Farming the Sea, a False Solution to a Real Problem: Critical Reflections on Canada's Aquaculture Regulations

Angela Lee & Pierre Cloutier de Repentigny

GIVEN THE DISMAL STATE of world fisheries and their continuing decline—exacerbated by climate change—aquaculture is touted by some to be a promising means for fulfilling the growing global demand for seafood, as reflected in its rapid growth as a segment of the global food system. However, large-scale aquaculture presents a complex set of environmental and social issues, and the introduction of genetically engineered fish and seafood adds a further layer of complexity to the already contentious nature of conventional aquaculture practices.

This article is a critical analysis of aquaculture regulation in Canada. In addition to setting out some of the major issues posed by industrialized aquaculture, it argues that shifting the "production" of seafood from marine fisheries to aquaculture merely shifts the cause of environmental damages. Further, in the context of food security, large-scale aquaculture is an inadequate and oversimplified solution to the problems raised by coastal and Indigenous populations' reliance on declining fisheries resources. Specifically, using two case studies, this paper criticizes the current system's overreliance on dominant risk paradigms, which are often closely informed by science. Yet, the relationship between law and science is fraught with tensions, as the two have notably different priorities and methods. In rethinking the role of aquaculture in natural marine resource management,

ÉTANT DONNÉ L'ÉTAT DÉSASTREUX des pêches mondiales et de leur déclin progressif (exacerbé par le changement climatique), l'aquaculture semble être selon certains, le moyen le plus prometteur de répondre à la croissance de la demande mondiale de fruits de mer, une croissance qui se témoigne par la popularité grandissante des fruits de mer en tant que composante du système alimentaire mondial. Cependant, l'aquaculture à grande échelle présente une série complexe de problèmes environnementaux et sociaux, et l'introduction de poissons et de fruits de mer génétiquement modifiés ajoute un degré de complexité de plus aux pratiques aquicoles conventionnelles, déjà controversées de nature.

Cet article présente une analyse critique des règlements sur l'aquaculture au Canada. En plus d'énoncer certains des problèmes majeurs posés par l'aquaculture industrielle, il stipule que le fait de transférer la « production » de fruits de mer de la pêche maritime à l'aquaculture ne ferait que déplacer la cause des dommages à l'environnement. De plus, dans le contexte de la sécurité alimentaire, l'aquaculture à grande échelle constitue une solution inadéquate et simpliste aux problèmes soulevés par les populations des côtes et les populations autochtones qui dépendent de ces ressources halieutiques en déclin. En utilisant deux études de cas en particulier, le présent document critique la surdépendance du système actuel aux paradigmes du risque dominant, qui

especially in a changing climate, it is important to ensure that careful regard is given to the socio-cultural factors, inequities, and environmental degradation that are inherent in the production of seafood.

sont souvent scientifiquement fondés. Pourtant, la relation entre la loi et les sciences déborde de tensions, étant donné leurs priorités et leurs méthodes largement différentes. Dans la réévaluation du rôle de l'aquaculture dans la gestion des ressources marines naturelles, plus particulièrement en situation de changement de climat; il est important de veiller à ce qu'une attention particulière soit prêtée aux facteurs socioculturels, aux inégalités, et à la dégradation de l'environnement inhérente dans la production de fruits de mer.

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INTRODUCTION

The detrimental environmental, social, and ethical impacts of industrial agriculture are becoming clearer and more widely recognized by the day.[1] In particular, there is increasing acknowledgement that conventional models of producing meat, dairy, and other animal products are deeply flawed, and that wide-ranging reforms are necessary, including in the ways that the relevant industries are regulated.[2] Yet, the importance and impacts of fish and fisheries often seem to be overlooked in broader conversations about animals, food systems, and sustainability. This is a curious omission, as fish are not only significant from a nutritional standpoint (representing a more affordable and available source of protein and other nutrients than other flesh foods), but also have profound social and cultural significance for many communities. Fishing can be a source of income, a form

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1 See e.g. Katy Keiffer, *What's the Matter with Meat?* (London, UK: Reaktion Books, 2017); Philip Lymbery & Isabel Oakeshott, *Farmageddon: The True Cost of Cheap Meat* (London, UK: Bloomsbury, 2014); Tony Weis, *The Ecological Hoofprint: The Global Burden of Industrial Livestock* (London, UK: Zed Books, 2013); Andrew Kimbrell, ed, *Fatal Harvest: The Tragedy of Industrial Agriculture* (Washington, DC: Island Press, 2002).

2 There are numerous regulatory reforms that have been proposed by animal advocates over the years. One example that has been recently debated in Canada is animal transport regulations. See e.g. Maureen Harper, "Legalized Cruelty: The Gaps in Canada's Animal Transport Laws" (26 May 2017), online: *iPolitics* <ipolitics.ca/2017/05/26/legalized-cruelty-the-gaps-in-canadas-animal-transport-laws> [perma.cc/ZP2S-H2KB].

of subsistence, and an emblem of heritage. Fishing can also be a serious cause of environmental decline, depending on how it is undertaken.

Methods and modes of fishing have evolved significantly over the years. At present, large-scale aquaculture—involving the farming of aquatic organisms (which can include fish, molluscs, crustaceans, and aquatic plants)—is steadily growing in popularity as a means of enhancing production.[3] Given the dismal state of world fisheries and their continuing decline—exacerbated by climate change—aquaculture is touted by some to be a potential solution to global food and nutrition security issues, and an avenue for fulfilling the growing demand for seafood. Indeed, aquaculture is among the fastest growing segments of the global food system, and presents both significant opportunities and challenges.[4] However, large-scale aquaculture implicates a complex set of issues, from environmental to social and economic.[5] National approaches to regulating aquaculture differ, and the strength or weakness of a country's approach has the potential to affect fisheries and the environment not only within that country's bounds, but globally as well.

Using Canada as a case study reveals many of the challenges inherent in regulating aquaculture. Canada is a unique subject of analysis in this context. The Canadian aquaculture industry is worth nearly a billion dollars in terms of production alone.[6] Salmon is the main species cultivated in Canadian aquaculture, especially in British Columbia (BC) and the Atlantic provinces.[7] Canada is the fourth largest producer of cultured salmon.[8] However, the case of the declining Pacific salmon—threatened by diseases,

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3 See Fisheries and Oceans Canada, "Farming the Seas—A Timeline" (last modified 3 March 2015), online: *Government of Canada* <www.dfo-mpo.gc.ca/aquaculture/sector-secteur/frm-tml-eng.htm> [perma.cc/LE56-T8PQ].

4 See e.g. Food and Agriculture Organization of the United Nations, *The State of World Fisheries and Aquaculture 2014: Opportunities and Challenges* (Rome: FAO, 2014) [FAO, *Opportunities*].

5 See Marc H Taylor & Lotta C Kluger, "Aqua- and Mariculture Management: A Holistic Perspective on Best Practices" in Markus Salomon & Till Markus, eds, *Handbook on Marine Environment Protection: Science, Impacts and Sustainable Management*, vol 1 & 2 (Cham: Springer, 2018) at 659–62.

6 See Fisheries and Oceans Canada, "Aquaculture: Production Quantities and Values" (last modified 24 January 2017), online: *Government of Canada* <www.dfo-mpo.gc.ca/stats/aqua/aqua15-eng.htm> [perma.cc/LE56-T8PQ].

7 *Ibid*.

8 See Canada, Commissioner of the Environment and Sustainable Development, *Reports of the Commissioner of the Environment and Sustainable Development to the Parliament of Canada: Report 1—Salmon Farming* (Ottawa: Office of the Auditor General, Spring 2018) at para 1.2 [CESD, *Spring Reports*].

pollution, climate change, and deficient fisheries management—provides a sobering example as to why stringent regulation is important in this sector.[9]

Further, genetically engineered (GE) fish and seafood—which have been receiving increased attention recently, as the AquAdvantage salmon recently became the first GE animal to be approved for human consumption by Canadian regulators—add a further layer of complexity to the already contentious nature of conventional aquaculture practices.[10] The paucities of the regulatory system when it comes to conventional aquaculture become all the more significant in the case of a new technology, of which the long-term effects and consequences are not yet known. The potential large-scale commercialization of GE fish and seafood, which could dramatically change the aquaculture sector, is thus highly relevant to any considerations of the future of food production and consumption, on both domestic and international scales. While aquaculture may appear to be a more sustainable way of producing seafood than relying on marine fisheries, much turns on how the questions and issues are framed. Arguably, shifting the "production" of seafood to aquaculture merely shifts the cause of environmental damages. Moreover, in the context of food security, large-scale aquaculture is an inadequate and oversimplified solution to the problems raised by coastal and Indigenous populations' reliance on declining fisheries resources.

Against this backdrop, this article offers some critical reflections on Canada's aquaculture regulation. It begins with an overview of the main issues associated with industrialized aquaculture, then goes on to summarize the Canadian aquaculture regulatory framework. The article subsequently offers two examples of contemporary failures of the current system: the risk of disease transfers associated with BC salmon aquaculture, and the approval of the GE AquAdvantage salmon. The conclusion argues that an overreliance on science and a narrow understanding of

9 See Canada, Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River, *The Uncertain Future of Fraser River Sockeye*: *Recommendations*, *Summary*, *Process*, by The Honourable Bruce I Cohen, vol 3 (Ottawa: Public Works and Government Services Canada, 2012) [Cohen, *Fraser River Sockeye, vol 3*].

10 See Health Canada, Statement, "Health Canada and Canadian Food Inspection Agency approve AquAdvantage Salmon" (19 May 2016), online: *Government of Canada* <www.canada.ca/en/health-canada/news/2016/05/health-canada-and-canadian-food-inspection-agency-approve-aquadvantage-salmon.html> [perma.cc/D4XE-83GP] (the approval also permits the AquAdvantage salmon (AAS) to be sold for livestock consumption) [Health Canada, "Approval Statement"].

"risk" serves to threaten the long-term resilience of fisheries and marine ecosystems, to the detriment of both people and ecosystems.

I. MAJOR ISSUES POSED BY INDUSTRIALIZED AQUACULTURE

Like any other industrial activity, fin-fish aquaculture can have considerable environmental impacts. Some of these impacts come from waste—mostly fecal matter and waste feed—that is directly rejected in coastal waters. This waste feeds bacteria, algae, and other organisms in the water, and thus reduces the availability of oxygen (*i.e.* causes eutrophication), triggering harm to many other marine species.[11] Aquaculture operations also result in the release of minerals (*e.g.* zinc and copper), chemicals (*e.g.* antifouling agents), drugs, and pesticides, which can result in the discharge of debris, fuel, and other operational discharge into coastal waters. Of particular concern is the release of antibiotics, which can cause wild fish contamination and antibiotic resistant bacteria, and of pesticides used to treat sea lice infestations (mainly SLICE), which are acutely toxic and persistent.[12] Additionally, the potential interaction of cultured salmon with wild ones, whether they escaped from enclosures or interacted through net pen operations (the dominant form of fin-fish aquaculture in Canada), can have serious consequences, such as the genetic displacement of wild salmon populations through interbreeding, and the spread of sea lice and infectious diseases.[13]

Both Pacific and Atlantic salmons are already under considerable stress. Recently, some populations of sockeye salmon—the emblematic species of BC fisheries—were recommended to be listed as endangered under the *Species at Risk Act*[14] by the Committee on the Status of Endangered Wildlife in Canada.[15] The added risks caused by aquaculture are thus

11 See Independent Aquaculture Regulatory Review for Nova Scotia, *A New Regulatory Framework for Low-Impact/High-Value Aquaculture in Nova Scotia*, by Meinhard Doelle & William Lahey, (Final Report) (Halifax: Province of Nova Scotia, 2014) at 8–9 [Doelle & Lahey, *Low-Impact*].

12 *Ibid* at 9–11.

13 *Ibid* at 11–13; Royal Society of Canada: The Academies of Arts, Humanities and Sciences of Canada, *Sustaining Canadian Marine Biodiversity: Responding to the Challenges Posed by Climate Change, Fisheries, and Aquaculture* (Ottawa: The Royal Society of Canada Expert Panel, 2012) (Chair: Jeffrey A Hutchings) at 137–142 [Royal Society, *Responding to Challenges*].

14 SC 2002, c 29.

15 "COSEWIC Wildlife Species Assessments (Short Version), November 2017" (last modified 18 December 2017), online: *Government of Canada* <www.canada.ca/en/environment-climate-change/services/committee-status-endangered-wildlife/assessments/short-version-november-2017.html> [perma.cc/JXU8-9KY4].

not insignificant, especially considering the cumulative nature of negative environmental impacts and the unknown effect climate change will have on already threatened salmon populations.[16]

Further, aquaculture invokes a number of social issues as well. Amidst a backdrop of ongoing global hunger,[17] an increasingly volatile climate system, and a continual quest for sustainable solutions to these interrelated issues, the role and importance of fish in addressing issues of global food and nutrition security is a progressively more important topic of attention.[18] Not only are fish and fish-related products a good source of protein and other essential nutrients, they also "provide income and livelihoods for numerous communities across the world,"[19] and play an important role in the cultural fabric of fishing communities.[20] Coastal Indigenous communities are particularly reliant on fisheries as a source of food, and are thus highly vulnerable to the loss of marine biodiversity.[21] In light of declining fish stocks, aquaculture can be viewed as a way to ensure long-term access to fish and seafood.[22] Indeed, the Canadian government recognizes this

16 See Royal Society, *Responding to Challenges, supra* note 13 at 88–90, 122–23; Fisheries and Oceans Canada, *Pathways of Effects for Finfish and Shellfish Aquaculture*, Science Advisory Report 2009/071 (Ottawa: Canadian Science Advisory Secretariat, January 2010); Fisheries and Oceans Canada, "Fraser River Environmental Watch Report July 30, 2018" (last modified 30 July 2018), online: *Government of Canada* <www.pac.dfo-mpo.gc.ca/science/habitat/frw-rfo/reports-rapports/2018/2018-07-30/index-eng.html> [perma.cc/V8LH-ZAUQ]; Lisa Johnson, "Fraser River is Now so Warm it May Kill Migrating Sockeye Salmon" (3 August 2018), online: *CBC News* <www.cbc.ca> [perma.cc/BMH4-B382].

17 See Food and Agriculture Organization of the United Nations, *The State of Food Security and Nutrition in the World: Building Resilience for Peace and Food Security* (Rome: FAO, 2017).

18 See FAO, *Opportunities*, *supra* note 4; Food and Agriculture Organization of the United Nations, *The State of World Fisheries and Aquaculture: Contributing to Food Security and Nutrition For All* (Rome: FAO, 2016); The High Level Panel of Experts on Food Security and Nutrition, *Sustainable Fisheries and Aquaculture for Food Security and Nutrition: A Report by The High Level Panel of Experts on Food Security and Nutrition* (Rome: HLPE, 2014) [HLPE, *Sustainable Fisheries*].

19 HLPE, *Sustainable Fisheries*, *supra* note 18 at 13.

20 See James R McGoodwin, *Understanding the Culture of Fishing Communities: A Key to Fisheries Management and Food Security*, FAO Fisheries Technical Paper No 401 (Rome: FAO, 2001) at 43–56; Zoe Todd, "Fish Pluralities: Human-Animal Relations and Sites of Engagement in Paulatuuq, Arctic Canada" (2014) 38:1–2 Études/Inuit/Studies 217.

21 See Andrés M Cisneros-Montemayor et al, "A Global Estimate of Seafood Consumption by Coastal Indigenous Peoples" (2016) 11:12 PLoS ONE, online: <journals.plos.org/plosone/article?id=10.1371/journal.pone.0166681> [perma.cc/7K5Q-2KHT].

22 See Siwi Msangi & Miroslav Batka, "The Rise of Aquaculture: The Role of Fish in Global Food Security" in International Food Policy Research Institute, *2014–2015 Global Food Policy Report* (Washington, DC: International Food Policy Research Institute, 2015) 61 at 61–62.

potential through its Aquaculture Policy Framework.[23] Thus, in addition to posing complex environmental questions and concerns, the future of fishing and aquaculture also raises important issues relating to social justice and inequality, such as distribution of economic benefits, distribution of negative impacts, and access to the seafood produced.[24]

II. AQUACULTURE REGULATION IN CANADA

The potential impacts of aquaculture operations summarized above highlight the need for a robust regulatory framework to ensure the social and environmental viability of aquaculture. Unfortunately, the regulatory landscape in Canada is, to say the least, complex, fragmented, and deficient in many respects,[25] as stated in government-commissioned reports[26] and as exemplified by the two case studies explored below. This Part concentrates on summarizing federal (as opposed to provincial and territorial) regulations, for two reasons. First, most of the provisions are applicable nationally and it is likely that constitutional jurisdiction over aquaculture lies with the federal government. Second, both case studies are situated

23 See Fisheries and Oceans Canada, "Aquaculture Policy Framework" (last modified 1 November 2013), online: *Government of Canada* <www.dfo-mpo.gc.ca/aquaculture/ref/APF-PAM-eng.htm> [perma.cc/TZ57-EEQR] (however, DFO does not measure or keep track of the food security impact of aquaculture or fisheries in general) [Fisheries and Oceans Canada, "Aquaculture Policy Framework"].

24 Canadian data have focused on the general economic impacts of aquaculture (*e.g.* export values or employment) and have neglected more complex social justice issues such as food security and poverty alleviation, an issue that is not unique to Canada: Christophe Béné et al, "Contribution of Fisheries and Aquaculture to Food Security and Poverty Reduction: Assessing the Current Evidence" (2016) 79 World Development 177. At the very least, coastal and Indigenous communities in BC are somewhat benefiting from the employment, fiscal, and other economic benefits brought by aquaculture: see British Columbia, Minister of Agriculture's Advisory Council on Finfish Aquaculture, *Final Report and Recommendations* (Victoria: British Columbia Ministry of Agriculture, 2018) at 35–36 [MAACFA].

25 See Meinhard Doelle & Phillip Saunders, "Aquaculture Governance in Canada: A Patchwork of Approaches" in Nigel Bankes, Irene Dahl & David L VanderZwaag, eds, *Aquaculture Law and Policy: Global, Regional and National Perspectives* (Cheltenham, UK: Edward Elgar, 2016) 183 at 185–87 [Doelle & Saunders, *Patchworks*]; CESD, *Spring Reports*, *supra* note 8.

26 See Canada, Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River, *The Uncertain Future of Fraser River Sockeye*: *The Sockeye Fishery,* by The Honourable Bruce I Cohen, vol 1 (Ottawa: Public Works and Government Services Canada, 2012) at 17, 202 [Cohen, *Fraser River Sockeye*, *vol 1*]; Doelle & Lahey, *Low-Impact*, *supra* note 11 at 39–45.

within the provinces of BC and Prince Edward Island (PEI), where the federal government has a direct regulatory role.[27]

Jurisdiction over fisheries is exercised by the Minister of Fisheries, Oceans and the Canadian Coast Guard (the Minister),[28] assisted by Fisheries and Oceans Canada (DFO).[29] The main piece of applicable federal legislation is the *Fisheries Act*.[30] The main ministerial power is found in section 7 of the *Act,* which gives the Minister the absolute discretion to issue leases and licences for fisheries or fishing, including those related to aquaculture. This discretionary power is limited only by other provisions of the *Act*, and by the regulations adopted thereunder. The Minister can specify in an aquaculture licence, including a fish transfer licence, conditions for the proper management and control of fisheries and the conservation and protection of fish.[31]

The *Fishery* (*General*) *Regulations* (*FGR*) prohibit the unauthorised transfer of any live fish to any fish habitat or fish rearing facility.[32] Transfers are authorized through licences that can only be issued by the Minister if:

> (a) the release or transfer of the fish would be in keeping with the proper management and control of fisheries;
> (b) the fish do not have any disease or disease agent that may be harmful to the protection and conservation of fish; and
> (c) the release or transfer of the fish will not have an adverse effect on the stock size of fish or the genetic characteristics of fish or fish stocks.[33]

The Minister has delegated the power to issue transfer licences to DFO's Regional Manager, Aquaculture Programs, who is advised by provincial

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27 Doelle & Saunders, *Patchworks*, *supra* note 25 at 185–88; *Constitution Act, 1867* (UK), 30 & 31 Vict, c 3, s 91(12), reprinted in RSC 1985, Appendix II, No 5; *Morton v British Columbia* (*Agriculture and Lands*), 2009 BCSC 136 at para 190 [*Morton v BC*]. For more on provincial regulations, see Doelle & Saunders, *Patchworks*, *supra* note 25 at 198–211.

28 The Minister of Fisheries and Oceans was renamed the Minister of Fisheries, Oceans and the Canadian Coast Guard, however, the previous name is maintained throughout legislation and regulations. See Fisheries and Oceans Canada, "Our Minister" (last modified 11 October 2018), online: *Government of Canada* <www.dfo-mpo.gc.ca/about-notre-sujet/minister-ministre-eng.htm> [perma.cc/4BFA-F7E4].

29 While the Department of Fisheries and Oceans is named Fisheries and Oceans Canada, the acronym DFO, standing for the Department of Fisheries and Oceans, is still widely used.

30 RSC 1985, c F-14.

31 See SOR/93-53, s 22 [*FGR*]; *Pacific Aquaculture Regulations*, SOR/2010-270, s 4.

32 *FGR*, *supra* note 31, s 55.

33 *Ibid*, s 56.

and territorial Introductions and Transfers Committees.[34] Inspections of aquaculture hatcheries are carried out every three months, and coincide with fish transfer licence applications. The inspections verify the presence of diseases of concern and advise the Regional Manager on licence conditions and whether or not the application should be approved.[35]

The *Fisheries Act* also grants the Minister several powers to protect fish from physical projects and pollution. For example, the *Act* prohibits "any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery" unless authorized by the *Act* or the Minister.[36] The *Act* further prohibits the deposit of deleterious substances into water frequented by fish unless authorized by regulations.[37]

The *Aquaculture Activities Regulations* (*AAR*)[38] establish the regime for authorizing work, and for the deposit of deleterious substances related to aquaculture operations. The deposit of authorized pesticides, prescription drugs, and biochemical oxygen demanding matter is only permitted if the aquaculture operation is licensed by the federal or a provincial government, and if the *AAR* requirements are met.[39] Such requirements include considering whether there are alternatives to a prescribed drug when used for pest control or to the use of an authorized pesticide, taking measures to minimize risk of accidental deposit of drugs, and taking reasonable measures to minimize detriment to fish and fish habitat.[40]

Larger aquaculture operations must also monitor the effect of deleterious substance deposits on oxygen demands, the concentration of free

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34 See *Namgis First Nation v Canada* (*Minister of Fisheries, Oceans and the Canadian Coast Guard and Marine Harvest Canada Inc*), 2018 FC 334 at paras 26–29 [*Namgis Injunction*]. See especially Fisheries and Oceans Canada, "Introductions and Transfers Committees — Provincial and Territorial Contacts" (last modified 4 October 2017), online: *Government of Canada* <www.dfo-mpo.gc.ca/aquaculture/management-gestion/contact-intro-eng.htm> [perma.cc/73WF-QQST]) (Fisheries and Oceans Canada guides the committee in its task); Fisheries and Oceans Canada, "National Code on Introductions and Transfers of Aquatic Organisms" (last modified 8 January 2018), online: *Government of Canada* <www.dfo-mpo.gc.ca/aquaculture/management-gestion/it-code-eng.htm> [perma.cc/AQ4S-ACAN].

35 *Namgis Injunction*, *supra* note 34 at para 28.

36 *Fisheries Act*, *supra* note 30, s 35. See generally Bill C-68, *An Act to amend the Fisheries Act and other Acts in consequence*, 1st Sess, 42nd Parl, 2018, cl 2.1(b) (as passed by the House of Commons 20 June 2018) (it should be noted that the government has recently introduced a bill in Parliament to enhance and modernize the habitat protection regime of the *Act*).

37 *Supra* note 30, ss 34(1), 36.

38 SOR/2015-177.

39 *Ibid*, ss 3–4.

40 *Ibid*, ss 5–7.

sulfide, and the presence of certain bacteria and marine worms in accordance with DFO's Monitoring Standard.[41] When any fish morbidity or mortality is observed outside an aquaculture facility within 96 hours of the deposit of a drug or pest control product, a fishery officer must be notified.[42] An aquaculture operation cannot be restocked if the concentration of free sulfide exceeds prescribed concentration limits, or if the seabed is covered in bacteria and marine worms beyond a prescribed level.[43] When these limits are exceeded, the Minister must be notified.[44]

As for the protection of fish habit, the *AAR* identify the following as prescribed works requiring approval pursuant to the *Fisheries Act*: the installation, operation, maintenance or removal of an aquaculture facility, and measures to control biofouling or the presence of fish pathogens or pests in the facility.[45] The deposit of deleterious substances is excluded.[46] To be approved, these works must operate under an aquaculture licence, and the aquaculture operation must take reasonable measures to mitigate the risk of serious harm to fish outside the facility.[47] These measures do not apply to aquaculture operations licenced under the *Pacific Aquaculture Regulations* (presumably, similar conditions would be imposed through licence conditions).[48] Finally, aquaculture operations must submit an annual report containing information on each deposit of drugs or pesticides and on monitoring measures,[49] and must keep records for inspection purposes.[50]

Aquaculture operations are also subject to general federal, and provincial and territorial laws, such as environmental and health regulations. One such law is the *Canadian Environmental Protection Act, 1999* (*CEPA*).[51] Part 6 of *CEPA* prohibits the manufacture or import of living GE organisms not included in the Domestic Substances List or constituting a "significant new activity" (*e.g.* the release of the organisms in the environment in a quantity or concentration greater than previously entered or was released

41 *Ibid*, ss 8, 9, 10(1), 11. See Fisheries and Oceans Canada, "Aquaculture Monitoring Standard" (last modified 13 July 2018), online: *Government of Canada* <www.dfo-mpo.gc.ca/aquaculture/management-gestion/aar-raa-ann7-eng.htm> [perma.cc/RN4Y-2GXZ].

42 *AAR*, *supra* note 38, s 13.

43 *Ibid*, s 11(2)(b)–(c).

44 *Ibid*, s 12.

45 *Ibid*, s 15(1)(a).

46 *Ibid*, s 15(2).

47 *Ibid*, s 15(1)(b)(i)–(ii).

48 *Ibid*, s 15(3).

49 *Ibid*, ss 14, 15(1)(b)(iii), 16(1).

50 *Fisheries Act*, *supra* note 30, s 61.

51 SC 1999, c 33 [*CEPA*].

into the environment), unless otherwise exempt under the statute.[52] To be included on the list, organisms must be assessed for their toxicity pursuant to *CEPA*[53] and the *New Substances Notification Regulations* (*Organisms*) (*NSNR* (*Organisms*)).[54] When the Minister suspects that the living organism is toxic or capable of becoming toxic, she can impose conditions for the manufacture or import of the organism, or prohibit it for two years, unless a regulation is adopted.[55] There are currently no specific regulations in place concerning GE salmon or any other GE aquatic species.

Dangerous or potentially dangerous substances used in aquaculture are usually independently regulated. Drugs (including chemicals used in feed) and pesticides used in aquaculture to prevent disease and parasites are subject to the *Food and Drugs Act*[56] and the *Pest Control Products Act*.[57] Both statutes set up mechanisms to evaluate and approve drugs and pesticides, and to control their sale, exportation, importation, labelling, and usage. The *Food and Drugs Act* also sets standards for the consumption of fish.[58]

The *Health of Animals Act* regulates the keeping, sale, import, and export of animals contaminated by or exposed to a reportable disease or toxic substance.[59] In order to control diseases and toxic substances, the Canadian Food Inspection Agency (CFIA) may treat or dispose of the affected animals, or impose necessary restrictions aimed at preventing or combating diseases.[60] These provisions are complemented by the *Fish Inspection Act*, which ensures standards (quality, labeling, sanitary, *etc*.) for establishments where fish are processed or stored for export (including between provinces).[61] Feeds used in aquaculture are regulated by the *Feeds Act*[62] for safety, effectiveness and labeling, whether imported or manufactured domestically.

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52 *Ibid*, ss 104, 106(1), 106(3).

53 *Ibid*, s 108(1). (Toxicity is defined as a substance "if it is entering or may enter the environment in a quantity or concentration or under conditions that (a) have or may have an immediate or long-term harmful effect on the environment or its biological diversity; (b) constitute or may constitute a danger to the environment on which life depends; or (c) constitute or may constitute a danger in Canada to human life or health." *Ibid*, s 64).

54 SOR/2005-248, ss 4, 6(d), Schedule 5.

55 *CEPA*, *supra* note 51, s 109.

56 RSC 1985, c F-27.

57 SC 2002, c 28.

58 *Food and Drug Regulations*, CRC, c 870, Part B, Division 21.

59 SC 1990, c 21.

60 *Ibid*, s 27.6; *Health of Animals Regulations*, CRC, c 296 (2017).

61 RSC 1985, c F-12.

62 RSC 1985, c F-9.

Furthermore, aquaculture operations could be subject to the *Species at Risk Act* if their activities or the construction of facilities have direct or indirect negative impacts on a protected species.[63] In a similar vein, aquaculture operations could be limited by the designation of marine protected areas under the *Oceans Act*.[64] Aquaculture operations also have to be considered for—and could potentially be impacted by—the adoption and implementation of endangered species recovery strategies and action plans, and of oceans integrated management plans.[65] It is also worth noting that the approval of aquaculture activities by the federal or a provincial government can affect constitutional Aboriginal rights, especially rights related to fishing, and could therefore be limited by them, including the duty to consult and accommodate Aboriginal peoples regarding actions negatively affecting their established or potential rights.[66]

Aquaculture regulations are primarily designed to mitigate environmental impacts. They are not preventive, and they give considerable leeway to the industry (except potentially section 56 of the *FGR*, depending on its implementation). DFO's role is limited mostly to reviewing the self-monitoring of the industry and intervening when a problem is reported. While the *AAR* have only been in force for few years and are thus difficult to evaluate for effectiveness, they likely do not offer sufficient safeguards, since they adopt the deficient standard mitigation model of Canadian environmental law, which also affects the *Pest Control Products Act* and *CEPA*.[67] In her Spring 2018 report on salmon farming, the Commissioner of the Environment and Sustainable Development found the *AAR* deficient in both their design and implementation.[68] Specifically, the Commissioner found that DFO did not assess whether the *AAR* were adequate to minimize harm to wild fish, that DFO was not validating the information in the industry self-reports, and that the *AAR* were not sufficiently enforced to minimize harm to wild fish.[69] Further, the fragmented

63 *Supra* note 14, ss 32–33, 37, 58.

64 SC 1996, c 31, s 35.

65 *Species at Risk Act*, *supra* note 14, ss 37–55; *Oceans Act*, *supra* note 64, ss 31–32.

66 See *Heiltsuk Tribal Council v British Columbia (Minister of Sustainable Resource Management)*, 2003 BCSC 1422. See also *Kwicksutaineuk Ah-Kwa-Mish First Nation v Attorney General of Canada et al*, 2012 FC 517.

67 See Stepan Wood, Georgia Tanner & Benjamin J Richardson, "What Ever Happened to Canadian Environmental Law?" (2010) 37:4 Ecology LQ 981.

68 CESD, *Spring Reports*, *supra* note 8.

69 *Ibid* at paras 1.51–1.63 & 1.75–1.85.

approach to regulation that is apparent in the case of aquaculture has been identified as a general roadblock for attaining sustainability.[70]

III. CASE STUDY: BC SALMON AND PISCINE REOVIRUS

Salmon fisheries and the impact of aquaculture on them have been a long-standing and contentious issue in BC.[71] Salmon are a core component of the culture and economy of BC, and of many First Nations. Nevertheless, DFO has not been a role model in ensuring the sustainability of the aquaculture industry, focusing primarily on economic development rather than environmental protection, despite the demonstrable risks associated with aquaculture.[72] It took litigation and the federal Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River (the Cohen Commission) to ensure that the federal government took responsibility over the impact of aquaculture on wild Pacific salmon.[73] However, the implementation of the Cohen Commission Final Report is still ongoing, and DFO's inadequate management of risk has led to further litigation.[74] Of particular concern is the management of risk related to diseases, a problem exemplified by the voluntary work of biologist Alexandra Morton, represented by the public interest environmental law organization Ecojustice.[75]

In March 2013, Ms. Morton gathered information about the transfer of Atlantic salmon smolts (juvenile fish) from a hatchery to an open water facility in Shelter Bay, BC, operated by the Norwegian-based corporation Marine Harvest. Some of the smolts tested positive for the piscine reovirus (PRV), which evidence suggests, but does not conclusively establish, is the

70 See David VanderZwaag, Gloria Chao & Mark Covan, "Canadian Aquaculture and the Principles of Sustainable Development: Gauging the Law and Policy Tides and Charting a Course" (2002) 28:1 Queen's LJ 279 at 300–01.

71 See e.g. Mark Quinn, "Jobs, Environment Clash at Marystown Meeting About $250M Salmon Farm", *CBC News* (14 March 2018), online: <www.cbc.ca> [perma.cc/TJ2J-EMTN].

72 See Cohen, *Fraser River Sockeye, vol 3*, *supra* note 9 at 11–12.

73 See Fisheries and Oceans Canada, "Response to Cohen Commission" (28 September 2017), online: <www.dfo-mpo.gc.ca/cohen/index-eng.htm> [perma.cc/25SQ-VLRC]; *Morton v BC*, *supra* note 27; Cohen, *Fraser River Sockeye, vol 1*, *supra* note 26.

74 See *Morton v Canada* (*Fisheries and Oceans*), 2015 FC 575 [*Morton v Canada*]; *Morton v Canada* (*Fisheries and Oceans*) (12 October 2016), Vancouver, FC T-1710-16 (application for judicial review); *Namgis First Nation v Canada* (*Fisheries and Oceans*) (6 March 2018), Vancouver, FC T-430-18 (application for judicial review); *Namgis Injunction*, *supra* note 34; see also *Marine Harvest Canada Inc v Morton*, 2018 BCSC 1302.

75 See Margot Venton et al, "Protecting Wild Salmon From Piscine Reovirus", online: *Ecojustice* <www.ecojustice.ca/case/protecting-wild-salmon-from-piscine-reovirus> [perma.cc/M6V2-QBFP].

cause of the infectious and deadly heart and skeletal muscle inflammation (HSMI) disease. As a result of her research, Ms. Morton warned DFO about the presence of PRV in some of the transferred smolts. DFO simply replied that the transfers were permitted. In response, she filed an application for judicial review challenging the legality of the fish transfer.[76] At issue was the compatibility of Marine Harvest's licence condition 3.1 on fish transfers with subsection 56(b) of the *FGR*, which states that a licence can only be issued if the transferred fish "do not have any disease or disease agent that may be harmful to the protection and conservation of fish."[77]

At the centre of the dispute was the concept of risk: the level of risk acceptable according to the *FGR*, and the risk posed by transferring fish infected with PRV. Justice Rennie (now of the Federal Court of Appeal), analyzed both points from a precautionary perspective. This fact alone merits attention, as the precautionary principle has thus far had a limited impact in Canadian case law, and the principle is not mentioned in the *Fisheries Act* or its regulations.[78]

Regarding the risk of disease harmful to fish, the evidence was, on one hand, that PRV is likely the cause of HSMI, and on the other hand, that the causal relation between the two had yet to be proven with scientific certainty.[79] The lack of scientific certainty did not deter Justice Rennie; he found it was enough that PRV may cause HSMI and thus may harm fish.[80] In other words, there was a risk, and ignoring the risk would not be exercising the appropriate degree of precaution. Justice Rennie then turned his attention to the interpretation of paragraph 56(b) of the *FGR*. He found the regime to be one of risk management embodying the precautionary principle.[81] Additionally, the Minister's mandate to conserve fisheries,[82] and the language of the provision ("*any* disease or disease agent" and "that *may* be harmful")[83] all pointed towards an interpretation of the provision as a strong protection against potentially harmful fish

76 *Morton v Canada*, *supra* note 74 at paras 1–9.

77 The condition is reproduced in *Morton v Canada*, *supra* note 74 at para 23.

78 See Pierre Cloutier de Repentigny, "Precaution, Sub-delegation and Aquaculture Regulation: *Morton v Canada* (*Fisheries and Oceans*)" (2015) 28:1 J Envtl L & Prac 125 at 133–39.

79 *Morton v Canada*, *supra* note 74 at paras 33–48.

80 *Ibid* at para 45.

81 *Ibid* at para 97. See *114957 Canada Ltée* (*Spraytech, Société d'arrosage*) *v Hudson* (*Town*), 2001 SCC 40 at paras 30–32 (the precautionary principle can be used as a tool of statutory interpretation).

82 See *R v Marshall*, [1999] 3 SCR 533 at para 40, 179 DLR (4th) 193.

83 *FGR*, *supra* note 31, s 56(b) [emphasis added].

transfers.[84] Ultimately, Justice Rennie found that conditions 3.1(b)(ii) and (iv) were not reasonable applications of paragraph 56(b), and as such were invalid and of no force and effect, largely vindicating Ms. Morton.[85]

DFO and Marine Harvest initially attempted to appeal the decision.[86] Before the appeal could be heard, it was discontinued, prompted by the detection of an outbreak of HSMI disease among farmed salmon.[87] A study of the outbreak conducted in part by DFO's biologists demonstrated a link between PRV and HSMI, and a statistical correlation between PRV and the severity of some HSMI symptoms.[88] Furthermore, subsequent research on PRV infection in wild and farmed salmon in BC revealed that 95 per cent of farmed Atlantic salmon are infected, and that 37–45 per cent of wild Pacific salmon close to aquaculture operations are infected—an infection rate that drops to five per cent for wild Pacific salmon the farthest from aquaculture operations.[89] At the preliminary injunction stage in a case brought by the Namgis First Nation challenging the legality of several fish transfer licences in their traditional territory, Justice Manson also found PRV to pose a serious risk of irreparable harm.[90] Despite the considerable risk posed by PRV transmitted through farmed salmon, the requirements of section 56 of the *FGR*, and the fact that DFO has recognized, to some

84 *Morton v Canada*, *supra* note 74 at paras 54–59.

85 *Ibid* at paras 61–72, 96–101. Condition 3.1(b)(iv) was further invalidated as it constituted an illegal sub-delegation: *ibid* at paras 74–94. See Cloutier de Repentigny, *supra* note 78 at 141–51.

86 See *Canada* (*Fisheries and Oceans*) *v Morton* (17 January 2017), Vancouver A-275-15 (FCA); *Marine Harvest Canada Inc v Morton* (17 January 2017), Vancouver A-274-15 (FCA).

87 See Morgan Blakely & Margot Venton, "Fighting for Government Oversight of Fish Farms", online: *Ecojustice* <www.ecojustice.ca/case/government-oversight-of-fish-farms> [perma.cc/MCT3-TVVZ]; Yvette Brend, "Deadly Salmon Disease Found in B.C. Farmed Stock, Federal Scientists Say", *CBC News* (21 May 2016), online: <www.cbc.ca> [perma.cc/S47Z-8C3A].

88 See Emiliano Di Cicco et al, "Heart and Skeletal Muscle Inflammation (HSMI) Disease Diagnosed on a British Columbia Salmon Farm Through a Longitudinal Farm Study" (2017) 12:2 PLoS ONE, online: <journals.plos.org/plosone/article?id=10.1371/journal.pone.0171471> [perma.cc/LD69-CBXQ]. See also Gustavo Palacios et al, "Heart and Skeletal Muscle Inflammation of Farmed Salmon is Associated with Infection with a Novel Reovirus" (2010) 5:7 PLoS One, online: <journals.plos.org/plosone/article?id=10.1371/journal.pone.0011487> [perma.cc/3ZMN-MPDH]; Øystein Wessel Finstad et al, "Immunohistochemical Detection of Piscine Reovirus (PRV) in Hearts of Atlantic Salmon Coincide with the Course of Heart and Skeletal Muscle Inflammation (HSMI)" (2012) 43:27 Veterinary Research.

89 See Alexandra Morton et al, "The Effect of Exposure to Farmed Salmon on Piscine Orthoreovirus Infection and Fitness in Wild Pacific Salmon in British Columbia, Canada" (2017) 12:12 PLoS ONE, online: <journals.plos.org/plosone/article?id=10.1371/journal.pone.0188793> [perma.cc/58F8-4STT].

90 *Namgis Injunction*, *supra* note 34 at paras 92–94.

extent, the link between PRV and HSMI, DFO refuses to test salmon for PRV before issuing a transfer licence.[91]

This pattern of behaviour in aquaculture risk management, regarding diseases in particular, is troubling, but also far from new. These risks were highlighted several years prior by Commissioner Cohen in his report: "I accept the undisputed evidence that there is some risk posed to Fraser River sockeye from diseases on salmon farms, but I cannot make a determination as to the precise level of risk. Therefore, precaution would suggest assuming that the risk is not insignificant."[92] He further stated that the "potential harm posed to Fraser River sockeye salmon from salmon farms is serious or irreversible," and that disease transfers do occur between farmed and wild salmon.[93] While the Commissioner's conclusions led to a temporary moratorium on salmon aquaculture in a sensitive area for the Sockeye salmon lifecycle, DFO's cavalier and potentially illegal attitude towards the risks inherent in aquaculture has not changed.

Additional concerns have also been raised regarding DFO's publication on January 5, 2018 of a *Notice of Intent with Respect to Amendments to Regulations for Managing Movements of Live Fish*.[94] The stated aims of the potential amendments are to clarify the scope of aquatic animal diseases regulated by DFO and the CFIA, and to reflect implementation of the National Aquatic Animal Health Program (NAAHP). The NAAHP provides the CFIA with a regulatory framework for managing fish-related disease risks, and DFO believes this results in some overlap with section 56 of the *FGR*. The issue of regulatory efficiency is not a problem *per se*, but it is often used as

91 See Devon Page & Alexandra Morton, "Fisheries Minister's Negligence is Putting the Future of Wild Salmon at Risk" (27 September 2016), online: *Ecojustice* <www.ecojustice.ca/fisheries-ministers-negligence-is-putting-the-future-of-wild-salmon-at-risk> [perma.cc/2K67-2PE9]; Fisheries and Oceans Canada, "Piscine Orthoreovirus (PRV) and Heart and Skeletal Muscle Inflammation (HSMI)" (last modified 26 May 2017), online: *Government of Canada* <www.dfo-mpo.gc.ca/science/aah-saa/species-especes/aq-health-sante/prv-rp-eng.html> [perma.cc/4SVZ-2FZH]; *Namgis Injunction*, *supra* note 34 at paras 30–39.

92 Canada, Commission of Inquiry, *The Uncertain Future of Fraser River Sockeye: Causes of the Decline*, by The Honourable Bruce Cohen, vol 2 (Ottawa: Public Works and Government Services Canada, 2012) at 114. See also Royal Society, *Responding to Challenges*, *supra* note 13 at 140.

93 Cohen, *Fraser River Sockeye, vol 3*, *supra* note 9 at 22.

94 Fisheries and Oceans Canada, "Notice of Intent with Respect to Amendments to Regulations for Managing Movements of Live Fish" (last modified 5 January 2018), online: *Government of Canada* <www.dfo-mpo.gc.ca/aquaculture/management-gestion/fgr-rpdg-eng.htm> [perma.cc/EM6S-DS85].

an excuse to weaken regulations.[95] The concern is thus that the *FGR* will be weakened, and that the shift of responsibility from DFO to the CFIA will only be partial due to the different mandates and areas of expertise of these two agencies.[96] While we will have to wait for the definitive text of the amendments and their regulatory impact assessment statements to judge their adequacy and potential impacts, the past and current behaviour of DFO does not suggest a positive outcome regarding risk management of fish diseases.

IV. CASE STUDY: THE AQUADVANTAGE SALMON

The AquAdvantage salmon (AAS) is a transgenic fish produced by the Massachusetts-based AquaBounty Technologies Inc. (AquaBounty). By combining genes from the Chinook salmon and the ocean pout with the genome of an Atlantic salmon,[97] the result is a fish that is able to grow faster and year-round, thereby reaching market size much sooner than its unmodified counterpart.[98] This feature is an obvious boon for the company who stands to profit, but AquaBounty also boasts that the AAS "is better for the environment and consumers," with their two major sustainability claims pertaining to conserving wild fish populations and reducing carbon emissions.[99] Thus, the AAS holds out the promise that it could "offer a way out of the deadly spiral of overfishing that is decimating wild fish

95 See April L Girard, Suzanne Day & Laureen Snider, "Tracking Environmental Crime Through CEPA: Canada's Environment Cops or Industry's Best Friend" (2010) 35:2 Can J Soc 219 at 231–32; Robert L Glicksman & Stephen B Chapman, "Regulatory Reform and (Breach of) the Contract with America: Improving Environmental Policy or Destroying Environmental Protection?" (1995) 5:1 Can JL & Pub Pol'y 9.

96 See Damien Gillis, "DFO's Plan to Gut Rules Protecting Wild Salmon from Fish Farm Disease" (11 January 2018), online: *The Tyee* <www.thetyee.ca> [perma.cc/3WXM-JS7R]; Margot Venton, Keegan Pepper-Smith & Olivia French, "Amendments to Fishery Regulations Could Put Wild Salmon at Risk" (9 November 2017), online: *Ecojustice* <www.ecojustice.ca/amendments-fishery-regulations-wild-salmon> [perma.cc/XR8T-GF57]. In fact, PRV is not a reportable disease under the *Reportable Diseases Regulations*, SOR/91-2.

97 See Fisheries and Oceans Canada, *Summary of the Environmental and Indirect Human Health Risk Assessment of AquAdvantage® Salmon*, Canadian Science Advisory Secretariat, Science Response 2013/023, at 2 [Fisheries and Oceans Canada, *Risk Assessment*].

98 *Ibid*.

99 AquaBounty, "Sustainable", online: <www.aquabounty.com/sustainable> [perma.cc/HZX2-BB6W].

stocks",[100] while also reducing the energy burden associated with sating the global appetite for seafood.

In Canada, genetically modified foods are generally classified and regulated as "novel foods," which are regulated by a constellation of federal agencies, departments, acts, and policies. In the case of the AAS, Health Canada and the CFIA deal with the food use of AAS for human and livestock consumption, respectively. Meanwhile, Environment and Climate Change Canada (ECCC) and Health Canada are the key authorities for assessing the potential harm of new substances, including organisms, to the environment and human health.

DFO also "assists in implementing the *NSNR* (*Organisms*) by conducting an environmental and indirect human health risk assessment for fish products of biotechnology and recommending any necessary measures to manage risks."[101] Assessments conducted for the purpose of complying with the *NSNR* (*Organisms*) are used to "ensure that human health, the environment and biological diversity are protected."[102] Although it was not determinative, the Science Response[103] produced as a result of DFO's risk assessment of the AAS was foundational to the AAS approval process in that it informed a finding of non-toxicity according to *CEPA* requirements,[104] and was used in order to make recommendations on any necessary risk-management measures to ECCC.[105] Based on the Science Response, ECCC indicated that AquaBounty could proceed with its plans to commercially produce sterile AAS eggs at their research and development facility in PEI, and then transport the eggs to a land-based facility in Panama for commercial grow-out and processing.[106] However, the

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100 Richard Martin, "One Fish, Two Fish, Strange Fish, New Fish" (13 February 2018), online: *bioGraphic* <www.biographic.com/posts/sto/one-fish-two-fish-strange-fish-new-fish> [perma.cc/L2JK-WVAB].

101 Health Canada, "Novel Food Information—AquAdvantage Salmon" (last modified 19 May 2016), online: *Government of Canada* <www.canada.ca/en/health-canada/services/food-nutrition/genetically-modified-foods-other-novel-foods/approved-products/novel-food-information-aquadvantage-salmon.html> [perma.cc/GHE4-UY6U] [Health Canada, "Novel Food Information"].

102 Government of Canada, *Guidelines for the Notification and Testing of New Substances: Organisms* (Ottawa, Public Works and Government Services Canada, 2010), online: <www.canada.ca/content/dam/eccc/documents/pdf/new-substances-guidelines-for-ganisms/En14-36-1-2011-eng.pdf> [perma.cc/WBA9-AYT7] at 12.

103 Fisheries and Oceans Canada, *Risk Assessment*, *supra* note 97 at 2.

104 *CEPA*, *supra* note 51, s 64.

105 Fisheries and Oceans Canada, *Risk Assessment*, *supra* note 97 at 1.

106 *Ibid* at 2.

approval also permits AquaBounty to grow out the fish in Canada,[107] and the company has also expressed interest in expanding production to other countries.[108] Since the initial approval of the AAS, a hatchery in PEI's Rollo Bay West has been approved by PEI's Minister of Communities, Land and Environment.[109]

Public submissions pertaining to the proposed expansion of the AquaBounty hatchery in PEI reflect a number of common themes, including concerns about potential escapes of the AAS and the subsequent risk to wild Atlantic salmon populations, concerns about environmental pollution, concerns about the impact on groundwater, and concerns about the environmental assessment process.[110] Despite the broad scope and the degree of risk associated with the concerns raised, a more precautionary approach to environmental assessment, and the ultimate approval of the project, was not taken by the government. According to the Coalition for the Protection of PEI Water, AquaBounty's approach to the approval process reflects "a classic example of project splitting, where the company was able to get approval for a smaller piece of the project (raising eggs) and then returned a short time later with what would seem to be their actual plan, thereby avoiding an independent evaluation of a very different project."[111]

In addition to the environmental concerns raised by the production, grow out, and transportation of AAS salmon and their eggs, there are also concerns related to the consumption of the AAS salmon itself. Consumers are not provided with transparent information about the AAS that would allow them to make choices about their consumption of the product. In response to concerns about potential long-term and latent health impacts, Health Canada notes only that its assessment of the AAS was conducted according to the Codex Alimentarius *Guideline for the Conduct of Food Safety Assessment of Foods Derived from Recombinant-DNA Animals* (Codex

107 *Ibid*.

108 See Tom Seaman, "AquaBounty Conducting 'Field Trials' of GM Salmon in Argentina, Brazil", *Undercurrent News* (28 July 2016), online: <www.undercurrentnews.com>.

109 See Brian Higgins, "Expansion of GMO Salmon Facility Approved by Province", *CBC News* (23 June 2017), online: <www.cbc.ca> [perma.cc/M6RW-EBDN].

110 See Prince Edward Island, "Proposed Redevelopment of Snow Island's Atlantic Sea Smolt Ltd. Facility (AquaBounty) in Rollo Bay: Public submissions — June 2017", online (pdf): <www.princeedwardisland.ca/sites/default/files/publications/aqua_bounty_eia_public_comments_summary.pdf> [perma.cc/KT7E-AVTV].

111 Kevin Yarr, "Genetically-Modified Salmon Plant Environmental Assessment 'Woefully Inadequate,' Says Coalition", *CBC News* (21 July 2017), online: <www.cbc.ca> [perma.cc/9WR8-6ECC].

Alimentarius *Guideline*),[112] concluding that "fillets derived from AAS are as safe and nutritious as fillets from current available farmed Atlantic salmon."[113] Since Health Canada did not identify any health and safety concerns in the course of its review, there are no special labelling requirements for the AAS.[114]

While the AAS has been granted the stamp of approval by regulators, there has been vocal opposition to the AAS by numerous environmental and food safety groups,[115] as well as rejection by industry organizations.[116] Several major grocery chains have pre-emptively declared their intention to boycott the fish.[117] An application for judicial review was also brought by Ecojustice on behalf of the Ecology Action Centre and the Living Oceans Society against Canada's Minister of the Environment and Climate Change, Minister of Health, and AquaBounty. The Federal Court ruled on December 23, 2015, that the Ministers acted legally in allowing the production of the AAS in Canada for commercial use, and that they had arrived at a decision that was "reasonable and made in the manner prescribed by the *Canadian Environmental Protection Act, 1999*."[118] With the Federal Court of Appeal's dismissal of the appeal on October 21, 2016,[119] the Federal Court's ruling stands.[120] The AAS is now available on supermarket shelves in Canada, much to the consternation of the groups that vigorously oppose it.[121]

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112 Codex Alimentarius, *Guideline for the Conduct of Food Safety Assessment of Foods Derived from Recombinant-DNA Animals*, CAC/GL 68-2008, online: FAO <www.fao.org/fileadmin/user_upload/gmfp/resources/CXG_068e.pdf> [perma.cc/TN77-LX7G].

113 Health Canada, "Novel Food Information", *supra* note 101.

114 Health Canada, "Approval Statement", *supra* note 10.

115 See e.g. Canadian Biotechnology Action Network, online: <www.cban.ca> [perma.cc/U3MY-GJRJ] (the Canadian Biotechnology Action Network is an umbrella group of organizations apprehensive about genetic engineering in food and farming that has been at the forefront of the efforts to raise concerns about the AAS and GM foods more broadly).

116 See e.g. Canadian Aquaculture Industry Alliance, "CAIA Position: Genetically Modified Salmon", online: <www.aquaculture.ca/caia-position-genetically-modified-salmon> [perma.cc/N7Q8-972E].

117 Suzanne Goldenberg, "Major US Supermarkets to Boycott GM Salmon", *The Guardian* (20 March 2013), online: <www.theguardian.com> [perma.cc/G5QP-EZYD].

118 *Ecology Action Centre v Canada* (*Environment*), 2015 FC 1412 at para 3.

119 See *Ecology Action Centre v Canada* (*Environment*), 2016 FCA 258.

120 The Supreme Court of Canada has previously expressed reluctance to engage in broader discussions of the moral or social implications of GMOs, preferring instead to leave those issues to Parliament: see generally *Harvard College v Canada* (*Commissioner of Patents*), 2002 SCC 76 at para 103; and *Monsanto Canada Inc v Schmeiser*, 2004 SCC 34 at paras 93–94.

121 See Emily Waltz, "First Genetically Engineered Salmon Sold in Canada" (2017) 548:7666 Nature 148, online: <www.nature.com/news/first-genetically-engineered-salmon-sold-in-canada-1.22116> [perma.cc/YP68-GA5V]; Ashifa Kassam, "GM Salmon Hits Shelves in

V. CRITICAL ANALYSIS OF SCIENCE AND LAW

The above case studies illustrate the fact that, as with many other natural resources and with industrial-scale food production more broadly, the management of fisheries and aquaculture in Canada is approached reductively, based on an ostensible commitment to "science and risk-management approaches endorsed by the Government of Canada."[122] However, such a commitment fails to contend with the reality that there is no singular, neutral, and objective understanding of what "science" and "risk management" entail. Science, on its own, does not necessarily provide conclusive answers that can adequately guide the inherently political exercise of decision-making based on calculated costs and benefits. In this way, the science of risk assessment is "falsely definitive, narrowly defining risk as the only relevant element for consideration of a technology's public acceptability and often failing to account for the ambiguity of risk-based research."[123] Additionally, science is often mobilized by governments to add a veneer of neutrality and legitimacy to what are ultimately political decisions.[124] Both scientific and political methods of assessing and addressing risk are subject to limitations, and failing to acknowledge these limitations can have wide-ranging effects.

In the case of PRV risk management, there is a clear disconnect between what DFO presents to the public—that is, policy and decision-making based on a precautionary approach[125]—and its actual management of diseases and risks related to aquaculture operations. DFO's actions suggest that it continues to demand scientific certainty or quasi-certainty of the threat posed by PRV and its extremely high occurrence within farmed Atlantic salmon populations before it will take measures to protect wild Pacific salmon populations. Section 56 of the *FGR*, as interpreted in *Morton v Canada*, and subsequently by the Minister,[126] suggests that fish transfer

Canada—But People May Not Know They're Buying It", *The Guardian* (9 August 2017), online: <www.theguardian.com> [perma.cc/95LK-CLXS].

122 Fisheries and Oceans Canada, "Aquaculture Policy Framework", *supra* note 23.

123 Christopher J Preston & Fern Wickson, "Broadening the Lens for the Governance of Emerging Technologies: Care Ethics and Agricultural Biotechnology" (2016) 45 Technology in Society 48 at 55.

124 See Mark Brown, "Environmental Science and Politics" in Teena Gabrielson et al, eds, *The Oxford Handbook of Environmental Political Theory* (Oxford: Oxford University Press, 2016) 491.

125 Fisheries and Oceans Canada, "Aquaculture Policy Framework", *supra* note 23; *Morton v Canada*, *supra* note 74 at para 44.

126 The Minister adopts a species or ecosystem approach to subsection 56(b) of the *FGR*: "subsection 56(b) of the *FGR* is aimed at a potential harm that is macro in nature: where

licences for salmon with PRV should not be issued. Nonetheless, whether or not DFO considers a transfer safe is a question of fact requiring the mobilization of scientific knowledge, at least to some extent. These facts continue to be contested, as ongoing litigation shows, but courts greatly defer to public agencies' scientific expertise and are reluctant to intervene in scientific debates.[127] The problem is the lack of recognition of the subjective nature of the production and use of science in decision-making by all parties involved, particularly regarding environmental protection and natural resource management.[128]

Additionally, science itself generates conflicting results, which at best leads to robust consensuses, but often does not.[129] Therefore, "[s]cience itself rarely provides sufficient basis for selecting between different courses of action, given that such action inevitably involves beliefs as to what the future should look like."[130] In the case of PRV, it seems that DFO has chosen to prioritize the economic well-being of the aquaculture industry, despite its conservation mandate,[131] and despite the important food security issues and social justice issues at play, especially regarding Indigenous peoples.[132] Given the clear value choices made by DFO in the

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the genetic diversity, species or ecosystem of a stock or conservation unit may be harmed such that they cannot sustain biodiversity and the continuance of evolutionary and natural production processes." *Namgis Injunction*, *supra* note 34 at para 32.

127 See *Inverhuron & District Ratepayers Ass v Canada* (*Minister of the Environment*), 2001 FCA 203. Even in *Morton v Canada*, *supra* note 74 at para 95, Rennie J was reluctant to make any general conclusions of facts, and instead relied on the fact that the Minister simply did not provide any scientific evidence for her assertions.

128 See T F Schrecker, *L'élaboration des politiques en matière d'environnement* (Ottawa: Commission de réforme du droit du Canada, 1984) at 37–41; William R Freudenburg, "Seeding Science, Courting Conclusions: Re-examining the Intersection of Science, Corporate Cash, and the Law" (2005) 20:1 Sociological Forum 3; Michael E Kraft, "U.S. Environmental Policy and Politics: From the 1960s to the 1990s" (2000) 12:1 J Policy History 17.

129 See Michael S Carolan, "The Bright- and Blind-Spots of Science: Why Objective Knowledge is Not Enough to Resolve Environmental Controversies" (2008) 34:5 Critical Sociology 725.

130 *Ibid* at 734, citing Daniel Sarewitz, *Frontiers of Illusion: Science, Technology, and the Politics of Progress* (Philadelphia: Temple University Press, 1996). See also Schrecker, *supra* note 128 at 41 [emphasis in original].

131 See *R v Marshall*, *supra* note 82; *Oceans Act*, *supra* note 64. See also Cohen, *Fraser River Sockeye, vol 1*, *supra* note 26 at 18–19.

132 See Susan Lunn, "Federal Government Not Doing Enough to Manage Risk of Fish Farms, Environmental Watchdog Says", *CBC News* (24 April 2018), online: <www.cbc.ca> [perma.cc/5QCA-Q6MG]; Cohen, *Fraser River Sockeye, vol 3*, *supra* note 9 at 11–12; *Namgis Injunction*, *supra* note 34 at paras 5, 93.

past, some have noted that its science advisory process tends to favour industry positions.[133]

This issue is not limited to disease risk management, but extends to aquaculture regulations in general. The various relevant legal provisions tend to give considerable discretionary powers to the government—a defining feature of Canadian environmental law[134]—which often require or rely heavily on techno-scientific knowledge. For example, while Canada has been described as relatively cautious with approving pesticide use in aquaculture, the lack of scientific knowledge about their negative health and environmental impacts is concerning.[135] Pesticide use has previously caused harm to marine biodiversity,[136] but no precautionary measures have been put in place to mitigate these known risks to the environment. In fact, the *AAR* are very permissive regarding the use of pesticides (as long as they have been approved by Health Canada), leaving the industry to monitor itself and report to DFO on its pesticide discharge and certain events, like fish mortality.[137] In addition to the inherent limitations of such regulatory models,[138] enforcement of environmental standards, even in the face of serious incidents,[139] appears to be non-existent.[140] Like the issue of disease transmission, the management of aquaculture pollutants by DFO is plagued by the same political use of science favouring economic development above other considerations.

133 See Stan Proboszcz, "Integrity of the DFO's Science Advisory Process in Question: Apparent Conflicts of Interest Between Fisheries and Oceans Canada's Science Advisory Process Must be Resolved to Save Endangered Wild Salmon Stocks" (10 April 2018), online: *Policy Options* <policyoptions.irpp.org/magazines/april-2018/integrity-of-the-dfos-science-advisory-process-in-question/> [perma.cc/FX5V-FJAC].

134 See David R Boyd, *Unnatural Law: Rethinking Canadian Environmental Law and Policy* (Vancouver: UBC Press, 2003) at 231–33.

135 Doelle & Saunders, *Patchworks*, *supra* note 25 at 194, citing Doelle & Lahey, *Low-Impact*, *supra* note 11 at 11.

136 Doelle & Lahey, *Low-Impact*, *supra* note 11 at 11.

137 See CESD, *Spring Reports*, *supra* note 8 at paras 1.51–1.63.

138 See R Michael M'Gonigle et al, "Taking Uncertainty Seriously: From Permissive Regulation to Preventative Design in Environmental Decision Making" (1994) 32:1 Osgoode Hall LJ 99 at 129–38.

139 See Jon Azpiri, "A Threat to Wild Salmon? Government Confirms Virus in Blood Discharge Pouring into B.C. Waters", *Global News* (20 February 2018), online: <globalnews.ca> [perma.cc/3HT8-GTRL].

140 See Environment and Climate Change Canada, "Environmental Offenders Registry" (last visited 11 October 2018), online: *Environmental and Wildlife Enforcement* <environmental-protection.canada.ca/offenders-registry> [perma.cc/H8CL-QEDD] (search conducted using keyword "aquaculture" and sector of industry "112—Animal production and aquaculture"); CESD, *Spring Reports*, *supra* note 8 at paras 1.75–1.88.

In the case of the AAS, over and above the final determination, it was the decision-making process that was problematic, on a number of grounds. Significantly, the decision was made without consulting many relevant stakeholders—including the public, Aboriginal groups, and Canada's salmon industry—and based on narrow considerations. Health Canada explicitly acknowledges that "[i]n order to protect the scientific integrity of the assessment process, socio-economic factors, such as potential market reaction, are not considered in the decision-making process with respect to novel products."[141] The Codex Alimentarius *Guideline* also specifies that it "addresses only food safety and nutritional issues" and does not address concerns about "animal welfare; ethical, moral and socio-economical aspects; [and] environmental risks related to the environmental release of recombinant-DNA animals used in food production."[142] Whether or not these concerns were taken into account by regulators, and if so, to what degree, remains in question.

GE animals are deeply problematic across a number of dimensions: aquatic organisms like the AAS present especially grave environmental threats "because their mobility poses serious containment problems, and because unlike domestic farm birds and mammals, they easily can become feral and compete with indigenous populations."[143] Although the risk of an AAS escape and subsequent harm to marine environments may currently be quantified as low, this risk multiplies with each additional hatchery and production farm. More broadly, concerns about fish escaping from aquaculture facilities are more than hypothetical; indeed, "[c]ultivated salmon have escaped into the wild from fish farms and these salmon already pose ecologic and genetic risks to native salmon stocks."[144] In fact, genetic displacement of wild salmon through interbreeding with farmed salmon has

141 Health Canada, "Frequently Asked Questions: AquAdvantage Salmon" (last modified 19 May 2016), online: *Government of Canada* <www.canada.ca/en/health-canada/services/food-nutrition/genetically-modified-foods-other-novel-foods/approved-products/frequently-asked-questions-aquadvantage-salmon.html> [perma.cc/SL83-N5ES] at question 10.

142 *Supra* note 112 at 57.

143 National Research Council of the National Academies et al, *Animal Biotechnology: Science-Based Concerns* (Washington, DC: The National Academies Press, 2002) at 4. See also Lingbo Li, Tony J Pitcher & Robert H Devlin, "Potential Risks of Trophic Impacts by Escaped Transgenic Salmon in Marine Environments" (2015) 42:2 Environmental Conservation 152; Robert H Devlin, L Fredrik Sundström & William M Muir, "Interface of Biotechnology and Ecology for Environmental Risk Assessments of Transgenic Fish" (2006) 24:2 Trends in Biotechnology 89.

144 National Research Council of the National Academies, *supra* note 143 at 11.

already occurred.[145] Washington state enacted a ban of net pen salmon aquaculture after thousands of Atlantic salmon escaped from damaged pens at a salmon farm in 2017.[146] This has put pressure on the BC government, which is now considering moving from ocean open-net to land-based aquaculture.[147] Although the risks posed by open-net fish farms may appear, as argued by some, to justify the move to land-based production models,[148] closed containment aquaculture raises its own concerns.[149] For example, a recent peer-reviewed study examining the environmental effects of Nova Scotia land-based fish farms observed some negative effects on biodiversity in downstream ecosystems.[150] An overreliance on the treadmill of technology fails to engage more fully with the underlying social, political, and economic problems with the way natural resources are conceptualized and managed, and simply delays or displaces the issues.

The relationship between science, law, and policy is an inherently uneasy one: "science as a discipline is, in many ways, more comfortable with risk and uncertainty than law, and one result of this is that the status of science as a co-traveller with law has become ever more strained."[151] Moreover, the formalistic understanding of risk adopted by science (and law informed by

145 See J W Carr et al, "The Occurrence and Spawning of Cultured Atlantic Salmon (*Salmo salar*) in a Canadian River" (1997) 54:6 ICES J Marine Science 1064 at 1071.

146 See The Canadian Press, "Washington State Puts Moratorium on New Fish Farms After Salmon Escape", *CBC News* (27 August 2017), online: <www.cbc.ca> [perma.cc/2EHG-SNYF]; Liam Britten, "Washington State Senate Bans Atlantic Salmon Farming in State Waters", *CBC News* (2 March 2018), online: <www.cbc.ca> [perma.cc/35SA-9R78]; US, HB 2957, *An Act Relating to Reducing Escape of Nonnative Finfish from Marine Finfish Aquaculture Facilities*, 2017–18, Reg Sess, Wash, 2018, s 2 (enacted).

147 See Deborah Wilson, "B.C. Government 'Very Interested' in Moving Open-Net Fish Farms Onto Land, Minister Says", *CBC News* (7 March 2018), online: <www.cbc.ca> [perma.cc/7N8B-XKQ3].

148 See Camille Bains, "Salmon Spill Prompts Open-Net Fish Farm Critics to Tout Benefits of Land-Based Aquaculture", *CBC News* (27 August 2017), online: <www.cbc.ca> [perma.cc/CC7M-DT58].

149 See e.g. House of Commons, *Closed Containment Salmon Aquaculture: Report of the Standing Committee on Fisheries and Oceans* (March 2013) (Chair: Rodney Weston) at 13–15, online (pdf): *Government of Canada Publications* <publications.gc.ca/collections/collection_2013/parl/xc51-1/XC51-1-1-411-03-eng.pdf> [perma.cc/8GSG-NAK7].

150 See Benoit A Lalonde, Christine Garron & Vincent Mercier, "Analysis of Benthic Invertebrate Communities Downstream of Land-Based Aquaculture Facilities in Nova Scotia, Canada" (2016) 2:1 Cogent Environmental Science 1, online (pdf): *Taylor & Francis Online* <www.tandfonline.com/doi/pdf/10.1080/23311843.2015.1136099> [perma.cc/8FQS-B54G].

151 See Karen Morrow, "Genetically Modified Organisms and Risk" in Luc Bodiguel & Michael Cardwell, eds, *The Regulation of Genetically Modified Organisms: Comparative Approaches* (Oxford: Oxford University Press, 2010) 54 at 57.

science) often diverges from public perceptions of risk, which frequently draw on a much broader range of considerations. Research has established that there are notable differences in risk perception based on factors like gender, race, and socioeconomic position, even accounting for differences in education and technical understanding.[152] As such, the mutually constitutive relationship between power and risk perception must be better accounted for in the processes of risk assessment and risk management.

A reductive and short-sighted approach to environmental regulation can lead to consequences that are far from favourable, especially given the complexity of ecosystems. In the case of GE fish, independent research has found that "many traits that appear to confer an advantage in the short-term could have long-term costs that make them overall detrimental."[153] However, DFO's Science Response—which was based primarily on information provided by AquaBounty itself—indicates an alarming lack of certainty regarding environmental and indirect human health impacts. For example, it explicitly acknowledges that although triploid AAS females are expected to be functionally sterile (to prevent organic reproduction), "the process of generating triploids at a commercial scale is not always 100% effective.... There is no information on the reproductive behaviour of female AAS (both diploid and triploid); *a significant knowledge gap*."[154] If an escape of an AAS were to occur, interbreeding could occur with wild Atlantic salmon and some species of trout, which could lead to genetic contamination and other unpredictable ecological consequences.[155] The fact that such an event has not yet transpired should not be glibly taken as an assurance that it will not occur in the future. Although a precautionary approach may prevent, or at least delay, the commercial development and deployment of technologies like GE fish, this does not void the potential benefits, but simply postpones them until more persuasive evidence has been gathered.[156] While this process may be more difficult and

152 See Melissa L Finucane et al, "Gender, Race, and Perceived Risk: The 'White Male' Effect" (2000) 2:2 Health, Risk & Society 159.

153 Olivier Le Curieux-Belfond et al, "Factors to Consider Before Production and Commercialization of Aquatic Genetically Modified Organisms: The Case of Transgenic Salmon" (2009) 12:2 Environmental Science & Policy 170 at 177.

154 Fisheries and Oceans Canada, *Risk Assessment*, *supra* note 97 at 7 [emphasis added].

155 See Krista B Oke et al, "Hybridization Between Genetically Modified Atlantic Salmon and Wild Brown Trout Reveals Novel Ecological Interactions" (2013) 280:1763 Proceedings Royal Society B1.

156 See Sandra S Batie & David E Ervin, "Transgenic Crops and the Environment: Missing Markets and Public Roles" (2001) 6:4 Environment & Development Economics 435 at 449.

time-consuming, a hasty but faulty decision is a dangerously inadequate substitute for a slower but sounder one.

The myopia and short-termism that plague environmental and natural resource law and management more broadly become even more problematic in the face of climate change. As Edward H. Allison, Neil L. Andrew, and Jamie Oliver note, "concerns for climate-induced threats to fisheries take place in the context of widespread overexploitation of fisheries, which reduces the scope for adaptation and increases risks of stock collapse through a combination of climate-related stresses and heavy exploitation pressure."[157] In developing and deploying climate change adaptation measures, the concept of resilience is crucial. According to Brian Walker *et al*., "[r]esilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks."[158] The relationship between risk and resilience is not straightforward, and striking a balance between the two is, again, a normative exercise. Unfortunately, in the case of fisheries and aquaculture, the balance seems to be tilting precariously against resilience-based models of management.

Within the dominant productionist paradigm, one of the operative assumptions is that scientific and technological innovation and ingenuity will ultimately resolve problems of global hunger and food insecurity. Yet, the problem is not one of absolute scarcity, but rather, one of uneven distribution.[159] Thus, increasing production does not go far enough towards addressing the root social, economic, and political problems underlying global hunger and environmental degradation. Increasing the efficiency of food production is one way of sustaining current production and consumption practices. However, current production and consumption practices cannot be said to be "sustainable" in an ecological sense, nor is a production system that heavily relies on technology and corporate control a resilient one.

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157 "Enhancing the Resilience of Inland Fisheries and Aquaculture Systems to Climate Change" (2007) 4:1 JSAT Agricultural Research 1 at 3, online (pdf): *International Crops Research Institute for the Semi-Arid Tropics* <ejournal.icrisat.org/SpecialProject/sp15.pdf> [perma.cc/BF6A-4XCS].

158 "Resilience, Adaptability and Transformability in Social-Ecological Systems" (2004) 9:2 Ecology & Society, online: *Ecology & Society* <www.ecologyandsociety.org/vol9/iss2/art5/> [perma.cc/P6GZ-H7WV].

159 See World Commission on Environment and Development, *Our Common Future*, UNGAOR, 42nd Sess, UN Doc A/42/427 (1987), online: *United Nations Documents* <www.un.org/en/ga/search/view_doc.asp?symbol=A/42/427 > [perma.cc/7Q7G-FPYW].

CONCLUSION

As the severe ecological impacts of our current patterns of natural resource consumption are increasingly realized,[160] including in the forms of climate change and declining fish stocks, we must consider all available options to ensure the ecological equilibrium necessary for life on earth. Nonetheless, as demonstrated in this article, choices made about the management of natural resources are rarely, if ever, free of consequences. It is thus necessary to critically assess potential solutions in light of broader issues relating to the environment and food security. The example of aquaculture is telling. On its face, the cultivation of fish and seafood might diminish our consumption of wild fish and thus conserve fish stocks. In some cases, cultivation may even contribute to reducing greenhouse gases while allowing continuous access to the resource. However, once we look below the surface, it is apparent that industrial aquaculture comes with its own complex set of environmental and socio-economic issues. In other words, favouring aquaculture may merely replace one set of problems with another.

The case of Canadian aquaculture regulation serves as a cautionary tale. As the two case studies demonstrate, a short-term and reductive approach to aquaculture regulation and decision-making can have serious ecological consequences, including the risk of future adverse impacts. This approach can, in turn, negatively affect the cultural and social well-being and food security of communities that depend on fish. The current regulations do not provide sufficient safeguards to create a sustainable framework for aquaculture. Furthermore, scientific knowledge is currently used in decision-making and risk management as a shield, hiding political or value choices favouring the industrial development of aquaculture and techno-scientific solutions to environmental and food security issues, without sufficient transparency.

Aquaculture may have a role to play in our quest for a more sustainable future, but to do so, it is clear that considerable legal and institutional changes are needed, particularly regarding the role of science. While such changes would require considerable restructuring of existing social and legal structures,[161] it is possible to offer some suggestions for reform to minimize the

160 See Will Steffen et al, "The Trajectory of the Anthropocene: The Great Acceleration" (2015) 2:1 Anthropocene Rev 81, online: *The Anthropocene Review* <journals.sagepub.com/doi/full/10.1177/2053019614564785> [perma.cc/747C-JF4B].

161 See Michael M'Gonigle & Paula Ramsay, "Greening Environmental Law: From Sectoral Reform to Systemic Re-Formation" (2004) 14 J Envtl L & Prac 333 at 352–55; Sally Bullen

negative effects of aquaculture as it exists within our current socio-legal system. For example, in terms of disease risk management, the well-established precautionary principle can serve as an effective guideline to avoid the current situation regarding PRV.[162] Instead of downgrading paragraph 56(b) of the *FGR*, as suggested by DFO's Notice of Intent, the regulation on fish transfer should specifically require proof that a disease or disease agent is not harmful to the protection and conservation of fish and marine ecosystems before a licence can be issued. Furthermore, the absence of conclusive scientific evidence demonstrating the harmful effect of a particular disease or disease agent should not be taken as proof that a transfer is safe. Hopefully, this requirement will foster much needed research on fish health, both by the industry and the government.[163] While DFO should continue to require internal monitoring of disease by aquaculture operators, a robust and well-funded program of systemic inspection and monitoring of aquaculture operations by DFO should be established and feed into a broader research program on fish and marine ecosystem health.[164] Disease and environmental inspections could be done jointly to maximize the use of resources. If ecosystem contamination is likely, the presence of any harmful disease should lead to the suspension of fish transfers and potentially to the destruction of the cultured stock. A similar regulatory system based on precaution could also be adopted for pesticides, other substances, and harmful activities linked with aquaculture. Additionally,

"Lessons from Feminist Epistemology: Toward an Environmental Jurisprudence" (1993) 23:2 VUWLR 155 at 164.

162 See Cohen, *Fraser River Sockeye, vol 3*, *supra* note 9 at 20–26; Cohen, *Fraser River Sockeye, vol 1*, *supra* note 26 at 36–37, 70–72; CESD, *Spring Reports*, *supra* note 8 at paras 1.47–1.50; VanderZwaag, Chao & Covan, *supra* note 70 at 288–93; David L VanderZwaag, Susanna D Fuller & Ransom A Myers, "Canada and the Precautionary Principle/Approach in Ocean and Coastal Management: Wading and Wandering in Tricky Currents" (2002) 34:1 Ottawa L Rev 117 at 150–51; Katie Steele, "The Precautionary Principle: A New Approach to Public Decision-Making?" (2006) 5:1 L, Probability & Risk 19. Guidance already exists in Canada and internationally regarding the application of the principle to decision-making: see Canada, Privy Council Office, *A Framework for the Application of Precaution in Science-Based Decision Making About Risk*, Catalogue No CP22-70/2003 (Ottawa: Privy Council Office, 2003), online: *Government of Canada Publications* <publications.gc.ca/site/eng/246284/publication.html> [perma.cc/DEY6-ADCH]; International Union for Conservation of Nature, IUCN Council, 67th Mtg, *Guidelines for Applying the Precautionary Principle to Biodiversity Conservation and Natural Resource Management* (2007), online (pdf): *IUCN Publications* <cmsdata.iucn.org/downloads/ln250507_ppguidelines.pdf> [perma.cc/75ER-3LBU].

163 See Cohen, *Fraser River Sockeye, vol 3*, *supra* note 9 at 60–61; MAACFA, *supra* note 24 at 13–16; CESD, *Spring Reports*, *supra* note 8 at paras 1.86–1.88.

164 See Cohen, *Fraser River Sockeye, vol 3*, *supra* note 9 at 18–19; Doelle & Lahey, *Low-Impact*, *supra* note 11 at 49–51.

to minimize the risk of contaminating wild fish populations, sensitive fish habitat zones that are off limits to aquaculture operations should be identified and established by regulation. Data on fish health, aquaculture pollution, and related scientific research (*e.g.* on GE salmon) should be publicly available to enhance transparency and increase knowledge and information sharing.[165]

The *Fisheries Act* and *CEPA* should also be amended to establish certain safeguards regarding the use of science. The *Fisheries Act* should have clear stated purposes based on conservation, sustainable use, food security, and the unique situation of Indigenous peoples. These purposes would guide the Minister in the application of the law and ensure an interpretation of the *Act* that favours the sustainability of fisheries. Purely economic considerations in decision-making should be prohibited. The purposes should also translate into further amendments, such as the explicit adoption of the precautionary principle, the establishment of independent and transparent scientific advice processes based on the *Act*'s purpose, and the inclusion of mechanisms to ensure the free, prior and informed consent of Indigenous communities affected by the implementation of the *Act*.[166] *CEPA* should be similarly amended.[167] Additionally, the current timeline for the review of new substances should be abolished to ensure adequate time for a holistic toxicity assessment of new substances by the relevant agencies, and to allow for consultation with the public and Indigenous peoples,

165 See Cohen, *Fraser River Sockeye, vol 3*, *supra* note 9 at 65; MAACFA, *supra* note 24 at 17–18.

166 See Sujatha Raman, "Science, Uncertainty and the Normative Question of Epistemic Governance in Policymaking" in Emilie Cloatre & Martyn Pickersgill, eds, *Knowledge, Technology and Law* (Oxford: Routledge, 2015) 25 at 27–29; *United Nations Declaration on the Rights of Indigenous Peoples*, GA Res 61/295, 61st Sess, Supp No 49, UN Doc A/RES/61/295 (2007) 1, art 19; Grace Nosek, "Re-Imagining Indigenous Peoples' Role in Natural Resource Development Decision Making: Implementing Free, Prior and Informed Consent in Canada Through Indigenous Legal Traditions" (2017) 50:1 UBC L Rev 95 at 118–21; MAACFA, *supra* note 24 at 10–11.

167 See also Joseph F Castrilli & Fe de Leon, "Speaking Notes on the Regulation of Toxic Substances" (submissions delivered to the House of Commons Standing Committee on Environment and Sustainable Development, Ottawa, 19 May 2016), online (pdf): *Canadian Environmental Law Association* <www.cela.ca/sites/cela.ca/files/CELASpeaking%20NotesHCENSDCommitteeMay2016.pdf> [perma.cc/US6U-CA5P]. ; Dayna Nadine Scott, "Reforming the *Canadian Environmental Protection Act*: The Assessment and Regulation of Toxic Substances Should be Equitable, Precautionary, and Evidence-Based" (submissions delivered to the House of Commons Standing Committee on Environment and Sustainable Development, Ottawa, 3 June 2016), online (pdf): *House of Commons Canada* <www.ourcommons.ca/Content/Committee/421/ENVI/Brief/BR8384458/br-external/ScottDayna-e.pdf> [perma.cc/UF2C-DUUF].

including ensuring relevant information is accessible, both in terms of material access to the information (*e.g.* online registry) and in terms of language (*e.g.* plain language summary). One or more independent appeal tribunals for decisions made under these statutes (and potentially under other environmental statutes) should be established, and should be composed of both jurists and relevant scientists whose independence should be guaranteed.[168] These tribunals should have the capacity to accept new evidence and review evidence submitted during licence application procedures *de novo*. Access to the tribunals should not be limited by rules of standing.[169] Such measures cannot eliminate the subjectivity of scientific research and advice, but it can at least mediate it by articulating the values underlying the research, thereby preventing a vacuum that could simply be filled by the political interests of the government of the day, ensuring added transparency to the process, and allowing for greater scrutiny.

Finally, the federal government should adopt a single, coherent and holistic national regime for aquaculture regulation under the auspices of DFO. This regime should exclude aquaculture on Indigenous territory, in which case the government should consider delegating regulatory power to Indigenous communities. Such a regime should integrate the above recommendations, adopt effective environmental and health standards according to the best available evidence, and be based on guiding principles, such as precaution, prevention, accountability, and transparency.[170] Additionally, DFO should study the cumulative effect of aquaculture and other stressors on the marine ecosystem, especially climate change stressors

168 See Doelle & Lahey, *Low-Impact*, *supra* note 11 at 96, 117–19. The protection afforded to the tribunals and its members should resemble the protection accorded by section 23 of the *Charter of Human Rights and Freedoms*, CQLR c C-12: see *2747-3174 Québec Inc v Quebec (Régie des permis d'alcool)*, [1996] 3 SCR 919, 140 DLR (4th) 577; *Québec c Barreau de Montréal*, [2001] RJQ 2058, 48 Admin LR (3d) 82. Environmental tribunals have tended to have a positive effect on the development of environmental law in Canada: see Marilyn G Lee, "How Tribunals and Appeal Boards are Contributing to Advances in Environmental Laws" (2014) 26:3 J Envtl L & Prac 249.

169 These factors should avoid the access to environmental justice issues addressed by the following sources: see Adam Driedzic, "Proving the Right to be Heard: Evidentiary Barriers to Standing in Environmental Matters" (paper delivered at A Symposium on Environment in the Courtroom: Evidentiary Issues in Environmental Prosecutions and Hearings, University of Calgary, 6–7 March 2015), online (pdf): *Canadian Institute of Resources Law* <cirl.ca/files/cirl/adam_driedzic-en.pdf> [perma.cc/UMT5-MNEV]; Jamie Benidickson, *Environmental Law*, 4th ed (Toronto: Irwin Law, 2013) at 133–39.

170 See Doelle & Lahey, *Low-Impact*, *supra* note 11 at 35–38, 51–54, 85–87; David M Dzidzornu, "Four Principles in Marine Environment Protection: A Comparative Analysis" (1998) 29:2 Ocean Dev & Intl L 91.

such as warming waters, in order to develop this new centralised regime.[171] DFO should also study the local, national, and international food security impacts of Canadian aquaculture, as well as the impacts on Indigenous communities, in order to inform political and policy discussions on the need for aquaculture and licensing (*i.e.* whether new operations are needed or pre-existing ones are made obsolete). Proper resources should be allocated for enforcement and compliance measures to ensure the effectiveness of the regulatory regime.[172]

Farming the sea is a false solution to a real problem, in that it fails to address the fundamental issues underlying marine resource management and food production. In rethinking the role of aquaculture in natural marine resource management, especially in a changing climate, it is important to ensure that careful regard is given to the socio-cultural factors, inequities, and environmental degradation inherent in the production of seafood. We must consider that solutions to ecological concerns likely do not lie within the current productionist mind frame that created the environmental crisis we seek to resolve in the first place.[173] Ad hoc reforms can help alleviate some of the negative effects of the current regulatory system, but a much broader rethinking of the large-scale industrial and profit-based nature of food production, and of the regulation that enables it is necessary if we are to see meaningful change.[174] It is only once these kinds of structural limitations are more explicitly acknowledged that we can move past a "perpetual state of status quo,"[175] and truly just, sustainable, and equitable solutions can emerge.

171 See Cohen, *Fraser River Sockeye, vol 3, supra* note 9 at 63–65.

172 *Ibid* at 54–57; see CESD, *Spring Reports*, *supra* note 8 at paras 1.75–1.85.

173 See Bradly A Harsch, "Consumerism and Environmental Policy: Moving Past Consumer Culture" (1999) 26:3 Ecology LQ 543; M'Gonigle & Ramsay, *supra* note 161 at 352–55.

174 See Michael M'Gonigle & Louise Takeda, "The Liberal Limits of Environmental Law: A Green Legal Critique" (2013) 30:3 Pace Envtl L Rev 1005.

175 See Lyne Létourneau, "The Regulation of Animal Biotechnology: At the Crossroads of Law and Ethics" in Edna Einsiedel & Frank Timmermans, eds, *Crossing Over: Genomics in the Public Arena* (Calgary: University of Calgary Press, 2005) 173 at 189.