National SCIENCE Challenges

RESEARCH ROUND-UP

Aquaculture: Tools, resources and research

This is a catalogue of our tools, resources and research that are relevant to aquaculture.

These were developed with stakeholders and Māori partners.
Some are already in use, others may require further development by users.

Summary

» AVAILABLE NOW

Visit the link or scan the QR code

Real-time forecasting tool

Digital Tool

This provides a daily forecast (like a weather map) of river plumes entering the sea and contaminant measurements that accurately estimate *E. coli* bacterial contamination risk in Tasman and Golden Bay waters.

Aquaculture farmers can use the tool to help manage shellfish harvest and minimise the number of days unnecessarily closed to harvest.

How much development is required?
Currently only applicable to Tasman Bay and Golden Bay. Costs to maintain this is estimated between $5,000 to $7,000 per month (depending on the extra features). Sampling costs are not included. With some further validation and testing this model could replace existing harvest rules.

Contact: Ben Knight, Cawthron
Find it at: sustainableseaschallenge.co.nz/real-time-forecasting-tool

Social licence language

Summary

The term 'social licence to operate' suggests that communities have power to grant or withhold approval of commercial operations in the marine environment. However, the language that the aquaculture industry uses when talking about social licence can empower or disempower communities.

This poster summarises the types of verbs that should be considered when discussing social licence to empower communities and build the genuine relationships required for social licence.

Find it at: sustainableseaschallenge.co.nz/social-licence-poster

Ecosystem services maps

Map

Knowing where biogenic refuge habitat is located can be useful when considering locations for aquaculture farm resource consents or marine spatial planning purposes. Biogenic habitat refuge maps are available for the Hauraki Gulf, Queen Charlotte Sound and Te Tau Ihu/Top of the South.

Find it at: sustainableseaschallenge.co.nz/ecosystem-services

Ocean Plastic Simulator

Digital Tool

This online public engagement tool tracks how floating plastic waste moves around Aotearoa New Zealand's coastline. With the right source data, it can be modified to show where plastic pollution has come from or to predict the movement of floating things. It has been adapted for use in environmental impact assessments and is being used to predict the ecological footprint of proposed salmon farm sites. The underlying model is being used in a number of ways, including research into biosecurity tools, tracking natural mussel spat, and the connectivity between farms to assess the risk of disease. The aquaculture industry could use it to track or predict larvae, spat, or lost equipment, and track the spread of disease or invasive species between farms.

Contact: Ross Vennell, Cawthron
Find it at: sustainableseaschallenge.co.nz/ocean-plastic-simulator

Ingredients Tool

Guidance

A practical one-page resource for marine managers, and others, to support broad participation in marine decision-making. If an aquaculture company is planning to expand operations, set up a new farm, or to improve community relationships, this can be used to structure discussions and encourage deep conversations.

Find it at: sustainableseaschallenge.co.nz/ingredients-tool

Ecosystem models

Model

We have developed a suite of ecosystem models to explore the implications of a range of environmental or management scenarios in Tasman and Golden Bays:

- *Atlantis Model* – An 'end-to-end' modelling tool that allows researchers and decision makers to test the effects of different scenarios on the whole ecosystem, encompassing everything from sunlight and nutrients through to predators and fisheries.
- *Food web model* and *size-based ecosystem model* – These are simpler to use with shorter run times than Atlantis and can be used to prioritise scenarios for Atlantis runs.

How to use this? For all these models, stakeholders and Māori partners can identify possible scenarios, but a modelling expert is required to run the models and support interpreting their outputs.

Contact: sustainableseasNC@niwa.co.nz
Find it at: sustainableseaschallenge.co.nz/ecosystem-models

Detecting harmful algal blooms

Our aim was to develop simple, cost-effective sensitive tests that could be used by public health agencies and the aquaculture industry to detect and monitor harmful algal blooms. These can reduce the risk of unnecessary closures. We trialled:

- *qPCR* – Detects and quantifies algal DNA in the water. The method was sensitive, simple and practical. We were able to estimate the amount of the algae present within 90 minutes of collecting samples. Cawthron is continuing to optimise this testing method.
- *Imaging FlowCytoBot* – This device can automatically identify and count algal cells underwater. Cawthron is now training image recognition software to identify local species, and working with an aquaculture industry consortium to investigate purchasing an IFCB.

Contact: Lincoln Mackenzie, Cawthron
Find it at: sustainableseaschallenge.co.nz/early-detection-of-harmful-algal-blooms

Aotearoa Cumulative Effects framework

A tool to help planners and agencies collaboratively manage cumulative effects across a range of scales (spatial and temporal), developed in partnership with Aquaculture New Zealand, government agencies and community representatives. It can be used to facilitate discussions with community, stakeholders, local authorities, and other users. It can also help identify potential issues to do with cumulative effects when developing resource consents applications.

Find it at: sustainableseaschallenge.co.nz/ace-framework

Mitigating ocean acidification around mussel farms

Two strategies – waste shell and aeration – were tested in field experiments to see how effective they are at mitigating acidification around mussel farms. Although we found that the two strategies have limited potential to mitigate ocean acidification around mussel farms (within the scope of this study), we have provided recommendations for future research:

- Investigate applying both strategies at the dropper line scale
- Consider more direct uses of waste shell such as calcination
- Aeration may be more beneficial upstream of the farm, as opposed to within it, but this requires further testing
- Assess natural 'bio-buffering' options such as macroalgae beds upstream of mussel farms

Contact: Cliff Law, NIWA
Find it at: sustainableseaschallenge.co.nz/mitigating-mussel-acidification

» UPCOMING RESEARCH

A novel approach to aquaculture in Aotearoa New Zealand

We are co-developing a 'disruptive' (ie different to the status quo) community-led business model that will allow small, whānau-owned aquaculture farms with fewer resources to compete as in the aquaculture industry. Pātiki tōtara/yellowbelly flounder is a strong candidate species for this new approach to aquaculture. This mahi is grounded in kaupapa Māori to reflect value across three key dimensions – hauora, oranga (social), kaitiaki (environmental/ecological) and mana motuhake (economic). We are:

- Exploring the relevant mātauranga Māori of pātiki tōtara
- Co-creating a minimal viable product based on a kaupapa Māori approach
- Advancing the science of pātiki aquaculture and hatchery technology

Contact: Simon Muncaster, University of Waikato
Learn more: sustainableseaschallenge.co.nz/a-novel-approach-to-aquaculture

Ecosystem connectivity: shellfish survival and salmon farm waste

We traced water and sediments from land through coastal food webs to identify the effects of key coastal developments (including aquaculture) on food web connectivity.

- *Shellfish survival* – We studied how changes in land-use have influenced uptake of organic matter and contaminants by bivalve populations including cockles, mussels, scallops and horse mussels
- *Commercial fish farms* – We studied how waste materials from salmon farming operations are taken up and processed by natural food webs

These two studies are expected to be published in 2021.

Contact: Steve Wing, University of Otago
Learn more: sustainableseaschallenge.co.nz/ecosystem-connectivity

» UPCOMING RESEARCH

Building a seaweed sector

Global seaweed production has more than doubled in the last 20 years, significantly exceeding natural supply. Seaweed aquaculture now accounts for more than 30% of global aquaculture production volume. We are co-developing a seaweed sector framework for Aotearoa New Zealand, incorporating EBM principles. We will test the framework using seaweed case studies to understand how it can effectively operate across different scales (local, regional, national; small to large businesses).

Contact: Serean Adams, Cawthron
Learn more: sustainableseaschallenge.co.nz/building-a-seaweed-economy

Indigenising the blue economy in Aotearoa

Extending earlier research by the *Whai Rawa, Whai Mana, Whai Oranga* project which mapped the Māori marine economy, this project will address key barriers that currently prevent Māori from using their marine resources in a more culturally relevant, economically impactful, and environmentally sustainable manner.

Contact: Jason Mika, Massey University or John Reid, J D Reid Ltd
Learn more: sustainableseaschallenge.co.nz/indigenising-the-blue-economy

Kohunga Kutai: creating a sustainable supply of seed mussels

Using mātauranga Māori and western science, we are working with iwi and three aquaculture business partners to develop an effective, biodegradable alternative to plastic spat-catching rope made from native plant fibres. Developing a commercial-scale, natural spat-catching product built on mātauranga Māori will help reduce plastic pollution from aquaculture activities, lead to the emergence of a new local industry based on native plants, and improve the sustainability of the green-lipped mussel industry.

Contact: Andrew Jeffs, University of Auckland or Nicola MacDonald, Ngāti Manuhiri Settlement Trust
Learn more: sustainableseaschallenge.co.nz/kohunga-kutai

Thinking outside the can: Engineering toheroa aquaculture

We are working with project partners Te Roroa and Bluetide Aquaculture to develop sustainable, community-based toheroa aquaculture in Te Taitokerau/Northland. While growing wild-harvested spat on farms has been successful for the green-lipped mussel industry, we are investigating if this approach will work for toheroa. We are also developing capacity and capability (including educational opportunities for upcoming generations) to support tangata whenua and community leadership and participation in aquaculture.

Contact: Phil Ross, University of Waikato or Taoho Patuawa, Te Roroa
Learn more: sustainableseaschallenge.co.nz/thinking-outside-the-can

Whakaika te Moana

Indigenous cultures have been practicing aquaculture throughout the Pacific for hundreds of years. Pre-colonisation, Māori aquatic cultivation economies existed in Aotearoa New Zealand and were anchored in practices like pā-ika and pā-auroa (eel-weirs).

We are exploring traditional aquatic cultivation practices (TACP) and knowledge held by our hapū partners from Whanganui and South Taranaki, and our indigenous relatives in Hawai'i and Canada, to grow our understanding of what hapū based aquaculture could look like.

The reconnection of hapū to mātauranga (Māori epistemology) tikanga (managerial customs), kawa (customary lore) and TACP, will enable hapū to reclaim and re-establish local economies based on TACP. Not only does this support a blue economy in Aotearoa New Zealand, it will also be a catalyst for Māori development and support kaupapa Māori approaches to aquaculture.

Contact: Te Rerekohu Tuterangiwhiu, Cawthron
Learn more: sustainableseaschallenge.co.nz/whakaika-te-moana

Watch now

The following videos, webinar or public talk recordings are useful resources.

Find them at: bit.ly/SusSeasYouTube

- Webinar: **Tracking ocean plastic**
- Video: **Mitigating ocean acidification**
- Webinar: **Measuring and mapping ecosystem services**
- Webinar: **Which ecosystem model works best for what you need?**
- Webinar: **Detecting and forecasting coastal contamination**