Chapter 2 • Summary of public submissions

Members of the public participated in the Inquiry by making oral submissions during community forums and written submissions via mail, email, or the Commission's website. These submissions were analyzed to incorporate public perspectives into the Commission's work. Those submissions that relate directly to causes of the Fraser River sockeye decline are summarized in this chapter. Those that address fisheries management topics are referred to in Volume 1.

I express my sincere appreciation to every person who took the time to write to the Commission or attend one of the Commission's community forums, and to share their views and concerns with me. I was impressed with how knowledgeable many people are about our Fraser River sockeye salmon, the threats sockeye face, and the management of the fishery, and about how passionate British Columbians are about protecting our wild sockeye stocks.

Public Forum, Campbell River, BC, 2010

Effects in the Fraser River watershed

A significant proportion of public submissions addressed how various factors operating in the Fraser River watershed may affect Fraser River sockeye salmon:

- general habitat loss;
- urbanization and development;
- groundwater use;
- gravel extraction and metal mining;
- hydroelectric projects;
- forestry;
- municipal wastewater;
- non–point source contaminants;
- pesticides;
- pulp mill effluent;
- freshwater climate change; and
- wildfires.

General habitat loss

Many people made submissions to the Commission on a range of habitat issues. Numerous individuals were concerned about habitat loss and suggested it could be a cause for the decline of Fraser River sockeye. Human activity was blamed for loss of Fraser River sockeye habitat, especially in the North Arm of the river. One submitter referenced a 2010 report by the Department of Fisheries and Oceans (DFO) which found that coastal and estuarine zones are deteriorating in both extent and condition.[1] Several submitters encouraged me to identify habitat loss as a cause of the decline of Fraser River sockeye, while one submitter called on DFO to reopen inaccessible sloughs and creeks and remove the remaining rocks from the Hell's Gate rock slide. One submission stated that less than 5 percent of salmon smolt habitat remains in the North Arm of the Fraser River. Another submission argued that there are very few salt marshes remaining in the Fraser River estuary, and that salt marshes are critical for salmon as they acclimatize to the marine environment.

Urbanization and development

The Commission received several written and oral public submissions raising concerns about linear development, including railway and pipeline construction, the Gateway Program and South Fraser Perimeter Road,* and the potential impacts on fish and fish habitat from these projects. One submitter noted that the damage caused by urbanization and development is evidenced by the Outdoor Recreation Council's 2010 decision to list the Fraser River as the fourth most endangered river in British Columbia. Other submitters said urbanization and development lead to increased levels of siltation and sedimentation in the Fraser River watershed, the disappearance of riparian ecosystems, and disruptions to flood plains and stream channels. A submission from the Social Ecology Institute of British Columbia stated that industrial and residential development has caused riparian degradation and explained that riparian systems are important for spawning salmon.

Groundwater use

Several public submissions expressed concern about a lack of knowledge regarding the impact that industrial activities have on groundwater sources, and about a lack of legal protection for small streams and groundwater.

Gravel extraction and metal mining

Several submitters said that metal mining introduces toxic chemicals into salmon habitat and increases water temperatures. Others argued that gravel extraction in the Lower Fraser River and metal mining in the Fraser River watershed are among the causes of the decline of Fraser River sockeye. I was told that the collapse of a tailings pond wall in 2008 released toxins into the Stellako River. One submitter said the BC Aggregate Pilot Project's† use of "green zones," or areas where "unregulated" open-pit mining is permitted, threatens

* The Gateway Program is a program of the Province of British Columbia aimed at improving the movement of people, goods, and transit through Metro Vancouver. It includes road and bridge improvements. One such improvement is South Fraser Perimeter Road – a new four-lane highway along the south side of the Fraser River from Delta to Surrey.

† In 2004, the BC minister of state for mining initiated the Aggregate Pilot Project in the Fraser Valley Regional District. The project develops recommendations to industry, local governments, and the province for new approaches to reduce conflict surrounding aggregate operations and secure a long-term supply.

to degrade salmon habitat, while another criticized the project for having an "inadequate" approval process and failing to respond to public inquiries in a timely manner.[2]

Hydroelectric projects

One submitter said that the Kemano Hydroelectric Project's diversion of the Nechako River and groundwater withdrawals are "exacerbating the devastating effects of below-average flows and higher-than-average water temperatures" during the Fraser River sockeye migration period.[3] Several submitters cited hydroelectric projects and run-of-river projects as a cause of the decline of Fraser River sockeye. Some submitters criticized the BC government for failing to implement an "environmentally based planning process" for proposed run-of-river projects.

Forestry

Submitters said that logging practices, such as clear-cutting and high-elevation logging, have made streams more vulnerable to increases in water temperature, surface runoff, debris accumulation, landslides, and channel disturbances. Logs left to drift and sink in the Lower Fraser River crush wetland plants and deplete oxygen from the surrounding water, harming migrating salmon.

Municipal wastewater

Submitters said that effluents released from Metro Vancouver's Annacis Island and Iona Island wastewater treatment plants are harmful to Fraser River sockeye and that the Iona plant may be responsible for post-1995 changed migration timing of Late-run Fraser River sockeye. The Capital Regional District's stormwater management system flushes high-velocity, toxic stormwater into sensitive salmon habitat. I was told that Salmon Arm discharges raw sewage directly into Shuswap Lake, and Lumby sewage seeps into Bessette Creek. Greywater containing harmful chemicals is discharged from houseboats into Shuswap Lake.

Non–point source contaminants

Non–point source contaminants are associated with diffuse discharges of runoff from a variety of areas. People expressed concern about the effect of contaminants on the sustainability of Fraser River sockeye. Contaminants from agriculture, vehicular traffic, consumer goods, industry, and other sources, I was told, have made the Fraser River a toxic soup of harmful chemicals, poisoning Fraser River sockeye as they migrate to and from the marine environment.

Pesticides

The Commission received several public submissions expressing the view that pesticides have affected salmon habitat. One submitter said that a 2002 study attributed the 90 percent mortality of Late-run Fraser River sockeye observed between 1994 and 2001 to pesticide application in our watersheds.[4]

Pulp mill effluent

Several public submissions suggested that effluent from pulp and paper mills is contributing to the decline in Fraser River sockeye. One submitter thought that sodium hydroxide and powdered tree bark discharged by mills in Quesnel, Prince George, and Port Alberni may have caused salmon smolt mortalities observed by the submitter in the 1960s and 1970s.

Freshwater climate change

Climate change is causing dramatic hydrograph changes in the Fraser River watershed, including warmer waters in creeks, declining water levels, reduced productivity in nursery habitats, and changing flows.

Wildfires

Wildfires result in erosion, increased water temperature and turbidity, and reduced refugia

and riparian cover over streams, all of which are harmful to salmon. Fire retardants sprayed across the Fraser River watershed may have contributed to the decline of Fraser River sockeye.

Effects on Fraser River sockeye in the marine environment

Many submitters identified factors operating in the marine environment that may affect Fraser River sockeye salmon. These factors included:

- harmful algal blooms;
- interactions with hatchery salmon;
- food abundance in the North Pacific; and
- marine climate change.

Harmful algal blooms

One submission highlighted a study in the journal *Harmful Algae* that found a strong correlation between naturally occurring blooms of the fish-killing alga *Heterosigma akashiwo* in the southern Strait of Georgia during the juvenile outmigration period and poor returns of adult sockeye two years later.[5] The submitter wrote that in 2007, *Heterosigma* was observed in three periods, the first of which (from late May to early June) coincided with the peak of the juvenile sockeye migration from the river and could explain the poor 2009 return.[6]

Interactions with hatchery salmon

I was told that fish from hatcheries in Alaska, Japan, and Russia have a detrimental effect on wild Fraser River sockeye. Hatchery-raised salmon were described as potential disease carriers, and they may also strain the carrying capacity of the ocean, reducing the food available for wild salmon. Population mixing or interbreeding between the two types of salmon may reduce biological diversity and harm population productivity, and bycatch of wild salmon by commercial fisheries targeting hatchery salmon harms the wild stocks.

Food abundance in the North Pacific

One submitter said that periods of food abundance in the marine environment correlate with strong returns of Fraser River sockeye, noting that "the amount of fish in different parts of the ocean is related to differences in primary production," or the type of organisms at the base of the food chain, such as phytoplankton or crab larvae.[7] The feeding area of each Fraser River sockeye stock may be highly specific and subject to local oceanographic conditions. If true, this specificity would explain why different Fraser River sockeye stocks appear to have different marine survival rates. The same submitter cited a 2010 study by Roberta Hamme and others which found that ash from a volcanic eruption in the Aleutian Islands caused a large phytoplankton bloom in the North Pacific in 2008.[8] The bloom likely provided an abundant food source for the 2006 brood year, improving the sockeye's rate of survival and leading to the "phenomenally large return" recorded in 2010.[9]

Marine climate change

Several submitters argued that climate change is having detrimental effects, including changed distribution and interactions of predator and prey species, increased water temperature, increased water acidity, increased carbon dioxide levels, higher rates of hypoxia, erratic winds, and reduced food availability. Climate change is creating a less friendly and less predictable ocean environment, lowering ocean productivity, and causing significant mortality among Fraser River sockeye. Another submitter said that, since Alaska's salmon stocks are healthy, it is more likely that Fraser River sockeye are declining because of local management decisions. I was also told that the effects of ocean environmental changes cannot be determined because the scientific community lacks sufficient data about the marine stage of the Fraser River sockeye life cycle.

Predation

Submitters said a variety of predators, including salmon sharks, mackerel, pilchards, hatchery salmon, and jellyfish, may be a cause of the decline of Fraser River sockeye. In particular, it was submitted that changes in ocean dynamics, such as increased temperatures, may have drawn Humboldt squid north into the migratory route of Fraser River sockeye. The squid, a predator, appeared in massive numbers off Vancouver Island in 2007, during the outmigration of the Fraser River sockeye that would return to spawn in 2009.

It was also submitted that aggressive seal populations in the Puntledge River, the Stikine River, and the Strait of Georgia at the mouth of the Fraser River are growing rampant, killing juvenile salmon during their outmigration.

Naturally occurring diseases and parasites

Submitters urged the Commission to investigate diseases in wild salmon, including those fish dying along the Alouette and Pitt rivers. One submitter said that outbreaks of the infectious hematopoietic necrosis (IHN) virus during the return migration and pre-spawning activities, when the adult sockeye immune system is at its weakest, can negatively affect stock recruitment. Another submitter said the high rates of pre-spawning mortality observed among early-migrating Fraser River sockeye may be due to Parvicapsula minibicornis, a protozoan parasite targeting sockeye gills and the glomerulus of kidneys. The submitter referenced a number of scholarly articles on the sources and effects of the parasite, including a 2010 study by Bradford and others, and suggested that Late-run Fraser River sockeye may be contracting the parasite between the mouth of the Fraser River and the confluence of the Harrison River.[10]

Population dynamics

Several submitters said that scientists lack a sufficient understanding of how population dynamics relate to stock size. For example, fisheries biologists do not understand the biology of populations exhibiting cyclic dominance, and fisheries forecasts based on population dynamics have failed repeatedly.

Several submitters called for an investigation into the number of five-year-old salmon present in the 2010 return, speculating that, rather than returning to spawn, a large portion of the 2005 brood year may have remained in the ocean in 2009 because of "feeding loop changes" due to warm ocean patches or other factors. Others discussed natural, known fluctuations in salmon populations, which could be due to either climatic phenomena (such as the Pacific Decadal Oscillation) or "species dynamics" associated with "gene pool, sex ratio, and age class" factors.[11]

Over-escapement of Fraser River sockeye

I was told that DFO's harvest management policies allow too many Fraser River sockeye back to spawn. This practice leads to crowding on spawning grounds, triggering stress-induced disease outbreaks that cause significant mortality among Fraser River sockeye and lead to poor returns in subsequent years. Commercial fishers, who are prevented from harvesting salmon, suffer ongoing financial hardship. One submitter disputed the alleged negative effects of over-escapement, referring to a 2002 news release by the Pacific Fisheries Resource Conservation Council stating that there is no evidence that higher escapements have resulted in stock collapse.[12]

Salmon farms

For additional discussion of public submissions on this topic, please refer to Volume 1, Chapter 8, Salmon farm management. Opponents of salmon farms said the industry has placed salmon farms in areas where salmon migrate in high concentrations, despite agreeing not to do so several decades ago. I was referred to articles and reports to support the argument that salmon farms are harmful to wild salmon, including work by Alexandra Morton, who testified in September 2011,

and the 2004 report of the Auditor General of British Columbia.[13] Many submitters urged me to recommend that salmon farms be permitted only in closed containment systems, preferably based on land, to protect the migratory routes of wild salmon. I was told that industrial-scale closed containment salmon farms are both scientifically and economically feasible.

Other submitters said that the salmon farm industry poses minimal risk to wild salmon, and that farms are unlikely to be the cause of the decline. Several supporters of salmon farming argued that the large 2010 return disproves claims that aquaculture caused the Fraser River sockeye decline. I was told that the industry provides important economic benefits to remote coastal communities and is a source of healthy food, and should be viewed positively by British Columbians and, in fact, all Canadians.

Still others urged caution, saying that there are not enough data about the effects of salmon farms on Fraser River sockeye and that I should, above all, recommend more research. Several submitters argued that the precautionary principle demands that salmon farms be closed or moved (onto land, for example) until the effects of aquaculture are determined.

More specifically, submissions addressed the issues of contaminants and waste, sea lice, escape of Atlantic salmon, and diseases.

Contaminants and waste

I was told that salmon farms discharge a wide range of harmful contaminants and waste into the environment, including growth hormones, antibiotics, pesticides, fecal material, neurotoxins, heavy metals, and polychlorinated biphenyls (PCBs). One submitter referred to the 2004 report of the Commissioner of the Environment and Sustainable Development, which described a significant buildup of organic waste material on the ocean floor beside a salmon farm site.[14] In contrast, another submission explained that all operating salmon farms are monitored for organic waste impacts and that waste data are reported to and audited by regulators. If a farm is found to exceed biomass thresholds, it must remain fallow until it returns to acceptable levels.

Sea lice

Submitters who argued that sea lice are a cause of the decline of Fraser River sockeye relied on "a mountain of evidence" or noted that studies by Scandinavian countries show that sea lice from salmon farms reduce the survival of migrating wild salmon.[15] Others pointed to agreement among the "the world's most noted scientists and the prestigious journals in which they write" that sea lice are a "recognized, documented and well known problem associated with open net cage fish farming."[16] Several submitters maintained that the salmon farm industry uses the chemical SLICE irresponsibly to control sea lice and that SLICE is harmful to crustaceans and shellfish. Other submitters disputed the claim that sea lice caused the decline of Fraser River sockeye, citing instead competition from hatchery salmon and overfishing "by foreign nations on the high seas."[17] One submission emphasized the strength of the industry's fish health efforts; frequent site visits and sampling by staff responsible for fish health; the use of vaccines; and data-reporting to, and auditing by, regulators.

Escape of Atlantic salmon

Several submitters said that, despite the industry's best efforts, farmed Atlantic salmon regularly escape from salmon farms, posing a variety of risks to wild Fraser River sockeye that include introducing "exotic or enhanced disease" contaminating the genetics of wild salmon, competing for food and habitat, and preying on juvenile wild salmon.[18] One submitter said that the Auditor General of Canada in 2000 identified an urgent need for DFO to address the lack of research into the effects of farmed and wild stock interaction.

Diseases

Many submitters argued that cramped conditions on salmon farms promote infectious disease outbreaks, which are spread to migrating Fraser River sockeye. Submitters identified three diseases spread in this manner: infectious salmon anemia (ISA), infectious hematopoietic necrosis (IHN), and bacterial kidney disease. Several submitters

referred to a correlation between the decline in productivity of Fraser River sockeye and massive IHN outbreaks on salmon farms in the early 2000s. Another submitter said that the likely location of the 2009 Fraser River sockeye run failure – between Queen Charlotte Strait and Hecate Strait – indicates the failure may have been caused by disease transfer from salmon farms during smolt outmigration, causing a latent mortality. Several submitters said the ISA virus is brought into salmon farms in British Columbia via diseased salmon eggs imported from Europe and South America, citing a 2010 article by Dr. Frederick Kibenge, who in December 2011 testified before me. In contrast, another submission described the various techniques used by the industry to test and treat farmed salmon, including vaccinations, pathogen testing, and routine sampling of fresh mortalities. The same submitter explained that each salmon farm company produces the vast majority of farmed salmon eggs it requires in British Columbia and that no eggs have been imported from Norway in a decade.

Cumulative effects

Several submitters suggested the cause of the decline may be the cumulative effects of a number of stressors facing Fraser River sockeye. One submitter said poor returns of Fraser River sockeye in 2009 were most likely caused by poor physical and biological conditions in the Strait of Georgia, high temperatures in the Fraser River, and various environmental stressors. Another submitter attached a paper examining the future impacts of climate change on Fraser River sockeye.[19]

I turn now to a consideration of several other investigations into the Fraser River sockeye salmon decline that were conducted before or during this Inquiry's activities.

Notes

1 Exhibit 1344.
2 Chilliwack Public Forum Summaries, September 29, 2010, pp. 1–2, available at www.cohencommission.ca.
3 Public submission, 0245-HUSBAND, p. 3, available at www.cohencommission.ca.
4 Exhibit 833.
5 Exhibit 1359.
6 Public submission 0358-HAIGH/Exhibit 1365, available at www.cohencommission.ca.
7 Public submission, 0044-PARSONS, p. 1, available at www.cohencommission.ca.
8 Public submission, 0264-PARSONS, available at www.cohencommission.ca; see also Exhibit 1353.
9 Public submission, 0264-PARSONS, p. 1, available at www.cohencommission.ca.
10 Exhibit 931.
11 Public submission, 0231-ONCLIN, p. 2, available at www.cohencommission.ca.
12 Public submission, 0245-HUSBAND, 100916, p. 6, available at www.cohencommission.ca.
13 Exhibit 1862.
14 Public submission, 0053-WOODWORTH, available at www.cohencommission.ca; see also Exhibit 88.
15 Public submission, 0093-WYENBERG; see also Public submission, 0318-COMMANDEUR, available at www.cohencommission.ca.
16 Public submission, 0085-DAWSON, available at www.cohencommission.ca.
17 Public submission, 0094-MACLEOD, available at www.cohencommission.ca.
18 Public submission, 0312-Russell; see also Public submission, 0126-HOLLINGSWORTH, available at www.cohencommission.ca.
19 Exhibit 1320.