

Scaling Investment into Sustainable Aquaculture in British Columbia

An Indicative Guide for Canadian Policy Makers

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Contributors

The author would specifically like to thank Jenna Stoner, Senior Aquaculture Analyst of the Sustainable Fisheries Partnership for her significant contribution to the report.

The report's information and conclusions have been gathered through a series of articles, interviews and discussions with international industry experts, institutional investors, non-governmental organizations and other relevant stakeholders. Much of the contents specific to BC were sourced from 23 interviews conducted throughout June 2019 with regional experts.

Acknowledgements

The format and basis for the report was based on the information and framework presented in the report *Towards a Blue Revolution*, authored by The Nature Conservancy ("TNC") and Encourage Capital, and the report is intended as an application of this information to the British Columbia ("BC") aquaculture industry. The author has maintained independence and autonomy over the report's contents and the selection of individuals that were interviewed during its preparation, and the views and recommendations expressed in this report are his own. While the report is intended to guide policy based on specific findings, further investigation into the details of those findings is suggested before they are used to make any policy decisions.

Methodology

Research, analysis and report authoring was undertaken by Jason Carter and was kindly made possible by the [Tides Canada Foundation](#) through Tides Canada Special Initiatives.

About the Researcher/Author: Jason Carter

Jason Carter created and led the structure for North America's first investment vehicle focussed exclusively on sustainable aquaculture from conception to operational launch. As an impact investment fund in exclusive partnership with Ocean Wise Conservation Association, the vehicle was structured to invest in the expansion of established aquaculture production facilities that were recommended sustainable by the Ocean Wise Seafood Program. Through assembling a diverse team of professionals offering exemplary experience in aquaculture, seafood sales and marketing, marine science, corporate governance, investment management, capital markets, finance and law, the vehicle had the requisite in-house experience to evaluate and support investments into often complex sustainable aquaculture technologies. While most impact investors in the space employ equity-investment strategies, development of specific debt-like vehicles such as the one Jason structured would provide critical additional financing to support innovative, capital intensive sustainable production systems where commercial bank financing is often challenging to secure.

Prior to that, Jason helped established Europe's first diversified royalty financing company, pioneering the finance method with European institutional investors. He helped the company raise £35 million for its initial round from a roster of investors including three of the top ten largest fund managers in the world. Jason has a degree in finance from Western University.

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Executive Summary

As pressures mount for global food systems to transition toward more sustainable production methods, aquaculture, now the fastest growing form of food production on earth, is recognized as having a critical role to help fulfill the growing demand for animal protein. Unfortunately, conventional aquaculture has outpaced regulation in many regions and the consequences are increasingly evident, with recent analysis illustrating damaged ecosystems and disease transfer, leading to food safety hazards and a limitation on production licences. These consequences have initiated widespread efforts to develop alternative and more sustainable aquaculture production technologies to keep up with the growing demand for seafood, some of which, after decades of research and development, are now ready for investment at scale.¹

A few of these efforts have been championed by innovative producers in BC, and there is now a significant economic opportunity that could be captured by scaling-up BC's sustainable aquaculture industry. However, BC's sustainable aquaculture industry faces a number of obstacles to capitalize on that opportunity, many of which result from the industry's regulatory environment. The convergence of market-ready innovative technologies, investor appetite and consumer demand have provided an appropriate stage for government to intervene and support a material transition to a more sustainable and economically prosperous aquaculture industry in BC.

The three categories of sustainable aquaculture technologies covered in the report include:

- 1. Land-based recirculating aquaculture systems ("RAS") for all species:** These closed-containment systems are separated from marine ecosystems, nearly eliminating the risk of negative impacts on marine environments, while enabling a more continuous supply versus conventional marine aquaculture, as production variables are more controlled.
- 2. Bivalve and seaweed aquaculture:** Bivalve and seaweed aquaculture is relatively less capital intensive and can help regenerate and maintain marine ecosystems if managed properly.
- 3. Offshore finfish aquaculture systems:** While still in early stages of technological development, offshore production systems (located up to approximately 50km off the coast) offer the potential to produce high volumes of fish in a deep ocean environment, away from sensitive coastal marine ecosystems and with a greater level of automation.

While outside the scope of the report, it must be noted that other potentially sustainable aquaculture and management practices should be considered for shaping aquaculture policy and regulations in BC. To consider the sustainability of other such practices, relevant stakeholder groups should work together to collectively determine both their commercial viability and environmental sustainability.

By ensuring BC's aquaculture facilities are both commercially viable and environmentally friendly, the province can attract more sustainability-minded investors, thereby unlocking both more concessionary capital for developing innovative facilities, and institutional capital for scaling-up those facilities. Doing so would also invite such investors into the capital structure in the beginning stages of facility development, enabling them to guide the scale-up of those facilities in a responsible manner as mainstream investors are attracted into the capital structure at later stages of growth. Without working towards both commercially viable and environmentally friendly production practices to attract sustainability-minded investors, transition to a more sustainable aquaculture industry could be further delayed.²

The assets under management of sustainability-minded investors are rising sharply:

- The estimated assets under management of impact investors, who seek to generate measurable social and environmental benefit alongside a financial return, more than doubled to US\$502 billion in 2018, from US\$228 billion in 2017.³
- The broader market of investors in the United States that integrate Environmental, Social, and Governance (“ESG”) analysis into their financial investment decision making processes was estimated to manage about US\$12 trillion of assets in 2018, up from US\$8.7 trillion in 2016.⁴
- The OECD states that the intergenerational transfer of wealth is estimated at \$41 trillion over the next 50 years, \$6 trillion of which is expected to be directed towards social issues.⁵

Many sustainability-minded are interested in sustainable aquaculture as a way to improve the food system and diversify their investment portfolios, but due to a combination of factors including a lack of expertise required to identify, manage and mitigate risks;⁶ a perception of the entire sector being too high risk, partly explained by increasingly prominent ESG factors;⁷ a lack of investable deal flow; and weak regulatory environments, they have been hesitant to invest in production facilities.

There is a clear role to be played by government to attract investment into BC's aquaculture industry through de-risking mechanisms and policy incentives. By improving regulation of conventional aquaculture and adjusting restrictive regulatory and permitting processes for sustainable production, policy makers can draw investment into the province's aquaculture industry. Further, policies that provide long-term stability over key risks in aquaculture production are more likely to attract investment and increase the bankability of production facilities.⁸

A group of federal and provincial government, industry, non-government organizations and Indigenous peoples are currently engaged in a discussion around how to advance the industry in a sustainable manner, providing the required alignment for advancement of the industry. To capitalize on this, it is critical that government ensure that the path towards this advancement and long-term growth is cleared by attending to relevant policy and regulations to encourage industry development over the next few years.

Government policies should be realigned and adjusted to enable increased investment into sustainable aquaculture in BC.⁹ Primary focusses of adjustments should include making the permitting process and regulatory regime more efficient and working to address the public perception of aquaculture.¹⁰ This should be done through implementing policies that provide meaningful and measurable sustainability metrics that enable accountability and transparency of policy makers and relevant regulatory bodies.¹¹

To that end, the report provides nine recommendations for Canadian policy makers, listed in no particular order of importance.

Recommendation 1: Improved regulation of conventional aquaculture practices. Government should improve regulation of conventional aquaculture and establish a consensus of sustainable aquaculture investment principles backed by public, private, and NGO leaders.

Recommendation 2: Creation of an Advisory Committee to streamline regulations and permitting processes specifically for the sustainable technologies listed in the report. It is evident that regulations and permitting processes have not adapted to enable the development of newer, more innovative sustainable technologies. An Advisory Committee comprised of producers, government officials and key industry experts should explore, define and address the numerous regulatory obstacles for the development of sustainable aquaculture in BC.

Recommendation 3: Creation of a Task Force to identify, evaluate and develop ‘Priority Regions’ for area-based management programs of shellfish aquaculture along BC’s coastline. Priority Regions would act as a strong catalyst for the capturing the seemingly unattended opportunity to build a significant shellfish industry in BC.

Recommendation 4: Tax grant programs. Tax incentives should be considered as an effective tool for helping scale the important yet nascent sustainable aquaculture industry by attracting commercial capital.

Recommendation 5: Loan guarantees. Loan guarantees would reduce risk for lenders and enable equity returns to be leveraged, increasing the investment attractiveness of aquaculture projects that would otherwise have a hard time securing debt financing.

Recommendation 6: Offshore aquaculture considered in the development of Canada’s Aquaculture Act. Policy makers should implement a development license program similar to that of Norway’s, which has been successful in drawing hundreds of millions of investment dollars into the innovation of offshore technologies. Such a development license program for innovative offshore technologies should be integrated into Canada’s potential Aquaculture Act.

Recommendation 7: Low-interest loans for shellfish aquaculture. Low-interest loans would play a critical role in supporting the initial development of shellfish aquaculture.

Recommendation 8: Biomass insurance. With access to government-provided biomass insurance, producers could lower risk for investors and draw significantly more capital into their operations.

Recommendation 9: Creation of innovation centres to support the development of diverse species and technology. These innovation centres could partner with universities' research and development programs to innovate new species for all types of sustainable aquaculture technologies and provide training to new grads looking to start their career in the industry.

For further detail on these recommendations, please refer to Part 6 of the report.

Part 1: Introduction

Report Preparation

Research, analysis and report authoring was conducted by Jason Carter, who has maintained independence and autonomy over the report's contents and the selection of individuals that were interviewed during its preparation. The report's preparation was kindly made possible by the Tides Canada Foundation.

The format and basis for the report was based on the information and framework presented in the report "Towards a Blue Revolution," authored by The Nature Conservancy and Encourage Capital, and the report is intended as an application of this information to the BC industry. Much of the report's contents specifically regarding BC were sourced from 23 interviews conducted through June 2019 with regional and national sustainable aquaculture experts.

Overview

As pressures mount for global food systems to transition toward more sustainable production methods, aquaculture, now the fastest growing form of food production on earth, is recognized as having a critical role to help fulfill the growing demand for animal protein. Unfortunately, conventional aquaculture has outpaced regulation in many regions and the consequences are increasingly evident, with recent analysis illustrating damaged ecosystems and disease transfer, leading to food safety hazards and a limitation on production licences. These consequences have initiated widespread efforts to develop alternative and more sustainable aquaculture production technologies to keep up with the growing demand for seafood, some of which, after decades of research and development, are now ready for investment at scale.¹²

A few of these efforts have been championed by innovative producers in BC. However, advocacy campaigns and other publications have increased consumer awareness of the potential damage caused by conventional aquaculture methods throughout the province. This has led to many consumers blanketing the province's entire aquaculture sector as environmentally harmful, reducing economic prospects even for more sustainable aquaculture methods.

As younger generations of consumers have been educated through such mediums to avoid buying farmed seafood altogether, institutional investors are taking notice, and are concerned that this trend could decrease demand and/or sales prices versus wild-caught alternatives.¹³ Issues such as these will need to be addressed to draw in the capital required to scale sustainable aquaculture in BC.

Due to its ability to align incentives of diverse market stakeholders, finance has the ability to address complex market problems, such as those inherent in BC's aquaculture industry.¹⁴ Indeed, the financial sector is being increasingly recognized as a third potential influence, beyond government and markets, on driving sustainability of the aquaculture industry by integrating environmental standards into the investment due diligence process.¹⁵

The number of sustainability-minded investors is climbing:

- The estimated assets under management of impact investors, who seek to generate measurable social and environmental benefit alongside a financial return, more than doubled to US\$502 billion in 2018, from US\$228 billion in 2017.¹⁶
- The broader market of investors in the United States that integrate Environmental, Social, and Governance (“ESG”) analysis into their financial investment decision making processes was estimated to manage about US\$12 trillion of assets in 2018, up from US\$8.7 trillion in 2016.¹⁷
- The OECD states that the intergenerational transfer of wealth is estimated at \$41 trillion over the next 50 years, \$6 trillion of which is expected to be directed towards social issues.¹⁸

Many such investors are interested in sustainable aquaculture as a way to improve the food system and diversify their investment portfolios, but due to a combination of factors including a lack of expertise required to identify, manage and mitigate risks;¹⁹ an assumption of the entire sector being too risky, partly because of increasingly prominent ESG factors;²⁰ a lack of quality deal flow; and weak regulatory environments, they have been hesitant to deploy capital. Also, because specific ESG data are hard to acquire on a company-level due to the opaqueness and private nature of the industry, such ESG risk assessments are usually performed at a sector level, instead of specifically for the company under evaluation;²¹ thereby directly linking regional and sectoral governance with ESG investor assessments.

There is a clear role to be played by government to attract investment into BC's aquaculture industry through de-risking mechanisms and policy incentives. By improving regulation of conventional aquaculture and adjusting restrictive regulatory and permitting processes for sustainable production, policy makers can draw investment into the province's aquaculture industry; concurrently, producers would be incentivized to meet the social and environmental standards of the sustainability-minded investors.^{22,23} Further, policies that provide long-term stability over key risks in aquaculture production are more likely to attract investment and increase the bankability of production facilities.²⁴

A significant economic opportunity can be captured by scaling-up BC's sustainable aquaculture industry. The convergence of market-ready innovative technologies, investor appetite and consumer demand have provided an appropriate stage for government to intervene and support a material transition to a more sustainable and economically prosperous aquaculture industry in BC.

A group of federal and provincial government, industry, non-government organizations and Indigenous peoples are currently engaged in a discussion around how to advance the industry in a sustainable manner, providing the required alignment for advancement of the industry. To capitalize on this, it is critical that government ensure that the path towards this advancement and long-term growth is cleared by attending to relevant policy and regulations to encourage industry development over the next few years. Specific federal government engagements involving these stakeholders that provide a near-term opportunity to do so include the potential Aquaculture Act and Framework for Aquaculture Risk Management.

This should be done through implementing policies that provide meaningful and measurable sustainability metrics that enable accountability and transparency of policy makers and relevant regulatory bodies.²⁵

Purpose and Audience for the Report

The report provides Canadian policy makers and other government officials an understanding and logical framework for determining how they can support increased institutional investment into BC's sustainable aquaculture industry, enabling long-term economic growth of the sector and international market competitiveness.

To this end, the report aims to achieve the following:

1. Outline the emerging market opportunity of sustainable aquaculture and BC's position within it.
2. Define the business and regulatory challenges of sustainable aquaculture production facilities in BC that could be addressed, along with development opportunities that could be supported, through government policy and regulatory intervention.
3. Provide background on the types of investors and capital that could catalyze the scale-up of BC's sustainable aquaculture industry.
4. Offer recommendations for Canadian policy makers to improve conditions for institutional investment into sustainable aquaculture in BC.

The report is intended to contribute to the continuing process of debate and consensus-building among the Canadian government, First Nations, aquaculture producers, investors and other relevant stakeholders. The report's objective is to provide information that will assist in policy implementation improving conditions for investment into highly scalable sustainable aquaculture in BC.

Approach

The objective of this study is to define and analyze the landscape of sustainable aquaculture production in BC to identify opportunities and obstacles for expansion that could then be addressed through government policy and regulation.

To identify these industry opportunities and obstacles, four key factors were considered:

- 1. Regulatory setbacks:** Regulatory requirements, processes and restrictions for both greenfield and existing pilot facilities were assessed to identify obstacles for new entrants, existing operations and expansion of existing operations.
- 2. Ongoing operational and business risks:** Key operational and business risks of pilot facilities were researched, along with any corresponding government support programs that aim to mitigate those risks. Where no such programs were found to exist, parallel situations in comparable industries were compared for potential applicability and/or transferability to BC's sustainable aquaculture industry.
- 3. Attractiveness for new entrants:** Evaluation of the advantages for new entrants to establish themselves in BC versus other regions was considered, along with any existing or potential incentives that could further attract commercial-scale operations into the province.
- 4. Potential for innovation:** The capacity for development of new species and technology to support a more diversified sustainable aquaculture industry in BC was explored, along with specific programs supporting sector innovation.

Scope

The report applies the impact investment thesis presented in Towards a Blue Revolution, utilizing the technologies defined as sustainable in that report as they are believed to offer the greatest potential for both commercial viability and environmental sustainability in British Columbia.

The three categories of sustainable aquaculture technologies covered in the report include:

- 1. Land-based recirculating aquaculture systems ("RAS") for all species:** These closed-containment systems are separated from marine ecosystems, nearly eliminating the risk of negative impacts on marine environments while enabling a more continuous supply versus conventional marine aquaculture, as production variables are more controlled.
- 2. Bivalve and seaweed aquaculture:** Bivalve and seaweed aquaculture is relatively less capital intensive and can help regenerate and maintain marine ecosystems if managed properly.

- 3. Offshore finfish aquaculture systems:** While still in the early stages of technological development, offshore production systems (up to approximately 50km off the coast) offer the potential to produce high volumes of fish in a deep ocean environment, away from sensitive coastal marine ecosystems and with a greater level of automation.

While outside the scope of the report, it must be noted that other potentially sustainable aquaculture and management practices should be considered for shaping aquaculture policy and regulations in BC. To consider the sustainability of other such practices, relevant stakeholder groups should work together to collectively determine both their commercial viability and environmental sustainability.

Part 2: Market Overview

International Market

Aquaculture, the fastest growing form of food production on earth, is a \$243.5 billion industry.²⁶ According to TNC and Encourage Capital, to meet forecasted demand, the global aquaculture industry will require an additional \$150-300 billion of capital investment into production infrastructure by 2030,²⁷ underlining the need to ensure that capital is deployed in ways that encourage sustainable development of the industry.

Sustainability-minded investors can help ensure that capital is deployed into production infrastructure that is more environmentally friendly and commercially viable, such as those technologies listed in the report. By creating an environment that caters to such investors, they could provide high-risk initial funding for projects and guide development while mainstream private capital markets take them to scale. This is discussed in greater detail in Part 5 of the report.

Already, we are experiencing signs of significant investment into more innovative and sustainable technologies through the strong interest in development of RAS production of Atlantic Salmon, as commercial-scale projects commence around the world. For example, a recent evaluation of planned RAS production in the United States totalled over 200,000 metric tonnes of annual production of Atlantic Salmon between six facilities – more than twice the amount of Atlantic Salmon produced in BC every year.²⁸

The ability to establish land-based RAS close to the end market provides those producers with significant cost savings due to reduced shipping expenses, which creates the largest cost advantage versus conventional netpens that rely on air-freight.²⁹ While conventional netpens still enjoy a significant advantage in terms of capital expenditure required versus RAS, stricter environmental standards, disease control, and water temperature / quality control for conventional netpens will likely continue to reduce this advantage over the long term.³⁰

The majority of the planned RAS facilities in the United States would serve the country's Northeast markets, but the facility proposed for Eureka, California would be competing directly with land-based RAS Atlantic Salmon producers in BC, along with the province's other Atlantic Salmon producers³¹.

British Columbia Market

The bivalve, seaweed, and offshore technology industries are largely undeveloped in BC, but it is clear that the province faces an increasing competitive threat for its existing Atlantic Salmon industry with market-ready RAS technology being planned for development in regions closer to

end markets, such as California.³² However, as many of those competing regions do not have the suitable infrastructure in place for such capital-intensive, innovative business models, they face a major constraint for development.³³

As the report focusses on investment into production assets, it is worth noting that holding a position in production assets and scaling them can help identify what is needed for successful scale of those assets and for realizing meaningful synergies between the involved technologies, services, and core production assets. This can provide an advantage for first movers of sustainable aquaculture production technologies to invest in those enabling technologies and services, which could then generate further financial value and improve efficiencies.³⁴

Part 3: Catalyzing Growth in British Columbia

Policy Objectives

Canadian policy makers have the opportunity to guide the direction of BC's aquaculture industry, which could have a significant impact on the continued utilization of the province's current supply chain infrastructure for aquaculture.

At this stage, policy makers should work to implement the following two strategies to develop the sustainable aquaculture industry in BC:

1. Supporting the innovation, development and commercialization of pilot facilities to encourage diversification of new species and technology.
2. Incentivizing the construction and scale-up of greenfield commercial-scale operations.

The economic impact of both routes is beyond the scope of the report. The following material intends to provide a foundation for deciding which policy would best support both options.

Foundations for Growth

Aquaculture in BC has been a contentious topic that has achieved broad media coverage, resulting in negative public perception and social pressures on conventional aquaculture production. As a result of this pressure, there is now an engaged group of government, industry, non-government organizations and Indigenous peoples that are exploring and debating different routes for advancing the province's industry in a sustainable manner.

The most cited obstacle to sustainable industry growth amongst interviewees was the delay and difficulty for producers to acquire an aquaculture licence. This obstacle emphasizes the need for clear, consistent and streamlined regulation for aquaculture operations, and is exemplified by the overall lack of new entrants into the land-based RAS and bivalve industries in BC over the last few years. For some established producers looking to expand beyond their current capacities, this can slow their business' development and decrease international competitiveness.

Other cited regulatory obstacles include the complex permitting and licensing processes, which should be investigated and streamlined for all sustainable aquaculture production processes where possible. Special consideration should be given to enable optimal site selection, as this has been determined as a key driver of operation and financial success of aquaculture operations.³⁵

Supporting Pilot Facilities for Diversification

Diversification of species and technology was frequently cited throughout the interviews completed for this project as a desire of industry stakeholders and government officials. Diversification would help mitigate the commodity risk that is prominent in the seafood industry due to the resulting product differentiation, branding, species selection, and facilities that enable cultivation of multiple different species based on market characteristics.³⁶ However, with efforts to innovate new and diverse species, it is important to keep in mind that the introduction of species not indigenous to the contemplated production area should be avoided.³⁷

Addressing pilot facility risks is also a challenge that must be addressed to draw in more capital to the industry.³⁸ After specific species and technologies are proven economically viable through examples of successful pilot facilities, investors will feel more comfortable deploying capital into the sector; to date, however, they have been hesitant to do so as pilot facilities that have not been successful innovating new species and technologies have been well-highlighted.^{39,40}

While some pioneers have already been practicing aquaculture with new types of species and technology in BC, success of their existing pilot facilities is needed to demonstrate to mainstream capital providers that an innovative business model is profitable and replicable.

As most aquaculture businesses should benefit from some economies of scale as a result of high operating leverage and increased production efficiencies, expansion capital will have an important role to play in the success of these pilot facilities.

Research conducted during this report's preparation outlined an apparent lack of government policy to support new entrants and their establishment: for example, no insurance exists for their biomass (being their biological assets in the water) and innovation funding for research and development is hard to acquire. This is in stark contrast to the agricultural sector which has access to both crop insurance and innovation funding through well-endowed government programs. The lack of new entrant and innovation support programs in aquaculture is a clear gap that has limited the ability of the sector to innovate relative to other agricultural commodities.

Some other general obstacles were cited for supporting pilot facilities in BC:

- **Ancillary revenue production:** The ability for producers to generate ancillary revenue is a feature that should be noted to support sustainable, innovative production technologies to succeed and reach profitability. This is especially true for pioneering producers that are innovating a new species, constructing their own hatchery, or learning how to consistently grow-out species to market size in land-based RAS, as these ancillary revenue sources provide a stable source of secondary income to fund the operations, research and development of these pursuits.

Common ancillary revenue sources for sustainable aquaculture include the sale of processed fish waste as agricultural fertilizer, the production of greens from an aquaponics facility and seafood processing services.

- **Collateral to secure loans:** One of the unique challenges of aquaculture producers acquiring financing is that there is generally no property value for the underlying production assets of an operation, especially in marine environments. This results in a lack of assets that can be used to secure loans; the inability of investors being able to compare asset values between companies due to the private nature of the industry furthers this issue.⁴¹
- **Access rights as leverageable assets:** The value of access rights or tenure systems, such as permit areas for aquaculture sites, as leverageable assets that could be used as collateral to secure financing has been highlighted in broader studies regarding the development of sustainable aquaculture, and should be investigated further to determine potential applicability for BC's industry.⁴²

Government policy and regulation that eases access for new entrants and supports their early establishment will also play a pivotal role in industry development and catalyze industry innovation, as new entrants generally embody more entrepreneurial behaviours than large existing incumbents.

Attracting Commercial-scale Operations

After pilot facilities succeed in proving the economic viability of a new species and/or technology, institutional investors will more be more comfortable deploying capital into those innovative facilities to capture the economies of scale that is available in sustainable aquaculture.^{43,44}

According to TNC and Encourage Capital, a single land-based RAS facility producing finfish needs to be between 2,500mt and 5,000mt to be economically viable.⁴⁵ Shared upstream and downstream infrastructure between facilities can also contribute to the economic viability of innovative facilities,⁴⁶ which is discussed in Chapter 6: Advancing the Industry.

TNC and Encourage Capital also concluded that an investment upwards of \$50 million would be required for the physical plant component of a land-based RAS operation.⁴⁷ Institutional investors will need to be attracted to the industry to raise such an amount of capital; however, even as pilot facilities may have proven economic viability, facilities face another barrier to scaling-up with institutional investment, as the lack of precedents for scaled-up facilities lead to a higher cost of capital and therefore a disadvantage for first-movers.⁴⁸ For this reason, policy makers should exercise tools such as loan guarantees and tax incentives to help address these obstacles for first-movers raising capital while also attracting pioneering commercial scale facilities to BC.

With much of the required upstream and downstream supply chain infrastructure already in place in BC, policy makers have an existing advantage to attract commercial-scale operations, which could leverage that infrastructure and expedite production ramp-up through actions that are recommended in detail in Part 6 of the report. To maintain and build the province's competitiveness in aquaculture, there seems to be a window of opportunity to take advantage of this situation by enacting incentives that draw large-scale productions and the required levels of investment.

Part 4: Technology Development Analysis

Land-based RAS

These closed-containment systems are separated from marine ecosystems, nearly eliminating the risk of negative impacts on marine environments while enabling a more continuous supply versus conventional marine aquaculture as production variables are more controlled.

The increasing pressure on conventional netpen producers, as well as a number of other favourable trends, has industry innovators focussed on land-based RAS; and while a number of RAS facilities innovating new species and technology have failed to reach economic viability in the past, recent efforts and milestones have renewed investor interest.⁴⁹ If the contemplated commercial-scale RAS projects in the global pipeline succeed at reaching economic viability and a steady-state of production, land-based RAS technology will likely become an attractive investment opportunity for a large number of institutional investors.⁵⁰

In BC, land-based Atlantic Salmon RAS has been regularly promoted as an attractive alternative to conventional netpen aquaculture.⁵¹ While moving the industry onto land could be economically viable at scale, it could be difficult over the long-run for the province to compete with land-based facilities located closer to its end markets due to their cost savings in shipping to market; for this reason, further investigation into diversifying species within land-based RAS in BC is suggested, along with the potential for development of commercial-scale aquaponics facilities in appropriate regions.

Through interviews with current land-based RAS producers cultivating a diversity of finfish and shellfish species in BC, it was apparent that aquaculture policy and regulations have generally not adapted to newer, more innovative land-based RAS technology.

Some examples of regulatory and permitting obstacles for land-based RAS in BC have been cited with:

- **Wastewater discharge permits:** Current wastewater discharge permits focus on limiting the concentration of waste rather than the actual amount of waste, reflecting a focus on older, flow-through aquaculture systems. This presents issues for land-based RAS, which discharges a significantly decreased volume of water compared to flow through systems (RAS recirculates upwards of 99.5% of its water) and a much higher concentration of waste within that discharged water, regardless of actual amount of waste.
- **Compliance with both aquaculture and agriculture regulations:** Land-based RAS evidently embodies characteristics of both aquaculture and agriculture operations in BC. The resulting compliance required with both sets of legislation has been cited as an obstacle to the development of important economic opportunities for new operations,

such as ancillary revenue generation. This is especially encumbering for newer, more innovative facilities that require owners to perform extensive research and development for growing new species.

- **Importing smolts across the border:** There are few hatchery suppliers for most species of seafood being produced using innovative sustainable technologies. Therefore, many smolts must be imported from hatcheries located across the border, which has led to two issues: 1) The acquisition of import licenses being difficult to acquire, taking up to five years to process in some instances; and, 2) The death of the animals due to the length of time it takes regulatory personnel to check each imported shipment, which must occur before the animals are placed back in the water.

As mentioned before, obtaining debt financing can be challenging for land-based RAS facilities, which is why most of the nascent industry is almost entirely equity funded. In addition to the difficulty of lenders valuing the facilities' assets to estimate the value of collateral, the vast majority of lenders do not know how to operate the facility itself, hence making it an unattractive asset to possess in the event of default and repossession.⁵² This results in higher risk for lenders, and a competitive disadvantage for producers to access debt financing versus other capital-intensive infrastructure managers.

The relative unattractiveness of a lender possessing a RAS facility through an event of default was cited in interviews, and the resale market for such facilities and equipment is apparently aware of this, leading to sharply discounted resale prices for the facilities and equipment. Some production owners also mentioned they likely wouldn't put up their land as collateral to finance the building of a facility or tank, as the decrease in relative liquidity and resulting value from the land asset to RAS equipment and facilities wouldn't be worth the risk for expansion.

While the potentially reduced environmental impacts of land-based RAS are promoted widely, it should be noted even these facilities can be harmful to the environment if not managed and regulated properly.⁵³

Bivalves and Seaweed

A seemingly overlooked and contracting industry in BC, bivalve and seaweed aquaculture can provide important benefits to surrounding ecosystems and offer an opportunity for significant economic development in BC if supportive government policy and regulation is put in place.⁵⁴ The lack of high upfront or ongoing capex costs for bivalve and seaweed aquaculture also offers a different and potentially more attractive risk-return profile versus other sustainable aquaculture technologies.⁵⁵

According to TNC and Encourage Capital, filter feeding shellfish can filter a substantial amount of water per day, up to 50 gallons per oyster, and seaweed farms have been shown to remove significant amounts of nitrogen and phosphorous.⁵⁶

Climate change is also a factor for bivalve production, as acidification can decrease the ability for shells to form and increasing temperatures can slow growth.

As bivalves represent a \$26 billion industry globally that has been growing at an average annual rate of 6% over the past 30 years,⁵⁷ and demand expected to remain strong, bivalve production should be considered a potentially significant category of BC's future sustainable aquaculture industry.

Several regulatory obstacles exist for the development of bivalve aquaculture in BC:

- **Securing new farm site locations:** Along with delays in aquaculture licenses, permitting for new sites has been difficult for producers to obtain due to lengthy processing time.

As governments and communities work towards reconciliation with First Nations, procedures and regulatory process at the provincial level to adequately consult with First Nations on site applications in traditional, unceded territory is evolving and may lead to a longer process. Early and open co-operation and communication with First Nations is a necessity and there are good examples where this has led to more equitable and durable projects in the long run.

- **Ability to test site for growth potential early in the permitting process:** It was mentioned that a series of hurdles had to be overcome by bivalve producers before they could perform an initial test for potential growth of their species at the targeted site. This leads to a significant investment of time and high-risk capital required from the producer before it's known whether the species can be produced efficiently on that site in the first place.
- **Unclassified coastal waters:** Producers have limited capacity to expand their operations along BC's southern coastline as most of the region's coastal waters are unclassified, and therefore need to be classified prior to any permitting. It is unclear how long the classification process would take, and this impediment should be considered by policy makers supporting the expansion of bivalve aquaculture in BC.

While the northern and central coastal regions include areas identified as suitable for shellfish aquaculture through the Pacific North Coast Integrated Management Area and Marine Plan Partnership for the Pacific Coast, neither have been integrated sufficiently with the Department of Fisheries and Oceans aquaculture planning activities.

- **Inefficient lease application process:** The lease application process for bivalve producers has been cited as taking a significant amount of time.

- **Hatchery availability:** It can take a number of years to innovate a species and develop a hatchery, which could provide a bottleneck to industry growth and diversification and a potentially unreliable supply of seeds.

Seaweed aquaculture shares similar characteristics and prospects as bivalve aquaculture in that both are relatively less capital-intensive and can also provide benefit to surrounding ecosystems. Seaweed is also increasingly being used for other applications in a diverse set of industries, leading to alternative investment opportunities.⁵⁸

No seaweed aquaculture sites in BC were identified during the preparation of this report. Globally, according to TNC and Encourage Capital, the seaweed market is estimated at \$6 billion, and has seen immense growth; from 2005 to 2015, the production of farmed seaweed doubled while wild harvests stayed nearly the same.⁵⁹ Like bivalves, the high growth of the last decade of seaweed production is expected to continue.⁶⁰

Offshore Finfish Aquaculture

Offshore aquaculture can be a more environmentally friendly and attractive alternative to conventional netpen aquaculture, as facilities are located farther from sensitive coastal habitats in a deep ocean environment and can produce large volumes of fish in a single structure. While located in harsher environments with larger wave sizes, the volume of water that passes through the production structure enables the reduction of effluent and marine ecosystem impacts, thereby reducing potential marine pollution.⁶¹

Though still in early stages of development, the amount of capital being invested into the innovation of offshore technologies and the regulatory focus on enabling its growth is advancing its potential as an important subset of the future aquaculture industry.⁶²

Other select benefits of offshore technology include improvements in feed conversion ratios and significant commercial performance advantages, such as larger scales of production, process automation, better water and product quality and increased site availability.

It is important to note that regulators and investors should assess the carbon footprint of offshore technologies before allowing them to be developed at scale and ensure that access to and from shore is done in an environmentally sustainable manner as possible.

As innovation of offshore technology is especially risky due to the size and capital requirements needed for the structures, large existing aquaculture producers with robust balance sheets and proven technological expertise are the most appropriate innovators for the industry, and thus should be incentivized to assume that role.^{63,64} Indeed, as Norway has incentivized its conventional netpen producers through government programs granting free development licenses for offshore technology innovation, it is now leading the technology's development. The

United States is also working to develop an offshore industry, investing in research and development and proactively enabling a suitable regulatory environment for its scale.⁶⁵

While BC does not yet have any offshore production of finfish, policy makers interested in advancing the province's aquaculture industry and transitioning it to more environmentally friendly practices should keep in mind that the technology could comprise an important subset of future industry market share and prepare accordingly. As BC and Norway share many characteristics regarding conventional netpen aquaculture, the Development Licensing Program launched by the Norwegian Directorate of Fisheries could be referenced as a potentially viable model to incentivize conventional netpen producers to innovate and transition to more sustainable production methods.

Part 5: Investment Considerations

Responsible Investment

The financial sector is increasingly being recognized as a third potential influence, beyond government and markets, on driving a more sustainable aquaculture industry.⁶⁶ Engagement by sustainability-minded investors can have systemic impacts by encouraging companies to transition towards more sustainable processes that are less harmful on surrounding ecosystems.

By ensuring BC's aquaculture facilities are both commercially viable and environmentally friendly, the province can attract more sustainability-minded investors, thereby unlocking both more concessionary capital for developing innovative facilities, and institutional capital for scaling-up those facilities. Doing so would also invite such investors into the capital structure in the beginning stages of facility development, enabling them to de-risk and guide the scale-up of those facilities in a responsible manner as mainstream investors are attracted into the capital structure at later stages of growth. Without working towards both commercially viable and environmentally friendly production practices to attract sustainability-minded investors, transition to a more sustainable aquaculture industry could be further delayed.⁶⁷

The assets under management of sustainability-minded investors are rising sharply:

- The estimated assets under management of impact investors, who seek to generate measurable social and environmental benefit alongside a financial return, more than doubled to US\$502 billion in 2018, from US\$228 billion in 2017.⁶⁸
- The broader market of investors in the United States that integrate Environmental, Social, and Governance (“ESG”) analysis into their financial investment decision making processes was estimated to manage about US\$12 trillion of assets in 2018, up from US\$8.7 trillion in 2016.⁶⁹
- The OECD states that the intergenerational transfer of wealth is estimated at \$41 trillion over the next 50 years, \$6 trillion of which is expected to be directed towards social issues.⁷⁰

Many sustainability-minded are interested in sustainable aquaculture as a way to improve the food system and diversify their investment portfolios, but due to a combination of factors including a lack of expertise required to identify, manage and mitigate risks;⁷¹ a perception of the entire sector being too high risk, partly explained by increasingly prominent ESG factors;⁷² a lack of investable deal flow; and weak regulatory environments, they have been hesitant to invest in production facilities.

Without an explicated set of guidelines outlining the environmental and social standards for sustainable aquaculture production in a region, and direction on how to measure and monitor compliance to those standards, sustainability-minded investors may be hesitant to invest due to the reputational risk they would assume by making sustainability claims for their investments.⁷³ Further, by ensuring the sustainability of investments, investors would assume less regulatory risk, as sustainable production facilities are less likely to be negatively impacted by major shifts in government policy during the term of investment. This issue can become more pronounced in regions where regulations and standards regarding sustainability are weakened or clouded, as many institutional investors do not have the in-house scientific expertise or capacity to both understand and navigate the regulatory environment and define sustainability standards and guidelines themselves.

BC produces a relatively small amount of aquaculture product compared to the rest of the world, but the social backlash against conventional netpen aquaculture has received international attention and has been referenced as an example of regulatory and social risk for investors that overlook sustainability considerations.⁷⁴

As advocacy campaigns and other publications have been raising awareness of the potentially harmful effects of conventional aquaculture, investors are also concerned that consumers, being educated through such mediums, will blanket the entire aquaculture sector as environmentally harmful, decreasing the economic prospects of even the more sustainable production facilities.⁷⁵ By helping address the negative public perception of aquaculture in BC through consumer education and regulatory improvements, policy makers could help drive production and economics of the entire sector.⁷⁶

Notable seafood ESG-related risks include events that impair operating financial results, such as food safety recalls, human health impacts, and farmed fish escapes.⁷⁷ These events can cause earnings volatility, by the risks being retained rather than being mitigated through public and private mechanisms.⁷⁸ Lack of disclosure required by private companies and of systems for monitoring and measuring ESG events make it challenging to perform ESG risk analysis on specific companies, and by extension decrease incentives for specific facilities to be de-risked.⁷⁹

If sustainable production is not distinguished from conventional production through some means of standards or minimum qualifications, the entire sector's future prospects in BC could be dimmed through consumer reactions to aquaculture, backed by non-profit partners and other stakeholders.

Aquaculture Investment Profiling

Investments into sustainable aquaculture production facilities have limited upside return potential for a given level of infrastructure, and are therefore more appropriately classified as a yield-based investment opportunity.⁸⁰ However, production facilities usually carry operating company-type

risks.⁸¹ Therefore, ideal investment structures could include debt or a debt-like financing instrument incorporating equity-like upside.

These characteristics underline the need for debt in the sector, as the capital-intensiveness of sustainable aquaculture technology such as land-based RAS and offshore technology require levered equity returns; but individual projects are generally not attractive for debt financing since, as mentioned before, desirable security for loans is usually unavailable.⁸² Therefore, attention should be paid to policies and other tools that would encourage the introduction and availability of debt financing to the sector in BC to catalyze equity returns and attract further commercial capital.

A profile of the different types of investment that could support the scale-up of the industry is described in the following section.

Categories of Investment Capital

Investing in the sustainable aquaculture industry is difficult. By understanding the different types of capital that could be drawn to the industry, how they could be blended together to deal with the high-risk nature of innovative production facilities, and which policies could attract such blended finance, growth of the nascent industry in BC could be accelerated.

There is a growing consensus that such innovative finance mechanisms are needed to mobilize private sector capital towards solving large, complex and pressing problems.⁸³ An increasing amount of impact investors are embracing the continuum of capital categories listed below in supporting the development of socially and environmentally beneficial industries.⁸⁴

Commercial capital: Commercial investment is needed to bring the industry to scale. However, investment targets must offer commercially suitable risk profiles by being able to offer leveraged returns after debt becomes more available to the sector. By structuring investments into sustainable aquaculture facilities according to the investment profile detailed above, significant private capital can be unlocked to help develop the industry sustainably.⁸⁵

Impact capital: Impact investors, who seek to generate measurable social and environmental benefit alongside financial returns, can help catalyze broader capital investment into sustainable aquaculture production systems by financing pilot facilities, prototypes, and research and development through high-risk, patient capital.⁸⁶ In addition, those impact investors can help define sustainability standards for aquaculture production along with the corresponding impact metrics.⁸⁷

As impact investors have focussed on equity investments into the sustainable aquaculture industry due to its nascent stage of development, the industry has now matured to a point where debt investments with equity upside could be made into established pilot facilities, helping bridge the financing gap and catalyzing the deployment of commercial bank financing.⁸⁸

Sub-commercial capital: Impact investors will accept lower financial returns for the promise of market-level impact in some cases. Such market-level impact could be defined as the pioneering of a new business model to prove its economic viability. In many cases, the need for sub-commercial investment is temporary; if the model is successful, it will inspire other firms to follow suit, and the emergence of competition will in turn drive down prices, increase quality and spark further innovation.⁸⁹

In assessing a pioneering firm, therefore, impact investors may weigh not just that firm's expected financial return and its expected direct impact, but also the benefits that could arise from launching an entire new model across the industry.⁹⁰

Concessionary capital: Concessionary investments, defined here as investments that forego some level of financial return to generate social and/or environmental benefit, will be needed to help catalyze and incubate innovative technologies, lower origination costs, and support new production methods as they scale.⁹¹ However, a number of factors have been inhibiting the deployment of concessionary capital, including a lack of consensus among industry stakeholders as to which opportunities qualify as both commercially viable and environmentally friendly.⁹² Additionally, responsible deployment of concessionary capital, as to not distort the markets, is a frequently debated topic among foundations and development finance institutions and should be considered carefully during the development process of sustainable aquaculture technologies.

Part 6: Advancing the Industry

Recommendations for Policy Makers

Existing government policies should be realigned and adjusted to enable increased investment into sustainable aquaculture in BC.⁹³ Primary focusses of these adjustments should include making the permitting process and regulatory regime more efficient and working to address the public perception of aquaculture.⁹⁴ This should be done through implementing policies that provide meaningful and measurable sustainability metrics that enable accountability and transparency of policy makers and relevant regulatory bodies.⁹⁵

Generally, the most effective way to build a sustainable aquaculture industry is to employ an ecosystem-based approach that integrates coastal zone management into operations, especially for marine aquaculture (while this is less relevant for land-based RAS due to the technology's higher level of containment, environmental impact assessments for land-based RAS are still important).⁹⁶ The strongest available framework to reference, which should be considered in detail by Canadian policy makers looking to develop their own such framework for BC, is the ecosystem approach to aquaculture (EAA) established by FAO.⁹⁷

There are nine recommendations for Canadian policy makers, listed in no particular order of importance.

Recommendation 1: Improved regulation of conventional aquaculture practices. Government should improve regulation of conventional aquaculture and establish a consensus of sustainable aquaculture investment principles backed by public, private, and NGO leaders. Doing so would draw in more responsible investors by decreasing reputational risk for those investors making sustainability claims,⁹⁸ as most investors lack the in-house capabilities to navigate complex regulatory environments themselves.

National and provincial-level scoping initiatives should be undertaken to define the boundaries of management units and the ecosystem, determine the relative importance of development and conservation goals, and ensure that stakeholders are well-informed about the costs and benefits of aquaculture development. Throughout the scoping process, relevant stakeholders, including government officials, policy makers, scientists, farmers, fishers and other competing environmental users should be closely consulted to ensure a balanced and successful planning process.⁹⁹

To help create a more investable environment for sustainability-minded investors, enforcement entities should improve and effectively manage environmental standards of aquaculture operations in BC.^{100,101} Continued public reporting of monitoring and enforcement is critical to encourage transparency and trust between the industry, the public and investors.

Government sustainability standards that are satisfactory to the general public should also be clarified and implemented, and could follow recognized aquaculture sustainability certification programs such as ASC, BAP and/or GlobalGAP. This will help emphasize the existence of the more sustainable methods, thereby increasing potential public support for a transition to sustainability from demographics previously unaware of more sustainable technologies. Further, this may also improve consumer perception regarding aquaculture in BC, bettering economics for the sector overall through increased product demand.

Recommendation 2: Creation of an Advisory Committee to streamline regulations and permitting processes specifically for the sustainable technologies listed in the report. It is evident that regulations and permitting processes have not adapted to enable the development of newer, more innovative sustainable technologies. An Advisory Committee comprised of producers, government officials and key industry experts should explore, define and address the numerous regulatory obstacles for the development of sustainable technologies in BC. It is suggested that the Advisory Committee is setup in time to integrate the Committee's conclusions and recommendations into the proposed Canadian Aquaculture Act.

A key issue to address with the Advisory Committee would be the efficiency of the permitting process for new entrants and pilot facilities.

For shellfish aquaculture, the state of North Carolina's passing of Senate Bill 648 in July 2019, which aims at streamlining the permitting process through the establishment of Shellfish Aquaculture Enterprise Areas, should be referenced for applicability to BC. Such programs also exist for many other states including Florida. Implementations of the Bill are intended to reduce potential conflicts with other users of space, which is also relevant for Recommendation 3 below.

Recommendation 3: Creation of a Task Force to identify, evaluate and develop 'Priority Regions' for area-based management programs of shellfish aquaculture along BC's coastline.

By assembling a Task Force to proactively identify Priority Regions for shellfish aquaculture, those Regions' waters could be classified in advance, tested for shellfish growth potential, after which licenses could be pre-approved with First Nations cooperation if determined suitable. The successes and conclusions of the Marine Plan Partnership for the North Pacific Coast should be considered by the Task Force to determine effective processes and fully leverage existing research.

Area-based management that would enable the operation of numerous small to medium-sized shellfish operations in one region would allow operators to collaborate to address regional disease threats, share knowledge to improve operational and biological efficiencies, and optimize the Region's collective competitiveness.

Pre-emptively assessing Priority Regions would allow for identification of marine ecosystem carrying capacity limits, which should then be integrated into permitting processes as bivalve and seaweed farming can negatively impact surrounding ecosystems if managed or sited improperly.^{102,103}

Collaboration between farms of Priority Regions through different organizational structures would create the opportunity for improved operational capacities, investment leverage through collective infrastructure, negotiating power, and increased deal size.¹⁰⁴

Important considerations for the Task Force in developing Priority Regions should include the available infrastructure, the diverse uses and users of the targeted regions, logistics for reaching market, potential economic growth for First Nations communities and the integration of a shared hatchery for tenants.¹⁰⁵

The deployment of shared hatcheries for Priority Regions should be investigated as they'd likely help ensure consistent and available supply of seed while enabling the few existing technical hatcheries experts to support numerous farmers at once, thereby loosening a potential bottleneck for industry growth.^{106,107}

In addition to expediting the regulatory process for Priority Regions, the collaborative efforts to determine which sites are best suited for operations, with support from key regulators and policy makers, will help address one of the key determinants of operational and financial success of aquaculture operations, being siting.¹⁰⁸

Recommendation 4: Tax grant programs. Tax incentives should be considered as an effective tool for helping scale the important yet nascent sustainable aquaculture industry by attracting commercial capital. For example, tax grants between 15-30% of capital costs could be provided to producers of diversified land-based RAS species that have demonstrated commercial viability with proven pilot projects, but face the aforementioned first-mover disadvantage due to lack of precedent commercial-scale facilities.¹⁰⁹ This would help accelerate commercialization of that species and technology and support continued utilization of existing supply chain infrastructure in BC.

Recommendation 5: Loan guarantees. Loan guarantees would reduce risk for lenders and enable equity returns to be leveraged, increasing the investment attractiveness of aquaculture projects that would otherwise face difficulty in securing debt financing. Loan guarantees also cater to equity investors indirectly by reducing the risk that debt financiers would trigger bankruptcy and seize the operation's assets.

In the beginning, this strategy would incur minimal costs for the government as no capital would be provided directly from government. The tax revenues resulting from the increased expansion and profitability of facilities could partially offset the guarantees that end up being paid out to lenders in the event of their borrower's default.

Loan guarantees are being used in the sustainable aquaculture industry elsewhere; a large land-based RAS producing Atlantic Salmon in the United States was able to utilize a loan guarantee from an export credit agency for a bank loan. Additionally, loan guarantees are available for agricultural businesses in Canada.

Recommendation 6: Offshore aquaculture considered in the development of Canada's Aquaculture Act. Policy makers should implement a development license program similar to that of Norway's, which has been successful in drawing hundreds of millions of investment dollars into the innovation of offshore technologies. Such a development license program for innovative offshore technologies should be integrated into Canada's potential Aquaculture Act.

Norway's Development License Program provides concessionary licenses to qualifying businesses to build large-scale innovative and commercially viable technology that addresses the environmental and health issues of conventional aquaculture. If the business successfully demonstrates the technology, it has the option to purchase it for discounted price versus that which would be offered in the open market.¹¹⁰

When initiating the program, policy makers should work to establish a process that prevents selection bias as much as possible.¹¹¹

Recommendation 7: Low-interest loans for shellfish aquaculture. As stated by TNC and Encourage Capital, the MARBIDCO loan program in Maryland has been successful in growing state's shellfish aquaculture industry.¹¹² The program enables shellfish aquaculture producers that own an aquaculture license to borrow between \$5,000 and \$100,000 without any history of operations, with no interest payable for the first few years. The producer may then apply for a maximum of two more loans, enabling them to access up to \$300,000. In the event of producer default, 40% of the first loan is forgiven, and 25% of the second and third loans would be forgiven.

Recommendation 8: Biomass insurance. With access to government-provided biomass insurance, producers could lower risk for investors and draw significantly more capital into their operations. This would provide a critical support mechanism for producers, especially during the early years of their operations when proving out their business model.

Biomass insurance is available in the land-based RAS industry and has been utilized by a large land-based RAS facility in the United States, though has been cited as being expensive.

Recommendation 9: Creation of innovation centres to support the development of diverse species and technology. These innovation centres could partner with universities' research and development programs to innovate new species for all types of sustainable aquaculture technologies and provide training to new grads looking to start their career in the industry. This will help address one of the prominent investment challenges for development of sustainable aquaculture, being the financing of early-stage R&D.¹¹³

The Vancouver Aquarium and Ocean Wise, along with DFO have been doing species testing for over 15 years. These programs, along with any that may exist at Vancouver Island University, should be explored to determine additional capacity potential and if they could play a key role in species diversification.

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