BC SALMON FARMERS ASSOCIATION

RAISING OPPORTUNITY

RAISING CLIMATE-FRIENDLY FOOD ON BC'S COAST

SUSTAINABILITY REPORT 2019

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Introduction

AS EXECUTIVE DIRECTOR of the BC Salmon Farmers Association, it gives me great pleasure to present this year's Sustainability Report: "Raising Opportunity"— renamed to recognize that climate friendly sustainable food production raises new opportunities in our coastal communities.

Having been the association's ED for over a year now, I'm proud to be working with such a dynamic and forward–thinking group of people, who have not only embraced sustainability as an opportunity, but are committed to continuous improvement. In the following pages, we report our industry's performance at each stage of the value chain: farming, processing and marketing. We highlight our key achievements, our valued partnerships and our new technology. Transparency of reporting continues to be an important commitment we take seriously.

This report is more than just an association initiative. It is a strong collaborative effort in every way. Many thanks to a dedicated team of BCSFA members who contributed significant time and energy to its creation. We appreciate your help in telling our important story.

As an industry, we are proud of the healthy product we produce using farm practices based in sound science. Farmed salmon is healthy for people and good for local communities and the planet. A sustainable salmon farming industry raises the level of opportunity for all of us.

Sincerely,

John Paul Fraser
Executive Director

Global

Organic Chinook Salmon from Creative Salmon Co. Ltd.

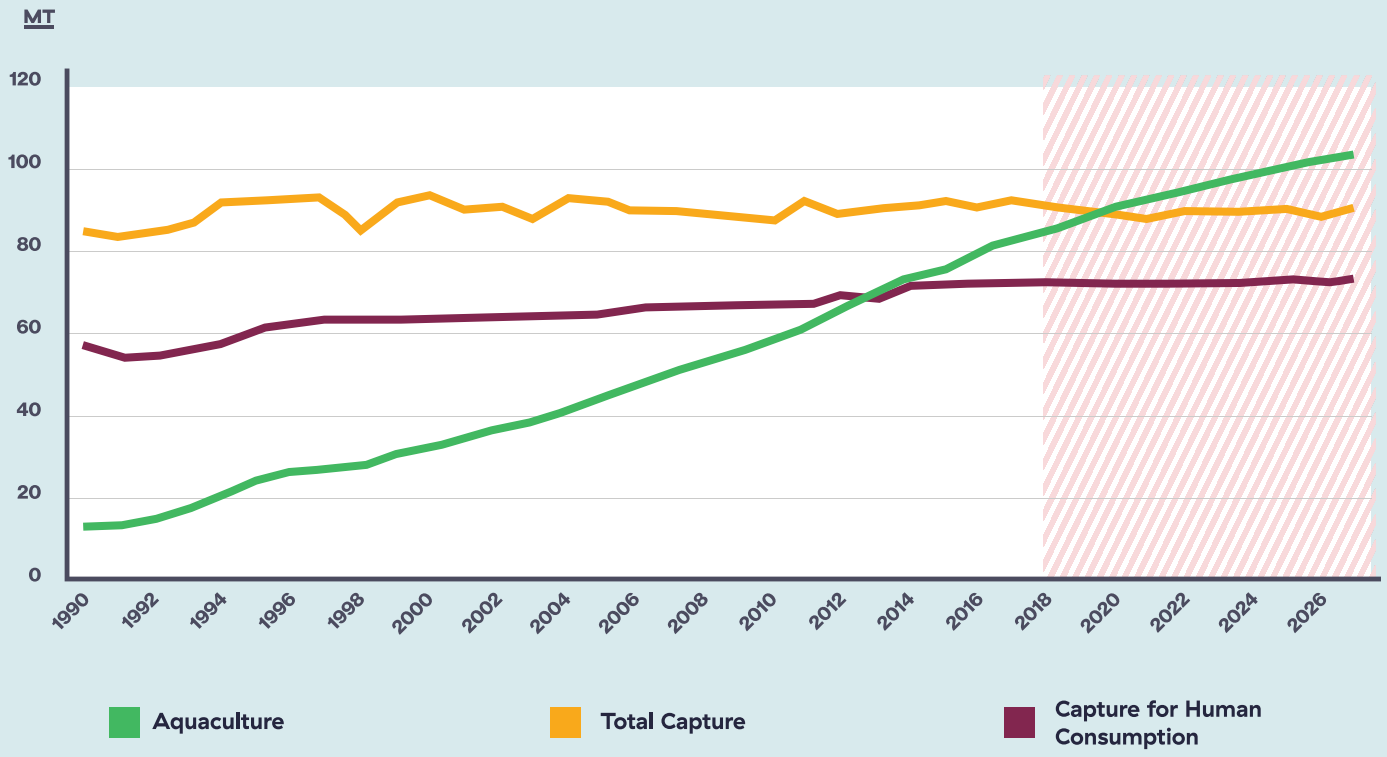
Global Food Production

The United Nations' Food and Agriculture Organization (FAO) recognized in 2009 that food production needs to increase by 70% in order to feed the projected 10 billion people expected to populate the earth in 2050.[1]

Also according to FAO, per capita consumption of fish is expected to increase and the World Bank predicts, in the report Fish to 2030 (2013), that aquaculture will continue to fill the supply–demand gap, and that by 2030, 62% of fish for human consumption will be farmed.[2,3] Aquaculture is literally an ocean of opportunity for a healthier planet and for British Columbia.

Production Outlook for Aquaculture, Wild Capture and Wild Capture for Human Consumption.[4]

Aquaculture Production Rises to the Challenge of Declining Wild Fisheries and Increasing Human Consumption.



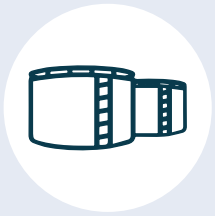
Food Security

With wild fish populations stagnant or declining from overfishing and climate change, salmon farmers provide the world with healthy and sustainably produced protein.[5]

Sustainable Salmon Farming Plays an Important Role in Feeding the World.[6,7]

Demand for protein is set to double by

2050



50% of seafood

is currently farmed. Aquaculture is needed to support wild fish stocks.

3.2 million tonnes

of farmed salmon are produced globally per year.

Eco-friendly Protein — Low Carbon Footprint

The waters of BC naturally provide the temperature, salinity and other conditions for farming healthy salmon. Less than 0.05% of the coastal area of BC produces almost 86,000 tonnes of fresh salmon annually.[8]

Farmed Fish is the Most Resource-Efficient Animal Protein on the Planet.[6,7]

				
Feed Conversion Ratio[5] (kg feed consumed per kg protein produced)	1.2—1.5*	1.7—2	2.7—5	6—10
Fresh Water[4] (litres used per kg protein produced)	4	7,600	13,000	9,500
Carbon Footprint[5] (grams CO_2-equivalent/typical serving of 40g edible protein)	0.6	0.9	1.3	5.9

*Figures reflect feed conversion ratio and carbon footprint of farmed Atlantic salmon

118 Marine Finfish Aquaculture Tenures and 20 Land-Based Farms

Operated by BCSFA members across the coastal regions of BC (115 salmon, 3 sablefish)

Food for thought.

Arable land is disappearing at the rate of around 1 hectare every 8 seconds — about 2 football fields.[23]

0.05%

Amount of BC's coast that all Salmon Farm sites in BC occupy

60—70

Amount of Salmon Farm tenures active at one time

Aquaculture Act for Canada

> **We've seen economics be the only driver on how decisions are made when it comes to resource development and management, and I'm proud to come from a province where we've managed to change that balance now. We need those proteins to come with small environmental footprint and I'm really pleased to support this industry that's providing them.**

Dallas Smith
Tlowitsis Nation
and President Nanwakolas Council.

CANADA IS THE WORLD'S ONLY major farmed seafood producing country without modern national legislation specifically designed to govern and enable its aquaculture industry. Therefore, it was welcome news when the Canadian Council of Fisheries and Aquaculture Ministers agreed to support the advancement of the legislative development process for an Aquaculture Act in Canada.

Along with the Canadian Aquaculture Industry Alliance, the BCSFA and its member companies will collaborate with federal, provincial, territorial and Indigenous and non-government partners to modernize federal legislation, regulations and programs keeping Canada's seafood farming business competitive, sustainable and innovative.

Working with Indigenous Communities

United Nations Declaration on the Rights of Indigenous Peoples

The Governments of Canada and British Columbia are committed to the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). The declaration outlines the importance of building productive, durable relationships with Indigenous partners and sets a higher standard than the process that has governed issues between industry and First Nations in the past.

BC salmon farmers agree this marks a significant opportunity to build meaningful relationships with local First Nations and is a tremendous step forward in the spirit of reconciliation. It is the industry's intent to continue to nurture established partnerships and build on newly formed relationships and goodwill.

Strong cooperative partnerships enable the production of a high quality food product, ensure protection of the environment and wild salmon and provide economic and social benefits to First Nations.

- Twenty BC First Nations have partnership agreements for farming salmon in their territory.
- 78% of all salmon farmed in the province is under a beneficial partnership with a First Nation.
- About 20% of salmon farming jobs are held by people of First Nations' heritage.
- Every new farm proposed in the last decade has been in partnership with First Nations.

Salmon Farming in the Broughton

In December 2018, the Government of British Columbia and the Governments of the Kwikwasutinuxw Haxwa'mix, Mamalilikulla, and 'Namgis First Nations announced the path forward regarding salmon aquaculture in the Broughton Archipelago. Both Cermaq Canada and Mowi Canada West contributed to a ground-breaking government-to-government process that delivered recommendations that will protect and restore wild salmon stocks, allow an orderly transition for salmon farms in the area, and create a more sustainable future for local communities and workers.

The establishment of indigenous oversight and increased engagement will support continued sustainable and responsible production of farmed salmon in the area until 2023 and allows for further agreements to be developed between the companies and First Nations.

Opposite Page
Dr. Diane Morrison Mowi Canada West and David Kiemele Cermaq Canada join the Chiefs of the 'Namgis First Nation, Mamalilikulla First Nation and Kwikwasut'inuxw Haxwa'mis First Nation, B.C. Premier John Horgan, and B.C. Minister of Agriculture Lana Popham at the announcement in Victoria on December 14, 2018.

Partnerships

While the industry plans for changes in the Broughton area, there are many arrangements with other First Nations that are longstanding and are renewed regularly proving strong working relationships can provide valuable lasting benefits for all partners.

The Kitasoo/Xai'xais First Nation and Mowi Canada West recently celebrated the 20-year anniversary of their partnership to farm salmon and process farmed fish at the plant in Klemtu.

Partnership agreements establish guiding principles for environmentally sustainable aquaculture practices. These practices are developed with the First Nation and are designed to meet the Nation's objectives. In some cases, First Nations' representatives participate in environmental monitoring activities to ensure the principles are upheld.

"This celebration honours our working with Mowi for 20 years. It was nice to be able to sit down with this group that has been with us for that time and share our culture. Mowi has a connection with us and we have been able to share and learn with them."

Hereditary Chief Harvey Robinson
Kitasoo/Xai'xais.

"The partnership with the people of Klemtu has really shaped our company and helped us all understand the benefits of deep relationships with First Nations in BC. The fish we have raised here in Klemtu have always been regarded as some of the best. The waters are great, but I think it probably has more to do with the people here and the connection between the community and the environment."

Dr. Diane Morrison
Managing Director, Mowi Canada West.

When I started working at Creative Salmon in May 2016, I wasn't sure what the future would hold. I applied myself and worked hard. That effort was recognized, and I was able to gain promotion to management at the farm. I'm proud to be part of the great work this company is doing and happy to be able to be living at home, raising my family, and supporting my community.

Aaron Martin
Tla-o-qui-aht First Nation member
and Creative Salmon employee.

Tlowitsis First Nation and Grieg Seafood Partnership
Proudly Displayed on the Clio Channel Farm.

"The Tlowitsis Nation stays informed about Grieg's operations from its meetings with senior staff, having our Guardians on patrol who also visit the farms, and also by our members who work for Grieg. We ask questions and attend industry events to understand how the industry is improving."

Chief John Smith
Tlowitsis First Nation.

Project —

Harbour Clean-up

In November and December of 2018, Cermaq Canada partnered with the Coastal Restoration Society and undertook a large-scale clean-up project in the Ahousaht Harbour — focusing specifically on the intertidal and subtidal seabed habitat areas. The clean-up was completed over several weeks and saw the removal of over 350 tons of debris, derelict vessels, ghost fishing gear and washed up, accumulated debris and plastics.

Partnership agreements cover all areas of importance for First Nations including economic benefits for the use of their traditional territory and providing employment in remote areas with few other opportunities.

Clean-up of Ahousaht Harbour.

Healthy Food

> **Fish is a food of excellent nutritional value, providing high quality protein and a wide variety of vitamins and minerals, including vitamins A and D, phosphorus, magnesium, selenium and iodine in marine fish.**
>
> The Food and Agriculture Organization (FAO)[9]

Fresh Product Available Every Day

Everyday millions of people around the world enjoy healthy, nutritious and delicious meals thanks to fish farmers. Aquaculture is an opportunity for a healthier planet and for British Columbia.

Three-quarters of the salmon harvested in this province each year is raised on farms. Just like terrestrial farmers, the BC salmon farmers are proud to grow healthy, high quality food.

Fresh farmed salmon is available year-round in a wide range of products that make salmon a good choice for families. BC fresh farmed salmon is to customers as quickly as the same day.

Good Nutritional Value

Salmon is nutritious, rich in micronutrients, minerals, marine omega-3 fatty acids, high-quality protein and several vitamins, and represents an important part of a varied and healthy diet.

Multiple studies indicate that including salmon in your diet will improve your overall nutrition and may yield significant health benefits.[11, 12, 13]

Omega-3s for Health

Salmon is a good source of Omega-3 fatty acids which have been recognized as playing an important role in health and well-being of people of all ages, especially for maintaining a healthy heart.[11, 12, 13]

Food for thought.

Canada's New Food Guide recognizes eating fish is an important part of a healthy diet.[10]

SALMON IS A SUPERFOOD!

- HIGH IN OMEGA-3 FATTY ACIDS
- LOWERS RISK OF CANCER
- LOWERS RISK OF STROKE
- LOWERS CHOLESTEROL LEVELS
- PREVENTS HEART DISEASE

AND SALMON IS AN EXCELLENT SOURCE OF

- PROTEIN
- ANTI-OXIDANTS
- A VITAMIN
- B VITAMIN
- D VITAMIN
- E VITAMIN
- B CAROTENE
- ZINC
- IRON
- COPPER
- MANGANESE
- SELENIUM
- CALCIUM
- PHOSPHORUS
- POTASSIUM
- SODIUM

Project —
Culinary Team BC

The BCSFA is proud to be a sponsor of Culinary Team BC. This dynamic group of young chefs, managed by John Carlo Felicella from the Vancouver Community College, will be representing BC at the 2020 World Culinary Olympics in Stuttgart Germany February 14—19, 2020. The team showcases BC farm–raised finfish at the majority of their fundraising events. BCSFA and Culinary Team BC is an ideal partnership that combines both premium food quality and culinary excellence.

For more information:
www.culinaryteambc.com/news–1

BC Culinary Team at Kyuquot Village preparing farmed sablefish and the delicious result (on the left). Terry Brooks, President, Golden Eagle Sablefish, and the Culinary Team in Kyuquot, BC (below).

"If our growing population wants to keep eating fish (and I certainly want to) the future is farming. By ensuring we put the ecosystem first, we can care for the fish we grow and, in turn, feed and nourish ourselves. One of the only ways we can continue to consume seafood with any sense of sustainability is to only consume seafood that is responsibly farmed and harvested and understood. I encourage my chef colleagues to visit a fish farm, meet with the farmers and learn about how the fish are raised."

Ned Bell
Chef and Ambassador, Chefs for Oceans.

06

Value to BC Economy

Food for thought.

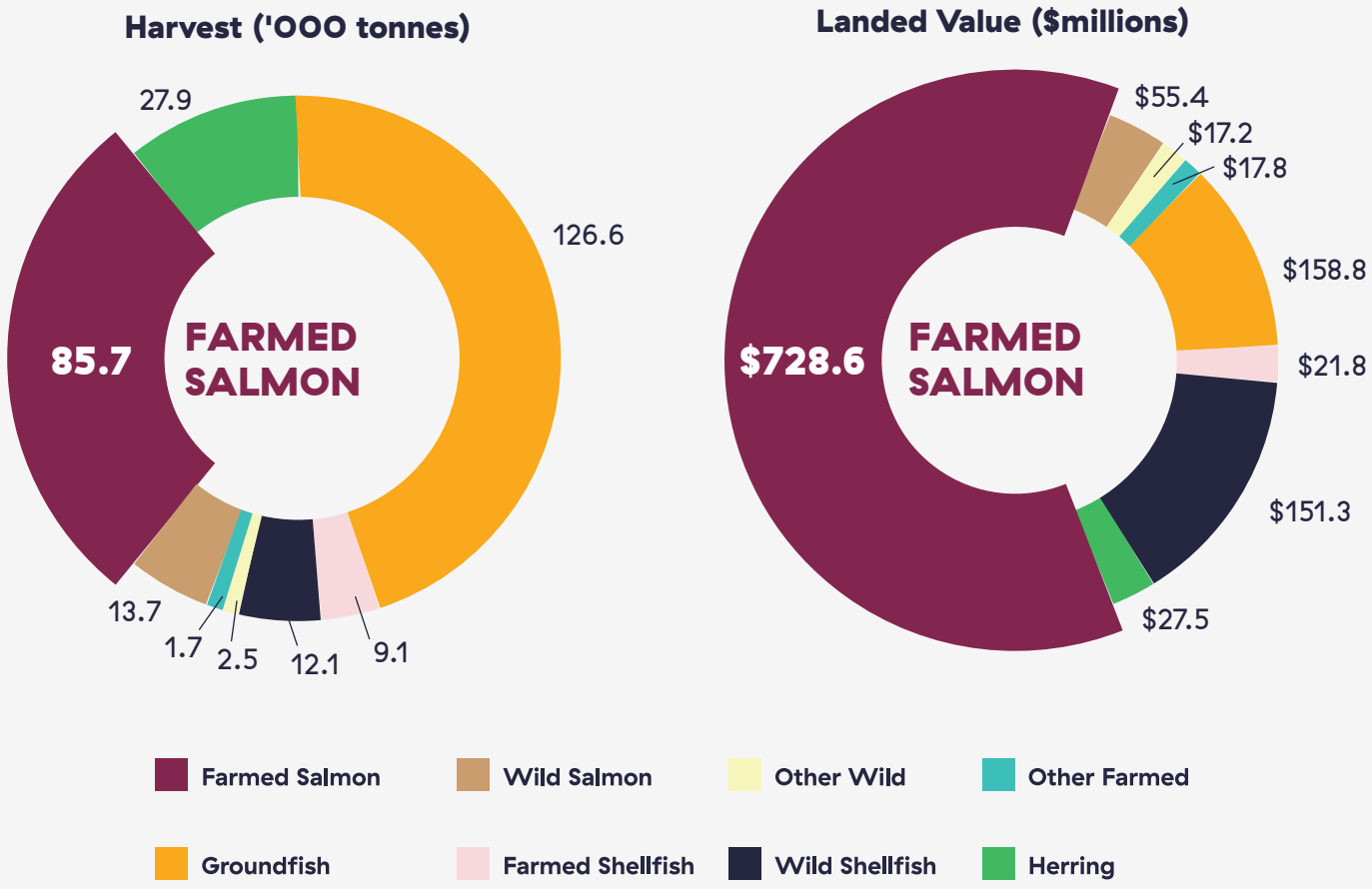
Farm-raised salmon is BC's highest valued seafood product, the province's top agricultural export and generates over $1.5 billion towards the BC economy.[16]

$1.5 Billion

Fish farming includes growing fish at hatcheries on-land, in the ocean, as well as processing harvested fish at several locations in the province. Though BC products are sold around the world, many benefits are realized locally.

Aquaculture has the most positive growth forecast in the Canadian agriculture sector and is expected to increase 4.2% per year — increasing the benefits to the province and to those of us who live here.[15,16]

Harvest Volumes and Landed Value of Farmed Salmon [16]



BC Farmed Salmon Facts

- Five species of salmon are farmed – Atlantic, Chinook, Coho, Sockeye and Steelhead
- 87,100 tonnes of salmon harvested annually valued at $819 million (2018)[29]
- Atlantic salmon accounts for over 97% of the landed value
- 86% of BC's salmon comes from farms[16]
- Farm-raised fish accounts for 1/3 the total seafood harvest, over 62% of landed value and almost half the wholesale value of all BC seafood[16]
- 60% of production is exported, 40% sold domestically[24]
- Overall economic impact of more than $1.5 billion[19]

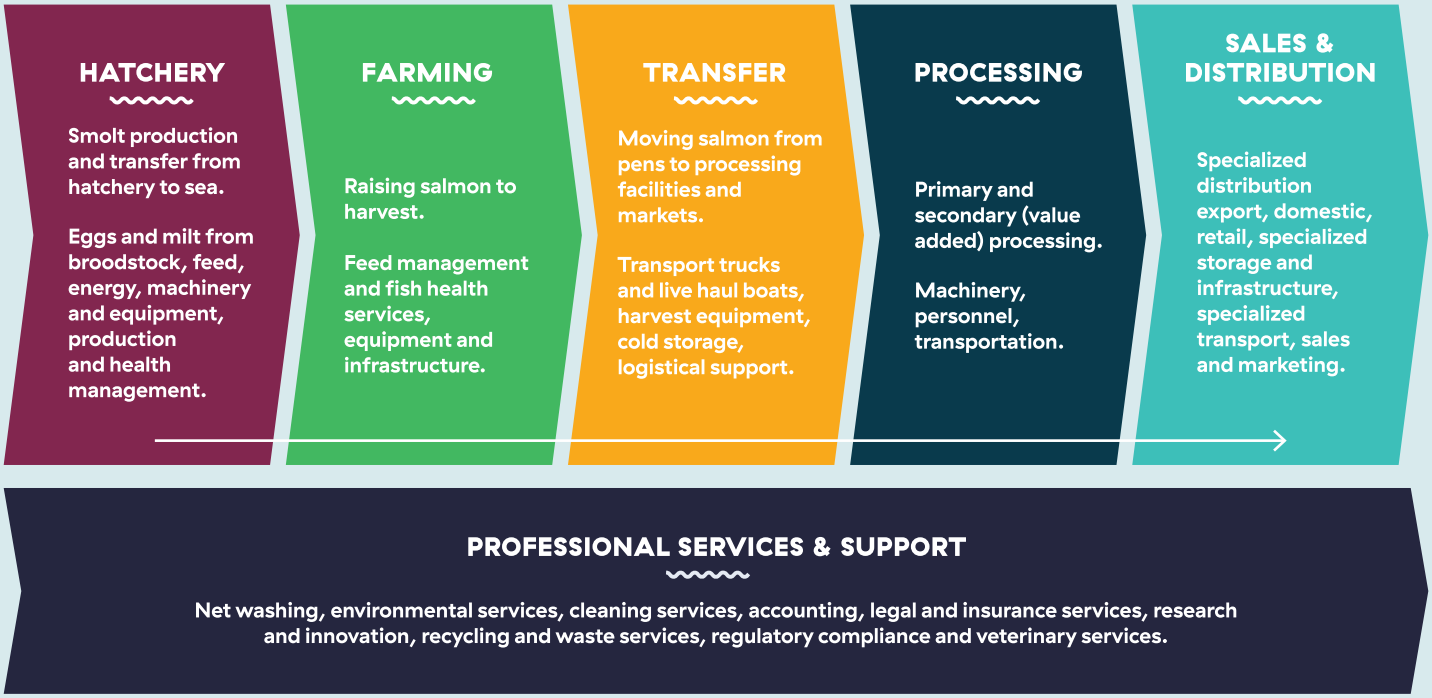
Employment

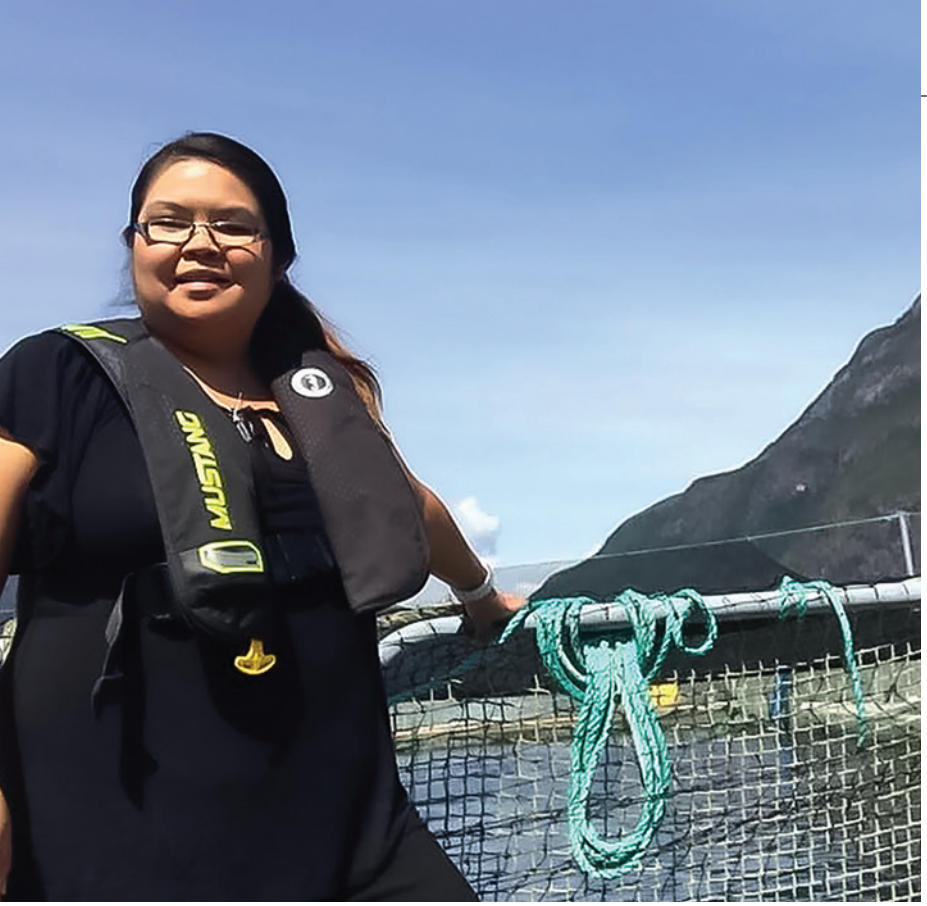
There are approximately 7,000 total full-time equivalent (FTE) positions supported by the BC salmon farming industry, including direct employment (directly related to the production of farmed fish), indirect employment (related to the supply of goods and services) or induced employment effects (when the direct and indirect generated incomes are spent and re-spent in the broader economy). Employment is typically year-round and includes numerous benefits including a salary of approximately 30% more than the median employment income in the province.[19]

Aquaculture has the youngest workforce of any agriculture sector in Canada.[17] Young people are attracted to salmon farming as a stable career with good paying jobs and opportunities for advancement.

Value Chain of Farm Raised Salmon

The salmon farming industry in BC expands across multiple service sectors, creating 7,000 jobs in mainly coastal communities.





Nellie Atleo at Cermaq Farm Site.

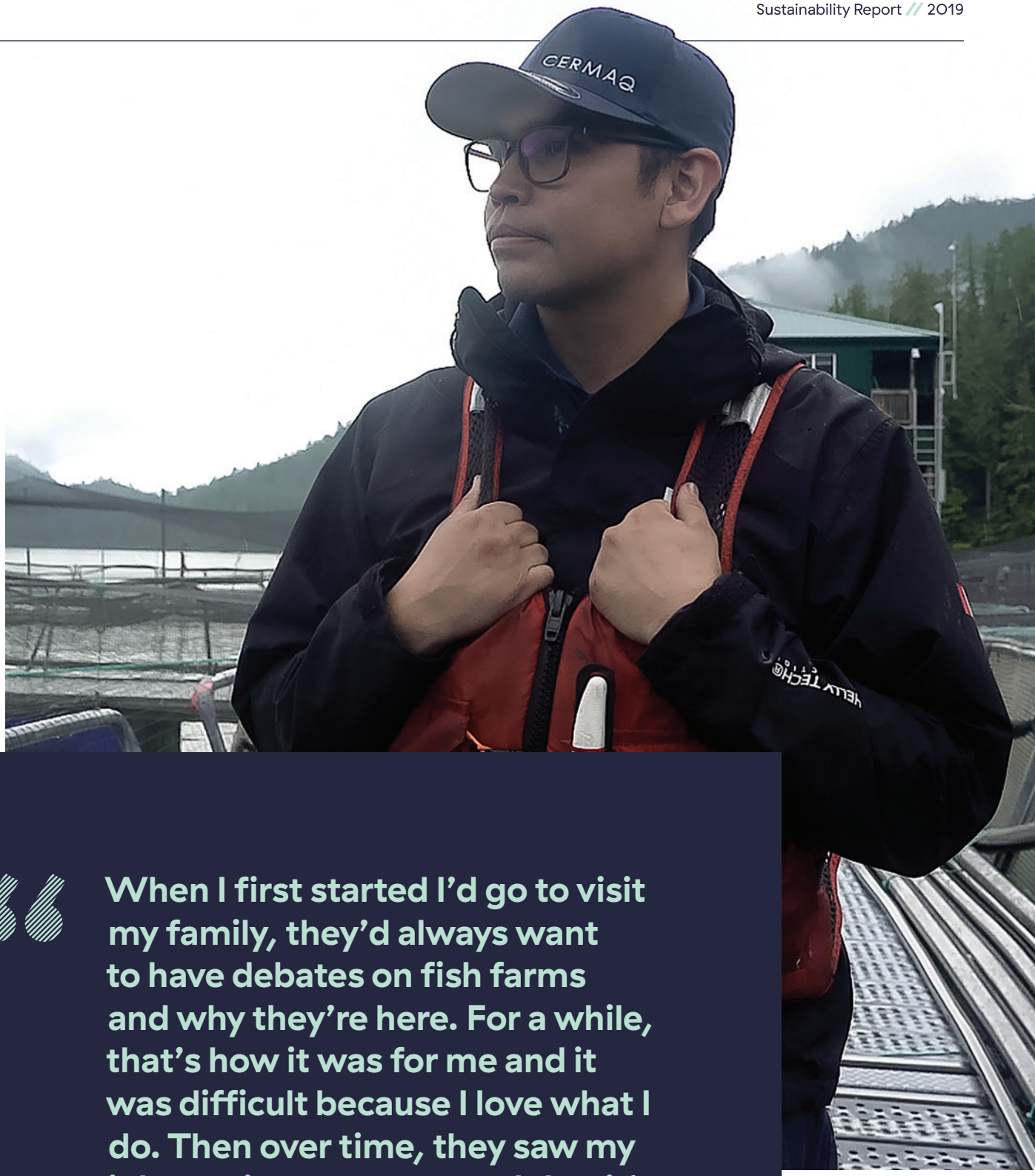
"The company has provided great support. They know and understand First Nations — like how a big family means having many family responsibilities. I look forward to coming to work each day, I work with a good team in the office and a good company."

Nellie Atleo
Member of the Tla-o-qui-aht First Nation, Human Resources Administrator in Cermaq Canada's west coast office in Tofino, and with Cermaq Canada for over five years.

Two Generations of Aquaculture Divers – Kelly Korol, President DIVESAFE International, and his son Hunter.

"Retaining strong ties to the BC salmon farmers and being the lead trainer for industry divers for over 30 years has enabled DIVESAFE International to grow from small local company to the largest commercial dive school in Canada and we now provide internationally recognized training for many programs. This year my son Hunter joined the industry – a second generation BC aquaculture diver! Providing opportunities for young people is one of the many benefits of working with a strong vibrant industry."

Kelly Korol
President, DIVESAFE International
Campbell River, BC.



> **When I first started I'd go to visit my family, they'd always want to have debates on fish farms and why they're here. For a while, that's how it was for me and it was difficult because I love what I do. Then over time, they saw my job turn into a career, and that it's where I want to be.**

Damon Rampanen
Cermaq Canada Saltwater Assistant Manager,
Tofino, BC.

Damon Rampanen at Cermaq Canada Farm Site.

Value to BC Communities

Salmon Farming is Good News for Coastal Communities

Farming companies and their employees are an integral part of BC's coastal communities — living locally, supporting causes, volunteering at events, and generally improving life in the community.

BC fish farmers hire locally and have a strong employee base in coastal communities providing steady and rewarding employment to thousands of people, invigorating economies of many coastal communities.

Salmon farmers participate in and support wild salmon conservation projects, beach cleanup activities, and other community events. Financial donations to scholarships, school projects and community organizations as well as financial and product donations to fundraisers, food banks further demonstrate industry's commitment to their communities.

Community Contributions by BC Salmon Farmers (2018)

375 DONATIONS

to organizations and charities

$750,000+

dollars contributed

37,000+

pounds of salmon donated

Wild Salmon Conservation

BC salmon farmers are committed to our wild salmon populations by supporting a wide variety of salmon enhancement initiatives in the communities we live in, to preserve, protect and enhance our coastal wild fish stocks. In addition to funding dozens of annual projects and donating equipment, BC salmon farming company employees also volunteer to help with activities like fin clipping, stream restoration and seines for brood stock. Being responsible environmental stewards and supporting the future health of wild salmon is important for us all.

Project —

Ukee Days

“Every summer the community of Ucluelet holds Ukee Days, a 3-day weekend long festival celebrating life on the West Coast. The event kicks off with the community BBQ for 350 people. Creative Salmon has been consistently involved, donating product, labour, and time to help make the evening a hit. This company has quietly participated for going on 20 years. It wouldn’t be the Ukee Days West Coast BBQ without Creative Salmon’s support and energy.”

Abigail K. Fortune
Manager of Parks & Recreation,
District of Ucluelet.

Ukee Days with Creative Salmon Employees Serving Farmed Chinook Salmon.

“Excel Career College is an Indigenous owned Post-Secondary Institution that has been adapting and growing along with the BC salmon farming industry. The College delivers customized and practical training in the coastal communities where salmon farmers are looking to hire creating opportunities for the community and supporting the economy of British Columbia.

Pauline Stevenson
President, Excel Career College
Courtenay, BC.

Grieg Seafood's Katie Maximick (back–row, right) Joins the Sewing for Fun Group at the Campbell River Community Centre.

Project —

Campbell River Specialized Recreation Programs

"It's our goal to create opportunities for a positive recreation experience for everyone. Grieg Seafood have been an amazing supporter of our programs for many years and it is deeply appreciated. Thanks for helping to make our programs affordable to all!"

Judy Ridgway
Programmer, Recreation & Culture,
City of Campbell River.

Certification

Continuous Improvement and Transparency

BC fish farmers produce food of the finest quality that meets the highest standards of environment accountability and social responsibility. Achieving these standards demands ongoing improvements in farming operations driven by research and development.

Transparency is important for salmon farmers. Information and public reporting can be found on company websites and includes data on sea lice counts, wildlife interactions, and escapes as well as wild juvenile salmon monitoring. This level of reporting often goes above and beyond what is required for the certification process.

The BC Salmon Farmers Association members have achieved certification through several independent, globally recognized standards in areas such as sustainability, environmental practices, quality, safety and food safety management. These certifications show a commitment to transparency, upholding high standards for operations, and ensures that companies are producing salmon in a sustainable, safe and ethical manner.

Commitment to Quality

All salmon farmers in BC are committed to meeting the requirements of independent, audited, third-party certification systems.

- The Aquaculture Stewardship Council (ASC) certification is an all-encompassing sustainability standard and all BC Atlantic salmon producers are committed to being certified. www.globalsalmoninitiative.org/about-us
- Best Aquaculture Practices 4 Star Program certification focuses on environmentally and socially responsible practices and has input from many conservation organizations. www.gaalliance.org
- Canada's Organic Aquaculture Standards was published in 2012 and updated in 2018. The principal goal of organic aquaculture production is to develop enterprises (finfish, shellfish, and aquatic plants) that are sustainable and harmonious with the environment. http://www.publications.gc.ca/site/eng/9.851011/publication.html
- Seafood Watch evaluates products for market so consumers can feel confident they are selecting products grown to the highest standards. BC farm-raised chinook and ASC certified Atlantic salmon are listed as a "Good Alternative" and are on the recommended list of seafood. www.seafoodwatch.org/seafood-recommendations

"One of the most pressing challenges we face is meeting the food, water, and energy demands of the growing population in a changing climate. Responsible marine aquaculture plays an important role in providing more nutritious food with fewer environmental impacts. British Columbia salmon farmers have worked hard to meet rigorous certification standards with the goal of producing a nutritious protein that is environmentally and socially responsible."

K. Thompson
Director, Seafood for the Future,
Aquarium of the Pacific.

Food for thought.

As of August 2019, 37 BC salmon farms are certified to the Aquaculture Stewardship Council sustainability standard.

Advances in Managing Sea Lice

SEA LICE OCCUR NATURALLY in BC waters on many species of fish. Farmed salmon smolts, from the freshwater hatcheries, entering the ocean do not have lice. Lice can be transferred to farmed salmon from the environment and from other fish.

The industry management of sea lice continuously improves through research and extensive testing of alternative measures and as a result now has innovative options to manage this pest. See BC Salmon Aquaculture: Innovation & Technology 2019 Report for detailed description of sea lice management tools at www.raisingopportunity.ca/technology-report.

Management —

Keeping Fish Healthy

- SLICE® (emamectin benzoate), an in-feed treatment used effectively in BC since 2009, kills all parasitic stages of sea lice and provides post-treatment protection for up to 10 weeks.
- Diluted hydrogen peroxide (H_2O_2) temporary paralyzes sea lice causing them to detach from the salmon and be collected for disposal. H_2O_2 breaks down into water and oxygen in the environment.
- Sea lice cannot survive in freshwater and state-of-art wellboats can now produce volumes of freshwater through reverse osmosis. Exposing salmon to a freshwater bath causes the lice to detach and they are collected for disposal.
- Hydrolicers are mechanical devices that use only pressurized ocean water to remove sea lice. The fish are sent through two chambers which first loosen and then remove the lice and eggs. The water is tripled filtered before it is returned to the ocean to ensure all removed lice and eggs are collected and stored for disposal.

Mitigation —

Reducing Sea Lice Numbers

- Integrated Pest Management is an area based, coordinated application and rotation of management practices among salmon farmers in a defined area.
- Year class separation ensures that different year-classes of farmed salmon are reared on separate farms reducing potential for sea lice transfer between generations.
- Proactive monitoring provides sea lice numbers regularly to enable optimal use of management tools.
- Anti-sea lice skirts are suspended from the top of the net pen and prevent sea lice larvae, found in the first few meters of water, from entering the pen.
- Years of selective breeding have produced smolts that grow faster, convert feed into flesh more efficiently and are more resistant to environmental challenges. Healthier, faster growing fish spend less time in the ocean reducing their exposure to sea lice.
- Chimney (Snorkel) nets, deployed at 10m, keep the salmon in deeper water and away from sea lice which are primarily found in the first few metres of water. The salmon access the water's surface to take air into their swim bladders through a lice resistant chimney (snorkel).
- Aeration diffusers or bubble curtains placed around the circumference of salmon pens create a barrier that deters sea lice from entering the salmon pen.

Opposite Page
Mowi Canada West's "Aqua Tromoy", which can be used to treat fish for sea lice using either fresh water or hydrogen peroxide. All of the removed sea lice are captured and stored for disposal on land. On the right is Cermaq Canada's "Salar" which treats for sea lice using only pressurized ocean water. Once the lice are removed, the fish are returned the farm and the ocean water is triple filtered before returning to the sea to ensure all of the removed lice are collected and stored for disposal on land.

10 Environment

Growing More Food While Protecting the Environment

The growing population is challenging us to create more food with less – to safeguard the environment and use it wisely.

Salmon farming has a low carbon footprint, high protein yield and efficient feed conversion ratio compared to other protein foods — sustainable food production into the future. To remain a viable industry, BC salmon farmers continue to invest in research to increase our knowledge about the environment and to develop technology to be more efficient protein producers while ensuring the integrity of the ocean.

Kris McNichol, Owner CPI Equipment, and Technical Crew.

> **CPI Equipment has developed services and equipment for the BC salmon farming industry as it has evolved. Our local company has designed and custom-built aeration systems that mitigate the effects of plankton and low oxygen and we provide ensiling systems for enhanced biosecurity — innovations geared to safeguarding the environment and making the industry more sustainable.**

Kris McNichol
President, CPI Equipment
Nanoose Bay, BC.

Ocean Plastics

The presence of microplastic in the ocean is a serious environmental issue. The United Nations estimates 100 million tonnes of plastic has been dumped into the oceans to date and if current trends continue, our oceans could contain more plastic than fish by 2050.[20]

BC fish farmers are taking measures to reduce plastic waste in the ocean. We partner with First Nations and coastal restoration organizations to clean up local beaches and estuaries. The objective is to remove accumulated plastics and garbage, restore and enhance near-shore and stream spawning habitat for wild salmon. We are also committed to reducing single use plastics and recycling used plastics.

Food for thought.

Canada has identified ocean plastics as one of the most significant environmental concerns and the Canadian government plans to create a zero plastic waste strategy for 2021.[21]

Gemini Marine has invested significantly in transportation boats and barges and equipment to provide recycling options for fish farms in BC. The pallets and plastic materials are packaged at the plant at Earls Cove on the Sunshine Coast and shipped to the lower mainland where they are 100% re-used.

"In response to the salmon farming industry commitment to the environment, Gemini Marine has developed the only aquaculture recycling program of its kind in North America. We are a local company that is recycling approximately 250,000kg of plastic annually with complete tracking from pickup to compacted billet delivery and electronic traceability of every pallet. Along with the industry, we have invested in reducing waste and protecting our oceans."

Rob Hoehn
President, Gemini Marine
Bowen Island, BC.

Wild Salmon — Our Commitment

A key component of sustainability is the protection of wild salmon stocks. Science completed over the past 30 years tells us that responsibly farmed salmon and wild salmon can co-exist in the ocean. Through the collaborative Marine Environmental Research Program (see details in the R&D section) BC salmon farmers have invested significant resources to better understand wild salmon populations and the marine environment.

The following code and industry activities ensure growing salmon in the ocean will not negatively impact wild salmon.

- The National Code on the Introductions and Transfers of Aquatic Organisms.
- Ongoing stringent testing to ensure that only healthy smolts enter the ocean environment.
- Vaccination of all smolts for protection against common pathogens for which effective vaccines are available.
- Continued investment in research through the Marine Environmental Research Program.
- Continued support of Salmon Enhancement programs.
- Strong commitment to containment — keeping farmed salmon in the net pen.

Delivery of custom-designed receiver sleeves deployed on the farms by salmon farmers in 2018 (From left to right: Paul Pattison, Mowi Canada West; Tom Foulds, Cermaq Canada; Erin Rechisky, Kintama Research Services. Photo courtesy of Kintama Research Services)

Research Update: Project —

Exposure Time of Free-ranging Juvenile Sockeye Salmon to Atlantic Salmon Farms in BC

This project tracked juvenile Sockeye salmon migration routes and residence time near salmon farms. Data collected indicates most wild salmon migrate through the western and central Discovery Islands and the residence times at individual farms were short indicating Sockeye juveniles are not attracted to farms.

> **I protect nature by doing my job properly and by making sure everything around the farm is safe and secure to prevent accidents like escapes. When you're working out in the open with Mother Nature, you're protecting her. You're keeping both sides safe.**

Rudy Dick
Mowachaht Muchalaht First Nation,
and long-time employee of Grieg Seafood.

Safeguarding the Environment

The BC salmon farming industry has a target of zero escapes. The use of synthetic polymer nettings has improved practices and contributed substantially to the decrease in fish escapes in recent years. Ongoing research into new polymeric fibers continues to provide innovative and stronger materials for nets and ropes.

Escaped Salmon Per Year, BC

Advances in net technology implemented by the industry have reduced the number of escaped farmed fish in British Columbia.

Fish Feed

SALMON FARMING COMPANIES constantly strive to remain at the forefront of environmental responsibility. An example of this is the industry's efforts to prioritize sustainable feed ingredients combined with efficient feeding techniques. As a result of these efforts, BC farmed salmon now require as little as 1.15 — 1.2 kg of feed to gain 1 kg of body weight and this feed conversion ratio (FCR) has improved over three-fold since 1990.

Food for thought.

Salmon farming has become a net producer of high-quality marine protein.[27]

Feed Innovations

Developing new feeds is complex as salmon farmers must balance the requirements for fish health, safeguarding the environment and the social factors associated with sourcing ingredients.

Ongoing research and development coupled with the need to satisfy both fish health requirements and consumer demand for responsible sourcing means a wide range of new and sustainable raw materials and ingredients are entering the feed picture.

- Over 40% of the fishmeal and well over 50% of the fish oil requirements in salmon feed are now sourced from wild capture fishery trimmings. These trimmings were once discarded as waste during the processing of wild capture fisheries for human food consumption.
- For many years, plant-based ingredients (corn, soy, pea, and canola) as well as sources from the byproducts of human consumption, such as poultry and pork trimmings, have steadily reduced the requirement for marine-based feed ingredients in fish feed.
- Innovative sources of feed ingredients such as camelina meals and oil, insect meals, algae oil, sunflower meal and rice meal; and high omega-3 canola oil.

Feed Management

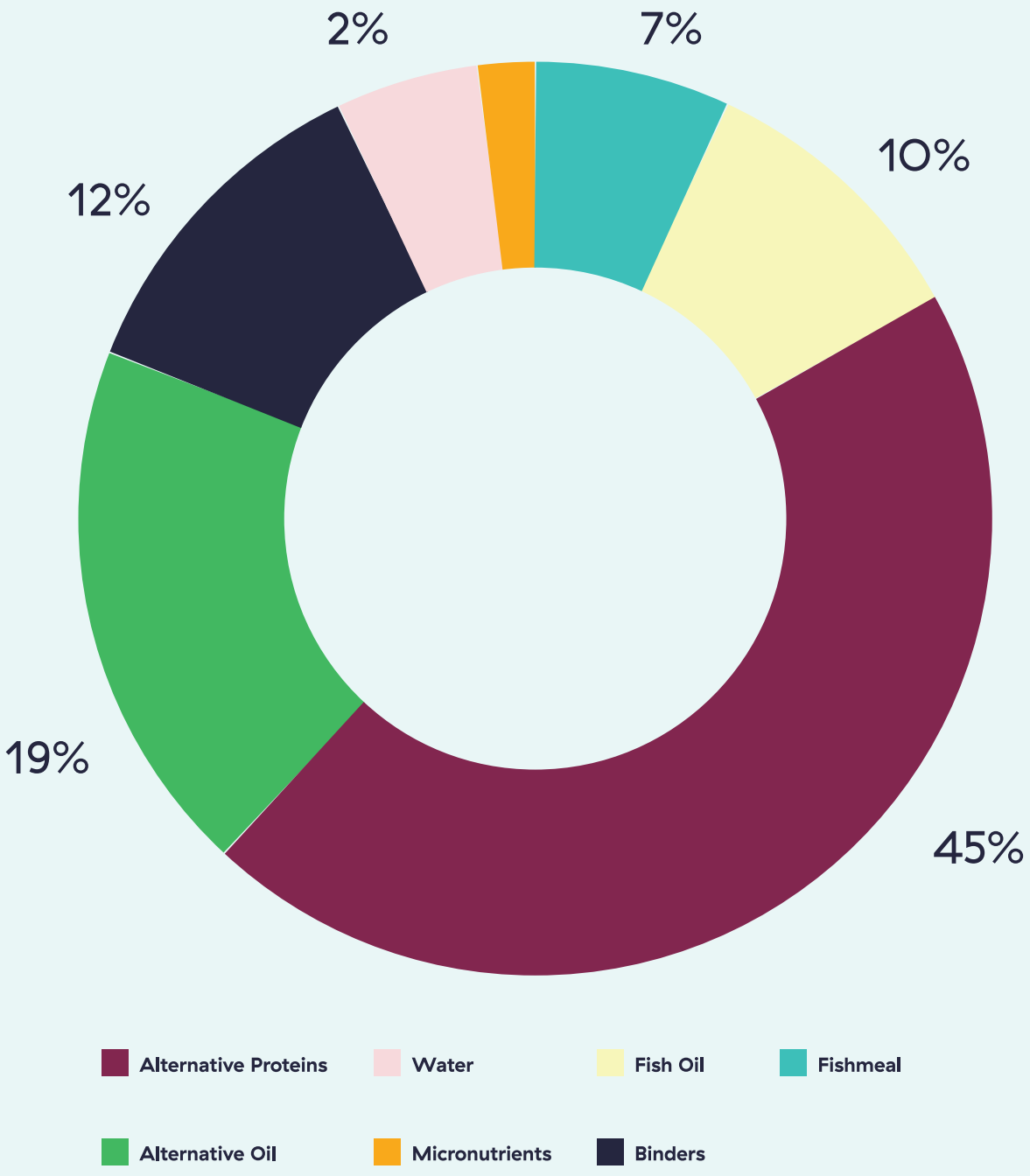
The feed used for farmed salmon is formulated to meet the nutritional needs of the fish and the sources of ingredients can change throughout the life cycle. For example, larger salmon can thrive on a diet lower in marine-sourced materials. Since more feed is consumed when salmon are larger, this feed formulation adjustment has tremendous impact on the overall requirement for marine ingredients. Feed ingredients have evolved considerably. Alternate protein and oil sources now account for almost 70% by weight of the feed formulation as shown in the graph below.

Additional feed information can be found in the BC Salmon Aquaculture: Innovation and Technology 2019 Report, see www.raisingopportunity.ca/technologyreport.

Food for thought.

Alternative and novel raw materials have enabled development of completely fishmeal-free salmon feeds while ensuring fish health and performance.

Composition of Fish Feed for Salmon
Saltwater Growout Phase




MUSTANG
SURVIVAL

12

Healthy Fish

BC SALMON FARMERS are passionate about the health of their fish. Licensed veterinarians and fish health professionals are dedicated to applying best practices and the highest standards in fish health care.

As a result, farmed salmon in hatcheries and grow-out facilities are very healthy and an average of 90% survive from entry into the marine cages through to harvest.

Fish Health Management

Plans, Professionals & High Standards

- All farms have comprehensive Fish Health Management Plans approved by Fisheries and Oceans Canada that include farm policies and practices geared to keeping fish healthy.
- Licensed veterinarians and fish health professionals administer all aspects of the fish Health Management Plan and regularly conduct fish health examinations.
- All farms have stringent biosecurity policies and practices designed to protect fish from harmful pathogens including strict protocols for all aspects of farming from site visits to stocking fish. Maximizing the health of farmed salmon protects wild stocks.
- Farms are only stocked with a single year class and prior to transferring fish, extensive testing is conducted to ensure only healthy, strong fish are being moved from hatcheries to farms.
- All salmon are removed from the site prior to re-stocking. After harvest, the farm is left fallow for several months before re-stocking to further reduce risk of disease or parasite transmission. During fallowing, nets are removed for cleaning and disinfection and site infrastructure is also cleaned.

Preventative Vaccines

- Vaccines are an integral part of fish health management and are administered to all fish prior to leaving the hatchery.
- The pathogens these vaccines protect against are not harmful to humans, but they can pose a threat to the health of the salmon. Vaccines have resulted in a substantial decrease in antibiotic use.

Food for thought.

Vaccines have been developed against many of the common bacterial and viral pathogens that are naturally found in the marine environment.

Food for thought.

BC salmon farmers provide government accurate and up-to-date fish health records. Data is publicly available at https://open.canada.ca/data/en/dataset/deefd1d7-7184-44c7-83aa-ec0db91aad27

Medical Treatments

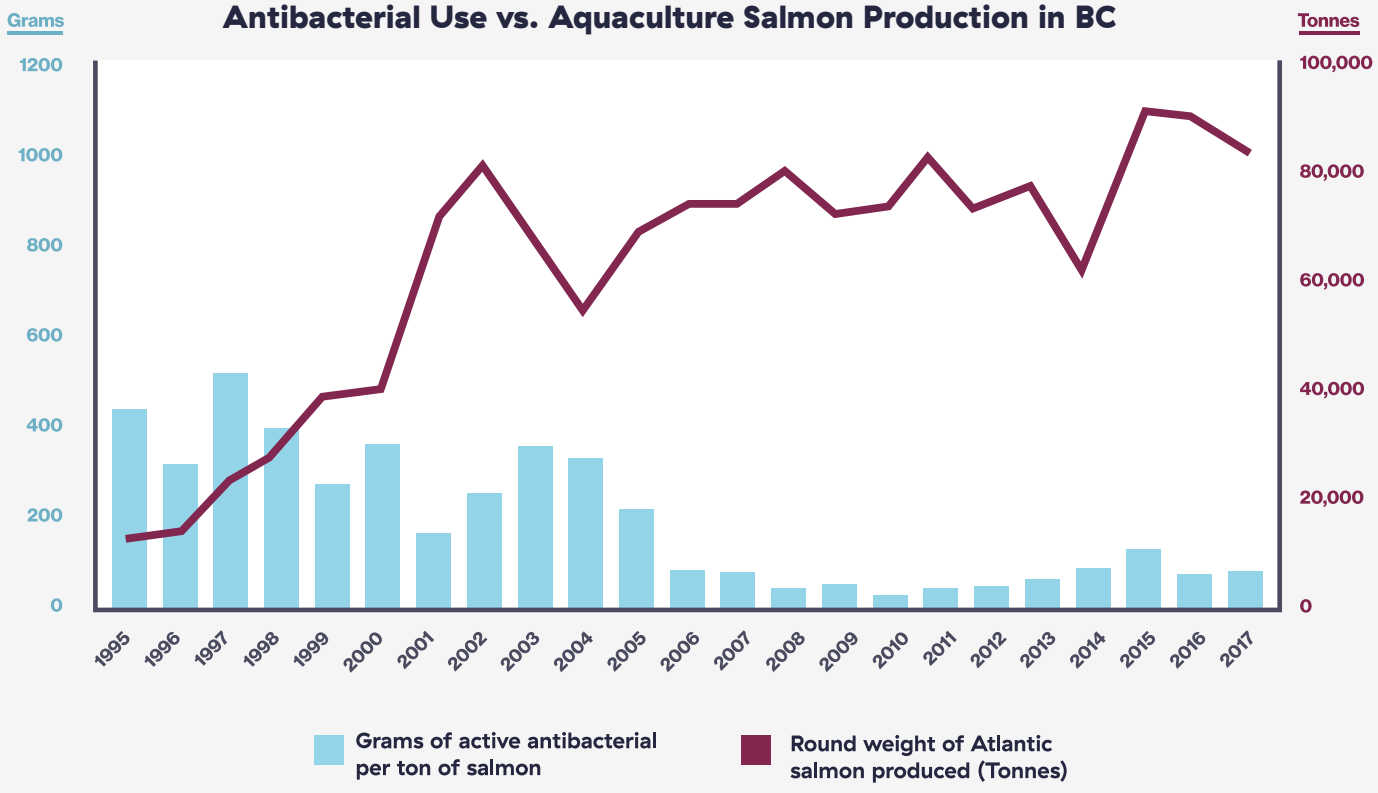
- Medical treatments are a tool for keeping fish healthy.
- Antibiotics have an important role in fish health and are only used when necessary.
- The majority of antibiotic treatments are for two bacterial diseases: Tenacibaculum and salmonid rickettsial septicaemia. With ongoing research into vaccine development, the industry is working towards elimination of antibiotic use in the future.
- Fish illness is managed with treatment products authorized by Health Canada and prescribed by a licensed veterinarian.
- Canadian Food Inspection Agency monitors the use of fish treatments to ensure treated salmon are safe to be consumed.[11]

Food for thought.

Even with increased salmon production, there has been a general decline in antibacterial use in BC attributed to the introduction of more effective vaccines for bacterial diseases and other advances in health management.[25]

Antibiotic Use in BC Aquaculture Salmon Production

With innovative fish health management, the use of antibiotics in BC has declined significantly even when the production of salmon has increased.



Fisheries and Oceans Canada, 2018

PRV

Piscine Orthoreovirus (PRV) is endemic in the marine environment of many countries and has been found in a variety of wild salmonid and non-salmonid fish. The strain of PRV identified in BC is genetically different from strains found in other areas of the world. Scientifically monitored exposures of Pacific and Atlantic salmon to the BC strain of PRV have not induced disease or mortality.

BC salmon farmers fully endorse the federal government's recent decision to allocate resources towards PVR screenings in freshwater hatcheries and health audits at marine farm sites. This will not only help to inform government policies and regulations but will also provide assurance to industry that problematic PRV strains are not present in BC waters.

Food for thought.

BC salmon farmers do not import fish from other countries. Our fish are grown here and enter the ocean as healthy smolts. Studies have shown that they only become infected with PRV once they're in the ocean environment and the virus is not causing farm-raised salmon to become ill.

Food for thought.

Our Commitment: To hold the well-being of our fish and animal health in the highest regard, optimizing production to minimize stress wherever possible.

Research Updates

Several industry supported research projects have increased our knowledge of PRV in BC.

- **PRV — Fitness of Sockeye Salmon**
  PRV load was not seen to cause physiological harm to juvenile sockeye salmon in seawater and Sockeye and Atlantic salmon with PRV loads similar to those seen in PRV-infected farmed & wild salmon had no consistent or major changes to maximum oxygen uptake, transport and capacity, basal metabolic rate, routine activity and capacity to tolerate severe hypoxia.
- **PRV — Environmental Reserves**
  All net-pen farmed Atlantic salmon in BC are expected to become infected with PRV during the first 6 months and will remain infected until harvest. PRV can be detected in seawater around some net-pens at various times during production but not in at least one non-farming area. Currently the source or infectivity of the PRV around farms is unknown and resident non-salmonid fish around farms are unlikely to be the source of PRV as evidenced by bycatch screening.
- **PRV — Resident Wild Species Around Salmon Farms**
  Only PRV1 has been found in BC to date. PRV 1 from wild and farmed Coho/Chinook is distinct from that of Atlantic salmon. PRV1 from the Canadian/US Pacific coast is not closely related to Atlantic Canada PRV1 and is more distantly related to Norwegian/Chilean PRV1. History movement of non-native fish between regions may influenced the genetic patterns of PRV1.

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R&D

RESEARCH AND DEVELOPMENT (R&D) is a cornerstone of maintaining a sustainable industry. BC salmon farmers invest significant resources to operate more efficiently, grow healthier fish and to better understand wild salmon populations and the marine environment.

Marine Environmental Research Program

$1.5 million industry dollars has been committed to the Marine Environmental Research Program (MERP) over 5 years (2015—2020) prioritizing research to fill knowledge gaps on marine species and the environment, and particularly on the health of wild salmon stocks.

Several MERP projects provided results in May at the 2019 Collaborations on the Coast Workshop. Projects are highlighted through this report and below.

Food for thought.

The recently published, BCSFA: Innovation & Technology Report 2019, shows tremendous evolution in technology sophistication since the 1970's. www.raisingopportunity.ca/technology-report

Research Updates

- Salish Sea Marine Survival Program — The survival of hatchery reared fish is 50–60% less than wild fish and critical mortality periods occur in the early marine period and over the first winter. Primary factors in the declines in Coho, Chinook and Steelhead in Puget Sound and Strait of Georgia were food, predation, and quality of the environment.
- Monitoring Stomach Content of Farm-raised Salmon in BC — Through 2017–2019, stomach contents of 14,100 farmed Chinook and Atlantic salmon were examined. Results showed a very low ~0.08% predation prevalence which is similar to previous studies (Hay 2004 and Johannes and Hay 2006). 80–90% were likely Herring, which aligns with farm incidental catch data.
- Investigations in Gill Health — Gill health is an emerging issue in BC and ongoing research was identified to better understand relative roles of infectious and non-infectious processes affecting gill health, gill health issues in wild and farmed fish and the effect of exposure to net-wash effluent. The available data suggest that at some sites there is an association between certain harmful algae and increased gill scores. In addition, laboratory studies conducted at PBS indicate that exposure of salmon to the effluent from net-washing increases the risk of gill pathology. The research has shown a low frequency of gill pathology in juvenile wild salmon from numerous sites in coastal BC.
- Investigations of Perch Health Profile in Consideration as a Cleaner Fish in BC — When considering the use of perch as cleaner fish to remove sea lice from Atlantic salmon, a key consideration is that the cleaner fish do not cause disease issues in sea cages. A health survey of perch species indicated no viral or bacterial agents identified and relatively common parasitic crustacean infections were present.
- The multi-year research project Comparative Susceptibility to Sea Lice Among Salmon Species in the North Pacific has shown sea lice have a broad range of hosts and highly variable interactions among host species. Innate immune mechanisms were seen to exist in highly resistant Pacific salmon species that may be informative for the management of sea lice on farmed Atlantic salmon. The consequences of synergistic co-infection were identified as requiring greater attention.

Technology

BC salmon farmers are leaders in the research and implementation of a wide range of innovations and technologies that directly target enhanced environmental sustainability while ensuring the welfare of the farmed fish under their care.

Throughout its history, the industry has conceived, tested, and implemented state-of-the-art innovation focused on protecting the marine environment and its resources, wild stocks of Pacific salmon, marine mammals, and freshwater resources.

> **As society has raised its environmental awareness, the BC salmon farming industry has continuously expanded its suite of eco-focused technologies and management practices. The BCSFA Innovation and Technology Report presents a glimpse into the future showing how BC farmers are pro actively anticipating requirements and striving to exceed the high environmental and animal welfare standards.**

John Paul Fraser
Executive Director, BCSFA

Project —

Equipment Energy Optimization and Carbon Footprint Reduction

West Coast Fish Culture identified the replacement of a diesel motor used to wash nets with an electric motor, upgrade an old tugboat engine, and facility electrical improvements as being key to reducing fuel and energy use and reduced air emissions.

Wastewater Treatment

Best Management Practices Focus on Prevention: In response to a sector-wide audit of fish processing BC plants in 2018, BCSFA member facilities have developed and implemented Best Management Practices (BMPs) that emphasize pollution prevention rather than remediation. These BMPs focus on improving the recovery of products and by-products, reducing water use where possible, minimizing the contact time between seafood solids and water, and designing conveyance and pumping systems that minimize the breakdown of seafood solids into finer particles and dissolved solids.

Best Achievable Technologies: In addition to BMPs, BC farmed salmon processing facilities also implement Best Achievable Technologies (BATs) to extensively treat wastewater prior to discharge into the environment. Rather than simply screening, plants now use systems such as dissolved air flotation (DAF) to clarify the wastewater and UV or chlorine disinfection prior to being discharged to the environment. BC farmed salmon processing facilities have invested substantially to update their wastewater treatment technologies to global practices, while working with the Ministry of Environment and Climate Change to update their wastewater permits to meet the new standards.

Land-based Fish Farming

BC salmon farmers, together with our valued indigenous partners, are committed to ongoing research into innovative new technologies that will continue to improve our environmental footprint, ensure protection of wild stocks, while maintaining healthy, delicious salmon for consumers.

BC salmon farmers lead the world in land-based recirculating aquaculture systems. All BC ocean-based farmers raise fish for their first half of their lives in land-based hatcheries and several fish farmers operate smaller land-based grow-out operations.

Land-based salmon farming currently has significant challenges which need to be addressed before it becomes a viable option for full scale commercial production. These challenges include fish health, broodstock development, stocking densities and large requirements for water and electricity.

With demand for healthy fish rising with the world's population and new technology being developed, land-based fish farming will play a larger role in future food production, along with ocean-based farming.

Michelle Franze, BCSFA, and Amanda Luxton, MOWI Canada West, at Dalrymple Hatchery, MOWI Canada West.

Our Membership

The BC Salmon Farmers Association (BCSFA) has 70 members, representing a range of salmon farmers, suppliers, partners and supporters from around British Columbia and beyond.

For contact information see bcsalmonfarmers.ca/members

AKVA Group

AON Reed Stenhouse Inc.

Aqua Pharma

Aqua–Pak & Noboco

Aqua–Terra Consultants

Aquatrans Distributors Inc.

Badinotti Net Services Canada Ltd.

BioCatalytics

Biomark

Brown's Bay Packing Company

Brunswick Jetters Ltd.

Cargill Aqua–Nutrition Canada /EWOS Feeds

Cermaq Canada Ltd.

Comox Valley Economic Development Society

CPI Pumps & Irrigation Ltd.

Creative Salmon Co. Ltd.

Cummins Western Canada

DB Schenker of Canada Ltd.

DESS Aqua Canada AS

District of Port Hardy

DIVESAFE International

Dynamic Systems Analysis Ltd.

Ecomerden AS

Elanco Canada Limited

Excel Career College

Flurer Smokery Ltd.

Flying Fresh Air Freight

Fuerste Vaccination Services

Gemini Marine Services Ltd.

Golden Eagle Aquaculture Inc.

Grieg Seafood BC Ltd.

Hardy Buoys

Intership BC Ltd.

Island Instrumentation Services Ltd.

James Walkus Fish Co. Ltd.

Kitasoo Aquafarms

Kuehne + Nagel Ltd.

Lions Gate Fisheries Ltd.

MERCK Animal Health

Morenot Canada Ltd.

MOWI Canada West

Nautical Consulting International Ltd.

NexGen Hearing Industrial

Njord Marine Services Ltd.

NLB Corporation

Oban Marine Ventures

Ocean Quality North America

Omega Pacific Hatchery Ltd.

Pacific Marine Construction

Passage Marine

Patogen AS

Pentair Aquatic Eco-Systems Inc.

Pharmaq

Phibro Animal Health Corporation

Poseidon Oceans Systems Ltd.

ReelData AI

Realtime Aquaculture

Saeplast America Inc.

Saltstream Engineering Ltd.

ScaleAQ

Sea Roamer Marine Services

Skretting North America

Syndel Laboratories

Taplow Feeds

Tidal Enterprises Ltd.

Tlatlasikwala First Nation

TRI-GEN Fish Improvement Ltd.

West Coast Fishculture (Lois Lake) Ltd.

West Coast Reduction Ltd.

Wilbur-Ellis

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BC SALMON FARMERS ASSOCIATION

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