



Submitted to the Substances Management Information Line, Information Management and Data Collection, Science and Technology Branch, Environment and Climate Change Canada

October 12, 2018

Comments provided by the Canadian Biotechnology Action Network on “New Notification related to AquAdvantage® salmon” as per the Voluntary Public Engagement Initiative: “Public engagement on the risk assessment of higher organisms under the New Substances Program.”

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Introduction

The Canadian Biotechnology Action Network (CBAN) is pleased to provide our comments on the “New Notification related to AquAdvantage® salmon” as well as our comments on the public engagement initiative through which our comment is invited.

CBAN brings together 16 groups to research, monitor and raise awareness about issues relating to genetic engineering in food and farming. CBAN members include farmer associations, environmental and social justice organizations, and regional coalitions of grassroots groups. Our member groups are: Canadian Organic Growers, Check Your Head, Council of Canadians, Ecological Farmers Association of Ontario, Ecology Action Centre, Growers of Organic Food Yukon, No More GMOs Toronto, Greenpeace Canada, Inter Pares, National Farmers Union, GMO Free PEI, Organic Agriculture Protection Fund of Saskatchewan, GE Free BC, Union Paysanne, USC Canada, Vigilance OGM. CBAN is a project on the shared platform of Tides Canada.

The Canadian Biotechnology Action Network has monitored the development of the genetically modified (GM or genetically engineered) salmon since our founding in 2007, and some of our member groups have monitored the development of this organism and associated issues for many more years. For over a decade, we have provided information to the public about the GM salmon and related developments, to encourage public engagement. We have also communicated with government agencies about various concerns and questions.

AquaBounty's GM Atlantic salmon is the first genetically modified animal in the world approved for human consumption. The company, now a subsidiary of the US biotechnology company Intrexon, owns the rights to the organism, which contains genetic material from two other species – an ocean pout and a Chinook salmon. The company claims that the fish grow to adult size faster than conventional Atlantic salmon.

As the world's first GM food animal and the first GM fish, this organism should be subject to a high degree of scientific scrutiny as well as broad societal discussion. We are concerned that the regulatory precedent being set in the case of the GM salmon is one of inadequate risk assessment and public consultation, and a lack of transparency. We are therefore hopeful that this public engagement initiative is only the first part of a new comprehensive risk assessment process that will include further public consultation and increased transparency. The process to date raises important issues about how to assess and introduce such a controversial and high-stakes technology.

The development and commercialization of GM animals in Canada needs to be subject to wide debate. In 2016, the Canadian Biotechnology Action Network made the following recommendations to the House of Commons Standing Committee on Agriculture and Agri-Food in their hearings on "Genetically Modified Animals for Human Consumption":

- There needs to be an assessment of economic impact before any GM product is approved for release;
- There is a need to strengthen environmental risk assessment including a need to assess the long-term, system-wide risks of each GM product and the use of this technology as a whole;
- Canada need systems for tracking and tracing all GM organisms;
- Canadians need transparency in regulation;
- Canadian consumers need mandatory labelling of all GM foods in the grocery store.

CBAN concluded that there is a need for a moratorium on the introduction of GM animals until Canadians have a chance to be heard, and until changes are made to increase the government's ability to regulate GM organisms (GMOs) and foods, including tracking and traceability, and transparency including mandatory GM food labelling. For example, the Canadian government has yet to implement the recommendations of the 2001 Royal Society of Canada's *Expert Panel on the Future of Biotechnology*.¹ Furthermore, Canada has two decades of experience with GM crops and foods that has not yet been evaluated and such an evaluation of the impacts should be undertaken before we consider introducing GM animals into our environment and food system.

The history of federal government assessments of GM crops and the subsequent environmental impacts that we can now observe provide lessons that can be applied to assessing the environmental risks of producing GM animals. For example, the Canadian Food Inspection Agency approved the release of genetically engineered herbicide-tolerant crops (corn, canola, soy, sugar beet, alfalfa) without a full assessment of the possible systematic and long-term impacts on agricultural practice and the environment. Now that we can observe the relationship between herbicide-tolerant crops and an increase in herbicide use,² we have an opportunity to assess, holistically, the impacts of herbicide-tolerant cropping systems which were expanded as each new GMO was approved for use. The CFIA nonetheless continues to approve new herbicide-tolerant crops and allow the stacking of multiple GM herbicide-tolerant traits.

We are similarly concerned about the long-term and wider impacts of permitting GM salmon production. The approval of one or more locations for GM fish production could lead to the gradual expansion of production to many more and diverse locations that would increase the risk of escape. The company AquaBounty began with a proposal to the Canadian government for production of up to 100,000 GM salmon eggs at Bay Fortune (Souris) PEI, to be shipped to Panama for grow-out and processing. Now, the company is building a new facility at Rollo Bay PEI where it says it wants to produce 250 metric tons of GM Atlantic salmon per year. We are concerned that approvals for production sites in Canada will lead to many other sites across Canada and the world as the company seeks to scale up commercial production. Large-scale commercial production could involve the raising of GM fish in the millions at numerous facilities, in diverse locations and ecosystems. As the scale of an operation increases, the chances of escape increase, as does the probability that some escapees will be fertile and capable of breeding with wild Atlantic salmon and/or other species.

Canada has allowed for the export of GM salmon eggs but has not yet ratified the Cartagena Biosafety Protocol whose objective is to ensure an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms that may have adverse effects on the conservation and sustainable use of biological diversity, specifically focusing on transboundary movements. We urge the government to ratify the Protocol and implement systems for labeling and traceability of GMOs.

Public Engagement

To our knowledge, this is the first consultation with Canadians on the manufacture or production a GM animal.¹

In 2013, the Minister of Environment posted a notice in the Canada Gazette indicating that the government had conducted a scientific risk assessment under section 108 of the *Canadian Environmental Protection Act, 1999* (CEPA) with respect to AquAdvantage Salmon (“AAS”) – a genetically modified (GM, or genetically engineered) Atlantic salmon organism. The notice set out a list of activities that are permitted in Canada with respect to the GM salmon.

The 2013 assessment was conducted without any public notification or consultation. The Canadian Biotechnology Action Network (CBAN) had written to the Minister of Environment as well as the Minister of Health asking whether an assessment was underway but we were informed that the fact of whether or not an assessment was taking place was confidential. In 2017, we urged the Ministers to ensure meaningful opportunities for public consultation as part of any new risk assessment process.

We therefore appreciate and applaud the objective of Environment and Climate Change Canada and Health Canada in working together to promote public engagement in the risk assessment of higher organisms (e.g. genetically modified plants and animals) under the New Substances Program. This is also in line with the December 2016 recommendation for more transparency in

¹ With the exception of the public engagement initiative of July “Notification for five ornamental aquarium fish that fluoresce” which we were not aware of until now.

the regulation of GM animals from the House of Commons Standing Committee on Agriculture and Agri-Food report “Genetically Modified Animals for Human Consumption”. However, **in implementation, the initiative is extremely limited in reach and depth and we have number of critical concerns including about a continued lack of transparency.**

1) Public Engagement Outreach

The Canadian Biotechnology Action Network was unaware of the Voluntary Public Engagement Initiative until quite late in the 30-days scheduled for public comment on the notification related to the GM salmon. This notice and short timeline constrains our ability to respond. Please inform us as to how CBAN and other interested groups can ensure we are notified of similar engagement opportunities under this initiative. We encourage proactive outreach to affected communities and interested parties including local communities and Indigenous peoples whose knowledge of local environments may be relevant to risk questions and who need to be consulted.

2) Lack of Transparency and Paucity of Information

Importantly, there is a paucity of information about the proposed use of the GM salmon which constrains our ability to comment. **We are invited to comment on the notification but are not provided with the notification to comment on.** The invitation states that, “The New Substances Program will publish summaries of higher organism notifications” for comment but we only see two short paragraphs describing, in very vague terms, the organism and its intended use:

“Activity: AquaBounty Technologies is constructing new production facilities to meet the growing global demand for AquAdvantage salmon. One facility will be used to produce eggs for farming of AquAdvantage salmon in the company’s facilities in Canada, the United States and Panama. The other facilities will be used to produce AquAdvantage salmon for commercial sale in Canada and/or export to other countries.

Genetic modifications: AquAdvantage salmon was developed by engineering a St. John River salmon with two genes from the Pacific salmon and from the Ocean Pout for expression of a growth hormone gene in AquAdvantage salmon. AquAdvantage salmon reaches a size of 100 g faster than non-engineered counterparts.”

Aside from the 2013 document “Summary of the Environmental and Indirect Human Health Risk Assessment of AquAdvantage” which describes the DFO risk assessment of commercial GM fish egg production, we do not see any documentation. We know from our previous requests for information that information submitted by AquaBounty to Environment and Climate Change Canada will be classified as confidential business information and is therefore not accessible to the public. We object to this classification and maintain that, in order to invite public comment, there should be information provided for us to comment on.

Environment and Climate Change Canada provides no information on where AquaBounty’s proposed production sites are located. The public is left guessing as to what location or locations are subject to assessment, if indeed locations are specified by the company. This hinders

meaningful comment on environmental risk issues. On June 10, 2016 the PEI government approved AquaBounty's request to redevelop an aquaculture facility at Rollo Bay, PEI, for the rearing of non-GM Atlantic salmon broodstock. On April 12, 2017 AquaBounty submitted an "Amended Environmental Impact Statement" to the PEI Communities, Land, and Environment Department for the commercial production of the GM salmon at the site. Is this the site, or one of the sites, subject of this notification from AquaBounty?

This lack of information obviously hampers our ability to share, as invited, scientific information and test data related to potential risks to the environment or human health from the new living organisms, such as environmental fate information, ecological effects information, human health effects information, and exposure information (sources, routes of exposure, etc.). Our ability to provide relevant information is hindered by the lack of information about the proposed use of this GMO, including information about the proposed locations and conditions of production. The request for groups to provide substantive information on environmental risk issues within 30 days, based on no information, does not respect the time and expertise of the public and interested groups.

In this regard, our concerns about this public engagement initiative reflect our previously expressed concerns with a similar initiative of the Canadian Food Inspection Agency called the *Biotechnology Notices of Submission Project* which invites the public to submit scientific comment on genetically modified crops that are being submitted for approval, but without providing any substantive information on the submission in question.³

3) Wider Consultation Scope

This public engagement initiative appears restricted to scientific issues and does not provide an opportunity to comment on non-scientific considerations such as ethical or social issues. The development and commercial introduction of genetically engineered animals should be subject to broad societal debate whereby the questions of need, social worth and ethics are addressed. For example, the Canadian Biotechnology Action Network has long argued for an assessment of the potential economic impact of new GMOs before they are commercially introduced.

4) Use of Company Language

We also note with concern that the public engagement initiative uses what we presume is the company's own description of the utility of the GMO. Specifically, the initiative states that AquaBounty Technologies is constructing new production facilities "to meet the growing global demand for AquAdvantage salmon." Does Environment and Climate Change Canada have data to support this statement? This company assertion is one line out of five that is provided to describe the technology and the production intent of the company.

Conclusion: The public engagement initiative lacks transparency and, because it provides no information of substance, it is too vague to allow for relevant scientific comment and meaningful public participation.

The Department of Fisheries and Oceans Assessment

The Canadian Environmental Protection Act aims to ensure that all new substances are assessed for their potential harm to the environment and human health prior to their import, manufacture, or sale in Canada. Fisheries and Oceans Canada (DFO) conducts CEPA risk assessments for fish products of biotechnology and recommends any necessary risk management measures to the Minister of the Environment and Climate Change and Minister of Health

Beginning in 1992, DFO made commitments to develop regulations for “transgenic aquatic organisms” and drafted a policy in 1997.⁴ The policy was not finalized and, following a 2004 audit, the Commissioner of the Environment and Sustainable Development asked DFO to develop the new regulations by 2005. Ultimately, these regulations were not developed and the regulation of genetically engineered aquatic organisms fell to CEPA, with a Memorandum of Understanding with Environment and Climate Change Canada. **The GM salmon is the test case for this regulatory arrangement for higher aquatic organisms and the risk assessment process should therefore be undertaken with the utmost care.**

On April 30, 2013, unbeknownst to the Canadian public, AquaBounty filed a notification under CEPA stating its intent to manufacture AAS/GM salmon eggs at its existing research facility at Bay Fortune (Souris), PEI and to export up to 100,000 of these GM salmon eggs annually, to be grown out in Panama. This notification triggered a risk assessment of GM salmon egg production that concluded with a meeting of experts from Fisheries and Oceans Canada that was reported on in the “Summary of the Environmental and Indirect Human Health Risk Assessment of AquAdvantage”. This document was published in 2013 shortly after the Minister issued approval. This same document is provided by Environment and Climate Change Canada in the context of this public engagement initiative.

- 1) A comprehensive risk assessment is required, according to the Federal Court and subsection 106(1) of CEPA, if the company AquaBounty wishes to manufacture or use its genetically modified “AquAdvantage” salmon outside the company’s facility at Bay Fortune. On June 6, 2017 CBAN and 11 other Canadian environmental organizations called on the Minister of Environment and Climate Change, Minister of Health, and Minister of Fisheries, Oceans and the Canadian Coast Guard, to carry out a comprehensive toxicity assessment on the company Aquabounty’s proposal to produce GM fish at its intended facility at Rollo Bay, PEI.⁵
- 2) CEPA risk assessments evaluate whether a given substance or organism is “toxic” for the purposes of section 64 of the Act however, in the risk assessment for GM salmon egg production, AquaBounty requested and was granted a waiver of information requirements pursuant to section 106(8)(b) of CEPA. Specifically, the Minister of Environment at the time granted a waiver of the legal requirement to provide data from a test conducted to determine the toxicity or invasiveness of AquAdvantage Salmon. The Minister granted this waiver on the basis that the organism would be manufactured at the existing Bay Fortune (Souris), PEI facility and contained there so as to satisfactorily protect the environment.
- 3) Commercially rearing these GMOs has not yet been subject to a risk assessment under CEPA. Rather, experts with DFO conducted a risk assessment on the manufacture of GM salmon eggs. DFO’s 2013 assessment was premised on AquaBounty’s stated intent to produce AAS eyed-eggs

at the company's facility in Bay Fortune (Souris), PEI and to export up to 100,000 of those eggs annually for grow-out in Panama. Based on this proposed use scenario, the DFO assessment concluded that the risks to the Canadian environment were low i.e. that the eggs could be contained at the Souris facility and if any were released into the natural environment they were unlikely to survive. However, the Minister of Environment issued a notice that went beyond the conclusions and recommendations of the DFO assessment to allow for the production of both eggs and fish, at the Souris facility.

The DFO risk assessment made it clear that any changes to the proposed use scenario of 100,000 eggs could result in a different risk assessment conclusion. Unlike eggs, AAS at later stages of development could survive and thrive in the natural environment in Canada if released. The DFO risk assessment was clear that changes to AquaBounty's proposal may result in the entry or release of AAS into the environment in a quantity, manner or circumstances significantly different than what was assessed. Given the potential hazard of AAS to the environment, including potential invasiveness, new activities such as commercial grow-out of the GM salmon in Canada could result in a different risk assessment conclusion.

The 2013 DFO assessment of GM fish egg production was clear that if these genetically modified fish were to be grown out to maturity in Canada, a further risk assessment would be needed to ensure protection of the Canadian environment and biodiversity. Commercial production of GM salmon at a facility other than the existing Bay Fortune facility must be subject to a CEPA toxicity assessment. It should therefore require a process similar to that carried out to assess the risks associated with producing GM salmon eggs at Bay Fortune.

Conclusion: There is a need for a comprehensive toxicity assessment, based on all legally mandated information, in order to ensure the protection of the Canadian environment and biodiversity. This assessment is necessary, including because the 2013 DFO assessment was for the manufacture of GM salmon eggs rather than the commercial production of GM salmon and because the requirement for the company to provide information on toxicity was waived. Such an assessment is expected to follow the process that produced the 2013 DFO "Summary of the Environmental and Indirect Human Health Risk Assessment of AquAdvantage".

Environmental risk

The stakes are high in relation to the production of GM salmon, including for the future of wild salmon. If there is an escape, the damage to wild populations of fish and our marine environment could be irreparable. Any escape could alter the biodiversity of entire ecosystems and the production of GM salmon would represent a threat to the survival of wild salmon populations. In fact, the 2013 DFO risk assessment found that, if escape occurred, the potential hazard to wild populations of Atlantic salmon would be high with reasonable uncertainty, with the potential hazard to biodiversity in Canada being unknown.

Containment Failure

Relying on physical containment and biological containment (triploidy) to prevent environmental harm is set for failure. Even the best and most redundant containment measures can fail. In fact, we have already observed containment failures and breaches with the escape of genetically modified animals and crop plants in Canada and in Panama. The most recent discovery of escaped GMOs is that of experimental (unapproved) GM wheat plants on a road in Alberta. The CFIA was unable to determine the source and cause of contamination and stated, “We may never know how this GM wheat came to be present on an access road.”⁶

The most obvious and inevitable threats to containment of on-land GM fish production facilities are human error and extreme weather, **both of which have already been seen in the research and production of GM animals.**

Human error:

There have already been two separate incidents in Canada whereby experimental (unapproved) genetically engineered pig carcasses, at two different institutions, were rendered for animal feed instead of being sent for incineration as biological waste.⁷ These failures were due to human error.

The possibility of human error needs to be addressed in the risk assessment. AquaBounty is selling non-GM (“non-transgenic”) Atlantic salmon eggs and fry,⁸ presumably from the Bay Fortune site where the GM fish eggs are currently produced for shipment to Panama. These sales of non-GM eggs and fry raise concerns about the possibility of human error that could lead to the inadvertent mixing up these non-GM organisms with the GM eggs and fry. Has the company audited all possible causes for escape due to human error, such as this one, and what protocols and mechanisms are in place to reduce the chances for such errors to occur? Is Environment and Climate Change Canada assessing the potential role of human error in containment breaches?

Extreme weather:

In the past, AquaBounty has reported flooding of its pilot plant in Panama due to severe weather, resulting in “lost” (presumably meaning killed) GM salmon.⁹ Physical containment is vulnerable to breach in extreme weather which is only predicted to increase with climate change. Has AquaBounty evaluated the biosecurity of the proposed production sites relative to catastrophic weather events and is Environment and Climate Change Canada applying the latest modeling of climate change impacts to this question?

Sterility:

Additionally, the biological containment (sterility) provided via triploidy is not 100%. As recognized in the 2013 DFO risk assessment, although AAS eggs are produced to be all-female and sterile, up to 5% could be fertile. DFO’s risk assessment noted that there is no

information on the reproductive behavior of AAS females – a knowledge gap characterized as “significant”.

The Consequences of Containment Failure

The consequences of containment failure are potentially devastating. Our experience in Canada with escapes of non-GM farmed salmon already provides lessons about these potential impacts.

There is a possibility that escaped GM salmon could breed with other species. For example, one study showed that GM salmon can interbreed with wild brown trout. Researchers have stated that the probability of inter-breeding could be significant with long-term, full-scale commercial production in Canada.¹⁰ Further, research published in the *Proceedings of the National Academy of Sciences* notes that a release of just sixty GE fish into a wild population of 60,000 would lead to the extinction of the wild population in less than 40 fish generations.¹¹

Experiments have shown GM salmon can outcompete and outgrow non-GM salmon, especially in times of food scarcity. When food abundance was low, dominant individuals (GMOs) emerged with strong cannibalistic behavior and dominated the acquisition of limited food resources. This is the well-known work of DFO scientist Robert Devlin who was one of the DFO experts engaged in 2013.

Conclusion: Risk assessments cannot focus on containment at the expense of assessing the toxicity of the organism itself. Relying on containment to prevent environmental harm provides a false sense of security that can permit the use of particularly dangerous organisms that, if escape occurs, pose risks with high stakes, as is the case with this genetically modified salmon.

Public concern

The regulation of this GM salmon is happening in the context of widespread public concern over genetically modified foods. This controversy has been ongoing for two decades and is global in scope. Most recently, PEI residents protested the GM salmon outside the International Symposium on Aquatic Health in Charlottetown.¹²

Agriculture and Agri-Food Canada’s own survey shows that Canadians are concerned about the impact of food production on our environment.¹³ Over 2000 individuals have sent letters to the Minister of Environment and Climate Change through the website of the Canadian Biotechnology Action Network, requesting a full assessment of the environmental risks of the GM salmon.

An Ipsos Reid poll conducted for CBAN in August 2015 shows a high level of awareness and concern about genetically modified foods among Canadians.¹⁴ In fact, 59% of Canadians oppose genetically modifying crops and animals to produce food, and 34% say they support it. 48% support a ban on all genetically modified food. On the GM fish, 45% of Canadians said they

would definitely not eat the GM salmon - 11% said they would; 32% say maybe; and 12% say they don't know or did not have an opinion.

Consistent with all polls over twenty years in Canada,¹⁵ 88% of Canadians want mandatory labelling of GM foods. Of these Canadians who say they want GM foods labeled:

- 87% just want to know what is in the food they are eating,
- 55% are concerned about safety,
- 47% are concerned about government transparency in regulation,
- 46% are concerned about corporate control,
- 46% think GM is not natural,
- 45% have environmental concerns,
- 30% have ethical concerns,
- 58% are concerned that not enough research has been done on the long-term health and environmental impacts.

Many of the above expressed concerns are highly relevant to a discussion of the environmental and health impacts, but also ethical and social impacts, of commercializing GM animals.

Notably, 57% of Canadians also said they are not confident in the government's safety and regulatory systems for genetically modified foods. In relation to this question of public confidence, we note that the risk assessment of this organism is taking place in the context of government investment in its development. The federal government has provided over \$8 million in grants and loans to support the development of this GM salmon, and is set to receive 10% royalties from AquaBounty on a related (unidentified¹⁶) product.¹⁷

Additional Documents

We would like to bring your attention to the following documents and interventions:

- Canadian Biotechnology Action Network, *Risk assessment for the production of genetically engineered salmon eggs*, Petition to Commissioner on the Environment and Sustainable Development in the Office of the Auditor General. 2013. http://www.oag-bvg.gc.ca/internet/English/pet_352_e_39090.html
- *Statement No GE Fish Research, Production, Consumption in, and Export from, Canada, signed by 76 groups in Canada*. 2014. <https://cban.ca/gmos/products/ge-animals/ge-fish/statement-opposing-ge-fish/>
- *Panama Fines GM Fish Company with Canadian Operation for Violating Environmental Regulations*. Canadian Biotechnology Action Network. Press Release. October 28 2014. <https://cban.ca/panama-fines-gm-fish-company-with-canadian-operation-for-violating-environmental-regulations/>
- Lucy Sharratt for the Canadian Biotechnology Action Network, *A Fishy Return on Investment: The policy collision over genetically modified salmon*, The Monitor, published by the Canadian Centre for Policy Alternatives, Sept/Oct 2018.

¹ Peter Andrée and Lucy Sharratt, *Genetically Modified Organisms and Precaution: Is the Canadian Government Implementing the Royal Society of Canada's Recommendations?* October 2014. <https://cban.ca/wp-content/uploads/Action-Plan-Report-Andree-and-Sharratt-1.pdf>

² Canadian Biotechnology Action Network, *Are GM Crops and Foods Better for the Environment?* GMO Inquiry, 2015. www.gmoenquiry.ca/environment

³ CBAN's 2015 report "Are GM Crops and Foods Well Regulated?" details our concerns with the *Biotechnology Notices of Submission* project, accessible at www.gmoenquiry.ca/regulation and our earlier correspondence on this issue to the CFIA can be read here: <https://cban.ca/wp-content/uploads/Letter-from-CBAN-re-CFIA-Notices-of-Submission-Project-and-GM-apple-1.pdf>

⁴ Canadian Biotechnology Action Network, *Are GM Crops and Foods Well Regulated?* GMO Inquiry, 2015. www.gmoenquiry.ca/regulation

⁵ Canadian Biotechnology Action Network et al., Letter to the Ministers, June 6, 2017 <https://cban.ca/wp-content/uploads/serious-concerns-re-GM-Salmon-Production-in-Canada-1.pdf>

⁶ Canadian Food Inspection Agency, *Questions and answers: Detection of genetically modified herbicide-tolerant wheat in Alberta*. June 14, 2018. <http://www.inspection.gc.ca/plants/plants-with-novel-traits/general-public/wheat-detection-2018/questions-and-answers/eng/1523593794211/1523593794476>

⁷ Canadian Biotechnology Action Network, *Are GM Crops and Foods Better for the Environment?* GMO Inquiry, 2015. www.gmoenquiry.ca/environment

⁸ AquaBounty Technologies, Inc., *Form 10-Q*, United States Securities and Exchange Commission, August 3, 2018. Pages 11 and 12.

⁹ Food and Water Watch US, Letter to Dr. Margaret A. Hamburg, Commissioner, US Food and Drug Administration, November 19, 2014. https://www.foodandwaterwatch.org/sites/default/files/FDA_Deny_AquaBountyTechnologies.pdf

¹⁰ Moreau, Darek T R, Corinne Conway, and Ian A Fleming. "Reproductive Performance of Alternative Male Phenotypes of Growth Hormone Transgenic Atlantic Salmon (*Salmo Salar*)."
Evolutionary Applications 4.6 (2011): 736–748. *PMC*. Web. 12 Oct. 2018.

¹¹ William Muir et al., *Possible ecological risks of transgenic organism release when transgenes affect mating success: Sexual selection and the Trojan gene hypothesis*, 96 *PNAS* 13853-13856, at 13853. November 23, 1999.

¹² *Islanders protest GM fish at aquaculture symposium*, The Guardian, PEI, September 3, 2018

¹³ Ann Hui, *Survey points to conservation as top priority for national food policy*, The Globe and Mail, September 5, 2018

¹⁴ Ipsos Reid, Poll commissioned by the Canadian Biotechnology Action Network, 2015. www.cban.ca/2015poll

¹⁵ Canadian Biotechnology Action Network, *Polls on GM Food Labelling in Canada: 1994-Present* www.cban.ca/labellingpolls

¹⁶ Atlantic Canada Opportunities Agency, response to a request for information from Lucy Sharratt for the Canadian Biotechnology Action Network, October 3, 2018. Available upon request.

¹⁷ Lucy Sharratt, *A fishy public investment*, The Monitor, Published by the Canadian Centre for Policy Alternatives, Sept/Oct 2018.