Considerations for assessing the environmental effects of seaweed aquaculture in Aotearoa New Zealand

Purpose statement

Seaweed aquaculture is an emerging industry in Aotearoa New Zealand. Growers are increasingly interested in expanding into seaweed aquaculture, particularly green-lipped mussel (*Perna canaliculus*) farmers looking to add seaweeds to existing consents. This document compares the environmental impacts of seaweed and mussel aquaculture and proposes some key management considerations to provide clarity when assessing environmental effects.

Seaweed aquaculture in Aotearoa New Zealand

As seaweed aquaculture is in the early stages of development in Aotearoa New Zealand, it is unclear which species and cultivation methods will be adopted by industry. However, initial trials have focused on growing seaweeds from longlines, similar to mussel aquaculture (Figure 1).

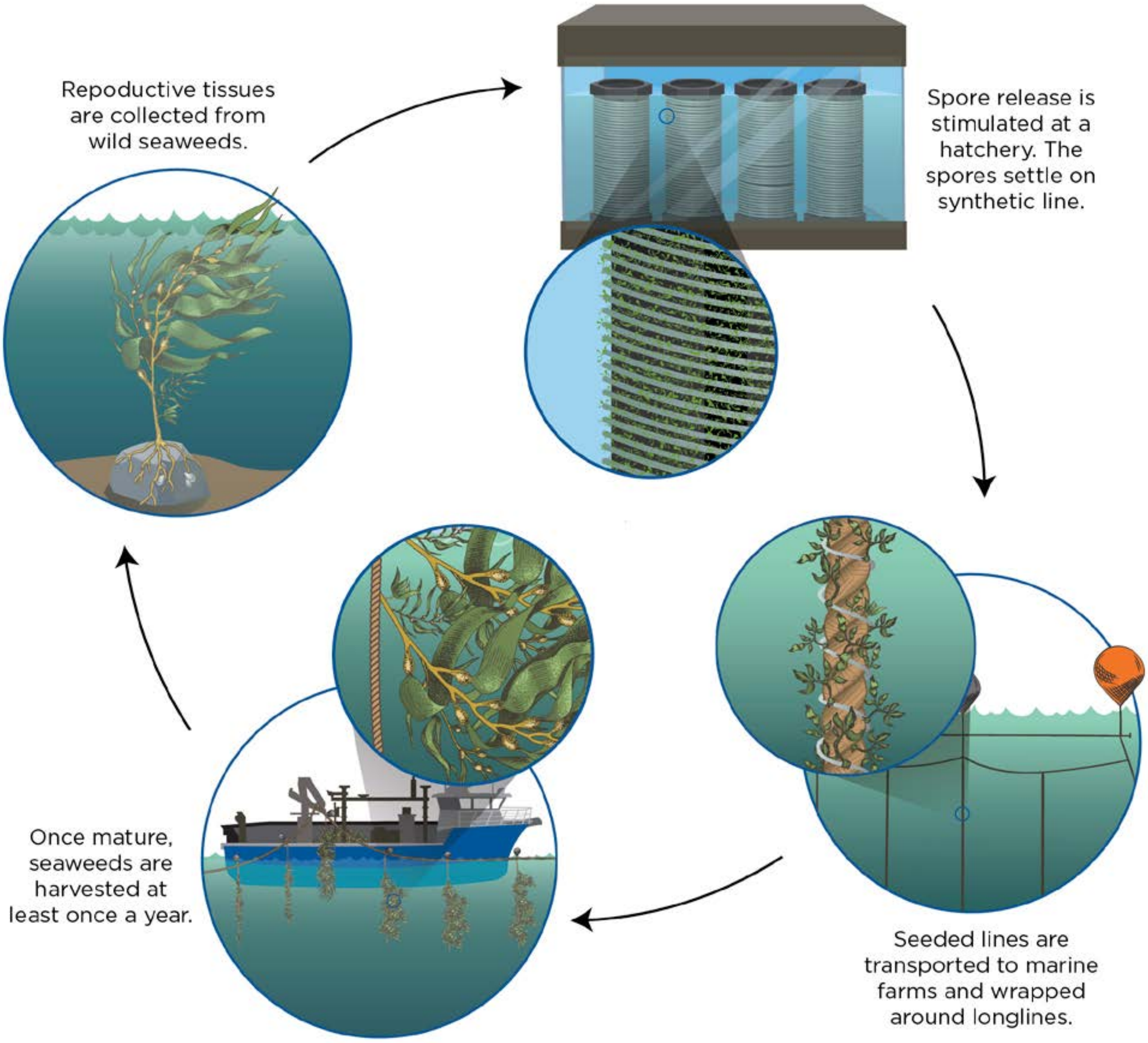

Figure 1 The typical production cycle for seaweed aquaculture operations located outside of Asia.

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Comparison of environmental impacts

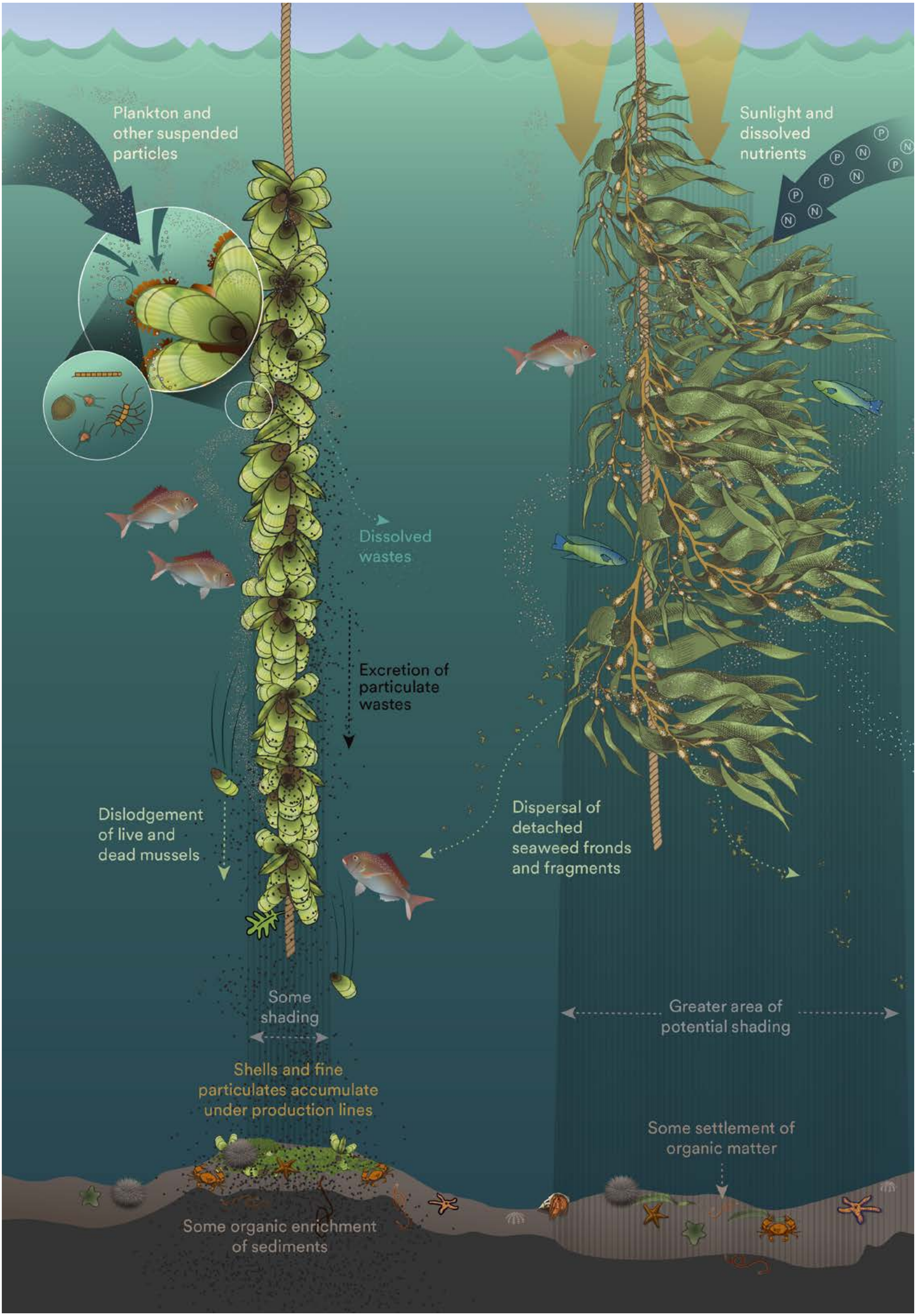
Aquaculture impacts are primarily driven by the production methods used and the feeding and excretion of the culture species. The following comparisons assume that seaweed and mussel aquaculture use similar long-line production systems.

Benthic Impacts

Mussel aquaculture	Seaweed aquaculture
Benthic and sediment composition	
Shells, mussels, and particulate wastes can accumulate under mussel production lines. This can increase the organic content of underlying sediments, elevate bacterial activity, deplete oxygen, increase sulphides, and promote changes in sediment size. These effects may promote greater abundances of enrichment-tolerant invertebrates, and attract scavengers and deposit feeders, such as star fish and sea cucumbers.	While seaweeds do not excrete particulate wastes, they do continually shed tissues as they grow. The release of seaweed tissues from large-scale farms could also potentially elevate bacterial activity and deplete oxygen within sediments and the surrounding water. Nonetheless, at similar scales, seaweed farms are expected to have less impact on benthic environments.
Shading	
Mussel lines and floats can shade the area underlying marine farms. This can negatively impact primary producers such as macroalgae.	As seaweeds float and spread out in water, they may shade and impact primary producers to a greater extent than mussel farms of equal size.

Water column impacts

Mussel aquaculture	Seaweed aquaculture
Plankton abundance and size	
High densities of filter feeding mussels may cause localized depletions in plankton and other suspended particles. In some cases, this may improve water quality but potentially impact the base of the food web.	Seaweeds absorb dissolved nutrients from the surrounding water. This may help improve water quality but reduce the amount of nutrients available to plankton and marine plants. This impact is unlikely at small to mid-scales.


Plankton and other suspended particles
Sunlight and dissolved nutrients
P
N
Dissolved wastes
Excretion of particulate wastes
Dislodgement of live and dead mussels
Dispersal of detached seaweed fronds and fragments
Some shading
Greater area of potential shading
Shells and fine particulates accumulate under production lines
Some settlement of organic matter
Some organic enrichment of sediments

Core principle: At equal scales, the impacts of seaweed aquaculture are likely to be similar or less than mussel aquaculture. If the environmental impacts of a mussel farm have been evaluated and deemed acceptable, the same site should be able to accommodate the potential impacts of a seaweed farm.

Key considerations for seaweed aquaculture

Sensitive habitats

Aquaculture production lines may shade the underlying area, while the installation and dragging of anchors and warps can physically disturb benthic habitats.

Mitigation: As with other aquaculture operations, seaweed farms should not be placed directly over sensitive habitats.

Species and seedstock

Farmed seaweeds could release genetic material (e.g. spores and gametes) into the surrounding water, facilitating their establishment outside farm boundaries. This could be an issue if the species is not naturally present in the area, or if selective breeding has promoted large genetic differences between farmed and natural populations.

Mitigation: Using locally sourced brood stock or reproductive material is likely the most effective way to mitigate this risk until the broader implications are understood.

Wildlife entanglements

The lower tension ropes used in seaweed aquaculture are likely to pose a greater entanglement risk for marine wildlife than mussel farming. In addition, floating seaweed fronds may obstruct the vision of wildlife leading to reduced avoidance.

Mitigation: Minimising entanglement risks will require implementing proper siting, design, layout and operational standards (e.g. marine mammal management plans).

Uncertainties

As seaweed aquaculture is still an emerging industry in many countries around the world, there are still many uncertainties regarding its potential environmental impacts. However, future studies may help address these uncertainties as research in this area increases.

For more information on this project, visit:

Summary report available at sustainableseaschallenge.co.nz/tools-and-resources/key-environmental-considerations-for-seaweed-aquaculture

Stocktake and characterisation of Aotearoa New Zealand's seaweed sector: Environmental effects of seaweed wild-harvest and aquaculture available at: sustainableseaschallenge.co.nz/tools-and-resources/nz-seaweed-sector-review-part-3/

Seaweed Framework available at www.sustainableseaschallenge.co.nz/tools-and-resources/seaweed-sector-framework/

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