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SCIENCE

Can We Kill *Caulerpa*?

Seabed at Aotea – Great Barrier Island carpeted with invasive seaweed species, Caulerpa (Photo: NIWA).

AN IMPACT REPORT FOR TE MOANANUI O TOI TRUST
FROM THE FACULTY OF SCIENCE

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Can we eliminate *Caulerpa* from our precious coast?

Two species of exotic seaweed, *Caulerpa parvifolia* and *Caulerpa brachypus*, were first identified in coastal waters of Aotea -Great Barrier Island in mid-2021. Since this time these invasive seaweed species have spread to a number of other coastal sites in north-eastern New Zealand. They are thought to be most likely accidentally transferred on anchors of vessels, such as yachts, that are moving between coastal locations. Both seaweed species are also capable of spreading vegetatively through sprawling growth across the seafloor and through the drifting dispersal of viable fragments that can establish at new locations.

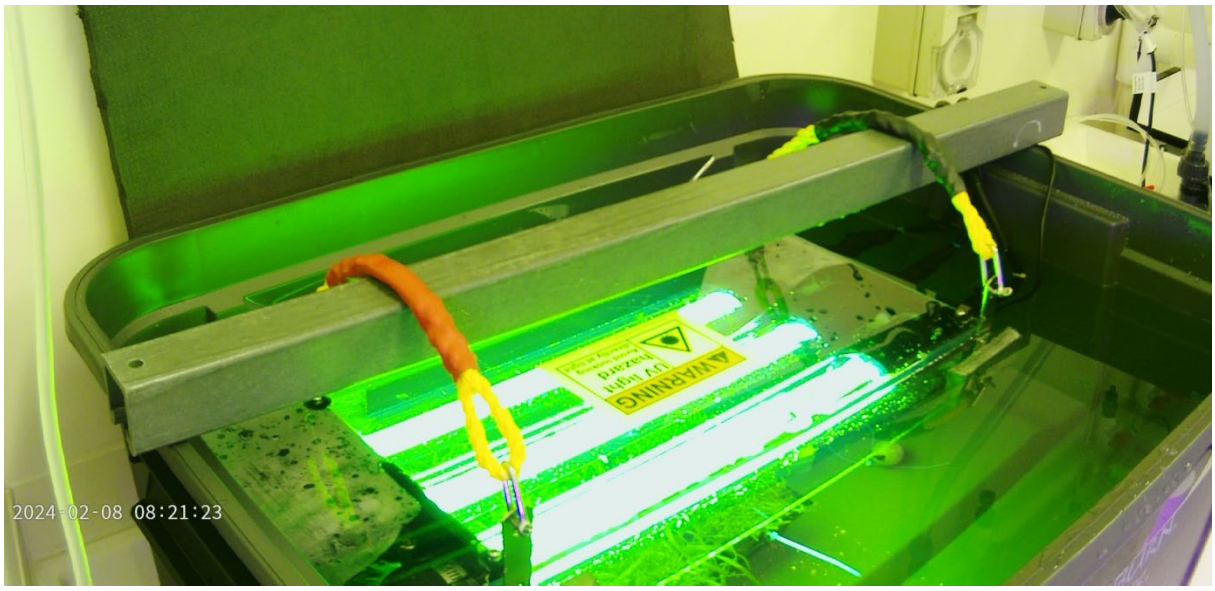
A number of exotic seaweeds have arrived in Aotearoa – New Zealand in the past, however, the arrival of these two *Caulerpa* species has caused widespread concern. Unlike many other exotic seaweeds, a variety of *Caulerpa* species are known from overseas to be both highly invasive and impactful on the natural marine environments to which they invade. This is largely due to their smothering growth form, which involves forming a fast growing and thick mat of vegetation on the seafloor, which smothers and excludes most other native species. The arrival of exotic *Caulerpa* in a number of locations around the world, has resulted in loss of natural seafloor diversity and associated productivity. For example, the spread of exotic *Caulerpa* in parts of the Mediterranean Sea have drastically altered natural marine habitats and resulted in a marked decline in important fish species. Hence, there has been a great deal of concern about the impact of the incursion of two exotic *Caulerpa* species into northern Aotearora – New Zealand.

Since the arrival of these exotic seaweeds, several control methods have been assessed including mechanised and diver-operated suction dredging, hand removal by divers, as well as smothering and chemical treatment. To date all treatment methods have been found to have significant drawbacks, including high cost, logistically difficult application, and generating an increased risk of spread through fragmentation of the seaweed. High power ultraviolet-C light (UV-C) has been used successfully for the treatment of nuisance lakeweed in the USA, but UV-C has not been applied for the control of nuisance seaweeds. Early in the incursion the idea of UV-C control of *Caulerpa* was put forward to government biosecurity advisors, but they were not supportive of testing its potential.

However, funding from Te Moananui O Toi Trust, together with hands-on help from iwi members, community groups and researchers enabled samples of both *Caulerpa* species to be moved into biosecure aquaria at the University of Auckland in early 2024. Quickly the project team worked out how to grow these seaweeds in captive conditions, enabling close-up and detailed research to be undertaken, including testing how to reliably kill them with UV-C light.

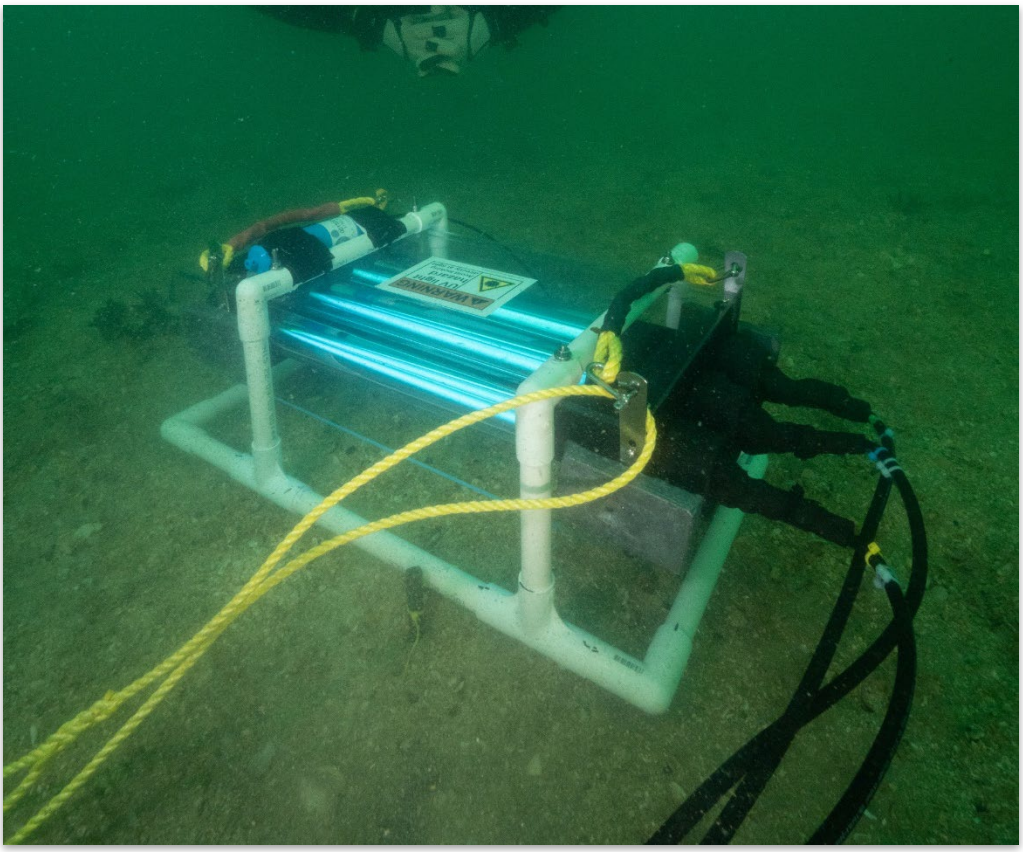
Caulerpa collected from seabed Aotea – Great Barrier Island community and taken into captivity at the University of Auckland's biosecure aquarium facility.

Once it had been figured out as to how the *Caulerpa* could be kept healthy and growing in the laboratory, a small UV-C lamp unit was imported from the USA to test with the *Caulerpa*. While both species were found to be affected by the UV-C treatment, one species was found to be more vulnerable, with a series of three doses of UV-C, each more than a week apart, being sufficient to consistently kill this species, *C. parvifolia*. The other *Caulerpa* species was found to be much more resistant to the UV-C treatment, rapidly recovering after the UV-C destroyed most of the seaweed fronds.



Small UV-C lamp being used to experimentally treat Caulerpa in captivity at the University of Auckland's biosecure aquarium facility.

The results from the study were sufficient to convince Auckland Council to support a field test of UV-C for controlling *C. parvifolia* at Rakino Island. The laboratory UV-C lamp was modified so it could be operated by divers and a rigorous treatment experiment was conducted over three months. The results showed that treating this *Caulerpa* species to UV-C could eliminate it from the seafloor.



Small UV-C lamp being used to experimentally treat Caulerpa on the seafloor at Rakino Island.

The results from Rakino Island were presented to the Biosecurity New Zealand, which is the government agency responsible for managing the *Caulerpa* incursion. The results were sufficiently promising for the agency to support a larger field trial of *Caulerpa* control which will commence in February 2025. The aim of this field trial is to deliver a UV-C system that can reliably destroy *Caulerpa* over larger areas of seafloor. The trial is set to run for six months.

In anticipation of this field trial, we have returned to the laboratory after importing more powerful UV-C lamps and discovered that with a higher dose of the UV-C light we can be much more effective at destroying both species of *Caulerpa*.

We are excited by the opportunity to develop a more effective tool for controlling *Caulerpa* in Aotearoa – New Zealand. The UV-C has the potential advantage of being cheaper to deploy, having less residual impact on the environment, and is less risky in terms of spreading *Caulerpa* via producing drifting fragments.

In addition, to the UV-C research and development, having *Caulerpa* in captivity has enabled some additional research on these invasive species, as relatively little is known about their

biology. Two research students have been investigating aspects of *Caulerpa* biology. One research student discovered an unusual marine snail living in the *Caulerpa* and is now examining the potential for using this snail, which loves to feed on *Caulerpa*, as a possible biocontrol method.

The second research student has examined the light, temperature, salinity and nutrient requirements of both *Caulerpa* species, so that we now have a much better understanding of what coastal areas are most at risk to further spread of the seaweed. Also, through this research we have noticed that *Caulerpa* is very vulnerable to elevated temperatures, a weakness that we believe with further research will also lead to another potential efficient control method. With further support from Te Moananui O Toi Trust we have been able to begin advancing the research efforts to advance this possibility also.

THANK YOU

- Thank you for helping to make this project possible, helping to empower a community to tackle a challenging threat to their marine environment, while also generating valuable new knowledge that can be used to continue to develop ways of controlling invasive seaweeds.

FINANCIAL INPUT

- The $25,000 contribution from the Te Moananui O Toi Trust has been largely used to cover cost of collecting and shipping *Caulerpa* into the laboratory and purchasing all the various aquaria equipment and consumables that have made this research possible.
- In addition to the generous contribution from the Te Moananui O Toi Trust, the University of Auckland has made a considerable contribution, supporting the research students with living stipends, covering their tuition fees, and providing all the research support and equipment. The research has used extensive amounts of staff time including academics and technical support, from aquarium and diving expertise. We are enormously grateful for the opportunity to partner with Te Moananui O Toi Trust and the community in this worthwhile research.

SUMMARY OF OUTCOMES AND IMPACT

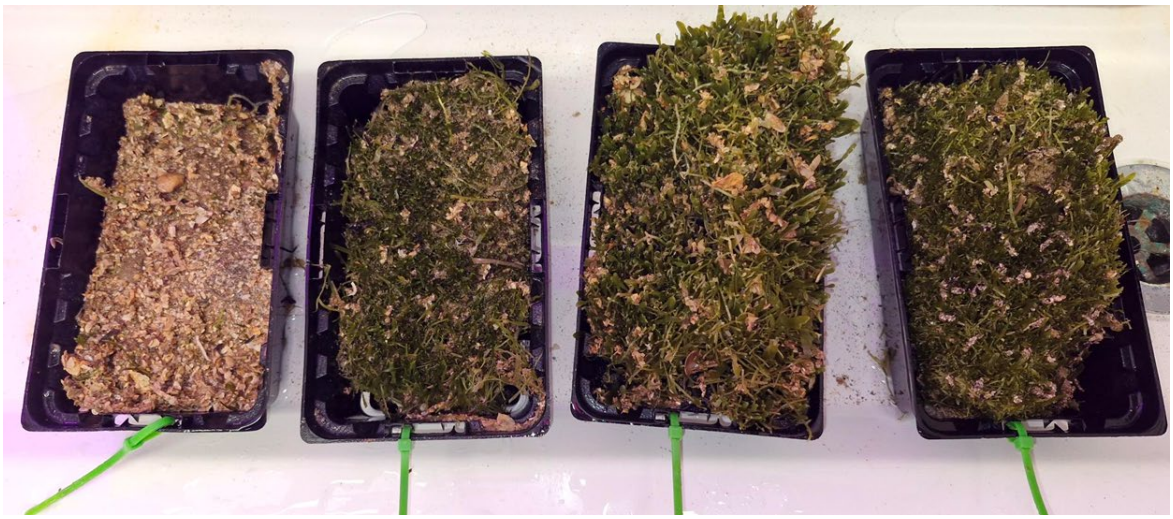
- Your support has helped enormously in laying a strong foundation for effectively tackling the incursion of exotic *Caulerpa* in Aotearoa – New Zealand's by:
    1. Helping with the research and development of a new and potentially highly effective tool for tackling the incursion of exotic Caulerpa, i.e., UV-C treatment.

2. Helping to empower the community and tangata whenua to tackle difficult challenges for their marine environment, with positive outcomes.
3. Enabling the generation of valuable new knowledge about the biology of exotic Caulerpa that can be applied to help manage this significant challenge.
4. Supporting the development of learning and expertise among students, university researchers, community and tangata whenua volunteers alike.

FUTURE PLANS

With the support of Biosecurity New Zealand, we will be undertaking a large-scale field trial of UV-C control of exotic *Caulerpa*, with the aim of developing an effective method for controlling *Caulerpa* in the coastal environment over large areas.

New knowledge coming directly from the project about the vulnerability of exotic *Caulerpa* to elevated temperatures will be closely examined through further research, with the aim of developing another approach to controlling exotic *Caulerpa* in the coastal environment of Aotearoa – New Zealand.



Caulerpa grown in the biosecure aquarium in small plastic nursery trays. The tray on the far left was treated with UV-C, the three trays to the right were the controls and were untreated.

For more information, please contact

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Bubble-snail discovered in Caulerpa from Aotea -Great Barrier Island in the biosecure aquarium at the University of Auckland. The snails have been found be voracious feeders of Caulerpa, opening the possibility that could be used as a method of biocontrol for Caulerpa (Photo: Brett Sutton)

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