Contents Page: McIvor – McLennan

All written comments received on the MPI salmon relocation proposal, grouped according to surname/business/organisation/Iwi name.

Written Comment No: 0114

Relocation of Salmon Farms in the Marlborough Sounds

Submission For Trudie M°Ivor Hot Smoke evening Shift.

I work as a kiln operator at Hot Smoke Buller Street.
Currently on Evening Shift, but have worked DayShift, & NightShift's also.

I have been with this company for 12 years + 9 months.

I am happy with the new proposal for the salmon farms.

Job security is a great thing for the Future & growing Potential for Marlborough.

Thankyou.

Trudie M°Ivor
[redacted]

Written Comment No: 0554

Subject	**NZ King Salmon Farms**
From	Stephanie McKay
To	aquaculture submissions
Sent	Monday, 27 March 2017 3:38 p.m.

Salmon Farm Relocation
Ministry for Primary Industries
Private Bag 14
Port Nelson
aquaculture.submissions@mpi.govt.nz

To: The Salmon Relocation Advisory Panel

I am Steph Mckay and I work in the harvest team for NZKS.
I support the potential salmon relocation process being proposed by MPI because I believe the salmon farm relocation will provide for better environmental, social and economic outcomes.
I understand that by relocating farms from lower water flow sites to higher water flows sites fish performance will improve and therefore the health of the salmon. It will also have a lower level of effect on the seabed which will have positive environmental benefits.
Environmentally adopting the Best Management Practice guidelines that were agreed by the Council and community is the future of aquaculture globally.
There will be more direct and indirect jobs created if this proposal goes ahead resulting in economic improvements for the communities in the top of the south.
Moving some farms away from baches to more remote locations will improve social amenities which is also a good thing.

I **would not** like the opportunity to be heard by the Advisory Panel.
Thank you,
Stephanie Mckay

Subject	**MPI Salmon Farm Relocation Project**
From	[redacted]
To	aquaculture submissions
Sent	Friday, 17 March 2017 1:01 p.m.
Attachments	<<MPI Salmon Farm Relocation Project.docx>>

--

Kind Regards,
Rachel McLaren, Customer Services Representative

New Zealand King Salmon

Free 0800 725 666 Fax 0800 472 566
orders@kingsalmon.co.nz

www.kingsalmon.co.nz

REGAL

ŌRA KING

Written Comments No: 0250

Salmon Farm Relocation

Ministry for Primary Industries

Private Bag 14

Port Nelson

aquaculture.submissions@mpi.govt.nz

To: The Salmon Relocation Advisory Panel

Rachel McLaren. Foodservice Customer Services Representative at New Zealand King Salmon.

I support the potential salmon relocation process being proposed by MPI because I believe the salmon farm relocation will provide for better environmental, social and economic outcomes.

I understand that by relocating farms from lower water flow sites to higher water flows sites fish performance will improve and therefore the health of the salmon. It will also have a lower level of effect on the seabed which will have positive environmental benefits.

Environmentally, adopting the Best Management Practice guidelines that were agreed by the Council and community is the future for aquaculture globally.

There will be more direct and indirect jobs created if this proposal goes ahead resulting in economic improvements for the communities in the top of the south.

Moving some farms away from baches to more remote locations will improve social amenities which is also a good thing especially from a navigation viewpoint.

I **would not** like to be heard by the hearings panel.

Kind Regards

Rachel McLaren

Written Comments Number: 0246

Subject	**Potential relocation of salmon farms in the Marlborough Sounds**
From	[redacted]
To	aquaculture submissions
Sent	Friday, 17 March 2017 4:50 a.m.
Attachments	<<George McLellan Sounds submission form.pdf>>

Dear Sir/Madam
My submission form in respect of the potential relocation of salmon farms in the Marlborough Sounds is **attached**.
For context, I am an owner of a holiday bach in Te Aroha Bay, Arapawa Island. I am also an investor in New Zealand King Salmon Limited ("**NZKS**") having purchased shares in the company at the initial public offering in October 2016. My bach overlooks the marine farm owned and operated by NZKS at Otanerau Bay, Arapawa Island.
Over the last 20 years I have spent a significant amount of my holiday time in Te Aroha Bay and East Bay. I invested in NZKS because I believe that fish farming represents the lowest impact and highest yielding economic option for the Sounds. Through my personal observations of the NZKS operation at Otanerau Bay over many years, including fishing, swimming and diving in the immediate proximity of the farm, I have continually been impressed by its low impact on the surrounding area.
The visibility of the farm in the area has not ever been a concern that I have shared. I personally believe that the social and economic benefits of the farm vastly outweigh any negative environmental consequences. I have also found that the Salmon farm, although originally controversial, has become a part of the East Bay community.
I write in support of the proposal to relocate all six salmon farms, and generally in favour of aquaculture in the Sounds generally.
Yours sincerely,
George McLellan

The Potential Relocation of Salmon Farms in the Marlborough Sounds: Feedback form

Written comments must be lodged by 5pm on Monday, 27 March 2017.

Comments can be:

- emailed to **aquaculture.submissions@mpi.govt.nz**
- posted to
  Salmon Farm Relocation
  Ministry for Primary Industries
  Private Bag 14
  Port Nelson 7042

Consultation questions

These questions are designed to stimulate your thinking and help us report back clearly on people's written comments. There are also spaces after each question on the feedback form for additional comments. These questions are the same as those in the consultation document.

Please make sure it is clear which aspect of the proposal (including question number if appropriate) you are commenting on.

MPI will consider all relevant material made in your written comments, so you are welcome to provide information supporting your feedback. Please make sure you include the following information in your written comments:

- the title of the consultation document
- your name and title
- your organisation's name (if you are submitting on behalf of an organisation), and whether your written comments represents the whole organisation or a section of it
- your contact details (such as, phone number, address, and email).

Written comments are official information

Please note that your written comments are official information. Written comments may be subject of requests for information under the Official Information Act 1982. The Official Information Act specifies that information is to be made available to requestors unless there are sufficient grounds for withholding it, as set out in the Official Information Act.

Persons who make written comments may wish to indicate grounds for withholding specific information contained within their feedback, such as if the information is commercially sensitive or if they wish, personal information to be withheld. The Ministry for Primary Industries will take such indications into account when determining whether or not to release the information.

Public hearings

A Marlborough Salmon Farm Relocation Advisory Panel will hold hearings in April. These hearings will allow people to speak to their written comments.

If you would like to attend a hearing and meet with the panel, please let us know as part of your written comments, including which location you would prefer.

Once we receive your written comments and your request to meet with the panel, we will notify you of the date, time and location.

☑	I would like to speak to my written comments at a public hearing
☐	I do not want to speak to my written comments at a public hearing

Questions

Question 1:
Do you think that up to six salmon farms within Marlborough Sounds should be allowed to relocate to higher-flow sites?

Yes. The significant operational benefits of relocation & the new regulations will be a net benefit to the Sounds.

Question 2:
Which of the potential relocation sites do you think are suitable for salmon farming?

I support all 6 new sites & believe such are better & more suitable than current sites operated by NZKS both economically & environmentally.

Question 3:
Which of the existing lower-flow sites should be relocated?

All for same reasons. Greater economic benefit & a lower environmental impact.

Question 4:
If you have concerns about particular sites, what are they and what could be done to address these concerns?

Navigation lights should be checked & radar pours.

Question 5:
Do you feel that there are potential benefits or costs of relocating farms that have not been identified?

Small costs in updating maps etc. easily outweighed by net benefits.

Question 6:
Are there rules, policies or conditions that you believe should be added? Please provide information to support any proposed new provisions?

No, already over-regulated.

Question 7:
Provided that detailed standards and requirements are met, do you agree that salmon farming on the potential relocation sites should be a restricted discretionary activity?

Yes, but future applications should be simplified.

Question 8:
Do you agree that the overall surface structure area of salmon farms should not be increased?

No, provided increases in structure size are done in a way that minimizes visible outward appearance.

Question 9:
If the sites at the existing lower-flow farms (other than Crail Bay MFL032) are vacated, do you believe that marine farming should be prohibited in these sites or do you think that these sites should remain open to other types of aquaculture for aquaculture settlement purposes?

The sites should be open to commercial use through a application / approval process.

Question 10:
Given the multiple ownership at Crail Bay MFL32, if this site is relocated, should aquaculture be fully prohibited or should shellfish farming be allowed to continue?

farming should be permited ~~but not fish~~

Question 11:
Do you agree with a staged adaptive management approach if salmon farming at the potential relocation sites proceeds?

Yes, but it should not be overly restrictive.

Question 12:
Is there any wording you agree or do not agree with in the proposed regulations?

No, but cuts of red tape.

Question 13:
Are there any particular issues at the existing lower-flow sites that you would like to comment on?

The seabeds at these sites is already damaged so might as well continue commercial use!

Question 14:
Which of the existing lower-flow salmon farms in the Marlborough Sounds do you think are a higher priority to relocate and why?

There is no high priority.

Question 15:
Is there anything specific that you would like the Minister for Primary Industries to be aware of for any of these sites when thinking about the potential relocation proposal?

Low visibility constructions

Question 16:
Are there particular landscape or natural character values that you want to identify to the Minister for Primary Industries for any of the potential relocation sites?

No. The new sites have less character than existing sites

Question 17:
Are there other effects on landscape and natural character not outlined in the Hudson Associates or Drakeford Williams reports that you would like the Minister for Primary Industries to be aware of?

No. I have personally noted a big improvement in drainage of rope etc washing up in East Bay over past 10 years.

Question 18:
Are there any further measures that you believe could be taken to reduce effects at on landscape and natural character at the potential relocation sites?

No.

Question 19:
What are your thoughts on the potential water quality effects at the potential relocation sites?

water quality impact will be lower than in present sites due to greater natural dilution at ALL sites.

Question 20:
Are there ways in which the potential relocation sites should be developed to help avoid, remedy or mitigate adverse effects on water quality?

Good oversight - involve locals in the oversight.

Question 21:
Are there other effects on water quality that you would like us to be aware of?

No.

Question 22:
What further information would you suggest the Minister for Primary Industries collects on water quality effects in relation to the Tio Point site?

None. I'm aware of.

Question 23:
What are your thoughts on the seabed effects at the potential sites?

The impact is minimal but is worthwhile. The seabed eventually restores itself.

Question 24:
Are there ways to develop the potential sites to help avoid, remedy or mitigate adverse effects on the seabed at each site?

None I'm aware of.

Question 25:
Are there other seabed values or effects that you would like the Minister for Primary Industries to be aware of?

no.

Question 26:
Are there effects on pelagic fish that you would like the Minister for Primary Industries to aware of?

no.

Question 27:
Are there effects on seabirds that you would like the Minister for Primary Industries to be aware of?

farms attract gulls which can be very noisy & annoying for residents.

Question 28:
Do any of the sites pose a greater risk to seabirds than other sites?

not that I'm aware of.

Question 29:
Are there marine mammals in the Marlborough Sounds that you think may be particularly impacted by this proposal?

Seals might cause less damage to nets around farms as they'll be more distressed.

Question 30:
Do any of the potential sites pose a greater risk to marine mammals than other sites?

NO.

Question 31:
Do you agree that there should be an independently audited Biosecurity Management Plan for salmon farming?

No, it's overly burdensome on the operation & will be double work.

Question 32:
What are your thoughts on the potential improvement in salmon health from the proposal? What about salmon welfare and husbandry?

Salmon will benefit from bigger / newer pens & better water flow - no downside for the Salmon!

Question 33:
Are there particular navigational effects at any of the potential relocation sites that the Minister for Primary Industries should be aware of?

As mentioned.

Question 34:
What is your view on the Waitata Mid-Channel site from a navigational perspective, and the possibility of cruise ships or large superyachts using the area?

It is minimal. It's just a thing that some places have farms.

Question 35:
Are there particular tourism and recreation values that you would like the Minister for Primary Industries to be aware of at any of the potential sites?

Tourists are actually interested in salmon farms - this helps NZ's image as a great food producer!

Question 36:
What measures could be taken to remedy or mitigate effects on tourism and recreation values if salmon farms were relocated to these sites?

Educate tourists about the huge steps taken to make these farms environmentally good & make them buy the Salmon products when they go home!

Question 37:
Are there other heritage values that the Minister for Primary Industries should be aware of?

yes consult iwi. as was been done.

Question 38:
Are there any other measures that should be taken to avoid, remedy or mitigate noise effects at any of the potential sites?

I've never found noise from farms to be an issue & have a barn next to one.

Question 39:
Are there any other matters in relation to underwater lighting that you think the Minister for Primary Industries should be aware of?

No.

Question 40:
Social and community effects of the potential relocation proposal are wider than just residential amenity. What effects do you think there will be as a result of the potential relocation proposal?

Some houses (like mine) will become less valuable to salmon farmers and more valuable to holiday makers. It's not relevant consideration.

Written Comments Number: 0246

Please use the space below to provide any additional comments you may have

I have owned a bach overlooking NZKS Otaneray farm for 20 years. I have always been very impressed by the way that farm is run to minimise environmental impact. It has become a member of the community and I've been on boards etc. The farm has been a major economic driver in the area for bike taxi companies etc, which improves general infrastructure for bach owners and residents and makes the sounds accessible. That is why I also invested in NZKS at the IPO in October. I support the changes 100%.

George McLellan.

Written Comments Number: 0246

Written Comment No: 0181

170 Elaine Bay Rd, Elaine Bay
RD3
French Pass 7193

Luke Southorn
Director, Economic Development & Partnerships
Ministry of Primary Industries
Private Bag 14
Port Nelson 7042

01 February 2017

Dear Sir,

Re: Potential Salmon Farm Relocation

I recently read a copy of the MPI publication "Potential relocation of salmon farms in the Marlborough Sounds".

I am concerned by MPI's involvement in the proposal, and the apparent attitude of the salmon farming industry to existing farm site management, and RMA/community-imposed constraints on salmon farming.

Coastal space throughout the Marlborough Sounds is currently administered under the Resource Management Act by the Marlborough District Council (MDC) and it is not a simple matter to 'relocate already allocated salmon farming space'. To do so would set a nationally significant, legal precedent in terms of resource management.

"Horse trading" resource consent conditions and locations is not permitted, as it undermines existing law. You can surrender redundant and unwanted consents, seek to amend existing laws and regulations, apply for new consents, or work with what you've got.

In 2012 and 2014 Professor Kenny Black visited New Zealand and worked with industry and science representatives to develop 'sustainable salmon farming standards'. He also reviewed compliance records from existing salmon farm sites in the Marlborough Sounds (Black, SRSL 2013). His observation that "... higher-flow sites are better for growing heaithy salmon, and reducing environmental effects in the Marlborough Sounds" is neither new nor earth-shattering.

Good, well-flushed, protected sites allow greater farmed salmon densities, less salmon stress, better feed conversion, faster growth, and reduced rates of waste accumulation on the sea-floor. When waste accumulation occurs, sites eventually become 'toxic' and must be periodically 'retired'. Professor Black (2013), however, also indicated that high-flow farm sites can result in a larger area of benthic disruption than low-flow sites.

An important conclusion from Professor Black's studies is that existing salmon farms must be operated within limits imposed by their local environment to ensure long-term sustainability.

The Te Tau Ihu Forum and the Marlborough Salmon Working Group both have a commercial interest in procuring the best possible salmon farming sites, and I accept that many existing farm sites in the Sounds can be considered "sub-optimal".

Some sites are "sub-optimal" because of poor initial planning (poor site selection by the applicant), poor site management (i.e. site contamination over time), a lack of environmental monitoring and a substandard recognition of environmental limits. A site's sup-optimal status could also be attributed to RMA or community-imposed planning constraints.
Shifting salmon farms might avoid ongoing site-contamination problems, but it is a temporary fix, and avoids the real problem which is poor farm site management.

In conclusion, I believe aspiring salmon farmers would be better off investing in on-shore farms and robust, more expensive off-shore farms.

The Marlborough Sounds is not a suitable area for industry expansion because of the visual, aesthetic and navigational impact new farms may have. The Sounds are also a unique ecological area and a nationally important recreational asset.

The salmon industry needs to become more environmentally responsible and community-conscious.

Marlborough Sounds residents are not prepared to tolerate lower local environmental standards or legal shenanigans to ensure continual salmon industry growth. Industry must embrace "sustainable growth" and environmental protection. Government's aquaculture expansion strategy must be reined in if environmental standards can't be met and suitable space cannot be found.

Taxpayer funds should be directed towards environmental protection and sustainable industries.

I hope these comments assist.

Yours truly,

Neil McLennan

CC: Rita Jacobsen, Pelorus Promotions Inc.;
Rob Schuckard, Sounds Advisory Group

Written Comment No: 0181

Subject	**Submission re. Salmon Farm Relocation**
From	[redacted]
To	aquaculture submissions; Explore Pelorus
Sent	Friday, 10 March 2017 4:29 p.m.
Attachments	<<MPI Discussion Paper 2017-04_Submission Neil McLennan_10Mar2017.pdf>>

Find attached my submission concerning MPI discussion paper 2017/04.
Regards,
Neil McLennan

Written Comment No: 0181

MPI Discussion Paper No: 2017/04
Potential relocation of salmon farms in the Marlborough Sounds

Submission to the Marlborough Salmon Farm Relocation Advisory Panel by Neil Roy McLennan

Address & Contact Details:

[redacted] French Pass 7193

Ph: [redacted] Email: [redacted]

The Potential Relocation of Salmon Farms in the Marlborough Sounds: Feedback form

Written comments must be lodged by 5pm on Monday, 27 March 2017.

Comments can be:

- emailed to **aquaculture.submissions@mpi.govt.nz**
- posted to
  Salmon Farm Relocation
  Ministry for Primary Industries
  Private Bag 14
  Port Nelson 7042

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- your name and title
- your organisation's name (if you are submitting on behalf of an organisation), and whether your written comments represents the whole organisation or a section of it
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Public hearings

A Marlborough Salmon Farm Relocation Advisory Panel will hold hearings in April. These hearings will allow people to speak to their written comments.

If you would like to attend a hearing and meet with the panel, please let us know as part of your written comments, including which location you would prefer.

Once we receive your written comments and your request to meet with the panel, we will notify you of the date, time and location.

[X]	I would like to speak to my written comments at a public hearing
[ ]	I do not want to speak to my written comments at a public hearing

Questions

Question 1:
Do you think that up to six salmon farms within Marlborough Sounds should be allowed to relocate to higher-flow sites?

No

Question 2:
Which of the potential relocation sites do you think are suitable for salmon farming?

See above

Question 3:
Which of the existing lower-flow sites should be relocated?

None

Question 4:
If you have concerns about particular sites, what are they and what could be done to address these concerns?

All proposed sites unsuitable, see submission

Question 5:
Do you feel that there are potential benefits or costs of relocating farms that have not been identified?

Yes, see submission

Question 6:
Are there rules, policies or conditions that you believe should be added? Please provide information to support any proposed new provisions?

See submission

Question 7:
Provided that detailed standards and requirements are met, do you agree that salmon farming on the potential relocation sites should be a restricted discretionary activity?

See submission

Question 8:
Do you agree that the overall surface structure area of salmon farms should not be increased?

See submission

Question 9:
If the sites at the existing lower-flow farms (other than Crail Bay MFL032) are vacated, do you believe that marine farming should be prohibited in these sites or do you think that these sites should remain open to other types of aquaculture for aquaculture settlement purposes?

See submission

Question 10:
Given the multiple ownership at Crail Bay MFL32, if this site is relocated, should aquaculture be fully prohibited or should shellfish farming be allowed to continue?

See submission

Question 11:
Do you agree with a staged adaptive management approach if salmon farming at the potential relocation sites proceeds?

See submission

Question 12:
Is there any wording you agree or do not agree with in the proposed regulations?

See submission

Question 13:
Are there any particular issues at the existing lower-flow sites that you would like to comment on?

See submission

Question 14:
Which of the existing lower-flow salmon farms in the Marlborough Sounds do you think are a higher priority to relocate and why?

See submission

Question 15:
Is there anything specific that you would like the Minister for Primary Industries to be aware of for any of these sites when thinking about the potential relocation proposal?

See submission

Question 16:
Are there particular landscape or natural character values that you want to identify to the Minister for Primary Industries for any of the potential relocation sites?

See submission

Question 17:
Are there other effects on landscape and natural character not outlined in the Hudson Associates or Drakeford Williams reports that you would like the Minister for Primary Industries to be aware of?

See submission

Question 18:
Are there any further measures that you believe could be taken to reduce effects at on landscape and natural character at the potential relocation sites?

See submission

Question 19:
What are your thoughts on the potential water quality effects at the potential relocation sites?

See submission

Question 20:
Are there ways in which the potential relocation sites should be developed to help avoid, remedy or mitigate adverse effects on water quality?

See submission

Question 21:
Are there other effects on water quality that you would like us to be aware of?

See submission

Question 22:
What further information would you suggest the Minister for Primary Industries collects on water quality effects in relation to the Tio Point site?

See submission

Question 23:
What are your thoughts on the seabed effects at the potential sites?

See submission

Question 24:
Are there ways to develop the potential sites to help avoid, remedy or mitigate adverse effects on the seabed at each site?

See submission

Question 25:
Are there other seabed values or effects that you would like the Minister for Primary Industries to be aware of?

See submission

Question 26:
Are there effects on pelagic fish that you would like the Minister for Primary Industries to aware of?

See submission

Question 27:
Are there effects on seabirds that you would like the Minister for Primary Industries to be aware of?

See submission

Question 28:
Do any of the sites pose a greater risk to seabirds than other sites?

See submission

Question 29:
Are there marine mammals in the Marlborough Sounds that you think may be particularly impacted by this proposal?

See submission

Question 30:
Do any of the potential sites pose a greater risk to marine mammals than other sites?

See submission

Question 31:
Do you agree that there should be an independently audited Biosecurity Management Plan for salmon farming?
See submission

Question 32:
What are your thoughts on the potential improvement in salmon health from the proposal? What about salmon welfare and husbandry?

See submission

Question 33:
Are there particular navigational effects at any of the potential relocation sites that the Minister for Primary Industries should be aware of?

See submission

Question 34:
What is your view on the Waitata Mid-Channel site from a navigational perspective, and the possibility of cruise ships or large superyachts using the area?

See submission

Question 35:
Are there particular tourism and recreation values that you would like the Minister for Primary Industries to be aware of at any of the potential sites?

See submission

Question 36:
What measures could be taken to remedy or mitigate effects on tourism and recreation values if salmon farmswere relocated to these sites?

See submission

Question 37:
Are there other heritage values that the Minister for Primary Industries should be aware of?

See submission

Question 38:
Are there any other measures that should be taken to avoid, remedy or mitigate noise effects at any of the potential sites?

See submission

Question 39:
Are there any other matters in relation to underwater lighting that you think the Minister for Primary Industries should be aware of?

See submission

Question 40:
Social and community effects of the potential relocation proposal are wider than just residential amenity. What effects do you think there will be as a result of the potential relocation proposal?

See submission

Please use the space below to provide any additional comments you may have

See submission from N.R. McLennan, Elaine Bay, 10 Mar 2017

Re: A 2016/17 proposal by MPI to amend the Marlborough Sounds Resource Management Plan to enable the relocation of up to six existing salmon farms

Statement by N.R. McLennan to the Salmon Farm Relocation Advisory Panel, dated 09 March 2017.

Introduction and Background.

1. My name is Neil Roy McLennan and I own a house and sea-kayak hire business in Elaine Bay, Pelorus Sound. I hold a M.Sc. degree in Earth Sciences from Waikato University, and M.App.Sc. degree in Aquaculture from the University of Tasmania.
   In the past, I have worked as a technical officer (engineering) and as a planner for the Taranaki and Manawatu Catchment Boards, as a mussel farm planner for Sealife Investments Ltd, and as a private aquaculture consultant. I'm now semi-retired. Sea-kayak hire and DoC campground management provide my income.

2. My family has owned property in Elaine Bay for about 60 years, and my kayak hire business is now 14 years old. Like many "locals" I have my own motor boat and fish the outer Pelorus area.

   I have observed different commercial and recreational activities in Pelorus Sound over several years. Besides traditional farming, forestry and fishing uses, the area is now increasingly catering for people who look for a holiday experience "off the beaten track", and who enjoy the tranquillity, safety, and relative loneliness the area provides.
   Mussel farming is an important commercial activity. Mussel farming and related activities do not interfere with recreational values in the area, and so far this industry has not resulted in any serious off-site environmental impacts. Depleted natural algal concentrations concern some people.

3. MPI released an 8 page summary paper titled "Potential relocation of salmon farms in the Marlborough Sounds" late 2016, and I responded to this paper (which invited public feedback) on 1 February 2017; refer to Appendix A.
   I have since read several reports prepared by MPI (and various consultants for MPI) on the salmon farm relocation issue, and I now wish to enlarge on my earlier comments.

4. The central argument behind the salmon farm relocation proposal is that existing low-flow farm sites (occupied by NZ King Salmon Ltd) are sub-optimal, and will not meet recently prepared Marlborough District Council (MDC) benthic guidelines.
   Relocation of six low-flow farms is deemed necessary by MPI to ensure the continued viability of King Salmon's operation (i.e. on-going profitability, staff employment and the fulfilment of export goals).

   It is also important to note that consents for the low-flow farms will expire between 2021 and 2024. They would probably not meet MDC standards to receive re-approval beyond their expiry dates.

5. I support MPI and marine farming association efforts to promote and enlarge the aquaculture industry in NZ, however I also believe that environmental issues need careful consideration, and aquaculture expansion must be handled in a sensible and socially responsible manner.

All New Zealanders value their "clean, green" coastal playground and want to see it retained. Most people would also prefer to live near a park or a playground rather than an industrial estate or an effluent outfall. For these reasons, I support environmental safeguards provided within the Resource Management Act.

6. From a planning perspective, NZ King Salmon (and MPI) face a zoning problem, because the proposed new high-flow salmon farm sites are mainly located in the CMZ1 zone (where no aquaculture is permitted within the current MDC resource management plan).
I therefore intend to address zoning issues, such as the suitability of the proposal itself, and the suitability of the area proposed for salmon farming.

   I do not believe that NZ King Salmon Ltd have managed their existing low-flow sites responsibly, and contend :

   i. environmental protection must be considered ahead of business viability;
   ii. the Marlborough District Council should be allowed to introduce its benthic guidelines and any other environmental safeguards as it sees fit;
   iii. government agencies and the NZ salmon farming industry need to confront fish farm waste management issues, and work with MDC to ensure finfish farming occurs in suitable areas; and
   iv. no salmon farms should be relocated to the entrance of Pelorus Sound until off-site water quality impacts, and alternative offshore, outer Sound finfish farming areas are examined.

Aquaculture Issues.

7. Between 1992 and 1994 I studied aquaculture in Launceston, Tasmania. My thesis involved larval rearing of striped trumpeter and I also completed a literature review on economic aspects of intensive and extensive salmon production (this involved comparing economic papers from Scotland, Norway, Canada, Japan and Chile). It is relevant to add that not all countries farmed the same salmon species. Never-the-less at that time (23 years ago!), salmon production methods were reasonably well-known. Established industries existed in Europe, North America, Japan and Chile, and salmon feed supply and farm development costs were of concern to the industry (just like today).

   Capital and farm operating costs associated with different fish production methods have already received study. Needham (1990) for example, reported landbased salmon production costs were almost four times those of sea-cage salmon production in Canada (at that time).
Similarly, Shaw (1987) found that the capital costs of salmon production within landbased recirculating seawater systems and in high-quality "offshore" sea-cages were 50-150% higher than those in lower quality "nearshore" sea-cages, enclosed embayments or fjords, in Europe. Blakstad (1993) and Myrseth (1988) have also reported on the relative costs of landbased and sea-based systems; and on the relative economics of large-scale and small-scale (traditional) sea-cage operations in Norway.

   [Note: Landbased production and offshore production evidently only made sense if their high operating and establishment costs were offset by marketing, licencing and monitoring, employee retention and housing, and product-transport advantages, all necessary business considerations. I therefore believe that MPI is somewhat "short-sighted" when it focuses solely on the relative

costs of onshore and offshore fish farm structures, as business viability is a complex and multi-facetted issue.
The economic studies did not assess the environmental merits of any particular salmon production method.]

I am sure that NZ King Salmon Ltd is well-aware of the relative merits of different land and sea-based salmon farming methods, and that a variety of more recent literature is available on these issues.

8. Twenty three years ago, disputes between low-cost, nearshore salmon farming advocates and environmentalists were also increasing. Problems with nearshore salmon farm site pollution emerged, and these problems prompted a shift to offshore salmon farming.

   General issues relating to landbased and sea-cage salmon farming are described by Forteath (1992), and an excerpt of his paper is presented at Appendix B. Comments on cage culture systems by Forteath (1992, pp 49-50) are particularly relevant.

Benthic and salmon farm relocation issues.

9. Aquaculture is a relatively new and unknown science in New Zealand, and the country can learn from overseas experiences and expertise. The development of improved benthic guidelines and the recent review of Marlborough salmon farm coastal consents by Scottish Professor Kenneth Black is a case-in-point, refer to Black (2013).

   I do not believe that the recently reported low-flow salmon farm pollution problems were a surprise to NZ King Salmon Ltd. Marlborough Council should be congratulated for inviting Professor Black and for reviewing the under-farm seabed monitoring data. It should now be supported while it assesses the need for any additional regulatory changes, and develops new resource management rules.

10. MPI discussion paper (2017/04) states that salmon farming at the low-flow sites in compliance with the MDC benthic guidelines would "likely cause a decrease in production with potential negative economic impacts" (p.47). After economic modelling, the report continues "Put simply, if the benthic guidelines are implemented at the existing farms under maximum and minimum stocking levels, there would be an estimated loss of $10 million GDP per year and 105 FTE's during the 2-5 year fallowing period, and an estimated ongoing GDP loss of $3.6 million to $10 million per year" (p.49).

    It is misleading to describe economic activity (GDP) as if it has some inherent value, without considering farm investment and return rates, and who benefits. It is also disturbing when the figures are presented in a MPI publication and used to rationalize or justify seabed pollution and farm over-stocking.
    The benthic guidelines will not cause any financial losses. NZ King Salmon Ltd will however lose production due to past site mismanagement, and these production losses appear likely to happen (due to site pollution) whether or not the MDC guidelines are implemented. A shift to new farm sites appears necessary simply because of exisitng low-flow site mismanagment.

11. NZ King Salmon Ltd should suffer the consequences of its past site management practices, and prepare new soundly based, environmentally sensitive, coastal consent applications to accommodate its salmon farming business.
MPI should not be involved in partisan resource allocation.

Planning for Finfish Farming.

12. Although no longer involved with the aquaculture industry, I have followed industry developments for several years. Developments include the 2006 NZ Aquaculture Strategy, Maori aquaculture claims settlement, recommendations from the 2010 aquaculture technical advisory group (TAG), and NZ King Salmon's applications for Marlborough Sounds water-space in 2012, and subsequent court decisions. I'm also aware of a recent decision from the Minister of Fisheries to establish an offshore marine farming zone near Coromandel.

    The Coromandel decision is interesting because it might indicate the nature of future finfish farming water-space allocations around New Zealand. The current fate of the Coromandel offshore marine farming zone is described at Appendix C. This offshore marine farming zone is 300 ha in size, approximately 10 km offshore from Coromandel within the Firth of Thames, and 20% of its space is allocated to local Maori. Applications for space within the zone are to be made available by tender, and subject to site-specific coastal consents being issued by the Waikato Regional Council.

Waste Management.

13. Back to the Marlborough salmon farm relocation proposal. I believe many of the MPI and associated consultant reports on the Marlborough salmon farm relocation proposal are shallow and place undue emphasis on the economic advantages of salmon production.
Major problems relate to the consideration given to salmon farm waste management; and to farm relocation options.

    Important differences exist between mussel farming and salmon farming. Mussel farming is an extractive industry as growing shellfish feed on naturally occurring algae in the water.
Finfish farming, however, relies on large quantities of pellet feed being added to the marine environment. Essentially salmon farming is a feedlot enterprise, with considerable waste discharge and minimal effluent controls.

14. In general fish farms are known to experience fungal, viral, bacterial, fouling and smell problems; and to attract seabirds, seals and predator fish including sharks.
Seawaters near a farm can also become nutrient enriched, affecting local marine life. Particular problems can include toxic algae, and changes to seaweed, jellyfish, zooplankton and seabed life (i.e. both species and abundance changes). Noise and lighting issues also need consideration.
These problems and their public impacts are reduced when farms are shifted offshore.
Waste treatments (such as water filtration, settlement ponds, ozone disinfection and bio filtration to allow water recirculation) are possible when salmon farms are established on land.

15. Deep water salmon farm sites are desirable because if under farm pollution occurs (ES >5), the separation between the seabed and the salmon cage reduces the risk of a salmon kill. Deep water sites are also generally cooler than shallow water sites, and over the summer months warm Marlborough Sounds water temperatures are not ideal for salmon farming.

The high-flow farm sites proposed by MPI are predicted to have greater productivity (and associated higher feed rates) than the low-flow sites because of their current, temperature and depth advantages, however, suitable offshore sites should yield similar advantages.

16. Fish farmers attempt to ensure optimum conditions for their farmed fish. In contrast, society has adopted less rigorous standards for general environmental management. When promoting developments, applicants are generally only required to meet "sub-lethal standards" (to protect their own stock) rather than optimum environmental standards. As a result many developments lead to an overall deterioration in nearby environmental health.

    On a fish farm there is a further complicating issue as dissolved and suspended wastes are discharged off-site (due to local water movement), while solid wastes normally accumulate under sea cages and become a farm threat (unless removed by the farmer).
    Fish farmers therefore ought to be encouraged to **reduce** total wastes, **minimize** dissolved and suspended wastes, and **remove** solid wastes which accumulate on the sea bed.

17. I agree with the MPI report that possible environmental impacts are poorly understood and on-going monitoring and adaptive management would be necessary if any relocation occurs.

Relocation Options.

18. The MPI reports present an inadequate assessment of different farm relocation options.
    The Marlborough Salmon Working Group (which contained community, government and industry representatives) for example has expressed diverse views on the attributes of different options; however, these differences of opinion are simply noted. They are not elaborated upon or resolved within the Working Group report (Marlborough Salmon Working Group report, dated 23/11/2016, pp. 13-15).

    The Working Group report (23/11/2016, p15) for example dismisses the offshore fish farming option and states "...offshore has become an emerging approach to marine farming." and "More research is required to develop offshore technology that can withstand NZ's higher energy locations and provide confidence to any future investor."
    It would be more correct to state that offshore finfish farming is now generally accepted as the best practical approach to reduce seabed and water quality contamination effects; and that the technology for offshore finfish farming already exists.

    The question really is whether low-cost sea-cage structures, located in sheltered recreational waters are desirable, and preferable to higher cost sea-cage structures in less sheltered, less frequented waters.

19. I believe finfish farming can flourish around NZ if government agencies promote offshore marine farming areas in suitable locations.

    In Marlborough, suitable areas for offshore marine farming could be within Port Underwood, Port Gore, Waitui Bay, Guards Bay, Admiralty Bay and Current Basin. Locals in these areas should be surveyed to determine their feelings towards particular proposals; and compensation should be considered for detrimentally affected parties (as offshore fish farms are not public works, they are proposed for private company benefit).

20. Nearshore finfish farms located at the entrance to Pelorus Sound are not desirable, because they have greater environmental impact than offshore farms. Most marine life is located around the coastal margin, on headland reefs and around sea mounts.

    Finfish farms should also be restricted to the outer Sounds to avoid adverse water quality effects on recreational fishing and tourism, and to avoid possible toxic algae, marine fouling and predator shark problems. The entrance to Pelorus Sound is already popular with recreational fishermen. If additional salmon farms are permitted at the entrance to Pelorus Sound, I believe the recreational and tourism potential of the area as-a-whole will be detrimentally affected, due to real and imagined shark attack and water contamination worries.

    Grouped farm structures located within "managed estates", off-shore and away from recreational areas, are considered less visually disruptive and better from an operational and a navigational safety point of view than scattered small-scale farms.

21. My letter to MPI dated 01 February 2017 (refer to Appendix A) also stated that the Ministry should be supporting business "sustainability".
    This term is often used as a marketing logo. It is difficult to define, as market conditions, loan repayments, law suits, errant weather systems, disease outbreaks, business competitors and farm management practices can all affect a venture's viability and sustainability.
    As a general concept the term "sustainability" relates to minimal adverse off-site impact, waste control, limited use of medications, environmental suitability, and the adoption of the best farm management practices.
    The company *Mt Cook Alpine Salmon* (which farms salmon in hydro-channels near Twizel) recently won a sustainability award from the 'Seafood Watch' organization, and NZ salmon farming practices were highly rated.

    New Zealand's reputation as a 'clean, green' food producer needs to be protected, and government needs to ensure salmon farming is undertaken in suitable areas.

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Appendices.

A. Letter to Luke Southorn, MPI, dated 01 February 2017

B. Excerpt of scientific paper by Professor Nigel Forteath titled 'Management Systems for Intensive Finfish Aquaculture', see Forteath (1992).

C. Article titled 'Coromandel Finfish Farming' by Justine Inns, Solicitor with Oceanlaw New Zealand. Printed in Aquaculture, ed. Sep/Oct 2016, p. 13. VIP Publications, Auckland, New Zealand.

Written Comment No: 0184

[redacted]
RD3
French Pass 7193

Luke Southorn
Director, Economic Development & Partnerships
Ministry of Primary Industries
Private Bag 14
Port Nelson 7042

01 February 2017

Dear Sir,

Re: Potential Salmon Farm Relocation

I recently read a copy of the MPI publication "Potential relocation of salmon farms in the Marlborough Sounds".

I am concerned by MPI's involvement in the proposal, and the apparent attitude of the salmon farming industry to existing farm site management, and RMA/community-imposed constraints on salmon farming.

Coastal space throughout the Marlborough Sounds is currently administered under the Resource Management Act by the Marlborough District Council (MDC) and it is not a simple matter to 'relocate already allocated salmon farming space'. To do so would set a nationally significant, legal precedent in terms of resource management.

"Horse trading" resource consent conditions and locations is not permitted, as it undermines existing law. You can surrender redundant and unwanted consents, seek to amend existing laws and regulations, apply for new consents, or work with what you've got.

In 2012 and 2014 Professor Kenny Black visited New Zealand and worked with industry and science representatives to develop 'sustainable salmon farming standards'. He also reviewed compliance records from existing salmon farm sites in the Marlborough Sounds (Black, SRSL 2013). His observation that "... higher-flow sites are better for growing healthy salmon, and reducing environmental effects in the Marlborough Sounds" is neither new nor earth-shattering.

Good, well-flushed, protected sites allow greater farmed salmon densities, less salmon stress, better feed conversion, faster growth, and reduced rates of waste accumulation on the sea-floor. When waste accumulation occurs, sites eventually become 'toxic' and must be periodically 'retired'. Professor Black (2013), however, also indicated that high-flow farm sites can result in a larger area of benthic disruption than low-flow sites.

An important conclusion from Professor Black's studies is that existing salmon farms must be operated within limits imposed by their local environment to ensure long-term sustainability.

The Te Tau Ihu Forum and the Marlborough Salmon Working Group both have a commercial interest in procuring the best possible salmon farming sites, and I accept that many existing farm sites in the Sounds can be considered "sub-optimal".

Some sites are "sub-optimal" because of poor initial planning (poor site selection by the applicant), poor site management (i.e. site contamination over time), a lack of environmental monitoring and a substandard recognition of environmental limits. A site's sub-optimal status could also be attributed to RMA or community-imposed planning constraints.
Shifting salmon farms might avoid ongoing site-contamination problems, but it is a temporary fix, and avoids the real problem which is poor farm site management.

In conclusion, I believe aspiring salmon farmers would be better off investing in on-shore farms and robust, more expensive off-shore farms.

The Marlborough Sounds is not a suitable area for industry expansion because of the visual, aesthetic and navigational impact new farms may have. The Sounds are also a unique ecological area and a nationally important recreational asset.

The salmon industry needs to become more environmentally responsible and community-conscious.

Marlborough Sounds residents are not prepared to tolerate lower local environmental standards or legal shenanigans to ensure continual salmon industry growth. Industry must embrace "sustainable growth" and environmental protection. Government's aquaculture expansion strategy must be reined in if environmental standards can't be met and suitable space cannot be found.

Taxpayer funds should be directed towards environmental protection and sustainable industries.

I hope these comments assist.

Yours truly,

N. R McLennan

Neil McLennan

CC: Rita Jacobsen, Pelorus Promotions Inc.;
Rob Schuckard, Sounds Advisory Group

MANAGEMENT SYSTEMS FOR INTENSIVE FINFISH AQUACULTURE

Professor Nigel Forteath

Introduction

This paper will consider problems associated with the choice of impoundments for intensive finfish aquaculture before undertaking an examination of some of the factors affecting the productivity of an aquaculture facility. Considerable interest is being expressed in recirculating systems for aquaculture and some of the important parameters associated with biofiltration will be highlighted. The successful management of an aquarium tank likewise is dependent on knowledge of the principles of biofiltration.

Site selection

The impoundments of choice will be selected after a consideration of the available water supply in the first instance. Major requirements for keeping fish alive are water, oxygen and removal of pollutants. Water demands are specific to each species and their exact determination can only be arrived at by knowledge of their oxygen needs and threshold of resistance to autopollution. Ideally, land-based farms should collect their water from springs or a water source devoid of agricultural, forestry or industrial enterprises to avoid external sources of pollutants. An abundant supply of water often is considered essential but in fact may not be necessarily the principal consideration. It may prove economically feasible to farm a site with a deficient water supply by using aeration techniques and treatment of the effluent thereby permitting safe recirculation of the water through the system.

Recently there has been increasing interest in the use of European, high technology, recirculating systems for the intensive culture of finfish. The success of this approach will depend on the economics associated with aeration, efficiency of water treatment, and the safety back-up arrangements for such operations. It will hinge also on the knowledge of the operator who must be fully conversant with recirculating system technology. Traditionally, the most economic aquaculture systems have been those relying on gravity fed water or farms consisting of floating cages in freshwater lakes. Suitable sites for the former are difficult to find in Australia close to a centre of population (an important commercial attribute). In most instances, it is also necessary to pump water from rivers or lakes because so few sites have an abundant water supply available throughout the year due to the arid climate. Cage culture in lakes is not permitted in most States. These considerations have resulted in a thrust towards mariculture or the extensive farming of farm dams which abound in many parts of the country, rather than the establishment of land-based intensive culture units requiring large amounts of water. However, if water quality was improved in the discharge from the farm much of it could be reused reducing the water demands considerably.

Impoundment design and construction

1. Intensive land-based systems

Earthen ponds and raceways are the cheapest to construct but attention must be paid to slope of walls and bottom of the impoundment units, and porosity and erosion coefficient of the soils. The slope of the land must be considered since complete draining of ponds is an essential management tool. Farm productivity is often adversely affected by economic constraints being imposed on building materials. Concrete ponds or raceways are expensive to construct in comparison with earthen ones but the latter may require greater management with respect to water quality.

Plastic lined ponds are not recommended for holding fish since dangerous levels of uneaten food and faeces may accumulate in "dead spots" which become anaerobic. Severe loss of stock will occur if fish are forced into this anaerobic zone during farm operations. Furthermore, break-down of accumulated organic waste by bacteria in plastic lined ponds is extremely slow resulting in turbid water whenever fish become active and stir up the debris on the bottom, for example during feeding. Impoundments constructed on the site of disused mine diggings are particularly inappropriate although construction may be cheap. Old mine tailings will continue to leach for many years and heavy metals are dangerous to fish and human health.

In both linear and circulating ponds, the water flow pattern is directly responsible for moving the fish derived sediments out of the system. The most effective water flow patterns for intensive salmonid impoundments are created by an across-the-pond weir inflow in order to avoid dead spots in the head end of the pond for rectangular units or vertical inflows in circular ponds or tanks brought about by a submerged pipe with several openings along its length. The optimum water replacement time within a pond will depend on the oxygen demands of the fish and the stocking density. For salmonids and other species with blood having a relatively low affinity for oxygen, or when water temperatures exceed the optima for species, replacement time should be in the order of 2-3 changes per hour. Determining the water replacement time in circular tanks and ponds is difficult because of the short-circuiting of the water: new water is leaving the pond continually while old water often is retained for long periods. Care must be taken to ensure water velocity does not exceed the energy providing capabilities of the diet. Velocities in the order of 0.9-1.6 m min^{-1} are considered to be well within the limits for most commercial fish feeds but a velocity of 1.8 m min^{-1} may have a growth inhibiting effect unless the diet is altered to provide increased energy. Most species of salmonids grow well at velocities <1.8 m min^{-1}. Many aquaculturists measure the effluent water quality of their intensive systems to ascertain its life support capability. To ensure good growth, it is desirable to ensure that the dissolved oxygen concentration in the effluent is not less than 5 mg/l and preferably 7 mg/l and NH_4 -N does not exceed 0.5 mg/l. However, more attention ought to be paid to the influent water quality parameters particularly to avoid hypoxic conditions in summer months. Algae and macrophytes growing up-stream of farm water supplies can remove significant amounts of dissolved oxygen in the early hours of the morning or on cloudy days. Regular oxygen readings or Secchi disc readings, in the case of algal blooms, can often detect potential danger periods in advance and permit aerators to be swtched on.

In rectangular ponds and raceways, the most efficient outfall design is an across-the-pond weir preceded by a baffle board which is the same distance above the bottom of the pond as the height of water passing over the top of the weir. This type of outfall permits efficient removal of uneaten food and faeces. It is necessary to prevent fish passing under the baffle board by placing a screen in front of it. Debris and dead fish coming to rest on the screen can be removed with relative ease by brushing the face of the screen.

In circulating ponds, the most efficient outfall design is the bottom pick-up with a centre drain. A major problem encountered in effluent drains in these systems is difficulty of cleaning. A serious blockage of the central drain may result in water being forced up over the pond wall: emergency overflow pipes with screens to prevent fish loss must be incorporated.

Aquaculturists wishing to improve water quality in the discharge water prior to reuse or for environmnetal reasons are faced with three basic processes for water

treatment in their impoundments, namely aeration, filtration for the removal of suspended solids, and biofiltration for the oxidation of ammonia and nitrite. Water treatment on the scale required in intensive culture systems can be expensive but if applied correctly can result in a rapid return of capital, with the added bonus of giving a "green" image to fish farms. Fishfarm effluent treatment is becoming a topic of increasing concern in many parts of the world. However, poorly designed and constructed tanks, ponds or raceways will make the task of maintaining water quality for reuse extremely difficult.

Oxygen not only is consumed by the fish but also by heterotrophic bacteria which digest uneaten feed and faeces collecting on the bottom of the pond. Consumption of oxygen is often particularly pronounced in earth ponds with a slow water exchange rate. Such impoundments act as a sedimentation tank resulting in a significant biochemical oxygen demand (BOD) on the system. Unlike raceway systems, it is often necessary to continually aerate ponds, or even provide pure oxygen, at times of hot weather and low water levels. A variety of device are able to increase oxyen levels but fine-bubble, low pressure diffused aeration is adequate unless emergencies occur requiring pure oxygen. Diffusers on the substratum of the pond turn the water over rapidly bringing oxygenated water to the bottom, while also reducing the build-up of organic waste. The latter are kept in suspension for longer allowing the water flow to move them towards the effluent. A further advantage of bottom diffusers is the prevention of anaerobic bacterial activity in the sediments capable of producing sulphide and methane. The presence of aerobic bacteria is highly desirable to ensure nitrification can take place thereby improving water quality in the pond by oxidation of toxic ammonia to non-toxic nitrate.

Removal of suspended solids is difficult in fishfarms due to the large volumes of water involved containing relatively small amounts of particulate matter. Sedimentation ponds tend to take up valuable space and require a retention time of several hours. Settlement ponds should be designed so that the volume flow through the pond (m^3/day) does not exceed 40 times the pond surface area (m^2). This is an essential prerequisite for the settlement of the majority of solid particles in most aquacultural farm effluents. Ponds also must be designed so that the ratio of length/retention time (i.e. a form of mean fluid velocity) does not exceed 3 metres/min. This is necessary to minimise resuspension of settled solids. Effluent suspended solid concentrations of less than 6mg/l are very difficult to maintain. This has lead to the development of a variety of devices in an attempt to increase efficiency including swirl seperators, settling chutes, lamellar sedimentation apparatus (Barnabe, 1990) and filter conveyor belt systems. The conveyor belt system is attracting considerable attention overseas at present.

Ammonium excreted by fish and bacteria can be converted to more acceptable forms of nitrogen by the use of ion exchange filtration in freshwater systems or via nitrification in both freshwater and marine systems using biological filters. The latter is more apropriate for fishfarms. However, nitrification only performs well in aerobic conditions and when water temperatures exceed 10°C. (Forteath, 1990).

2. Cage culture systems

Site selection for cage culture has undergone significant changes over the years, particularly in the marine environment. There is now an increasing interest in establishing farms in more exposed offshore waters in order to increase production through better water quality and avoid environmental conflicts. Considerable fears have been expressed by environmentalists recently about the

eutrophication of freshwater lakes and sheltered marine bays by fishfarms while the farmers themselves have found that inshore marine farms in particular are becoming harder to manage with age. Long established farms in Scandinavia, for example, are having difficulty controlling disease outbreaks and in Scotland sea-lice are proving a major problem for the industry. The use of antibiotics is doing little to enhance the reputation of fishfarmers amongst the green lobby. The fallacy that cage culture requires nothing more than regular feeding of the stock has proved extremely costly. It is now widely accepted that this method of husbandry requires knowledge and skillful management to be viable. Cage and pond culture have many management problems in common.

Water movement through the cage is essential in order to provide the fish with oxygen and to ensure removal of autopollutants. Considerable volumes of water are moved through a cage via the swimming activity of the fish particularly during feeding. However, much of this water is drawn up through the bottom panels of the net. Thus it is essential when selecting a site that sufficient water depth exists below the cage in order to avoid faeces and uneaten food being drawn back in and fouling the water. Cage nets are usually four or five metres deep and a water depth of at least 3 times the net depth is recommended. This depth is the minimum required at low tide in the marine environment. There is a great deal of evidence that waste feed and faeces accumulate beneath cages resulting in localised oxygen depletion and a build up in potentially toxic compounds (Beveridge, 1987). The latter are receiving increasing attention since it is believed that they are a possible causative agent of gill damage. Furthermore, Rosenthal (1985) reported that these sediments cause a build-up in disease causing micro-organisms.

Solid waste accumulation beneath cages is remarkedly localised and affects an area of some 60 metres within the vicinity of a cage for the most part. Leaving a site fallow for a six month period greatly reduces fishfarm sediments.

In the marine environment, tidal movement and currents are responsible for water exchange. In the ideal site, periods of slack water should be minimal. It has been found that tidal currents in the range 10-60cm s^{-1} are satisfactory for most species but much depends on cage design and stocking density. Cost of cage moorings and netting will increase as current speeds become greater although some of the cost may be offset by the greater permissable stocking density. Beyond a certain point, deformation of the net in particular will cause an unacceptable reduction in cage volume. Also fish will have to expend large amounts of energy maintaining station which will reduce their growth rate. Forcing the fish to crowd together in hot weather is extremely dangerous given the inverse relationship that exists between dissolved oxygen concentration and increasing salinity and temperature. At current speeds of 55cm s^{-1} in New Zealand , for instance, it is necessary to place baffles in front of the cages to try to reduce water flow which billows the net and reduces the living space for the fish.

Cage farming in lentic water bodies relies on wind action and water movement caused by the fish themselves for water exchange. Exposed areas of lakes are preferred but flow rates usually are slower than marine sites (0.2-2.0cm s^{-1}). Sometimes farmers take advantage of the outflow of lakes to increase water movement. Deep water is essential.

Cage culture in lotic environments is not common in Western countries but in Asia large rivers are often utilised. Major problems may result particularly with respect to efficient feeding because of rapid feed loss in the flowing current. A farm situated in the effluent water from a power station in Poland has reported severe body flexures in carp. The current

speeds were between 2.6-12.3cm s^{-1} (Backiel *et al*, 1984). It is doubtful that intensive culture in cages in lotic environments will ever be economically viable.

The type of material, mesh size and degree of fouling all influence water exchange through the cage. There is a decrease in current flow entering the net with a reduced mesh size and increase in fouling. However, water movement may be enhanced by the activity of the fish thereby reducing adverse effects to some extent. In Tasmania, fouling is considered a serious problem and farmers regularly clean nets in summer months; most farms change all nets at two to three week intervals. The development of an efficient antifouling paint is a research priority. Net meshes vary bewteen 12-28mm. Fish are placed in the larger mesh nets as soon as practicable to increase water movement. In Scotland, several operators never alter mesh size prefering to grow the fish in 12mm mesh throughout the production cycle. This approach reflects the considerable differences in fouling and water temperatures experienced in the two countries and serves to emphasise the need to adopt different management strategies for culture of similar species in different parts of the world.

Predation on freshwater and marine sites is a problem. Birds can be controlled by covering tanks and cages with nets. However, larger predators such as seals, sharks and crocodiles are more difficult to control. Tasmanian farmers have invested large sums of money in attempting to prevent losses from seal attack. Underwater seal scarers have proved ineffective and farms have been forced to protect caged stock by periphery nets enclosing the entire farm site or heavy duty galvanised wire fencing placed around individual cages. Experiments are underway using "thick" meshed nets alone in an attempt to overcome the inconvenience of the other two methods which hamper routine activities around the farm or cages.

Many different types of structure for sea farming have been developed to suit sites of varying exposure. In Australia, the Norwegian polar-cirkel type cage has proved popular since individual units can be moored singly to ensure adequate water movement through each cage in the warm summer months. They come in a variety of sizes up to 60-65m in circumference and may support a net of 1500m^3 or greater. There is considerable interest overseas in the development of larger cages which can withstand severe wave action in exposed sites. Some experimental cages are claimed to be able to withstand waves 7m high. These cages may have net volumes of 6,000-10,000m^3 and hold 120-130 tonne of fish.

Factors affecting the productivity of an aquaculture facility

It is important to recognise that the productivity of an aquaculture facility depends on many factors, many of which can be quantified for only a few well researched species. Each factor should be considered a variable and because they are interrelated an attempt to reduce or control one is likely to have ramifications in respect to the others. A pivotal role in the management of aquaculture systems involves recognition of the influence each factor brings to bear on the cultured species. A major problem existing in Australia is that little is known about indigenous species of fish in the culture situation. Because their biology is poorly known, farmers largely are forced to base their management strategies on species which have been farmed overseas for many years. In the absence of scientific evidence, fish farming becomes an "art" embossed with mysticism.

It is helpful to list the factors that are considered important although the following are not claimed to be exhaustive and some aquaculturists will put greater emphasis on certain parameters than

others. The following list is based on Klontz (1979).

Fish Associated:

Behaviour
Nutritional requirements
Environmental requirements
Product definition
Growth rate
Infectious disease history
Cannibalism
Oxygen uptake
Oxygen demand
Faecal solids
Ammonia-nitrogen
CO_2

Water Associated:

Dissolved oxygen
Ammonia-nitrogen
Nitrite-nitrogen
CO_2
Alkalinity
pH
Suspended solids
Settleable solids
Temperature
Carrying capacity
Pollutants - (natural, agricultural, municipal and industrial)
Water utilisation
Salinity
Hardness (Ca++)
BOD
Viscosity

Impoundment Associated:

Water volume
Water velocity
Composition
Flow pattern
Water replacement time
Outfall design
Shape

Nutrition Associated:

Feeding rate
Feed efficiency
Feed style
Nutritional quality
Feed storage

Management Associated:
Fish sampling techniques
Feeding frequency
Record keeping
Pond cleaning
Fish grading techniques
Management programming
Management objectives

The following notes will concentrate on the fish associated factors.

Behaviour: The design of impoundments for aquaculture must take into account the behaviour pattern exhibited by the species. Perhaps the carp can be considered the only finfish which has been domesticated and is able to adapt its behaviour to a remarkable number of different ponds, tanks and cages: carp can be grown up to several kilograms in fish boxes for instance. However, attempting to raise most fish in a pond or cage which inhibits their normal swimming behaviour pattern, for example shoaling, may cause considerable stress and loss in production.

The behaviour of fish may change as they mature. Brood-fish may require very different habitats from juveniles of the same species. Failure to provide the correct stimuli for gonad development will at best result in the production of poor quality gametes which in turn will give rise to weak offspring.

Territorial fsh are difficult to grow under intensive conditions but the situation will be made worse if the fish are forced to invade each others territories during feeding. It is essential to use feeders which distribute the feed over a wide area of pond or cage permitting the fish to forage within their home range.

Written Comment No: 0181

Nigel Forteath

Management Systems

Nutritional requirements: Fish may be herbivorous, carnivorous or omnivorous. Obviously, for optimum productivity fish must be fed a diet which meets their nutritional requirements. Standard production rations for trout or salmon are unlikely to be appropriate for most other species. Furthermore salmonid diets are extremely expensive. Feed costs are a major expenditure on the farm and research is urgently needed into appropriate artificial diets for Australian native species. Live feed in the form of rotifers and brine-shrimp continue to form the basis for the rearing of fish larvae in the hatchery situation.

Environmental requirements: Fish are poikilothermic and temperature is considered a controlling factor in aquaculture. Coldwater fish are those residing in water averaging 15^{o}C or less; coolwater fish prefer temperatures within the range 15^{o}C - 20^{o}C; and warmwater fish require temperatures above 20^{o}C. Fish biologists recognise that each species has a Standard Environmental Temperature (SET) which is the temperature at which the biochemistry of the body is workng optimally. Work carried out on rainbow trout has shown that for each ^{o}C below SET there is a 9% decrease in growth rate from the optimum. However, improved diets and genetic selection for trout have tended to mask this effect to some extent. Furthermore, a rise in temperature a few degrees above SET may not have a marked effect on growth if sufficient dissolved oxygen is available to the fish.

Salinity tolerance varies amongst aquatic species. Stenohaline species show little tolerance to changes in salinity unlike euryhaline species. Many marine species are effected adversely by low pH whereas freshwater organisms are usually better adapted to fluctuations between 6 and 9. Tolerance to different environmental conditions can change dramatically within a given life cycle.

Important differences in physical requirements occur which must be taken into account by the aquaculturist. For example, some aquatic organisms are tolerant of crowding while others are not; yabbies can not be stocked at the density of salmon (density is usually expressed as kilograms per m^3). Of course benthic dwellers will not utilise the water-column more than a few centimeters of the bottom in contrast to pelagic species.

Light may play a crucial role. Some brood-fish will only spawn in subdued light and also it has been found that survival of certain larval life forms is ehanced by keeping them in heavily shaded tanks. Crepuscular species, such as abalone, prefer to feed at night. Others, such as the salmonids, will only feed on artificial food in daylight. The farmer has to adopt techniques which will ensure regular feeding.

Many of the failures in aquaculture are due to a poor understanding of the environmental requirements of a given species. Thus it is vitally important to research their life-history thoroughly.

Product definition: Scant attention is paid to this factor by aquaculturist since too often the industry is product driven rather than market driven. However, it is an important consideration. There is little point in a fish-farmer for instance trying to produce 200g fish if there no market for them. On the other hand the resources and environment necessary for the farmer to produce 2.5kg fish of the same species profitably are quite different to those required for 200g fish. For a fish to become a good product there must be a clear definition of what that product is in the first place. A facility designed to produce a given size of fish is rarely suitable for another without modification.

Growth rate: Growth rate has been expressed as either the increased length or weight of the animal over a given period of time. The specific growth rate is commonly used in aquaculture to predict

Coromandel FINFISH FARMING

BY JUSTINE INNS, BA, LLB, SOLICITOR WITH OCEANLAW NEW ZEALAND

As ever with Aquaculture, one of the biggest battles is securing the availability of *space* in which to farm. Even when space has theoretically been made available though, there can still be a long way to go before farming can actually commence, as shown by the unusual, and slow, progress of farming in the **Coromandel Marine Farming Zone**.

In December 2010, the then Minister of Fisheries Phil Heatley established an Ministerial Advisory Panel to consider a proposal for a 300-hectare aquaculture zone located in the south-eastern Hauraki Gulf/ Tikapa Moana and west of the Coromandel Township. The proposed zone, known as the Coromandel Marine Farming Zone (CMFZ), was intended to make space available for finfish farming. The Panel (of which I was a member) was supported by the Ministry of Fisheries' Aquaculture Unit, received a range of scientific and other advice, and consulted with the Coromandel community, tangata whenua and other interested groups and organisations.

When the Panel reported back to the Minister at the end of February 2011, it recommended that the CMFZ should be progressed, as it appeared that the area would be environmentally suitable for finfish farming and that farming should not result in significant adverse effects on navigation, fishing, cultural or aesthetic values. Full consideration of any applications for farming would be required, and staged development, subject to strict monitoring conditions, would probably be appropriate.

At the time, aquaculture in the proposed zone was a 'prohibited activity' under the Waikato Regional Coastal Plan (RCP), so significant amendments to the Regional Coastal Plan were required in order to establish the CMFZ. The Government decided to fast-track this by including amendments to the RCP in the Resource Management Amendment Act (No.2) 2011, bypassing the usual (and drawn out) processes of consultation, submissions and hearings under the Resource Management Act 1991.

Having Regional Coastal Plan rules that opened the zone to finfish farming is one thing; getting to the point of actually establishing a farm (or farms) is quite another, however. The new rules in the Regional Coastal Plan require that no-one can apply for resource consents to farm in the zone *unless* they hold an 'authorisation' issued by the Waikato Regional Council.

Authorisations in relation to 20 percent of the zone have been issued to the Takutai Trust in accordance with the Maori Commercial Aquaculture Claims Settlement Act (for the Trust to hold on behalf of the iwi of the region).

The remaining authorisations will be issued through a 'weighted attribute' tender, which weighs the extent to which each tender proposal:

- Achieves the purpose of the Coromandel Marine Farming Zone, i.e. providing for finfish farming, while:
  - Avoiding effects on significant ecological values and on other users of the area;
  - Ensuring that space in the zone is allocated to the most efficient and effective use; and
  - Requiring staged and adaptive management and consistent monitoring;
- Promotes the sustainable management of natural resources;
- Contributes to the economic and social wellbeing of the region and country;
- Demonstrates the environmental management practices of the applicant; and
- The tender price offered by the applicant.

Despite the original 'fast tracking', it was only in May 2016 – a mere *five years* after the CMFZ was legally established – that the Strategy and Policy Committee of the Waikato Regional Council adopted staff recommendations to open the zone to tenders.

To be fair to the Council, it seems that it has only been relatively recently that a commercial operator has indicated a serious interest in investing in the untested farming of hapuku and/or kingfish. (The waters of Tikapa Moana are too warm to farm salmon.)

The successful tenderer (or tenderers) who obtain authorisations for the CMFZ can *then* begin the process of applying for resource consents in the usual way. Baseline surveys will need to be undertaken, as well as a full assessment of the environmental and other effects of the specific farming proposal.

Although the establishment of the Coromandel Marine Farming Zone in the Regional Coastal Plan avoided the need for formal submission and hearing processes and legal appeals, it's likely that the resource consent process will face all those hurdles.

Advice received by the Ministerial Advisory Panel and government back in 2011 indicated that production of 8,000 tonnes of kingfish could generate export revenues of $110 million per annum by 2025, with 8,000 tonnes of hapuku bringing in up to $200 million. But commercialising a new fish species isn't quick or cheap: even with the benefit of the initial 'fast track' process, the same advice estimated that an investment of $80 million to $100 million would be required and that it would be at least 7 to 10 years before investors realised a return on that investment.

And that's without factoring all the risks resulting from the need to develop new markets, technologies and infrastructure, such as hatcheries. Not easy.

Justine Inns is a partner at Oceanlaw. She has spent more than a decade as an advisor to various iwi including several years with Ngai Tahu.