BC Salmon Aquaculture Transition:

Then & Now

BC SALMON FARMERS

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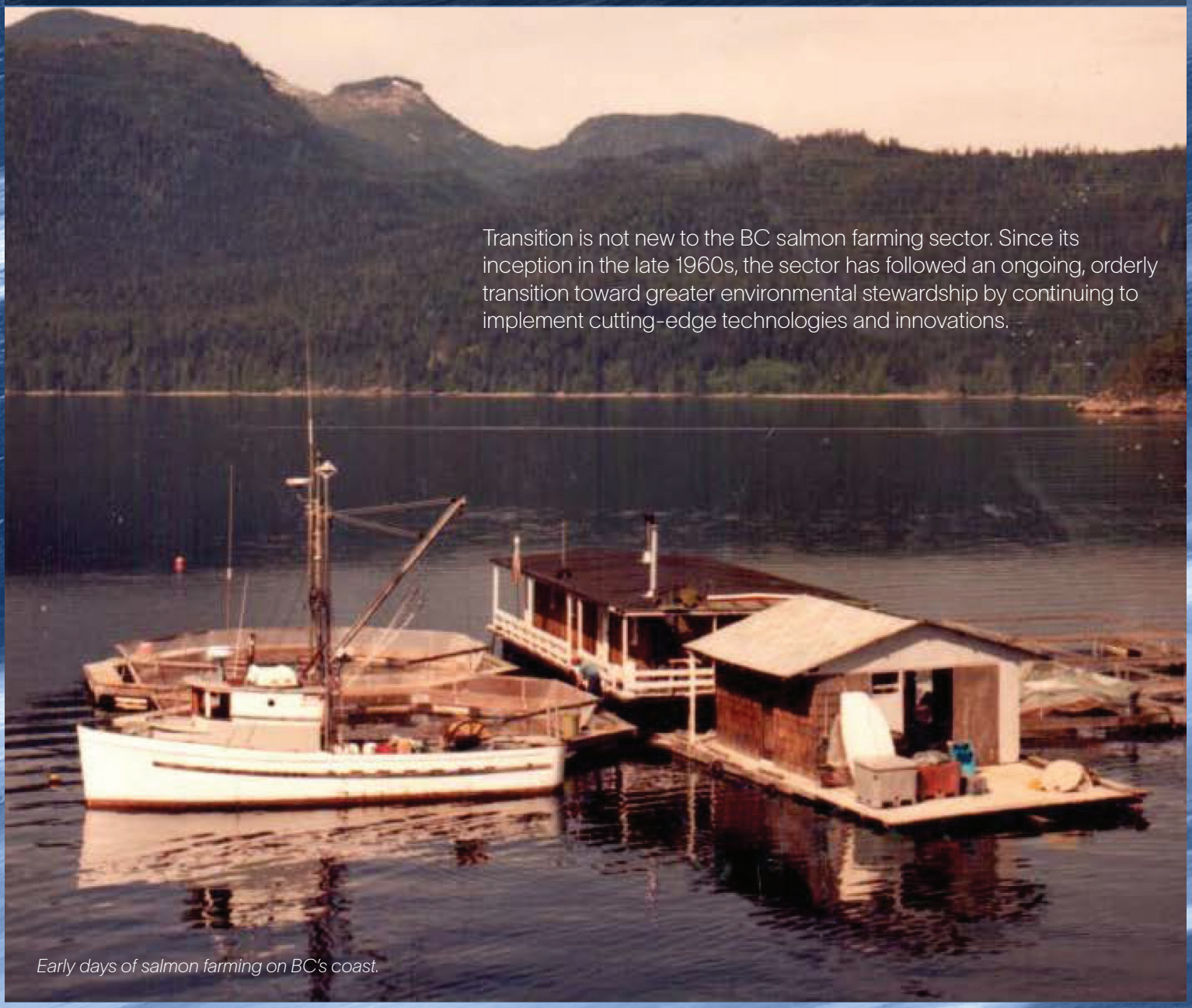
Transition Then...

Transition is not new to the BC salmon farming sector. Since its inception in the late 1960s, the sector has followed an ongoing, orderly transition toward greater environmental stewardship by continuing to implement cutting-edge technologies and innovations.



Early days of salmon farming on BC's coast.

Environmental Performance

Salmon Farm Siting

In the beginning:

During the early years of salmon farming in BC, the ocean conditions needed for optimal farmed salmon growth and development – together with protection of the ocean floor ecosystem – were not well understood. As a result, some farms were situated in areas where salmon farming was not compatible with environmental sustainability.

Today:

Comprehensive siting criteria ensure that farms are situated well away from species at risk, critical habitats, salmon bearing streams, and other important ecosystem components. After a suitable location that meets these criteria is identified, modelling is carried out to ensure that the amount (biomass) of fish to be cultured is within the carrying capacity of the receiving environment. Regulations establish thresholds that limit the intensity and extent of the impact that the farm may have. These rigorous thresholds are set to ensure that any impacts are temporary and that recovery will occur in a brief and reasonable timeframe.

Containment Systems

In the beginning:

Early net pens were primarily constructed from wood with nylon knotted netting similar to that traditionally used in the fishing industry. The pens were often moored to the seabed using cables attached to one-ton pieces of concrete. Unable to withstand the winds and tides in exposed coastal areas, the pens were situated in protected waters – often in areas where the marine environment was less suited to supporting sustainable salmon farming.

Today:

Net pen systems have evolved significantly from their wood-based predecessors. Ocean pens are now constructed from steel or high-density polyethylene – and are engineered, built, and anchored to the specifications of the operational environment. The net enclosures are manufactured from modern polymers that provide excellent and long-lasting durability, strength, and reliability. Current net pens are anchored to the seabed via sophisticated mooring systems designed and modelled by engineering firms to ensure fitment for the conditions of the infrastructure and the site e.g. engineered to dampen the forces generated by site-specific wave motion. The strength and durability of these innovations allow containment systems to be situated at exposed marine sites with greater capacity to support environmentally sustainable salmon farming – and have reduced fish escapes to almost zero in recent years.

Feeding Systems

In the beginning:

Early feeding practices consisted of hand-feeding – where feed was thrown onto the surface of the water. The amount fed was dependent upon observations by the farm worker throwing the feed – who based feeding decisions on surface feeding behavior.

Today:

BC salmon farms now use sophisticated models, real time feedback, and automated feed delivery systems that evenly distribute a set amount of feed throughout the pen at designated times; these innovations optimize fish performance and feed consumption. While feeding, salmon behaviour is closely monitored primarily via underwater video cameras. Automated delivery and underwater monitoring ensure that only the amount of feed that salmon will eat is delivered to the pen; this significantly reduces the amount of feed that falls to the ocean floor, thereby supporting a healthy benthic ecosystem.

Feed Ingredients

In the beginning:

Early feed formulations were dependent on fishmeal and fish oil as the primary sources of dietary protein and fat.

Today:

To reduce the industry's dependency on wild fisheries, aquafeed companies are increasingly replacing wild-caught protein and oil sources with alternative plant and animal sources. New sustainable raw ingredients being incorporated into feed include: certified soy and palm oil products, soy protein concentrate, maize gluten, guar meal, and by-products from cereal processing & oil seeds. These alternative and novel raw materials have enabled fish feed companies to develop some salmon feed formulations that are completely fishmeal-free while delivering equal performance in terms of fish growth and health.

For feed formulations that do require marine oil and/or protein, aquafeed companies are increasing their usage of seafood trimmings and locally sourced by-products. The use of trimmings and by-products from wild fisheries upcycles 'waste' materials into healthy fish feed. Up to 30% of the marine oil and proteins utilized in some feed formulations is now derived from seafood trimmings and by-products.

Antibiotic Use

In the beginning:

Livestock and poultry farmers have used antibiotics to treat and prevent disease, increase feed conversion, and preserve food since the 1930s. Due to the lack of fish vaccines, early salmon farmers followed the lead of livestock and poultry farmers, using antibiotic for the treatment of bacterial diseases.

Today:

Continually improving health management practices, combined with vaccination against common pathogens, have facilitated a significant reduction in the use of antibiotics on BC salmon farms. For example, between 1997 and 2017, the use of antibiotics on BC salmon farms declined from 516g to 59g per ton of salmon (89% decrease). Currently, less than 5% of farmed salmon require antibiotic treatment. BC salmon farmers are striving to reduce usage even further – with the goal of eventually eliminating all use of antibiotics.

Dr. Terra MacDonald, certified veterinarian with Mowi Canada West.

Protection of Wild Salmon

The 2012 Cohen Commission of the Inquiry into the Decline of Sockeye Salmon in the Fraser River concluded

"Data presented during this Inquiry did not show that salmon farms were having a significant negative impact on Fraser River sockeye".

Rather, the Cohen Commission and other investigations identified a string of cumulative factors as contributors to the decline of wild salmon; these factors include: climate change, a long history of overfishing, impacts to watersheds from logging, urban development, industrial pollution, fishing interceptions outside of BC, and competition with ocean ranching in Alaska, Japan, and Russia.

While there is no evidence that salmon farming is contributing to the decline of wild salmon, many of the sector's innovations are focused on ensuring the sustainability of wild salmon populations. Stronger understanding of surrounding wild salmon populations inform risk mitigation, operational strategies, and innovation development.

Comprehensive Vaccine Programs

In the beginning:

Globally, fish vaccines were in an early developmental phase until the mid/late 1990s. During this phase, vaccines existed only for a limited number of bacterial infections (e.g. vibrio); vaccines against other diseases were less effective, had side effects, and were extremely expensive to develop and produce.

Today:

When disease free, vaccinated juvenile farmed salmon are transferred from hatcheries to ocean net pens, they are challenged by bacterial and viral pathogens that exist naturally within wild salmon populations. Vaccines have been developed against many of the common bacterial and viral pathogens that impact farmed salmon. Vaccination of all juvenile farmed salmon before transfer to the marine environment significantly increases farmed salmon health and reduces the potential of disease transfer to and from wild stocks.

Stringent Fish Health Testing

In the beginning:

Few diagnostic tools had been developed to evaluate the health status of farmed salmon.

Today:

Salmon farmers have developed a sophisticated suite of diagnostic tools – and are going even further with ongoing research and development to continually improve and refine diagnostic testing of both fish and the environment. Fish health testing prior to transfer to the marine environment ensures that only healthy juvenile farmed salmon enter the ocean.

Sea Lice Prevention and Treatment Strategies

In the beginning:

While the species of sea louse most commonly reported on wild and farmed salmon in the Pacific Ocean off BC's coast is *Lepeophtheirus salmonis (L. salmonis)*, infections and impact from *L. salmonis* infestations were very rare on BC salmon farms. BC aquaculture veterinarians therefore did not consider sea lice to be a serious health concern for farmed salmon.

In addition to the low pathogenicity of the Pacific *L. salmonis*, veterinarians also knew that large populations of wild salmon carry significant sea lice loads – and have developed species-specific levels of sea lice resistance. As a result, they did not consider that the limited number of sea lice on salmon farms could impact the already significant sea lice numbers occurring naturally within populations of wild salmon.

Today:

Aquaculture veterinarians in BC continue to consider that: (1) *L. salmonis* poses a low health risk for farmed salmon; (2) *L. salmonis* from salmon farms do not contribute significantly to the total sea lice loads found in populations of wild salmon. While salmon farms in BC are not scientifically a concern in regard to *L. salmonis*, it has become a topic of concern for the public. Therefore, as responsible stewards of the marine environment, BC salmon farmers have now developed a full suite of sea lice enumeration methods, prevention strategies, and treatment options to keep sea lice levels below the regulatory threshold. Sea lice numbers are routinely monitored at all BC farm sites to enable optimal use of management tools and minimize risk to wild salmon. Enhanced sea lice and thresholds monitoring is implemented during the juvenile salmon out-migration period to confirm that sea lice levels on farms do not exceed the regulatory threshold.

Wastewater Treatment Innovations

In the beginning:

Prior to discharge into the marine environment, wastewater from the processing of wild and farmed salmon was historically passed through a screen to remove particulate matter.

Today:

While wild salmon processing plants continue to primarily rely on screens to remove particulate matter, facilities processing farmed salmon are now equipped with innovative wastewater treatment technologies – including UV and chlorine treatment – that support the health of the marine environment and minimize potential pathogen transfer to wild fish stocks.

Summary: Environmental Performance

Through this ongoing transition to achieve higher standards of environmental responsibility, the BC salmon farming sector now has the smallest environmental footprint of all animal protein-producing industries. With a low carbon footprint, low land use, low water consumption, and efficient feed conversion ratio, farmed salmon contributes a healthy and climate-friendly protein source to the world's food needs. According to the High Level Panel for A Sustainable Ocean Economy: "The largest potential (carbon reduction) gains for food production lie in the sustainable expansion of marine aquaculture."

Sustainability Metric					**Unit of Measurement**
Carbon Footprint	0.60	0.88	1.30	5.92	Carbon dioxide equivalent (g CO2eq) per typical edible protein
Land Use	3.7	7.1	11.0	102	Area (m2) to produce 100g of protein
Water Consumption	2,000	4,3000	6,000	15,400	Litres per kg of edible meat
Feed Conversion	1.2–1.5	1.7–2.0	2.7–5.0	6.0–10.0	Kilograms (kg) needed to increase the animal's bodyweight by 1kg
Edible Yield	68%	46%	52%	—	Edible meat/total body weight

Indigenous Reconciliation

In the beginning:

The provincial and federal governments permitted salmon farming companies to choose sites without adequate government consultation with the First Nations in whose territory the farms were operating. Not all First Nations had input into siting locations or the environmental performance of farms in their territory – and many received no economic benefit from their operation.

Today:

Many Nations and salmon farming companies are on a journey of reconciliation. The sector's evolution to higher environmental standards has been aided by partnership agreements forged between BC salmon farmers and BC First Nations over the past 20 years. In many of these agreements, the level of environmental performance stipulated by the First Nation partner exceeds that required by Federal regulation. Often, Indigenous guardians monitor farm sites and independent biologists ensure that the production is done according to sustainable principles established by First Nations and companies.

The agreements between BC salmon farmers and BC First Nations demonstrate the role that partnerships can play in achieving meaningful reconciliation. Seventeen First Nations now hold beneficial partnership agreements with BC salmon farmers. Each of these agreements is founded upon the recognition of First Nations' rights, including the right to exercise jurisdiction over the land, resources, and waters within their territories – rights that form the very core of the reconciliation process.

Each of these partnerships brings significant socioeconomic benefits, business opportunities, and jobs to Indigenous communities – many of which have struggled with economic hardship resulting from declines in resource industries. Partnerships also establish a commitment to work collaboratively – combining expertise and knowledge – for the preservation and protection of wild salmon.

Economic Lifeline for Remote Coastal Communities

In the beginning:

Like Indigenous communities, the economies of other remote coastal communities in BC also suffered greatly from the decline of resource industries.

Today:

The development of sustainable salmon farming has offered these communities an economic lifeline by creating a diverse range of supply and service business opportunities – as well as a significant number of direct and indirect jobs. Jobs within the salmon farming sector pay approximately 30% more than the median employment income in BC.

Food Security and Canada's Blue Economy

In the beginning:

In 1986, BC produced 391 tonnes of farmed salmon with a value of 2.7 million.

Today:

BC farmed salmon is the province's #1 seafood export and #1 agri-food export. In fact, it is BC's 10th most important export commodity overall. For example, in 2019, BC Salmon Farmers Association members produced 83,180 tonnes of farmed salmon valued at $771 million, creating 353 million meals of high-quality protein. The sector plays a significant role in bringing greater strength and resilience to the province's food-supply chain.

British Columbia chef holding a farm-raised organic King (Chinook) salmon.

Transition Now... Net Pen Transition Plan

Modern feeding systems are part of BC salmon farming.

Net Pen Transition Plan

While the BC salmon farming sector's high standard of environmental responsibility has been recognized by multiple independent, global certification systems, BC salmon farmers regard their current achievements as a snapshot of their ongoing transition toward technologies, tools, and innovations to reduce their impact on the environment even further.

Two significant structural changes currently taking place in the BC salmon farming sector are stimulating the next phase in the sector's ongoing transition to enhanced environmental performance:

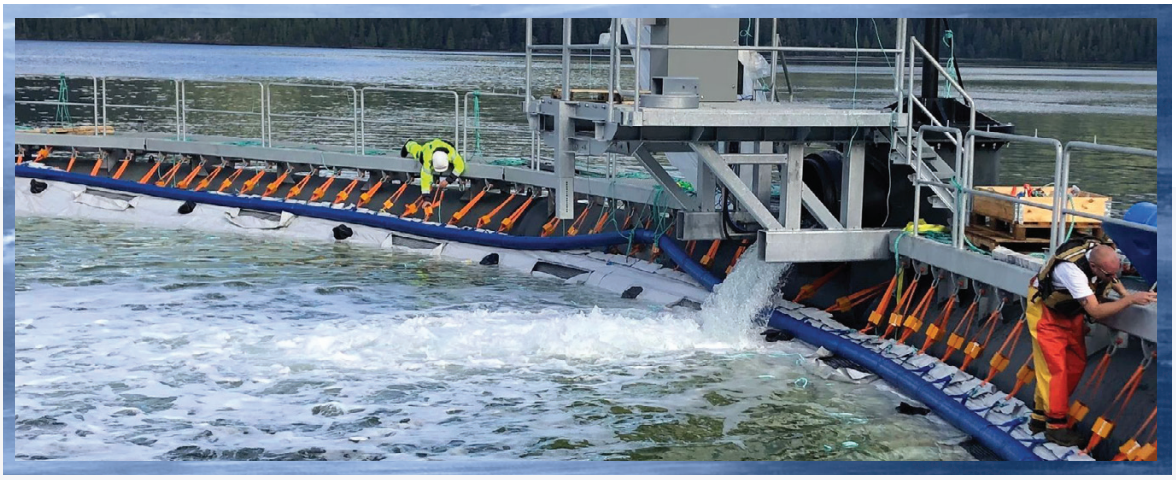
- First Nations have stepped forward to assume leadership in guiding the sector's future growth and development.
- Through its development of a new framework for sustainable salmon farming (Net Pen Transition Plan), DFO is expressing a strong and clear vision for the future of the sector.

Together, these critical changes have the potential to create a level of business certainty that will allow BC salmon farming to play an even greater role in the ongoing process of reconciliation in BC. It will also expand the sector's capacity to contribute to the success of Canada's Blue Economy Strategy by generating the magnitude of economic benefits, jobs, investment, and regional growth that will help to advance BC's economy on a low-carbon, environmentally sustainable, climate-resilient, and competitive pathway.

To further the development of its Net Pen Transition Plan, DFO has released a Framework for Discussion document to guide engagement and consultation activities with the BC salmon farming sector, BC First Nations, and other stakeholders. The following sections present the sector's reflections and recommendations regarding the Framework for Discussion document.

Sector Vision of Transition:

Working alongside our Indigenous partners, the BC salmon farming sector is founded upon an inclusive, ecosystem approach to management that progressively enhances the sector's environmental performance, with a special focus on wild salmon protection, through the development and implementation of innovative tools and new technology. Increased business certainty resulting from greater public and government awareness of the sector's high environmental standards facilitates further growth and development, resulting in stronger socioeconomic development for coastal communities – and an even greater capacity to contribute to Canada's Blue Economy.



Cermaq Canada's semi-closed containment system at their Millar Channel site.

BCSFA Fundamental Principles of Transition Plan:

1

First Nations Right to Self-Determination

The Transition Plan must fully recognize and support Indigenous rights to self-determination and the rights of First Nations to make informed decisions on matters that impact their territories.

2

Reconciliation

The Transition Plan must ensure continued opportunity for capacity building within Nations and equitable economic opportunities – as well as establish a framework for enduring long-term relationships.

3

Governance

The Transition Plan must include a governance model based upon tripartite agreement (First Nations, federal, and provincial governments) – and provide a robust role in governance and oversight for Indigenous rights holders in whose territories the salmon farms operate.

4

Sustainable Sector Growth

The Transition Plan must support the creation of an attractive business environment that signals Canada is committed to advancing growth in sustainable salmon farming in coastal BC. A transition growth plan that builds towards increasing production volumes.

5

Alignment with Federal Initiatives

The Transition Plan must support investment in innovative practices and technology, and other federal government priorities, especially the Climate Change Plan and Blue Economy Strategy.

6

Trust and Transparency

The Transition Plan must provide clear communication processes and outlets, including engagement opportunities, that will help to foster a better understanding of the industry and create trust and transparency with local First Nations who have aquaculture within their territories, as well as First Nations who have an interest, and the broader Canadian public.

Design Features of Transition Plan:

Licences

DFO Framework for Discussion document (page 8):

Indicates that by operating under higher standards of performance, salmon farms would gain the security of a longer term licence.

Sector Input:

The sector recommends that, to enable development and implementation of innovations and new tools and technologies, licences must be issued for terms long enough to provide security for significant investment. Consideration should be given to amending the Fisheries Act to allow for licences longer than 9 years to provide security for higher financial risk initiatives.

Developmental Licence

DFO Framework for Discussion document (page 7):

Indicates that the department is considering the concept of a developmental licence.

Sector Input:

The sector encourages DFO to consider novel licencing initiatives (e.g., developmental licence) that support the implementation and trialing of innovations and new technologies that further enhance the sector's environmental performance. DFO could establish a developmental licence for the development and trialing of cutting-edge innovations and technologies that support the ongoing evolution of the sector's environmental performance. Given the associated higher risk, developmental operations would require long term licences (minimum 9 years) and other incentives (e.g., such as increased biomass above that of existing licences) – as well as R&D and other financial support from government. Similar to the Norwegian model, this type of license should provide a clear pathway for transitioning from a developmental licence to the operating licence held by the majority of salmon farming operations.

Enhanced Environmental Performance

DFO Framework for Discussion document (page 2):

States that the Transition Plan will detail an expected and quantifiable set of metrics for type, scale, and timing of results to progressively minimize or eliminate interactions between cultured and wild salmon.

Sector Input:

BC salmon farmers support establishing clear objectives, metrics and targets that progressively minimize or eliminate harmful interactions between farmed and wild salmon. The sector recommends that the following areas require significant consideration during the identification of all tools, metrics, and targets.

a. **Tools**

   i. **Developmental and implementation timeframes**

   Framework for Discussion document (page 5):

   States that the Transition Plan should consider other key factors such as technological development timelines.

   Sector Input:

   The sector strongly supports DFO's perspective that the time required to develop and implement new technology – as well as expand green power capacities – must be factored into the timeframe established for the achievement of a performance target.

ii. Ecosystem approach to management

Framework for Discussion document (page 9):

Proposes participation in area-based production planning as a new tool to support enhanced performance.

Sector Input:

The sector strongly supports the inclusion of an ecosystem approach to management Ecosystem Approach to Management (EAM), which is inclusive of Traditional Ecological Knowledge (TEK), as an enhanced environmental performance tool. EAM will facilitate the integration of salmon farming within the wider ecosystem in such a way that it promotes sustainable development, equity, and resilience of interlinked social and ecological systems. EAM will lead to better environmental, social and economic outcomes, improved resilience to climatic variability, and consideration and management of multiple external threats and cumulative impacts at relevant scales.

iii. Flexible implementation

Framework for Discussion document (page 7):

Indicates that rather than mandating the use of specific technology, the Transition Plan will incentivize the adoption of new management tools that are capable of helping a salmon farm reach a specified performance target.

Sector Input:

To ensure success, the sector recommends that the Transition Plan must provide each operation with sufficient flexibility to allow the selection of tool(s) to achieve a specific target to be based on factors such as First Nations priorities, regional characteristics, and species cultured. Based on these factors, the license holder would develop a plan outlining the tools that would be most suitable to achieve the performance target.

iv. Climate action and climate response

Framework for Discussion document (page 2):

Proposes the Transition Plan vision as: Advance innovation and growth in sustainable aquaculture in British Columbia that progressively reduces or eliminates interactions between salmon open-net pens and wild salmon while also taking into account social, cultural and economic objectives.

Sector Input:

The sector recommends that the vision should be clarified to refer to "harmful" interactions, and should be expanded to take climate objectives into account. Enhanced environmental performance tools must support the sector's capacity to undertake climate action and climate response in the context of Canada's vision for GHG reduction, food production, and food security.

b. Metrics and Targets

i. Need for scientific consensus

Framework for Discussion document (page 12):

States that enhanced target metrics would be based on the best available science.

Sector Input:

Given the existence of divergent scientific information regarding some areas of salmon farming, the sector feels that the phrase 'best available science' requires further refinement. The sector therefore recommends revised wording that incorporates findings from the Report of the Independent Expert Panel on Aquaculture Science:

> *'Enhanced metrics and performance targets established to measure and evaluate the sector's environmental performance must be based on best practices for synthesizing available scientific evidence on aquaculture risks. This includes incorporation of Indigenous and local knowledge as well as the use of systematic reviews, external peer review and other universally accepted standards.'*

ii. Variable Targets

Framework for Discussion document (page 12):

Suggests that target metrics could vary based on coastwide or regional environmental, social, and technical factors...

Sector Input:

Target metrics should be Indigenous led and include Traditional Ecological Knowledge (TEK) and Ecosystem Approach to Management (EAM).

iii. Evaluation of progress

Framework for Discussion document (page 7):

States a goal of the Transition Plan would be to define incremental improvements in environmental performance which would provide evidence of a move to progressively minimize or eliminate interaction between cultured and wild salmon. On page 13, the document recognizes that innovations implemented to bring about these improvements in environmental performance must have room for both success and failure.

Sector Input:

The sector understands the need to define incremental improvements in environmental performance to evaluate progress toward the performance target. However, it is essential that evaluation of incremental performance be sufficiently flexible to allow for setbacks or failure – so that operations not showing a consistent rate of improvement are not considered to be out of compliance. This will provide the security required for the sector to invest in new technologies and innovations to achieve these incremental improvements.

Social/Cultural and Economic Performance

DFO Framework for Discussion document (page 2):

Proposes a vision for the Transition Plan that includes "taking into account social, cultural and economic objectives." On page 5, the document identifies industry competitiveness and viability and community economic considerations as key factors that the Transition Plan should consider.

Sector Input:

In order to take social, cultural, and economic objectives into account, the sector recommends that metrics should also be established to evaluate the following:

- Social/cultural and economic wellbeing of Indigenous and non-Indigenous coastal communities where salmon farming contributes to the local/regional economy.
- Consideration of the important keystone role salmon aquaculture plays in supporting marine based industry supply chains, infrastructure, and professional service capacity (including fish health, production and environmental expertise to support emerging wild salmon protection initiatives).
- BC salmon farming's viability and its capacity to contribute to the success of Canada's Blue Economy Strategy that seeks to "grow Canada's oceans economy to create good middle-class jobs and opportunity for coastal communities."

Education / Training

DFO Framework for Discussion document (page 20):

Proposes that DFO could incentivize transition by providing support for recruitment and training to maintain a highly skilled employee pool.

Sector Input:

The level of support needed for recruitment and training is dependent upon the level of business certainty. The skill level of the current workforce is fully capable of supporting the sector's transition. Rather than being limited by skill level, sector transition efforts may be limited by challenges in attracting and retaining workers. Given the current level of uncertainty, individuals seeking to establish a career are less likely to choose to participate in the BC salmon farming sector – and current workers may elect to seek employment in other salmon farming jurisdictions or sectors. The difficulties in attracting and retaining workers could be easily rectified by improving the investment climate through actions such as extending the length of licences to a minimum of 9 years.

In an environment that supports investment in sustainable salmon farming, the sector will be able to increase recruitment and training of young people from coastal and Indigenous communities. While existing post-secondary institutions with fisheries and aquaculture programs currently face enrolment challenges due to sector uncertainty, greater certainty would allow these institutions to gear up to meet the training requirements of new entrants.

Trust and Transparency

DFO Framework for Discussion document (page 2):

States that one of the objectives of its Transition Plan is to improve trust and transparency in processes which assess and respond to new scientific information, demonstrating clear and quantifiable improvement in sustainable performance, ensuring Canadians have confidence in management of aquaculture.

Sector Input:

To ensure Canadians have confidence in the regulation and performance of the BC salmon farming, the sector recommends that the Transition Plan should detail how DFO will initiate a program to proactively communicate:

- The science upon which the Transition Plan is based
- The processes used to assess and respond to new scientific information
- The processes used to monitor and evaluate performance of the sector
- The environmental performance of the sector as determined by DFO monitoring and evaluation

This should include a dedicated DFO communications position that is adequately resourced, to proactively communicate to the public.