Tasman Aquaculture Review

PREPARED FOR TASMAN DISTRICT COUNCIL | JUNE 2021

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Revision Schedule

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
0	22/6/21	First draft	FL	RP	RP	
1	23/6/21	Draft for client	FL			FL
2	25/6/21	Second draft	FL	RP	RP	
3	25/6/21	Final				FL

Quality Statement

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STATUS Final | Project No 310003227

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Tasman District Council has embarked on a review of the Tasman Resource Management Plan that will include review of the current aquaculture provisions. As a first step in that process, the Council wishes to understand whether the current provisions are fit for purpose and to identify future areas of demand from the aquaculture industry.

Industry interviews and a literature review have informed the development of this report. Interviews were conducted with the majority of the industry participants in Tasman, and with two of the three research providers. Advice was sought from participants on likely future species to be grown in the Tasman region, existing and future demand for space for aquaculture, requirements for research and experimental aquaculture, and on-land infrastructure needs. Participants were also asked for their views on the contribution that conservation or restorative aquaculture could make in the region.

The only species currently grown in Tasman are green lipped mussels. The majority of participants in this report noted an interest in seaweed aquaculture in the future, and several other bivalve species are also considered potential candidates. Opinion is more divided on finfish aquaculture, with a recognition that any finfish aquaculture would need to occur further offshore than the current Aquaculture Management Areas and with species that are adapted for the current and likely future water temperatures in the bays. Interest was also expressed in polyculture.

While a number of industry participants consider that there is sufficient space for the industry in the existing Aquaculture Management Areas, interest continues to be expressed by some in further space. A common theme of feedback was that the existing space could be used more efficiently than is currently the case, with provision for different structures, multiple species consenting and different uses of the current seasonal and rotational spat catching space. Offshore space, and nursery space for shellfish between spat and grow-out were also identified as potentially desirable.

Spat supply remains a critical issue for industry, both in terms of access to spat and spat retention. The spat catching sites at Wainui Bay are considered to be very important, partly because of the contribution they make to the diversity of spat that can be farmed (with associated production benefits) and because of the large amount of spat that is produced from a relatively small area. Spat retention continues to be an issue, and it was noted that the prime periods for spat settlement in the bays now seem to be out of step with the period prescribed in the Tasman Resource Management Plan.

The flexibility to undertake small scale trials and experiment with species and structures more easily was noted by all industry participants who mentioned experimental aquaculture in discussion, and for the two research providers access to research space is seen as critical and not currently easily available.

Issues with on-land infrastructure primarily relate to the facilities at Port Tarakohe, which are seen as not fit for purpose and dangerous at times. Particular concerns were expressed about how the port infrastructure will cope when mussel farming is at full production, with issues being experienced now when farming is not fully developed. Issues with the Takaka Hill Road, and accommodation for workers in Golden Bay were also raised.

A role for aquaculture in conservation and restoration activities was acknowledged by a number of participants, with the seabed condition in the bays of particular concern.

Review of the potential future demands for aquaculture against the provisions of the Tasman Resource Management Plan have demonstrated a number of areas where the provisions could be reviewed to enable, or at least not hinder, future development of the aquaculture industry in the region. Key areas include the dates of the spat catching season, availability of spat holding space, continuation of spat catching sites at Wainui Bay, provision for more flexible use of marine farming space in the Aquaculture Management Areas, and potentially provision for aquaculture further offshore.

1.0 INTRODUCTION

Tasman District Council (the Council) has embarked on a review of the Tasman Resource Management Plan (the TRMP) that will include review of the current aquaculture provisions. As a first step in that process, the Council wishes to understand whether the current provisions are fit for purpose and to identify future areas of demand from the aquaculture industry. Stantec New Zealand (Stantec) was contracted to contribute to this first stage of review.

1.1 SCOPE

The scope of the project was to understand future demand and options for innovation for aquaculture in Tasman and Golden Bays, and to undertake a first, high-level review of the TRMP provisions to identify whether they enable or hinder the desired future development. The scope was focused on a series of questions:

- What species do the industry want to grow in Tasman District (finfish, seaweed, other bivalves, other species)?
- New thinking around spat catching and retention – what's changing/developing?
- Where do these species need to grow (inshore/offshore)?
- Is there sufficient space to accommodate aquaculture growth?
- Experimental aquaculture – does or is this adequately provided for, where does it need to take place or where would it be most likely to occur, what does it look like in terms of activities?
- What changes in farming practices are likely to occur over the next 10-20 years (e.g., structures, harvesting practices)?
- What infrastructure is likely to be needed to support change or growth in the industry (e.g., housing needs)?
- Are there options for and interest in restorative and conservation aquaculture in Tasman?
- What are iwi aspirations for aquaculture (commercial and settlement)?

A decision was made early in the project that iwi aspirations for aquaculture in relation to settlement would be investigated by Tasman District Council through consultation with iwi, and that Stantec would concentrate on the commercial operations of iwi.

1.2 METHODOLOGY

Initial scoping discussions were held with the Council, Aquaculture New Zealand (AQNZ) and the Marine Farming Association (MFA) to confirm the questions to be investigated, develop an understanding of the most effective ways to involve industry and seek industry contacts. MFA and AQNZ provided contact names for the majority of the industry participants in the region, particularly the major consent holders, but also a series of smaller operators.

Four days' worth of industry interviews were conducted in Nelson and Motueka in late May 2021 with industry participants and two of the three research institutes working in aquaculture. For those individuals or organisations unable to be seen in that week, follow up discussions by Zoom or in person in Christchurch were held in the first three weeks of June, to provide as wide a coverage of the Tasman and Golden Bay industry as possible.

In parallel with industry discussions a literature review, primarily of New Zealand work relevant to innovation in aquaculture was undertaken. The current TRMP provisions were also reviewed, to inform the planned high-level review of the interaction between plan provisions and future demand for aquaculture in the region.

1.3 REPORT STRUCTURE

The structure of this report is as follows:

- Section 1 provides an overview of the project, its scope and methodology
- Section 2 identifies future demand for aquaculture in the region from industry interviews and literature, grouped into a series of major topics:
    - Species
    - Space
    - Structures
    - Experimental aquaculture
    - Infrastructure
    - Restorative and conservation aquaculture
    - Spat
    - Other matters raised during discussions

  Each section commences with the feedback received from industry, and then outlines the major themes derived from the literature review, many of which support the industry feedback received and provide a useful cross-check of it. A summary of the key findings of section 2 is provided at its end
- Section 3 addresses the current TRMP provisions, and using the results of the investigations outlined in Section 2, considers at a high level the extent to which the plan provisions enable or hinder future aquaculture development in the region
- Section 4 provides a brief conclusion.

2.0 FUTURE AQUACULTURE IN TASMAN

2.1 SPECIES

2.1.1 Industry feedback

The only species currently grown in Tasman are green lipped mussels. Green lipped mussel spat, and scallop spat are caught, with scallop spat being grown and then redistributed onto the seabed as part of a scallop enhancement programme (although that programme is currently running at about 10% of its previous capacity).

In discussions with industry, interest was expressed in the following species:

- Seaweed – 14 of the 17 industry individuals or companies spoken to expressed an interest in seaweed aquaculture
- Flat oysters[1]
- Scallops – if grow-out could be commercialised
- Blue mussels
- Ribbed mussels
- Toheroa
- Geoduck
- Paua
- Sponges

[1] Although the recent removal of flat oysters from all marine farms in the Marlborough Sounds due to concerns with importing *Bonamia ostreae* to Southland may cause a significant degree of caution about proposals to commence marine farming again (MPI, 2020).

- Fish species – hapuku, flounder, snapper, kingfish, trevally as examples

Opinion was divided on finfish aquaculture in Tasman. While there is interest in finfish aquaculture from some of the industry, from research providers and from the Government, other noted that environmental conditions are likely to make finfish aquaculture challenging. Water temperatures are generally accepted as too warm for salmon, and currently too cold for kingfish or snapper. A water depth of 30 – 40m, with good tidal exchange is also needed to manage seabed enrichment effects (near seabed currents in the bays are in the order of 5 – 10 cm/s in the AMAs – Zeldis et al, 2011a, p. 6). Tasman and Golden Bays are relatively shallow, with 30m water depth not being reached until a considerable distance offshore, particularly in Golden Bay (see Figure 1). Locating aquaculture a long way from shore will have economic impacts both in terms of the distance that harvested product needs to be moved (and that vessels need to be operated over) and the investment in structures required to farm in very exposed conditions.

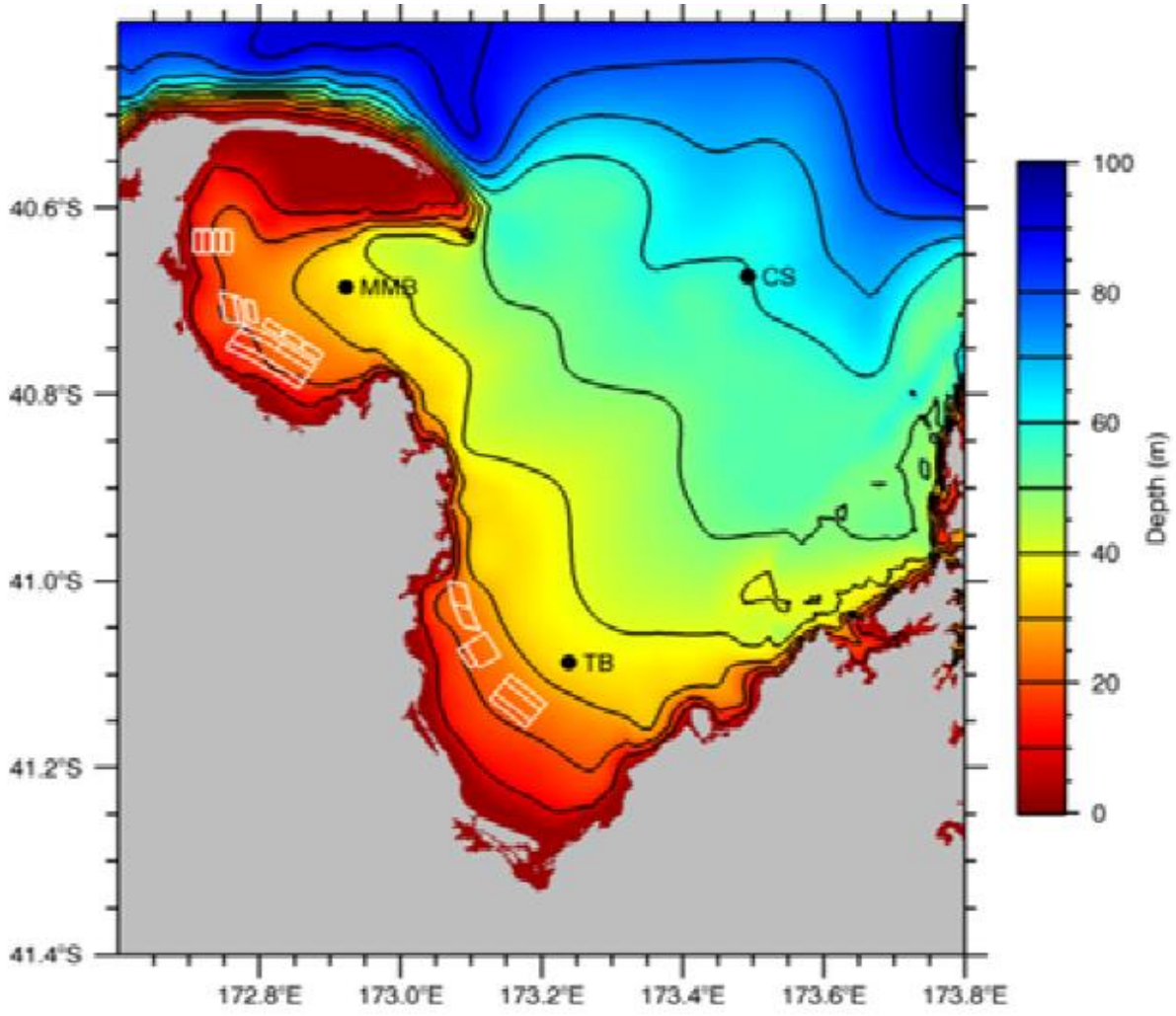

Figure 1: Bathymetry Tasman Bay and Golden Bay

Source: Zeldis et. al., 2011, Figure 2

A number of industry participants noted a desire for polyculture or integrated multitrophic aquaculture and would like to be able to grow more than one species on any given line.

2.1.2 Literature review

There is a good-sized body of literature available on innovation in aquaculture species in New Zealand, including seaweed, finfish, geoduck and integrated multitrophic aquaculture.

Seaweed aquaculture in New Zealand has been described as being at an 'early developmental stage', with the potential to provide 'high quality, pollution-free seaweed stocks, as well as value-added nutritional and cosmetic products (White and White, 2020). White and White (2020) provide a comprehensive recent review of current seaweed harvesting in New Zealand, with 59 marine farmers (over 170 marine farms) currently consented to 'farm' seaweed. Current farming largely consists of harvesting seaweed that has settled and grown on mussel long lines, rather than actively seeding stock and then harvesting it. Recent research into the aquaculture of *Sarcothalia atropurpurea* (an endemic red seaweed that produces the carogeenan used in gelling, stabilizing and thickening agents) and *Gigartina atropurpurea* has shown that production of spores in the laboratory and their on-growing in open water is possible, but neither has been commercialised to date (McNeil & Falshaw, 2017; McNeil, Page and Falshaw, 2003). Interest is growing throughout New Zealand in farming of *Asparagopsis armata*, with recent success in triggering spore release meaning the likely upscaling of an existing pilot farm at Stewart Island (Steyl, 2021), and at least one industry organisation in Tasman expressing interest in a consent variation to provide for harvest from current farms.

Commercialisation of seaweed aquaculture still needs to address a number of issues, including challenges of producing spores (rather than harvesting plants as the first stage of farming from the wild), outplanting them and ensuring they survive, harvest method (pruning vs removal of whole plants) and the area of space likely to be needed for full-scale production (McNeil, Page and Falshaw, 2003; Heasman et. al., 2020).

In terms of finfish, domestication of both kingfish and hāpuku has been progressing. Kingfish are now being grown in a land-based recirculating aquaculture facility at NIWA's Bream Bay Aquaculture Centre in Northland, but do not appear to be destined for marine grow-out in the near future (NIWA, 2020). The upper North Island represents the area that is most likely to be suitable for the culture of kingfish, having a warmer water temperature profile, sites suited to sea pen farming, and existing infrastructure in many locations. The one previous attempt to grow kingfish at Crail Bay was unsuccessful because of low water temperatures (Symonds et al, 2014) and this is therefore likely to pose a challenge in Tasman as well. There are also potential issues with parasites for endemic kingfish (Symonds et al, 2014). NIWA is continuing to work on development of hāpuku broodstock, but no commercial farming has been undertaken to date. NIWA noted hāpuku in the reports prepared at the time of the aquaculture reform legislation in 2011 as a finfish species that might be suitable for Tasman (Zeldis et. al., 2011a).

Geoduck is currently caught from a small area of Golden Bay, but there appears to be little information on the location or size of the broodstock population, nor on where other populations in New Zealand might be located. While geoduck aquaculture appears possible there are a number of unanswered questions in relation to stocking density, suitable growing space and potential long terms effects on ecosystem processes and biodiversity (Gribben and Heasman, 2015; Forrest and Hopkins, 2017). A question also remains about whether geoduck aquaculture meets the definition of aquaculture activities under the Resource Management Act 1991.

Overseas, innovation is also occurring in the development of integrated multi-trophic aquaculture (also referred to as polyculture). A good overview of both the concept of, and recent work in, integrated multi-trophic aquaculture can be found on the following webpage of the Fisheries and Oceans Canada website: https://www.dfo-mpo.gc.ca/aquaculture/sci-res/imta-amti/imta-amti-eng.htm.

Integrated multi-trophic aquaculture is likely to be most effective when a combination of species, each occupying a different trophic level are included in the overall scheme (Zeldis et. al., 2011b). Figure 2 illustrates the Canadian concept of integrated multi-trophic aquaculture, showing an upper trophic level of finfish, with lower trophic level species such as bivalves and seaweed removing nutrient excreted by the fish into the water column, and deposit feeders such as sea cucumbers and sea urchins feeding on the fish detritus.

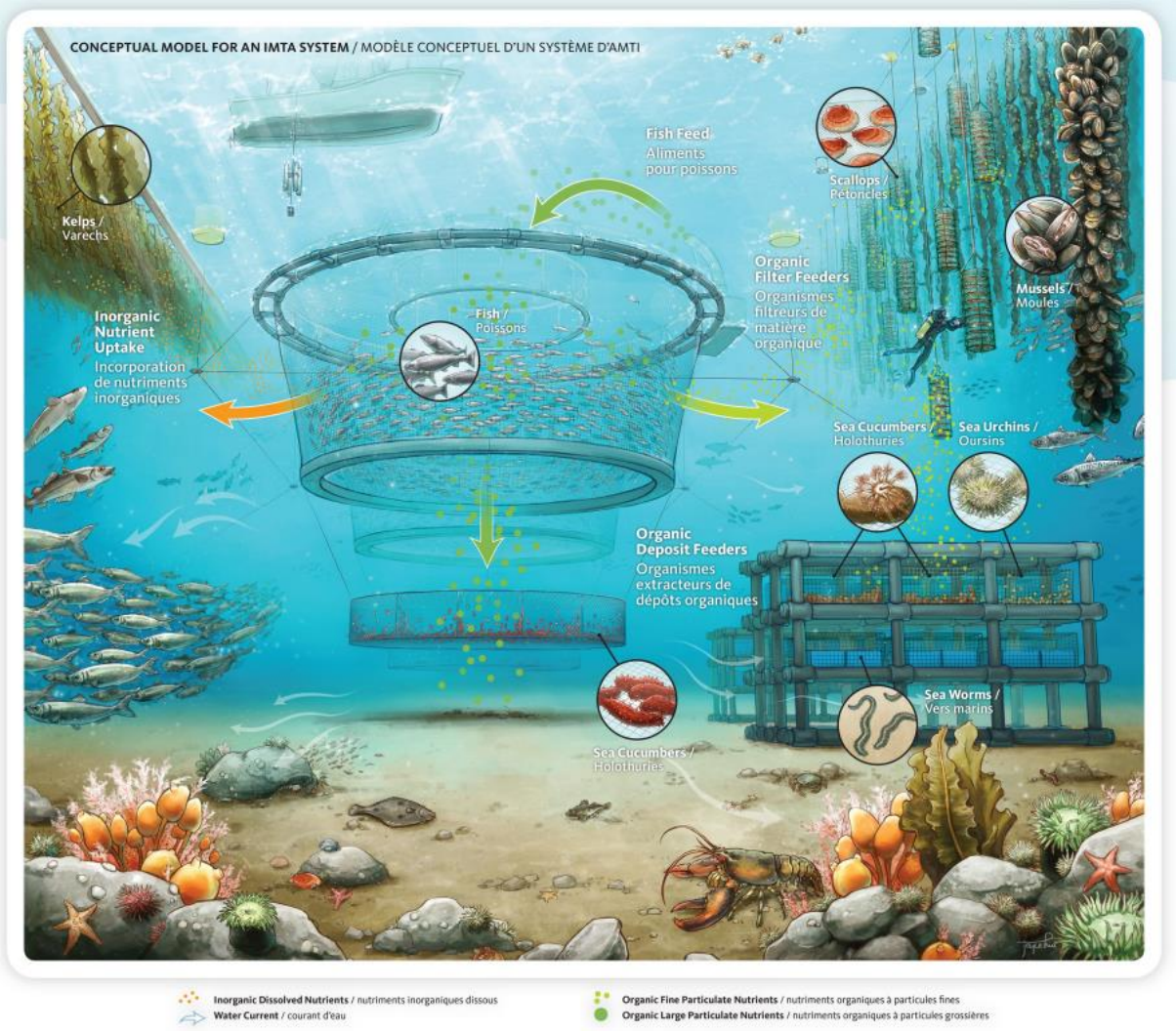

Figure 2: Conceptual model for an integrated multi-trophic aquaculture system

Source: Fisheries Canada

Integrated multi-trophic aquaculture operations can also provide habitat and foraging opportunities for marine invertebrates, marine mammals and seabirds (O'Shea et. al., 2019).

2.2 SPACE

2.2.1 Industry feedback

Industry responses to questions about whether there was sufficient space in the current AMAs followed three themes:

- That there was sufficient space for the next 5 -10 years (particularly considering that not all sub-zones are currently at full development), but after that it was possible that either further space would be needed or that the existing space would continue to be sufficient
- That whether there was sufficient space really depended on how the market develops over time and the demand for seafood

- That there will always be demand for new space, with some industry participants constantly on the lookout for further space that they may be able to develop within the AMAs, and those participants more likely to be interested in further space beyond that provided by the existing AMAs.

Those participants who identified that there was sufficient space did note that increased use of existing space could be made, and either transitioning spat catching space to farming space as needed or providing for spat holding space in the identified spat catching sub-zones to free up lines in marine farming space could provide more efficient use of space without having to increase the area available for aquaculture in the bays. Flexibility in the use of the current space in terms of structures and species was also seen as critical to ensuring that it was used as efficiently as possible.

Some participants noted that spat supply was likely to be the larger constraint than water space over time (see section 2.7 below).

In terms of where the existing marine farming and spat catching space is located, discussion with industry suggests that:

- Space in a different location may be needed for the intermediate stage between spat and grow-out, although it is not currently known what makes up good nursery space
- Space may be needed for restorative or conservation aquaculture (see section 2.6 below)
- Issues with spat retention may mean that current spat catching space is not ideally located (see section 2.7 below)
- Overall, the industry is happy with the marine farming space currently available in golden bay, and increasingly with the Tasman bay space
- There is interest in offshore aquaculture (although a number of industry participants noted that the existing amas would already be considered to be offshore aquaculture), but this was tempered by economic, access and physical conditions considerations, and 'inshore' space will still be needed to support it

2.2.2 Literature review

Most of the relevant literature relates to offshore space. It is worth noting however that as part of the preparation of its 2019 report *Farming the Sea*, the Environmental Defence Society was told that now that the AMA space was operational there was more than enough space to meet current and future anticipated demand. This does not necessarily accord with universal industry opinion (EDS, 2019). The EDS report also notes that increased spat retention may result in increased production from existing space (EDS, 2019).

The report *Towards a Blue Revolution* (O'Shea et. al., 2019) notes that worldwide, most commercial offshore projects have come online in the last five years, so it is a relatively recent phenomenon worldwide. Due to relatively high capital requirements, the complexity of operations in these more exposed locations, and general uncertainty about how regulation will be implemented, early users of offshore space tend to be highly risk tolerant. In the Norwegian industry (which is probably the most advanced in terms of offshore finfish aquaculture), proposals are being developed by major industry players who have an annual revenue starting at $250 million[2] (O'Shea et. al., 2019). Whether the New Zealand industry therefore has sufficient capital to develop space further offshore in Tasman remains a question. In addition, the need for more robust equipment to withstand conditions, restricted access due to weather conditions, distance for vessels from ports and the need for structures to be modified to deal with the conditions all add uncertainty and cost to open ocean aquaculture (Heasman et. al., 2020)

[2] Assumed to be expressed in $US.

2.3 STRUCTURES

2.3.1 Industry feedback

Relatively little feedback was provided by industry on structures, beyond the general request for flexibility in the use of space within the existing AMAs, which would be likely to incorporate flexibility in structures.

Research providers however were very interested in provision for trials of novel structures. Structures mentioned during industry discussions included:

- Continuation of the existing longline structures, but with changes such as larger but fewer floats, or changes to address float attachments and reduction of debris
- Use of suspended cages for growing scallop spat (to up to 75mm)
- Mobile structures that move around a single point mooring
- Use of netting at or near the surface for seaweed
- More robust structures for open ocean aquaculture (see section 2.3.2 below)

Addition of wind farms, solar arrays and wave energy generators to farms were also noted as possibilities.

For some industry participants technical advances tend to be incremental and come from existing industry players trying things on farms (for example, a couple of lines of different species within an overall green-lipped mussel farming operation).

2.3.2 Literature review

Recent innovations in structures have tended to be related to open ocean aquaculture – both finfish and shellfish farming.

Development of new structures for salmon farming has increased in momentum in recent years (EDS, 2019). Norway is leading the development of these structures, with versions including submersible cages (Akva), oil rig type designs (Ocean Farm 1), ships (Havfarm) and large fully enclosed structures (Huage Aqua's The Egg, and MNH's Aquatraz) (O'Shea et. al., 2019). Links to websites about each of the structures are included in the references list. In 2019 The New Zealand Institute for Plant and Food Research Limited received 5 years of funding for the development of a Mobile Autonomous Production System (MAPS), intended to be a low impact, offshore mobile technology for finfish production (https://www.plantandfood.com/en-nz/article/six-endeavour-fund-successes-for-plant-food-research).

The Cawthron Institute is also investigating new open ocean structures, for shellfish aquaculture. The general approach is that open ocean structures need to be stable and robust in much higher energy conditions than inshore structures are subject to, and that it is not enough to use the same design but make the ropes thicker, the anchor systems heavier and the shackles larger. A technological revolution in structures is required, with structures currently being piloted in the Bay of Plenty including a shellfish 'tower' and a double backbone longline structure. (Heasman et. al., 2020).

2.4 EXPERIMENTAL AQUACULTURE

2.4.1 Industry feedback

Feedback from industry and research providers showed two broad types of experimental activity occurring or proposed in the coastal marine area:

- Small scale experimentation by marine farmers on existing farming or spat catching areas – such as the trialing of new species on one or two lines within a marine farm, or the development of subtle changes in structure design. Examples include the growing of settled scallop spat in suspended cages, and the development of mussel floats that need less or no lashing

- Research experimentation into new structures and new species, including performance monitoring and remote technology, that requires access to marine space

The flexibility to undertake small scale trials and experiment with species and structures more easily was noted by all industry participants who mentioned experimental aquaculture in discussion. Unsurprisingly both of the research providers with whom discussions were held identified access to research space as critical to their work. Both Cawthron and Plant and Food currently access space by reaching arrangements with existing consent holders, but identified inadequate provision for experimental aquaculture as a significant bottleneck to long-term research plans. Ideally a variety of spaces are needed, at varying distances offshore, to cover the majority of research needs. Within these spaces flexibility is needed in feed types, species and structures for periods of 6 weeks to two years, or for longer term projects with species through three production cycles to recognise the possibility of time lags in establishing experimental work and crop failures.

The idea of a collective research space to act as a research hub, with no provision to turn it into commercial space, but with provision for both industry and research providers to test ideas, was suggested as a potential solution. Alternatively, facilitating research work throughout the region's coastal marine area but not allocating space for it would ensure that the correct conditions for each specific research programme could be utilised.

2.4.2 Literature review

Work on structures by Cawthron and Plant and Food has been discussed in section 2.3 above. Both research providers also have breeding programmes for various species, which are regularly reported in the literature.

The importance of research space is recognised by EDS, which suggests the creation of research and development hubs and pilot farms (EDS, 2019). Camara and Symonds note that in order to be sustainable and profitable marine farmers require stock that performs well under commercial culture conditions, and that investment in genetics and biotechnology is therefore also needed (Camara & Symonds, 2014). These requirements speak to the importance of on-water research of these species.

2.5 INFRASTRUCTURE

Industry participants spoken to as part of the preparation of this report were asked about any issues they were aware of with infrastructure to support the marine farming industry in Tasman – principally land based infrastructure to support the on-water spat catching and farming activities.

Almost universally industry participants identified issues with the facilities at Port Tarakohe in Golden Bay, including:

- The capacity of the wharf to service vessels
- The capacity of the port area to provide for the multiple trucks that will be needed as the area farmed grows
- Insufficient berthage available for vessels at the port
- Lack of a food grade wharf
- The tidal range making the concrete wharf dangerous at times to load and unload vessels from
- Lack of land around the port for storage and land bases, and uncertainty of access to the existing land (noting that storage requirements are greater in Tasman and golden bays because the sea conditions mean that all floats need to be brought onshore following harvest, and that ancillary services such as engineering for vessels and vessel machinery also need land close to the port)
- Overall development to ensure interface of marine farming operations with other operations at the port
- Increasing competition with recreational users
- Costs to access the port

A number of industry participants made the point that Port Tarakohe has issues now, and will not be sufficient when the AMAs reach full production, so issues need to start to be addressed while the industry is still some way

off full production. Developing the port could attract the engineering services needed to assist the marine farmers and with the development of a nursery site as well economic prospects for Golden Bay overall would improve.

Issues with the road from Port Tarakohe and with the Takaka Hill Road in particular were noted by some industry participants. Once the marine farming space is at full development there is likely to be somewhere in the region of 2,500 truck and trailer loads of mussels being trucked over the hill per year, with the vehicle movements being compressed into the available harvest windows in the bay.

Labour issues in Golden Bay were identified, and a lack of accommodation for workers.

The channel at Port Motueka and the difficulty of accessing the port were noted by those industry participants bringing product into that port. Opportunities for redevelopment at the port, and the provision of further commercial and industrial land were also noted.

Hatchery and nursery space will be needed to address likely spat constraints for the industry, with an on land hatchery likely to be required in Golden Bay.

2.6 RESTORATIVE AND CONSERVATION AQUACULTURE

2.6.1 Industry feedback

A number of industry participants spoken to identified restoration of the seabed of Golden Bay and Tasman Bay as important, although almost all acknowledged that this will require management of land-based activities, as the rivers entering each bay are a significant source of fine sediment. Measures to restore the benthic environment are supported, but would need to be science-led to ensure they are effective. The existing marine farms can play some role in improving the seabed, as monitoring is generally showing a more stable benthic environment underneath the farms, and the gradual build-up of biogenic habitat as a result of mussel drop from the lines. Doubts were expressed about whether the introduction of hard substrate (such as bulk mussel shell or old concrete anchor blocks) would make a difference against the volume of river derived sediment entering the bay and considering the generally lighter attachment of introduced older mussels to these areas, but provision of space for restorative and conservation efforts was seen as useful.

Some industry participants considered that it would be useful if the regional plan acknowledged:

- Ecosystem services provided by aquaculture
- Carbon sequestration benefits of growing algae (particularly where the algae were being grown solely for that purpose rather than for later harvest)
- Activities associated with the restoration of wild populations
- Measures to address soft sediment deposition in the bays
- Benefits of recreational fishing around farms, and the seabed protection provided by the farms

Other ecological benefits include that:

- The marine farms act as attractants to other wild species and ecosystems develop around them
- Aquaculture can be used to address other issues, such as coastal erosion

A couple of participants noted that green-lipped mussel is a native species and farming them is replacing native populations that previously existed, and their role in filtering nutrients in the bays was noted. The potential for introducing lines into areas of the no trawl zones in the bays to assist to improve the habitat was also suggested.

2.6.2 Literature review

Conservation aquaculture is defined as ‘human cultivation of an aquatic organism for the planned management and protection of a natural resource’ (Froehlich, Gentry and Halpern, 2017). Figure 1 of Froehlich, Gentry and Halpern (2017), reproduced as Figure 3 below provides a useful conceptual framework for conservation aquaculture. Restorative aquaculture can be seen to be a sub-component of conservation aquaculture.

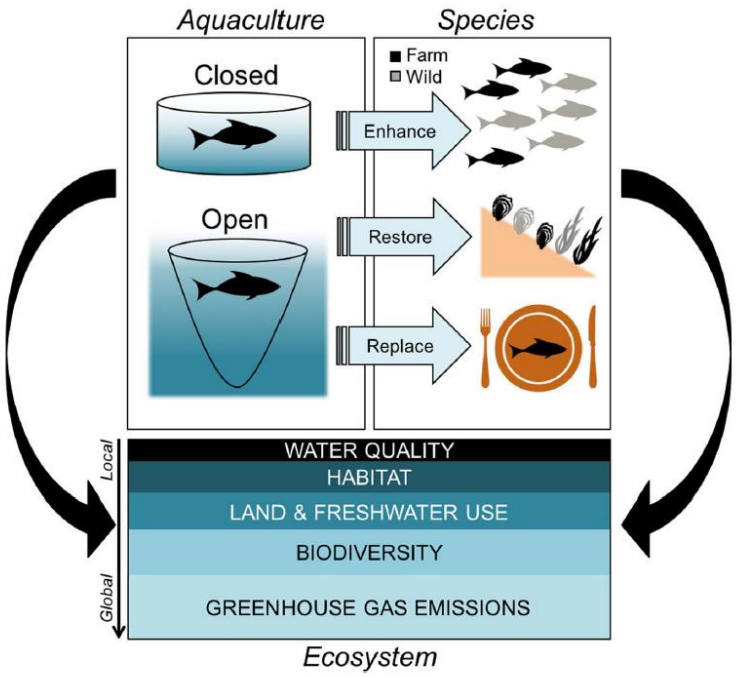

Fig. 1. Conceptual framework of how aquaculture is or can be used for conservation at a species and ecosystem scale. *Large arrows* indicate conservation links. At the species level, *enhance* refers to supplementing a wild population (hatchery), *restore* indicates biogenic restoration, and *replace* signifies farmed species replacing wild species – particularly overexploited or threatened – on the market (food or ornamental). Each component can apply to numerous taxonomic groups (finfish, bivalves, crustaceans, and seaweeds). Connections to ecosystem-level objectives can occur relative to the aquaculture type (*left panel*) and species (*right panel*). *Closed* versus *open* aquaculture denotes the generalized farming practices with differing resource requirements and impacts (e.g., freshwater use). Broad categorization of local to global ecosystem scale is reflected in the size of each box. Note, not all aquaculture practices for conservation result in every ecosystem component depicted.

Figure 3: Conceptual framework for conservation aquaculture

Source: Froehlich, Gentry and Halpern, 2017, Figure 1

Ecosystem benefits provided by aquaculture can include improvements in water quality, provision of coastal defence against erosion, sequestration of carbon and provision of habitat for wild species (Froehlich, Gentry and Halpern, 2017). As a next step, Froehlich, Gentry and Halpern note that *'At a local or regional ecosystem scale, strategic siting and cultivation of harvestable species has potential for net-benefits to the surrounding environment'*. A combination of conservation needs, other ecosystem benefits and production of a saleable commodity may be used to determine where to appropriately place aquaculture within a wider geographic area (Froehlich, Gentry and Halpern, 2017).

The benefits of marine farming for the conservation or restoration of marine values have been the subject of a number of recent publications in New Zealand. *Farming the Sea* recognised that marine farming could provide benefits to the marine environment through for example seaweed extracting nutrients and carbon from the water column while also being grown as a market product, or shellfish farming areas being located where they can contribute to restoration of the seabed (EDS, 2019). It may however be more appropriate to consider conservation or restoration aquaculture on a bay or region wide scale to position it where it will achieve the most or be most effective (EDS, 2019).

Also in 2019, NIWA completed a comprehensive review of local and international literature on the contribution of mussel farming to the marine environment (Stenton-Dozey and Broekhuizen, 2019). That review found that the existing standing crop of mussels in the Marlborough Sounds, and the associated biofouling and aggregated fish species provided at least a partial substitution for the historic shellfish beds that have been lost due to trawling, dredging and the effects of land use activities in the Sounds. Mussel harvests are likely to remove approximately 50% of the nitrogen load that arises from the rivers that empty into the Marlborough Sounds. 'Reefs' derived from mussel aquaculture provide three-dimensional habitat that provides food, shelter and protection for other marine flora and fauna, and that can help to stabilise seabed sediments. The farms themselves provide food and shelter for a variety of fish species, and marine mammals such as common and bottlenose dolphins have been observed using mussel farms to herd their prey. Many of these effects have yet to be quantified but have been demonstrated qualitatively (Stenton-Dozey and Broekhuizen, 2019).

Recent research on restoration of mussel reefs showed that restored mussel reefs can enhance denitrification and reduce the risk of eutrophication, as well as restored ecosystem function (Hillman et. al., unpublished). By placing experimental mussel reefs at locations in the Hauraki Gulf with varying sediment grain size, the researchers found that denitrification was enhanced at all sites (so with varying sediment grain size), illustrating that the mussels were enhancing removal of nitrogen from the water column through multiple different pathways (Hillman et. al., unpublished). Problems remain however with finding an effective way of restoring larger areas of

seabed (in the order of square kilometres) and guarding against mussel loss within a short time of deployment (Alder, Jeffs and Hillman, unpublished). Logistics of deploying adult mussels tend to restrict successful reef development to smaller sizes (square metres) and use of juvenile and sub-adult mussels risks predation, particularly of individuals derived from culture as opposed to translocations of wild stock (Alder, Jeffs and Hillman, unpublished; Jeffs, 2019). Inclusion of a hard substrate (such as concrete blocks or rubble) in mussel restoration deployment efforts has yet to be demonstrated to be truly successful. Research is continuing both in the North Island and with a recently launched restoration project in the Marlborough Sounds (Benjamin, Jeffs and Handley, 2020).

The concept of offsetting effects of marine farming has also been suggested, which could include investment in restoration initiatives (EDS, 2019).

2.7 SPAT

2.7.1 Industry feedback

Issues with spat retention are being experienced. Mussel spat can be caught reasonably easily in the existing spat catching AMA sub-zones, but retention on lines is proving difficult as after a month or so, for currently unknown reasons, spat are off-migrating.

Considerable value was placed by a number of the industry participants in this report on the Wainui Bay spat catching sites. The sites are seen as important because of the quantity and diversity of spat that they offer to marine farmers in the region, with local spat performing differently from Kaitaia spat. The Wainui Bay spat also seems to be having fewer problems with off-migration than the Kaitaia spat, and its counter-seasonality is important – mussels from Golden Bay spat (including from Wainui) fatten in winter, spring, and early summer, and then those from Kaitaia spat fatten for the balance of the year, giving year-round harvest ability. Loss of access to Wainui Bay spat was seen as having the same effect on the industry as losing GLM9 (Kaitaia) quota, in that a spat source that is significant to the viability of the mussel farming industry in Tasman and Golden Bays would be lost if access to Wainui Bay spat was no longer available.

2.7.2 Literature review

The 2019 EDS report *Farming the Sea*, the AQNZ *New Zealand Greenshell Mussel Spat Strategy* and authors such as Camara and Symonds (2014) note the advantages of use of spat from different geographic sources, to spread harvest over a year.

Spat retention is a significant problem. Industry studies of the seeding of beach-cast spat from Kaitaia suggest that the conversion of seeded spat to final product is approximately 5%, with hatchery spat achieving a 20% retention rate (AQNZ, 2019). These figures are supported by a recent study by the Cawthron Institute and the University of Auckland, which showed losses of up to 82% of mussel spat during the nursery stage on a farm in Marlborough (South, Floerl & Jeffs, 2020). The industry has a modest goal currently, to increase spat retention to over 5% by 2035, but even this goal will require considerable research and better understanding of the causes of spat stress that lead to off-migration (AQNZ, 2019). The AQNZ *Spat Strategy* notes the potential benefits of using nursery systems to grow smaller spat to larger size-classes before seeding out, and these nursery systems could be land or marine based (AQNZ, 2019).

Timing of spat catching is also relevant to both the ability to catch spat and to spat retention. Data provided in the *Golden Bay/Tasman Bay Ring Road Spat Catching Spat Strategy* (2020) show peaks of spat in the water column regularly occurring outside the spat catching period of 1 November to 20 April in the years 2016 – 2020. The spat catch will vary both temporally and geographically in the bays and so a range of catching times and location is desirable. Spat caught at times of higher temperature and lower rainfall (generally during summer) seem to show a lower retention rate (Golden Bay/Tasman Bay Ring Road Spat Catching Limited, 2020).

2.8 OTHER MATTERS

In response to questions about how industry participants had found the staging of development of space, responses included:

- Staging has meant that development of the space to date has taken a long time
- Staging can be information intensive and cost prohibitive, particularly when the use of the space is for a relatively low-income stream product. In combination with the effects of the pandemic, this may explain why some space has yet to be developed in the AMAs
- For some industry participants staged development is still a work in progress, particularly for those sub-zones where consents have only been issued within the last few years
- Allowing trials at full intensity of development would be helpful in order to be able to fully understand effects
- The sudden availability of large areas of space after the first stage has been completed can cause challenges, particularly with spat constraints during development, and processing capacity constraints as full production is reached for the first time for some participants
- Questions were asked about whether money currently being spent on 5-year monitoring reports could be better spent elsewhere, recognising that the current monitoring is showing improvement in the seabed condition within the farmed blocks
- Some participants felt that justification for the staging approach was not strong, particularly where control sites are subject to being affected by other activities in the bays

Other matters identified in discussions with industry about the TRMP provisions in general included:

- The regional coastal plan's handling of cumulative effects should be addressed
- Better biosecurity pathway management needs to be encouraged for all parties using the coastal marine area
- If the plan is being reviewed, should the nesma apply?
- The regional coastal plan rules are very prescriptive, and the spat catching dates in particular are becoming problematic, as the main spat settlement season seems to have changed (as has ability to retain spat). Spat settlement now appears to be greatest in autumn and late winter/early spring, outside the 1 November to 30 April spat catching dates defined in the regional coastal plan. The summer period for spat catching in the plan also conflicts with maximum recreational use of the bays
- Plan provisions are not supportive of changing consent conditions
- Adjusting the plan provisions to recognise the three 'layers' of the coastal marine area in which species can be farmed (benthic/mid-water/surface) might be more appropriate than identifying particular species that can be farmed in plan provisions
- Plan provisions should recognise the physical benefits to structures of aligning them with the waves rather than parallel to shore

2.9 SUMMARY

On the basis of discussions with industry and a literature review it seems most likely that future aquaculture in Tasman will involve:

- More flexible use of the existing AMA space for different species, primarily shellfish, but also seaweed and possibly bottom dwelling organisms, and ability to culture multiple species within one farming area
- Possible changes in use of sub-zones within the AMAs, recognising a reduction in spat catching activity, and the need for spat holding space out of marine farming zones in order to maximise use of the farming zones
- Changes to times of the year that spat are caught
- Development of hatchery and nursery space, both on land and in the water
- Continued spat catching at the Wainui Bay sites

- Provision for offshore aquaculture, to recognise the Government's strategy and to provide an avenue for existing industry interest, but noting that development may not occur for some time due to existing physical conditions, water depth and temperature, and the capital necessary to develop offshore space
- Recognition of the ecosystem services provided by aquaculture and use of it for restoration and conservation purposes
- Facilitation of research (shorter term and with clauses to ensure use of space does not transition to commercial use) for both species and structures
- Upgrade of Port Tarakohe and zoning of sufficient space around ports throughout the region for engineering and land-based activities such as storage

3.0 CURRENT TRMP AQUACULTURE PROVISIONS

Using the summary provided in section 2.9 the existing provisions of the Tasman Resource Management Plan (the TRMP) have been considered, to identify whether they enable or hinder the identified potential needs for future aquaculture.

3.1 SPAT CATCHING

In relation to spat catching the existing objectives and policies in Chapter 22 of the TRMP set out an approach that provides for spat catching across the AMA sub-zones, with the scallop and mussel spat catching only zones limited to seasonal and rotational spat catching.

Rules 25.1.3.1 and 25.1.3.2 of the TRMP provide for the seasonal and rotational scallop and mussel spat catching activities across subzone (a) AMA1 Waikato, subzones (a) – (k) AMA 2 Puramakau and subzones (a) – (h) AMA3 Te Kumara, as either a controlled activity (if subsurface backbone lines are used) or a restricted discretionary activity (if surface backbone lines are used). Any spat catching proposed that does not meet the seasonal and rotational requirements of Rules 25.1.3.1 and 25.1.3.2 (being that it occurs between 1 November and 30 April and in only a sub-set of the spat catching AMA subzones) is a prohibited activity under Rule 25.1.3.3, as is the catching of spat other than scallop or mussel spat.

Spat catching and spat holding at the Wainui Bay farms is provided for as a discretionary activity under Rule 25.1.4.4 of the TRMP. The principal condition is that any aquaculture activities at these sites must use longline structures, incorporating surface buoys.

Spat catching at any site outside the AMAs or the existing Wainui Bay farms is prohibited by Rule 25.1.4.7.

'Spat catching' is not a defined term in the TRMP, but from the use of the phrase 'spat holding' in Rule 25.1.4.4, and the seasonal provision for spat catching in the AMAs it is clear that spat holding is not possible in the AMAs under the current rules.

The current provisions provide a consenting pathway for the Wainui Bay farms, although likely changes to the TRMP to implement the New Zealand Coastal Policy Statement 2010 provisions in relation to landscape and natural character, and existing community opposition to them is likely to make any consenting process difficult.

Current provisions for the other spat-catching AMA subzones do not recognise the apparent change in spat settlement seasons that has occurred since the provisions were first drafted. They also do not provide for the holding of spat within the sub-zones, which reduces the potential efficiencies of the marine farming zones. Prohibiting spat catching in areas away from the AMAs and Wainui does not enable the TRMP to recognise that spat catching activities may not be ideally located as conditions in the bays change.

3.2 MARINE FARMING

For marine farming, objectives and policies in Chapter 22 of the TRMP set out a framework for marine farming that requires it to be within identified sub-zones of the AMAs, seeks efficient utilisation of the AMAs for

aquaculture activities and manages development of the sub-zones through a 'cautious and adaptive' approach. Marine farming is also to be undertaken (Policy 22.1.3.6) in a way that:

- Safeguards the life-supporting capacity of the environment;
- Is compatible with and does not adversely affect existing aquaculture activities; and
- Avoids as far as practicable adverse effects on the environment, and where complete avoidance is not practicable, ensures that adverse effects are remedied or mitigated.

Changes made to the TRMP provisions by direct Government intervention in 2011 allow the farming of more than just green-lipped mussels, and provide for aquaculture involving additive species in the marine farming subzones, subject to a tendering process to be run by the Council. No tendering process has been run to date.

Rules for marine farming are contained in Chapter 25, under section 25.1.4. In terms of marine farming of filter feeding bivalves, including mussels, Rule 25.1.4.1 provided for the development of a first stage (of 50ha at full intensity, or 75ha at 2/3rds intensity) as a controlled activity. In practice most if not all of the consent applicants applied for the full sub-zone, with the required staging,[3] as a restricted discretionary activity under Rule 25.1.4.2. All marine farming under these two rules is to be done using longline structures with surface buoys. Marine farming using other structures is classified as a discretionary activity under Rule 25.1.4.3.

Marine farming of other extractive species (i.e., species that are not bivalves but can be farmed without requiring any addition of feed) is provided for as a discretionary activity, also under Rule 25.1.4.3 of the TRMP. The activity is subject to the same staging requirements as marine farming of filter feeding bivalves and cannot be considered under this rule if aquaculture involving additive species is already occurring in the AMA sub-zone.

Aquaculture involving additive species is provided for as a discretionary activity under Rule 25.1.4.5. As set out in the relevant policies an authorisation is required to apply for consent for aquaculture involving additive species, so access to this rule relies on the Council having run a tender process for the additive aquaculture space.

Marine farming outside the conditions of each of the rules is a prohibited activity under Rule 25.1.4.6. This is the rule that ensures marine farming does not occur within the seasonal and rotational scallop and mussel spat catching AMA sub-zones. As for spat catching, marine farming outside the AMAs or the Wainui Bay sites is a prohibited activity under Rule 25.1.4.7.

The existing provisions provide a consenting pathway for all extractive species, although any species other than filter feeding bivalves may face a more difficult consenting process as a discretionary activity. Structures other than longlines are also discretionary activities as opposed to restricted discretionary activities, which may make trialing or transitioning to innovative structures more difficult. It is worth noting that some industry participants spoken to as part of the preparation of this report stated that only green-lipped mussels could be farmed in Tasman, so it may not be clear that consent can currently be applied for other extractive species. The policy settings, with a focus on avoiding all adverse effects where practicable does not recognise that activities could be sustainable, and safeguard life-supporting capacity, while having minor adverse effects on the environment. Policies in the plan also do not recognise ecosystem services that aquaculture can provide, and its potential role in restoration and conservation activities.

Aquaculture involving additive species (such as finfish or pāua) is provided for in the AMAs, but only after Council has run a tendering process for space, and only across a relatively limited extent of the available AMA space. Reports prepared by NIWA at the time of the Government intervention in the TRMP (Zeldis et. al., 2011) noted that conditions in the current AMAs were likely to be marginal for finfish. To date Council has not run a tendering process and so no aquaculture involving additive species is planned or occurs within the AMAs. Current TRMP provisions prevent aquaculture outside the AMAs and finfish aquaculture is therefore currently unlikely to be developed in Tasman. The current plan provisions prevent aquaculture occurring any further offshore in the bays, and will not allow implementation of the Government's *Aquaculture Strategy 2019* in relation to offshore aquaculture. The prohibition on aquaculture outside the existing AMAs and the Wainui Bay farms means that marine space for the nursery stage of shellfish farming is not readily available, but may be critical to the ongoing development of the industry in the region.

[3] Noting that subzone AMA1(b) was not required to be staged.

Changing structures within marine farming subzones of the AMAs will require either a new consent (as a discretionary activity) or a variation to an existing consent. Participants in this report noted that was not a simple process, and the plan may therefore be hindering innovation and efficient use of the space within the existing AMAs through its focus on longline aquaculture. Seaweed aquaculture in particular may require different structures than the existing longlines, and was a species identified by the majority of individuals engaged in this report as a likely future species for aquaculture.

The existing plan provisions and their implementation to date mean that using space within the existing AMAs more flexibly, and farming multiple species within a marine farm space, requires a variation or a new consent, both of which would be considered as discretionary activities. The policy framework is not explicitly enabling of this type of use, and updated rules and policies might facilitate more innovative use of the existing space.

The TRMP provisions make no allowance for experimental aquaculture or research space. While structures can be trialed (with the appropriate coastal permit for the structure) outside the AMAs, any species work cannot be undertaken, and it is likely that both structure and species will need to be tested to prove new aquaculture technology. The consent process under the current plan provisions is a disincentive to research providers, who are currently utilising space in other regions where the regulatory framework is more enabling.

While the marine farming sub-zones in the current AMAs are not all fully developed currently, some consent holders have fully developed space and would use more space if it was available. Conversely, the seasonal and rotational nature of the spat catching sub-zones, and the decrease in scallop spat catching activities, means that there is 'unused' space within the current AMAs. This 'unused' space could potentially offer opportunity for growth in the industry if TRMP provisions were altered to provide for it, without expanding the overall footprint of aquaculture in Tasman and Golden Bays. It is acknowledged however that development of the provisions for the spat catching sub-zones was part of the overall aquaculture enquiry that led to the current TRMP provisions, and the effects of concern at the time of that enquiry may still exist to an extent that would preclude further or difference development of the spat-catching sub-zones.

A quite large area of land around Port Tarakohe is zoned light industrial, and issues with the physical infrastructure at the Port cannot be directly addressed by changes to the TRMP. There does however appear to be a shortage of unused industrial zoned land at Port Motueka. Issues identified by participants at Port Tarakohe, Takaka Hill and with accommodation in Golden Bay would need to be addressed by means other than plan provisions.

3.3 SUMMARY

On the basis of the discussion provided in sections 3.1 and 3.2 above, key areas that warrant consideration in any review of the TRMP provisions relating to aquaculture are:

- Adjustment of the dates of the spat catching seasonal and rotational use of AMA sub-zones, to reflect changing patterns of spat settlement
- Availability of spat holding space, in order to make best and most efficient use of available marine farming space
- Continuation of the Wainui Bay spat catching sites
- Revisiting provisions around farming extractive species, to provide greater flexibility to change, install new structures and experiment with species
- Recognising the ecosystem benefits that aquaculture can provide and the value of restorative and conservation aquaculture, and that aquaculture with minor effects may be appropriate
- Whether to provide for applications for offshore aquaculture (further offshore than the current AMAs) to facilitate the Government's Aquaculture Strategy and recognise ongoing innovation in the industry
- Provision of nursery space, if the appropriate physical conditions for that space can be identified
- Provision for research and experimental aquaculture.

A number of infrastructure issues have been identified through discussions that inform this report, but are not as amendable to addressing via the TRMP provisions.

4.0 CONCLUSION

Discussions with participants in the aquaculture industry in the Tasman region have identified a number of directions in which the industry is likely to develop in the next 10 –20 years. Principal changes are likely to be in the species farmed and the structures used for farming, although finfish farming does not currently appear likely to occur in the region until further work has been done on commercialising species for whom the temperature range in the area is suitable. Space for research and facilitation of experimental aquaculture will be important to support changes in the industry. The Government's strategy to encourage offshore aquaculture also cannot currently be realised in Tasman, due to the prohibition on aquaculture activities outside the existing AMAs and the Wainui Bay farms.

Spat catching and retention will continue to be critical for the industry. The industry places a high value on the continued operation of the Wainui Bay spat catching sites, in part because they support spat diversity and seem to offer better retention than Kaitaia spat.

Current TRMP provisions have guided the staged development of aquaculture space in the region and will continue to have an influence until the existing AMA space is fully developed. With some marine farming zones only having received consents in the last couple of years the extent to which plan provisions facilitate or hinder future aquaculture development is not easy to assess. However, some clear themes have emerged from this report, particularly in relation to innovative and efficient use of existing space, support for spat catching and spat holding and the worth of providing more explicitly for research and experimentation.

5.0 ACKNOWLEDGEMENTS

Stantec wishes to record its sincere appreciation to the following individuals and organisations who freely gave of their time to be involved in this report:

- Ned Wells, Marine Farming Association
- Stephanie Hopkins, Aquaculture New Zealand
- Paul Smith, PSP Group, and Geoffrey Rowling, Motueka
- Doug Loder, Talleys Group
- Sarah Cumming and Hamish Wilson, Fisheries New Zealand/Ministry for Primary Industries
- Dave Taylor, Aquaculture New Zealand
- Simon Karipa, Maara Moana/Ngati Apa ki To Ra
- Toni Grant, Maara Moana/Ngati Tama
- Dorje Strang, Sealord and Golden Bay Community Trust
- Bob Nicolle and Graeme Coates, Ring Road Consortium companies
- Scott Gillanders, Maclab
- Helen Musley, Suzy Black, Maren Wellenreuther and Dominic Boothroyd, Plant and Food Research
- Margaret Soderberg, Maara Moana/Koata Limited
- Kevin Heasman and Leo Zamora, Cawthron
- John Young, Clearwater Mussels
- Riki Kotua and Andy Elliot, Wakatu
- Karen O'Brien, Kono
- Rob Pooley, Just Mussels
- Thomas Hildebrand, Ngāi Tahu Seafood Resources Limited
- Bill Wallace, Golden Bay Marine Farmers' Consortium
- Alison Undorf-Lay and Mike Mandeno, Sanford

Any errors in the representation of the industry perspective on the future of aquaculture in the Tasman region lie with the report authors.

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