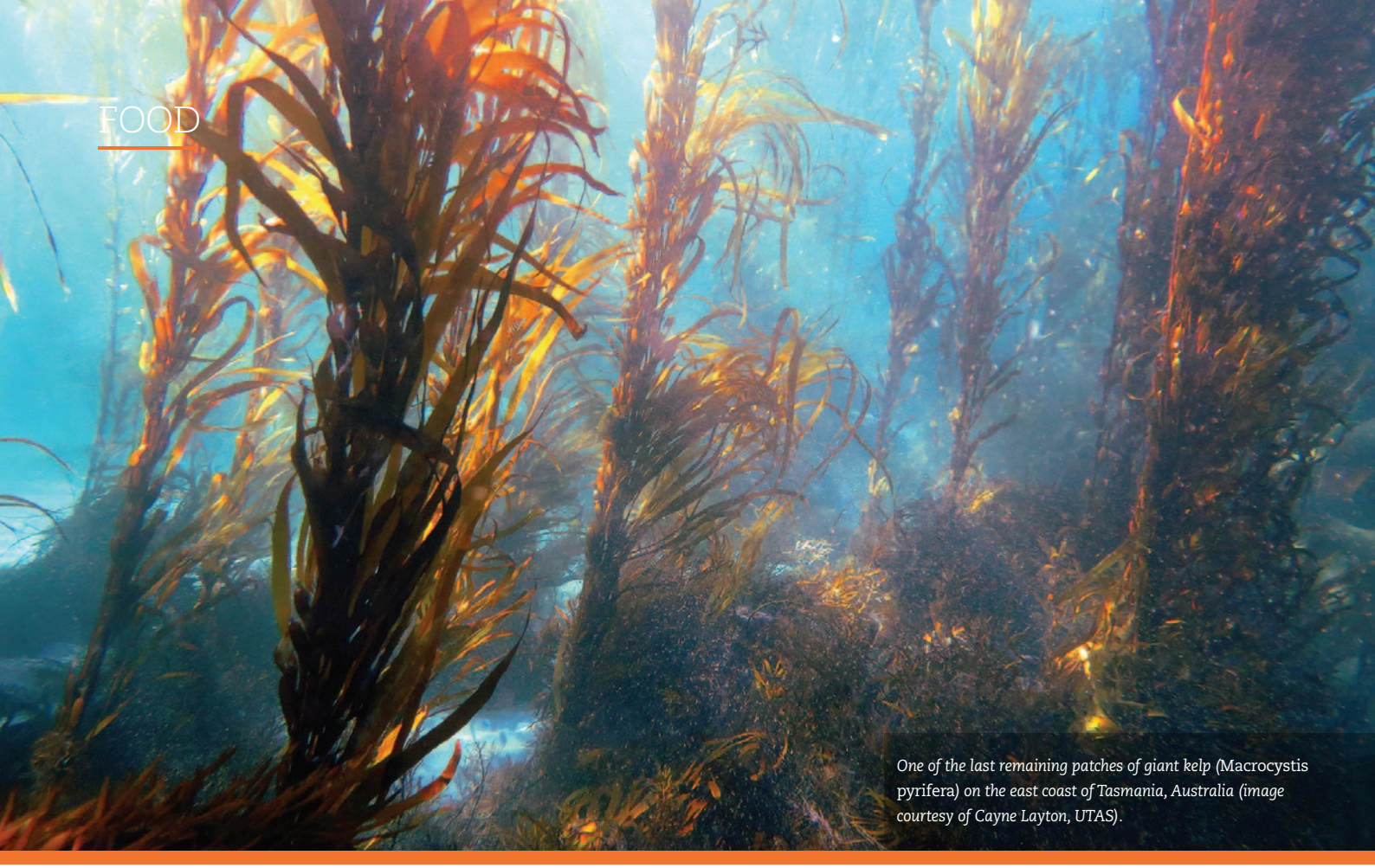

*One of the last remaining patches of giant kelp (*Macrocystis pyrifera*) on the east coast of Tasmania, Australia (image courtesy of Cayne Layton, UTAS).*

The future is kelp!

Researchers at TEAGASC and the Cawthron Institute, New Zealand, are looking at bioproduct isolation from native Irish and New Zealand macroalgal species.

Background

Seaweed has a rich history of use in Asia as food and medicine, and in Ireland it was used as a fertiliser and animal feed (Morrissey *et al.*, 2001). At present, the range of seaweed products spans food, feed, dietary supplements and pharmaceuticals, with bioenergy intermediates and materials. This range of products is attributed to the biological properties of constituents from seaweeds. Kelp is the common name for one order of brown seaweeds, Laminariales, which includes approximately 30 genera. The word 'kelp' originally described the burnt ash of brown seaweed. Kelp species range in size from several centimetres to over 50 metres for the giant kelp found off the coast of Australia, New Zealand, California, and South America. The maximum length for Irish kelp species is four to five metres.

The ALGIPRO research project focuses on two kelp seaweeds: *Laminaria digitata (L. digitata)*, a native Irish species; and, *Macrocystis pyrifera (M. pyrifera)*, a native New Zealand species. *L. digitata* has several common names, including in English oarweed or in Irish leathrach or coirrleach. *L. digitata* is a very common kelp found in low-level waters around the Irish, north European, and eastern North American coast, and can grow up to 2.5 metres long and 60 centimetres wide. Surveys of the Irish coast have found *L. digitata* around the entire Irish coastline, with 56 % of the coast from Donegal to Cork having some level of kelp coverage (Hession *et al.*, 1997). *M. pyrifera* is commonly known as giant kelp and is considered one of the fastest growing kelp species, with one individual growing to more than 45 metres, at a rate of as much as 60 centimetres per day.

Benefits to industry

Within a commercial context, the global seaweed industry is worth just under €5 billion per annum, with 85 % of this used for human consumption, and seaweed-based polysaccharides (carrageenan, agar, and alginates) accounting for almost 40 % of the world's hydrocolloid market. In Europe, brown seaweeds are traditionally used to produce additives (e.g., alginates) or animal feeds in the form of meal.

Almost 300 seaweeds have been investigated for their commercial potential, yet only five genera and 10 species provide 98 % of the seaweed required by the seaweed industry. Interestingly, *L. digitata* and *M. pyrifera* are not included in this list of utilised species.

In 2016, the *L. digitata* global wild harvest yielded ~45,000 tonnes,

and the yield of *M. pyrifera* was 31,835 tonnes, yet *M. pyrifera* only produced ~1 tonne through aquaculture, indicating the potential to increase this volume significantly, which would also protect the native kelp forests from further exploitation.

New knowledge from ALGIPRO

ALGIPRO is focused on these two relatively untapped kelp species for their aquaculture potential to produce kelp bioproducts at a viable commercial scale. This is being pursued through two aspects: firstly, optimised cultivation strategies to improve both the speed of biomass production and also the quality and quantity of bioproduct being produced; and, secondly, optimised extraction through scalable, less environmentally impactful extraction approaches. This will enable improved biomass recovery and conversion to viable products, as well as a reduction in solvent use and extraction costs, which is the area where commercial viability bottlenecks currently occur. Current cultivation trials using *M. pyrifera* are applying factorial analysis of cultivation conditions and concentrating on temperature in the first trial, and then light in the second trial. Recent studies have shown that these conditions significantly impact biomass production and algal health. Initial results from field samples indicate that the protein percentage of dry weight (DW) exceeds 12 %. The aim of this aspect of the study is to mimic optimised field conditions within an aquaculture environment. Regarding optimised extraction at scale, preliminary tests are being carried out at the Cawthron Institute in Nelson, NZ, where the analytical chemistry team is testing extraction protocols on cultivated *M. pyrifera*. The return phase of this Marie Curie co-funded fellowship with Teagasc will focus solely on the optimised, scalable extraction strategies, comparing conventional extraction systems with several new systems including microwave-assisted extraction (MAE), enzyme-assisted extraction (EAE) and pulse electric field (PEF) extraction.

Conclusion

The overall aim of this project is to produce viable bioproducts from these two species sourced for their protein and polysaccharide content. This project is included under the marine farm context and fits appropriately under the European Union's new 'Farm to fork' directive, investigating the marine farm potential of the native Irish kelp, leathrach.

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Authors

Diane Purcell-Meyerink
Marie Skłodowska Curie/Teagasc Research Leaders 2025 Fellow at the Cawthron Institute, Nelson, New Zealand
Correspondence: Diane.PurcellMeyerink@teagasc.ie

Maria Hayes
Research Officer, Teagasc Food Research Centre, Ashtown, Dublin 15

Mike Packer
Senior Research Scientist, Algal Biotechnology Group, Cawthron Institute, Nelson, New Zealand.