

Information Regarding Concerns about Farmed Salmon - Wild Salmon Interactions

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Key Statement #1: Diseases in BC farmed Atlantic salmon pose no more than a minimal risk of serious harm to the health of migrating wild salmon.

Key evidence: Less than 1% of BC farmed Atlantic salmon die of diseases that might be infectious to wild Pacific salmon (e.g., 2014 data; 645 fish examined). Among the other 99% of farmed salmon, 90% survive and 9% die of other causes. The potential for infectious disease to spread *from sick farmed salmon to other farmed salmon* is greater than the potential for disease to spread *from sick farmed salmon to wild salmon*. Therefore, it is reasonable to estimate that farm-source diseases kill less than 1% of wild salmon per *year*. This rate is substantially less than the estimated natural mortality of young wild salmon of 3% per *day*.

Key Statement #2: The Cohen Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River investigated the effect of wastes and chemicals discharged at salmon farms, and escapes from salmon farms, and concluded that they are unlikely to have any population level effects on Fraser River sockeye. No new information about these variables has been brought forward in the past 4 years to change this conclusion.

Table of Contents

| | |
|--|----------|
| Accreditations and Qualifications | 2 |
| Evidence that diseases in BC farmed Atlantic salmon pose no more than a minimal risk of serious harm to the health of migrating wild salmon | 3 |
| Concern #1 - Justice Cohen's conclusion in his final report: "In summary, I have concluded that net-pen salmon farming in the Discovery Islands poses a risk of serious harm to Fraser River sockeye through the transfer of diseases and pathogens." | 4 |
| Concern #2: "In the absence of any data confirming that salmon farming is not hazardous to wild salmon..." | 5 |
| Concern #3: Are farming challenges in Norway applicable to BC? | 5 |
| Virus testing: Fish Health Audit and Surveillance component of the BC Fish Health Program | 7 |

| | |
|---|-----------|
| Low prevalence of diseases in BC farmed Atlantic salmon that have potential to spread to wild Pacific salmon | 8 |
| Infectious salmon anemia virus (ISAV) in British Columbia | 9 |
| Piscine reovirus (PRV) in British Columbia..... | 10 |
| Canadian Environmental Protection Act, 1999: Precautionary Principle – Administrative Duties – Duties of the Government of Canada..... | 10 |
| Evidence that Atlantic salmon are not asymptomatic carriers of disease that might affect wild Pacific salmon | 11 |
| Antibiotic use in BC aquaculture declined from 2002 – 2013..... | 11 |
| BC Farmed salmon harvests 2001 – 2013 | 12 |
| Norwegian farmed salmonid harvests 2001 – 2013 | 12 |
| Chilean farmed salmonid harvest 2014 – 2016 | 13 |
| Farmed salmon escapes represent minimal risk of serious harm to wild Pacific salmon..... | 13 |
| Fraser River pink salmon returns 1959 – 2013 | 14 |
| Fraser River sockeye salmon returns per spawner, 1956 – 2013..... | 14 |
| Scientific Literature Cited | 15 |

Accreditations and Qualifications

The BC Ministry of Agriculture’s Animal Health Centre is ISO 17025 accredited by the Standards Council of Canada¹.

The Animal Health Centre is also fully accredited by the American Association of Veterinary Laboratory Diagnosticians (AAVLD).

Supporting this accreditation are 765 unique documents, which include 625 internal Standard Operating Procedures (SOPs) and 12 external SOPs (from CFIA). The proficiency of our molecular diagnostics technicians are validated quarterly by external proficiency tests (e.g., the technician receives an “unknown” sample, and she must test it and determine if it has the pathogen being tested).

Gary Marty has a Bachelor of Science degree (BSc) in Fisheries and Wildlife Biology, a Master’s of Science degree (MSc) in Fisheries Biology, and two earned doctoral degrees: Doctor of Veterinary Medicine (DVM) and a Ph.D. (Comparative Pathology). Dr. Marty is board certified in anatomic

¹ The scope of the accreditation is available at http://palcan.scc.ca/specs/pdf/987_e.pdf

pathology by the American College of Veterinary Pathologists. Dr. Marty has been conducting fish histopathology for nearly 30 years, and he has more than 50 peer-reviewed scientific publications.

Evidence that diseases in BC farmed Atlantic salmon pose no more than a minimal risk of serious harm to the health of migrating wild salmon

Based on the information available, I am confident that BC farmed Atlantic salmon pose no more than a minimal risk of serious harm to the health of migrating wild salmon. My conclusion is supported by 606 reasons and by Alexandra Morton's testimony:

Last year, Alexandra Morton provided key testimony to the Canadian Senate's Standing Committee on Fisheries and Oceans, regarding the potential for disease transfer: "It is all about dilution. If you were a football field away from somebody with the flu, you are very unlikely to get it, but if you are in an elevator that is stalled with four people with the flu you probably will get it."²

A natural extension of this statement is that if you are in a stalled elevator with four people that are sick, and you do not get sick, then you are even less likely to get sick if you are a football field away. This type of scenario would be expected if the people in the elevator had AIDS, which is not contagious through the casual contact that would occur in a stalled elevator.

The biology of disease transfer is similar among people and salmon. Therefore, the elevator concept can also be applied to salmon farms. If healthy cultured salmon living in the same farm as sick salmon do not get sick, we can be confident that the wild salmon outside of the pens are unlikely to get sick from the same cause.

In 2014, I estimate that 99.4% of BC farmed Atlantic salmon did not die of infectious diseases of concern to wild salmon. If only 0.6% Atlantic salmon confined to farms died from an infectious disease of concern to wild salmon, it is reasonable to assume that the proportion of wild salmon dying from farm-source infectious disease is even less than 0.6%. We have no evidence of pathogens that are carried by Atlantic salmon with little affect but then transfer to and kill Pacific salmon (see page 11 for details). A mortality rate of 0.6%/year is negligible compared with the natural mortality rate for young wild salmon of 3% per day³.

In 2014, DFO's scientifically designed Fish Health Audit and Surveillance Program tested samples from 645 freshly dead farmed Atlantic salmon for disease. Based on analysis by board-certified veterinary pathologists at the BC Animal Health Centre, **606** (94%) died of something other than an infectious disease of concern. Only 39 (6%) fish died of a disease that has the potential to spread to wild salmon (see page 8 for details). Many of the **606** farmed Atlantic salmon were living in close quarters with these 39 diseased fish 24 hours a day, 7 days a week, for their entire lives, and yet they did not die of these

² Proceedings of the Standing Senate Committee on Fisheries and Oceans, Issue 4 - Evidence - Afternoon meeting, Nanaimo, Wednesday, March 26, 2014; <http://www.parl.gc.ca/content/sen/committee/412%5CPOFO/04EV-51273-E.HTM>

³ Cohen Commission Final Report, Volume 2, p. 67, column 1

infectious diseases. Also, because less than 10% of the fish on the farms die each year⁴, we can conclude that only about 0.6% (one tenth of 6%) of the BC farmed Atlantic salmon in 2014 died of an infectious disease of concern to wild salmon.

Concern #1 - Justice Cohen's conclusion in his final report: "In summary, I have concluded that net-pen salmon farming in the Discovery Islands poses a risk of serious harm to Fraser River sockeye through the transfer of diseases and pathogens."⁵

Information: This statement needs to be put in context. Justice Cohen did not state whether the risk was minimal or great. Indeed, the final report states, "I cannot quantify the likelihood of harm occurring based on the evidence before me."⁶ Other parts of the Final Report provide evidence that the unknown level of risk is decreasing and no more than minimal:

- 1) "the quality and quantity (in terms of breadth of data collected) of the fish health database are impressive"⁷;
- 2) "There was a statistically significant declining trend in the number of high risk diseases reported by salmon farms between 2003 and 2010"⁸; and,
- 3) "Data presented during this Inquiry did not show that salmon farms were having a significant negative impact on Fraser River sockeye."⁹

The concept of disease risk might seem ominous when it is applied to a species and environment that most people do not understand very well. However, this concept is not as ominous when applied to our own lives. For example, Justice Cohen's conclusion about the risk could be revised to say, "*Air travel to Vancouver International Airport poses a risk of serious harm to British Columbians through the transfer of diseases and pathogens*". Recent North American examples of Ebola virus, Measles, and Influenza support this statement, and yet, we do not shut down air travel to eliminate this risk. Instead, we take precautions to mitigate the risk to no more than minimal. If we consider how we deal with other daily risks, the conclusion is similar. For example, the most recent data from Statistics Canada reports that 2,351 people died in transport accidents in 2011¹⁰, and yet, we do not shut down all transportation to eliminate the risk. Instead, we take precautions to mitigate the risk.

A good example of the declining trend in the number of high risk diseases in BC is the IHN disease (infectious hematopoietic necrosis). From 2001 – 2003, an IHN outbreak among farmed Atlantic salmon spanned 22 months and affected 36 farms (Saksida et al. 2006). The only IHN outbreak since then

⁴ Cohen Commission Final Report, Volume 2, p. 67, column 1

⁵ "The Uncertain Future of the Fraser River Sockeye" [hereafter referred to as the "Cohen Commission Final Report"]. Volume 3: Recommendations – Summary – Process; p, 25, column 1

⁶ Cohen Commission Final Report, Volume 3, p. 21, column 1

⁷ Cohen Commission Final Report, Volume 3, p. 18, column 2

⁸ Cohen Commission Final report, Volume 2, p. 164, last full paragraph

⁹ Cohen Commission Final Report, Volume 3, p. 24, column 2

¹⁰ Statistics Canada: <http://www5.statcan.gc.ca/cansim/pick-choisir?lang=eng&p2=33&id=1020540>

occurred in 2012, and it was limited to three farms spanning 3 months¹¹. We now have a vaccine that is being used for all Atlantic salmon; if use of this vaccine continues, we may never have another IHN outbreak among farmed Atlantic salmon in BC.

Concern #2: “In the absence of any data confirming that salmon farming is not hazardous to wild salmon...”

Information: This statement is not correct. Three peer-reviewed scientific publications provide evidence that current BC salmon farm production is not having a significant impact on wild salmon populations.

First, Alexandra Morton and her colleagues examined wild pink salmon populations in 2007 in the Broughton Archipelago (an area with salmon farms) and the BC central coast (a reference area to the north without salmon farms). They concluded that “...there was no detectable difference in mean survival for the Broughton Archipelago relative to the central coast.” (Morton et al. 2011).

Second, I was part of a collaborative research project that examined disease in juvenile outmigrating pink salmon in 2007 and 2008 (Saksida et al. 2012). At the same time, the BC Fish Health Auditing and Surveillance Program studied farmed salmon that died in the net pens¹². The pink salmon had one set of abnormalities and parasites, while the farmed salmon had a different set of abnormalities; only sea lice were shared by both groups of fish. Researchers agree that sea lice from fish farms did not adversely affect Broughton pink salmon populations in 2007 and 2008 (Marty et al. 2010; Morton et al. 2011).

And third, a recent scientific publication from researchers based in the State of Washington and Simon Fraser University reported no relation between farm fish production in the Discovery Islands and Fraser River sockeye salmon returns (Ruggerone and Connors 2015).

Also, the Cohen Commission reported, “Data presented during this Inquiry did not show that salmon farms were having a significant negative impact on Fraser River sockeye.”¹³

Concern #3: Are farming challenges in Norway applicable to BC?

Information: Salmon farm harvests in Norway are 15 times greater than in BC (In 2012, the production of Atlantic salmon and rainbow trout in Norway was 1 232 095 and 74 583 tons, respectively (Taranger et al. 2014).

Since I joined the BC Ministry of Agriculture in 2004, the annual **increase** in Norwegian farmed salmon production in most years has been greater than the annual total BC farmed salmon production, which has been fairly stable around 80,000 tonnes (see page 12). Indeed, annual farmed salmon

¹¹ CFIA website: <http://www.inspection.gc.ca/animals/aquatic-animals/diseases/reportable/2015/infectious-haematopoietic-necrosis-2012-/eng/1339177995042/1339178134615>

¹² Cohen Commission Exhibit #1678, Area 3.3 data.

¹³ Cohen Commission Final Report, Volume 3, p. 24, column 2

production in a single Norwegian fjord (~70,000 tonnes/yr., Hardangerfjord; Husa et al. 2014) nearly equals that of all BC farmed salmon. A recent study of water conditions in Hardangerfjord concluded, **“The good ecological conditions of the parameters studied in the fjord show little evidence of a regional impact from the fish farming industry despite the intensive production level”** (Husa et al. 2014).

Finally, nominal catches of wild Atlantic salmon have declined in nearly all jurisdictions over the past few decades. However, these declines are not greater in Norway than in jurisdictions without abundant salmon farms (Torrissen et al. 2013):

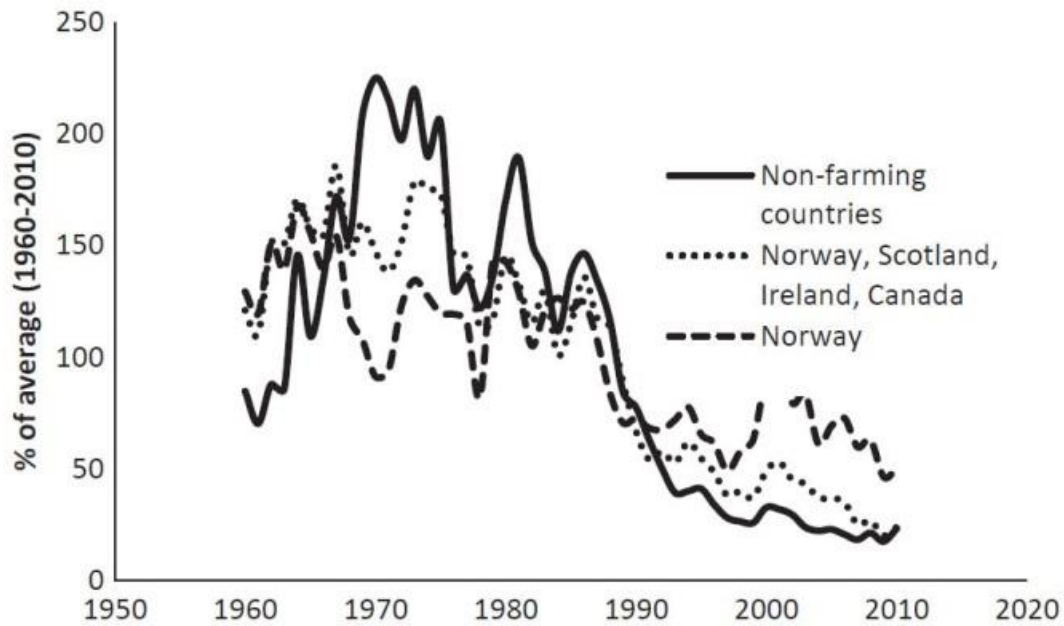


Figure 1 Relative nominal catch of Atlantic salmon from 1960 to 2010 in ‘non-farming countries’ (USA, Russia, Iceland, Sweden, Denmark, The Faeroe Islands, Greenland the UK – except Scotland, France and Spain), ‘Norway, Scotland, Ireland and Canada’, and ‘Norway’(NASCO 2011). The Faeroe Islands is included among ‘non-farming’ as their salmon fishery is a marine fishery.

Reference Information

Virus testing: Fish Health Audit and Surveillance component of the BC Fish Health Program

Initiated in 2003 by the aquaculture industry working with the BC government, this program is now administered as a requirement of licence by Fisheries and Oceans Canada (DFO). Government fish health technicians conduct up to 30 onsite farm audits per quarter, examining mortality records and sampling fresh carcasses for diagnostic evaluation. The program samples dead fish because they are more likely to have diseases of concern than the living fish.

From 600 – 800 fish per year, samples are analyzed by bacteriology, histopathology (nine organs), and PCR analysis (for five pathogens). Bacteriology and PCR analysis for this program has always been conducted by the BC Ministry of Agriculture’s Animal Health Centre in Abbotsford. Histopathology has been done by the Animal Health Centre during all years except for 2012 and 2013.

Now in its 13th year, the Program has sampled 7,205 farmed salmon and conducted PCR tests on all samples for **ISAV** (infectious salmon anemia virus), **IHN** (infectious hematopoietic necrosis virus), and **IPNV** (infectious pancreatic necrosis virus). A test for salmon alphavirus (**SAV**, the cause of pancreas disease) was added to the program in 2014 (n = 836). All test results have been negative—no virus:

| # | Year | # positive | # negative |
|----|-------|------------|------------|
| 1 | 2003 | 0 | 648 |
| 2 | 2004 | 0 | 675 |
| 3 | 2005 | 0 | 586 |
| 4 | 2006 | 0 | 644 |
| 5 | 2007 | 0 | 763 |
| 6 | 2008 | 0 | 588 |
| 7 | 2009 | 0 | 585 |
| 8 | 2010 | 0 | 238 |
| 9 | 2011 | 0 | 317 |
| 10 | 2012 | 0 | 632 |
| 11 | 2013 | 0 | 693 |
| 12 | 2014 | 0 | 721 |
| 13 | 2015 | 0 | 115 |
| | Total | 0 | 7205 |

For more details about this program, see:

<http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/health-sante-eng.html>

Low prevalence of diseases in BC farmed Atlantic salmon that have potential to spread to wild Pacific salmon

Based on data from the BC Fish Health Audit and Surveillance Program in 2014:

of dead farmed Atlantic salmon sampled: **645**

of Audit Program dead Atlantic salmon that did not have a disease that might spread to wild Pacific salmon: **606** (=94% of total)

of Audit Program dead Atlantic salmon with disease that might spread to wild Pacific salmon:

| # of fish | Type of infectious agent |
|-----------|---|
| 4 | Virus: VHSV (n = 4) |
| 26 | Bacteria: <i>Piscirickettsia salmonis</i> infection (n = 12) <i>Renibacterium salmoninarum</i> (n = 10) <i>Yersinia ruckeri</i> (n = 2) Unidentified Gram-negative bacteria (n = 1) <i>Vibrio splendidus</i> (n = 1) |
| 9 | Parasite: <i>Neoparamoeba</i> sp. (n = 8) <i>Sphaerothecum destruens</i> -like organism (n = 1) |
| 39 | Total (= 6% of all samples during 2014) |

Pathogens of concern that did not affect any Audit Program farmed Atlantic salmon (i.e., 0/645 affected)

Aeromonas salmonicida infection (cause of furunculosis)

Cryptobia salmonicida

Infectious hematopoietic necrosis virus (IHNV)

Infectious pancreatic necrosis virus (IPNV)

Infectious salmon anemia virus (ISAV)

Parvicapsula minibicornis

Salmon alphavirus (SAV)

Vibrio anguillarum

Infectious agents that affected some Audit Program farmed Atlantic salmon, but are mostly a result of environmental exposure rather than fish-to-fish spread:

Kudoa thyrsites

Moritella viscosa

Pigmented fungi

Tenacibaculum maritimum

Infectious agents that affected some Audit Program farmed Atlantic salmon but have never been identified in Pacific salmon: *Microsporidium cerebralis* and Presporogonic myxosporean (brain) infection

Infectious salmon anemia virus (ISAV) in British Columbia

The ISA virus has generated significant publicity in BC over the past 3.5 years. The Factsheet released by The United States' APHIS Veterinary Services in May 2013 summarized the important points very well: "Q. Is ISA found in the Pacific Northwest? A. **No**. While some media reports indicate that ISA virus is found in both farmed and wild salmon from British Columbia, Canada, these statements are not accurate."¹⁴

This document is supported by extensive testing of Pacific salmonids, most recently summarized in the journal "Fisheries" (Tables 1 and 2 of Amos et al. 2014); all results were negative—no virus: Washington (# fish tested = **923**) and Alaska (# fish tested = **1,431**). From "Conclusions and Next Steps": "information from historic surveillance (active and passive) for fish viruses as well as the negative findings from the 2012–2013 effort provide a significant body of data indicating the nonpresence of ISAV in salmon stocks of the U.S. Pacific Northwest and Alaska."

Also, CFIA tested for ISAV **8,006** wild or hatchery BC Pacific salmonids sampled in 2012 and 2013 using validated published methods (Caraguel et al. 2012). All results were negative—no virus.¹⁵

During the Cohen Commission ISA hearings, Commission Counsel asked each witness the same question: "Do you believe that there is ISAV or a related virus present in Pacific salmon?"¹⁶ Dr. Are Nylund, University of Bergen, Norway, answered, "...if you look at the situation in wild Pacific salmon that we've seen so far and the result presented by Miller here, I don't think we have seen evidence of ISA virus in Pacific salmon, so far. No hard evidence."¹⁷

Cultus Lake sockeye salmon tested for the ISA virus: test results from analysis conducted in 2004 were never confirmed by OIE standards. Therefore, the best conclusion from a diagnostic medical perspective is that the results were false positives. False positive test results are not a threat to wild salmon.

In 2004, DFO postdoctoral researcher Molly Kibenge drafted a manuscript in which she reported presumptive positive results for the ISA virus from 64 out of 64 Cultus Lake sockeye salmon¹⁸. Commissioner Cohen summarized the evidence that he thought was relevant regarding these results in his October 29, 2012, final report¹⁹ (emphasis mine); Dr. Frederick Kibenge "said that for Cultus Lake sockeye **the product obtained was not a match for ISAv.**[Cohen Commission Transcripts, 2011-12-16, p. 7] Indeed, in an email from Dr. Molly Kibenge to Dr. Jones, she says that 'the sockeye clone sequences show homology to short sequences of human, mouse, rat, and zebrafish clones.' [Cohen Commission Exhibit #2140; Transcripts 2011-12-19, p. 112] Dr. Jones said this indicated that **the PCR results for the Cultus Lake fish were false positives.** [Cohen Commission Transcripts, 2011-12-19, p. 112]."

¹⁴ http://www.aphis.usda.gov/publications/animal_health/2013/faq_isa_pacific_nw.pdf

¹⁵ <http://www.inspection.gc.ca/animals/aquatic-animals/diseases/reportable/isa/wild-anadromous-salmonids/eng/1410057185143/1410057186002>

¹⁶ Cohen Commission Hearing Transcript, 2011-12-15, page 57, lines 17 - 19.

¹⁷ Cohen Commission Hearing Transcript, 2011-12-15, page 57, lines 27 - 31.

¹⁸ Cohen Commission Exhibit 2045, page 15, Table 1

¹⁹ Cohen Commission Final Report, Volume 1, p. 458;

Piscine reovirus (PRV) in British Columbia

Piscine reovirus has generated significant publicity in BC over the past 2.5 years. An American organization, the Pacific Northwest Fish Health Protection Committee, recently investigated the available information about PRV in Western North America and concluded, “**The ubiquitous nature of piscine reovirus (PRV), its apparent long time presence in wild Pacific salmonid stocks and the lack of clear association with disease suggest the virus poses a low risk to wild species of Pacific salmonids.**”²⁰

The lead author on the resultant white paper, Dr. Ted Meyers, has a Ph.D. in fish histopathology, and he has been conducting histopathology on Alaska salmonids for about 30 years. The white paper also stated:

1. “The disease “heart and skeletal muscle inflammation” (HSMI) has not been reported in wild salmon populations in Norway or elsewhere and thus appears to only be a threat to farmed fish.”
2. “Surveys detected the presence of PRV genetic material in wild and cultured Chinook and coho salmon from Washington State, BC Canada, and Alaska, where years of surveillance have reported no presence of HSMI.”
3. “HSMI has not been reported in North America.”
4. “HSMI has not been reported in trout or Pacific salmon species.”

These conclusions are consistent with the data in the three peer-reviewed scientific publications that include analysis of samples from BC (Kibenge et al. 2013; Marty et al. 2014; Garver et al. 2015).

Canadian Environmental Protection Act, 1999: Precautionary Principle – Administrative Duties – Duties of the Government of Canada

2. (1) In the administration of this Act, the Government of Canada shall, having regard to the Constitution and laws of Canada and subject to subsection (1.1),

(a) exercise its powers in a manner that protects the environment and human health, applies the **precautionary principle** that, where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation, and promotes and reinforces enforceable pollution prevention approaches;²¹

Cost-effective measures are already being used to minimize farmed fish disease.

²⁰ http://wdfw.wa.gov/pnfhpc/pubs/ireports/Piscine_Orthoreovirus_PNFHPC_Whitepaper.pdf

²¹ Canadian Environmental Protection Act, 1999; <https://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=CCODE5E2-1>

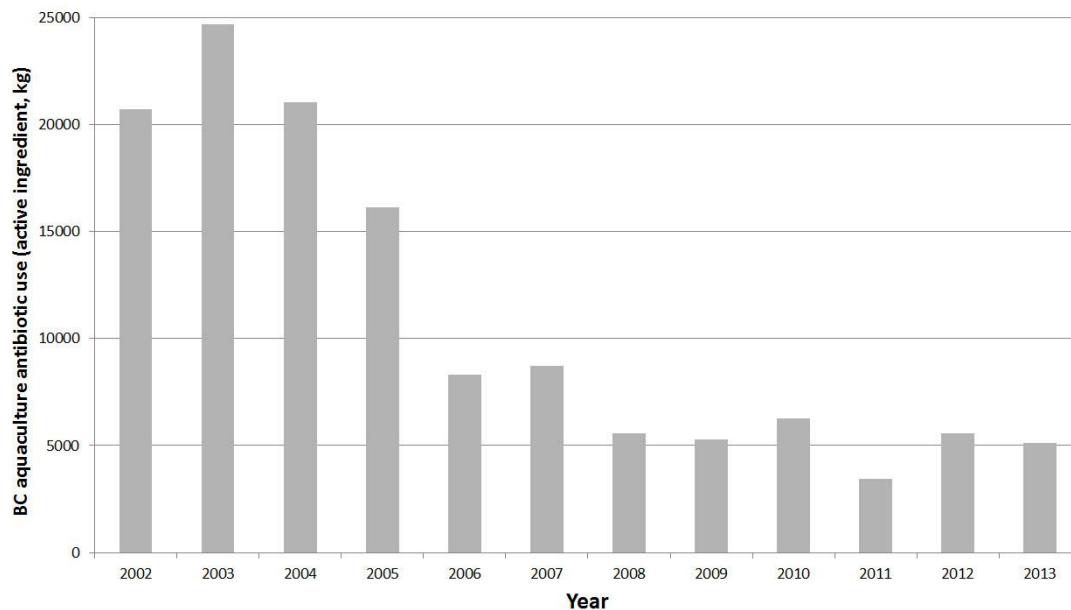
Evidence that Atlantic salmon are not asymptomatic carriers of disease that might affect wild Pacific salmon

Over the past two decades, six scientific studies have been conducted in which Atlantic salmon sourced from commercial farmers were cohabited with various Pacific salmon species under controlled laboratory conditions (Johnson 1993; Johnson and Albright 1992; Johnson et al. In preparation; St-Hilaire et al. 2001; Sutherland et al. 2014; Traxler et al. 1993). The Pacific salmon never developed unexpected disease from the Atlantic salmon: evidence that the Atlantic salmon were not carrying an unknown disease of concern to Pacific salmon. In Norway and Chile, rainbow trout and coho salmon have sometimes been reared near Atlantic salmon, but I am not aware of any cases in which the rainbow trout or coho salmon developed disease that could be attributed to Atlantic salmon carrying the disease without any symptoms.

These studies and circumstantial evidence support the conclusion that Atlantic salmon are not asymptomatic carriers of a disease that affects Pacific salmon.

Antibiotic use in BC aquaculture declined from 2002 – 2013

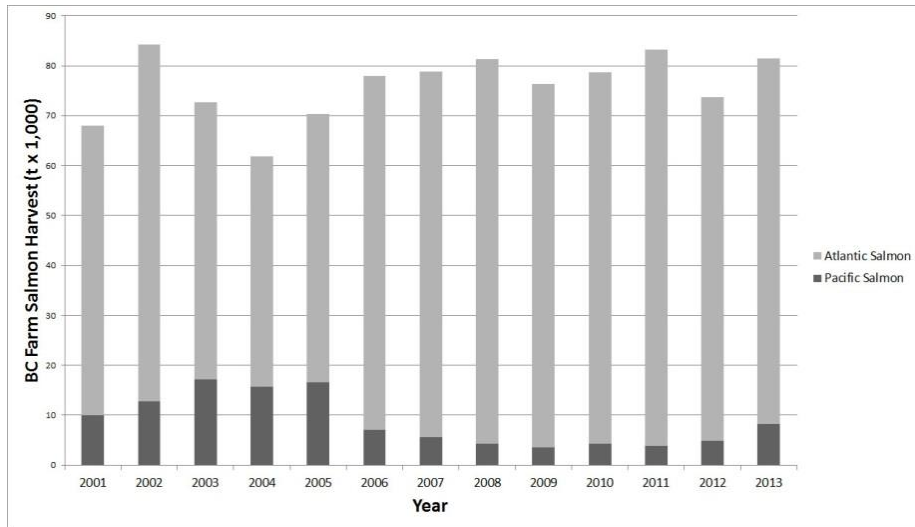
Antibiotic use in aquaculture in BC is by prescription only from a licenced veterinarian. Each year, feed companies report to the BC Ministry of Agriculture the amount of prescription antibiotic added to feed. Through improved fish health management and improved vaccines, antibiotic use over the past decade has declined from greater than 20,000 kg each year from 2002 – 2004 to around 5,000 kg each year from 2011 – 2013²²:



²² BC Ministry of Agriculture records and http://www.agf.gov.bc.ca/ahc/fish_health/Antibiotic_Graphs_1995-2008.pdf

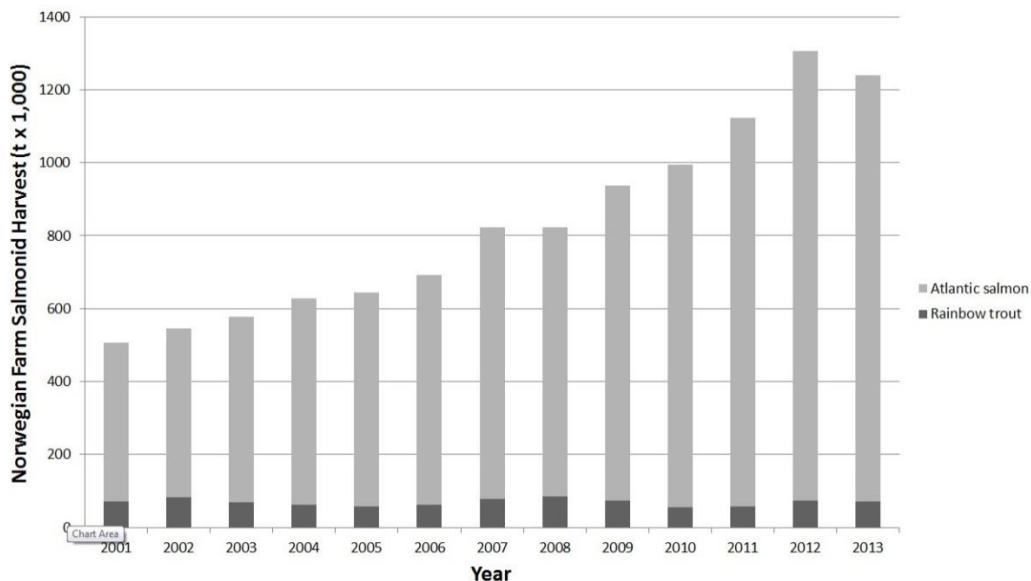
BC Farmed salmon harvests 2001 – 2013

Information: Salmon farming tenures and production quotas have changed little over the past decade. Minimal variability in harvest supports the conclusion of no major outbreaks since the IHN outbreaks of 2001- 2003 (Most recent data: <http://www.agf.gov.bc.ca/stats/YinReview/Seafood-YIR-2013.pdf>):



Norwegian farmed salmonid harvests 2001 – 2013

Information: The Norwegians grow more rainbow trout than BC grows all salmon combined. Norway has a few farms break with ISA nearly every year. Even though rainbow trout are sometimes grown on the same farm as Atlantic salmon with ISA, ISA has never been reported in Norwegian rainbow. No other diseases in Norwegian farmed rainbow trout have been attributed to spread from asymptomatic Atlantic salmon. Data from: <http://www.fiskeridir.no/english/statistics/norwegian-aquaculture/aquaculture-statistics/atlantic-salmon-and-rainbow-trout>



Chilean farmed salmonid harvest 2014 – 2016

Information: The Chilean’s grow more rainbow trout and more coho salmon than BC grows all salmon combined. During the infectious salmon anemia (ISA) outbreaks of the late 2000s, cases of ISA affected only the Atlantic salmon; ISA was never reported for rainbow trout or coho salmon. No other diseases in Chilean farmed rainbow trout or coho salmon have been attributed to spread from asymptomatic Atlantic salmon; in some cases, the different species were cultured on the same farm.

| Chilean salmon harvest 2014 & forecasts for 2014-2016 | | | | | | |
|---|----------|----------|----------|--------|----------|-------|
| | 2014 | | 2015 | | 2016 | |
| | Forecast | Official | Forecast | | Forecast | |
| Atlantic | 623,390 | 610,000 | 589,238 | -3.4% | 554,828 | -6.2% |
| Coho | 128,625 | 156,000 | 155,102 | -0.6% | 141,396 | -9.7% |
| Trout | 123,457 | 126,000 | 96,705 | -23.3% | - | - |
| Total | 875,472 | 892,000 | 841,045 | -5.7% | 696,224 | - |

All figures in metric tons. Forecasts as supplied by [Salmonex](#). The 2014 official data is from [Sernapesca](#). Source: [Salmonex/ Undercurrent News](#)

Source: “Undercurrent News”, March 9, 2015, 5:53 pm.

Farmed salmon escapes represent minimal risk of serious harm to wild Pacific salmon

One hundred and seventy times, Atlantic salmon were deliberately released into North American waters where they were not native. These releases were by fisheries managers in an attempt to establish reproducing populations. One hundred and seventy times those efforts failed (MacCrimmon and Gots 1979). The number of unintentional escapes from BC salmon farms has declined substantially in the past decade. For example, from 2001 – 2004, 110,928 farmed salmon were reported to have escaped²³; from 2011 – 2014, only 321 farmed salmon were reported to have escaped from marine open net pens²⁴. Justice Cohen concluded: “I am satisfied that wastes and chemicals discharged at salmon farms, and escapes from salmon farms, are unlikely to have any population level effects on Fraser River sockeye.”²⁵ Because all farmed salmon in marine open net cages are vaccinated against diseases of concern, and less than 1% of farmed Atlantic salmon die each year of diseases that might transfer to Pacific salmon, disease from escaped farmed Atlantic salmon is unlikely to have any population level effect on wild Pacific salmon.

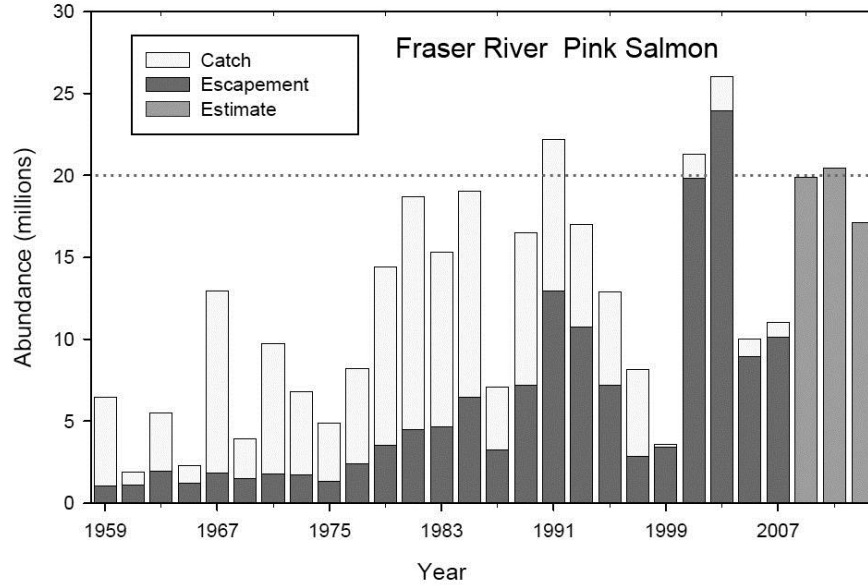
²³ Table 1 in Noakes, D.J. 2011. Impacts of salmon farms on Fraser River sockeye salmon: results of the Noakes investigation. Cohen Commission Tech. Rept. 5C. 113p. Vancouver, B.C.

²⁴ <http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/escape-evasion-eng.html>

²⁵ Cohen Commission Final Report, Volume 2, p. 114, end of column 1

Fraser River pink salmon returns 1959 – 2013

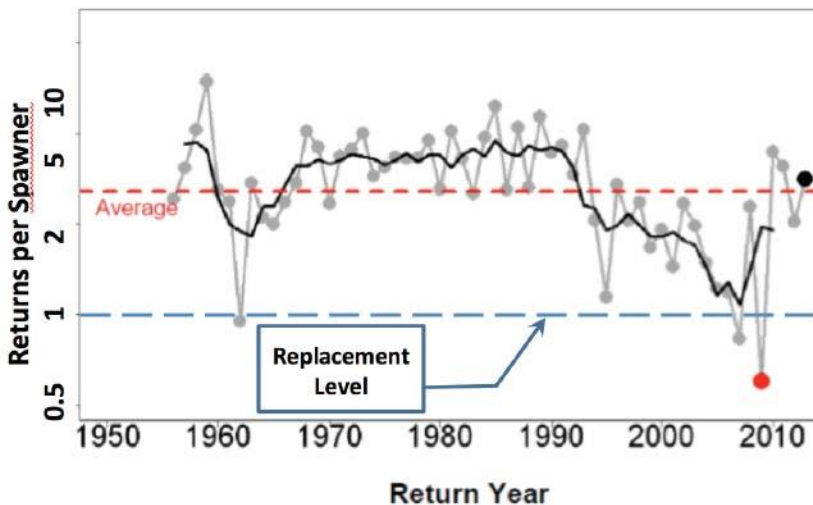
Information: The five most abundant returns have occurred since fish farms were established in BC in the mid-1980s.



Fraser River sockeye salmon returns per spawner, 1956 – 2013

Information: After many years of decline in the 1990s and 2000s, since 2010 the number # of returns per spawner has been near the historic average.

Fraser River Sockeye Salmon



Each dot is the number of adults that returned to the coast per parent from four years previous. The solid curve is a running average. Note the low productivity in 2009. The final dot is a forecast for 2013; such forecasts are always uncertain.

"Fraser sockeye salmon: an uncertain future"
SFU Think Tank report, February 2013

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