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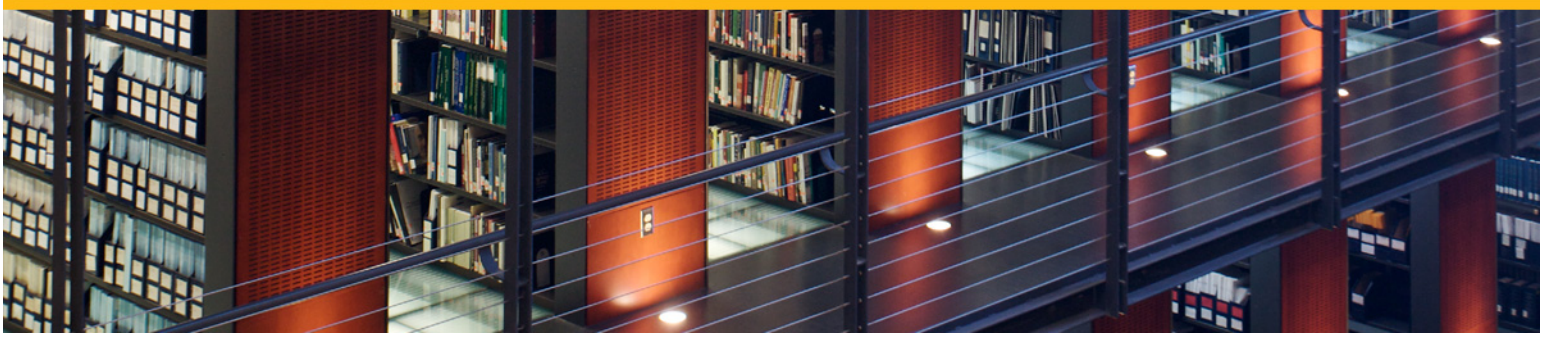

Aquaculture in Canada

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Aquaculture in Canada

(Background Paper)

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1 INTRODUCTION

In just 50 years, global aquaculture has grown from an almost negligible industry to rival the production of wild capture fisheries. While the latter has stagnated over the last 25 years, aquaculture production has expanded about five times, which has enabled the food fish supply per capita to grow.[1] Canada's aquaculture industry is relatively small compared with that of other countries, but it has a strong niche market in some species, particularly Atlantic salmon, and it is important economically to a number of coastal communities. However, the aquaculture industry in Canada faces economic and environmental challenges. This paper describes the Canadian aquaculture industry, current issues it faces and options for its growth.

2 THE AQUACULTURE INDUSTRY IN CANADA

World aquaculture production was 63.6 million tonnes in 2011, with almost 90% of this production in Asia.[2] In the same year, Canadian production was 162,000 tonnes or 0.25% of the global total. In 2009, Canada ranked 20th in the world in terms of the value of its aquaculture production.[3] Canadian aquaculture production quadrupled between 1990 and 2001, but has been stable over the last decade.[4]

Finfish account for more than 90% of Canadian production by weight. However, because shellfish are worth more by weight, finfish production represents 76% of the total by dollar value.

In 2011, British Columbia produced more than 60% of Canada's aquaculture output by value. New Brunswick and Newfoundland and Labrador are also important salmon-producing provinces. Prince Edward Island produced more than 40% of shellfish in Canada by value, with British Columbia, Nova Scotia and Newfoundland and Labrador also being significant producers.

Atlantic salmon farming constitutes about 70% of aquaculture in Canada by value. Canada produced about 7% of the world's farmed salmon in 2009, ranking fourth behind Norway, Chile and the U.K. (Scotland).[5] Other finfish raised in aquaculture facilities include rainbow trout, Arctic char and coho salmon.[6] Some Arctic char is raised in Yukon.

In 2011, half of the value of shellfish aquaculture in Canada was accounted for by blue mussels. Blue mussel production was $39 million, while that of oysters was $19 million.[7] Other shellfish produced include clams and scallops. European countries such as France, the Netherlands and Spain are the leaders in mussel production. In addition to finfish and shellfish, seaweed is grown in New Brunswick and Quebec.[8]

The amount and value of finfish and shellfish harvested through aquaculture by province is shown in Table 1.

Table 1 – Aquaculture Production in Canada, by Province, 2011

Province	2011 Production			
	Shellfish		Finfish	
	Tonnes	Value ($ thousands)	Tonnes	Value ($ thousands)
Newfoundland and Labrador	3,000	8,221	14,264	111,829
Prince Edward Island	23,018	33,063	N/a	2,242
Nova Scotia	2,199	9,890	5,817	33,397
New Brunswick	634	2,673	21,640	140,641
Quebec[a]	394	661	420	2,344
Ontario	–	–	3,738	17,700
British Columbia	9,400	19,600	75,870	445,400
Canada	38,646	74,108	123,567	763,033

Note: a. Not including restocking. Restocking, the raising of fry to restock lakes for wild fishing, is included by Quebec as part of its aquaculture production in the Statistics Canada source. Other provinces also restock, but do not report it as aquaculture production. Restocking is therefore omitted for this portrayal of the aquaculture industry in Canada.

Source: Table prepared by the authors, using data from Statistics Canada, Table 1-5, "Aquaculture, production and value, by province and Canada – 2011," *Aquaculture Statistics 2011*.

In addition, maps in the appendix show various aspects of aquaculture production on the east and west coasts of Canada.

2.1 Economic Impact

Aquaculture production generates economic activities in related sectors of the economy. In 2010, Fisheries and Oceans Canada (DFO) published a computer model analysis of the total economic activity derived from the aquaculture industry. The economic activity created by aquaculture within each province is between 1.5 and 2.3 times that of aquaculture production alone in the same province (Table 2).[9] However, because aquaculture production in one province may stimulate economic activity across Canada, the overall factor is larger, at 2.8.

The gross domestic product (GDP) is essentially this economic output minus input requirements.[10] In 2007, the GDP generated by aquaculture was estimated to be roughly 0.06% of the Canadian GDP. However, in some regions within the country the economic importance of aquaculture is greater. For example, Prince Edward Island's aquaculture industry represented 1.3% of the island's total GDP, while for British Columbia, which has the largest aquaculture industry in Canada, aquaculture represented 0.2% of the province's GDP (Table 2).

Table 2 – Economic Impact of Aquaculture in Canada, by Province, 2007

Province	Aquaculture Industry Output ($ thousands)	Gross Aquaculture Industry Output Including Economic Activity Stimulated ($ thousands)	Gross Output/ Industry Output	GDP for Aquaculture ($ thousands)	Aquaculture as % of Total GDP	Number of People Employed
Newfoundland and Labrador	40,000	65,791	1.6	34,600	0.12	405
Prince Edward Island	30,200	70,633	2.3	59,600	1.29	1,165
Nova Scotia	52,989	79,587	1.5	41,900	0.12	670
New Brunswick	185,809	400,038	2.2	147,100	0.53	2,420
Quebec[a]	12,915	19,623	1.5	14,385	0.00	159
Ontario	17,000	26,372	1.6	15,810	0.00	216
British Columbia	407,766	946,129	2.3	425,300	0.22	5,960
Canada	761,570	2,139,270	2.8	1,005,200	0.06	14,500

Note: a. For Quebec, unlike in Table 1, the output associated with restocking is included in this analysis because the DFO analysis used as the source included restocking for Quebec only.

Sources: Statistics Canada, Table 1-1, "Aquaculture, production and value, by province and Canada – 2007," *Aquaculture Statistics 2011;* Fisheries and Oceans Canada, *Economic and Socio-Economic Impact of Aquaculture in Canada*, 2010, estimated using Statistics Canada Interprovincial Input-Output Model (2005 version); and Statistics Canada, *Real gross domestic product, expenditure-based, by province and territory*. Note that the output estimates in Statistics Canada *Aquaculture Statistics 2011* are somewhat different than those reported in Fisheries and Oceans Canada's 2010 report. The Statistics Canada estimates are used to allow direct comparison between the output in 2007 and that reported for 2011 in Table 1.

Despite the relatively small contribution of aquaculture to overall economic outcomes at the national and provincial levels, it is important at the local level. In 2007, in the Comox–Strathcona region of British Columbia and in northeastern Prince Edward Island, for instance, aquaculture was responsible for 10% of employment income, while in Charlotte County, New Brunswick, it accounted for 26% of employment income.[11] Aquaculture also presents a potential economic development opportunity for some First Nations communities in Canada.[12]

3 CHALLENGES AND OPPORTUNITIES

3.1 CHALLENGES

While aquaculture production has demonstrated strong growth in developing countries, particularly in Asia and in South America, for the past 10 years, Canada's dominant aquaculture sector, Atlantic salmon, has not experienced any growth. This has resulted from several factors. A decline in price for Atlantic salmon in the global marketplace has been accompanied by an increase in the value of the Canadian dollar. In addition, from 1995 to 2002, a moratorium was placed on new salmon farm licences in British Columbia, to allow for an environmental assessment of salmon aquaculture. Another moratorium was introduced in 2009 after the British Columbia Supreme Court ruled that aquaculture regulation was a federal responsibility. The challenges facing the industry can therefore be divided into three categories: the

economics of the international marketplace, the environmental impacts and social licence,[13] and the regulatory framework.

3.1.1 Global Economic Considerations

The aquaculture industry operates in a global marketplace, with salmon prices being set by global supply and demand. Currently, the most rapidly growing supplier of salmon aquaculture products is Chile, which has a competitive advantage due to low labour and materials costs.[14] According to the Food and Agriculture Organization of the United Nations, Chile is expected to have significant future production increases, while production in the northern hemisphere may be limited by a lack of new siting locations.

Canada is highly dependent on the U.S. market for its aquaculture products. In 2011, for example, 97% of Canada's farmed salmon exports and 99% of its mussel exports were destined to the U.S.[15] Canada's exports therefore depend on global competition and the strength of the U.S. market.

3.1.2 Environmental Considerations

Net pen salmon farming is the dominant form of aquaculture in Canada. In this method, salmon eggs are reared to small salmon (smolt) in holding tanks on land for 12 to 18 months and are then transferred to floating nets in the ocean to finish growing to market size, which can take another 18 to 24 months. Other aquaculture operations, such as those for mussels, also take place in the ocean. Because aquaculture operations in Canada are located largely in the ocean, they are subject to risks posed by weather, temperature, disease, predation and organisms that can affect growth or, as in the case of paralytic shellfish poisoning, render the product toxic or unfit for human consumption. Costs are increased as a result of losses and control efforts. As many of these factors will be influenced by climate change, it is a significant overarching environmental concern. [16]

However, the main issue in the public eye with respect to aquaculture is the potential impact of net pen operations on the environment. Some of the most commonly cited concerns include:

- local nutrient pollution into water systems, by waste feed/feces;
- local chemical pollution from use of chemical treatments;
- effect on wild fish, by escapees interacting with wild fish populations and through disease spread; and
- reliance of salmon production on supplies of fishmeal and fish oil from huge industrial fisheries, mostly from South America, which may not be globally sustainable.[17]

If salmon net pen aquaculture affects wild populations of fish, traditional fishing industries may be put at risk, with significant economic implications for those involved in those industries, who may be located in the same region as communities supported by aquaculture. On the west coast, concern has been raised regarding the

large recreational industry, which supports about 7,700 jobs in British Columbia and generates $288 million a year.[18] On the east coast, some commercial fishermen are concerned that open net pen salmon aquaculture might, for example, affect the wild lobster fishery in their area.

The environmental impacts of net pen aquaculture on wild species in Canada have been difficult to observe, as the population dynamics of aquatic organisms are complex. East coast salmon populations were in decline before salmon farming was introduced, and lobster landings are generally quite high. Salmon populations in the waters of British Columbia, particularly the important runs in the Fraser River, have declined overall, but vary considerably from year to year. For example, in 2010, the Fraser River sockeye salmon returns were the highest since 1913.

Nonetheless, the stakes for commercial and recreational wild fisheries are considerable, and concern over fish farming has led to a number of investigations, including the 1995 Salmon Aquaculture Review that was associated with the moratorium on salmon aquaculture in British Columbia. That review found that salmon aquaculture presented a low overall risk to the environment, but noted many gaps in understanding its effects on wild populations.[19] More recently, decline in an important wild stock caused the federal government to initiate the Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River (Cohen Commission).[20]

3.1.2.1 The Cohen Commission

The overall goal of the Cohen Commission, established in by the federal government in 2009, was to develop recommendations for improving the "future sustainability" of the sockeye salmon fishery in the Fraser River. To this end, one of the terms of reference for the Cohen Commission was "to make independent findings of fact" regarding aquaculture.

Regarding the impact of open net pen aquaculture on wild stocks of Fraser River salmon, the Cohen Commission found that Fraser River sockeye salmon face some likelihood of harm from disease and pathogens in salmon farms, and that this potential harm is serious or irreversible. Although Commissioner Bruce Cohen concluded that the quantity and quality of data were strong, he also noted that the record was not long enough to draw any statistical conclusions, suggesting that another 10 years of data would be required to draw such conclusions. As a result of the uncertainty, the Commissioner applied the precautionary principle[21] to net pen aquaculture management and called for a moratorium on all farmed salmon expansion in the Discovery Islands region of British Columbia while the data are collected.[22] After data have been gathered, he recommended a test of minimal harm, stating that, if "DFO cannot confidently say the risk of serious harm is minimal, it should prohibit all net pen salmon farms from operating in the Discovery Islands."[23] He also recommended that siting criteria for salmon farms along the migration routes of wild fish be reviewed to explicitly include proximity to migration routes and that farms that do not comply with new criteria should be relocated. The salmon aquaculture industry in British Columbia was supportive of the recommendations, stating, "We're confident that our farms are not a risk to wild salmon and support more research to confirm that."[24]

The Cohen Commission also made recommendations regarding DFO's role as both advocate for salmon aquaculture and conserver of wild stocks: "When one government department (in this case DFO) has mandates both to conserve wild stocks and to promote the salmon-farming industry, there are circumstances in which it may find itself in a conflict of interest because of divided loyalties."[25] The Commission recommended that "the Government of Canada should remove from the Department of Fisheries and Oceans' mandate the promotion of salmon farming as an industry and farmed salmon as a product."[26]

3.1.3 Regulatory Uncertainty

The aquaculture industry is overseen by a combination of federal and provincial authorities. The federal government has jurisdiction over the regulation of fish products marketed for export and interprovincial trade; the protection of commercial, recreational and Aboriginal fisheries; and research and development. DFO is responsible for the application of the *Fisheries Act*, and Transport Canada grants authorizations for aquaculture facility plans under the *Navigation Protection Act.* The safety and quality of aquaculture products, feeds and veterinary drugs used by the industry are governed by other departments, including Health Canada, Agriculture and Agri-Food Canada, and the Canadian Food Inspection Agency.

Through a series of memoranda of understanding, the provinces are generally responsible for aquaculture planning, site leasing, licences and site approvals. However, British Columbia relinquished responsibility for regulating the west coast ocean-based finfish aquaculture industry to the federal government in 2012. This transfer of responsibility followed a 2009 British Columbia Supreme Court ruling that fish farming was a fishery and therefore fell under the exclusive jurisdiction of the federal government.[27] The federal government has now developed *Pacific Aquaculture Regulations*, under the *Fisheries Act*, to manage west coast aquaculture. However, east coast aquaculture remains largely under the purview of the provinces.[28]

3.2 Options and Opportunities

3.2.1 Regulatory Certainty

The complex legislative and regulatory environment, which varies from province to province, may hinder the growth of the aquaculture industry. To address this situation, as well as some of the other regulatory challenges faced by the aquaculture industry, the Canadian Council of Fisheries and Aquaculture Ministers, at their November 2010 meeting, endorsed a National Aquaculture Strategic Action Plan Initiative (NASAPI).[29] The NASAPI sets out a vision for the sustainability of the aquaculture industry, including three key areas of action: governance, social licence and reporting, and productivity and competitiveness. Regulatory guidelines developed by NASAPI were developed with a view to improving consistency and interpretation among regional authorities and to levelling the playing field for producers. Action plans put in place under the NASAPI include elements to improve

governance, communication of information, and technological advancement for controlling disease, and to examine emerging technologies.

Although one of the NASAPI's goals is improved coordination of regulations, many stakeholders have advocated that the federal government develop an explicit legislative framework for aquaculture through a federal aquaculture Act. They feel that an adequate framework cannot be provided by the *Fisheries Act*.

3.2.2 Emerging Technologies

Emerging technologies and farm management practices could address some of the environmental concerns about open net pen aquaculture. New disease-control mechanisms such as vaccines are under development and could reduce the costs of disease and the impacts on wild fish populations.

Isolating fish from the environment would also control the spread of disease to wild fish and prevent interactions between wild populations and escaped farmed fish. Closed containment aquaculture refers to several methods that isolate the rearing environment from the natural environment in order to reduce or eliminate interaction between the two. [30] Ocean-based solid-wall containment systems and land-based recirculating aquaculture systems (RAS) are two technologies that are currently being explored. While closed containment is used for some finfish species, including coho salmon, and for rearing Atlantic salmon smolt, full-scale operations for Atlantic salmon are currently at the pilot stage and face economic challenges.

Closed containment systems also permit full environmental control over the raised fish, allowing for optimal growing conditions, preventing disease and controlling water quality. One potential economic challenge associated with RAS, however, is that it could be deployed inland, which could diminish the coastal employment benefits currently associated with net pen aquaculture.

Another method being considered to control the effects of aquaculture on water quality and improve productivity is integrated multi-trophic aquaculture (IMTA). This system of farming involves raising different species together in a way that encourages the use of one species' waste as another's nutrition.[31] There is currently an IMTA pilot project in the Bay of Fundy, in which seaweed, mussels and Atlantic salmon are being farmed together. A smaller sustainable ecological aquaculture project in Kyuquot Sound, on the west coast of Vancouver Island, has also begun research into this farming method.

3.2.3 Marketing and Diversification

To develop markets and promote environmentally sustainable practices, nongovernmental organizations, retailers and the aquaculture industry have developed certification programs to inform consumers of the source of seafood and the methods used in its production, with the goal of decreasing the impact of fisheries on the oceans. Products certified as sustainable can often obtain a significant price premium on the marketplace. The success of such programs depends on the accuracy and clarity of the information conveyed by the label and associated

information. However, there are currently numerous aquaculture certification programs to which consumers are exposed, each of which may apply different criteria and set different standards, and may or may not include third-party verification. The fact that there are so many programs and no global standard for aquaculture certification may diminish their effectiveness.[32]

Fostering the development of commercially viable alternative species for aquaculture is another way to lessen the industry's dependence on salmon farming. The NASAPI includes initiatives to prepare a business case and a developmental plan for aquaculture of alternative species such as cod, halibut, Arctic char, sturgeon, scallops, soft-shelled clam, walleye and geoduck.[33]

4 CONCLUSION

Canadian aquaculture production remains small in terms of global production and provincial GDP; however, the industry is important economically to a number of coastal communities in Canada. The industry's growth has been hindered recently by several factors, including the low global price of salmon, dependence on Atlantic salmon and the U.S. market, environmental impacts and consequent perceptions of the industry's sustainability, and a complex regulatory environment.

The NASAPI and its associated action plans aim to advance the industry economically and environmentally and to provide it with an improved social licence to operate in Canada. The NASAPI includes fostering research and development of new technologies and alternative species, encouraging the participation of First Nations communities, preparing the industry to adopt international certification programs, and improving consistency of environmental standards, monitoring and reporting across the country. However, a number of stakeholders have recommended in addition that Parliament adopt a national aquaculture Act to address regulatory uncertainty.

NOTES

1. Food and Agriculture Organization of the United Nations [FAO], *World Review of Fisheries and Aquaculture*, Rome, 2012, p. 4.
2. Ibid., p. 27.
3. Fisheries and Oceans Canada [DFO], *Aquaculture in Canada: Facts and Figures*.
4. Ibid.
5. FAO, *FAO Yearbook of Fishery and Aquaculture Statistics 2009*, Rome, 2011, p. 75.
6. DFO, *Aquaculture in Canada: Facts and Figures*.
7. Statistics Canada, Table 1-5, "Aquaculture, production and value, by province and Canada – 2011," *Aquaculture Statistics 2011*, Catalogue no. 23-222-XWE, Ottawa, 2012.
8. DFO, *Aquaculture in Canada: Facts and Figures*.

9. Note that the estimates in DFO, *Economic and Socio-Economic Impact of Aquaculture in Canada, 2010*, are somewhat lower (1.5) because they use different estimates of output than those used in Table 1.

10. Ibid.

11. Ibid.

12. Aboriginal Aquaculture Association, *NAF II-National Aboriginal Fisheries Forum II*, Campbell River, British Columbia, October 2012.

13. The social licence to operate given to a company or project has been described as "a community's perceptions of the acceptability of a company and its local operations," the level of which "is inversely related to the level of socio-political risk a company faces." Robert Boutilier and Ian Thomson, *Modelling and measuring the Social License to Operate: Fruits of a Dialogue Between Theory and Practice*, On Common Ground Consultants Inc. and Robert Boutilier and Associates, Ottawa, 2011.

14. FAO, Cultured Aquatic Species Information Programme: Salmo salar *(Linnaeus, 1758)*, Cultured Aquatic Species Information Programme, Fisheries and Aquaculture Department, January 2004.

15. Statistics Canada, Table 2-3, "Exports of selected Canadian aquaculture products, by country of destination – 2011," *Aquaculture Statistics*, Catalogue no. 23-222-XWE. Ottawa, 2012.

16. R. K. Pachauri and A. Reisinger, eds., *Climate Change 2007: Synthesis Report*, Intergovernmental Panel on Climate Change, Geneva, Switzerland, 2008, p. 33.

17. FAO, 2004, citing the World Wildlife Fund.

18. British Columbia Ministry of Environment, *Sport Fishing*, Oceans and Marine Fisheries Branch, Victoria, 19 November 2010.

19. British Columbia Environmental Assessment Office, *Salmon Aquaculture In British Columbia: Summary Report of the Salmon Aquaculture Review*, Victoria, 1997.

20. Commission of Inquiry into the Decline of the Sockeye Salmon in the Fraser River [Cohen Commission], *Final Report*, Vancouver, 31 October 2012.

21. While the *Fisheries Act* does not refer to the precautionary principle, most legal references to the precautionary principle in Canadian federal law define it as follows: "[W]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." (See preamble of the *Canadian Environmental Protection Act, 1999* as an example.)

22. The Discovery Islands region in British Columbia is a geographical constriction between Vancouver Island and the mainland through which most Fraser River salmon migrate.

23. Cohen Commission, "Recommendations," Chapter 2 in *Final Report*, Vancouver, 2012, p. 25.

24. BC Salmon Farmers Association, "Salmon farmers support Cohen Commission report," News release, 1 November 2012.

25. Cohen Commission, "Recommendations," p. 12.

26. Ibid.

27. *Morton v. British Columbia (Agriculture and Lands)*, 2009 BSCS 136.

28. A case with similar constitutional implications as *Morton* is currently under review in Nova Scotia. See *Saint Mary's Bay Coastal Alliance Society, The Village of Freeport, The Village of Tiverton, The Village of Westport, Freeport Community Development Association, and Atlantic Salmon Federation v. Minister of Fisheries and Aquaculture and Kelly Cove Salmon Ltd.*, Notice of Appeal, Halifax, No. 352001, 7 July 2011. The constitutional questions have since been separated and will require the filing of a separate judicial review before they can be addressed (Hugh Wilkins, Ecojustice, personal communication with authors).

29. DFO, *National Aquaculture Strategic Action Plan Initiative*.

30. DFO, *Closed Containment Technology*.

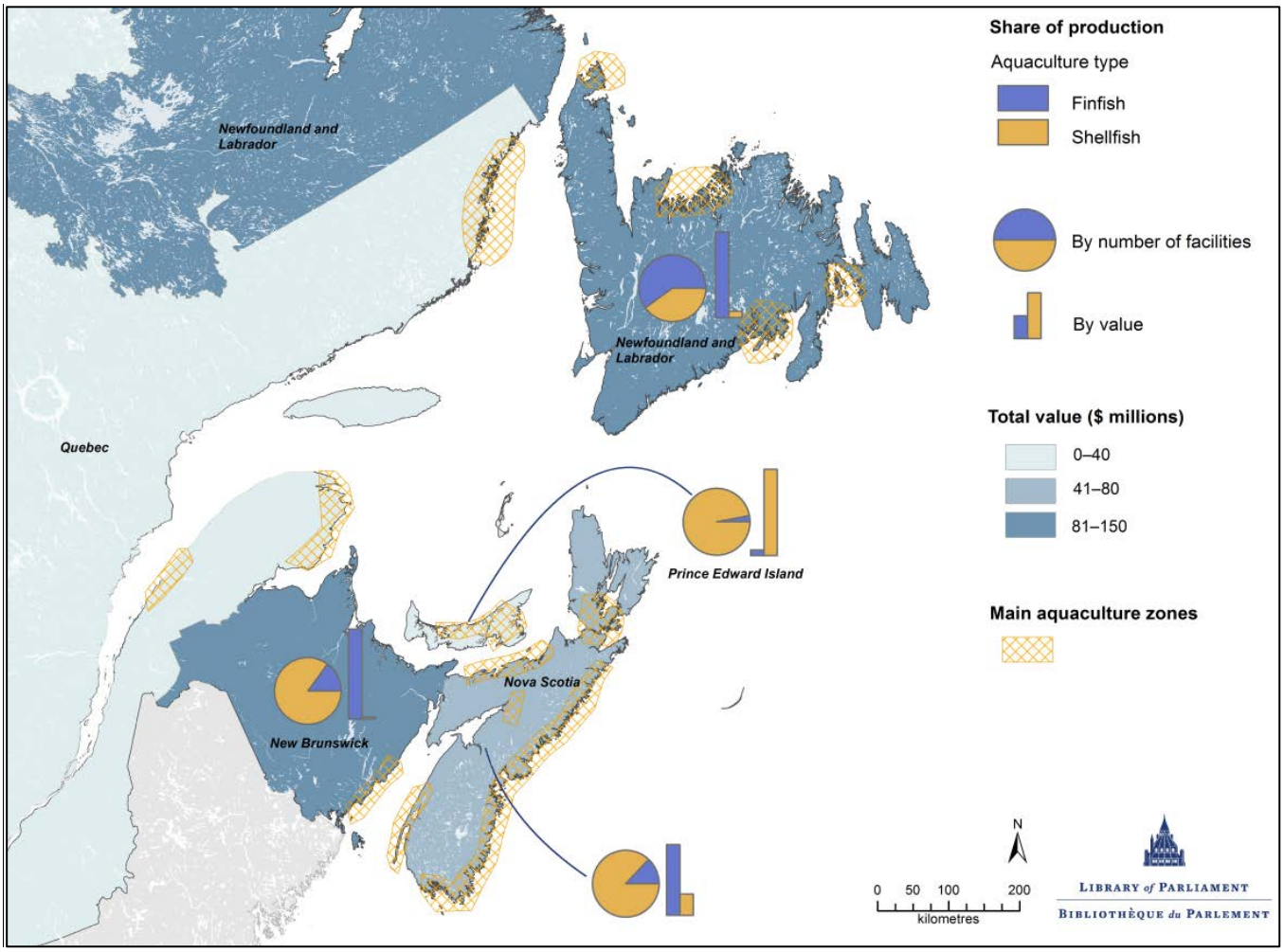
31. Canadian Aquaculture Industry Alliance, *Integrated Multi-Trophic Aquaculture*.

32. Global Trust Certification, *Global Market Report On Aquaculture Standards and Certification*, Report prepared for the Canadian Aquaculture Industry Alliance, November 2009.

33. DFO, *Aquaculture in Canada 2012: A Report on Aquaculture Sustainability*, Ottawa, 2012.

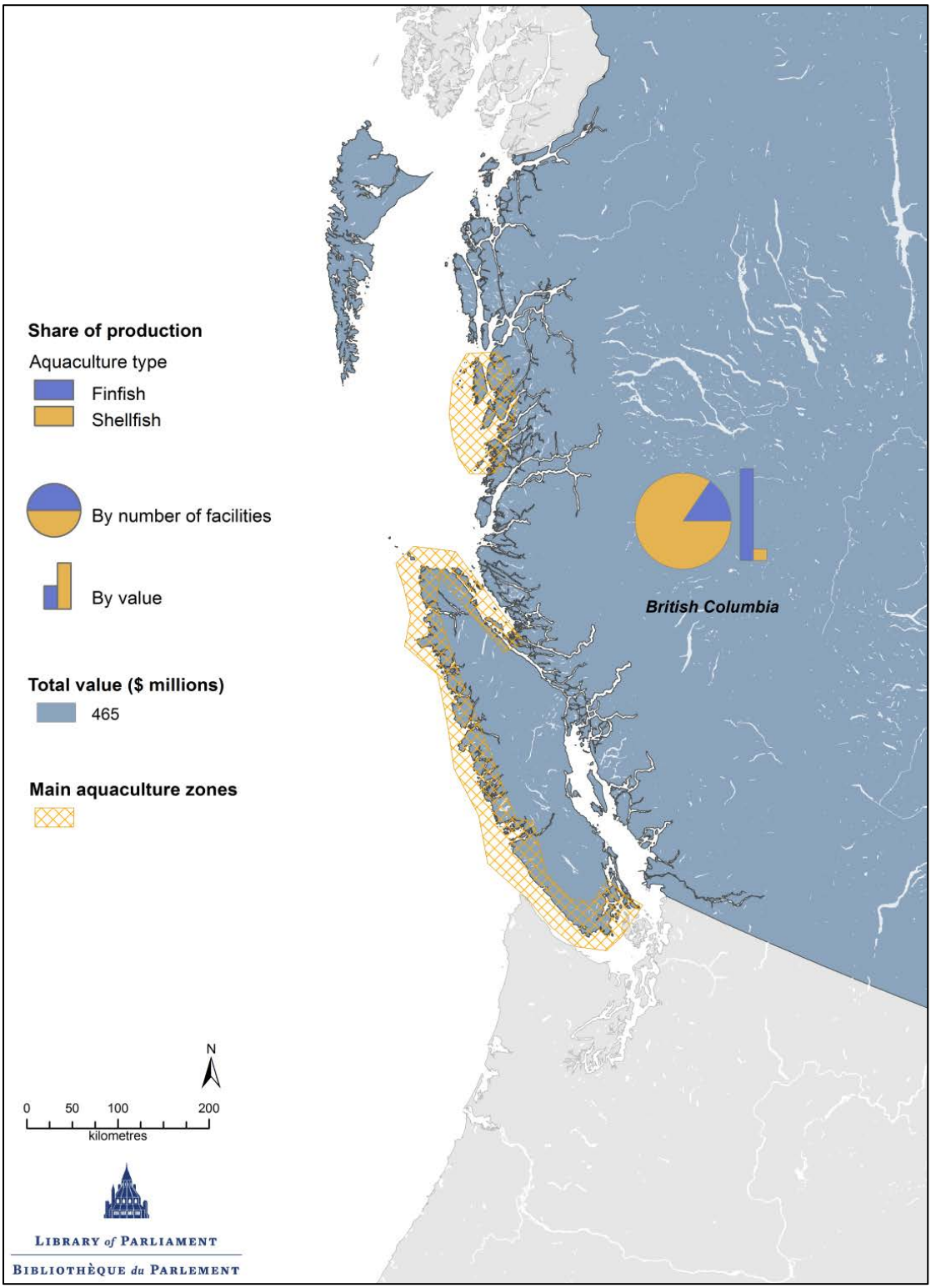
APPENDIX – AQUACULTURE PRODUCTION ON THE EAST AND WEST COASTS OF CANADA

Figure 1 – Aquaculture Production on the East Coast of Canada



Sources: GIS data – Government of Canada and DIVA GIS. Additional data was extracted from provincial aquaculture websites. Coordinate system – Canada Atlas WGS84.

Figure 2 – Aquaculture Production on the West Coast of Canada



Sources: GIS data – Government of Canada and DIVA GIS. Additional data was extracted from provincial aquaculture websites. Coordinate system – Canada Atlas WGS84.