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Date [redacted]
Subject: OIA 2023/15: Salmon mortalities

Kia ora [redacted] team,

Our OIA 2023/15: Salmon mortalities

As discussed at our last meeting, the Institute has now published in final draft the *Discussion Paper 2023/04: Exploring the role of aquaculture in our marine space*. This paper aims to illustrate the current state of New Zealand's ocean management in the Marlborough Sounds and Cook Strait using NZKS's marine farms as a case study. Although it has been a difficult and complex paper to research, we believe the discussion paper sets out the current state of salmon farming management in New Zealand accurately. What we found was a low level of stewardship of the marine space, a poor governance record in terms of the intent of the legislation and a general disregard for public consultation (see the preface). The paper concludes by making a number of recommendations for consideration.

Before we can finalise the paper, we have identified one outstanding area that requires further research. We feel the final draft does not explain or examine salmon mortalities in sufficient detail, in particular the relationship between water temperature, mortality rates and other factors (see the highlighted text in a page from the discussion paper far below).

Background

We understand salmon mortalities fits under the responsibility of MPI. We have found two reports on the subject:

- *MPI Technical Paper 2013/19*. This was due to a significant spike at Waihinau Bay, which was 'significantly higher compared with other NZKS sites in February and March 2012'.

- *MPI's Technical Paper No. 2017/39*. This was due to higher than usual rates of fish mortality between years 2012 and 2015. For example, 'The Waihinau Bay site continued to experience unusually high mortality levels during the following two summers, with up to ~70% mortality in February 2015.'

The Institute has identified three further spikes in recent years; in the 2018/2019 year, the 2021/22 year and the 2022/23 year. To this end, could MPI please answer the following questions regarding salmon mortalities.

Official Information Questions – all salmon farms in New Zealand

Question 1: MPI Publications

Please provide a list (and links) of all MPI publications that research and/or discuss salmon mortalities in New Zealand since the year 2000 (this is broader than just the Marlborough Sounds and should include Stewart Island)? Note: The list should include *MPI Technical Paper 2013/19 and Technical Paper No. 2017/*39.

Question 2: Mortalities – by farm

Provide an update of Table 2 (see below, also found in the *Technical Paper No. 2017/39)* showing the percentages of mortalities to the year 2022 - **by farm**, by year, by percentage and by tonnes?

a. Please also explain what the percentage means in practice (given NZKS move the salmon around).
b. Please add the tonnes of dead fish to the updated Table (as requested in Q2 above)? This is due to our concerns that the percentage may not illustrate the true volume of dead fish.

Question 3: Mortalities – by landfill

Please provide a list of all salmon mortalities by landfill location (e.g. Blenheim landfill), by year and by tonnes? Please outline who has provided what information (e.g. MDC or NZKS).

Official Information Questions – NZKS salmon farms only

Question 4: Recent Spikes

This question relates to the 'recent spikes' in salmon mortality that occurred in the 2018/2019 year, the 2021/22 year and the 2022/23 year (see the Institute's discussion paper for the supporting evidence). We are wanting to learn more about the research and actions MPI has undertaken since 2015. The sub-questions are as follows:

a. Explain under what circumstances NZKS *must* advise MPI of salmon mortalities (e.g. is it triggered by a figure in tonnes and/or a new illness in the salmon)? Please provide a link to the document that specifies the threshold/trigger point. Has any circumstance occurred that has triggered NZKS to contact MPI or MPI to contact NZKS since 2015 over mortalities? If yes, please explain. Please specify any questions MPI have asked of NZKS in regard to the recent mortality spikes since 2015 and NZKSs responses?
b. Since 2015, what work has MPI undertaken to test each farm for *the two organisms* found in 2015, being NZ-RLO1 and NZ-RLO2? Please explain who has undertaken what tests, what farm and when?
c. Since 2015, what work has MPI undertaken to test each farm for *other organisms* that may cause stress or mortalities? Please explain who has undertaken what tests, what farm and when?
d. Advise the test results and conclusions in response to (b) and (c) above by NZKS farm.
e. Explain MPIs view as to the cause of the three 'recent spikes' (mentioned above). For example, *Technical Paper No. 2017/39* (p. 18, see excerpt below) mentions a number of possible reasons). Do any of the possible reasons explain the current spikes? Are any of those listed been found not to be a potential cause of the recent spikes (if yes, please list)? Have other new potential reasons been found (please explain)?
f. The *Technical Paper No. 2017/39,* in its conclusion (p. 32, see except below), outlines a list of 'possible further work' MPI might consider. Please advise what has been undertaken by MPI in regard to each of the possible workstreams listed?
g. What actions have been undertaken by MPI to minimise the pain and suffering to the stressed fish in the three recent spikes? Please explain the process/conditions specified by MPI for killing stressed fish and removing the dead fish to the landfall?

If you have any questions or points of clarification please do not hesitate to contact me.

Best wishes,

Wendy McGuinness
Chief Executive

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Table 2: Percentage of fish that died during the summer months (1st February to 1st May) across the six main New Zealand King Salmon production sites from 2010 to 2016. A marked reduction in mortalities was observed in 2016.

Farm	Year						
	2010	2011	2012	2013	2014	2015	2016
Waihinau Bay	6	15.9	21.8	n/a	32.5	66.5	Destocked
Forsyth Bay	Destocked	Destocked	Destocked	48.1	Destocked	Destocked	Destocked
Ruakaka Bay	3.3	5.4	7.5	7.6	6	20.2	16.7
Clay Point	3	3.7	5.3	14.4	7.4	7.3	5
Te Pangu Bay	8.6	9.8	11.8	13.3	12.9	8.9	2.7
Otanerau Bay	Destocked	Destocked	Destocked	Destocked	Destocked	Destocked	10.7

site in March 2015, daily mortality rates reached over 320 deaths per 10,000 fish per day causing the overall loss of almost 70% of fish on the site. This mortality event may have been unusually severe due to higher water temperatures (a greater number of days where the water temperatures exceeded 18°C) and an abrupt decline in feed intake approximately 4 to 6 weeks prior to the mortality peak that was not associated with any known dietary or management changes. These factors may have created an optimal environment for pathogen replication and/or predisposed fish to developing clinical disease through the immunosuppressive effects of thermal and nutritional stress. Apart from water temperature, Secchi depth, and the presence of *T. maritimum*, there were no other significant differences in environmental conditions or management practices between the six production sites that could explain the variation in mortality rates.

Although the organisms isolated from moribund fish have previously been associated with mortality, we cannot establish a direct causative relationship based on the historical data alone. This leads to several biologically plausible, but not mutually exclusive hypotheses:

1) The organisms may be acting synergistically and initial infection with *T. maritimum* may have increased susceptibility to NZ-RLOs by creating breaches in the skin barrier,
2) The organisms may be acting independently and only one may be responsible for the excessive mortality,
3) Thermal stress, nutritional stress, or stocking density may have predisposed fish to developing clinical disease following exposure to one or both organisms and/or,
4) The mortality was caused or enabled by other unmeasured environmental or management factors, perhaps unrelated to either organism.

The aetiology of mortality events associated with skin lesions in farmed salmon is complex and multifactorial. Assuming that both *T. maritimum* and NZ-RLOs are ubiquitous in the Marlborough Sounds region and may have been present for some time, the multivariate analysis findings suggest that high water temperatures coupled with an acute drop in feed intake may predispose fish to experiencing unusually high mortality rates.

13 Conclusion

At this stage of the response MPI has not been able to ascertain the definitive cause of the mortality events at Waihinau Bay. MPI has isolated three strains of RLO and further testing is required to determine whether these could be the cause of mortality.

Possible further work that would benefit this response, as well as improve on-farm biosecurity and animal welfare might include:

- Testing of all NZKS farms in the Marlborough Sounds to build a complete picture of the distribution of the pathogens.
- Testing of the wild and recreational fisheries to determine presence or absence of pathogens outside of marine salmon farms.
- Further exploration of the possible relationship between NZ-RLOs and elevated mortalities through:
    - Challenge testing of salmon in a PC2 lab,
    - Development of a vaccine suitable for industry use, subject to results of challenge testing.
- For NZKS and the rest of New Zealand's salmon industry to adopt international best management practices for minimising biosecurity risk.
- MPI working with the NZSFA to develop a Code of Practice for Animal Welfare.
- Collaboration with Tasmania to compare the complete gene sequences between TAS-RLO and NZ- RLOs.
- Conducting further analysis on mortality data supplied by NZKS, given knowledge on the presence of NZ-RLO1 and NZ-RLO2 as obtained during the response.

Infographic 6: An overview of NZKS's operations – By the numbers, Graph 7a

Graph 7a: Comparing water temperature with cost of mortality

Note: Data supplied in Graph 7a on water temperatures is from MDC and NZKS and has been collated by Ms Hanneke Kroon M.Sc.Eng (committee member of the Kenepuru and Central Sounds Residents' Organisation). Water temperatures are at 12 selected sites close to NZKS farms (see Graphs 7b-7d overleaf) and are taken at various depths (e.g. 1.5 m and 5 m) but they are recorded at the same depth over time (see Figure 1, p. 29). This means that the number of months is out of 48, being 12 coastal water monitoring sites times four months. For example, in 2016/2017, 8 out of 48 months were above 17°C. The cost of mortality is from the NZKS annual reports (Note: 2020/2021 is a 7 month FY, see p. 6, Annual Report FY21) . This graph indicates that the cost of mortality per tonne has increased significantly in the 2022/2023 year (see also Graph 3b). We are unsure why the 2017/2018 and 2018/2019 cost of mortality is so low given that the number of months above 17°C over that same time period was so high. We have assumed that it is the length of time the water exceeds 17°C that determines the tonnes and therefore the cost of mortality. However, there may be other factors at play.

The actual cause/s of fish mortalities is the responsibility of MPI. Fish mortalities fall within the remit of MPI (rather than MDC). Currently MDC does not require or collect any records concerning mortalities at any of the NZKS farms. From an 'effects' perspective under the RMA, the only MDC requirement is that the odour from the temporary storage of dead fish is managed properly; however, this condition only relates to three of the twelve farms (see condition 48 on consents U140294 (Waitata); U140295 (Kopāua/ Richmond); and U140296 (Ngāmāhau)).

The 2012–2015 mortality event

An *MPI Intelligence Report* (MPI Technical Paper No. 2017/39) (pp. 17–18) indicated that stocking densities along with several other factors could have contributed to the unusual level of mortalities in 2015. From 2012 to 2015, only the Waihinau Bay and Forsyth Bay sites experienced periods of excessively high mortality in the summer months (February to May). MPI notes that '[d]uring the largest mortality peak at the Waihinau Bay, daily mortality rates reached over 320 deaths per 10,000 fish per day causing the overall loss of almost 70% of fish on the site'. MPI concluded:

> 'Although the organisms isolated from moribund fish [very sick fish] have previously been associated with mortality, we cannot establish a direct causative relationship based on the historical data alone. This leads to several biologically plausible, but not mutually exclusive hypotheses:
> 1) The organisms may be acting synergistically and initial infection with T. maritimum may have increased susceptibility to NZ-RLOs by creating breaches in the skin barrier,
> 2) The organisms may be acting independently and only one may be responsible for the excessive mortality,
> 3) Thermal stress, nutritional stress, or stocking density may have predisposed fish to developing clinical disease following exposure to one or both organisms and/or,
> 4) The mortality was caused or enabled by other unmeasured environmental or management factors, perhaps unrelated to either organism.'

The 2018/2019, 2021/2022 and 2022/2023 mortality events

The Institute has requested further information from MPI on more recent mortalities, given the cost of mortalities as illustrated in the graph below and the mortality shown in the NZKS annual report, copied in Graph 3b: Summer mortality, 2017–23, p. 24.

Fischer, J. & Appleby, J. (May 2017). *Intelligence Report: NZ-RLO& T. maritimum 2015 response*. Ministry for Primary Industries (MPI), pp. 17–18. Retrieved 1 September 2023 from www.mpi.govt.nz/dmsdocument/18253-NZ-RLO-T.-maritimum-2015-Intelligence-Report