Kenepuru and Central Sounds Residents Association

Marlborough Aquaculture Rules Working Group ('ARWG')

Ecological Carrying Capacity – Next Steps

1. What This Paper Is About

1.1 This paper seeks to advance ARWG matters in terms of water column ecological carrying capacity ('ECC').

1.2 To this point we have determined a number of CMU's to a preliminary stage. This is understood to be subject to ecological carrying capacity issues (and in some areas also remains subject to other tests, such as for significant adverse landscape or natural character effects).

1.3 It is considered appropriate to bring forward the matter of ecological carrying capacity for a number of reasons:

- The continued absence of any agenda or conveyed methodology for addressing ECC when determining AMA's is concerning. This is now all the more pertinent given the proposed National Environmental Standard which stands to frustrate any adaptive management approach.
- The Technical Advisory Group's apparent reluctance to objectively engage on key ECC matters.

2. What Is Ecological Carrying Capacity

2.1 To refresh, ECC is the stocking or farm density (or spatial allocation) beyond which unacceptable ecological impacts result. ECC is determined by looking at the additive effects of multiple local scale effects, such as multiple benthic footprints and the incremental depletion of phytoplankton and zooplankton, as well as the cumulative spread of pests/diseases among farms leading to multiple reservoir populations[1]. As the KCSRA representative has already reported to the ARWG[2], the Cawthrone Institute has defined ECC as being:

> ***the level of suspended culture beyond which there would be a significant change to the major energy fluxes or structure of the food web[3]***.

3. How Do We Know We Have an ECC Problem ?

3.1 Despite its claimed shortcomings, the author of the NIWA Biophysical model concedes that some of the changes predicted by the model are large enough that other aspects of the foodweb *may change materially*[4]. ECC is thus *more than likely* exceeded in these areas.

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[1] Refer paragraph 28 Ryder Consulting report *Mussel Farming in Central Pelorus Sound*, Dr Brian Stewart, December 2015, as circulated to the MAWG group April 2017.

[2] Refer 25 May meeting.

[3] *Predicting the carrying capacity of bivalve shellfish culture using a steady, linear food web model*. Weimin Jiang, Mark T. Gibbs, Cawthron Institute, Nelson, New Zealand, November 2004.

[4] Refer para 41 Dr Brian Stewart paper supra

The worst areas identified by the NIWA Biophysical Model are the **Kenepuru Sound**, followed by **Clova Bay**, then **Beatrix Bay** and **Crail Bay**. The model predicts that up to **90% or more of zooplankton** in these areas is being consumed by the existing mussel farms. This is *all year round* in the Kenepuru Sound and over the ecologically important summer period in the other areas. The point at which 100% of zooplankton is consumed represents **system collapse** - i.e. wherein the ecosystem cycle has been rendered down to one of just nutrient–phytoplankton–cultured mussels–detritus[5].

3.2 KCSRA has tabled to the ARWG robust professional scientific opinion that, all things considered, there are *strong indications* that the low flush areas of **Clova Bay, Crail Bay and Beatrix Bay** are being farmed beyond an acceptable ECC[6].

3.3 Attempts to undermine the significance of these results and opinions with references to the likes of historical natural mussel beds have proven to be unfounded.[7] Claims the marine environment is significantly modified by the likes of siltation anyway (and therefore ECC matters can be ignored) are both irrelevant and unhelpful[8].

4. How Did We Get Here ?

4.1 Quite simply, mussel farming has been allowed to significantly expand in sheltered low flush areas of the Marlborough Sounds with no monitoring and with no regard to cumulative ecological effects. Whilst concerns were raised back as far as the late 1990's they have generally been suppressed or ignored. The severity of the cumulative ecological effects are beginning to be realised now through work such as the NIWA Biophysical Model. Claims made to this ARWG that there are scientific reports suggesting further capacity in Beatrix Bay have been withdrawn.

4.2 There is a lack of knowledge in this area - something that is acknowledged by both Cawthron in its comprehensive 2009 report on the effects of aquaculture[9] and by MPI in its 2013 summary of the effects of aquaculture[10]. There are nonetheless various models/methods/tools now emerging for determining ECC – all of which, in our view, point to over-farming issues within the Sounds. These include the Aquaculture Stewardship Council standards for phytoplankton depletion[11], the Linear Food Web carrying capacity methodology used by the Cawthron Institute for Tasman/Golden Bay in 2005[12], and more recently the more sophisticated and perhaps most telling NIWA Biophysical model.

5. Appropriate Approach From Here

5.1 It seems relatively certain that we have a problem now, even if its severity cannot be precisely determined because of a lack of historical monitoring.

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[5] Jiang and Gibbs *supr*a

[6] See paragraphs 55 and 56 Ryder Consulting report supra

[7] *A 1,000 year history of seabed change in Pelorus Sound/Te Hoiere, Marlborough,* April 2017

[8] For example, Dr Steve Urlich in second report from TAG dated 7 June 2017

[9] *Sustainable Aquaculture in New Zealand: Review of the Ecological Effects of Farming Shellfish and Other Non-finfish Species* Cawthron Report No. 1476 [page 30]

[10] *Overview of Ecological Effects of Aquaculture* Ministry for Primary Industries 2013 [page 13]

[11] As per KCSRA paper dated February 2017

[12] Jiang and Gibbs supra

5.2 MDC has shown a clear preference for leaving ECC to be addressed later under an adaptive management regime. Suggestions have also been made by TAG that the likes of the ASC standard stands as a valuable 'triage tool' that can be used 'as an orange light' that demands 'further investigation'. This begs the question – what is the further work that is needed ? How much certainty is needed before the problem is accepted as real ? TAG, having itself suggested that 'further investigation' is needed, has as yet been unable to advise just what it is that actually needs to be done to affirm the problem.

5.3 There is no legal or policy level prerogative to wait for the indicated adverse effects to be scientifically proven to a statistically significant degree.

> ***The blunt point is that we do not see it as acceptable to move ahead with the existing density of farming knowing there are more than likely material adverse effects in what appears to be a vain hope that there might be evidence found to the contrary at some stage in the future. Rather, we believe the adverse effects can and must be addressed now through the adoption of a precautionary approach in the spatial allocation process***.

6. How Might ECC Be Worked Into The Spatial Allocation Process

6.1 Long term controlled empirical monitoring can be used to scientifically determine the impact of suspended mussel culturing in the low flush at risk areas at issue. The crippling factor with this is that there has been no monitoring of the environment before mussel farms were introduced to the Marlborough Sounds.

6.2 The strength of the indications that we do have now means that we must adopt the tools that we do have now – such as the ASC Standard, the NIWA Biophysical Model predictions, and the Linear Food Web model. Cawthron acknowledge that spatial modelling tools offer a way of estimating ECC on "bay-wide" or "regional" scale[13]. Most recently Dr Michael Freeman, a water quality specialist and hearing commissioner, endorsed the use of the ASC standard as a tool for addressing cumulative effects[14]. From these tools we can determine, to the best we practicably can today, acceptable levels of intensive culturing for AMA's in the at risk areas. To the extent possible, the ECC as determined today using todays tools might then be calibrated going forward through a programme of long term controlled empirical monitoring.

6.3 To this end we believe the ARWG should:

A. Use ASC calculations to set suspended culturing thresholds for phytoplankton depletion in each CMU - and from this determine the size and placement of AMA's within the relevant CMU's. *This is a relatively simple exercise as illustrated below.*

[13] 2009 Report supra [page 32]
[14] U150653 December 2016

B. Use the NIWA Biophysical Model[15] to set suspended culturing thresholds for wider food web disruption, such as zooplankton depletion, in each CMU and thus the size and placement of AMA's within CMU's. This is as described at page 13 of the KCSRA February 2017 paper and would simply involve model runs under alternative scenarios to determine acceptable farming density in the at risk areas.

C. Design and implement a long term monitoring programme with a view to using that to calibrate the ECC thresholds as set today under A and B above.

6.4 *Setting AMA Spatial Area Using ASC Standard for Phytoplankton Depletion*

6.4.1 As we have noted, the ASC standard offers a very simple and objective way of determining an ECC, at least for phytoplankton depletion. The inputs are simply:

- The volume of water potentially affected by cultured mussels in a CMU
- The harvest size water filtration rate of mussels grown in the CMU
- The 'primary production time' for the CMU

6.4.2 From this a very simple calculation determines how many cultured mussels the CMU can ecologically sustain. *Importantly, the necessary information for these ASC calculations can be relatively easily collated <u>now</u>.*

6.4.3 For example, mussel farms in the Clova Bay CMU can be said to affect a water-body area of up to 760 hectares. This means that under the ASC standard the CMU can sustain the suspended culturing of up to 112M mussels. This equates to approximately 780km of dropper lines seeded with an average of 140 mussels per metre. This, in turn, equates to 33 hectares of mussel farm surface area using standard 18-20 metre gaps between backbone lines as is common practice today. On this basis Clova Bay AMA's should be determined such that **cultured surface area does not exceed 33 hectares** with controls added preventing farming density within the AMA beyond standard seeding and dropper line densities.

6.4.4 Mussel farms in Beatrix Bay can be said to affect a water-body area of up to 2,500 hectares. This means that under ASC calculations the CMU can sustain the suspended culturing of 586M mussels. This equates to 4,189 km of dropper lines with an average of 140 mussels per metre. This, in turn, equates to **171 hectares** of mussel farm **surface area** using 18-20 metre gaps between backbone lines.

6.4.5 Mussel farms in Crail Bay can be said to influence a water-body area of up to 1,900 hectares. This means that under ASC calculations the CMU can sustain the suspended culturing of 380M mussels. This equates to 2,718 km of dropper lines with an average of 140 mussels per metre. This, in turn, equates to **107 hectares** of mussel farm **surface area** using 18-20 metre gaps between backbone lines.

[15] This might be done in conjunction with a Linear Food Web model although we understand this may take more time and would require accurate estimates of food web composition before mussel farms were introduced to the Sounds.

6.4.6 TAG has advised the ARWG that the ASC can be plausibly shown not to be exceeded in the Beatrix Basin if different water volume, filtration rates and mussel numbers being grown are used. However, to date TAG has refused to provide the water volume, filtration rates or mussel numbers that it used to achieve this outcome – because they have not been peer reviewed. This is at odds with the fact that they nonetheless considered it fit to release a conclusion that is directly based on those values.

6.4.7 We welcome an open discussion on appropriate input values. However, in the meantime we believe the TAG advice provided on the basis of input values that they will not release must be taken as specious to the point of being a nullity.

6.5 *Setting AMA Spatial Area Using NIWA Biophysical Model*

6.5.1 The ASC standard does not accommodate zooplankton depletion. The second stage of the ECC procedure should thus be the undertaking of run(s) of the NIWA Biophysical Model logic adopting alternative densities of farming in at risk CMU's to the point that an acceptable level of zooplankton depletion is attained. **In our view this should be no greater than 20%** - as indicated in the KCSRA February 2017 paper. There appears to be no reason why this exercise can't be undertaken *now* - and as noted in our view there are legal and policy level requirements to determine an ECC now.

6.5.2 AMA density would then be determined from the lesser of the maximum density under the ASC standard or that as found necessary to achieve an acceptable zooplankton depletion rate under runs of the NIWA Biophysical Model.

6.5.3 We note that TAG has advised that some caution should be adopted when interpreting the NIWA Biophysical results. We nonetheless note that the model results show very serious levels of zooplankton depletion to the point that the *model's logic would need to be very extensively flawed* for zooplankton depletion to be, in reality, acceptable. Further, TAG is yet to answer questions from ARWG on just what it is that needs to be done to improve the purported unreliability of the Biophysical model's predictions on zooplankton depletion.

6.5.4 On that note we perceive TAG to be uncomfortable with the NIWA Biophysical Model, but without any apparent grounded basis. Suggestions were initially made that the results needed to be significantly moderated because there has historically been mussels on the sea bed. However, the Coring Study has since proven otherwise. Follow up questions posed to TAG on the significance of the model's zooplankton predictions have been avoided with irrelevant and unhelpful diversions to siltation being of a greater concern. We welcome an open discussion on the NIWA Biophysical Model predictions but call for more objectivity from TAG on the matter. This might be achieved with a more balanced make up, including a representative selected by community interests.

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