Before Southland Regional Council

APP-20157616-V1

under: the Resource Management Act 1991

in the matter of: Applications by Sanford Limited to change the conditions of various resource consents that authorise the farming of salmon in Big Glory Bay, Stewart Island

by: **Sanford Limited**
Applicant

Statement of evidence by Benjamin Armor Wybourne

Dated: 11 March 2019

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INTRODUCTION

1 My full name is Benjamin (Ben) Armor Wybourne, I reside in Tutaki Valley in the Tasman District.

QUALIFICATIONS AND EXPERIENCE

2 I hold the degree of Bachelor of Applied Science in Aquaculture with Honours from the University of Tasmania.

3 I am employed by Skretting Australia (Skretting) as their Technical Account Manager for New Zealand and have held this role since 2002. Skretting is an international manufacturer of aquaculture feeds.

4 I started working in the salmon farming industry in 1990. Since then my roles in the industry have included:

4.1 Seafarm shift worker (fish feeding, handling, husbandry, diving, pen and mooring maintenance);

4.2 Salmon hatchery worker;

4.3 Smolt transport technician;

4.4 Salmon harvest supervisor; and

4.5 Technical and Commercial Management, including managing and contributing to various aquaculture research and technical projects, experimental design and analysis, analysis of fish performance, feed management, fish nutrition and feed development, technical troubleshooting, fish health issues, product quality, contract negotiations.

CODE OF CONDUCT

5 Although these proceedings are not before the Environment Court, I have read the Environment Court's Code of Conduct for Expert Witnesses and I agree to comply with it as if these proceedings were before the Court. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

6 The purpose of my evidence is to set out:

6.1 Some background about Skretting and its experience in fish feed manufacturing and use on marine farms;

6.2 Some facts and figures about salmon feed formulations and how the feeding of fish is managed;

6.3 How pellet production and the feeding of fish has evolved over time and is continuing to evolve;

6.4 The importance of nitrogen in salmon feed and how releases into the environment are minimised; and

6.5 My summary and conclusions.

SKRETTING COMPANY PROFILE

7 Skretting is a major manufacturer of aquaculture feed with around 3,500 employees, producing over 2.5 million tonnes of feed per annum from plants located worldwide. Skretting supplies feed to over 60 aquaculture species, has production facilities in 19 countries and sells feed in more than 40 countries. Skretting's head office is in Stavanger, Norway, and the company is owned by Nutreco, which in turn is owned by the Dutch company SHV Holdings.

8 Skretting undertakes detailed, ongoing research into its fish feed formulations, with the main research facility being its Aquaculture Research Centre (ARC) in Norway. The ARC operates several hundred trial tanks and has a full analytical laboratory. The Skretting Feed Technology Plant in Stavanger is a research-scale complete extrusion feed production line which, among other things, researches feed manufacture and makes diets for experimental work at the ARC. Skretting also operates eleven research and validation facilities for different aquaculture species in nine countries, including Italy, Spain, China, Japan and now in Okiwi Bay, Marlborough, New Zealand. Skretting is also an operating member of the Experimental Aquaculture Facility in Hobart, Tasmania.

9 Skretting currently supplies about 65% of the salmon feed used in New Zealand, with the majority of this coming from Skretting's plant near Hobart, Tasmania. The total feed requirement of the New Zealand salmon industry is currently around 30,000 tonnes.

10 Skretting's feed mill in Tasmania is certified and accredited by international standards including AS/NZS ISO 9001 (Quality Management Systems), ISO 14001 (Environmental Management Systems), HACCP (Hazard Analysis and Critical Control Points), FeedSafe (Australian Stockfeed Code of Practice), Global GAP (Good Agricultural Practices) and Best Aquaculture Practices (BAP). Skretting also operates a comprehensive internal tracking and tracing system, NuTrace.

FEED FORMULATIONS AND THE FEEDING OF FISH

11 Farmed salmon in New Zealand receive 100% of their nutritional requirements from manufactured dry pellets. These dry pellets are a

'complete feed', in that they supply all the requirements of the fish for macronutrients (protein, fat) and micronutrients (vitamins, minerals). As such, no other feed is required.

12 Current feed formulations used by Skretting (and by other major feed manufacturers) incorporate knowledge gained from decades of research and investment. Skretting alone currently spends in excess of 20 million Euro (approximately NZ$33 million) per annum on aquaculture nutrition research and has invested on this scale for many years.

13 As a result of research and development investment, modern salmonid feed formulations are very different to those of 20 years ago. These advances have resulted in both economic and environmental benefits, as follows:

13.1 Reliance on marine raw materials has greatly reduced. Early pelleted feeds typically contained 50-70% fishmeal. Most of Skretting's feeds sold today contain only 5% fishmeal, and Skretting can offer feeds containing no marine raw materials at all, with no reduction in fish health or performance, or change in product quality.

13.2 The protein content of modern diets is typically 10 percentage points lower than early diets, and early diets contained about double the protein the fish actually required for growth and health. Modern diets provide oil as an energy source for the fish, rather than protein, an approach known as 'protein sparing'. Modern diets also reduce protein content as fish get larger, recognising that larger fish require less protein than smaller fish. Reduced diet protein also directly reduces nitrogen discharges to the environment as the feed nitrogen levels more closely matches dietary requirements.

13.3 Feed Conversion Rate (FCR – the number of kilograms of feed used to produce 1 kilogram of fish) has also reduced markedly, as diet energy levels have increased (discussed further below at paragraph [17.2] and [19]). Lower FCRs also reduce nutrient discharges to the environment because more of the feed fed is retained in the carcass of the fish.

THE EVOLUTION OF FISH FEED PRODUCTION AND FISH FEEDING METHODS

14 Early salmonid rearing involved feeding of chopped up fish and mussels. This was inconvenient, inefficient and tended to contaminate the rearing water. 'Moist' pellets were then developed, which were often made on-site from similar materials. Moist pellets gave better control over nutritional properties (e.g. fishmeal or micronutrients could be added) but still had many of the drawbacks of chopped fish.

15 Nutritionally complete dry (and shelf-stable) feeds for salmonids were first made in quantity using pellet mills. These low-cost and simple machines compress materials (sometimes with the addition of steam) into 'pressed

pellets', or 'steam pressed pellets', with little cooking occurring. Many poultry, calf and pig feeds are still made with this technology, as are the wood pellets used in pellet fires. Pressed pellets supplied the early development of salmon farming around the world through the 1970s and 1980s.

16 The New Zealand salmon farming industry, including the salmon farms in Big Glory Bay, relied almost exclusively on pressed pellets (both imported and manufactured locally) until the mid to late 1990s. By this time a new 'extrusion' pelleting technology was introduced for salmonid diets. Extruders are more complex and expensive machines that use a rotating screw or screws to apply shear and compression to raw materials, before extruding them through a die to make pellets. Extrusion fish feed plants cost many tens of millions of dollars to construct and include a large amount of ancillary supporting equipment that gives additional control of the production process, including steam injection, oil vacuum coating and supplementary heating.

17 While extrusion manufacture is more costly than pressed pelleting, the advantages outweigh those additional costs because:

17.1 Extrusion effectively cooks pellets, which improves digestibility and reduces chip (i.e. broken pellets) and dust. Pressed pellets typically contain 5% chip and dust (which is not eaten by fish and is lost to the environment) while extruded pellets are below 1% chip and dust.

17.2 Extrusion allows the addition of much higher oil levels. Pressed pellets were limited to about 22% oil (with difficultly – in fact 10-14% was more typical) while greater than 40% oil can be achieved with extrusion technology. Higher oil content (and thus energy content) is an important factor in achieving lower FCR.

18 The way feed is delivered to the fish (*feed management*) has also evolved dramatically over the years. Specifically:

18.1 Feeding on early sea farms was undertaken by hand and often relied on the fishes' 'surface response'. Feed would be thrown from a walkway or boat onto the surface of pens and when observed fish behaviour suggested they were full, feeding was stopped. Alternatively a calculated amount of feed would be given, regardless of fish behaviour;

18.2 Modern fish feeding invariably uses underwater feedback equipment to minimise the loss of uneaten pellets from cages. This equipment detects uneaten feed at depth, the most common tool used is an underwater camera at 5-10 metres depth. When feedback technology was introduced, it was discovered that uneaten feed was often being lost from the bottom of cages during meals, despite monitoring of the 'surface response';

18.3 A range of other new technologies supports feed management on modern sea farms. Feed companies and farmers have developed accurate mathematical models to predict growth and feeding, which helps deliver optimal amounts of feed and to analyse and improve fish performance. Feed on grower farms is rarely delivered by hand and pneumatic feed delivery is now the norm. Formal programs for monitoring the condition of feeding equipment to minimise chip and dust creation is now also standard practice.

19 The switch from pressed pellets to extruded pellets, and the improvements in feed management described above, have resulted in a reduction in FCR from around 2.8 in the early 1990s to around 1.8 currently. This figure varies around the world due to site-specific variables, including fish species, current speeds, and water temperature.

THE ROLE OF NITROGEN AND ITS MANAGEMENT

20 For practical purposes all the nitrogen in fish food (and all the nitrogen released from fish to the environment) derives from the diet protein content.

21 The relationship between protein content and nitrogen content is so strong that feed manufacturers almost never directly measure protein in feed, but instead measure the nitrogen content, as a proxy for protein.

22 In that regard, Skretting measures the nitrogen content of every batch of feed produced, as a routine quality control for protein content.

23 The accepted ratio for converting nitrogen content to protein content for marine proteins is 6.25 (i.e. protein% = 6.25 x nitrogen%), and this is the figure that I provided **Dr Hartstein** for use in his modelling work.

24 Nitrogen from fish feed can be released to the environment through three main pathways:

24.1 Uneaten feed (either uneaten whole pellets or chip and dust);

24.2 Undigested nitrogen in faeces; and

24.3 Metabolised nitrogen released in soluble form (primarily as ammonia across the gills).

25 Other minor pathways also exist (for example nitrogen in sloughed mucous), but these are so small that they can effectively be ignored.

26 Fish use nitrogen to build tissue and other vital functions. As a result, nitrogen is an essential nutrient and cannot be eliminated from fish diets. However, all three main pathways for nitrogen release to the environment are influenced by feed formulation and / or feed management, as I will now discuss.

26.1 Managing Uneaten Feed Loss:

(a) Control of chip and dust is achieved through use of properly manufactured pellets and feeding system maintenance. Comprehensive quality control checks during manufacture are standard practice at Skretting to ensure products meet their technical specifications for pellet durability.

(b) Careful feed management (e.g. use of camera feedback, care not to spread pellets outside the cage etc) ensures an optimal amount of feed is delivered with little waste.

26.2 Managing undigested nitrogen in faeces:

(a) No practical protein source is completely digestible; some of the fed protein is always released in the faeces. This issue exists throughout nature and is not a consequence of the use of manufactured fish feeds.

(b) Only protein that is absorbed from the gut can be used by the fish. Nutritionists refer to this protein as the "Digestible Protein". Commonly this is around 70% of the total protein in a feed, although this figure can vary widely. If a feed has a protein digestibility of 70%, then 30% of the consumed protein is released in the faeces.

(c) Formulating feeds to maintain good fish health assists protein digestion.

(d) Choosing more digestible raw materials allows the required digestible protein to be delivered from a smaller quantity of total protein.

(e) As diets have become more nutrient dense, there has been a concerted move away from lower-digestible raw materials over the last 20 years. This trend is likely to continue.

26.3 Managing Release of Metabolised Nitrogen in soluble form:

(a) Protein that is absorbed from the gut is broken into its constituent amino acids (the building blocks of protein).

(b) These amino acids have two main fates:

(i) They are used to build tissue, incorporating nitrogen into the carcass of the fish; or

(ii) If surplus to what the fish requires for tissue synthesis, they are used ("burnt") for energy and the contained nitrogen is released across the gills as ammonia.

(c) Reducing stress and maintaining good fish health can reduce protein turnover and soluble nitrogen release.

(d) The amount of nitrogen released as ammonia is influenced by the feed formulation:

(i) Excess protein in the formulation causes the surplus to be used for energy and the nitrogen released. Feed manufacturers have put much effort into researching the exact protein requirements of fish in order to avoid this situation, because protein is an expensive component of the diet; and

(ii) Tissue synthesis uses amino acids in generally fixed ratios. If the proportions of amino acids in the feed differ significantly from these ratios the fish will consume additional protein to meet their tissue synthesis amino acid requirements, while using surplus amino acids for energy and releasing the nitrogen. Again, this issue is closely controlled by the feed formulation.

SUMMARY AND CONCLUSIONS

27 In summary, improvements in feed management technology over the past decades have resulted in a reduction in FCR and more efficient use of nitrogen. We can now be very precise about the amount of nitrogen that is contained in the feed and released into the environment. Skretting is assisting Sanford to deploy cutting-edge technology in Big Glory Bay to ensure that the FCR at the salmon farms is low and that nitrogen is released through food in the most targeted and efficient way possible.

Ben Wybourne

11 March 2019