BEFORE THE COMMISSIONERS ON BEHALF OF
FRIENDS OF NELSON HAVEN AND TASMAN BAY INC.

IN THE MATTER OF

Application U190438 by The New Zealand King Salmon Company Limited for Coastal Permit (Marine Farm) – North of Cape Lambert, North Marlborough

BETWEEN NEW ZEALAND KING SALMON COMPANY LIMITED

AND MARLBOROUGH DISTRICT COUNCIL

STATEMENT OF EVIDENCE OF ROB SCHUCKARD

REVIEW OF EFFECT ON SEABIRDS FROM PROPOSED CAPE LAMBERT MARINE FARM

October 2021

EXECUTIVE SUMMARY

The Resource Management Act 1991 and the New Zealand Coastal Policy Statement - 2011 (NZCPS) are important statutory tools for managing coastal biodiversity in New Zealand. One of the mechanisms for achieving the protection of coastal biodiversity values is the requirement that applications for resource consents include an "Assessment of Environmental Effects" (AEE). New Zealand is committed to the Convention on Biological Diversity (CBD)[1] and New Zealand's obligations pursuant to the CBD are reflected in the provisions of the RMA. The 'National Plan of Action for Seabirds' is submitted as part of the reporting program to address that 90% of our seabirds are threatened.

Many of the principles of ecology which apply when carrying out an AEE are contained within the regulatory framework that guides decision-making, including the NZCPS and relevant Regional and District Plans. However, it is also recognized that the ability to sustainably manage activities in the coastal environment are hindered by a lack of understanding about coastal processes. There is need to take a precautionary approach and seek additional knowledge, to guide decision-making. Such hinderance is exacerbated by information that is either incomplete, or is not providing the required detail beyond a broad judgment.

Establishing not just what impacts are but whether "adverse effects" can be avoided, mitigated or remedied, is one of the most important components of an AEE process. In order to prepare an AEE therefore, adequate evidence and knowledge needs to be gathered to appropriately address this question. Adequate ecological assessment is an essential part of achieving sustainable management and the purpose of the RMA. A robust framework for AEEs is essential.

Seabirds are part of conspicuous biodiversity that is numerous, visible, relatively easy to identify, widespread and relatively well researched. They allow for rapid assessments, in a reasonably short time-scale and provide data on an ecosystem level. Studies about seabirds at least, should contribute and help to understand the ecological processes in the regional environment, providing publicly consumable evidence about areas of high, medium and low importance for biodiversity.

Mapped spatially, these data provide a way of making important design decisions, in accordance with the requirement to avoid, remedy, and mitigate adverse effects for resource management. This baseline knowledge can help target additional focused work, e.g. on given species or particular habitat locations and provide or contribute to development of monitoring protocols.

The evidence provided by experts from the applicant for the Cape Lambert application that relates to scale of proposal and potential effects on seabirds and their feeding habitat does not provide information that is required to properly assess this significant application:

- a clear overview on what is proposed is missing (structures applied for, feed levels that are being applied and consistancy with tonnage of harvested fish)

[1] New Zealand's Sixth National Report to the United Nations Convention on Biological Diversity – Reporting Period: 2014-2018.

- baseline information on seabirds that occur in the applied area and can be assessed on the wider impact of the activity is missing.

To understand the effects on birds, we first needed to understand the importance of the applied area for seabirds. No attempt has been made to quantify the use of the applied area by any species, nor have numbers of any particular species been provided that use the area on a regular basis. No dedicated fieldwork was commissioned to provide such information. Detailed, systematic and quantitative information on the at-sea distribution of virtually all species is currently lacking for the application making it very difficult to access the level of effect on poorly described seabird values.

SCOPE

My name is Rob Schuckard. I hold a Master of Science in Biology (University of Amsterdam – 1979 - ornithology). I have been involved in ornithological projects with authored or co-authored publications in a range of journals and have a good understanding of project design and what is required to assist the decision makers in their assessments of effects on ornithological subjects. For the Board of Inquiry, I presented evidence for Sustain our Sounds to consider the 2012 'New Zealand King Salmon Co. private plan change' request to the Marlborough Sounds Resource Management Plan through resource consent applications for nine new sites for salmon farming.

The Board raised concerns about the effect of salmon farming on New Zealand King Shag and I was asked by NZKS to prepare a first King Shag Management Plan (KSMP)[2] as was required per consent conditions. For Friends of Nelson Haven and Tasman Bay I managed and participated in the 'Seabird, Marine Mammal and Surface Fish Surveys of Golden and Tasman Bay' as mediation outcome from the Environment Court to identify biodiversity and prepared the analysis of the environmental impact of the relocation of low flow salmon farming in the Marlborough Sounds with particular regard to the impact of the relocation sites on New Zealand King Shag (*Leucocarbo carunculatus*)[3]: As an elected community-representative on Sounds Advisory Group I have participated in a number of aquaculture-working-groups and co-authored a number of guidelines for best practise [4], [5], [6], [7].

I have presented expert evidence for many council hearings, five Environment Court cases and a Board of Inquiry.

Friends of Nelson Haven and Tasman Bay Inc. (Friends) asked me to prepare evidence for the hearing to access the application U190438 - coastal permit - New Zealand King Salmon company limited – Proposed Coastal Permit for Salmon Farm 6 to 12km due north of Cape Lambert. My

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[2] Schuckard R.. 2015. KING SHAG MANAGEMENT PLAN - The New Zealand King Salmon Company Ltd Plan. March 2015

[3] Potential relocation of salmon farms on the Marlborough Sounds Proposal to amend the Marlborough Sounds Resource Management Plan to enable the relocation of up to six farms by regulation made under S 360 of RMA 1991. MPI Discussion Paper: 2017/04

[4] Best Management Practice guidelines for salmon farms in the Marlborough Sounds: Part 1: Benthic environmental quality standards and monitoring protocol.

[5] Marlborough Salmon Working Group preparing the advice to Ministry for Primary Industries (MPI) on relocation of low flow farms.

[6] Best Management Practice guidelines for salmon farms in the Marlborough sounds. Part 2: Water quality standards and monitoring protocol

[7] MARLBOROUGH AQUACULTURE REVIEW working Group. The working group was tasked to collaboratively assess the spatial allocations for shellfish marine farming.

evidence on assessing the values of seabirds in the area and the impact and uncertainties of the impact on those values relied on a number of reports provided by applicant and involved parties. For addressing these topics, I have read the following reports:

1. McClellan, R. 2019. Potential Effects on Seabirds of Open Ocean Fish farming, Cook Strait. Contract report No. 4594. Client report for New Zealand King Salmon.
2. Fisher, P. 2019. Seabird Review Memorandum for Marlborough District Council. Review of the Potential Environmental Impacts on Seabirds by King Salmon Offshore Farm Consent Application U190438. This report was at my request released at 1st October 2021 by under the Local Government Official Information and Meetings Act. The report was commissioned but author was not able to update his review as result of the revised information from NZKS and MDC decided not to use the information provided.
3. Knight BR 2021. Updated water quality modelling for the Blue Endeavour proposal. Prepared for The New Zealand King Salmon Company Ltd. Cawthron Report No. 3479.
4. Gaskin, C. 2021 Best Practices and technologies available to minimize and mitigate the Interactions between Finfish Open Ocean Aquaculture and Seabirds. Northern New Zealand Seabird Trust Aquatic Environment & Biodiversity and Aquaculture teams – Fisheries New Zealand Fisheries New
5. Connor-McClean, B.; Ray, S.; Bell M. & Bell, E. 2020. Offshore aquaculture in New Zealand and its potential effects on seabirds. Unpublished Wildlife Management International Technical Report to the Ministry of Primary Industries.
6. GAYE BENNET, D. 2021 Statement of evidence on seabirds for The New Zealand King Salmon Co Limited – This report was received at 1st October 2021 and is separately assessed as Appendix 1.

INTRODUCTION

The spatial term 'offshore' has created confusion and misunderstandings. A number of government agencies and regional councils share the responsibility for managing activities in New Zealand's 'offshore waters '. These waters between 0 – 200nM include both our Exclusive Economic Zone and Continental Shelf and our territorial waters.

All aquaculture in the Marlborough Sounds, including all existing salmon farms and application U190438 are in the Territorial Sea Baseline between the low water mark up to 12nM, being part of the 'offshore' waters. So effectively, this application is not significantly different from any other application in this part of the coastal marine area. Only an application beyond the 12nM zone would require a fundamentally regulatory approach.

The option of 'offshore farming' was part of the discussions of the Marlborough Salmon Working Group (MSWG) to seek 'alternatives' [*emphasis*] to the sites being sought for relocation. However, New Zealand King Salmon (NZKS) perceived the relocation project as 'intrinsically linked' to the open ocean project, to continue as a successful business. Ministry of Primary Industry agrees that both existing and 'offshore' farms (undefined in spatial context) are required in tandem.

The Marlborough Salmon Working Group (MSWG) recommended that 'The Marlborough salmon farming industry is encouraged to continue research into *'… offshore farming to ensure ongoing environmental and social improvement'*. Such commitment should reflect a wide-ranging exploration for sites best suited to deal with deposition of salmon waste with the least environmental impact and effect on biodiversity values (including seabirds).

Application U190438 does not follow such objective; to the contrary, the exploration for a site had a narrow spatial and environmental scope. At least, if there was a wider scope, such evolution of the decision process towards this site has not been provided. Such approach is a significant flaw in NZKS intention to reach the industry's objective for environmental and social improvements of their industry.

At this stage, it appears that the wider public is 'consulted' to comment on both intrinsically linked proposals, 'relocation sites'[8] and 'offshore farming' proposition[9]. Both applications (Relocation Proposal and U190438) represent the biggest expansion of this type of aquaculture in the Marlborough Sounds and the country, with a significant release of additional anthropogenic nutrients into the coastal marine area with uncertain implications for biodiversity values in a warming climate.

Matters of uncertainty in allocating aquaculture space (cumulative impact, thresholds and adaptive management) have not been properly addressed since the early years of the introduction of aquaculture as resource user in the Marlborough Sounds. MPI identified cumulative effects from aquaculture in 2013[10] as:

- Ecological effects in the marine environment that result from the incremental, accumulating and interacting effects of an aquaculture development when added to other stressors from anthropogenic activities affecting the marine environment (past, present and future activities) and foreseeable changes in ocean conditions (such as in response to climate change).

Council's own monitoring data show that the Sounds marine biodiversity is not in good shape[11], with fewer fish, not as many species, serious loss of biogenic habitats and sedimentation in estuaries smothering thousands of hectares of seabed of allocation of more space or use of more resources from the same spatial allocation has further increased anthropogenic competition with the natural world.

Since the RMA was enacted a number of planning provisions have not been able to stop biodiversity decline:

- Continuing ecological and wildlife degradation in the Coastal Marine Area including the Sounds;

[8] MPI Discussion Paper No: 2017/04 and adopted by Marlborough District Council in Variation 1 and 1A for aquaculture provisions in the Marlborough Environment Plan.

[9] Application U190438 to install a salmon farm(s)within a 1,792-hectare site (3.3km wide by 5.4km long) in the open ocean, 6km to 12km due north of Cape Lambert.

[10] OVERVIEW OF ECOLOGICAL EFFECTS OF AQUACULTURE - Ministry for Primary Industries PO Box 2526, Pastoral House, 25 The Terrace Wellington 6140. ISBN 978-0-478-40536-1 (online) August 2013.

[11] State of the Environment Report 2015. Our Land, Our water and Our Place. Marlborough District Council, pp150.

- Decline in biodiversity and loss of ecosystem services and natural capital;
- Increasing resource conflict in the marine environment;
- Cumulative effects of land use activities, including urban development, forestry and farming on the water quality of coastal waters;
- Increased exposure to coastal natural hazards exacerbated by climate change;
- Deteriorating quality of recreational values, including for fishing, swimming and boating;
- Cumulative effects of activities on natural character, landscape and recreational values from activities and structures in the coastal marine area, including jetties, moorings, reclamations and marine aquaculture.

Appropriateness of site allocation for further resource use has never been determined in a holistic sense reflecting maintenance (and restoration) of ecological integrity as a fundamental component of sustainable management and decision-making processes. Knowledge of the spatial scale of ecological processes across the seascape can provide direct evidence of connectivity between various ecological, geological and hydrodynamic components in a marine setting.

Biodiversity response of our coastal environment to climate change is likely negative and aquaculture productivity itself is not immune to a changing coastal environment. Application for allocation of more space is not only aiming to further develop the industry, it is also a necessity to maintain levels of existing production output. Higher water temperatures are causing significant thermal stress for salmon operations resulting in a declining productivity. About 8,000 tonnes of salmon was produced around 2011, similar to the 2018 harvest but now including three new farms operational since 2016. After the year 2018, the harvested fish was even lower in volume compared to 2018 with 7,336Mt in 2020. At the same time, a number of salmon farms have major issues with compliance and mortalities (or disease). These challenges are calling into question the appropriateness of this industry in a warmer or warming coastal marine space.

Whether static farm structures are the best solutions for an adaptive approach of farming salmon during warming conditions is not only a fundamental environmental question but also an economic one. The effect of this industry on the environment is, in a warming climate, arguably getting worse. Often the economic benefit of salmon farming to the Norwegian economy is provided as template for New Zealand. This comparison is flawed. Salmon farming in Norway takes place between 60 and 70 degrees north (~7,200km north of equator), where effect of the release of nutrients and transformation into primary production (a main concern) is suppressed by lower light conditions. Salmon farming in Marlborough Sounds is at 41 degrees south (~4,500km from equator). A warming ocean is also a problem in Norway, to meet the growing demand for seafood in a changing climate.

In New Zealand, the entire ocean has warmed as result of climate change with the strongest warming in eastern Cook Strait, in particular the Wairarapa Coast[12]. Climate warming affects phytoplankton species composition and spatial distribution, and favors species that are best adapted to the changing conditions. Shifts in phytoplankton can have far-reaching consequences for

[12] Sutton, P.J.H. and Brown, M. 2019. Ocean temperature change around New Zealand over last 36 years. New Zealand Journal of Marine Freshwater Research, Vol 53, No 3: 305-326.

ecosystem structure and functioning. Both changes in climate forcing and nutrient loadings are aspects of global change that are expected to profoundly impact coastal hypoxia[13].

The contribution of marine farming to the regional and national economy is recognized as an important contribution to economic well-being. Aquaculture generated over $600 million in revenue nationwide in 2018, employing 3000 people and is one of the bigger resource users in the Marlborough Sounds.

Public concerns about the dynamics between aquaculture and the Marlborough environment should not be sidelined and were already expressed in a number of early surveys by Council (2012) and MPI (2014)[14]. In latter survey 41% of respondents agree that aquaculture poses a risk to natural sea life where 38% disagree. These concerns have never been properly addressed in decision processes for further site allocation. However, the potential for this industry to occupy space in the future depends on the maintenance and even restoration of ecosystem integrity to occupy that same public water space. Marine farming can give rise to adverse effects, including:

- Change in currents
- Change in water quality through increased sedimentation
- Negative impact on landscape and natural character.
- Modification of benthic habitat
- Interruption of natural biotic patterns across the seabed and in the water column
- Changes in marine biodiversity, in particular on benthic species.
- Impact on feeding habitats of seabirds and marine mammals.

Sustainable management depends on accountable use of the common resources. Such is achieved by promoting models, driven by cooperation and concern for the common good. Modelling should reflect the high diversity of biotic habitat types that are present in marine systems with separate but complementary predictive frameworks for significant and sensitive marine habitats[15]. Already in 1995, the Department of Conservation's Guideline for Ecological Investigations of Proposed Marine Farm Areas[16] acknowledges a number of wider ecological issues related to marine farming. The Department did not provide a framework on how to address these issues. The published guideline suggested that a responsibility to address cumulative effects may not necessarily lie with individual applicants but with the industry as a whole. That specific proposal to the regulator and industry never came to fruition and a case by case (ad hoc) application process has been maintained ever since. Up to today, more expansion of resource use is proposed through intensification of allocated space. Protection and management of the natural world has not progressed in such a way that decline of biodiversity has been reversed or even halted.

[13] Diaz, R.J. and Rosenberg, R. 2008. Spreading Dead Zones and Consequences for Marine Ecosystems. Science 321, 926-929.
[14] Public perceptions of New Zealand's aquaculture industry, 2014. Ministry for Primary Industries. 14 August 2014
[15] Smith, V.H., Tilman, G.D. and Nekola, J.C. 1999. Eutrophication: impacts of excess nutrient inputs on freshwater, marine, and terrestrial ecosystems. Environmental Pollution 100 (1999): 179-196.
[16] Davidson, R.J. 1995. Guideline for ecological investigations of proposed marine farm areas. Department of Conservation. Occasional Publication No.25.

The Supreme Court[17] released its decision on New Zealand King Salmon's application to establish nine new salmon farms in the Marlborough Sounds. The Supreme Court set out the tests to be applied in determining whether an adaptive management approach is appropriate. The Court found that it depended on an assessment of the following four factors:

- The extent of the environmental risk (including the gravity of the consequences if the risk is realized).
- The importance of the activity (which could in some circumstances be an activity it is hoped will protect the environment).
- The degree of uncertainty.
- The extent to which an adaptive management approach will sufficiently diminish the risk and the uncertainty.

WHAT IS PROPOSED?

In 2011, New Zealand King Salmon applied for nine new salmon farms in the Marlborough Sounds through a Board of Inquiry under Section 147 of the Act. The Board dealt with a significant amount of evidence but was critical of the modelling and waste that was presented for consideration of this plan change:

> [438] We accept that the modelling of the nutrients introduced to the water column is conservative for the scenarios presented to us. However, those scenarios were generally, for the initial feed rates for each farm and, for some of the modelling, the (higher) summer loadings. The applications for each salmon farm seek almost double this feed level – the maximum conceivable feed levels as listed in the proposed conditions of consent. The approach taken was in marked contrast to the modelling of effects on the benthos which used these maximum feed levels. This astonishing gap in the prediction of effects on the environment cannot be explained away by emphasizing that the modelling is conservative and nor can it simply be filled by invoking adaptive management. It is a fundamental failing in the assessment of effects on the environment that we would not expect to see in a project of this magnitude and importance.

Application U190438 for water space north of Cape Lambert in the Marlborough Sounds seems not much different. The amount of feed that is proposed to enter the water volume through this application is unclear or vague at best. For assessing the impact of what is applied for, a maximum application of feed and its effect should be based on a clear presentation of number of pens with a known size, stocking rates and overall insight into occupancy rate of the pens. At this stage it is unclear how monthly feed regimes lead to the proposed annual feed application of 20,000 tonne of feed.

[17] SC 84/2013 [2014] NZSC 40 Between Sustain our Sounds Inc. (Appellant) and the New Zealand King Salmon Co.

If a full growth cycle from smolt to harvestable fish for the applied site is proposed, 20,000 tonne per annum will not provide an annual harvest of about 10,000 tonnes of fish. With a Feed Conversion Rate of 1.81, 20,000 tonnes of feed can provide a harvest of 11,000 tonne of fish. However, that is over a time span of 18 months from smolt to final product.

To extrapolate the growth period of 18-month growth cycle for fish over a two-year cycle, the maximum amount of feed applied for over this period is 20,000 tonne of feed per annum or 40,000 tonnes per two years. The application for an infrastructure of two blocks with 2 rows of five pens each with 35 m deep applies for two types of pens with a different circumference (Model 1 and Model 2). Such infrastructure could provide the following maximum production cycle:

Model 1 - 168m with a water volume of 78,610 m^3 (1,572,200 m^3 for 20 pens)
Model 2 - 240m with a water volume of 160,428 m^3 (3,208,560 m^3 for 20 pens).

These water volumes are very important because they provide the maximum volume of fish that can be contained based on animal welfare rules used by NZKS. In the King Salmon Report[18], a maximum stocking rate of 2.5% was proposed as a matter of fish welfare. For the Cape Lambert application[19], a near maximum density of fish of 22 kg/m^3 (2.2%) is proposed (Knight 2021).

For the Cape Lambert application, feed levels of 10,000 tonnes per annum per block or 20,000 tonnes of feed per annum are proposed. Smolt (weighing between 20g and 300g) will take about 18months (10 and 20 months[20]) to grow to a harvestable fish of about 3.5kg to 3.8kg.

If the fish is reaching the harvestable size, 2.2% of the pen volume can have a maximum harvestable fish volume as follows:

Model 1 - 168m with 1,572,200 m^3 of water holds 34,600Mt of fish
Model 2 - 240m with 3,208,560 m^3 of water holds 70,600Mt of fish.

Over the growth period of 18 months, a FCR of 1.81 allows to calculate the feed application that is required to reach the maximum capacity of the farm infrastructure:

Model 1 - 168m with 34,600Mt of fish requires 62,600 tonnes of feed over 18 months
Model 2 - 240m with 70,600Mt of fish requires 127,800 tonnes of feed over 18 months.

Model 1 (with fallowing) requires 57% more feed to reach the 22 kg/m^3 (Knight 2021 - 2.2%) and Model 2 (after the growth cycle of 18 months with fallowing), requires 220% more feed to reach the 22 kg/m^3.

[18] New Zealand King Salmon Report to establish nine new salmon farms in the Marlborough Sounds. 13th August 2011. Par 240, pp62.
[19] Knight BR 2021. Updated water quality modelling for the Blue Endeavour proposal. Prepared for The New Zealand King Salmon Company Ltd. Cawthron Report No. 3479, pp40.
[20] LEARNING RESOURCE Unit Standard 19852V2 L e v e l 2 C r e d i t 1 0. Outline the Salmon Farming Industry in New Zealand and Worldwide

However, the applicant is not clear if growing a single year class fish in 18 months is proposed and if so, if fallowing period (see Knight 2021 – pp 3) is a part of the management. If fallowing is not part of the managed cycle of growing fish, an additional 6 month a feed needs to be added to the total feed supply to be used over a two-year period.

Knight (2021) estimated that for each tonne of feed about 49 kg of N[21] is produced from fish excretions. Over the growth cycle of 18 months with fallowing the amount of nitrogen that is produced with the maximum fish density of 2.2%:

Model 1 - 168m - 62,600 tonne of feed produces 3,100 tonne nitrogen
Model 2 - 240m - 127,800 tonne of feed produces 6,300 tonne of nitrogen

The nitrogen waste produced by a person through faeces and urine over 18 months is about 4000g [22], [23], [24], [25]. Each tonne of salmon produced has the human population nitrogen equivalent of about 14 people. With a total maximum production, the proposal provides a population equivalent for nitrogen:

Pen proposals	Feed (tonne)	Fish (tonne)	Nitrogen waste fish 18months (kg)	Nitrogen waste person 18 months (kg)	Population equivalent
	1	0.6	43-49	3.2	7.8
	1.8	1	77-88	5.7	14
168m – 18 months	62,600	34,600			485,000
240m – 18 months	127,800	70,600			990,000
Annual Feed levels from all consented farms[26] in 2017 and 2018	~20,000				
Annual Feed levels if relocation farms are granted	20,000 - 4,900+8,100= 23,200[27]				

[21] SoE Board of Inquiry - Rob Schuckard Sustain our Sounds. I calculated that each tonne of salmon released 43 kg of N through excretions.
[22] Jönsson, H. and Vinnerås, B. 2004. Adapting the nutrient content of urine and faeces in different countries using FAO and Swedish data. In: Ecosan – Closing the loop. Proc. 2nd Intern. Symp. Ecological Sanitation, April 2003, Lübeck, Germany. p 623-626. (www2.gtz.de/ecosan/download/ecosan-Symposium-Luebeck-session-f.pdf)
[23] Vinneras, B., 2001. Faecal separation and urine diversion for nutrient management of household biodegradable waste and waste water. Department of Agricultural Engineering, Report 245, SLU, Uppsala.
[24] Vinnerås, B., Jönsson, 2002. The performance and potential of faecal separation anhd urine diversion to recycle plant nutrients in household wastewater. Bioresource Technology 84:275-282.
[25] Olsen Y. and Olsen L.M. 2008. Environmental Impact of Aquaculture on Coastal Planktonic Ecosystems. K. Tsukamoto, T. Kawamura, T. Takeuchi, T. D. Beard, Jr. and M. J. Kaiser, eds. Fisheries for Global Welfare and Environment, 5th World Fisheries Congress 2008, pp. 181–196.
[26] Waitata, Kopaua and Ngamahau are operating at initial feedlevels that can double over time.
[27] To be surrendered 4,900 tonnes (Otanerau – 1,300 tonnes, Waihinau – 1,500 tones, Ruakaka – 2,100 tonnes) and to be added 8,100 tonnes (Tio Point – 1,600, Horseshoe Bay - 1,500 tonnes and Richmond South – 5,000 tonnes)

Model 1 - 168m with 34,600Mt of fish is a population equivalent of 485,000 people
Model 2 - 240m with 70,600Mt of fish is a population equivalent of 990,000 people.

The infrastructure of this new farm can release over a production cycle of 18 months with fallowing between 9.5% and 19.5% of the nitrogen produced by the total population of New Zealand (5,084,000 people).

Possibly, the farm is not working on a single year class basis and semi grown fish is being transported from the sounds for further fattening. If so, it is impossible to extract from the expert and technical evidence the feed levels that are being applied for. If the farm is getting integrated in a wider management concept (see table), and fish densities of between 2.2% and 2.5% are aimed for, the overall nitrogen release is still relevant. New Zealand King Salmon is the largest producer of nitrogen waste in the coastal environment of the Sounds and their overall and integrated production cycles (from confined space in the Sounds to outer Cape Lambert) need to be fully assessed for a complete understanding on what is proposed. Such information provided by applicant is conflicting and objectives for this application are obscure.

In addition to the confusion of the application, peak monthly feeding is considered with a maximum discharge of 2,286 tonnes per month for 9 consecutive months per block. Such application would already take the feeding over the total maximum of two blocks of 20,000 tonnes. Over 9 months to to use 20,574 tonnes per block adds to about 40,000 tonnes for the whole operation. Such proposition is twice the amount of what is proposed as a maximum of 20,000 tonnes for the whole operation. Calculations to provide the detailed monthly limits are not provided and are uncertain. Knight (2021 – pp3) suggest that 40,000 tonnes in a 9-month period is 'theoretically possible' followed by 'significant periods of fallowing'. It is not clear what the monthly peak levels are in such scenario nor if the modelling incorporated the maximum feed application that is envisaged here. There is a significant discrepancy in what is proposed as a maximum application for this infrastructure. Such was also the situation for the application in front of Board of Inquiry. The 40,000 tonnes that are suggested are effectively closer to the Model 1 with the 168m pens as presented in this evidence. If correct, the population equivalent is a helpful parameter for providing context to whatwhat this application means in environmental sense.

SEABIRDS

Of the 360 seabird species on the world, 86 breed in the New Zealand region, including 38 which breed nowhere else. Te Mana o Te Taiao - Aotearoa New Zealand Biodiversity Strategy 2020 identified that of the marine birds[28], 28 (31%) are 'Threatened' and 53 (60%) are 'At Risk' and Aotearoa New Zealand has the highest number of endemic seabirds globally. Biodiversity of the coastal and marine areas of New Zealand has not been well described[29]. Cook Strait is one of the

[28] Te Mana o Te Taiao - Aotearoa New Zealand Biodiversity Strategy 2020. Department of Conservation. August 2020
[29] Not much progress since 1998, when the director-general of the Department of Conservation, reflected on our knowledge of our marine environment (SEAVIEW CONFERENCE): *Less than one percent of New Zealand's marine area has been surveyed to assess the diversity of marine species and ecosystems.*

recognized Key Biodiversity Areas (KBA, previously known as Important Bird Areas[30]). Fairy Prion, Fluttering Shearwater, Sooty Shearwater, Australasian gannet, Black billed Gull and Black fronted tern are known to use Cook Strait as foraging area. Criteria used for Cook Strait are: 1) hold more than threshold numbers of one or more globally threatened species (A1), 2) hold >1% global population of seabirds (A4ii).

The evidence of the applicant on seabirds is a desktop analysis of the potential effects of the Cape Lambert application on seabirds[31]. To develop an understanding of the ecological context of the application, a review of existing data and literature took place. However, no site visits took place to initiate or design a baseline study with dedicated fieldwork. The 'value' of ecological features of the applied area, based on ecosystem function and services have not been determined. Latter would be necessary to determine which consequences of an activity are likely to give rise to 'adverse effects'. For data and outcome integrity, there are two principal rules about ecological surveys that need to be followed: 1) Surveys should encompass seasonality. Generally speaking, there will be at least two very distinct seasons and the difference between these is likely to be stark. Seabirds such as Sooty Shearwaters that nest in summer arrive in their millions. Such birds provide a great deal of information on spatial dynamics and are almost totally absent in winter (See red circle in seabird table). 2) Weather conditions vary in summer and winter and this affects the likely impacts of activities. Without dedicated fieldwork the evidence presented for seabirds falls short and does not provide the detail and commitment that one would expect from such a significant application.

The analysis identifies 8 topics of potential effects. The author perceives it as 'very likely' that the sea birds will get attracted to the farm if wild fish populations get attracted to the farm. Such 'attraction' and 'interaction/collision' with farm may be exacerbated by the use of artificial underwater lighting. The congregations of bait fish can increase the interactions with the farm. The report is however uncertain about the effect of underwater lighting use in a Cook Strait setting.

An analysis of congregations of potential prey items around the farm is very important and detailed information is required about the fish congregations and shoaling together with zooplankton concentrations that are around and interact with the bird species that occur in the wider area of the application. Species need to be identified for their likely interaction with the farm and assessed on the potential interactions with the activity. Such approach requires at least a full year fieldwork to accomplish such an analysis.

The species list provided is an amalgamation of E-bird observations from predominantly a small part of the Cook Strait, the trajectory of the Cook Strait ferry. The Cook Strait is a highly complex marine system with significant differences in characteristics between east and west. The north-western section of Cook Strait is a relatively flat shelf with depths down to 100 m, markedly different from the south-eastern section where Cook Strait Canyon falls off rapidly to 1,000 m and joins the head of the 3,000-m-deep Hikurangi Trench. Strong convergent tidal flows in the context of a subtropical oceanic convergence zone leads to large currents with tidal dynamics further

[30] Forest & Bird (2014). New Zealand Seabirds: Sites at Sea, Seaward Extensions, Pelagic Areas. The Royal Forest & Bird Protection Society of New Zealand, Wellington, New Zealand.
[31] McClellan, R. 2019.Potential Effects on Seabirds of Open Ocean Fish farming, Cook Strait. Evidence prepared for New Zealand King Salmon.. Contract Report No.4594.

complicated by the strong wind forcing and the density gradients introduced by the regional oceanography. Upwelling occurs at all times of the year, but its surface signature is only visible in summer months. Differences between waterbodies in east and west may well be reflected in the seabird populations that have been recorded. What species and dynamics are relevant for the applied site requires fieldwork and the assessment is unlikely to be served with extrapolating eBird data for this application.

The area of the application is a dramatic combination of oceanic currents and islands. Latter are predominantly managed for their conservation values. Combined with underwater features like McManaway and Witt Rock that are relatively uncommon in Marlborough the overall environment supports a distinct assemblage of species in high numbers. Their remoteness and exposure to bad weather limits fishing and netting. This has resulted in the presence of a unique assemblage of fishes and invertebrates. The large range in water depth, good light penetration and extremes in wave exposure help create a variety of habitat types.

The broad-scale marine benthos or 'benthoscapes' in and around the applied site is complex and heterogeneous, with habitat patches defined by dominant species that modify the environment and strongly influence benthic community structure. Species in benthic assemblages differ in their traits and behaviors, and therefore, have variable effects on benthic habitat characteristics, benthic-pelagic coupling, and ecosystem functioning. One or a few 'key species' make disproportionately large contributions to habitat architecture and system dynamics. Horse mussels have generally a strong direct effect on benthic–pelagic coupling; increasing sediment fluxes to the seafloor, depletion of phytoplankton and changing ammonium and oxygen concentrations. Much information is lacking on the food web links between primary productivity, zooplankton, fish and seabirds. More research is needed for a better understanding of trophic relationships and the impact of increased resource applications.

The assessment for potential effects has identified 29 species of 'tube-nosed' seabirds from the order of Procellariforms through eBird. eBird is the world's largest biodiversity-related citizen science project, with more than 100 million bird sightings contributed each year around the world. There is uncertainty if these seabirds will be attracted to the operational farm (McClellan 2019 – pp 31). Such uncertainty is adding to the necessity that the area requires to be surveyed prior to the farm being established for at least one year and better two years. Such survey of monthly visits will not only provide a dedicated insight in the species that use the area, during the year, it also will provide a test for appropriateness of the application to be established.
So far, the report mentioned five factors that may pose collision risk. Such analysis without a clear understanding of species and use of environment by these species makes it impossible to design a management plan to avoid or mitigate risk to seabird species.

The evidence on Seabirds for the Cape Lambert application provides a summary of potential effects and mitigation options. Without a clear description of species, seasonality of occurrence and assessment of foraging preferences and prey locality, it will be very difficult to mitigate the effects that may in fact been underestimated as well. A Seabird Management Plan is proposed to mitigate 'adverse effects' have, but such sequence for introducing a Management Plan after consenting is flawed. A baseline survey should be carried out on the species composition and foraging to establish the appropriateness of applied activity. After this process, to develop a management plan for the lifetime of the project, should detail mitigation of any impacts that could become 'adverse effects' for certain species. A Management Plan should also identify species for which there is residual uncertainty. All this preliminary work should be based on fieldwork to establish the appropriateness of the activity prior to establishing the farm. Standards for the assessment of biodiversity should include:

- Level of information in baseline report that is required for consenting of application combined with assessments of effects on the environment ("AEE")
- Information necessary to assess the baseline of the environment including ecosystems and biodiversity.

Both standards are missing from the experts input.

In 2011 Friends and Australian Worldwide Exploration commissioned seabird surveys by air and by boat to get a better understanding of the seabirds that were populating this marine area of New Zealand[32] after a consenting process for oil drilling was challenged in the Environment Court. It is surprising that this information at relatively close vicinity of the application site has not been utilized. The outcome of this survey provided a comprehensive list of species that may well be quite relevant and representative for the western part of the Cook Strait, including the application site.

Failing to predetermine significance thresholds for biodiversity is undermining of environmental assessment process. The core objective of an AEE is to determine what is an "adverse effect". If the AEE determines that a change will impinge on an important value, then the next question is, should this be avoided or mitigated? Avoidance would be prudent in cases where something is so valuable that the risk of proceeding is too great. In cases where the receiving environment is less valuable (and maybe remediation is possible), then mitigation may be an option. So, by leaving the question of what is valuable to the end of the assessment process, it will rarely be possible to gauge the acceptability of something or how it needs to be managed. I am of the opinion that the seabird information is not meeting the mark of establishing the basic information required to set a baseline for species and the environmental conditions for these species to survive. Not even the species list meets the mark as relevant or meaningful for this applied site and its surroundings.

Surveys commissioned by FONHTB/AWE by air and by boat for the area of Golden Bay and Tasman Bay between Farewell Spit and Stephens Island provide a simple template on how a seabird AEE can be commissioned. This survey resulted in a widescale analysis of marine mammals, seabirds and distribution of fish shoals. Fish shoals were incorporated in the same survey. Two hotspots of seabird density were apparent between 40 and 60m depth south east of Farewell Spit and the largest hotspot west of D'Urville Island at similar depths. The latter hotspot overlapped with the occurrence of the largest fish schools. Species of fish schools from the air could not be identified but

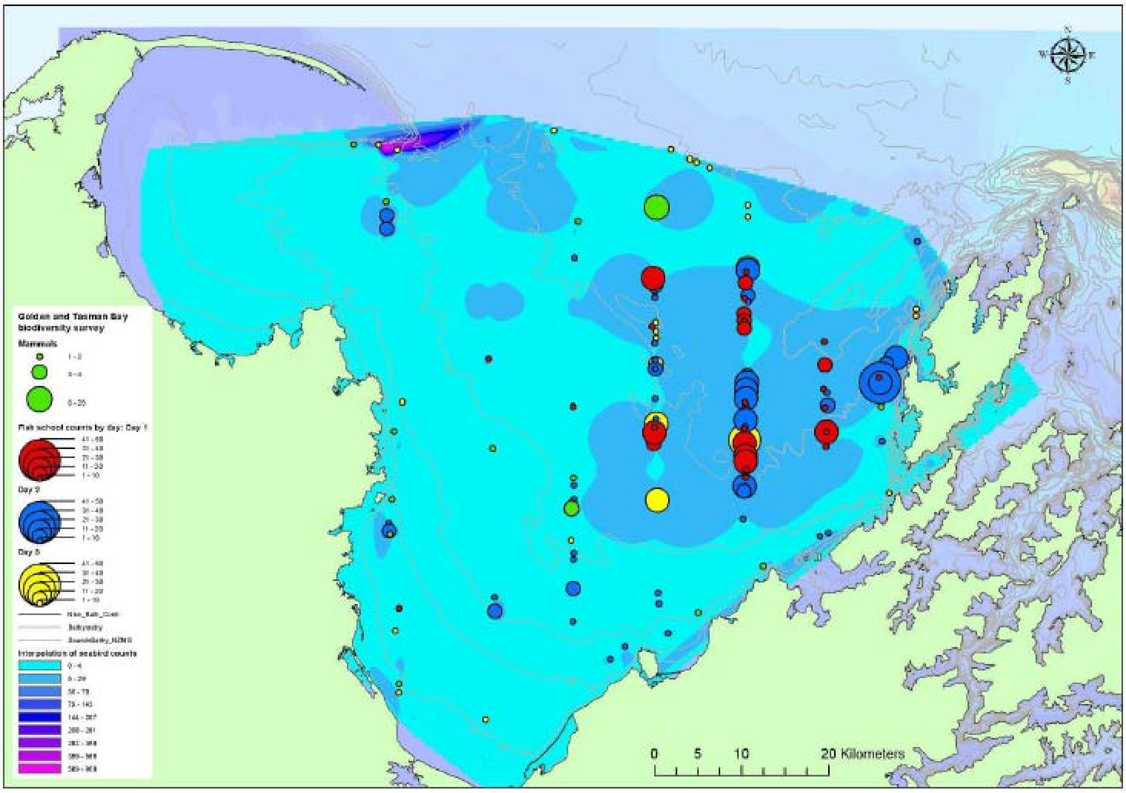
[32] Handley, S., Sagar, P.. 2011. Seabird, marine mammal and surface-fish surveys of Tasman and Golden Bay, Nelson. Part A: Aerial Surveys. NIWA Client Report No: NEL2011-018.

aggregations of small baitfish in combination with kahawai are widespread and provides feeding opportunities for in particular Fluttering Shearwater and White fronted tern.

The surveyed area recorded 22 species during the boat surveys and 16 during the aerial survey. At the 10th of June 2019 I visited the applied area and took bird surveys while we were investigating the benthic environment with a ROV. The six transects are only provided as indication of bird species and numbers in the area and were not designed as profile for an ongoing field protocol. This survey took place in the winter when Flesh footed Shearwater and Sooty Shearwater are in the northern hemisphere.

Total species	16	22	10th June 2019
	Aerial	**Boat**	
Australasian Gannet	**310**	**278**	✓
Fairy Prion	**140**	**163**	✓
Fluttering Shearwater	**100**	**225**	✓
White fronted Tern	**85**	**131**	✓
Spotted Shag	**47**	**98**	
Flesh footed Shearwater		**100**	O
Little penguin	**2**	**83**	✓
Sooty Shearwater	**3**	**52**	O
Black backed Gull	**41**	**32**	✓
Red billed Gull	**31**	**9**	✓
White capped Mollywawk	**10**	**78**	✓
Arctic Skua		**15**	
Pied Shag		**13**	
Buller's Shearwater	**8**	**14**	
Northern Royal Albatross	**5**		
Giant petrel	**3**	**3**	✓
Black Swan	**1**	**1**	
Caspian Tern	**1**	**1**	
Bullers Mollymawk	**1**		
King Shag		**2**	
NZ Shoveler		**1**	
Grey backed Storm Petrel		**1**	
Diving Petrel		**9**	✓
White faced Storm Petrel		**2**	
Westland black Petrel			✓

Species from aerial survey (22-24 November 2010) and boat survey (11, 14 December 2010 and 10, 14 January 2010) from Golden and Tasman Bay compared with bird boat survey U190438 (10 June 2019). (Blue - IBA trigger species, Red circle – Absent due to seasonal absence as a migratory species)



Location and density bubbles of all marine mammals and all fish species atop interpolation of bird densities, recorded by aerial survey, 22-24 November 2010. .

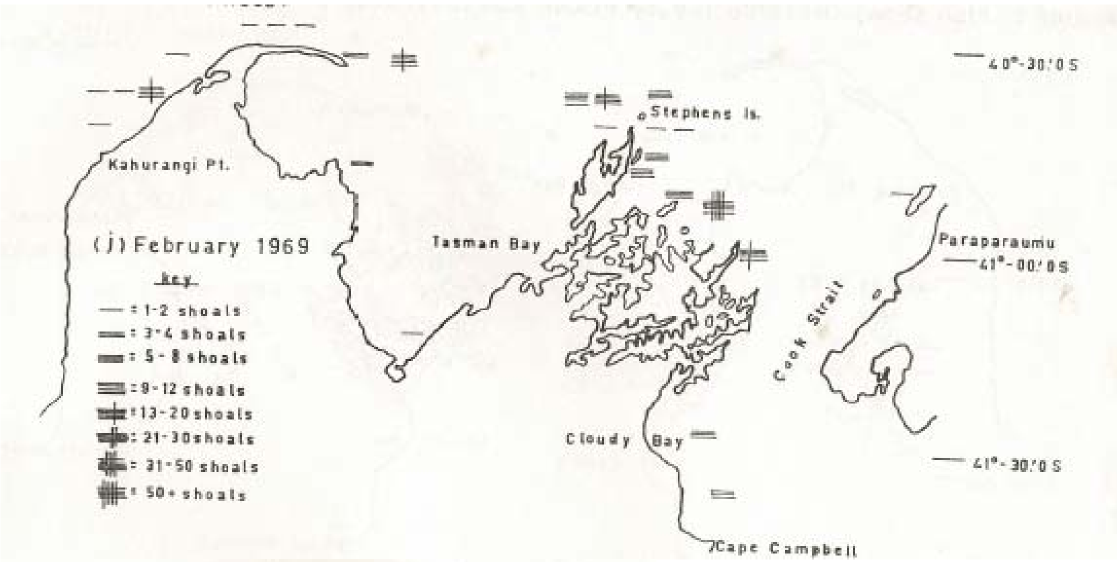
In 1968 and 1969, similar aerial surveys were conducted of the top of South Island[33]. Many spawning Kahawai shoals were recorded during November 1968 but most shoals were recorded in February, north from Port Gore (Part of Area III, Outer Sounds above Cape Jackson to Forsyth Island). This area overlaps or is very close to the Cape Lambert application site and a strong reasoning for dedicated fieldwork in the area to understand and map the dynamics between currents, upwellings and the flow on effect to zooplankton, fish birds and marine mammals. During our field visit at 10th June 2019 a big pod of Dusky Dolphins was passing through the area applied for. Squat lobster (*Munida gregaria)* was widespread at that time in the outer Marlborough Sounds.

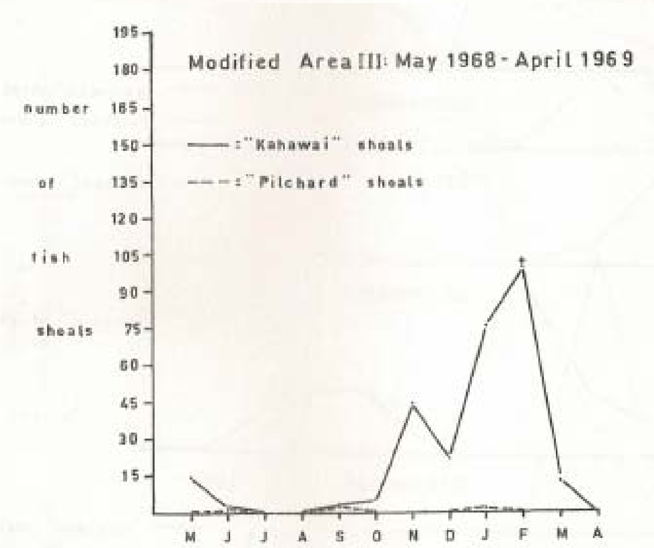
[33] Webb, F.B. 1971. Survey of Pelagic Fish in the Nelson Area (1968-1969) by Spotter Plane. Fisheries Technical Report No.69. New Zealand Marine Department.

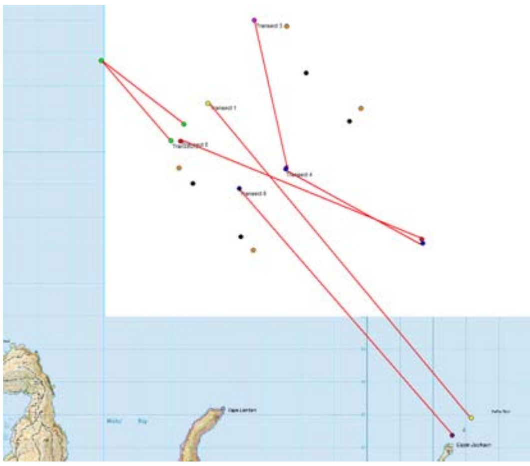
Latter plays an important role in the food webs as a bottom-feeder on the detritus, scavenging and occasionally an active predator was widespread and likely explaining the high number of Red billed Gulls. They are an important prey species including commercially important fish species, squid, octopus, bird and whales. In this they provide a crucial link between the particulate organic matter on the seafloor and the top predators.

Euphausiids are zooplankton that are widespread in the Cook Strait coastal waters. The fauna occurrence of 11 species is of diverse origins and is dominated by 3 species and only 2 of the 11 are breeding species[34]. Euphausiids are an important prey for Buller's Shearwater, Fluttering Shearwater, Fairy Prion, Common Diving Petrel, White-faced Storm Petrel, Sooty Shearwater, Red-billed Gull. Bird species have been recorded to feed with Kahawai and Trevally[35] on euphausiids over very wide areas[36].

[34] Bartle, J.A. 1976. Euphausiids of Cook Strait: A transitional Fauna? N.Z. Journal of Marine and Freshwater Research 10 (4) : 559-76. Dec. 1976
[35] Trevally was recorded during our ROV assessment as a species that occurs in the area.
[36] Gaskin, C., Adams, N. 2019. Indirect effects on seabirds in northern North Island POP2017-06 (Milestone 7 Report) Comparison of availability of food species in fish shoals and how those items are represented in different seabird diets in the region,







Six transects surveyed for seabirds at 10th June 2019.

Common Name	Marlborough Sounds and Coast	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Total 10th June 2020
		12.5km	6.5km	4.7km	4.7km	8.0km	9.9km	
	Number of birds since March 2018 (>50)							
Little Penguin	613	3			1			**4**
White capped Mollymawk	58			3	2	1		**6**
Flesh footed Shearwater	314							
Fluttering Shearwater	20,806	8		1	5	54	150	**218**
Sooty Shearwater	54							
Cape Pigeon	84							
Westland Petrel	105			2				**2**
Fairy Prion	366				2			**2**
Diving Petrel	154	1	2		3	22	3	**31**
Northern giant Petrel	38		1	1				**2**
Australasian Gannet	2,360							
King Shag	1,753							
Black Shag	173							
Little black Shag	226							
Little Shag	382							
Pied Shag	1,162							
Spotted Shag	2,412							
Southern Black backed Gull	4.695		1	5	2	9	2	**19**
Arctic Skua	140							
Black billed Gull	610							
Red billed Gull	17,236	9	2	59	12	150	500	**632**
Black fronted Tern	217							
Caspian Tern	447							
White fronted Tern	2,483	26	1		1	3	50	**81**

List of seabirds per transect: 10th June 2019.

Only with dedicated fieldwork can the interaction between these different marine trophic levels be recorded and assessed for its significance. It is of fundamental importance that these surveys are happening prior to he establishment of the farm and should be carried out on a monthly basis for at least a year.

USE OF LIGHTS

General lights as navigational marker or night activities may have an impact on seabirds. High mortality of seabirds occurs through grounding of fledglings as a result of attraction to lights[37] . Procellariiformes (petrels, shearwaters, storm petrels, gadfly petrels and diving petrels) that breed in burrows, only attend breeding colonies at night, and are consequently most at risk from the effects

[37] Rodríguez A, Holmes ND, Ryan PG, Wilson K-J, Faulquier L, Murillo Y, Raine AF, Penniman J, Neves V, Rodríguez B, Negro JJ, Chiaradia A, Dann P, Anderson T, Metzger B, Shirai M, Deppe L, Wheeler J, Hodum P, Gouveia C, Carmo V, Carreira GP, Delgado-Alburqueque L, Guerra-Correa C, Couzi F-X, Travers M & Le Corre M (2017) A global review of seabird mortality caused by land-based artificial lights. Conservation Biology 31:986-1001.

of artificial light. Seabirds can interact with lights from offshore oil and gas platforms and in some instances likely causing hundreds of thousands of bird deaths annually[38]

Use of lights will be part of the applicant's consent[39]:'The use of underwater lighting in salmon farms is common practice as it increases production and reduces the risk of maturation of the salmon prior to harvest.'. The lights provide a soft green glow and be deployed 5m below the water surface between January/February and off in October. Artificial lighting is an effective means of attracting small marine organisms, such as larval fish and zooplankton[40].

Illumination of the net-pens in Canada is common practice during the winter and spring. Studies suggest that lights commonly used in open net-pen aquaculture may increase the abundance of some fish species around pens, thereby increasing the probability that farmed fish and wild species directly and indirectly interact in coastal marine environments[41]
Many seabirds fly at night and are disorientated by bright navigation and underwater lights. Interactions can increase seabird mortalities from collisions with super structure of cages and moored vessels. Also enhanced prey aggregation around fish-farms may increase adverse interactions with seabirds.

EUTROPHICATION AND HARMFUL ALGAE BLOOMS.

Eutrophication is the leading cause of water quality impairment around the world[42] and the result of the increase in the rate of production and accumulation (over-enrichment) of water with nutrients such as nitrogen and phosphorus as a result of human activity. The sources of nutrients potentially stimulating algal blooms include sewage, atmospheric deposition, groundwater flow, as well as agricultural and aquaculture runoff and discharge.

Nitrogen is the key limiting nutrient of primary production in most temperate estuaries and coastal marine ecosystems and has a greater importance to understanding eutrophication problems in marine ecosystems. Nitrogen and phosphorus loading into marine waters can initiate a biological process of eutrophication and culminate in a fundamental shift in the food web structure of an area and lead to ecological simplification. As indicated in this assessment the management of the farm is uncertain but the release of nitrogen and phosphorus is very significant and potentially as much as almost 20% of the population of the country.

Phytoplankton controls nutrient chemistry of oceanic waters through cycling & regeneration of nutrients. Toxic species can be harmful to higher trophic levels, disrupting normal ecosystem function. The dominance of toxic algae can result in a failure of normal predator-prey interactions,

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[38] National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds, Commonwealth of Australia 2020'.`

[39] Preece, M. 2021. EVIDENCE OF MARK ANTHONY PREECE ON BEHALF OF THE APPLICANT. Dated this 1st day of October 2021

[40] Cornelisen C 2011. The New Zealand King Salmon Company Limited: Assessment of Environmental Effects – Submerged Artificial Lighting. Prepared for The New Zealand King Salmon Company Ltd. Cawthron Report No. 1982.

[41] McConell, A., Routledge, R., and Connors, B.M. 2010. Effect of artificial light on marine invertebrate and fish abundance in an area of salmon farming. Mar Ecol Prog Ser Vol. 419: 147–156,

[42] Diaz, R., Rabalais, N.N. and Breitburg, D.L. 2012. Agriculture's Impact on Aquaculture: Hypoxia and Eutrofication in Marine Waters. OECD Publishing 2012.

which in turn enhances the transfer of nutrients that sustain toxic species at the expense of competing algal species[43].

Algal blooms, including algae species causing HAB's, have been implicated in a number of marine fish kills including in New Zealand[44]:

Table 1. Potential biotoxin producers monitored in New Zealand waters (PSP, NSP, DSP, ASP: paralytic, neurotoxic, diarrhetic, and amnesic shellfish posioning, respectively; after Hallegraeff *et al.*, 1995).

Microalga	Toxin	Human health implication
Alexandrium catenella, *A. minutum* complex, *A. ostenfeldii*, *A. tamarense*	Saxitoxins; gonyautoxins	PSP
Chattonella antiqua, *C. marina*	Breve-like	NSP
Coolia monotis	?	Unknown
Dinophysis acuta, *D. acuminata*	Okadaic acid; dinophysis toxin 2 (DTX2); pectenotoxin 2	DSP
Fibrocapsa japonica	Ichthyotoxic (?)	None
G. mikimotoi complex	Breve-like	NSP, respiratory distress
Gyrodinium galatheanum	Breve-like	NSP
Heterosigma akashiwo	Ichthyotoxic	Ass. with peppery taste
Ostreopsis siamensis	?	Uncertain
Prorocentrum lima	Okadaic acid; DTX1,4; diol esters	DSP
Protoceratium reticulatum	Yessotoxin	Uncertain
Pseudo-nitzschia australis, *P. delicatissima*, *P. fraudulenta*, *P. multiseries*, *P. pseudodelicatissima*, *P. pungens*, *P. turgidula*	Domoic acid	ASP

High and very high HAB risk in the form of shellfish and fish toxicity have occurred near all the salmon farms, in particular during the summer months. However, similar HAB were also identified at the control sites and it was suggested that nutrient waste from existing farms was not of notable environmental significance at levels of production at that time[45]. A number of reports document the occurrence and abundance of harmful algal blooms in the vicinity of cage farms[46], [47] but none of these monitoring programs were experimentally or statistically designed to answer the question of whether salmon aquaculture influence blooms of harmful algal blooms.

Impact of toxic algae on seabirds reveal an array of responses ranging from reduced feeding activity, inability to lay eggs, and loss of motor coordination and death[48]. Bird deaths caused by HABs have been recorded worldwide[49],[50]. Some dinoflagellate algae destroy the waterproof layer of feathers that

[43] Glibert, P.M. 2012. Ecological stoichiometry and its implications for aquatic ecosystem sustainability. Environmental Sustainability 2012, 4:1–6

[44] Rhodes, L.L., Mackenzie, A.L., Kaspar, H.F. and Todd, K.E. 2001. Harmful Algae and mariculture in New Zealand. ICES Journal of Marine Science, 58: 398-403

[45] Hopkins GA 2004. Seabed impacts of Marlborough Sounds salmon farms: Te Pangu Bay monitoring 2003. Cawthron Report No. 847b. 25p plus appendices.

[46] Wildish, D.J., Martin, J.L., Wilson, A.J., Saulnier, A.M. 1990. Environmental monitoring of the Bay of Fundy salmonid mariculture industry during 1988 and 1989. Can.Tech.Rep.Fish.Aquat.Sci.

[47] MacKenzie, L.A., Smith, K.F., Rhodes, L.L., Brown, A., Langi, V., Edgar, M., Lovell, G., Preece, M. 2011. Mortalities of sea-cage *salmon (Oncorhynchus tshawytscha)* due to a bloom of *Pseudochattonella verruculosa* (Dictyochophyceae) in Queen Charlotte Sound, New Zealand. Harmful Algae (2011), doi:10.1016/ j.hal.2011.07.003

[48] Shumway, S.E., Allen, S.M., Boersma, P.D. 2003. Marine birds and harmful algal blooms: sporadic victims or under-reported events.? Harmful Algae 2, 1:1-17.

[49] Lewitus, A.J., Horner, R.A., Caron, D.A., Garcia-Mendoza, E., Hickey, B.M., Hunter, M., Huppart, D.D., Kudela, R.M., Langlois, G.W., Largier, J.L., Lessard, E.J., RaLonde, R., Rensel, J.E.J., Strutton, P.G., Trainer, V.L., Tweddle, J.F. 2012. Harmful algal blooms along the North American west coast region: History, trends, causes and impacts. Harmful Algae 19:133-159

keeps seabirds dry, restricting flight and leading to hypothermia. One of these dinoflagellates is *Akashiwo sanguinea* a regularly blooming species in Onapua Bay, Tory Channel[51]. This algae species may increase the frequency of foam induced bird mortality events in the coastal environment as a result of coastal warming and climate variability[52].

A shift of phytoplankton species composition can create conditions that are favourable to nuisance and toxic algal blooms. Impacts of toxic algae on seabirds reveal an array of responses ranging from reduced feeding activity, inability to lay eggs, and loss of motor coordination and death[53]. Bird deaths caused by HABs have been widely reported[54]. The future challenges to already degrading coastal habitats will be exacerbated by predicted climate change and its impact on algal blooms[55]. Climate-induced changes in salinity, temperature and mixing, which all influence both oxygen conditions and species mean that hypoxia (low oxygen concentration) tolerance will be of importance. Climate change is a rather new phenomenon and it is only relatively recently that we are seeing attempts to integrate more and more of the consequences of this new reality. The impacts of eutrophication, independent of the source of the flux, will be significantly influenced by this new reality. Both changes in climate forcing and nutrient loadings are aspects of global change that is expected to profoundly impact coastal hypoxia through more stratified water conditions.

Planning towards these realities is not reflected in this proposal. The effects of large-scale climate warming are causing long-term variations in oxygen content and saturation as an observed increase in temperature has led to a general decrease in oxygen solubility of water masses. Mitigation of effects should reflect the realities of an uncertain future and we should not take comfort from the poorly known assimilation capabilities of the marine environment to date.

The assessment of potential effects of the application on biodiversity and seabirds in particular is of limited value to assess biodiversity of the area. One would have expected that an application of this magnitude would have shown a more dedicated approach to record offshore seabird values and their foraging areas for the applied area. It is strongly recommended that at least a full year monthly dedicated transect surveys (preferably more) to record the species and foraging areas of seabirds in the wide applied site is required as a bare minimum of baseline information.

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[50] Jessup DA, Miller MA, Ryan JP, Nevins HM, Kerkering HA, Mekebri A, et al. (2009) Mass Stranding of Marine Birds Caused by a Surfactant-Producing Red Tide. PLoS ONE 4(2): e4550. https://doi.org/10.1371/journal.pone.0004550

[51] L. McKenzie presentation Aquaculture review meeting 3 October 2016 (NIWA, Wellington)

[52] Jones T., Parrish J.K., Punt A.E., Trainer V.L., Kudela R., Lang J. 2017. Mass mortality of marine birds in the Northeast Pacific caused by *Akashiwo sanguinea*. Mar Ecol Prog Ser. 579: 111–127.

[53] Shumway, S.E., Allen, S.M., Boersma, P.D. 2003. Marine birds and harmful algal blooms: sporadic victims or under-reported events.? Harmful Algae 2, 1:1-17.

[54] Lewitus, A.J., Horner, R.A., Caron, D.A., Garcia-Mendoza, E., Hickey, B.M., Hunter, M., Huppart, D.D., Kudela, R.M., Langlois, G.W., Largier, J.L., Lessard, E.J., RaLonde, R., Rensel, J.E.J., Strutton, P.G., Trainer, V.L., Tweddle, J.F. 2012. Harmful algal blooms along the North American west coast region: History, trends, causes and impacts. Harmful Algae 19: 133-159

[55] Al-Ghelani, H.M., AlKindi, A.Y.A., Amer, S., and Al-Akhzami, Y.K. 2005. Harmful Algal Blooms: Physiology, Behavior, Population Dynamics and Global Impacts – A Review. SQU Journal For Science, 10: 1-30.

Rob Schuckard 6th October 2021

APPENDIX 1- Review evidence of Dr Della Gaye Bennet on behalf of the applicant. - Dated 30 September 2021

It was only a week prior to me submitting evidence, that Dr Della Gaye Bennet submitted additional evidence on seabirds. This report was downloadable from the council website at 1st October 2021. It is uncertain if her evidence replaced the information provided by Dr McClellan or is in addition to that seabird report. Some concerns that were raised about the seabird report of Dr McClellan in my evidence have been partially addressed. These include a site visit on 11 February 2021 (and a night site visit on 9 September 2021). However, a site report on seabirds and their foraging area was not part of her evidence.

Dr Gaye Bennett [100] refers to the recommendation of the monitoring guidelines to develop a baseline monitoring programme lasting for at least a year to understand the presence and density of seabirds in the proposed area prior to and during farm development. I fully agree with such proposition as is explained in my evidence. She is however satisfied that such recommendation is **<u>not</u>** required prior to the consenting process and that there is sufficient information available about seabirds in the proposed area.

As is assessed in my evidence, I do not support such an approach. The information for this area comes from fisheries observer records and eBird records to identify seabird species within the Marlborough Sounds and Cook Strait. For eBird, most of the information is recorded from people that cross the Cook Strait with the ferry (Cook Strait hotspot). I agree that the area of the trajectory of the ferry provides a helpful contribution to the generic species list of Cook Strait but is not site specific to be extrapolated over the applied site. That is what both Dr McClellan and Dr Gaye Bennett submitted, a species list and mitigation protocol for each species. How these species are using the wider area of the application should be an essential component of the consenting process and is missing from their recommendations. Data from fisheries observers are also not presented in such a way that they are site specific for this application. It also may be noted that during the Benthic Wokshop for this application at 30th August 2021, maps were produced that the fishing intensity of the application site and its surroundings was either absent or of a very low nature. We may also conclude that the fisheries observer data are not site specific.

Information provided in applicants expert evidence is helpful to establish the seabirds that potentially may use they area but is of limited value as baseline information. To understand the effects on birds, we first needed to understand the importance of the applied area for birds that visit the wider area of the application. Such attempt to quantify the use of the area by any species and the density of these species is an important missing component from the evidence. Detailed, systematic and quantitative information on the at-sea distribution of all species, combined with site specific trophic modelling and the implications of a eutrophication of the surrounding waters is missing from this application.