New Zealand King Salmon

OPERATIONS REPORT

NZKS Operations Report

INTRODUCTION

The Marlborough District Council and Central Government are working with NZ King Salmon and community representatives on options to implement the Best Management Practice guidelines (BMP) for salmon farms in the Marlborough Sounds.

Options to enable adoption of BMP include the potential relocation of some existing low flow farms to more environmentally appropriate locations to ensure the guidelines can be met in the future. Other less likely options might include an additional number of similar sites to allow for rotational management of the benthos, in water collection of faecal material that is as yet unproven commercially, or remediation of the seabed also as yet unproven.

Six existing low flow salmon farms are currently positioned in sites not ideally suited to modern salmon farming. These are Crail Bay (2), Forsyth Bay, Waihinau Bay, Otanerau Bay and Ruakaka Bay. Relocating these farms on an equivalent space for space basis to more suitable locations will result in better environmental, social and economic outcomes.

Low flow farms contribute approximately 9 hectares of surface structures in these locations.

NZ King Salmon has seafarm sites with attributes showing a range of values for water depth, temperature profile and current speed. Sites that are colloquially referred to as "low flow" generally have average flows of less than 10cm/sec, are usually in a shallower location and are generally warmer through summer than sites such as those in Tory Channel where high flows and cooler temperatures (<16.5C) prevail.

Low flow sites will be difficult if not impossible to farm cost efficiently if BMP is adopted on these sites. One estimate is that production will need to be reduced by some 50-60% from current and historical levels in order to comply fully.

Nine potentially suitable sites have been identified; these now require an Assessment of Environmental Effects (AEE) for each site to determine if they are suitable. This Report contributes to the preparation of the AEE.

A very significant volume of environmental information is available on salmon farming in the Marlborough Sounds and where necessary this has been updated. The AEE will use the updated information including this updated report where appropriate for its assessment.

Of the potential suitable sites, all will require new infrastructure as existing infrastructure on the low flow sites does not possess the design characteristics suitable for more exposed and higher flow locations.

This is an opportunity to adopt not only BMP Benthic but also Best Management Practice guidelines for salmon farms in the Marlborough Sounds: Operations.

OVERVIEW OF NEW ZEALAND KING SALMON

New Zealand King Salmon is the world's largest aquaculture producer of the King salmon species, accounting for more than 50% of global aquaculture production. King salmon (Oncorhynchus tshawytscha) is a Pacific salmon species, comprising only 0.7% of total global salmon aquaculture production and wild catch. King salmon is generally regarded as the premium salmon species in terms of taste and nutritional quality, possessing superior colour, fat and Omega-3 oil content, fillet size and desirable texture characteristics.

We have consent for eleven seafarm sites in the Marlborough Sounds. We operate eight seafarms including three new seafarms consented in 2014 with a 35 year term. Seven of these are currently stocked with fish and the three other sites are fallowed.

New Zealand King Salmon was a pioneer in marine salmon farming in New Zealand, utilising King salmon stock introduced from California over 100 years ago. We have been growing and selling salmon to consumers in New Zealand and overseas for over 30 years. We have a well-established domestic market presence and share along with a history of successfully selling our products in offshore markets including Australia, North America, Japan, Asia (ex Japan), Europe and others. During the last financial year, 44% of our revenue was generated from international sales.

We believe New Zealand King Salmon's key points of difference are the rare species of salmon that we produce and the high quality premium brands that we have developed. We believe that under our Ōra King brand, we are one of the first protein companies in the world to achieve branding all the way through to the restaurant menu. Our retail products also have strong brand recognition in New Zealand.

New Zealand King Salmon has three key brands under which we produce a range of products from whole fresh fish to value added products including fillets and portions, cold smoked and wood roasted product. Where these key brands are not used, we generally sell our products under the New Zealand King Salmon label. Our products are sold to international and domestic retail (supermarket) and foodservice customers, such as restaurants, caterers and hotels.

OUR BRANDS

ŌRA KING™

REGAL™

Southern ocean

OUR HISTORY

A NEW ZEALAND FIRST

Fry introduced to Bubbling Springs hatchery at Takaka. This was the first time salmon had been cultivated in New Zealand commercially.

1976

SEAFARM FARMING LEGALISED

Legislation passed allowing the raising of salmon in seafarms.

1983

REGAL SALMON ACQUIRES NZ SALMON'S DOMESTIC SALMON FARMS

1992

ENTRY INTO THE USA MARKET

Mid 1990's

NEW ZEALAND KING SALMON FORMATION

New Zealand King Salmon formed from the merger of Regal Salmon and Southern Ocean Seafoods. New Zealand King Salmon controls over half the domestic salmon market.

1996

1976 1983 1992 1996

1983

TENTBURN FUNDED

The New Zealand Salmon Company lists on the stock exchange, raising capital to fund a hatchery at Tentburn.

1986

REGAL SALMON FORMATION

The South Island Salmon Partnership and South Island Salmon Company merged to form Regal Salmon.

Mid 1990's

ENTRY INTO THE AUSTRALIAN MARKET WITH FRESH PRODUCTS

1996

OREGON GROUP FIRST INVESTS IN NEW ZEALAND KING SALMON

2000

Early 2000's

WE BECOME THE FIRST NZ SALMON COMPANY TO ACHIEVE FULL YEAR ROUND HARVEST

Focus on using breeding programme to produce higher harvest weight fish and year round harvest.

2008

2008

INTERNATIONAL PREMIUM POSITIONING

We secured the first premium frozen portion business with a high-end restaurant group.

2008

CLAY POINT

In a joint venture with Te Atiawa, our new generation seafarm at Clay Point became operational.

DIRECT CAPITAL INVESTMENT IN NEW ZEALAND KING SALMON

2008

2011

2010

INTERNATIONAL RETAIL

We secured our first major overseas retailer outside Australia with cold smoked product into Migros, Switzerland.

2011

WAIAU HATCHERY ACQUISITION

We acquired our third hatchery allowing improved freshwater risk management.

2012

ŌRA KING

Ōra King, our premium foodservice brand, launched. Inspired by, and created for, fine-dining chefs around the world.

2013

ŌRA KING AWARDS

Inaugural Ōra King awards event held celebrating Ōra King and leading chefs'

Dec 2014

SEAFARM LICENCES

We were granted three new licences for 35 years which allow us to double existing production over time.

2016

Jul 2016

FIRST HARVEST FROM NEW FARMS

FULL VERTICAL CONTROL

We believe a key component to ensuring the highest possible quality and brand positioning is retaining complete vertical control, enabling year round production, processing and supply of high quality salmon.

We control all elements of the value chain from breeding and growing through to harvest and processing. Fish are harvested and processed on the same day with fresh whole fish generally dispatched to customers within 24 hours of harvest.

1

We operate three hatcheries. For broodstock, smolt and as risk mitigation.

2

Broodstock is tagged and monitored throughout its life – we assess the best female and male salmon.

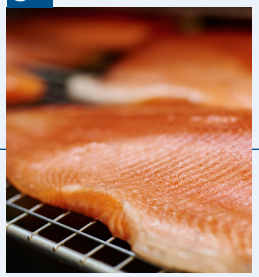
3

Following transfer from freshwater hatcheries, salmon are grown in one of our seawater farms.

4

Salmon are humanely harvested at sea and transferred back to our processing facilities in Nelson on the same day.

5



Salmon are weighed, gutted and gilled. Depending on final use, further processing can take place (including cutting into fillets or smoking).

6

Ultra premium fish are branded Ōra King and individually numbered for traceability. Relationships with chefs and restaurateurs allow us to participate in "menu poetry".

OUR COMMITMENT TO THE ENVIRONMENT

New Zealand King Salmon is firmly committed to sustainability and managing our resources for the long term. Quality and sustainability are achieved through managing several key factors: maintaining a clean rearing environment; ensuring healthy salmon using proactive aquaculture management; sourcing sustainable and nutritious feed ingredients; and practicing careful and humane harvesting methods.

New Zealand King Salmon, the Marlborough District Council, the Ministry for Primary Industries and other key stakeholders and experts have worked together to develop the Best Practice Guidelines for salmon farming in the Marlborough Sounds. These Best Practice Guidelines will help protect the environment while including the local community and industry, and are standards we can proudly promote to the world.

The New Zealand salmon industry was the first and only ocean-farmed salmon producing region to attain the 'Best Choice' (green) accreditation in the Monterey Bay Aquarium Seafood Watch sustainability guide in 2015. Monterey Bay is generally regarded as a global leader in sustainable seafood guides and has rated approximately 90% of global seafarmed salmon aquaculture systems. Of those reviewed, less than 1% have been rated green.

[8] Source: As to Atlantic salmon, Chicken, Pork and Beef, data from the Global Salmon Initiative Sustainability Report (2010); as to Lamb, data from Bjorkli, J. Protein and energy account in salmon, chicken, pig and lamb. M.Sc. Thesis, Norwegian University of Life Sciences (UMB), Norway (2002), cited by

SEAFARM CONSENT CONDITIONS AND BEST PRACTICE GUIDELINES

In New Zealand, consents and regulations for fish farming are primarily legislated under the Resource Management Act 1991 and the Fisheries Act 1996. The Ministry for Primary Industries and the Marlborough District Council administer the regulatory requirements and monitor consent holder activity and effects.

To monitor compliance with consent conditions, reviews of the environmental effects are undertaken annually by independent scientists and reported to Council. Those reports are then subject to scrutiny by scientific and technical officers and often subject to external peer review. A number of consent conditions provide for an adaptive management process, which allow us to respond to monitoring results by adapting our operations in a manner that will ensure we are or will be compliant with consent conditions within agreed timeframes.

Monitoring results have shown that our seafarms are in overall compliance with the environmental quality standards contained in individual current consents.

With our support, the Best Practice Guidelines have been developed to apply across all of our seafarms, drawing on international science, and are now in the process of implementation. These guidelines will form part of consent conditions, at the latest when existing consents are renewed. To facilitate the transition to best practice, all seafarms are already tested against this performance criteria.

There is currently technical non-compliance against consent conditions at certain test locations at Clay Point and results at Te Pangu demonstrate a need for further sampling in the next 12 months. The monitoring shows effects that are not biologically significant, and non-compliance is localised. An application has been lodged in respect of Clay Point to adopt the Best Practice Guidelines at that site (in place of existing consent conditions), with which we believe the site would currently comply. Minor operational adjustments are being implemented at Te Pangu (which do not adversely affect the economics of the operation of the seafarm).

While the Otanerau and Forsyth seafarms are recognised as complying with their consent conditions (and have been rated compliant by the Marlborough District Council), those farms do not comply with the Best Practice Guidelines at the present time. The Ministry for Primary Industries and the Marlborough District Council are working with New Zealand King Salmon and the community to improve the environmental, social and economic performance of these seafarms.

In order to comply with Best Practice guidelines a significant reduction in feed discharge is required to reduce benthic effect. Another option would be to move the farms to other areas that give a better environmental outcome yet allows the business to continue.

New Zealand King Salmon's practice has been to work closely with the Marlborough District Council to ensure acceptable environmental performance at our seafarms. That practice will continue.

BIOLOGY OF KING SALMON IN NEW ZEALAND

Salmon is the common name for several species of fish in the family Salmonidae. Typically, salmon are anadromous; that is they are born in fresh water, migrate to the ocean, then return to fresh water to reproduce. However, there are populations of several salmon species that are restricted to fresh water throughout their lives.

Species of salmon are generally divided into two main groups: the single Atlantic Ocean species and a number of Pacific Ocean species (e.g. King salmon, Steelhead (Rainbow) trout, Cherry, Chum, Coho, Pink and Sockeye salmon).

DESCRIPTION OF KING SALMON

King salmon, Oncorhynchus tschawytscha from the Greek words onkos (hook), rynchos (nose) and tschawytscha (pronounced shaw-witch-shaw) comes from the Kamchatka Peninsula in Russia where, as in Alaska, it is the common name for the species and is thought to refer to their distinctive black gums. King salmon are the largest of the Pacific salmon and are also referred to as 'Quinnat' or 'King' salmon.

Native to the northwest coast of North American and northeast Asia, King salmon range from Kotzebue Sound, Alaska, to Santa Barbara, California to north Asia from Japan to the Kamchatka Peninsula in the Russian far east and the Chukchi Sea. They have not spread into the Arctic drainages, nor are they found in the warmer waters south of the Sacramento River. It is likely that their range is limited by water temperature.

The King salmon is blue-green or purple on the back and top of the head with silvery sides and white ventral surfaces. It has black spots on its tail and the upper half of its body. Its gums are often black/dark purple. Adult fish typically range in size from 840 to 910mm and the average size range is from 4.5 to 23kg.

LIFE CYCLE

The optimum water temperature range for King salmon is 6-17°C, with maximum growth achieved in temperatures between 12-17°C. Rapid changes in temperature within this range can cause death, and most fish adapt to a narrow temperature and salinity range.

In the wild, King salmon may spend one to eight years in the ocean (averaging three to four years) where they grow to maturity, before returning to their home rivers to spawn. The fish tends to lose condition as they migrate upstream.

In all species of Pacific salmon, the mature individuals die within a few weeks of spawning, a trait known as semelparity. Salmon that are not killed by other means, show greatly accelerated deterioration (phenoptosis or "programmed aging") at the end of their lives. Their bodies rapidly deteriorate right after they spawn as a result of the release of massive amounts of corticosteroids.

King salmon spawn during autumn in larger and deeper waters than other salmon species and can be found on the spawning redds (gravel nest) from September through December in their northern hemisphere native habitat. In New Zealand the main salmon runs into the rivers occurs in March with spawning occurring in April/May.

After laying eggs, females guard their redd for four to 25 days before dying, while males seek additional mates. King salmon eggs hatch, depending on water temperature, 90 to 150 days after deposition. Spawning is timed to ensure that young salmon fry emerge during an appropriate season for survival and growth. In the northern hemisphere, young fish can live in freshwater for three to 18 months before travelling downstream to estuaries, where they can remain as smolt for several months. In New Zealand, by far the majority of juvenile King salmon pass directly to the ocean at the relatively young age of three to six months.

HISTORY OF KING SALMON IN NEW ZEALAND

Following several unsuccessful attempts in the 1870s to introduce King salmon for a recreational fishery by various Acclimatisation Societies, they were successfully introduced to New Zealand by the Marine Department, who hoped to initiate commercial rod fishing and canning industry (although this never eventuated).

A hatchery was built on the banks of the Hakataramea River (a tributary of the Waitaki) and between 1901 and 1907 salmon were imported from the Baird Fish Station, located on a tributary of the Sacramento River in California. That operation was a success with, not only fish being successfully released but the fish adopting the Waitaki River and returning there to spawn.

King salmon became established, with sufficient numbers of adults returning that the population was self-sustaining in rivers on the east, and to a minor extent west, coasts of the South Island. Since 1907 imports of salmon ova into New Zealand have not been permitted, so all King salmon in New Zealand are the descendants of those original fish.

In the wild King salmon are restricted to the South Island, the major runs being on the east coast in the Clutha, Waitaki, Rangitata, Rakaia and Waimakariri Rivers, although smaller runs occur in many other East Coast rivers such as the Hurunui, the Ashley and the Ashburton. Other small stocks of sea-run King salmon are found on the South Island's West Coast, particularly in the Taramakau, Hokitika and Paringa Rivers. There are also a few landlocked stocks of King salmon in some South Island lakes. Although juvenile fish have been caught in some North Island rivers, there are no consistent runs of King salmon in the North Island.

Since the early days of salmon introductions, the Government, anglers and acclimatisation societies have operated hatcheries which boosted stocks in rivers where runs had been established and from whence attempts were made to stock new rivers. Even today, the so called 'wild' fishery is supplemented by these operations.

DIFFERENCES BETWEEN KING SALMON AND ATLANTIC SALMON

Atlantic salmon, as the name suggests, are the species of salmon which reproduce in northern rivers on both the coasts of the Atlantic Ocean. Atlantic salmon (Salmo salar), are not closely related to King salmon but are also generally anadromous; however unlike Pacific species, they are iteroparous, meaning they can spawn more than once. King salmon are more closely related to Rainbow trout (Oncorhynchus kisutch) being of the same genus.

Atlantic salmon accounts for over 99% of all farmed salmon and is the predominant species farmed in Norway, Chile, and Scotland. While attempts have been made to farm this species in New Zealand, these were unsuccessful.

Of all the salmon species King salmon are the most difficult to grow. In their native range in the northern hemisphere they suffer from a range of serious diseases such as bacterial kidney disease (BKD). King salmon can be difficult to handle without causing damage to the fish and subsequent fish losses, in addition they tend to panic easily, especially if crowded, scales are easily lost and secondary infection can set in.

King salmon do not convert feed as efficiently as for example Atlantic salmon. The New Zealand farmers achieve a feed conversion ratio (FCR) of ~1.8 in seawater, compared to reported FCR's of 1.0 to 1.4 in Atlantic salmon. This primarily occurs for a number of reasons, as follows:

a. King salmon have higher flesh oil (typically 25% at harvest in the fillet) than Atlantic salmon (17%). Because the tissue of King salmon contains more energy than Atlantic salmon, they require more feed energy to build each kilogram of tissue.

b. Atlantic salmon diets are manufactured to contain more energy (>35% oil is common) than King salmon diets (26% oil maximum). This is because King salmon are naturally oily fish, and too much oil in the diet can cause flesh quality problems in this species.

c. Energy partitioning calculations show that the points noted in (a) and (b) above account for at least 80% of the difference in FCRs between Atlantic salmon and King salmon.

d. Despite the higher FCR of King salmon, because they use lower-oil diets and retain more oil in the flesh, the efficiency with which Atlantic salmon and King salmon retain oil and energy is similar.

HOW WE PRODUCE WHAT WE SELL

PRODUCTION PROCESS

We are a fully vertically integrated operation with key infrastructure located in the Marlborough Sounds, Nelson, Golden Bay and Canterbury. Our 30 year history, and experience producing the King salmon species, have meant we have generally been able to adapt to changing farming challenges and conditions over time, and this remains an ongoing focus for us.

The production process can be split into three areas:

HATCHERIES

- This is where we breed salmon and grow smolt to 130 grams for transfer to our seafarms.
- 3 hatcheries across the South Island.
- Approximately 28 employees.
- Existing hatcheries have capacity to put approximately 3.5 million smolt to sea annually, or to support an annual harvest volume of some 11,500 MT.

SEAFARMS

- This is where we grow smolt to harvest weight salmon.
- 8 operational seafarms throughout the Marlborough Sounds.
- Approximately 85 employees.
- Existing seafarms support annual production volumes of approximately 6,000 MT, with the three new seafarms consented in 2014, the eventual annual production capacity is expected to increase to more than 12,000 MT.
- Further opportunities are available to improve environmental and fish performance including swapping low flow sites for higher flow locations.

PROCESSING FACILITIES

- This is where we process harvested salmon into finished products.
- Processing operations are based in Nelson.
- Approximately 239 employees.
- Core processing infrastructure capacity (for gutting, gilling and grading) is currently estimated at 7,500 MT per annum. This could be doubled by adding an extra shift for limited additional spend.

BREEDING, HATCHING AND GROWING

The New Zealand King Salmon business is operated in a manner that allows for year round production.

Our unique point of difference begins with our breeding programme. We have been running a breeding programme at our hatcheries for more than 20 years across 8 generations of salmon, with approximately 115 families of fish and records on more than 200,000 fish. The fish we use for breeding are referred to as "broodstock".

We believe the output of this programme, which crosses the traits of observed families for beneficial inherited characteristics, is a fish with superior characteristics to wild King salmon. Our primary focus has been on developing fish that are bred for culinary excellence and that grow faster, and therefore larger, than wild King salmon, with a higher fat content. Externally conducted studies show that, after two months, New Zealand King Salmon's fry have grown more than 50% larger than wild King salmon.[11]

Fry typically spend around 8 months in the hatchery at which time they are mature enough to undergo smoltification (the ability to exist in salt water). After smoltification, they are transferred to specific seafarms which will ensure the appropriate nurturing to a harvest weight and quality on a year round continuous basis. Typically, our salmon spend around 16 months at the seafarms before harvest.

Illustrative King salmon lifecycle

[11] Source: Nelson Marlborough Institute of Technology – Salmon Rearing Project, 2013.

OUR HATCHERIES

We operate three hatcheries across the South Island in Takaka, Tentburn and Waiau. The wide geographic dispersion of our hatcheries acts to mitigate the risk of disease or natural disaster. Our key hatcheries have ample water supply which we believe will facilitate any future expansion beyond our eight operational seafarms.

HATCHERY	LOCATION	ACTIVITIES	CONSENT EXPIRY DATES
Takaka	Golden Bay	Production of broodstock and eggs	Fish farm licence currently in renewal process Water permit expires in 2034
Tentburn	Canterbury	Smolt production	Various licences and permits expiring between 2026 and 2038
Waiau	North Canterbury	Backup for broodstock and smolt	Fish farm licence currently in renewal process Water permits expire between 2028 and 2039

TAKAKA BROODSTOCK FACILITY

Located immediately downstream from the Waikoropupu Springs in Golden Bay, the Takaka hatchery benefits from one of the clearest sources of freshwater in the world, bubbling from the ground at approximately 14,000 litres per second at a relatively stable temperature of just under 12oC - a great temperature for rearing salmon.

The facility was established by a private individual in the mid-1970s, and in 1977 a diversion of Springs River into the farm was established and permits were granted to increase the water take and discharge. Water take and discharge permits currently allow NZ King Salmon to take and use water from downstream of the Waikoropupu Springs for the purposes of salmon farming, as well as to discharge water and salmon farming effluent via a settling pond to the Springs River. A further discharge direct to the Springs river is allowed when the settling pond is being maintained.

Operating under these consents conditions, the hatchery is NZ King Salmon's broodstock facility producing up to 7 million ova annually from the selective breeding programme and currently provides all of the ova requirements that are then hatched and on-grown in freshwater at the Tentburn and Waiau hatcheries to the smolt stage before being transported to the seafarms.

The Takaka hatchery employs a farm manager, nine full-time and one part-time staff members.

TENTBURN HATCHERY

Close to the mouth of the Rakaia River, Tentburn was developed during the mid-1980s by The New Zealand Salmon Company Ltd. It was initially conceived as an ocean-ranching site whereby the salmon would be hatched and released to the ocean with the intent that they would return three years later as harvestable salmon. During this time, the facility came close to achieving the 1% return of salmon required to ensure profitability, but never quite succeeded. A number of factors led to the ultimate failure of Tentburn as an ocean-ranching site and these included the presence of trawlers fishing off the coast of New Zealand, shags, seals and predatory fish, as well as recreational fishers who lined the culvert leading into the hatchery. There were also difficulties maintaining the fish ladder across a beach that is frequently affected by gravel movement.

Tentburn is however a great facility for producing smolt for sea pen growout, with the main advantages being plentiful land area, good access and suitable freshwater supply.

Using technology developed in the United States, the Tentburn hatchery has 60 raceways, and water is continuously pumped from two spring fed streams. Two wells are also used at Tentburn to obtain better quality water for incubation and development of the smolt during the early stages of the lifecycle.

The Tentburn hatchery currently employs a farm manager, 13 full-time permanent, one permanent part-time staff member, and produces approximately 2,500,000 smolt annually.

WAIAU HATCHERY

Located between Rotherham and Waiau on SH70 in North Canterbury, the Waiau Hatchery was established in 1987 by the Amuri Salmon Company. For the next 20 years it produced up to 100 tonnes of 2kg+ freshwater salmon per year, which were grown in a combination of raceways and ponds. The main water supply originates in springs 1km upstream that are fed from the Waiau river catchment and in addition there are three wells on site. The hatchery was purchased by NZ King Salmon in 2011. NZ King Salmon currently uses the hatchery to rear 300,000 smolt per annum as well as broodstock, but it has the potential to produce up to 1,000,000 smolt. There is one manager and two full-time permanent employees located at Waiau.

SMOLT PRODUCTION

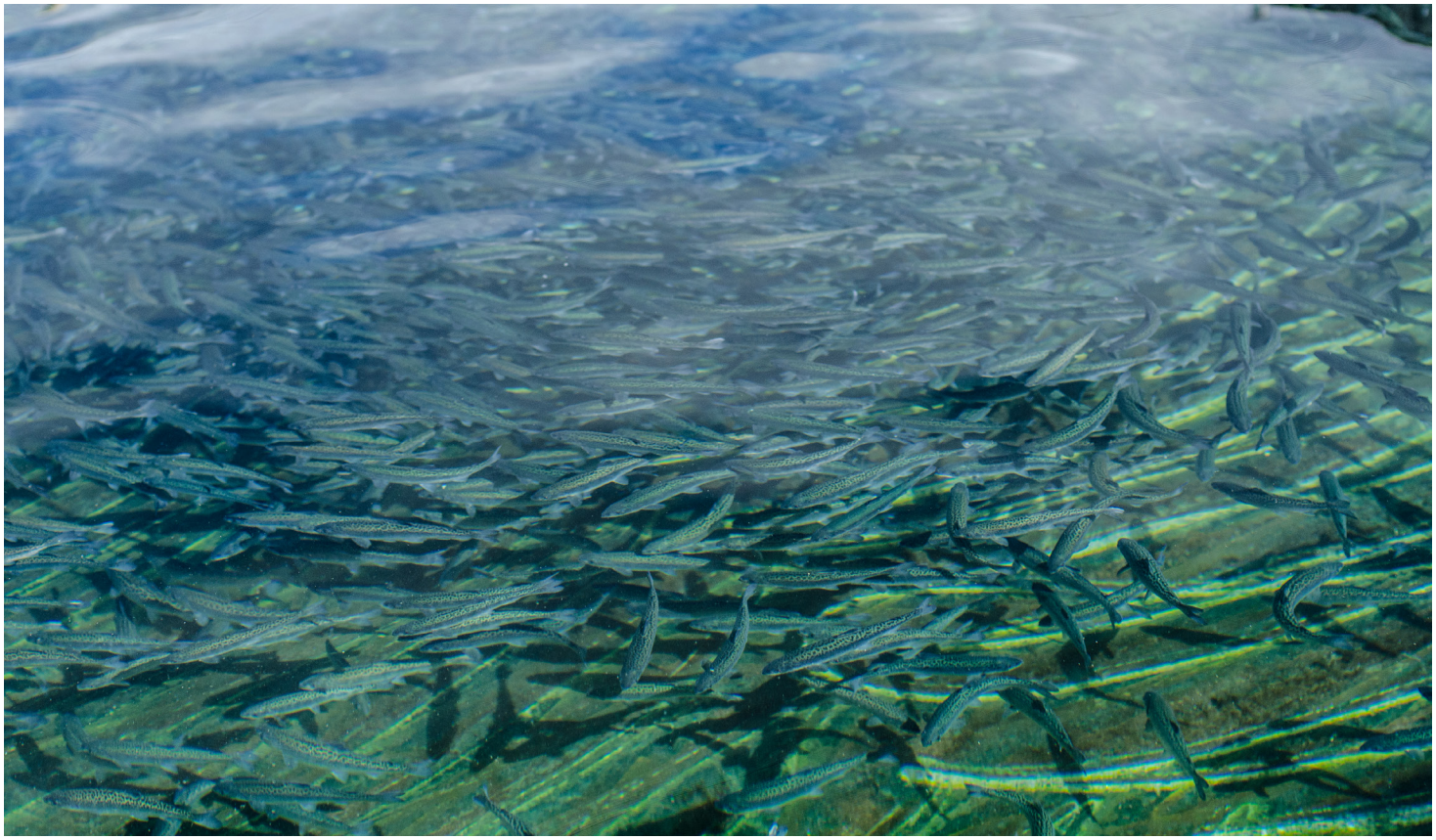
NZ King Salmon's world class selective breeding programme, which breeds for grow-out performance and marketing qualities in the fish, is similar to those run for land-based farm animals. King salmon spawn in freshwater and therefore the breeding programme is located at the Takaka hatchery with a back up of broodstock and eggs in Waiau. However the Tentburn, Takaka and Waiau hatcheries are run together as one operation. At any one time there may be three year classes of brood stock and these are currently located at Takaka.

Through photoperiod technology NZKS is able to spawn broodstock from December to July. Weighing between 7-15 kg they are stripped of eggs at three years of age; producing ~6,500 eggs each; resulting in the production of ~10 million eggs in total. About 85% of the eggs survive.

Using the latest technology, each broodstock fish carries a PIT identification tag (microchip) which is recovered from the female fish post-spawning and used to identify her eggs. Also we are able to identify our broodstock through genotyping technology. Following collection of the eggs, the milt from a predetermined male is collected, chilled and the PIT number of that male is recorded to enable appropriate 'matches' to be made as part of the breeding programme.

The PIT tags and genotyping enable NZ King Salmon to keep track of the individual fish and the 120 family lines currently used as part of the breeding programme. In addition, maintaining the families from each cohort at both locations is a risk management tool to ensure that the company is protected in the event of significant fish loss at one site. There are also 20,000 fish from the family lines that are reared in a net pen, enabling NZ King Salmon to assess family and individual performance in the seawater environment. The siblings (growing in freshwater) of the best performing fish in seawater, are then identified and used for further selective breeding of the broodstock lines.

NZ King Salmon utilises various controls (e.g. feeding, lights, chilling the fertilised eggs, grading out small fish and selective breeding) to enable staff at the hatchery to regulate the growth and maturation rate of the juvenile salmon. This enables the company to stagger entry of the fish to the net pens and therefore assists NZ King Salmon to produce fish that are consistent and predictable in size, and able to be harvested year round.



SMOLT TRANSFER

Smolt transfer to the net pens occurs on two occasions during the year; in spring (October to December) and again in autumn (April to June). Pursuant to the Freshwater Fish Farming Regulations, a Fish Transfer Authorisation is obtained prior to transfer of the smolt.

Pumps at the hatchery are used to pass the smolt through an electronic counter to custom-made insulated tanks on truck and trailer units, which are fitted with an aeration system and supplied with oxygen. Oxygen levels are monitored and computer controlled in the tanks. The units are fitted with a top opening for loading, and chutes at the bottom for release.

Following arrival at either Picton or Havelock, the truck and trailer units are loaded onto a barge and taken to the sea pens, a journey which can take up to four hours. During this journey seawater from a deck hose is flushed through the tanks to help the smolt acclimatise to the seawater growing environment. Once the truck and trailer units arrive at the farm, the smolt are discharged directly into the seawater.

To ensure year round market supply, New Zealand King Salmon operate different strategies of selectively bred fish which, along with the environmental characteristics of each farm site, determine where the final destination of the smolt will be.

SEAFARM OVERVIEW

This description applies to New Zealand King Salmon's existing and proposed farms.

As at June 2016 New Zealand King Salmon is farming eight of the eleven currently consented farms in Marlborough, to on-grow the fish from smolt (~50-200g) to a harvestable size of approximately 4kg, in which one of the eight is currently fallowed.

While each sea farm has its own environmental characteristics, the seven operational farms plus one currently fallowed but to be restocked in 2017 are currently managed as one integrated system, rather than independent production units.

New Zealand King Salmon farms can be categorised as:

- Higher flow sites with cooler water temperatures located in Tory Channel (Clay Point, Ngamahau and Te Pangu).
- Higher flow warmer water temperatures (Waitata and Kopaua)
- Lower flow sites with warmer water temperatures (Crail Bay, Waihinau, Otanerau, Ruakaka and Forsyth)

Salmon are distributed between these sites according to the site characteristics in terms of water flows, temperature profiles, smolt growth strategy and forecast harvest requirements. Generally the cool water sites in Tory Channel receive smolt in spring, while the warmer sites receive smolt during the autumn transfer period.

Fish are transferred between sites by counting them across from the grower nets at the farm they are being transferred from, into another net pen that is moored alongside the farm. That net pen unit is then very carefully towed by tug using tidal flows to propel them to the new site.

Each component of New Zealand King Salmon's farm management strategies, processes and techniques has been tried and tested over the years. New Zealand King Salmon has comprehensive operating and training manuals and management plans which are regularly updated.

Since the early development of the industry in New Zealand, salmon farming technology and processes have evolved and New Zealand King Salmon has a wealth of institutional knowledge gained over many years of first-hand experience in the marine environment. However, many challenges have arisen along the way, and acknowledgment of these challenges and taking actions to implement a satisfactory response is one of the reasons why NZ King Salmon is the successful company it is today.

OUR SEAFARM SITES

Until recently, we operated five seafarms based in the Marlborough Sounds. In December 2014 three new consents were issued, each with a 35 year term, and we recently harvested the first of these seafarms, Waitata, in July 2016. Unlike some of the existing seafarms (which are converted mussel farms), the new consents are for sites that were selected specifically for King salmon production, with characteristics (such as higher water currents) that will provide better production and environmental outcomes. We expect these new consents will enable us to approximately double existing production over time.

The map opposite shows the location of New Zealand King Salmon's seafarms and the table below provides key information on each seafarm. In the past we have successfully renewed all consents. The consent for our largest existing seafarm, Te Pangu, was successfully extended in January 2016 for a further 20 years to 2036.

SEAFARM	LOCATION	MAXIMUM SURFACE STRUCTURE AREA (HA)	MAXIMUM FEED DISCHARGE [1] (MT / P.A.)	CONSENT EXPIRY
Existing Seafarms				
Te Pangu	Tory Channel	1.5	6,000	2036
Clay Point	Tory Channel	2.0	4,000	2024
Otanerau Bay	Queen Charlotte Sound	2.0	4,000	2024
Ruakaka Bay	Queen Charlotte Sound	2.0	4,000	2021
Waihinau Bay	Pelorus Sound	2.0	3,000	2024
Forsyth Bay	Pelorus Sound	2.0	4,000	2024
Crail Bay x 2	Pelorus Sound	Not in use – currently fallowed		2024
New Seafarms				
Waitata	Pelorus Sound	1.5	3,000 (current), 6,000 (maximum eventual limit)	2049
Ngamahau	Tory Channel	1.5	1,500 (current), 4,000 (maximum eventual limit)	2049
Kopāua	Pelorus Sound	1.5	1,500 (current), 4,000 (maximum eventual limit)	2049

Notes to table and map:

[1] New Zealand King Salmon will often choose to farm well within the maximum consent limits, particularly at low flow sites.

MAP OF OUR SEAFARMS (Marlborough Sounds)

Data Sources:
Topographical Map sourced from LINZ. Crown Copyright Reserved

RUAKAKA FARM

The Ruakaka Bay farm, in Queen Charlotte Sound was established in 1985 as a small research based, approx. 0.5 ha farm by the South Island Salmon Partnership (the precursor to Regal Salmon). It is located on the site of the first registered mussel farm in New Zealand and still retains Marine Farm Licence 1 (MFL1) status. The site, the oldest of New Zealand King Salmon's farms, is characterised by water depths of around 35m and low current flows (average mid-water current speed of 3.7 cm/s). Over an annual period, water temperatures at this site generally range from ~11-18°C (however can peak at up to 20°C). Salmon are raised in 20 steel net pens (20mx20m) and the site currently produces approximately 1,000mt of salmon per annum.

OTANERAU FARM

Prior to considering Tory Channel as a safe place to locate salmon net pens, Regal Salmon obtained a salmon farming permit in Otanerau Bay, the southern extension of East Bay in the north of Arapawa Island. The site, which was developed late 1989, is adjacent to mussel farms and the two industries have been compatible since that time. Water depth at this site ranges from 37m-39m and current flows are characterised as 'low' (average mid-water current speed of 6 cm/s). Water temperature generally ranges from ~11.5-18°C (but can exceed 18°C for an extended period), but due to the consistently higher warmer temperatures in summer at this site, salmon are only grown here for nine months of the year (April to January). In 2009, Otanerau was significantly reduced in size with a number of net pens removed from the farm and shifted to other NZ King Salmon sites. Currently Otanerau has an annual harvest of ~800mt of salmon which are grown in 12, 20mx20m steel net pens at this site.

WAIHINAU FARM

The Waihinau farm was originally located in Hallam Cove, the then owners Newhaven Salmon Company moved to the cooler waters of Waihinau Bay in 1989-90. Newly formed Southern Ocean Seafoods Ltd took over the site in 1990. Water depth at the site ranges from 28m-30m, and water flow is categorised as 'low' to 'moderate' (average mid-water current speed of 8.4 cm/s). Currently the Waihinau Bay farm site is fallow with anticipated use as a smolt farm in 2017. Over an annual period, water temperature generally ranges from ~12-17.5°C (but can exceed 18°C for an extended period).

FORSYTH BAY FARM

The farm at Forsyth Bay was originally a mussel farm and was developed by Southern Ocean Seafoods in 1994. Water depths at the site are around 35m and as with Ruakaka, current flows are classified as 'low' (average mid-water current speed of 3.1 cm/s) and average water temperatures range from ~12-17.5°C. (but can exceed 18°C for an extended period).

THE CRAIL BAY SITES

These sites are located in water depths ranging from 19m-31m, and with low mid-water current flows ranging from 2.5-3.5cm/s and water temperature ranging from 11-20°C. The more northern site (Li48) currently is fallow. The southern site (Li32) has mussel lines only.

The Crail Bay sites are seen to have been of transitional assistance to the company as they are suboptimal in terms of production ability.

TE PANGU FARM

In their search to find deeper sites and cooler water temperatures Regal Salmon obtained a permit to farm salmon in the cooler, high current flow Te Pangu Bay site (Tory Channel) in the early 1990's. The motivation behind this was to reduce the mortality of smolt during spring, which at times could reach 50% if the spring water temperature rose in conjunction with the smolt introduction into the seawater. At Te Pangu this phenomenon did not occur because of the cooler oceanic water in Tory Channel. In 2009 New Zealand King Salmon significantly upgraded the farm, installing larger net pens, much improved mooring systems, new barge facilities and a number of other innovations including modern feeding systems, net cleaning technology and mooring line tension monitoring. Water depth at this site ranges from 27m-31m, and current flows are characterised as 'high' (average mid-water current 15 cm/s). Water temperatures generally ranging from ~11.5–16.5 °C. Currently there are 12, 25mx25m and six 30mx30m steel net pens at this site, producing approximately 2,000mt of salmon per annum.

CLAY POINT FARM

Following the success of the Te Pangu farm, New Zealand King Salmon sought further suitable areas within Tory Channel to establish farms. In the initial years, development at the Clay Point site was limited because of restructuring and the challenges posed by such a deep and fast moving water force. The farm was eventually officially opened in 2007, operating under a marine farm licence shared with local Iwi Te Atiawa Manawhenua Ki Te Tau Ihu Trust. This site is located in water depths ranging from 30m-40m and it has the highest water velocities of all of New Zealand King Salmon's farms with average mid-water flows of 19.6 cm/s. The high water flows, and cooler water temperatures (~10.5-16.5°C) compared to farms in Pelorus and Queen Charlotte Sounds make this site ideal for growing salmon. Currently there are twelve, 30mx30m steel growing sea pens at this site which produce 2000mt of salmon per annum.

NEW EPA SITES

New Zealand King Salmon obtained three new sites as a result of an EPA appointed BOI process and subsequent challenges in the High and Supreme Courts. Nine sites including one that had been granted a consent were applied for. Four were granted by the BoI and the decision upheld by the High Court. However appeal to the Supreme court on one of the sites (Papatua) overturned the decision resulting in only three sites being approved.

NGAMAHAU FARM

The Ngamahau farm was commissioned in October 2015 and currently consists of three 40mx40m net pens, a feed and accommodation barge and total maximum discharge of 4,000mt, initially 1,500mt per annum with potential 3 yearly increases of 500mt . The water depth ranges between 25m-35m. The flows are high with average mid-water current flows of 22 cm/sec and water temperatures ranging between 10.5-16.5°C. Harvest of approximately 700mt is expected later in 2016.

WAITATA FARM

The Waitata farm was commissioned on site in January 2016 and currently consists of four 40mX40m net pens, a feed and accommodation barge and total maximum feed discharge of 6000mt, initially 3,000mt per annum with potential 3 yearly increases of 1000mt. The water depth ranges between 30m-60m. The flows are high with average mid-water current flows of 19-21 cm/s and water temperatures ranging between ~12-18.0°C. The first harvest was in July 2016 of 625mt.

KOPĀUA

The Kopāua (Richmond) farm was placed on site in April 2016 and currently consists of two 40mX40m net pens, a feed and accommodation barge and total maximum feed discharge of 4,000mt, initially 1,500mt per annum with potential 3 yearly increases of 500mt. The water depth ranges between 30m-52m. The flows are high with average mid-water current flows of 13-24 cm/s and water temperatures ranging between ~12-18.0°C. The first smolt were introduced to the farm in May/June 2016, with a harvest of approximately 700mt expected in 2017.

SOCIALLY RESPONSIBLE CORPORATE

In recent years New Zealand King Salmon has increased participation in environmental based initiatives in the Marlborough region as this fits well with the New Zealand King Salmon sustainability ethos. For example New Zealand King Salmon supports a range of programmes in conjunction with Marlborough Department of Conservation, the Link Pathway connecting Picton with Havelock, the Marlborough Sounds Restoration Trust wilding pine project, the Kaipupu Point Sounds Wildlife Sanctuary, the Paper4Trees schools recycling programme and the Nelmac Garden Marlborough festival.

New Zealand King Salmon supports a range of educational institutions including the Aquaculture Unit at Queen Charlotte College in Picton, the 1st XV rugby team at Marlborough Boys College, annual scholarships for aquaculture students at NMIT (Nelson Marlborough Institute of Technology), and the KiwiCan programme run by the Graeme Dingle Foundation at Picton School. Upcoming support includes a comprehensive education resource for Marlborough schools, which will also be online for global access, as well as a range of support for Marlborough Girls College.

New Zealand King Salmon also supports numerous community events, normally with product for functions and fundraising. Some examples of events and organisations that the company supports are: Nelson/Marlborough Rescue Helicopter, the Waikawa Boating Club; Queen Charlotte Yacht Club Sailing Regatta, Marlborough Book Festival, Picton Maritime Festival, Marina 2 Marina annual Picton run, Havelock Mussel Festival, The Grape Ride, the conservation tent at the Marlborough A&P Show.

For the past three years New Zealand King Salmon has run the popular 'Sounds, Salmon & Songbird' cruises in conjunction with Marlborough Tour Company and Kaipupu Point Sanctuary, to enable locals to visit a salmon farm and experience the Marlborough Sounds at an accessible price point.

New Zealand King Salmon is a strategic partner of Destination Marlborough, with a view to driving the visitor economy and the region's international reputation through the promotion of local food and beverage products and experiences. The company is regularly contacted by Destination Marlborough, other tourism groups, such as Tourism New Zealand, and food and beverage partners, to undertake promotional tours with visiting television programme makers and other VIPs who visit the region. Participating in these promotional activities allows New Zealand King Salmon to assist with lifting the profile of Marlborough within New Zealand and overseas. For example, in late 2015, company staff participated in the filming of a number of television programme shoots that were screened in New Zealand and overseas.

New Zealand King Salmon gets involved in Marlborough business networks including sponsoring the environmental section of the Marlborough Chamber of Commerce annual awards. Support is also given to the Marlborough chapter of the Institute of Directors to deliver a series of speaker events to the business community.

New Zealand King Salmon has also recently joined the Sustainable Business Network (SBN), a national organisation helping businesses succeed through becoming more sustainable and delivering benefits to communities, employees and our natural environment as well as shareholders – profit fit for the 21st century.

BARGES & MOORING SYSTEMS

BARGES

Barges are used instead of boats as they provide a good stable working platform, allow more effective use of the deck area, are more cost effective and can be custom made in accordance with NZ King Salmon specifications.

A standard barge comprises a floating two storey building attached to the farm structures. The lower floor consists of the large feed storage area, feeding equipment, a workshop, freshwater holding tank, shower, diesel storage and generator room. The upper level houses the offices, including a feeding station where the feeding process is closely monitored; a staff kitchen area, shift worker bedrooms, shower and toilet. It is proposed that a non standard low profile (<3m) "circular appearance" barge containing feed storage and feed distribution equipment is located on the proposed mid Waitata Reach site. Feeding will be controlled remotely.

The three farms granted through the EPA process have an on-site barge that must be built with a nautical-style design.

The farm staff usually communicate via cellphones, but each farm also has an alternate source of communication, including Wifi.

Freshwater is delivered to the farm holding tanks on a delivery barge.

The discharge of up to 500m3 of grey water, (from showers and other personal hygiene uses, food preparation and clothes washing) is a permitted activity in the Marlborough Sounds, under the Marlborough Sounds Resource Management Plan (Rule 35.1.2.8). As at 2016, the discharge of grey water from New Zealand King Salmon farms remains well below 500 m3 per day.

Black water or sewage is contained in tanks on the barge, and regularly collected by Marlborough Waste Collection on the servicing barge.

Diesel is also contained on the barge in large under floor tanks. This supplies the fuel to run the feeding equipment and domestic requirements.

MOORING SYSTEMS

While typically the net pens and barge on a salmon farm will only occupy 1-1.5 ha of surface area, the farm moorings do not lie directly beneath the net pens. Ensuring the structural integrity of the farm, means that the moorings (with mooring lines attached) need to be located a sufficient distance from the structures so as to provide adequate tension to hold the farm securely in place. This is the reason why salmon farm consents are typically for an area approximately 10-times greater than the area covered by the surface structures alone.

There are a number of different types of net pen anchoring systems available to salmon farmers. Screw anchors (auger type steel anchors) are now used routinely as a secure and proven means of mooring salmon farms.

Each farm mooring line and mooring layout is designed by a qualified engineer. An agreed mooring maintenance programme forms part of the consent conditions and operating policy of each farm. Tension measuring devices, known as load cells, are fitted to the chain and used to monitor and manage the mooring systems to ensure safe working loads are maintained at all times.

NETS

NETS PENS

Currently, most New Zealand King Salmon's fish are grown using steel pens of a range of different sizes from 42 x 42m with 20x20m nets, to single structures of approximately 125m x 65m with 30x30m nets. Older pens comprise of a floating structure, which consists of a perimeter of spirally welded steel pipe (up to 1m diameter), with an internal surface area that is divided into sections using the same steel pipe.

More recent pens at Waitata and Kopāua use a multi hinged steel frame supported by plastic floats (Wavemaster). It is anticipated that the Wavemaster style of pens will be used should there be suitable space available in areas that are less exposed.

The grower nets are made of nylon, and the mesh size varies from 12.5 to 35mm on the bar (knot to knot). New Zealand King Salmon has utilised various mesh size options in the past and experience has shown the best mesh size to use. In order to contain the smolt when they are first introduced to the net pen, a smaller mesh size is required, however smaller mesh constrains water flow and enhances biofouling. To reduce the effects of biofouling and maintain water circulation, which replenishes dissolved oxygen levels and assists with waste removal from the net pen, it is important to move the fish to grower nets with a larger mesh size as soon as possible.

Typically the steel net pens will have a walkway attached to the top of the structure, with associated handrails attached to the walkway. At some of the existing farms there is also a suspended walkway across the centre of the pen.

Small older circular plastic net pens were used at the Crail Bay farms. Recent industry trends show that larger plastic pens of up to 240m circumference (approx 76m diameter) are prefered; for these net pens. Welded HDPE pipe provides the flotation. Circular plastic pens are very commonly used overseas. It is proposed that in future this type of net pen will be used at more open sites where fetch or landscape issues require either a more flexible (to cope with wave action) or less visible structure.The pens are low profile and the dark colour blends well in to the surrounding environment. There are no interconnecting walkways and where serious landscape issues may prevent locating a stationary barge on site the pens may be serviced by boat or motorised barge. This is not an option that New Zealand King salmon prefers as it creates a relatively inefficient and costly feeding scenario that requires daily vessel visits.

BIRD NETS

Salmon farms tend to be attractive structures for birds; fish feed is appealing to gulls and a range of shags species use the net pens for drying and roosting.

On occasion for no apparent reason large numbers of gulls may decide to roost on a salmon farm for a period of days then equally without apparent reason leave. We suspect this may have something to do with storm conditions and the birds are using the farm as a safe haven.

Bird access to feed and/or smolt has been an issue in the past. Acoustic orchard bird scarers were trialled over a decade ago on the farms, however they were found to attract, rather than deter, seabirds. A gas cannon similar to those used on orchards was also trialled, but was determined to be ineffective as the birds became used to it.

Overhead nets exclude birds from the net pen structure. The black polyethylene bird nets are still under development, as while generally effective, birds are still observed over the farm.

New Zealand King Salmon has undertaken mesh size trials to determine the best option for the bird nets and as a result of these trials; the 47.5 mm has been determined to be the most effective mesh size.

In addition to the use of bird netting, New Zealand King Salmon has a seabird policy in place. In order to minimise the attraction of seabirds to the farm sites, all salmon feed held on the farms must be covered. Floating dead fish are collected as soon as they are noticed, and the mortality bins are covered at all times.

PREDATOR NETS

A range of predator netting configurations have been trialled by New Zealand King Salmon over the years, including predator nets around the farm. The preferred predator net system currently utilised by New Zealand King Salmon, is a combination nylon/ polyethylene net that surrounds the whole farm structure. This net extends for over 2m above the water and acts as a deterrent to both seals and sharks.This type of exclusion net was first installed on company farms in 2000.

While seals are still a common sight around the edge of the predator nets, and very occasionally they manage to obtain a reward for their attention, predator nets are by far the most effective method of excluding seals and other predators. They have the added advantage of distancing the fish from predators, thereby reducing stress in the fish.

The grower and predator nets are cleaned in-water by remotely controlled pressure washing systems. This ensures fouling does not restrict the flow of water through the nets nor allow mussel biomass to exceed the flotation capacity of the net pen structures.

Although New Zealand King Salmon currently holds a coastal permit that provides for the use of antifouling paints, apart from a trial at the Te Pangu farm, it does not use antifouling paint on its nets and has not done so since 2011. The coastal permit requires that annual monitoring be undertaken to determine the effects of any discharge of the anti-fouling paint on the seabed and benthic community composition, particularly in relation to copper.

MARINE MAMMALS

The New Zealand fur seal should not be under-estimated in terms of their intelligence. They are observant and very able to assess opportunities and take advantage of any compromise in predator defence systems on salmon farms. Seals are protected under the Marine Mammal Protection Act 1978, administered by the Department of Conservation (DoC).

New Zealand King Salmon has worked with DoC for a number of years in order to come up with the best solution for seal interaction. Trials have included attempts to transport the tagged seals to another colony in Kaikoura, or the South Island West Coast, however these same animals were usually back to the Marlborough Sounds (and place of capture) within a few days of being released.

New Zealand King Salmon has a permit from DoC which allows seals entering the net pens to be caught and released. The permit also allows farm staff to deter seals from entering the net pens. The killing of any seal is not permitted.

New Zealand King Salmon also has a specific Marine Mammals and Sharks Policy in conjunction with DoC, which, in addition to providing guidelines for the handling of seals that do enter the farm, aims to minimise the risk of seal entry to farms.

The seal policy includes recording and reporting seal activity around the farm to company management and DoC (Picton office). Inspection dives and video observations made while in water net cleaning can assist in locating seal access points. Seals inside the farm predator net generally indicate a hole in the net that requires location and repair.

NET CLEANING

In order to achieve maximum growth rates, farmed salmon require clean water which contains high levels of dissolved oxygen, and low levels of contamination. Any restrictions to the water flow through the netting results in less water flowing through the net, this in turn has a negative impact on dissolved oxygen and waste levels in the net pens.

Unfortunately, salmon nets suspended in the marine environment provide an ideal growing structure for small marine organisms (e.g. algae, barnacles, tubeworms, hydroids, mussels etc) which are collectively referred to as biofouling. This biofouling not only reduces water flow, but also makes the nets heavy, which means they are difficult to handle, adds additional strain to the mooring and floatation structures and cause wear and tear on the equipment, net pen structures and the net mesh. In order to prevent this, regular net cleaning is a critical and significant part of New Zealand King Salmon's operations.

The grower nets are not treated with antifouling products so need to be cleaned approximately once a month, especially during the summer months. The older 20m x 20m grower nets are cleaned when there are no fish in the pen; this is generally done by having one empty pen for every seven pens in use, which means that the fish can be rotated around the eight net pens to allow cleaning to occur. At the older farms the nets are spread and lifted above the water so that they can be walked over and water-blasted clean. Nets are then left to dry to ensure that all biofouling organisms have died. A shower of rain or freshwater further assists with killing off biofouling.

NZ King Salmon has developed an automated net cleaner and uses off the shelf remotely controlled equipment which cleans the grower nets in the water (in-situ). These cleaners use high pressure water directed through rotating discs. The 'head' which contains the discs slides up and down the sides of the net and blasts off the fouling organisms. The cleaning heads of the remotely controlled machines are controlled using feedback gained from in-water cameras. Not only is the in situ cleaning much quicker, it also reduces farm noise by minimising the use of water blasting equipment. In situ net cleaning is carried out with fish in the net pen.

Predator nets are cleaned in water on a required basis to keep fouling to a minimum.

The predator nets are no longer treated with a copper-based antifouling paint (apart from a trial on the Te Pangu farm). When due for a change out these nets are brought to the surface and crushed through a mussel crusher to remove the larger biofouling organisms which settle on the net over time. They are then taken to the land-based facility to dry out and the remaining biofouling is removed.

Discharges from net cleaning activities are covered by resource consent which allows NZ King Salmon to discharge biofouling organisms and copper based anti-fouling from nets and structures. Copper levels under the farms are independantly monitored and reported on annually.

New Zealand King Salmon uses the principle of satiation feeding to ensure that the fish are fed an amount that matches their appetite, which varies throughout the salmon life cycle.

SALMON FEED

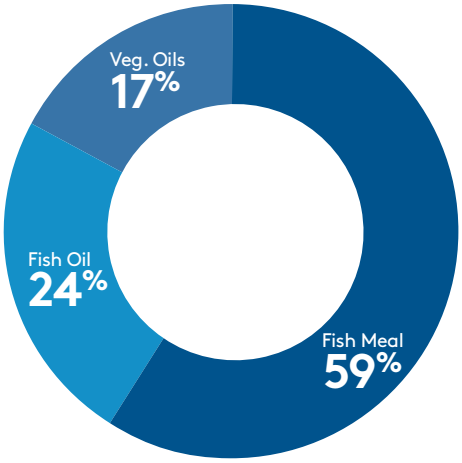
Our most significant cost is feed, which annually accounts for ~40% of all cash expenses. Historically, the two most important ingredients in fish feed have been fish meal and fish oil, however, through time the use of these ingredients has been reduced and replaced by agricultural products and poultry by-products. The Global Salmon Initiative, a global salmon industry body of which New Zealand King Salmon is a member, is focused on continuing to reduce the use of fish meal and oil in salmon feed.

We seek to replicate a wild salmon diet while ensuring the feed we use contains a range of key nutrients, vitamins and trace elements beneficial for salmon growth and human consumption.

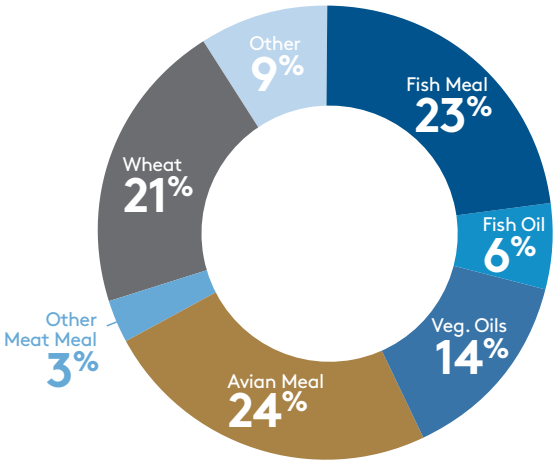
No feed company offers a feed composition developed specifically for King salmon and accordingly we have invested in feed development initiatives. We continue to undertake and commission research and work with our suppliers to further understand and refine feed composition to optimise FCR. For example, we are currently working with private science providers and the Government to conduct a four year study into King salmon nutrition that is expected to conclude at the end of 2018.

Feeding the salmon is one of the most important operations on a salmon farm, with the main objective being to achieve maximum growth of the salmon while minimising feed wastage and ensuring all nutritional requirements of the salmon are met.

Global salmon aquaculture – components of feed (1990)[12]



New Zealand King Salmon – components of feed (Current)

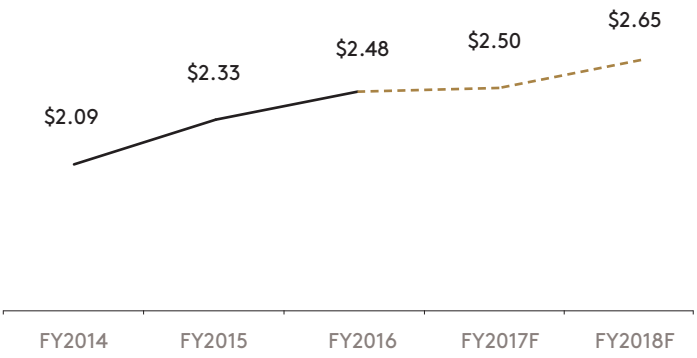


Percentages are approximate and based on our most commonly used feed type.

[12] Source: Marine Harvest – Salmon Industry Handbook 2016.

Feed is made by a range of international manufacturers, and we endeavour to source our feed from multiple manufacturers to enable robust performance benchmarking and ensure adequate price tension. We target a balanced spread of suppliers at any point in time, however from time to time there may be transition periods which result in greater concentration with a supplier or suppliers for a period during transition. We are currently in such a transition period, but expect to return to the targeted mix across a range of suppliers within the Prospective Period. The chart below shows that feed prices, in New Zealand dollars per kilogram, weighted across all feed types have increased in recent years, primarily due to changes in feed composition (particularly between FY2014 and FY2015), foreign exchange rates and inflation in the costs of the underlying feed components, and are expected to continue to increase for similar reasons.

Weighted average feed cost (NZ$ / kg)



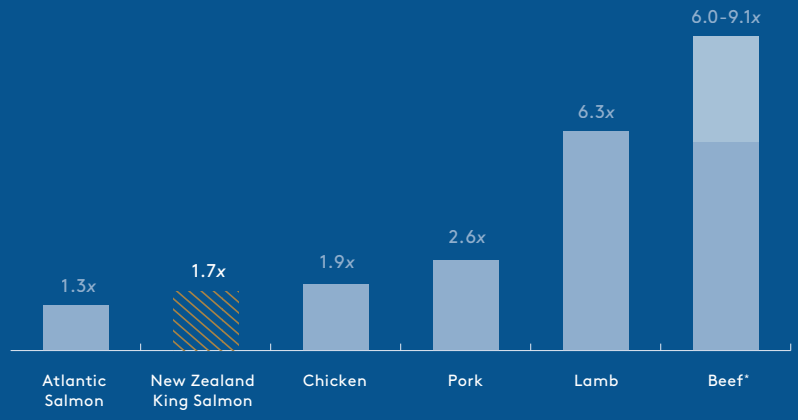
SUSTAINABILITY AND ENVIRONMENTAL IMPACT

Farmed salmon are an efficient form of protein production relative to other animal protein alternatives. Salmon are efficient to farm because they are cold-blooded and virtually weightless in water. Feed conversion ratio (FCR) measures the efficiency of different protein production methods, calculated as the mass (in kilograms) of feed needed to increase the animal's bodyweight by one kilogram. The lower the FCR, the more efficiently feed is being converted to live weight.

With increasing global protein consumption, it makes sense for producers and consumers to focus on efficient conversion of feed to live weight to meet the growing demand for food.

Our average FCR over the last five years of 1.7x outperforms land based animal farming alternatives such as pork, sheep and beef. However, the King salmon species has a less efficient FCR than Atlantic salmon, in part due to its higher fat content. The components of New Zealand King Salmon's feed have evolved over time. In 1990, fish meal and fish oil comprised 83% of global salmon aquaculture feed. Our feed currently comprises only 31% of these components, with the remainder substituted by vegetable and land-based animal by-products.

Feed conversion ratio of farmed animal protein production[8]



*The FCR of beef production has a range due to the varying types of feed used.

Salmon farming generally benchmarks favourably against its animal protein alternatives on most sustainability metrics, with the lowest arable land and irrigation water requirements of the farmed animal protein producers, and lower carbon footprint.

HISTORY OF FEED

Types of feed for farmed salmon have evolved markedly over the years, as described in the following paragraphs.

The first manufactured food in the salmon industry were steam pressed pellets. These pellets contained dry, ground materials (e.g. fishmeal, flour) that are processed through a pellet press, with steam applied. Some oils can also be incorporated into the pellets, and the resulting pellet is dry (<10% moisture) and shelf stable. However this technology struggles to deliver pellets containing more than 12% oil and typically results in 5% chip and dust (which fish do not eat). FCR's of 2 to 3 were common in the NZ industry on steam pressed pellets. Those diets continued to contain mostly fishmeal and fish oil.

In the 1990's extruded pellets became available. Increasing the oil content (and thus energy content) of diets greatly improves the efficiency of which protein is used in the diets. This was the key motivation for the global shift to extruded pellets. By the mid to late 1990's these were common in New Zealand and today are used almost exclusively.

Extruded pellets are made using highly technical production lines that incorporate a cooking extruder. Extruded pellets can be made that contain high oil levels – above 40% oil is possible. Compared to steam pressed pellets, extruded pellets are also durable (little chip and dust, which reduces feed wastage) and have increased nutrient digestibility, due to the increased level of cooking that occurs during production.

Increasing the oil content also allows the protein content of the diet to be reduced. It can be considered that low oil steam-pressed pellets contain "too much" protein per unit of energy, i.e. more protein than the fish need in order to build their own tissue. In this situation the surplus protein is used by the fish for energy. Using protein for energy is costly and increases nitrogen excretion into the environment. The concept of using oil to supply energy to prevent protein being used for energy is known as "protein sparing".

Extruded King salmon diets used in the NZ industry today typically contain 25% oil and 38% protein. While affected by growing conditions and a range of other factors, the industry-wide FCR is currently around 2.0. This is higher than is commonly seen in the Atlantic salmon industry (which has average FCRs of approximately 1.3). This difference is likely primarily due to the following:

- King salmon have higher flesh oil (typically 25% at harvest in the fillet) than Atlantic salmon (17%). Because the tissue of King salmon contains more energy than Atlantic salmon, they require more feed energy to build each kilogram of tissue.
- Atlantic salmon diets are manufactured to contain more energy (>35% oil is common) than King salmon diets (30% oil maximum). This is because King salmon have a different nutritional requirement for protein and energy (oil) than Atlantic salmon.
- Energy partitioning calculations show that the points noted in above account for at least 75% of the difference in FCRs between Atlantic salmon and King salmon.

Despite the higher FCR of King salmon, because they use lower-oil diets and retain more oil in the flesh, the efficiency with which Atlantic salmon and King salmon retain oil and energy is similar.

NUTRITIONAL REQUIREMENTS OF SALMON

King salmon are carnivorous fish, and as such the primary macronutrients in a salmon diet are protein and fat; they have only limited capacity to utilise carbohydrate. Salmon also require a range of micronutrients, for example vitamins C and E, selenium and zinc.

As an anadromous species (born in freshwater but spend the majority of their life in seawater), wild salmon juveniles start feeding in freshwater, on a range of freshwater invertebrates. After salmon migrate to sea, their diet consists mainly of crustaceans (e.g. krill) and small fish.

The diet of salmon in the wild also contains astaxanthin, a carotenoid and strong antioxidant. Astaxanthin gives salmon flesh its pink colour. Salmon cannot synthesise astaxanthin but instead astaxanthin is accumulated from natural sources in the diet, such as krill and other crustaceans. Astaxanthin is required for egg and fry development and for fish health. It is also redistributed when fish sexually mature in order to pigment the skin and protect the oil in their eggs.

The diet of wild salmon in seawater is also high in the long-chain Omega-3 fatty acids DHA and EPA. Salmon have a limited ability to synthesise long-chain Omega-3 in any quantity, so must obtain it from the diet.

SUBSTITUTION OF MARINE RAW MATERIALS IN SALMON FEED

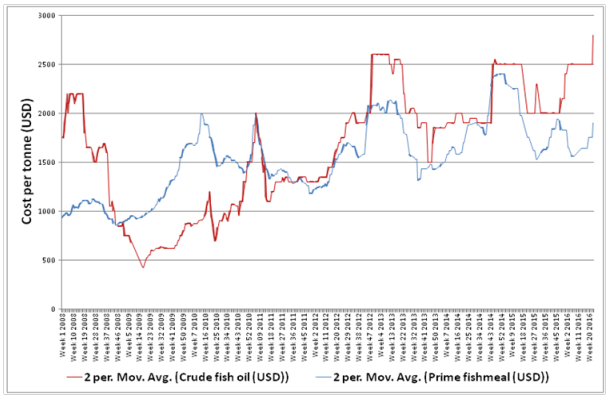
Early diets contained mostly fishmeal and fish oil, which has resulted in the criticism that salmon farming consumes far more fish than it produces.

Two sources supply fishmeal and fish oil for use in salmon diets:

- Reduction fisheries; these are fish specifically caught for fish meal production; and
- Trimmings; these are by-products of fish caught for human consumption.

Skretting Australia supplies over 85% of the feed to the New Zealand salmon farming industry and over 90% of New Zealand King Salmon's feed. Diets supplied by Skretting (and other suppliers) to the New Zealand industry source >80% of the fishmeal used from reduction fisheries (primarily Peruvian anchovy).

There are both economic and environmental drivers to reduce the level of marine raw materials used in salmon feed. While volatile, the long term trend in fishmeal and fish oil prices has shown a steady rise. Aside from absolute price, avoiding the volatility of fishmeal and fish oil prices is also a strong commercial incentive to reduce their use in fish feed.



Index price of fishmeal and fish oil since 1998 (USD per tonne), from Crystal Ocean/Kilpatrick.

Fishmeal prices have risen due to the following:

- Increasing demand from aquaculture, particularly from China;
- Strong demand from agriculture (pig farming, poultry farming) - although currently fishmeal is usually priced out of this market;
- In the case of fish oil, the rise of the nutraceuticals industry (Omega-3 health supplements); on current trends, it is possible by 2020 this industry will consume all the world's production of fish oil;
- Static supply. While the key reduction fisheries are tightly controlled and relatively stable, they are fully exploited. There is no opportunity to increase harvests.

As a result, the major salmon feed producers have invested heavily in research to determine how the use of marine raw materials in fish feeds can be reduced, while still retaining fish health, performance and product quality and flavour. Skretting, for example, currently spends approximately NZ$10m per annum researching this field, including some money spent directly on research into fishmeal and fish oil substitution in King salmon feed for New Zealand King Salmon.

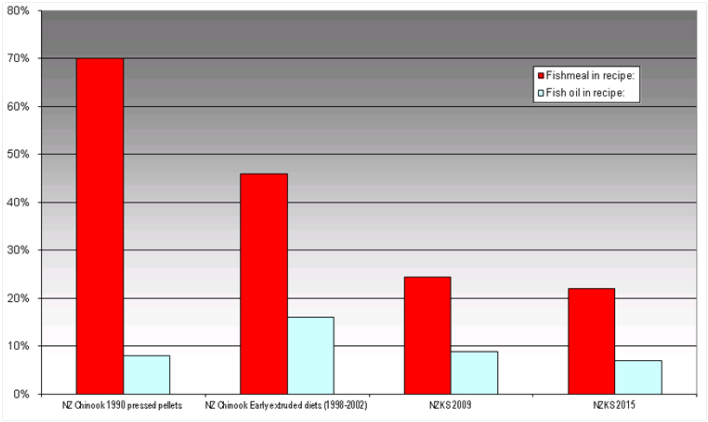
This research has resulted in significant progress. Marine oil has been replaced by other animal or vegetable oils, while marine protein has been replaced by land animal proteins and vegetable proteins. This substitution of products has led to lower cost fish feeds and an improvement in the raw material sustainability of the diets without compromising fish performance and product quality.

A recent advance in knowledge on fishmeal replacement has allowed a further step in fishmeal replacement with no loss in fish performance or product quality. Diets currently supplied to New Zealand King Salmon contain slightly less than 25% fishmeal, in contrast to 1990 diets that contained 70% fishmeal. In addition, the total amount of 1990 diet required per tonne of fish produced was greater than is needed with modern, energy-dense extruded diets. The amount of fishmeal and fish oil used historically and today in New Zealand King salmon diets is shown in below.

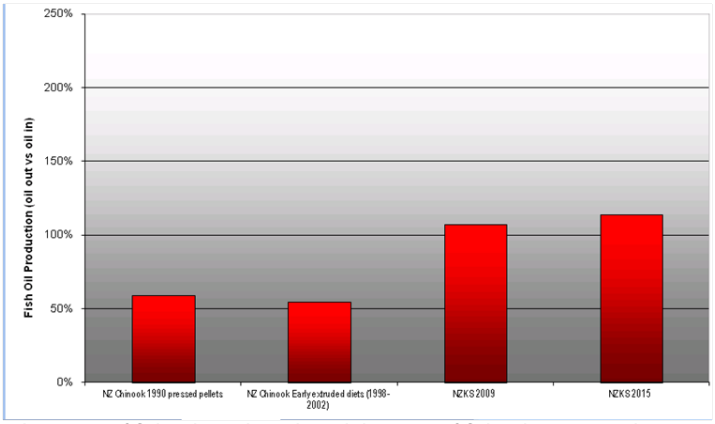
Combining the information from above with industry FCR's and reduction fishery yields of fishmeal and fish oil, allows the calculation of the kilograms of reduction fisheries consumed to produce each kilogram of farmed King salmon. Such calculations are commonly referred to as "FIFO calculations" ("Fish-In / Fish-Out") and the results are shown in below. This is a worst-case scenario, as it does not allow for the use of trimming meals.

It can be seen that the tonnes of marine resources used per tonne of King salmon produced has more than halved over the last 20 years. Currently, for each tonne of New Zealand King Salmon produced, 2.7 tonnes of anchovy is used for fish oil. Because the fishmeal from only 0.8 tonnes of anchovy is required, in addition to the tonne of salmon produced, a surplus of 422kg of fishmeal remains, which can be used for other productive purposes. By comparison, a wild salmon is estimated to require 10-20 kg of wild fish per kg of salmon produced.

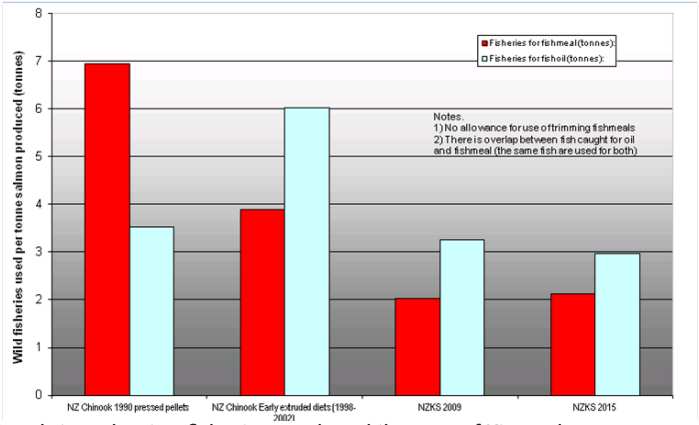
New Zealand King Salmon now produces more fish protein and fish oil than is consumed, and thus is a net producer of fish protein and fish oil. This is in marked contrast to the situation for King salmon production only 10 years ago, when two to three times more fish protein and fish oil was consumed than was produced.



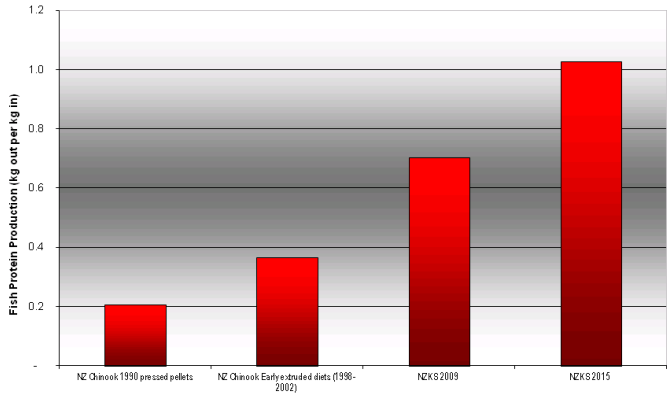
Trends in fishmeal and fish oil used in New Zealand King salmon diets. Amounts shown are weighted averages for whole-of-life production.



Kilograms of fish oil produced per kilogram of fish oil consumed in NZ King Salmon farming, historically and today.



Trends in reduction fisheries used per kilogram of King salmon production (separate requirements for fishmeal and fish oil).



Kilograms of fish protein produced per kilogram of fish protein consumed in NZ King Salmon farming, historically and today.

PROTEIN SOURCES

The proteins contained in fish food are a mixture of fish meal, land animal proteins and vegetable proteins.

It has been determined that fish do not require any particular protein raw material (such as fishmeal) per se, rather they require an appropriate mix of digestible amino acids (the building blocks of protein). The necessary mix of amino acids can be derived from a varied mix of different raw materials. Understanding the amino acid availability from specific raw materials is an important topic of research at fish feed companies.

The choice of protein source varies with cost and availability. Protein in New Zealand diets is typically derived from:

- Fishmeal; primarily Peruvian anchovy;
- Poultry meals (meatmeal, bloodmeal, feathermeal); these rendered products are a by-product of poultry slaughtered for human consumption in Australia. These products are excellent nutritional materials for carnivorous fish.
- Mammalian meals (meatmeal, bloodmeal); these rendered products are a by-product of cattle, sheep and pigs slaughtered for human consumption in Australia. Currently only bloodmeal can include porcine products due to New Zealand import restrictions.
- Plant protein meals; faba bean meal, lupin meal, corn gluten, wheat gluten and soya protein concentrate.

Bovine Spongiform Encephalopathy (BSE) has been raised as a concern around the use of mammalian meals in fish diets. This concern is unwarranted for the following reasons:

- Molecular studies indicate that fish prion proteins (PrP) have low similarity to mammalian PrP's, indicating a high species barrier.

- No transmissible spongiform encephalopathies (TSE's, of which BSE is an example) have been found in any fish species. Scientific committees of the European Union have concluded that there is no evidence of TSE's existing in any wild or farmed fish.
- Transmission studies have found no evidence that TSE agents can replicate or persist in fish, or pass from mammals to fish or from fish to mammals. Comparable studies in susceptible mammalian species readily demonstrate replication and transmission of TSE agents.
- It has been shown that trout do not absorb prions from their intestines and that prions cannot be detected in the tissues of trout that have been experimentally fed high loads of infectious prions.
- All mammalian products fed to fish in New Zealand must derive from only Australia or New Zealand – both of which are regarded by the World Health Organisation as being free from BSE.

Concerns around the presence of antibiotics and banned substances (e.g. growth hormones) in poultry products included in salmon diets have been raised. However these concerns are unwarranted, as poultry by-products used in New Zealand King Salmon diets derive from poultry slaughtered for human consumption in Australia. As such they are subject to strict controls on residues and a comprehensive residue monitoring program. For example, the Australian Government's National Residue Survey (NRS) for 2009-10 tested 330 commercial poultry samples (9570 analyses) and found no residues (including antibiotics) or environmental contaminants above the Limits of Reporting for products for human consumption.

OILS

It was traditionally thought that fish required fish oil in their diet. However research has shown that fish have a digestible fatty acid requirement that can be met from a variety of oil sources. Fish oil is still used extensively in salmon diets, but primarily to introduce long chain Omega-3 fatty acids (mostly EPA and DHA) into the salmon fillet. The fatty acid composition of a salmon fillet is strongly influenced (and to an extent mirrors) the fatty acid composition of the diet. At present fish oil is the only practical source of EPA and DHA.

Fish oil is a by-product of fishmeal production, although due to the rise of the nutraceutical industry it is now considered a particularly valuable commodity in its own right.

Poultry oil, a by-product of poultry slaughtered for human consumption, is used to replace fish oil in New Zealand salmon diets. This poultry oil is sourced from Australian poultry. Poultry oil acts as an energy source for the fish and has the same saturated fat content as fish oil.

The principal reason poultry oil is used in New Zealand is because of price and quality. In both Australasia and North America poultry oil is less expensive than the available vegetable oils. In some parts of the world, especially Europe and also Chile, vegetable oils are used in salmon diets. Neither vegetable oils nor poultry oil contain appreciable levels of EPA and DHA.

The proportion of marine oil used compared with the total oil added to the feed determines the proportion of long-chain Omega-3 expected within the oil in a salmon fillet. As the amount of marine oil used falls, the EPA and DHA in the diet is retained more efficiently; salmon retain Omega-3 more efficiently when there is less in their diet.

Expected long-chain Omega-3 content of King salmon fillets grown on different diet oil blends.

Fish oil as % of total oil added to feed	L-C Omega expected per 100g of fillet, harvest-size fish	Relative to requirement for FSANZ* claim "Good Source of Omega 3"	Fillet needed for Recommended Daily Intake of 500mg L-C omega-3 per day
100%	5000 mg	167 X	10 g
50%	2750 mg	92 X	18 g
30% (Current NZKS Diets)	1500 mg	50 X	33 g

*Food Standards Australia and New Zealand

Fillets remain a very good source of long-chain Omega-3, requiring the consumption of only 33 grams of fillet per day to meet the human recommended daily intake.

CARBOHYDRATE

Carbohydrate in the diet supplies a limited amount of energy to the fish, but in extruded diets is useful as a binding agent (it holds the pellets together).

The sources of carbohydrate used in diets to NZ King Salmon are typically:

- Australian wheat;
- Faba bean meal (which contains both protein and carbohydrate);
- Potato starch.

MICRONUTRIENTS

A number of vitamins and minerals are required to maintain fish health; most are not discussed individually in this document. Research over many decades has identified these requirements, with refinement in understanding continuing today. A vitamin and mineral premix is added to all modern diets, at an inclusion rate below 1%.

To allow salmon to develop normal flesh colour and for fish health, astaxanthin is added to diets at amount of less than 80ppm. Astaxanthin accumulation is a biological requirement of salmon, as demonstrated by the fact that salmon muscle contains binding sites specific to astaxanthin, unlike the muscle of most other fish species. These binding sites cause salmon to capture and store ingested astaxanthin. When astaxanthin is fed to species of fish that lack these binding sites, their flesh remains white. The astaxanthin used is synthesised chemically, but is chemically identical to that which exists in nature.

Zinc is an essential micro-nutrient in salmon diets. Insufficient zinc leads to cataract formation and other fish health problems. Zinc can be supplemented in the diet in two forms – inorganic zinc (for example zinc sulphate) or organic zinc (generally complexed with an amino acid, e.g. zinc methionine). While both can meet the zinc requirements of fish, organic zinc is absorbed much more efficiently by fish than inorganic zinc. The raw materials in the New Zealand King Salmon diet contains about 50-70 ppm zinc. This zinc is associated with calcium and as such is unavailable to the fish and is not considered to be able to meet any of the zinc requirement of the salmon. Currently diets are supplemented with 100ppm inorganic zinc, resulting in a total diet zinc content of about 160ppm.

Dietary zinc has a potential environmental impact because some of the zinc in the feed is excreted and can accumulate in the sediments under and around a fish farm. In August 2011 NZ King Salmon switched to using organic zinc in their feed; this will be supplemented at 37.5ppm, and will reduce the total zinc content in the diet to approximately 95ppm. In addition, use of organic zinc will mean a greater percentage of the zinc remaining in the diet will be absorbed, rather than excreted. The overall result will be much reduced zinc output from the fish into the environment.

Experience of organic zinc at Canadian salmon farms indicates it produces very marked reductions in sediment zinc, compared to the use of inorganic zinc, with improvements of between 40-60% observed. It is expected that similar improvements will be observed at the New Zealand King Salmon farms.

SUSTAINABILITY OF FISH SPECIES USED FOR MARINE OIL AND MARINE PROTEIN

Reduction fishery species are often small, bony and not favoured (or readily caught and processed) for direct human consumption. Species caught in reduction fisheries (such as Peruvian anchovy) are generally fast-growing and short-lived. As a result they are considered generally resilient to fishing pressure.

However reduction fisheries can be over-fished. The Peruvian anchovy fishery, from which most New Zealand King Salmon fishmeal and fish oil currently derives, was increasingly over-fished through the 1960's and effectively collapsed in the early 1970's. It did not show significant recovery until the 1990's, when strict controls supported by research were introduced.

Since the 1990's the fishery has shown generally stable biomass despite natural environmental swings (particularly due to El Niño). Government authorities apply tight monitoring and control to this fishery, regularly restricting or halting fishing when biomass surveys indicate this is necessary.

ABSENCE OF GMOs, ANTIBIOTICS, MERCURY, POP'S

Feed supplied to New Zealand King Salmon does not contain genetically modified organisms (GMOs) according to legislation in the EU, Japan and Norway.

Under Australian and New Zealand regulations the feed is deemed "GMO DNA-free". While the feed contains no GM organisms, some of the vitamins included as micro-additions have been manufactured by GM organisms. The organisms themselves are not present in the feed.

Unwanted contaminants, or residues (e.g. heavy metals, antibiotics, persistent organic pollutants (POPs, such as dioxin)) can potentially enter feed primarily through raw materials. To control the risk from residues, feed companies operate a comprehensive residue monitoring program. Skretting for example has the following contaminant residue monitoring programme in place:

- Consists of global analysis (shared results tested at specially selected overseas laboratories) and local analysis (additional tests chosen by Skretting).
- The global tests are decided each year by Nutreco's Food Safety specialists (Nutreco is Skretting's parent company) who have an understanding of which contaminants are the most important scientifically, politically and socially.
- Skretting tests many samples of feed and raw materials for a profile of residues each year. Hundreds of results are collected each year mainly focussed on heavy metals, antioxidants, dioxins, polychlorinated biphenyls (PCB's), nitrosamines and pesticides.
- EU limits are applied to all tests, as these are the most thorough and stringent.

Results from these monitoring programmes enable feed companies to purchase their raw materials from low risk regions and suppliers, and to obtain a thorough understanding of food safety risk in the aquaculture industry around the world.

Skretting publishes a Residue Report biannually, which is available to customers on request. These monitoring systems have shown residues in all Skretting feed to be far below all FDA, EU and Australian limits.

As with terrestrial agriculture, antibiotics may be applied in aquaculture to control disease. In the rare case that they may be used in aquaculture, they can be administered either via feed or injection. Under New Zealand law, they can only be included when prescribed by a veterinarian and will require consent if added to the food.

Due to the lack of salmon diseases in New Zealand coastal waters, antibiotics are not required in the New Zealand salmon industry, and as such, Skretting has never supplied salmon diets that contain antibiotics to any New Zealand customer. However, it should be recognised that although this is the current enviable situation for New Zealand salmon farmers, there may be a requirement to use an animal remedy at some point in the future. Management of this use will be under the Agricultural Compounds and Veterinary Medicines Act 1997, and the Hazardous Substances and New Organisms (HSNO) Act 1996.

Similarly, there is no need for lice treatments or anthelmintics (also sometimes supplied via feed) in the New Zealand salmon industry, and such products have never been used in commercial production. However, if the need arose, antibiotics, lice treatments, anthelmintics or other animal remedies could be added to the feed.

FEED AND FAECES

The majority of benthic nutrient enrichment around a well-managed salmon farm derives from faeces excreted by the salmon. With poor feed management , uneaten feed pellets can also contribute to benthic enrichment. Poor feed raw materials and production processes can also affect digestibility and thus contribute to benthic effects. Old-fashioned steam-pressed pellets resulted in the release of uneaten chip and dust to the seabed. Modern farms that use waste feed detection systems (such as feeding cameras) when feeding extruded diets, avoid most uneaten pellet loss.

There is some scope to influence the release of faecal nutrients into the environment by manipulating feed composition. Switching to higher-energy diets could potentially reduce faecal dry matter output by 20% or greater. This is likely to be the subject of research in the next few years. It is expected that, for New Zealand King Salmon's current feed range, about 20% of the dry matter consumed is excreted as faeces.

Technology is already being applied to manipulate the physical properties of fish faeces for some applications (e.g. hatchery systems). This could potentially be used to assist faeces to disperse from around seafarms, diluting them, or to concentrate faeces directly under farms to limit the size of effect footprints (or to assist collection). Such manipulation will require further research before commercial application in a seafarm setting.

FEEDING THE SALMON

Salmon feeding behaviour is complex, and the appetite of the fish varies over time, in addition they feed to a depth of at least 7-10m making feeding behaviour difficult to monitor from the surface. There are two key parts to New Zealand King Salmon's feeding system; the feed delivery equipment which delivers the food to the net pens, and the feed monitoring equipment which monitors feed consumption and pellet wastage.

On New Zealand King Salmon farms 'spinner' and 'Akva' systems are used to deliver the feed. These systems have been developed to minimise feed wastage and maximize salmon satiation. They ensure adequate distribution of the pellets in the net pen to enable every fish to have access to them.

Feed pellets are delivered to the farm in large bags (~1mt) and stored in the barge until required. Newer barges such as that currently at the Waitata farm have hoppers into which the feed is placed on delivery. On the older barges bags are stacked in the storage area then emptied into a hopper or feed silo as required and the feed is either delivered to the net pens via a mobile hopper (older spinner system), or propelled from the feed silos in the barge through pipes by air to the individual net pens (Akva system). The newer barges use the Akva blower system.

An older spinner system is used at Ruakaka. Feed is delivered to the spinners via transportable hoppers. Pellets are fed into the system from these transportable hoppers suspended above each net pen; the pellets fall into a motorised spinning disk that spins them out via a restriction plate (to control the rate of feed delivery) over a wide area of the net pen.

Salmon feeding systems; (a) transportable hopper; (b) spinning disk; (c) Aquasmart buoy and feeder; (d) AKVA camera.

The Akva system, used at most sites, is used as a means to move feed pellets which have been emptied into the feed silos in the barge.

The feed is transported in plastic (HDPE) pipes using airflow to the appropriate net pen where it is spread around using a roto-spreader which is attached to the end of the feed pipe in the net pen. The rate and quantity of feed delivered to the net pens is controlled using the AkvaSmart computer programme . An underwater video-camera is placed in the water under the feed drift zone; this is connected to a television monitor in the farm office, which is watched constantly during feeding to enable the feed rate to be adjusted based on the number of pellets drifting past the camera.

When the fish reach the required harvest weight, at 10-15 months, feeding is stopped for approximately three days to ensure their stomachs are empty prior to harvest.

REDUCING WASTE FEED

Feed costs are the most expensive component of producing salmon, accounting for up to 60% of production costs. In addition, the high organic content of feed means that an accidental deposit of waste feed on the seabed over time will have a greater environmental impact than the faecal matter that is deposited in the farm footprint. The minimisation of waste feed is therefore both a commercial and environmental objective of New Zealand King Salmon.

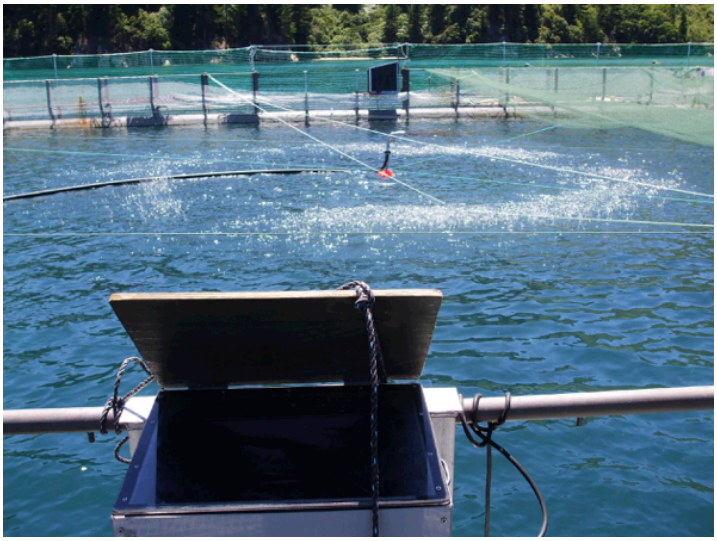
Although very minimal, feed lost to the environment may occur as a result of:

- Too much feed delivered to the fish during a feeding period as a result of incorrect settings and/or monitoring of feed delivery systems.
- Fish swimming activity during feeding causing feed to be dispersed/lost through the netting net pen.
- Failure of control mechanisms in feed delivery system, leading to non-programmed feed delivery.
- Predator activity during feeding causing fish to go off their feed as pellets are passing through the water column.
- Small fish such as mullets and spotties may enter the net pens through the mesh and feed along with the salmon; however this has not been observed to be a major issue at NZ King Salmon's farms.

New Zealand King Salmon has addressed all the points above and continues to work to further reduce feed wastage. Measures to reduce feed wastage include:

- Continual evolution of feeding strategies and feeds with better understanding leading to reduced wastes. In particular, NZ King Salmon has observed considerable reductions in feed wastage by constantly monitoring net pens with cameras in them to ensure feeding is stopped before feed is wasted. As a result, all camera monitored pens are continuously monitored by New Zealand King Salmon staff during feeding in order to reduce feed pellet waste.
- Feed is delivered to each net pen either by a spinning disc on the hopper or rotating blower system (roto-spreader). Salmon feeding activity is kept away from the outside edges of the net pen by adjusting the spread of the feed; this reduces the risk of feed in the water being dispersed out of the net pen through the netting while fish move energetically within the net pen.
- Feeders, hoppers and delivery systems are checked at least once a day to ensure that they are working properly, and audits on the spinners are conducted regularly.
- Feed is transported to the farm using a fit for purpose vessel. The crane and forklift used are certified to lift in excess of the weight of a feed bag. Lifting strops and chains comply with OSH requirements for the task of off-loading from the transfer vessel to the barge at the site. On older barges the feed is stored in an area where spillage cannot directly enter the sea. Feed is moved within the barge by electric hand forklifts and chain hoists are used to lift the feed into the silos or hoppers. Newer barges have silos loaded directly from the delivery vessel so does not need to be moved within the barge.

Roto-spreader in operation feeding the fish.



In addition, New Zealand King Salmon has carried out initial experiments to measure feed loss at two of its farms using existing feeding equipment. The trials were conducted at Te Pangu, a high flow site where the Akva camera feeding equipment is used, and Ruakaka, a lower flow site where the spinners are employed. The methodology and results of these assessments were as follows:

- Te Pangu: the airlift system, generally used to assist with the retrieval of morts was activated in the test net pens during feeding, to direct any waste pellets into a multilayer net where they were trapped. The quantities of trapped pellets were counted and recorded daily. At the end of the month long trial, the percentage waste was calculated as a proportion of the total amount fed, and was found to be far less than 0.1%, or a handful of pellets over the course of a month.
- Ruakaka: Divers checked the bottoms of the nets after every feed for a week. These initial trials found no evidence of feed pellets caught in the nets, which were fouled enough to prevent pellets falling through the net.

ENVIRONMENTAL MANAGEMENT

It is important that salmon farms are managed sustainably to ensure long term tenure and stewardship through not compromising the environment and fish health, thereby ensuring that the quality of the fish is good and economics of the business is sound.

New Zealand King Salmon works within the environmental constraints at each farm site by managing production levels to ensure compliance with its agreed consented conditions. Older consent conditions will eventually be reviewed and BMP benthic guidelines will be adopted across all pre EPA sites prior to or during 2024.

Following completion of the annual monitoring, Cawthron provides New Zealand King Salmon and MDC with an annual monitoring report which is independently peer reviewed. New Zealand King Salmon operates its farms using an adaptive management process. This ensures that, in the event that any farm exceeds the agreed environmental quality standards, a farm management response is immediately activated to bring the farm back within the agreed standard. This response is clearly identified in the EPA site consent conditions and also in the BMP benthic guidelines that have already been adopted on the Te Pangu farm and about to be adopted on the Clay Point farm

The New Zealand King Salmon Board, management team and staff are fully aware and committed to the need to act responsibly to ensure the ongoing environmental integrity of the Marlborough Sounds. An Environmental Policy for Aquaculture Operations has been in effect for a number of years. A Board appointed committee, which includes an external expert, has been appointed to oversee the implementation and management of this policy.

Salmon farming does result in an environmental footprint, but this is kept to a minimum by modern and effective farming practices and technical innovations. The objectives of the Environmental Policy are a commitment by New Zealand King Salmon to:

- Implement sustainable and environmentally sound business practices.
- Work in harmony with our unique environment.
- Meet the requirements of the relevant legislation and the Aquaculture New Zealand environmental code of practice for salmon farms "A+".
- Continuous improvement to strive for world class environmental standards.
- Take organisational and personal ownership for the Environmental Policy.
- Ensure that New Zealand King Salmon's environmental footprint is well managed.
- Work within the principles and implementation of sustainability and environmental awareness.
- Provide corporate leadership in environmental awareness.

CONSOLIDATED FARM MANAGEMENT

One of the strengths of New Zealand King Salmon from a market perspective is the ability to produce fish year round that are consistent in quality and size. Recognition of the various attributes of each of the farm sites, and managing these sites in conjunction with one another is an important aspect that contributes to the company's ability to achieve consistent production.

Each of New Zealand King Salmon's existing and proposed sites have slightly different attributes, in particular with regards to water temperature and current flows. In order to maximise the attributes of each site, New Zealand King Salmon uses an integrated management strategy, whereby all the existing farms are treated as one integrated system to farm salmon. This allows New Zealand King Salmon to utilise resources efficiently, whilst minimising risk, as well as to achieve year-round production of a consistent product for customers.

New Zealand King Salmon acknowledge that ideally the farms would be managed in three discrete geographic areas to minimise the potential for disease or pest species introduction and transference around the Sounds. However this strategy is not practical from an operational perspective, and given the low likelihood of disease outbreaks or the transfer of pest species as a result of salmon farming, the company has chosen to operate the farms as an integrated unit, although with separation distances that are in excess of overseas norms. In the event of a disease outbreak or marine pest infestation, New Zealand King Salmon would implement a management response to ensure that salmon farming operations are not responsible for spreading disease or marine pests throughout the Sounds.

Water temperature has the strongest effect on salmon growth, so managing the sites according to their temperature profiles enables New Zealand King Salmon to achieve greater growth rates of the young fish during the warmer summer months. Examples of this approach include:

- Only introducing smolt into the cooler Tory Channel sites (Clay Point and Te Pangu) during spring, in order to avoid warmer water temperatures over summer (which results in high smolt mortalities). The young salmon are held at these two sites until around April, when water temperatures have dropped sufficiently at the other sites so as not to impact on growth or survival. The fish are then transferred, by towing them in sea pens, to these sites where they will stay until harvested.
- In the cooler autumn month's smolt can be introduced to any of the operating sites, as water temperatures are well within the optimum range of the fish.
- Water temperatures at Otanerau in summer exceed the maximum temperature for optimum growth of the salmon (18°C), so salmon are only grown on this site during the cooler eight or nine months of the year. During summer the designated Otanerau smolt are held at one of the Tory Channel sites with cooler water temperatures.

Other specific methods utilised internationally for managing a group of salmon farms include the following:

- Fallowing: There are options for the use of fallowing as a management strategy, as follows:
- Disease management: Fallowing could potentially be used by New Zealand King Salmon to manage disease, as removing disease hosts (i.e. fish) from the site results in the disease cycle being broken.
- Single Year Class: This is a good strategy in salmon farming areas where disease is an issue, as it prevents diseases from being transferred across the generations.
- Geographic Spread of Farms: In salmon farming areas where disease is prevalent, this is a good strategy. However in New Zealand, salmon farms are widely spread, particularly in areas where water currents are slower and therefore the farm is 'flushed' less often.

BIOSECURITY

Salmon genetic material (i.e. eggs, milt, broodstock) is not imported to New Zealand, so there is no biosecurity risk posed by that means. New Zealand King Salmon's Biosecurity Management Plan includes on-farm, as well as vector-based, management measures to reduce the risk of spread, including:

- Methods to manage vectors that could spread marine pests and disease agents to or from salmon farms;
- Routine practices to manage fouling of nets and structures;
- A passive surveillance regime to facilitate early detection of unusual or suspicious organisms associated with farm structures;
- An effective disease surveillance regime for salmon stock;
- The use of husbandry and harvesting methods consistent with best practice for the minimisation of disease risk;
- On-farm management measures to prevent, control or contain biosecurity risks to the extent practicable.

RISK MANAGEMENT

New Zealand King Salmon have undertaken an assessment of the potential risks to farming operations. In addition the company has the following emergency response plans in place:

- An Emergency Response Plan has been prepared in consultation with the Harbourmaster that deals with potential issues such as navigation and tsunamis.
- A detailed Oil Spill Plan is included as part of the Seapen operations manual. This instructs farm workers on specific protocols that must be followed to enable a planned response to an oil or hydrocarbon spill from any of the farm sites.
- Net pens are able to be towed to a 'safe' location in the event of a toxic algae bloom.
- Jellyfish can be 'attracted' to the grower nets by the vortex created by the salmon swimming behaviour. This is not a problem if the jellyfish are present in small numbers, but if the jellyfish bloom as a result of favourable environmental conditions, 'jellyfish strike' can occur. Sheer numbers of jellyfish block off the water exchange to the net pens (by blocking the mesh), thereby depleting oxygen and causing the net sides to contract. This causes the fish to panic and increase their swimming speed, thus creating a vortex and 'attracting' more jellyfish to the walls of the net pen. A process for preventing and resolving such an event, should it occur, is detailed in the Seapen operations manual.

SEABED REMEDIATION OPTIONS

Salmon farming is known to cause a localised impact to the seabed within the 'footprint' of the farm. Remediation of this impact by natural processes can only occur if the farm stops production, or waste matter falling to the seabed from the farm is much reduced or ceases.

Numerous attempts have been made by the global aquaculture industry to minimise the environmental effects of salmon farming operations. Some of the options assessed by Cawthron for the Ministry for Primary Industries (MPI) and New Zealand King Salmon, to minimise the environmental impact include :

- Collection of organic wastes before they reach the seabed, or physical remediation of impacted sediments. A number of solutions have been proposed or trialled overseas, including: collection of particles falling to the seabed; deployment of artificial reefs beneath net pens to process farm waste before deposition; collection of detritus from the seabed using submersible pumps; and harrowing of enriched seabed sediments to enhance oxygenation and organic matter processing.
- Microbial and chemical remediation. Techniques that involve adding a mixture of bio-fixed bacterial species (bio-augmentation) and oxygen release compounds (bio-stimulation) as a means of enhancing the rate of decomposition of organic matter in sediments have been trialled beneath fish farms overseas. These trials have indicated the potential for enhancing recovery rates in organically rich sediments, but they are yet to be tested at full farm scale.

New Zealand King Salmon along with other salmon farmers employed the Cawthron institute to carry out a seabed remediation trial on its Forsyth Bay salmon farm. Four options were trialed on a relatively small scale including aeration, injecting water, harrowing and removal of the sediment. Only removal appeared to have any benefit, however a further trial on a commercial scale will be required before the effectiveness and practicality of that technique can be determined. A further trial is proposed, however New Zealand King Salmon maintains a watching brief on developments in this area.

FISH HEALTH AND WELFARE

FISH WELFARE

King salmon are naturally shoaling animals, and as such being contained in a net pen is not contrary to their natural instinct. New Zealand King Salmon's maximum stocking rates result in only 2.0% of the net pen volume being occupied by fish, with seawater comprising the remaining volume.

Salmon producers globally suffer from significant diseases and parasites, however New Zealand is fortunate in that our coastal waters are currently free of major salmon pathogens such as bacterial kidney disease (BKD), the skin parasite Gyrodactylus salaris, and infectious salmon anaemia (ISA). While sea lice species such as Caligus sp. are a major concern to salmon farmers in the northern hemisphere, parasitic sea lice are not an issue for New Zealand raised King salmon.

Every fish in the farm is valuable to New Zealand King Salmon, and fish welfare is therefore very important. New Zealand King Salmon have a detailed section on King salmon (biology, life-cycle, diseases) in their Training Manual, which is used as a resource for all new staff joining the Aquaculture team. New Zealand King Salmon complies with animal ethics legislation.

The likely cause of death is determined for all morts as a preventative measure to identify trends and potential problems (e.g. algae bloom, disease outbreak, poor water quality). New Zealand King Salmon also has a protocol that must be followed by farm staff in the event that elevated numbers of morts are observed. This includes detailed instructions for taking samples of the morts and healthy fish for histological and bacteriological analysis so that the cause of the increased mortalities can be accurately determined.

New Zealand King Salmon harvest their fish when they are still immature, as once mature they have very little market value. The Humane Slaughter Association, based in the UK, has visited NZ King Salmon operations and approved the harvesting techniques employed.

MANAGING MORTALITIES

Mortalities are a fact of life when raising animals, and salmon that die in the net pens are colloquially known as "morts". The deaths occur for a number of reasons, such as age, from lesions, predator damage, congenital defects, secondary infections, runting or natural attrition. These impacts naturally occur in the wild.

Morts collect at the bottom of the net pens and are retrieved by divers at least twice a week, or on the new farms by running the air lift equipment which creates air flow and sucks the fish to the top of the net where they can be collected.

Mort collection is important for a number of reasons:

- To count to maintain accurate production records
- To classify them according to cause of death
- To ensure early detection of problems with the fish, and if necessary implement a management response to prevent further losses
- To minimise attraction of predators to the net pen such as sharks, which can feed on the morts and damage the nets
- To minimise the potential spread of disease from morts to the living salmon
- To minimise waste and additional weight in the net pen from the morts.

New Zealand King Salmon has secure storage units on all farms for holding mortalities. The morts are regularly collected by one of the service vessels and disposed of by rendering hereby minimising any odour associated with fish mortalities.

HARVEST AND PROCESSING

Fish are humanely harvested and transferred to the processing operation in Nelson on the day of harvest. In Nelson, all fish are gutted and gilled, inspected, graded and weighed. Premium fish are graded Ōra King based on a stringent set of quality requirements.

Processing commences on the night of harvest, ensuring the freshest possible products are packed for all global markets with despatch of whole fresh fish generally the following morning. Fish will either be sold whole, or go on for further value-added processing. New Zealand King Salmon's processing operations include wood roasting, cold smoking, marinating, filleting and portioning of salmon.

Further planned capital investment is targeted at improving harvesting and processing efficiency, and providing increased capacity for value-added and premium product processing.

New Zealand King Salmon has a specialist harvesting team of nine staff who commute on a dedicated vessel to the farm they are harvesting from. During the harvest period at a given farm, the team harvests up to 50-60 tonne per day, five days a week (Sunday to Thursday), which ensures continuance and consistent supply to all customers.

In order to collect the fish for harvest, the harvest team drop a 'snatch' net into the net pen that the fish are to be harvested from and a proportion of the fish in that net pen are confined. The net then holds these fish at the surface and is used to guide them to a floating pontoon which has been placed in the net pen by the harvest team.

Once guided into the pontoon, the fish pass through a number of compartments containing anaesthetic (Aqui-S) to sedate them. and finally into a compartment containing carbon dioxide saturated water which renders them comatose. This series of compartments ensures that the fish are anaesthetised prior to death and is designed to make the harvest process as stress free and humane as possible for the fish with the added benefit of maintaining quality out-turn.

Once comatose, the salmon are lifted by a brailer onto a table on the 'dumb' barge moored alongside the farm during harvest operations. The main artery in the throat of the fish is cut by hand and they are placed into insulated bulk tankers and bins filled with ice slurry where they continue to bleed. The harvested fish are then collected by a motorised barge and transported back to the closest port (Picton or Havelock) and trucked to the New Zealand King Salmon factory for immediate processing. The blood and water is contained in the insulated bulk tankers and bins and disposed of appropriately at New Zealand King Salmon's primary processing plant along with other waste.

INFRASTRUCTURE

NZ King Salmon has a range of infrastructure requirements necessary to support farming operations.

NZ King Salmon only utilises the ports of Havelock and Picton to support its net pen operations; it is very rare for the company to access alternative port facilities such as those at Elaine Bay, Pelorus Sound. It is not envisaged that this will change with the development of the proposed sites.

The Havelock and Picton facilities are well placed to support marine farming operations, and at each of these ports NZ King Salmon utilises the following:

- Port facilities to transfer feed, ice, equipment,
- Port facilities to transfer live and harvested fish;
- Barge services;
- Light engineering and utility services;
- Vessel repair and maintenance services;
- Dive industry services.

The factories in Nelson currently undertake all of NZ King Salmon's processing; however in the event that production is markedly increased, it is likely that NZ King Salmon will develop a processing factory in Picton, closer to the Marlborough Sounds farms and to major transportation routes.

Currently all salmon feed is imported; however the feed companies have indicated that should the total New Zealand requirement for feed exceed 30,000mt then construction of a feed mill in New Zealand would be seriously considered with Marlborough as the prime candidate if that is the area where fish production is greatest.

NZ King Salmon currently air freights whole fresh gilled and gutted fish from Nelson airport, however at times this puts pressure on the freight capacity of the airport and charter planes have been used on occasion. The development of a primary processing factory in Picton, and the potential for increased air freight requirements would strongly support the case for Blenheim airport to utilise larger planes, which would also benefit tourism operators and other primary producers in the Marlborough region.

REGIONAL SPILL-OVER BENEFITS

The June 2015 ASB Regional Economic Scoreboard rated the economic performance of Marlborough as near the bottom of the pack.

As part of its operations, NZ King Salmon is linked to other supply sectors; therefore any growth has 'ripple' effects whereby increased expenditure can deliver additional benefits elsewhere in the regional economy.

There are also a number of local servicing companies who benefit significantly from NZ King Salmon's operations; these include:

- Barge services;
- Wharf and port facility providers
- Engineering suppliers;
- Science providers;
- Tourism and travel operators;
- Professional service providers (e.g. information technology, employment/human resources, etc).

As the most significant growing area in New Zealand for King salmon, the Marlborough region will receive significant profile worldwide as NZ King Salmon evolves the 'provenance' proposition. While it is hard to assign a dollar value to this in terms of benefit to the region, there is no denying the benefits received from the Marlborough region's profile as a producer of 'sauvignon blanc'.

LABOUR

We employ approximately 440 people, of whom approximately 350 are involved in production (breeding, growing, harvesting and processing fish).

Fish breeding and growing typically requires access to skilled labour which can be difficult to source domestically. At times, we have recruited offshore when we have needed to replace skilled aquaculture positions.

OPERATIONAL VESSELS

NewZealand King Salmon has a range of vessels that are used by team members for transportation to and from the sea farms. Health and Safety is of the utmost importance to New Zealand King Salmon and the company has a detailed Vessel Operation Policy, including a maintenance plan, to ensure the vessels are operated in a safe and responsible manner so as to minimise risk to New Zealand King Salmon personnel and property.

New Zealand King Salmon currently utilises three distinct types of vessel, as follows:

- Farm tenders for use in the enclosed water limits of the Marlborough Sounds, operations restricted to particular areas depending on the farm they are based at.
- Water taxis for use by commuting staff in the enclosed water limits of the Marlborough Sounds.
- Larger work vessels, also for use within the enclosed water limits of the Marlborough Sounds.

All staff operating the vessels must have undertaken appropriate training to enable them to operate the vessel safely and responsibly. There is a fully qualified skipper and first aider on board at all times, and staff in the vessels can communicate with the farms and land-based operations via cellphone. The vessels are also fitted with marine radios and emergency locator beacons. In addition New Zealand King Salmon has a Designated Person Ashore who is responsible for the appointment, training and management of vessel skippers and vessel operations.

New Zealand King Salmon's Safe Ship Management programme requires all vessels to keep logbooks. In addition, any damage, accident or incident that occurs to or on the vessels is reported in accordance with New Zealand King Salmon accident and incident reporting procedures. Following an accident/incident, a review of the event is undertaken, and operating procedures are modified if necessary.

In addition to the vessels owned by New Zealand King Salmon, a number of other specialist vessels are utilised during salmon farming operations, these include:

- Large barges to transport the truck and trailer units carrying smolt for the farms, bulk bags of feed, harvested fish and other large freight. These barges are operated by O'Donnell Park Barging Ltd (Picton) and Johnsons Barge Service Ltd (Havelock).
- Barges for special activities such as predator net changes. These barges are usually supplied by Kenny Barging Ltd.
- Tugboats are used for towing the net pens between sites.

New Zealand King Salmon vessel activity varies seasonally, with the main activity as follows:

- During harvest (which lasts approximately three months at any given farm), the harvest barge and harvest crew vessel commute daily from Sunday to Thursday.
- Commuter vessels travel to and from the farms Monday to Friday.
- Barges transporting food, and carrying out other logistical work (e.g. net changing, moving equipment etc) usually travel to the farms twice a week.
- Tugs and barges are utilised to move net pens/fish once or twice a year.
- Vessels carrying customers, television crews and other one-off visitors.

PROCESSING & DISTRIBUTION

The newly harvested fish are transported via truck to New Zealand King Salmon's main primary processing plant in Nelson, where they are gilled, gutted and undergo a quality control inspection. The Picton factory, to be developed once volume threshold is obtained, is also intended to be a primary processing plant, which will eventually receive a proportion of the newly harvested fish.

At the primary processing plant fish are then graded and, if not being dispatched whole as gilled and gutted (G&G) product, they are sorted and either processed for fillets at the main factory, or sent to one of the other three processing plants where the 'value-added' processing (e.g. hot smoked, cold smoked, gravalax, portion control etc) is undertaken.

ALTERNATIVES TO NET PENS

There are several ways in which salmon may be harvested:

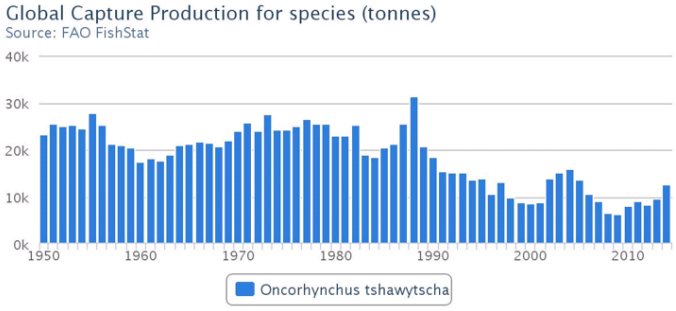
- Wild fishing using lines and nets;
- Ocean ranching whereby the salmon are hatched in a hatchery, released to the wild, and caught during their run back up the river to spawn (generally considered a form of wild fish);
- Closed containment salmon aquaculture, also known as re-circulating aquaculture systems, whereby either a land or sea-based containment system of some description is used and the water recycled through the system.

WILD FISHING

The indigenous King salmon population in the northern Pacific Ocean and southern Arctic Ocean is heavily fished. FAO Fisheries statistics for the global capture production for King salmon show a steady decline in wild catch.

Wild fishing of salmon commercially is not an option as salmon is not part of the New Zealand quota management system; all wild salmon in New Zealand are reserved for amateur fishing, and any salmon caught at sea must be landed as bycatch. In addition it is not likely that there are sufficient wild stocks in this country to sustain a regular commercial salmon harvest.

The declining quantities of wild salmon caught can be contrasted with the increasing demand for the species. Wild King salmon are at risk of overfishing and global aquaculture and New Zealand aquaculture alone, which produced ~12,500mt liveweight of King salmon in 2015, exceeds the King salmon global capture industry (12,441mt in 2014).



Global capture production for Oncorhynchus tshawytscha (FAO Fisheries statistics).

OCEAN RANCHING

Ocean ranching is the method by which much of the wild salmon fisheries in New Zealand and in other parts of the world remain stocked. First attempts at ocean ranching in New Zealand were carried out in the 1980s in Golden Bay, and on the Waitaki and Clutha Rivers (as part of the ICI/Wattie Salmon project). The first major commercial attempt was at Tentburn, a 6.7 hectare site on the Canterbury Coast which was originally established for this purpose, however, this site failed as an ocean ranching facility due to fishing pressure and predators such as seals. The Tentburn site is currently one of New Zealand King Salmon's three hatcheries.

Internationally, ocean ranching was attempted in countries like the US, Canada and Scandinavia before sea pens were introduced in the 1960's and 1970's. However, because the fish are "wild" the hatchery has no proprietary interest until the grown salmon are back within the facility, limiting a company's chances of benefiting financially from their investment.

Because of this, the method has mainly been used by public authorities and non-profit groups as a way of artificially increasing salmon populations in situations where they have declined due to over-harvest, the construction of dams and habitat destruction or disruption. Unfortunately, there can be negative consequences of this sort of population manipulation, including genetic 'dilution' of the wild stocks. Many jurisdictions are beginning to discourage supplemental fish planting in favour of harvest controlled habitat improvement and protection. As New Zealand does not have native stocks this is not an issue.

LAND BASED SYSTEMS

There are two main types of land based systems for raising salmon, as follows:

1. Flow-through (single pass) freshwater systems, employed by salmon farmers such as in the hydro-electric canals and rivers of the central South Island. The three New Zealand King Salmon hatcheries are flow through.

2. Closed containment systems, where seawater is pumped ashore or use limited amounts of freshwater. Such systems are not common in areas where land has a high value and energy costs are high. This precludes the majority of New Zealand for this type of farming.

New Zealand King Salmon has had firsthand experience with growing fish to a harvestable size in a freshwater land-based facility. Prior to 1998, the Waikoropupu Springs, Takaka site was producing up to 367 mt of harvest salmon per annum. Quality issues, including fish size, along with an increased need by the company for space and water for smolt and broodstock rearing resulting in New Zealand King Salmon ending land-based rearing of adult fish.

Internationally, there are a number of small-scale operators that use closed containment systems to grow salmon to harvest. These include:

- Aqua Sea Corporation in Washington State; who grow Coho salmon in a land-based freshwater system and market the product as 'Sweet Spring' salmon.
- Swift Aquaculture in British Columbia, produce Coho in freshwater systems on land.
- Agrimarine in British Columbia grow Atlantic salmon in a freshwater system on land, and recently launched a floating seawater system.
- Danish company, DTU Aqua is currently developing technologies to produce large trout (and potentially salmon) in a land-based seawater system.

Currently there are no large scale land-based seawater farms in New Zealand, as they are generally not suited to the New Zealand way of farming. The risks associated with the water intake system collapsing and/or breaking, disease management and disposal of effluent trapped in the settlement tanks remain problematical for this type of land based farming system.

While favoured by some environmental groups and those opposed to net pen farming, closed containment and re-circulating aquaculture systems are mainly limited to hatcheries and small producers. The primary reason for this is that both land based marine farms and re-circulating water systems require large amounts of capital and a high degree of technical skill and high running costs. Fish quality such as taste and texture can also be quite different from the prefered marine farm grown product.

NZ King Salmon is not aware of any recirculation system that is commercially viable and operating without subsidy or similar financial support.

In February 2011 at the Seafood Summit in British Columbia, a panel discussion on closed containment systems was attended by major industry players, who conceded that these systems would have a role to play in the future of aquaculture. As such, there may come a day when closed containment systems are considered economically viable in New Zealand; however New Zealand King Salmon do not consider this method a viable option for the foreseeable future.

CONCLUSIONS

This report has provided an overview of New Zealand King Salmon operations. It details the history and information regarding current facilities and sites.

It discusses opportunities for improvements including moving to higher flow sites, the operational requirements, employment opportunities and spill over benefits of maintaining or increasing production and achieving an environmentally better outcome.

Operational details of fish production including policies, management plans and responses to issues are addressed.

Environmental management is a key factor when considering operation of a salmon farm. The report explains how voluntarily New Zealand King Salmon has worked with various parties including Marlborough District Council to develop Best Management Practice guidelines and has agreed a timeline to incorporate across all of its farms.

This report also discusses how farms are not operated in isolation but rather as part of an integrated management strategy.

Infrastructure requirements, alternative fish farming options and detailed feed information is given.

Maintaining or increasing production through improved environmental practice is critical to ensure ongoing proven performance with its associated social, economic and environmental benefits. Moving existing low flow farms to areas more suitable for salmon farming will achieve all of these benefits.