Left: AgriSea research technician, Taylor Moore checks Ulva australis (sea lettuce) growing in tanks as part of a trial to determine if it can help improve river water quality.

Sea lettuce shows promise

With a goal of less waste, less run-off, less nutrients entering the waterways, sea lettuce has great potential. By **Elaine Fisher.**

The very characteristics which cause Ulva australis (southern sea lettuce) to be a nuisance when it covers beaches and clogs marine structures and fishing lines, are those which make it potentially ideal for cleaning up coastal waterways.

Paeroa seaweed innovation company AgriSea is working with the University of Waikato (UoW) on a trial using sea lettuce to absorb excess nitrogen and phosphorus from waterways, enabling cleaner water to be returned to rivers, streams and the sea.

AgriSea's chief innovation officer Tane Bradley says the trial at Kopu near Thames, is already showing promising results.

"Now that we're in full swing, we're learning constantly and it's exciting to see the growth rates of the Ulva species and how it copes with unpredictable events such as recent extreme weather. There are promising results with an average over a seven-week period of seaweed tripling its weight every week."

The Government is investing more than $697,000 in the project through the Ministry for Primary Industries' Sustainable Food and Fibre Futures fund (SFF Futures). AgriSea is contributing $108,000 and the Agricultural and Marketing Research and Development Trust (AGMARDT) is investing $150,000. Thames-Coromandel District Council has gifted the land lease worth $40,000, with support from Ngāti Maru and Ngāti Hako. Hauraki District Council and Te Waka also assisted with the consent process.

Tane says the bioremediation project has the potential to remove nutrients, which have been contributing to a proliferation of sea lettuce in the ocean, from river systems.

"This trial is investigating the creation of a sustainable source of seaweed that can be processed into bio-stimulants and returned to the land. In this form, nutrients are more bioavailable, meaning the plants can uptake them much more efficiently. The ultimate goal is less waste, less run-off, less nutrients entering the waterways in the first place."

Ulva was selected because it has great bioremediation potential, and for its ability to remove nutrients and assimilate them into its tissue.

"Ulva australis has attributes that we wanted to test further, including its ability to tolerate

fluctuations in temperature, salinity, light, and nutrient availability, including an excess of nutrients."

AgriSea, which is leading the project, established the site and project team, liaised with manawhenua and brought other expertise onboard.

"We have employed a dedicated research technician, Taylor Moore, who maintains the site and is in charge of growing and harvesting the seaweed. Our role is essentially everything up to the analysis of the final product; the seaweed and water samples. We send the samples to Waikato University which is analysing the samples and compiling the data."

AgriSea CEO Clare Bailey says the UoW's engineers helped immensely in the set up and with council engagement and site design.

"Environmental research fellow Marie Magnusson has used systems like this in Australia. The catalyst was learning about these systems in Australia and seeking to see if they could be deployed here outside of a research lab in order to help clean water and provide efficient seaweed production. The IP will be open, and we intend to teach others about how to do this.

"The idea is that it can be easily scalable. For example the dewatering unit which reduces the water from the grown seaweed is actually a washing machine that has been modified."

Above: Sea lettuce is being grown in ponds at Kopu near Thames to see if it can absorb excess nitrogen and phosphorus from water.

Right: AgriSea chief executive Clare Bailey with Ulva Australis seaweed growing in tanks at the University of Waikato's Tauranga aquaculture facility.

BONUSES FROM THE SEA

THE TRIAL TO ESTABLISH IF ULVA australis (sea lettuce) can effectively remove nutrients from rivers may produce more than improved water quality.

"We are still exploring potential applications from this trial, which essentially is an environmental project but is also providing useful knowledge on growing seaweed that could be harvested and used in multiple ways, as AgriSea has done for 26 years," AgriSea's chief innovation officer Tane Bradley says.

"There are salts that can be extracted, processed to remove the protein content (at roughly 20 percent protein there is huge applicability here) and other extracts, all having commercial applications.

"AgriSea is a seaweed innovation company, and while we've been producing and refining our range of bio stimulants for use on farms and orchards for more than 25 years, we've also undertaken a lot of independent scientific research to diversify the uses of seaweed.

"This includes using what's left over as waste from producing our farm nutrition products. We partnered with Scion in a project to test the properties of different seaweeds, including Undaria

Clare says the idea isn't unique.

"Similar systems have been developed for large-scale wastewater treatment and by farmers treating their small wastewater sites. It can also use freshwater species, can be upscaled or downscaled very easily, and the variables (stocking densities, flow rates and temperatures) can all be adjusted to suit specific needs."

The project began with the collection of seaweed from a source near the trial site, which was cultivated at the UoW's aquaculture facility where researchers use DNA barcoding to confirm its genetic identity.

"Using various methods - the seaweed spores go through a tumble process which forces them to form little colonies. These are grown to a suitable size for our ponds and transported to Kopu for release into three ponds with a total area of 60 square metres," Tane says.

Water for the ponds is taken from the Waihou River and eventually pumped out to the river mouth after going through more filters to ensure no seaweed is released to the environment.

When seaweed grown in the ponds is harvested, a team of the university's algae scientists analyse the amount of nitrogen (among other things) present in the seaweed and in the water, to provide a measure of the N in the incoming and outgoing water to indicate how much is removed.

Minister for Primary Industries, Damien O'Connor said the aims of this two-year proof-of-concept research support many of the goals set out in Fit for a Better World, the Government's 10-year food and fibre sector roadmap aimed at lifting productivity, sustainability and creating jobs to drive New Zealand's economic recovery from Covid-19.

pinnatifida and Ecklonia radiata.

"Two years into the project, researchers commercially licensed a nanocellulose hydrogel to AgriSea, and our Paeroa factory is being upscaled for further development of this."

Hydrogels are used in burn wound dressings, biomedical engineering applications, drug delivery, cosmetics, and in agriculture supporting plant health to name a few examples. The gels can absorb vast amounts of water (up to 1000 times their own weight) to form a jelly-like substance.

Ecklonia radiata is used in AgriSea's product Fortress+ Dairy, launched as an animal nutrition supplement for dairy cows after being scientifically found to assist during the onset of lactation, when increases in metabolic demands can result in disorders, stresses and reduced milk production. AgriSea also produces an animal tonic in liquid form and has been working on developing a human health drink.

Despite research revealing new potential uses for seaweed and its extracts, Tane says AgriSea's main focus remains on helping farmers in New Zealand improve their farm profitability through soil and animal health.