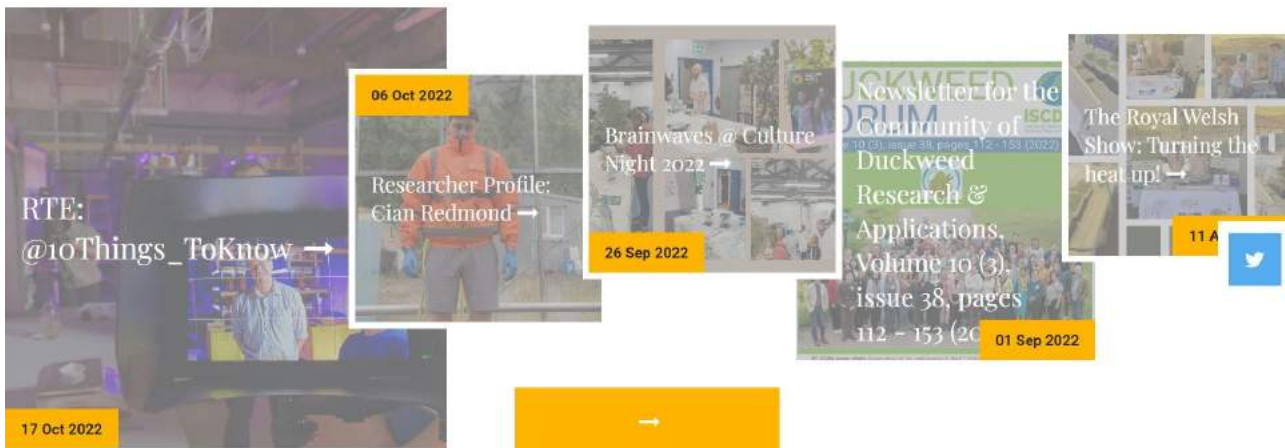


Social Media



Follow our journey on Twitter [@BrainwavesEU](https://twitter.com/BrainwavesEU).
DMs are always open if you'd like to get in touch.

Project Website



Find all your Brainwaves-related information and resources here.

[Visit our website](#)

BRAINWAVES

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