Canada's Violations of the Fisheries Act and NAAEC by Allowing British Columbia Salmon Feedlots to Degrade Wild Salmon Habitat

Pink salmon fry from Broughton Archipelago parasitized by adult sea lice – Photo courtesy of Alexandra Morton

Citizen Petition

Submitted to the Commission for Environmental Cooperation Under the North American Agreement On Environmental Cooperation

Submitted by:

Center for Biological Diversity
Pacific Coast Wild Salmon Society
Kwikwasu'tinuxw Haxwa'mis First Nation
Pacific Coast Federation of Fishermen's Associations

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SUMMARY

Pursuant to Articles 5(1) and 14 of the North American Agreement on Environmental Cooperation, the Center for Biological Diversity, Pacific Coast Wild Salmon Society, Kwikwasu'tinuxw Haxwa'mis First Nation and Pacific Coast Federation of Fishermen's Associations (petitioners) submit the following petition to the Secretariat of the Commission for Environmental Cooperation, asserting that Canada is violating and failing to effectively enforce the Canadian Fisheries Act (R.S.C. 1985 c. F-14), contrary to its obligations under the North American Agreement on Environmental Cooperation. The petitioners seek a finding that Canada is violating and failing to effectively enforce the Fisheries Act by allowing salmon feedlots to degrade wild salmon habitat and erode the capacity of the British Columbia ecosystem to support wild salmon.

Despite mounting evidence of harm to British Columbia's wild salmon runs and severe threats to wild salmon in Canada and the United States, Canada has permitted more than 100 commercial salmon feedlots to operate in the narrow migration routes used by wild salmon of British Columbia and the United States, including the Fraser River, exposing wild salmon to amplified levels of parasites such as sea lice, viral and bacterial diseases, toxic chemicals and concentrated waste. Canada's apparent violations of its own Fisheries Act are allowing commercial salmon feedlots to erode the capacity of the British Columbia ecosystem to support wild salmon. The potential for British Columbia salmon feedlots to introduce, amplify and spread pathogens also jeopardizes the health of every other wild salmon run along the Pacific Coast, as well as the entire West Coast salmon fishing industry, because these stocks co-mingle.

This petition describes the natural life cycle of wild salmon, the biology of naturally occurring sea lice, declines in wild salmon populations, and the best scientific knowledge about the threats and impacts of parasites and disease from salmon feedlots. It also chronicles public reaction to the crisis and attempts to address the problem. The petition provides background on the impacts of fish feedlots in British Columbia on wild salmon and the intensifying threats of disease and parasites caused by inappropriately sited aquaculture. Finally, it outlines the failure of Canada's Department of Fisheries and Oceans and the provincial British Columbia government to act in accordance with Canadian law to protect wild salmon populations, and details how these government entities are actually promoting expansion of harmful salmon feedlots. The need for immediate action is even more urgent with the recent discovery of the deadly salmon virus, Infectious Salmon Anemia, in wild Pacific salmon for the first time.

This is a formal petition filed under the Citizen Submission on Enforcement Matters process of the North American Agreement on Environmental Cooperation (NAAEC). When a country that is a party to the North American Trade Agreement fails to enforce one of its own environmental laws, a party may petition the NAAEC Secretariat to develop a factual record on the matter. Canada's Fisheries Act prohibits the harmful alteration, disruption or destruction of fish habitat (Section 35) and the addition of deleterious substances to fish habitat (Section 36). This petition details the failure of the Canadian government to enforce these sections of the Fisheries Act by allowing salmon feedlots to plague wild salmon habitat with amplified levels of parasites, potentially devastating diseases and harmful toxins.

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I. BACKGROUND

A. British Columbia Salmon

Pacific salmon have been a cornerstone of Western Canada's natural ecology, cultural history and economy for thousands of years. Salmon play a large role in the development and maintenance of British Columbia's coastal forest and marine ecosystems.

Every fall, wild Pacific salmon swim upstream into the rivers and streams in which they were born. The salmon fight their way against the current, until they reach shallow gravels bars where they deposit and fertilize their eggs. Once the reproductive process is over, most species of salmon die in the rivers and streams, leaving their carcasses to provide nourishment for the entire ecosystem. Predators such as bears, eagles, osprey and humans prey upon the running salmon, often in an effort to build food supplies for the coming winter. Scavengers such as raccoons and crawfish dine on the remnants. Whatever remains break down into nutrients and enriches the rivers and forests themselves.

When fertilized salmon eggs hatch, the salmon fry, depending on the species, either remain in the fresh water for a year or more, or immediately make their way downstream to the ocean. Upon reaching the ocean, the young salmon, now called smolts, tend to stay close to the coastline during their first winter. Because of their size, these young salmon are vulnerable to predation, strong ocean current, competition for food resources, pollution and parasites. After spending their first winter near the coast, the young salmon move out into the open ocean. Pacific salmon generally spend from one to four years eating and growing in the nutrient rich Pacific Ocean. When their biological clocks indicate that it is time to reproduce, salmon complete the cycle by returning to the rivers or streams in which they were born, where they spawn and die. There are five species of native Pacific salmon that occur in British Columbia waters (chinook, chum, coho, pink and sockeye salmon) as well as steelhead trout and cutthroat trout.

Chinook salmon (*Oncorhynchus tshawytscha*), the largest of the Pacific salmon, spawn in a relatively small number of streams in British Columbia. Chinook production is mainly in major river systems, most importantly the Fraser River. After hatching, most chinook in British Columbia remain in fresh water for at least a year. Adult chinook return from the ocean to spawn after two to seven years. River systems can have more than one stock of chinook, with timing of spawning runs encompassing spring, fall and winter runs.

Chum salmon (*Oncorhynchus keta*) spawn in medium-sized streams and rivers. In short coastal streams, chum fry emerge from gravel beds in spring and move directly to the sea in a day or two. Chum fry remain in larger river systems for up to several months before reaching the ocean. Most chum spend two or three summers at sea before returning to home streams to spawn.

Coho salmon (*Oncorhynchus kisutch*) are found in most British Columbia coastal streams. Young coho generally spend one year in freshwater before migrating as smolts to the ocean, where they spend up to 18 months, tending to remain in nearshore coastal waters. Most coho return to spawn at three years of age, but some mature earlier and return as 'jacks' at only two years.

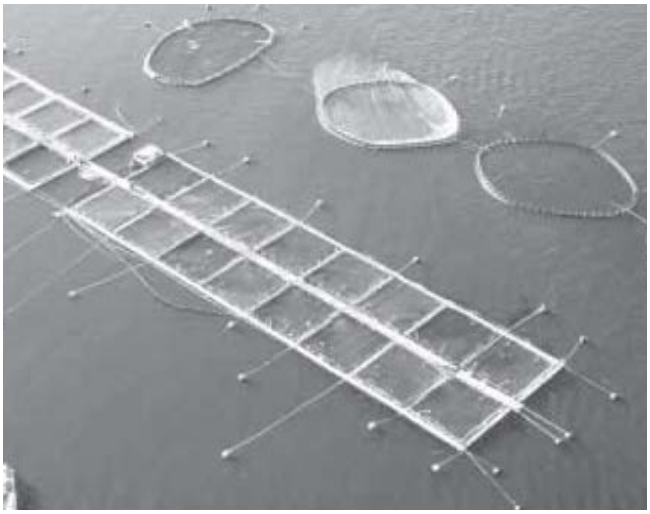
Pink salmon (*Oncorhynchus gorbuscha*) are the most abundant salmon in British Columbia waters. Pink salmon have a short, two-year lifespan. Adults migrate to their home stream from July to October and the majority spawn in waters close to the sea. Young fry enter the ocean immediately after emerging from the gravel in the spring and after a few days to several months in the estuary and nearshore zone, move out into the open ocean.

Sockeye salmon (*Oncorhynchus nerka*) spawn in late summer or fall in lake-fed systems; at lake outlets, in lakes, or in streams flowing into lakes. Major spawning runs in British Columbia are in the Fraser, Skeena, Nass, Stikine, Taku and Alsek rivers. Young sockeye may remain in their freshwater nursery lakes for a year or more, with some waiting until the second or third year to make their seaward journey. In many of the lakes of the Fraser River system in particular, sockeye are abundant in one of every four years. Sockeye can mature at ages between two and six years old but in most systems, one age group (usually four-year-old fish) dominates, meaning most of the offspring produced in any one brood-year return to spawn four years later.

B. Commercial Salmon Aquaculture in British Columbia

Salmon "farming" began in British Columbia in the early 1970s, though large-scale commercial aquaculture took hold in the late 1980s. British Columbia is now a distant fourth of the largest producers of "farmed" salmon in the world, after Norway, Chile and the United Kingdom (OMFB 2009). Salmon are by far the most common commercially produced aquaculture species in British Columbia, accounting for nearly 89% of all aquaculture products by weight from 2007-2009 (OMFB 2009). Nearly 80,000 metric tons of salmon are produced annually in British Columbia salmon feedlots.

British Columbia salmon feedlots import salmon eggs, which are then fertilized and incubated. Young salmon are raised in hatcheries until they are able to live in saltwater pens, where they remain until they are harvested. Mature salmon are kept in open-net floating pens, which consist of open net cages or mesh nets, placed in sheltered bays and fjords along a coast.

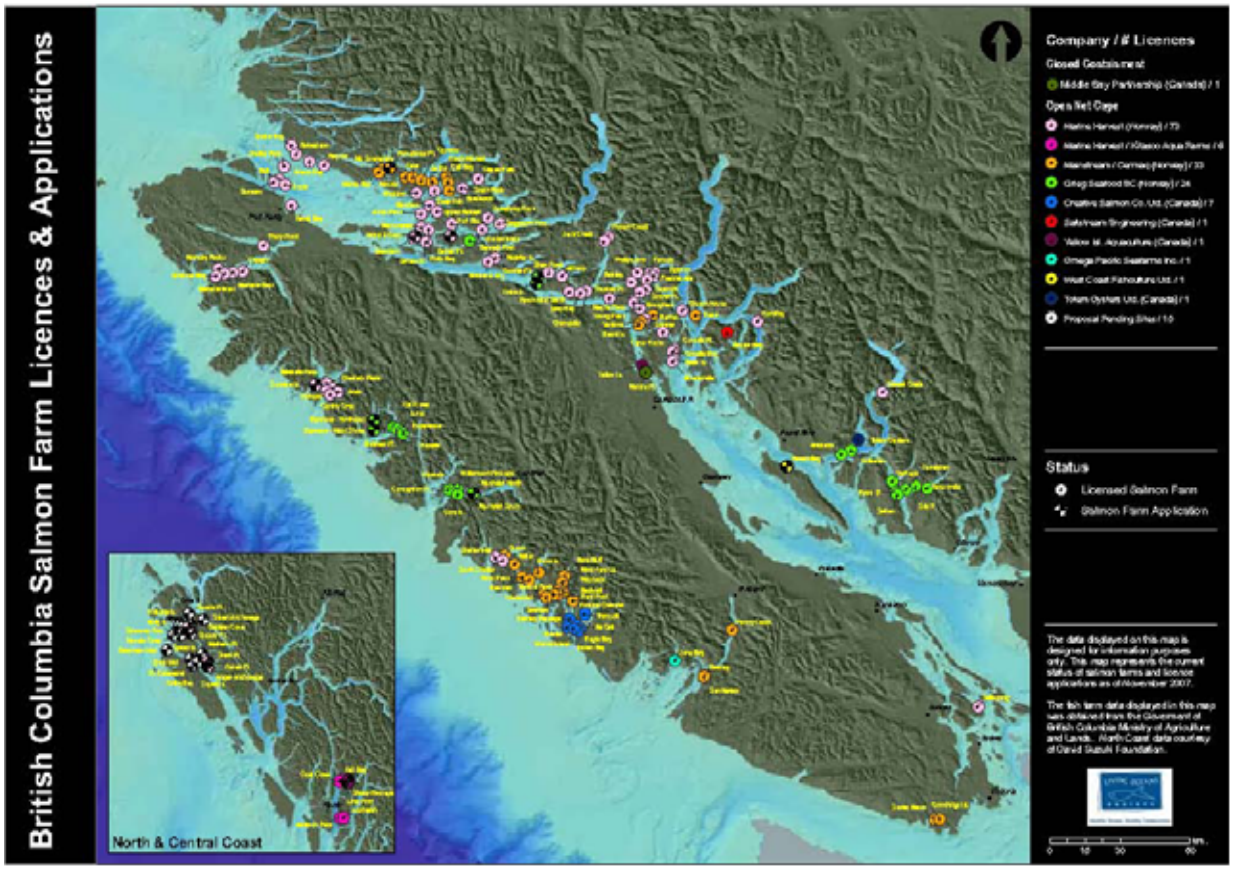


Floating salmon pens - David Suzuki Foundation photo

Aquaculture pens of 1,000 square meters can house 35,000 to 90,000 mature fish, depending on fish size and species (Keller and Leslie 1996; WWSS 2004). Stocking densities at fish feedlots typically range from 8 to 18 kg per cubic meter for Atlantic salmon and 5 to 10 kg per cubic meter for chinook salmon (EAO 1997). DFO states that a typical salmon feedlot in British Columbia operates 6 to 24 net cages that contain between 35,000 and 50,000 fish per cage; thus holding from 210,000 to 1.2 million fish (DFO 2012).

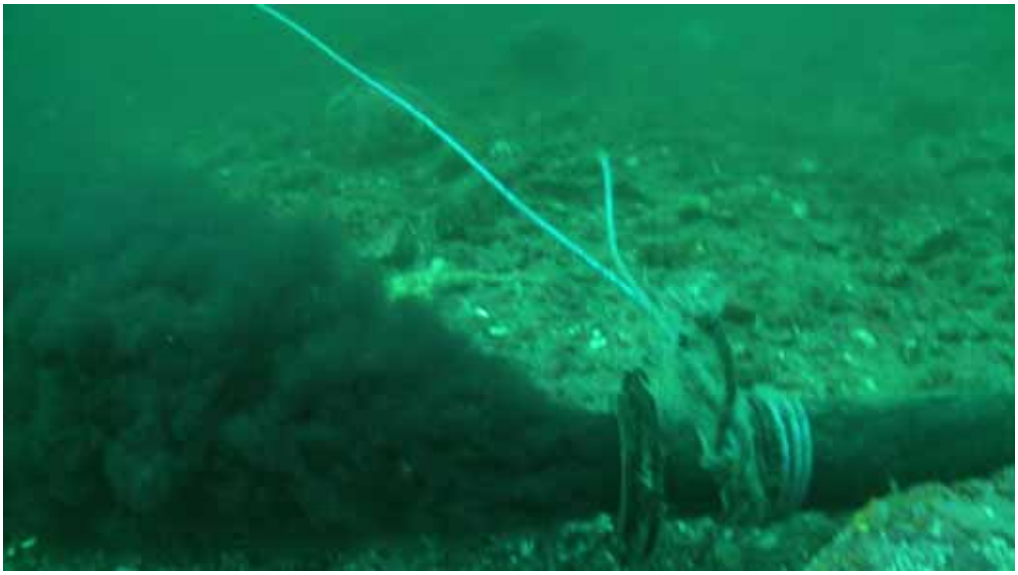
The confined salmon are fed concentrated fish feed, which is commonly soaked in chemical treatments and antibiotics designed to remedy parasite infestations (such as sea lice) and bacterial infections. Any unconsumed feed, excrement, pesticides and antibiotics pass through the pens and enter the surrounding environment. Decapod crustacean such as crabs, lobsters, prawns and shrimp, which are important scavengers within wild salmon habitat, tend to be drawn to the accumulated discharge settling on the seabed beneath finfish aquaculture operations (Bright and Dionne 2005).

Salmon "farms" are essentially concentrated animal feedlots that are offshore, releasing all wastes into the ocean. In British Columbia salmon feedlots are universally located in the calm waters of protected channels and bays, in wild salmon and herring migration routes.



British Columbia salmon feedlot tenures as of 2007; courtesy of Georgia Strait Alliance

These channels are traveled by wild salmon during their breeding season and by juvenile salmon making their journey from spawning streams to the sea. Thus, almost all south coast British Columbia salmon are exposed to salmon feedlot effluent passing over their gills twice in their life cycle. In addition, many species of salmon smolts will spend their first winter in the protected inlets and bays used by salmon feedlots, subjected to the salmon feedlot pollution, disease and parasitic infestation when they are most vulnerable. Because of the presence of fish feedlots, waters that were once both a nursery and sanctuary to juvenile wild salmon are now riddled with pollution, chemicals, disease and parasites.



Salmon feedlot effluent pipe discharging blood from a fish farm packing plant into Discovery Passage off central eastern Vancouver Island, along the migration route of the largest wild salmon run in British Columbia. Samples from this plume were teeming with hatching sea lice. Photo courtesy of Alexandra Morton

British Columbia salmon feedlots primarily use Atlantic salmon (*Salmo salar*), a species markedly more susceptible to sea lice than Pacific salmon species (Johnson and Albright 1992; Fast et al. 2002). The vast majority (94%) of "farmed" salmon in British Columbia in 2009 were Atlantic salmon. The remainder are chinook or coho salmon (BCSFA 2003; WWSS 2004). Fisheries and Oceans Canada (DFO) began permitting Atlantic salmon eggs to be imported into British Columbia in 1985, despite the government's own concern about their impact on native salmon and warnings about the potential for transmission of disease and possible displacement of native wild salmon. In 2004, the Canadian Fish Health Protection Regulations were waived to allow eggs from Iceland that did not meet these regulations.

As of 2009, salmon feedlots were operating at more than 130 sites (tenures) in British Columbia, with over 85 feedlots active at any given time. Most (92%) of the British Columbia salmon aquaculture industry is controlled by three Norwegian corporations. In 2009 these fish feedlots occupied a combined total of 4,575 hectares (OMFB 2009). More than half (61%) of the tenures (84) are on eastern Vancouver Island and the mainland coast, 35% (48 tenures) are on western Vancouver Island, and 4% (6 tenures) are on the central coast. The Canadian federal government, British Columbia provincial government and the aquaculture industry have indicated they would like to double feedlot salmon production in British Columbia over the next

decade, with attendant environmental hazards spreading far beyond the surface area of the feedlots.

C. Fish Feedlot Amplification of Sea Lice

Sea lice are small marine copepods that occur naturally in the Northern Hemisphere. Sea lice are ectoparasites that attach to the outside of fish, either on skin, fins, or gills, and feed off of their blood, tissue and mucus. The term 'sea lice' refers to several small crustacean species of the family Caligidae that live and feed on fish. At least thirteen different species of sea lice live in British Columbia waters. Only *Caligus clemensi, Lepeophtheirus cuneifer* and *Lepeophtheirus salmonis* have been reported on feedlot and wild salmon in British Columbia. *L. salmonis* is almost always found only on salmon. In British Columbia waters, *C. clemensi* and *L. salmonis* may damage both feedlot and wild salmon, and are a major concern both for the aquaculture industry and for wild salmon conservation. While *L. salmonis* is often more prevalent and more damaging than *C. clemensi* (Kabata 1988; Morton et al. 2004), studies in the Broughton Archipelago in 2003 indicated that 20% of chum salmon were infected with *C. clemensi* and only 7% with *L. salmonis* (Gallaugher et al. 2004). *C. clemensi* are host generalists and therefore jump more frequently between hosts, increasing their ability to transfer pathogens fish to fish.

Sea lice have a life cycle involving ten different stages, but can only attach to fish during a short stage known as the 'copepodid' stage and can only harm salmon in successive stages during which lice attach to and feed upon the host fishes' body tissues and blood. Sea lice normally do not harm adult salmon because the scale integrity and body mass of adult salmon makes them tolerant to the stresses imposed by sea lice. However, even small numbers of sea lice may harm or kill juvenile salmon prior to scale development. As few as five lice may seriously harm a juvenile Atlantic salmon of 15 grams or less, while 11 or more can kill it (WWSS 2001; Costello 2009). Morton and Routledge (2005) showed that short-term mortality of wild juvenile pink and chum salmon is increased by infestations of just 1 to 3 sea lice. Small numbers of lice can harm or kill salmon indirectly, by increasing the fishes' stress levels and weakening their immune systems. A "load" of only one louse per gram of fish can be lethal (Finstad 2002; Costello 2009). Weakened salmon are more prone to infections and parasites. The open wounds caused by sea lice allow diseases and parasites to enter the fishes' bodies (Mustafa et al. 2001). A salmon fry or smolt infected by sea lice can suffer stress, osmotic failure, viral or bacterial infection, serious fin damage, skin erosion, constant bleeding, deep open wounds, and sometimes death (Mustafa et al. 2001; Bright and Dionne 2005). Smaller and younger salmon are more at risk to either the lice or to disease, and higher densities of sea lice are more likely to cause stress, disease, and death to young, small or weak salmon (Johnson 1998).

Some species of salmon are more susceptible to sea lice than others: adult pink salmon generally carry the most lice (5.8 adult sea lice per fish) and have the most infected population (92% of adult pink salmon have sea lice); coho are the most resistant to lice, although even they are susceptible; Chinook and Atlantic salmon have mid-range susceptibility (Nagasawa et al. 1993; Connors et al. 2010a,b). Louse-induced mortality of pink salmon can exceed 80% (Krkosek et al. 2007). Morton et al. (2008) showed that for pink and chum salmon in the Broughton Archipelago, salmon feedlot exposure was the only consistently significant predictor of sea lice

abundance; as well as evidence suggesting salmon feedlots are associated with sea lice infestations of sockeye salmon and larval Pacific herring (*Clupea pallasii*).

Juvenile chum salmon from Broughton Archipelago near salmon farms, covered with sea lice
Photo courtesy of Alexandra Morton

It is also possible and likely for sea lice to carry diseases between feedlot and wild salmon (see section I.D on diseases, below). There are a variety of ways diseases may be transferred from feedlot fish to wild sockeye, including horizontal transfer of shed pathogens, via feedlot salmon escapees, via movement of infected sea lice (vectoring), and through discharge of untreated "blood water" from processing facilities (Dill 2011). Sea lice as a disease vector has already been shown for Infectious Salmon Anemia virus (ISAv) on the Atlantic coast (Dannevig and Thorud 1999; USDA 2002) and proper sea lice management at salmon feedlots is required to prevent the spread of ISA virus (Hammell and Dohoo 2005). The furunculosis bacterium has also been found on the bodies of sea lice, making it likely that sea lice spread this disease as well (Johnson 1998). There are a number of studies showing that sea lice may be vectoring numerous diseases from feedlot to wild fish, such as Infectious Pancreatic Necrosis virus, Salmonid alpha virus, ISA virus, IHN virus, Furunculosis, bacteria (such as *Tenacibaculum maritimum, Pseudomonas fluorescens*, and *Vibrio* spp.), and microsporidian, *Paranucleospora theridion* (Nylund et al. 1991, 1993, 1994; Nese and Enger 1993; Rolland and Nylund 1998; Johnson et al. 2004; Hammell and Doho 2005; Karlsen et al. 2005; Barker et al. 2009; Lewis et al. 2010; Stull et al. 2010; Nylund et al. 2011; and see Dill 2011).

Sea lice are intolerant of fresh water and usually detach from adult salmon when they migrate up freshwater rivers to spawn, or fall off and die within a couple days to a few weeks (Finstad and Bjorn 1995; MacVicar 1997). Thus, under natural conditions, vulnerable salmon fry are born in a lice-free environment in fresh water. Under natural conditions, when juvenile wild salmon enter the coastal waters for the first time in spring, their adult counterparts, as well as the sea lice, are miles offshore. These fry will not encounter sea lice until some weeks after marine entry, at which time they will have sufficient body mass and scale fortification to withstand the impacts of sea lice.

Natural populations of sea lice seldom harm wild salmon; however, salmon feedlots alter natural sea lice transmission dynamics and amplify sea lice populations (Kabata 1970; MacKinnon 1997; Bakke and Harris 1998; Krkosek et al. 2005). Stocking hundreds of thousands to millions of fish in small pens in confined waters makes fish feedlots ideal breeding grounds for parasites such as sea lice, and drastically increases the number of lice in surrounding waters. Stress levels associated with crowding make feedlot salmon more susceptible to lice infestation and most of British Columbia's feedlot salmon are Atlantic salmon, which are inherently more susceptible to sea lice than many other salmon species (Johnson and Albright 1992; MacKinnon 1997; Bakke and Harris 1998; Fast et al. 2002).

Studies in Norway, Ireland, and Scotland suggest that most sea lice larvae originate on feedlot salmon, and that densities of larval and adult lice are much higher in feedlots than in the wild (Tully and Whelan 1993; Costelloe et al. 1998; Butler 1999; Heuch and Mo 2001; Bjorn 2002; Costello 2009). Wild salmon captured near salmon feedlots in Europe carried an average of 100 lice per fish, while salmon captured away from feedlots carried an average of 13 lice (Finstad 2002). Assuming that the Norwegian regulation allowing a maximum of 0.5 gravid (pregnant) female lice/fish on salmon feedlots was followed, an estimated 29 billion sea lice eggs may have been produced by Norwegian feedlot salmon in the year 2000 (Heuch and Mo 2001). Another study on Scotland's west coast feedlots found that feedlot salmon produced 78 to 97% of all Scottish lice, and that wild salmon produced fewer than 1%, while escapees from salmon feedlots accounted for the remainder (Butler 2002).

British Columbia's salmon feedlots are universally located in calm protected coastal waters within only a few kilometers from the mouths of salmon rivers, allowing lice to easily travel from adult feedlot salmon to susceptible wild fry and smolts. Salmon feedlots anchor anomalously large and stationary populations of adult salmon, which are collectively infested with extraordinary numbers of sea lice, directly in the migratory corridors of juvenile wild salmon. Even low numbers of lice per fish add up to considerable numbers of lice per feedlot, with up to a million salmon hosts. Numerous researchers have demonstrated that salmon feedlots in British Columbia dramatically increase the infestation rates of parasitic sea lice in wild salmon (Morton et al. 2004; Krkosek et al. 2005; Krkosek et al. 2007; Mages and Dill 2008; Morton et al. 2008; Krkosek et al. 2009; Connors et al. 2010a, 2010b; Krkosek et al. 2010; Price et al. 2010; Krkosek et al. 2011; Price et al. 2011).

Though it is impossible to determine exactly how many sea lice eggs can be produced by lice from a single salmon feedlot, scientists can estimate lice egg production, and even the limited industry data on sea lice numbers at British Columbia salmon feedlots that has been made public shows incredible amplification of sea lice (Marty et al. 2010b). Krkosek et al. (2010) showed that exponential population growth of lice within a feedlot, rather than sustained louse immigration from wild sources, drive lice outbreaks on British Columbia salmon feedlots. Twelve active salmon feedlots in the Broughton Archipelago containing between 1 and 5 million Atlantic salmon were estimated to host over 6 million gravid sea lice that produced 1.6 billion eggs during two weeks in the winter of 2003 to 2004 (Orr 2007). Nearly 1.7 million infectious larval lice can be produced at one salmon feedlot alone, twice a month. The British Columbia aquaculture industry reports an average 0.05 of gravid (egg bearing) female lice sea lice per fish. A typical British Columbia salmon feedlot has over half a million or more salmon, which

translates to over 25,000 egg bearing female lice and approximately 6.25 million sea louse eggs, based on a conservative estimate of 250 eggs per female in a two week period. Given an average egg survival rate of 26.8% (Johnson and Albright 1991), approximately 1.675 million infectious larval lice could be produced at a single feedlot twice a month. However, companies normally wait until their feedlot reaches the government's treatment threshold of three motile lice per fish before consulting a veterinarian. By the time medicated feed is delivered, administered and takes effect, lice levels could be much higher. British Columbia continually has salmon feedlots with hundreds of thousands of fish reaching levels of 10 lice per fish. Keeping in mind these are only estimates based on the limited data industry provides and considering the more than one hundred salmon feedlots in the Broughton Archipelago, Georgia Strait and along the British Columbia coast, it is easy to understand why sea lice from salmon feedlots are such a problem.

A study in the Broughton Archipelago found that sea lice were almost 9 times more abundant on juvenile wild salmon near feedlots holding adult salmon and 5 times more abundant near feedlots holding smolts, than in areas distant from fish feedlots (Morton et al. 2004). The study found that 90% of juvenile pink and chum salmon sampled near salmon feedlots in the Broughton Archipelago were infected with more than 1.6 lice per gram of host mass, a proposed lethal limit when the lice reach mobile stages. Sea lice abundance was near zero in all areas without salmon feedlots. Salinity and temperature differences could not account for the higher infestation rates near the fish feedlots. The Broughton Archipelago has nearly 100 discreet wild spawning areas in 64 rivers, large enough for scientists to evaluate control areas which have no salmon feedlots. The most immature life stages dominated the lice population throughout the study, suggesting the source of lice was a stationary, local salmonid population, i.e. the salmon feedlots. No such wild population could be identified.

Krkosek et al. (2005) showed that sea louse infection pressure imposed by an isolated salmon feedlot in British Columbia was four orders of magnitude greater than ambient levels, resulting in a maximum infection pressure near the feedlot that was 73 times greater than ambient levels and exceeded ambient levels for 30 km along the two wild salmon migration corridors. The feedlot-produced cohort of lice parasitizing the wild juvenile hosts reached reproductive maturity and produced a second generation of lice that re-infected the juvenile salmon. This raised the infection pressure from the feedlot by an additional order of magnitude, with a composite infection pressure that exceeded ambient levels for 75 km of the two migration routes. This research concluded that a commercial salmon feedlot directly contributes sea lice to the ambient habitat approximately 30,000 times greater than the natural production of sea lice in an area of equal size.

There have been a few studies purporting to counter the overwhelming scientific evidence that sea lice are magnified and then transmitted from feedlot to wild salmon and the strong associations between salmon feedlots and recurrent infestations of wild juvenile salmon in British Columbia. For example, the contention of Brooks (2005) that ocean temperatures and salinities prevent transmission of lice from feedlot salmon to sympatric wild juvenile pink and chum salmon was based on flawed interpretations, misleading analysis and incomplete evaluation of scientific literature (Krkosek et al. 2005). A DFO lab study testing salmon lice resistance (Jones et al. 2008) claimed that Pacific salmon are resistant to damage from sea lice except in their extreme infancy when first leaving their natal rivers. However, this limited study

exposed juvenile pink salmon to infective stages of lice for only a few hours, resulting in artificially low mortality rates. Migrating wild juvenile salmon, like those in the Broughton Archipelago, are exposed to lice for weeks or months. An independent scientific study (Krkosek et al. 2009) that examined the process of sea louse transfer to wild juvenile salmon in the field where salmon are exposed to sea lice over a longer period of time reached entirely different conclusions. Particularly telling is a study of salmon feedlots in a primary salmon migratory corridor in British Columbia which removed their stock of feedlot-raised salmon in 2003, resulting in both a decline in sea lice populations and an increase in wild salmon survival rates (Morton et al. 2005; Beamish et al. 2006). A recent study responding to and evaluating previous claims of no impacts to wild salmon from sea lice on salmon feedlots showed that that sea lice abundance on feedlots is negatively correlated with productivity of both pink and coho salmon in the Broughton Archipelago (Krkosek et al. 2011). This study analyzed fish feedlot data and pink salmon and coho salmon data from 1970 to 2009 over a wide geographic area in the Broughton Archipelago, and found up to 80% higher mortality for juvenile wild salmon that swam near fish feedlots when sea lice populations were high among feedlot fish compared to those that did not swim near fish feedlots.

British Columbia aquaculture companies report their sea lice and disease information to a central database overseen by their industry association, the British Columbia Salmon Farmers Association (BCSFA). This association provides monthly reports summarizing sea lice abundance by region to the British Columbia Ministry of Agriculture and Lands (BCMAL). The public only sees summarized data reported online by BCMAL. This coarse information has little value for researchers or concerned citizens, nor has the BCMAL data been properly evaluated. Every year scientists report elevated levels of lice on wild juvenile salmon near fully-stocked salmon feedlots. Current monitoring, managing, and auditing are clearly not effectively protecting wild salmon. The aquaculture industry's primary concern is the impact of sea lice on the health of feedlot fish, and the reduction in the number of lesions caused by sea lice infection. Protection of wild fish, which requires a much more precautionary approach, is not the industry's concern or responsibility.

D. Fish Feedlot Transmission of Disease

Salmon feedlots pose the serious threats of introducing, amplifying and transferring diseases from feedlot fish to wild fish. As long as open-net pens are used which allow constant exchange of water to the marine environment and salmon are crowded into confined areas, diseases will likely be exchanged between feedlot and wild salmon. As researcher Alexandra Morton has stated, "if you move diseases across the world and brew them among local pathogens, in an environment where predators are not allowed to remove the sick, you get pestilence."

There are four major infectious diseases that infect salmon in industrial aquaculture operations: Bacterial Kidney Disease (BKD), Infectious Hematopoietic Necrosis (IHN), Infectious Salmon Anemia virus (ISAv), and Furunculosis (Ferguson 1989; McDaniel et al. 1994; Traxler and Richard 1996; Kent and Poppe 1998; Kent et al. 1998; EC 1999; St-Hilaire et al. 2001; WOAH 2001; Kurath et al. 2003; Werring 2003; Saksida 2004). BKD and IHN are common throughout salmon feedlots worldwide.

BKD is a chronic systemic bacterial condition of salmon caused by *Renibacterium salmoninarum*. Infection can result in significant mortalities in both wild and feedlot salmon, and BKD affects fish in freshwater and seawater environments. Nearly all age groups of fish can be affected, although the disease is rare in very young fish. Losses are generally chronic, occurring over an extended period. BKD is a leading cause of death to feedlot chinook and coho salmon, and a serious danger to wild pink, sockeye, and chum salmon (Keller and Leslie 1996). The first outbreak of BKD in feedlot salmon in Scotland was recorded in 1976. Since then it has been found in salmon feedlot operations around the world. BKD is frequently reported by BCMAL in British Columbia salmon feedlots.

IHN is a virus that affects both wild and feedlot salmon. The virus carried is by adult wild salmon without visible symptoms, but is particularly dangerous to juvenile wild sockeye (Traxler et al. 1998). Chinook, coho and rainbow trout can also contract the virus, and Atlantic salmon, which have little natural resistance, are particularly susceptible (Gardner and Peterson 2003). IHN has caused two extensive disease epidemics in British Columbia on the largest wild salmon migration route (StHilaire et al. 2001; Saksida 2006).

Furunculosis is a highly infectious disease caused by the bacterium *Aeromonas salmonicida*, Both Atlantic and Pacific salmon are susceptible to this disease at all stages of their lifecycle. It causes large boils to appear on the surface of the skin. In 2005 furunculosis killed 1.8 million Atlantic salmon smolts at a single commercial salmon hatchery on Vancouver Island. The disease occurs in salmon feedlots throughout Scotland, Norway, Canada, the Broughton Archipelago in British Columbia, and Washington State.

Many have long feared that British Columbia's salmon aquaculture industry poses the possibility of an outbreak of the highly contagious ISAv, a marine influenza virus. This deadly disease has appeared in many places where salmon are raised in open net-cage aquaculture. ISAv was first detected in Norway in 1984. Since then, it has spread to the Faroe Islands, Scotland, eastern Canada and the United States. In 2007 an ISAv outbreak among Chilean salmon feedlots became an epidemic leading to the death or destruction of 70% of the country's feedlot salmon. The Chilean ISAv outbreak was from a virus strain from Norway (Vike et al. 2009). Norway exports large amounts of Atlantic salmon embryos every year to Chile, and there is no wild counterpart of this ISAv strain in the Americas. A 1996 outbreak of ISAv in eastern Canada forced the killing of 9.6 million feedlot salmon in New Brunswick. There is no cure for ISAv. Once it strikes, a feedlot's entire stock usually must be destroyed since the virus has never been successfully eliminated from infected populations.

The British Columbia aquaculture industry has stated that they have never found one case of ISAv in British Columbia salmon feedlots among the mere 600 to 800 fish they claim to test each year. However, aquaculture industry documents entered into evidence in 2011 during the Cohen Commission Inquiry (a recently completed Canadian government inquiry into the causes of the Fraser sockeye salmon declines) revealed that symptoms of ISA were detected in feedlot fish over one thousand times since 2006 (Morton 2011). In Canada, ISAv only became a "federally reportable disease" in 2011, meaning that now all suspected or confirmed cases must be immediately reported to the Canadian Food Inspection Agency (CFIA). Yet over 1,100 reports by a British Columbia aquaculture veterinarian of "classic lesions" associated with ISAv

were never reported to the CFIA (Morton 2011). Evidence presented at the Cohen Commission in 2010 revealed that DFO scientists and the Atlantic Veterinary College in Prince Edward Island detected signs of ISAv as long ago as 2002 in 117 wild salmon from the Bering Sea in Alaska to Vancouver Island in Canada, but the Canadian government neither fully investigated the findings nor allowed a draft research paper on the findings by a DFO researcher be published. There is no evidence Canada informed the U.S. that salmon caught in Alaska tested ISAv positive even though it is an internationally reportable disease as per the World Animal Health Organization, of which Canada is a signatory nation.

In 2011, ISAv was detected in four species of wild Pacific salmon from two different salmon generations, 600 km apart in British Columbia. At the Cohen hearings testimony was provided on ISAv in feedlot chinook salmon and in the 2007 out-migrating juvenile Fraser sockeye, the age class that crashed in 2009. If this disease is exotic and spreads throughout wild salmon populations, the consequences could be devastating to all wild salmon runs, not just in British Columbia, but throughout the Pacific Coast. Sockeye salmon smolts were collected in British Columbia in early 2011 as part of a long-term study on the collapse of the Rivers Inlet sockeye populations. The study was led by Simon Fraser University. Forty-eight sockeye smolts collected were noted to be noticeably thin and samples were sent for analysis to the world-accredited World Animal Health ISAv reference laboratory at the University of Prince Edward Island. Two of the 48 smolts tested positive for the European strain of ISAv. The CFIA and DFO also tested the 48 sockeye samples, but had only gill tissue, while the lab that found the virus had heart tissue, but that tissue was all used up in the previous tests.

CFIA and DFO announced in November 2011 they found no sign of ISAv in the samples, publicly proclaiming that fears of the deadly disease spreading are unfounded. Yet the CFIA acknowledged the samples had been captured and stored for other purposes and were in such poor condition and degraded over time such that no definite conclusions could be drawn. At the Cohen Inquiry Ms. Nelle Gagne, who did the testing for DFO, corrected these public statements testifying that she did get one weak positive, but that the samples she received were so degraded results could not confirm presence or absence of the virus (See Cohen Inquiry Final Arguments by lawyer Greg McDade). Both DFO and CFIA acknowledged that more testing is needed before any conclusions are drawn, yet made unfounded public statements concluding the virus is not in British Columbia. CFIA and DFO have so far not gone back to the places where the positive tested fish came from to take further and better quality samples. The fact that further testing of the degraded samples could not confirm the initial results showing presence of ISAv does not negate the positive results. Furthermore, independent testing of the samples by a Norwegian laboratory found one weak positive result among multiple tests of the sockeye, despite poor sample quality. Fresh samples of adult coho, chinook and chum salmon from a tributary of the Fraser River subsequently sent to the World Animal Health Lab produced three more positive results, suggesting ISAv is indeed present in wild populations of Pacific salmon. Particularly disturbing is the fact that researchers examining only 60 fish found ISAv in two different fish generations, 600 kilometers apart, in four different salmon species.

Testimony by the CFIA at the Cohen Inquiry revealed that DFO is no longer in charge of the ISAv investigation or management because the virus is such a high concern to international

trade. The CFIA has no mandate to protect wild salmon and thus there is no agency in Canada tasked to protect wild salmon from the ISA virus.

> DR KLOTINS: …So if, let's say, we do find ISA in B.C. and all of a sudden markets are closed, our role [CFIA] is then to try to renegotiate or negotiate market access to those countries. Now what it will be is a matter of they'll let us know what the requirements are. We'll let them know what we can do and whether we can meet that market access. If we can't meet it, then there will be no trade basically (Cohen Inquiry Testimony, Dec. 19, 2011; see http://www.cohencommission.ca).

Viruses such as ISAv are known to mutate in the culture environment and the presence of this pathogen could potentially harm wild salmon runs in British Columbia and beyond, since most runs and species of Pacific salmon co-mingle in the ocean as adults. The mother strain of ISAv, known as HPR0, can be detected by RT-PCR, but it cannot be cultured. The legal definition of ISA virus in Canada includes culture and so by definition this strain of ISA virus is not recognized. Science reports HPR0 mutates in the form of a deletion in a specific portion of the RNA and becomes virulent in response to a high density captive environment, such as in the fish feedlots. Failure by the government of Canada to act on this issue without delay potentially jeopardizes the health of every other wild salmon run along the Pacific Coast, as well as the entire West Coast fishing industry.

The only rational response to the likely discovery of this deadly virus in British Columbia waters is to immediately initiate comprehensive, independently-audited testing of wild salmon, feedlot salmon, hatchery and other fish that could be infected (such as herring and pilchard) to determine the extent of the virus; conduct the testing necessary to track the source of the disease; immediately cull all fish in any feedlot site where fish test positive for ISAv; remove salmon feedlots from the narrow passages used by the Fraser River and other salmon; fast-track the development of closed containment systems for salmon aquaculture; and present a firm, expedited timeline for phasing out all open net-cage operations.

Unfortunately, this has not been the response of the Canadian government, DFO or the provincial British Columbia government. Meanwhile, U.S. Senators from Washington, Oregon and Alaska, recognizing the severe threat to U.S. salmon runs, have taken the right step with a legislative amendment calling for study of the possible impacts the infection might have on the Northwest Pacific's fishing industry. U.S. agencies, including the Department of Agriculture, along with Canadian and American Indian tribes, are developing plans to conduct more tests, trace the origin of the disease and find ways to combat it. On January 17, 2012, the aquaculture industry publication Intrafish reported that the price of "farmed" salmon has declined so much that closed containment projects by Marine Harvest, the biggest Norwegian operator in British Columbia, have been cancelled.

E. Fish Feedlot Toxic Chemicals and Pollution

"Farmed" salmon are held in flow-through nets and cages, essentially flow-through feedlots that allow fish waste and added chemicals such as antibiotics, pesticides and anti-foulant type paint chips used in industrial salmon feedlot operations to freely pass into marine waters. A typical

British Columbia salmon feedlot is holding from a half million to one million adult fish. Fish wastes can accumulate under and around salmon feedlots and degrade habitat surrounding the feedlot, smothering portions of the ocean bottom, contaminating the marine ecosystem and depriving species of oxygen (Findlay and Watling 1997; Pohle et al. 2001; Lampadariou et al. 2005). Even if the bulk of the waste is carried away from the feedlot site by ocean currents, it is going somewhere and can cause localized pollution in other areas.

Salmon feedlots add drugs - such as antibiotics and therapeutants - to salmon feed, and chemicals - such as antifoulants and disinfectants - are also released into the environment by feedlots in an attempt to control unwanted organisms and diseases. Vaccines and antibiotics are used in salmon feedlots to control infections. Vaccines are given by inoculation but antibiotic treatments are typically done through medicated feed, which increases the chance that antibiotics will pass into the environment, either directly or through the feces, affecting wildlife and other organisms and remaining for long periods of time. Little is known about how these chemicals affect the marine ecosystems, however, studies investigating contaminants near British Columbia salmon feedlots found that rockfish near salmon feedlots had elevated levels of mercury compared with rockfish found elsewhere; parasites, tumors and lesions have been found on ground fish harvested near salmon feedlots; and clam beaches used by First Nations in the Broughton Archipelago have been destroyed by the accumulation of black muck and sludge that has been attributed to salmon feedlot waste (BCAFC 2004; DeBruyn et al. 2006).

Salmon feedlots can use a variety of methods to attempt to prevent and treat sea lice outbreaks and pathogen transmission, including closed containment aquaculture, proper site location, separating year classes, minimizing crowding, fallowing, feedlot maintenance and husbandry to help prevent outbreaks; and chemicals and drugs to treat feedlot salmon after an outbreak occurs (Costello 1993; SHC 2003). British Columbia salmon feedlots do not utilize some of the primary methods to prevent sea lice outbreaks, which are: using closed containment; proper site location, which maximizes the chances that feedlot salmon will be healthy by ensuring that feedlots are not located near potential sources of infection, such as salmon-bearing streams, migration routes and other salmon feedlots; and separating year classes, which prevents smolts (i.e. the lice-free, freshwater juveniles) from contacting the older and already lice-infested fish. Mapped locations of siting of salmon feedlots in British Columbia makes it clear there are no instream or estuarine locations for an industry this size to move to that do not include wild salmon migration routes.

Fallowing, which breaks the reproductive cycle of sea lice, appears to have only been used sparingly in British Columbia, and then only in response to severe crises. Fallowing is taking all of the salmon out of a feedlot and leaving it empty for one production cycle (two years) to allow the seabed below the feedlot to recover from damage caused by the feedlot and break the cycle of sea lice and other disease infestation in that feedlot. Fallowing is most effective if all the feedlots in an entire archipelago or channel are emptied; making it much less likely that feedlots will be reinfected by their neighbors. To be effective, fallowing must be done in conjunction with a separation of year classes to ensure that smolts are not infected by adult fish in the same feedlot. Morton et al. (2005) reported on a three-year study of sea lice infestation rates on wild juvenile pink and chum salmon in the Broughton Archipelago, following a 2003 British Columbia Ministry of Agriculture, Food and Fisheries (MAFF) order for fallowing along the presumed migration route of wild juvenile Pacific salmon in this area. Morton et al. (2005) assessed the effectiveness of fallowing by comparing sea louse infestation rates on wild juvenile

salmon near three Atlantic salmon feedlot sites prior to, during, and after fallowing, and found that overall, *L. salmonis* levels were significantly reduced at the study sites during fallowing but returned to the original level after restocking.

The primary treatment for sea lice infestations in British Columbia salmon feedlots is a reactive treatment of a chemotherapeutant given to feedlot fish in food after a sea lice infestation has occurred. Although diluted by surrounding water, the chemicals entering the marine environment via feces may affect non-target wild crustaceans and may remain in the environment from ten days to six months (Horsberg et al. 1987; Costello 1993; Roth and Richards 1993; Fraser 1995; Roth et al. 1996; Erdal et al. 1997; Hart et al. 1997; Ritchie et al. 1997; Treasurer and Grant 1997; Valles and Koehler 1997; Roth 2000). The ability of sea lice to develop resistances to chemical treatments is also a major issue (Hammell 2002) and has led to use of bath treatments, which release the drug directly into surrounding waters.

Even though the Canadian federal and provincial governments insist that sea lice are not a problem (Marty et al. 2010a), commercial salmon feedlots still find it necessary to deposit significant amounts of chemical neurotoxins into coastal waters in order to address the "non-problem." Canadian federal rules require Atlantic salmon aquaculture to monitor the abundance of sea lice on their feedlots once a month, and take definite and rapid action in the form of chemical treatment if an average of three motile lice per fish are observed during juvenile March to July wild salmon out-migration times (DFO 2011a). The government's treatment threshold of three lice per fish is not based on any science and is a purely arbitrary number. Lice loads which may not be a "problem" for large, commercially raised Atlantic salmon can easily cause problems for the much smaller wild salmon.

The chemical treatments for sea lice infestations of salmon feedlots have potential consequences as ecologically drastic as the sea lice themselves. The primary chemical weapon used on sea lice in British Columbia salmon feedlots is emamectin benzoate, sold under the trade name SLICE. Emamectin benzoate is in a class of chemicals called avermectins, axonic poisons which act by lethally interrupting the neurological processes sea lice feeding on the salmon's treated tissue (Schulman et al. 1985; Valles and Koehler 1997). SLICE is added as a coating on commercial fish feed and is absorbed into the tissue of salmon, where it takes about a week to be eliminated (SPAHC 2002).

Emamectin benzoate use in British Columbia salmon feedlots began in 2000 and increased steadily through 2005: in 2003 0.1 gram of emamectin was used per metric ton of fish; that increased in 2004 to 0.17 g/mt; and to 0.27 g/mt in 2005; and use averaged just under 0.2 g/mt from 2006 to 2008 (BCMAL 2005, 2008). Use figures since 2005 translate to an annual average of 7,240 kilograms of SLICE used by salmon aquaculture in British Columbia to treat lice-infested fish. Although chemical industry and Canadian government agencies claim that SLICE is safe (SPAHC 2002; MAFF 2003), studies show that SLICE can have significant effects on species other than the targeted sea lice, including other crustaceans (such as copepods, shrimp, crab and lobsters). In fact, the label of the pesticide "Proclaim," in which emamectin benzoate is the only active ingredient, clearly warns that "[t]his pesticide is toxic to fish, birds, mammals, and aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when

cleaning equipment or disposing of equipment wash water" (Novartis 1999). Documented effects of emamectin benzoate on other crustaceans range from disruption in molting and breeding behaviors to death (SEPA 1999; Haya et al. 2001; Brooks et al. 2002; Waddy et al. 2002; Bright and Dionne 2005). Because of its low solubility in water, SLICE is very likely to bioaccumulate in marine sediments, possibly to levels toxic to nearby marine animals (Brooks et al. 2002).

Despite these findings, the Canadian government has not been quick to seek an understanding of the negative effects SLICE has on the environment near treated feedlots, and describes its level of understanding as "extremely sparse" (Bright and Dionne 2005). Environment Canada acknowledges substantial knowledge gaps in data on chronic (as opposed to acute) toxicity; ecologically relevant effects other than mortality; endocrine disruption effects (e.g., altered moulting and reproduction); and toxicity data for benthic meiofauna such as nematodes, which are potentially sensitive and ecologically important indicator species (Bright and Dionne 2005).

SLICE is classified as a drug because it is fed to commercially raised fish rather than applied externally. Drugs are regulated by the Food and Drugs Act, whereas pesticides are regulated by the Pest Control Products Act (CFIA 2003). SLICE has yet to be tested for food safety by the Canadian Food Inspection Agency (CFIA 2001) or to be permitted for use through the Pesticide Control Act. Up until June 2009, salmon aquaculture in British Columbia used SLICE to control sea lice through the Emergency Drug Release Program (EDR), which allows the use of non-approved drugs when recommended by veterinarians for emergency situations (MAFF 2003). In June 2009, the Bureau of Veterinary Drugs (Health Canada) quietly approved the use of SLICE. Health Canada has refused to release the research supporting the approval, since it was conducted by the manufacturer, and is "proprietary information" not available to the public.

SLICE's commercial approval in 2009 was accompanied by the lifting of a prior mandatory withdrawal period of 68 days between the last use of SLICE and harvest of treated fish for human consumption. Yet SLICE's active ingredient emamectin benzoate can remain in the tissues of treated salmon for weeks or even months. The U.S. Food and Drug Administration has listed emamectin benzoate as an unapproved drug that should not be used on fish destined for consumption in the U.S. According to British Columbia Ministry of Environment information, on average, SLICE is used at least once during the production of every feedlot salmon from British Columbia (CAAR 2009). From 2001 to 2003, an annual average of 40 million Canadian feedlot salmon were treated with SLICE, according to Health Canada, Emergency Drug Release documents (Cox 2004). Canada exports the majority of its "farmed" salmon to the United States.

There is emerging evidence that SLICE is becoming ineffective in treating sea lice in some salmon feedlots (DFO 2009b). There are reports from Chile, Norway and Canada's east coast indicating that sea lice are showing signs of resistance to emamectin benzoate treatments, likely due to frequent and heavy applications (Lees et al. 2008). Since sea lice may have begun evolving a resistance, some fish feedlots outside of British Columbia are replacing SLICE with deltamethrin, another neurotoxin marketed as Alphamax, for the treatment of sea lice. Alphamax is known to be relatively toxic to fish and invertebrates and acutely toxic to crustaceans (Bellona Foundation 2009). Alphamax is administered via a chemical bath: the net-cages are surrounded by tarps, fish soak in pesticide solution and then the tarps are opened and the chemical is released

into the ecosystem. DFO has acknowledged concerns regarding Alphamax's "effect on other marine species and the eco-system in the vicinity of aquaculture cage sites" (DFO 2009b).

A salmon feedlot in New Brunswick, Canada was charged in November 2011 with violating the Canadian National Fisheries Act for illegal use of cypermethrin, an agricultural pesticide prohibited for use in marine environments. Illegal use of this pesticide in 2009 and 2010 killed hundreds of lobsters in the Bay of Fundy in at least three different sites near the fish feedlot. There are limited legal or environmentally acceptable options available to these companies to deal with sea lice as they become resistant to the less toxic drugs.

F. Escaped Invasive Fish from Fish Feedlots

Salmon feedlots pose the risk of escape of non-native fish from pens. Feedlot salmon can and do escape into the natural environment, but the extent of the problem is not researched and unknown. Storms, equipment failure, attacks by marine mammal predators or human error can all result in significant release of feedlot salmon into the surrounding water. Over time, even more salmon can escape due to smaller accidental releases or escapes referred to as "leakage."

All aspects of the issue are debated—from the numbers of escaped fish to the impacts on the genetic, biological and ecological status of wild salmon. Escaped fish have the potential to spread disease and parasites, as well as compete with wild salmon for food and habitat. Although the majority of commercial raised salmon in British Columbia are Atlantic salmon, coho and chinook are also kept on feedlots, which poses the added risk of interbreeding with wild salmon and genetically affecting indigenous stocks, potentially decreasing wild salmon biodiversity.

The decision to raise alien Atlantic salmon in Pacific waters largely came from the entry of Norwegian companies into the British Columbia aquaculture industry. Atlantic salmon was the aquaculture species of choice in Norway, and for decades the companies invested in developing markets for this product. In the late 1980s, Norwegian companies were faced with strict environmental regulations and feedlot size restrictions in their own country, so they expanded into countries where regulations were less strict, such as Canada and Chile (Marshall 2003).

Delivery of Atlantic salmon smolts to salmon feedlot in Broughton Archipelago - photo courtesy Alexandra Morton

Genetic risks to wild salmon are greatest with aquacultured Pacific salmon, almost all of which are now Chinook. The potential for interbreeding between feedlot and wild Chinook is high, whereas genetic differences make it unlikely that feedlot Atlantic salmon would breed with wild Pacific salmon (Allendorf and Thorgaard 1984). Because interbreeding decreases genetic diversity, disease resistance and adaptability, the genetic risks associated with escaped native feedlot salmon are serious (Gardner and Peterson 2003). The main ecological concern is how feedlot fish may impact wild fish. Escaped feedlot salmon—both Atlantic and Pacific—are capable of competing with wild salmon for food and habitat. Invertebrates and juvenile fish (including salmon) have been found in the stomachs of feedlot Atlantic salmon (Black et al. 1991; Morton and Volpe 2002). Particularly worrisome are interactions between wild and feral feedlot salmon on the same spawning grounds (Gardner and Peterson 2003). Regardless of unsuccessful attempts to introduce Atlantic salmon to wild salmon rich British Columbia rivers from 1905 to 1934 (MacCrimmon and Gots 1979; Alverson and Ruggerone 1997), escaped Atlantic salmon have now been documented in some 80 British Columbia rivers and are known to have spawned in the Tsitika River on northern Vancouver Island (Volpe et al. 2000). Rivers or streams with diminished wild Pacific salmon have lower 'biotic resistance' to colonization by Atlantics (Volpe et al. 2001). The impact escaped feedlot Atlantic salmon have on wild Pacific salmon depends on how effectively the Atlantic salmon adapt after escaping. One European study indicates that feedlot Atlantic salmon can adapt very well, since escaped feedlot salmon are routinely caught by commercial fishermen seeking wild salmon. In the Faroe Islands, between 20 and 40% of all fish caught are escaped feedlot Atlantic salmon (Hansen et al. 1998).

Escaped Atlantic salmon caught in gill net fishery in Queen Charlotte Strait, October 2009
Photo courtesy of David Kaufman

Understandably, the number and magnitude of salmon escapes in British Columbia are difficult to determine. The British Columbia Ministry of Agriculture, Food and Fisheries (MAFF, now called BCMAL) reported a total of 500,000 feedlot salmon (mostly Atlantics) escaped from pens between 1992 and 2000 (MAFF 2003). According to BCMAL, over 1.5 million feedlot salmon escaped into British Columbia waters between 1987 and 2008 (BCMAL 2008). From 1995 to 2000, BCMAL reported losses of an average of 46,255 feedlot Atlantic salmon annually into British Columbia coastal waters. However, these figures likely grossly underestimate escapes. Morton and Volpe (2002) collected 10,826 Atlantic salmon caught by commercial fishers on British Columbia fishing grounds in 17 days of open fishing periods in 2000, 40% more than DFO's passive monitoring program reported caught over 8 weeks of the same fishing period. Research done in British Columbia estimates that 0.5 to 1 percent of juvenile Atlantic salmon in production "leak" from their pens each year (Alverson and Ruggerone 1997). One percent of the approximately 80,000 tons of feedlot salmon produced each year in British Columbia translates into approximately 160,000 additional feedlot salmon escaping into British Columbia's marine environment on a yearly basis. Other researchers have estimated continuous leakage of as high as 3% (Morton and Volpe 2002), which would translate into nearly half a million escaped feedlot salmon. Escaped feedlot salmon are usually recorded within 500 km of the escape site, but have been recorded up to 2,000 to 4,500 km from the escape/release site (Thorstad et al. 2008).

The Atlantic Salmon Watch Program is a joint initiative between DFO and BCMAL. Although there are questions whether this initiative is still functional, the program has in the past conducted monitoring and removal of escaped Atlantic salmon from streams and reported observations of escaped Atlantic salmon in over 80 British Columbia rivers. It also documented juvenile Atlantic salmon, indicating successful spawning, in three British Columbia rivers.

G. Fish Feedlot Links to Declining Salmon Populations

Like all natural fish populations, wild salmon are subject to some fluctuation. However, salmon runs in British Columbia have not historically suffered the same declines as many runs in the United States. Severe declines of British Columbia wild salmon returns began in the early 1990s, leading to an outright moratorium on new salmon feedlot licenses in 1995. In 1997 the Canadian government commenced a Salmon Aquaculture Review, which erroneously concluded that the risks salmon feedlots pose to the environment are low (EAO 1997). This review preceded the major outbreaks of lice in British Columbia salmon feedlots, did not fully investigate the impacts feedlots have upon wild stocks, and overlooked the fact that wild salmon are in decline wherever salmon aquaculture is conducted in marine net pens (Ford and Myers 2008). Despite lingering skepticism, the government lifted the moratorium in 2002, and the commercial aquaculture industry immediately began investing hundreds of millions of dollars in new feedlots.

Numerous studies show that lice infestations associated with salmon feedlots may have depressed wild salmon populations and placed them on a trajectory toward rapid local extinction and that salmon feedlots can cause parasite outbreaks that erode the capacity of a coastal ecosystem to support wild salmon populations. Studies in Europe concluded that "reduction of wild salmonid abundance is also linked to other factors but there is more and more scientific

evidence establishing a direct link between the number of lice-infested wild fish and the presence of cages in the same estuary" (European Commission 2002).

For years, the Canadian aquaculture industry and government have insisted that sea lice in salmon feedlots are not a threat to wild salmon, yet an overwhelming body of scientific studies suggests the opposite: sea lice are dangerous and harmful to wild salmon. DFO has dismissed studies linking sea lice and salmon feedlots to wild salmon declines, noting the many potential sources of at-sea mortality for salmon (DFO 2009a). Such explanations for salmon declines offered by DFO include climate change, ocean pollution, over-fishing and habitat destruction. However, pointing out these global problems does not negate established links between sea lice, disease and fish feedlots and wild salmon population declines. Leading researchers report that if sea lice outbreaks had continued without SLICE, then extinction of some British Columbia salmon runs would have occurred (Krkosek et al. 2007). This suggests in British Columbia salmon are now dependant on drug applications with potentially toxic marine side-effects.

Broughton Archipelago

Broughton Archipelago salmon feedlot tenures – courtesy of Living Oceans

In the Broughton Archipelago, a group of islands north of Johnstone Strait off the northeast coast of Vancouver Island, sea lice from salmon feedlots are implicated in the collapse of the 2002 pink salmon run (PFRCC 2002). More than 3.6 million pink salmon returned to spawn in 2000

and similar numbers were expected in 2002, yet only 147,000 salmon returned. Though wide fluctuations in pink salmon populations are natural, analyses conducted by both DFO and the PFRCC showed that the Broughton collapse was not "natural" (PFRCC 2002). PFRCC's report to DFO noted that there was evidence that the Broughton Archipelago's population of juvenile wild salmon was infested with sea lice, a condition essentially unreported previously for juvenile wild salmon in the natural environment elsewhere in British Columbia (PFRCC 2002). There is increasing evidence the 2002 pink salmon collapse likely stemmed from a massive kill of outward migrating juvenile pink salmon in 2001 caused by sea lice originating in local salmon feedlots. The Broughton Archipelago has British Columbia's densest concentration of fish feedlots, with 29 feedlot tenures; 17 of them were active in 2003 (MAFF 2003). Most of the feedlots are located directly on salmon migration routes (LOS 2003).

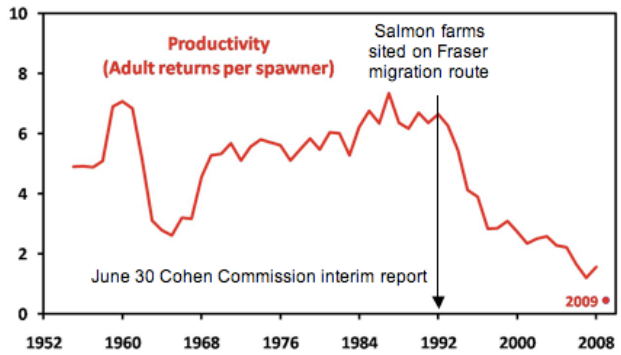
Evidence suggests that juvenile pink salmon were infested with sea lice during their outward migration, when the threat from sea lice is normally low, because adult salmon are normally scarce at that time of year. The salmon feedlots made sea lice available precisely when the juvenile pink salmon were most vulnerable to them (PFRCC 2002). Furthermore, other populations of pink salmon in waters near the Broughton Archipelago did not plummet in 2002 and generally increased in abundance, which suggests that the cause of the decline originated in the waters of the Broughton (PFRCC 2002).

Juvenile pink salmon emerge from stream gravels in late winter and early spring, and almost immediately start making their way to the ocean. They are only 3.5 cm long when they reach salt water and weigh only 0.3 grams (Heard 1991; Morton et al. 2004). They live in the shallow, productive waters of estuaries and coastlines, where plentiful food allows them to grow rapidly before migrating farther out to sea (Scott and Crossman 1973). During their initial stages in the sea, juvenile pink salmon rely heavily on shallow, food-rich, coastal saltwater zones—estuaries, wetlands and beaches. Brackish estuaries are especially important as they provide ideal conditions for adapting to salt water. Shallow coastal waters also offer protection from predators and strong ocean currents. After several weeks feeding on small plankton, juvenile pink salmon migrate to sea, where they stay for 12–16 months (Scott and Crossman 1974; Healy 1980; Godin 1981) Of the Broughton Archipelago's 27 feedlot tenures, 16 were located directly in the path of migrating juvenile pink salmon (LOS 2003).

Though juvenile pink and chum salmon are the most susceptible to sea lice, coho and chinook salmon as well as sea-run cutthroat trout and steelhead trout in the Broughton Archipelago are also at risk of lice infestations, especially out-migrating juveniles (Johnson and Albright 1992; Nagasawa et al. 1993; Johnson 1998; Fast et al. 2002). A study in the Broughton Archipelago found that 90% of juvenile pink and chum salmon near salmon feedlots were infected at or above lice loads considered to be lethal (Morton et al. 2004). Other research in the area found that 28% of juvenile pink and chum salmon were infected with lice (Jones and Hargreaves 2007). Krkosek et al. (2011) analyzed recently available sea lice data on feedlots and spawner–recruit data for pink and coho salmon populations in the Broughton Archipelago and nearby regions where feedlots are not present; their results show that sea lice abundance on feedlots is negatively associated with productivity of both pink and coho salmon in the Broughton Archipelago.

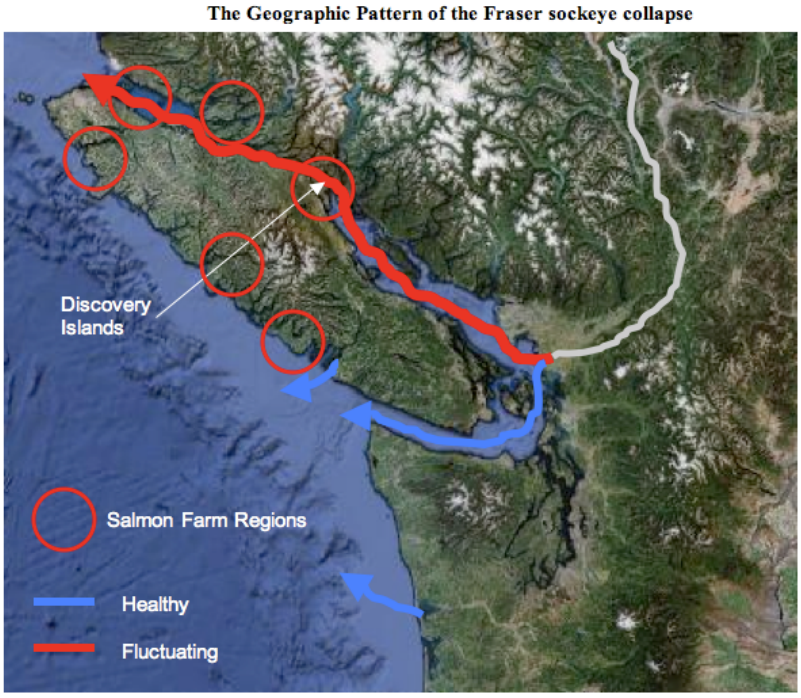
Fraser River

The Fraser sockeye fishery is Canada's most valuable, accounting for nearly half the economic value of all salmon caught in British Columbia. Most Fraser sockeye runs immediately went into steep decline in 1992 when salmon feedlots were placed on the sockeye migration route.

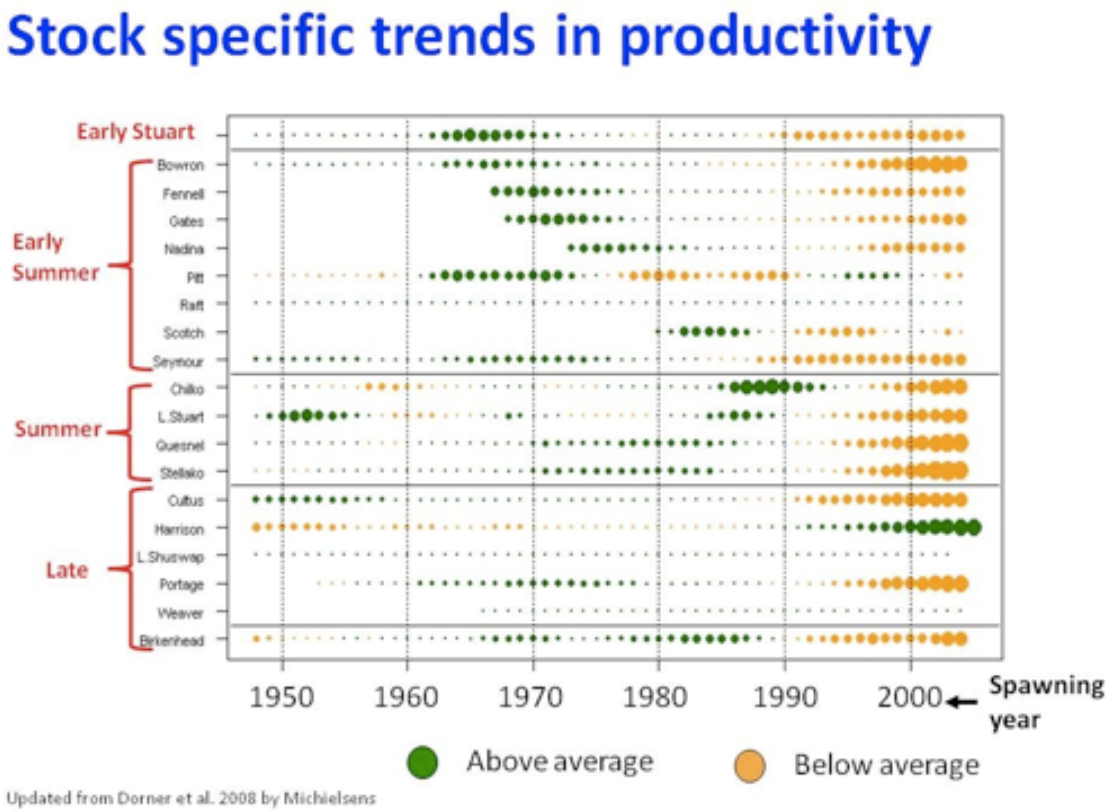


From Morton (2011)

Sockeye runs from the Fraser River watershed plummeted throughout the 1990s and 2000s, and some runs are now on the brink of extinction. However, only the sockeye runs that migrate through water used by salmon feedlots have experienced a decline in productivity. In contrast, the Harrison sockeye run, which migrates out to sea via the Strait of Juan de Fuca around the Southern tip of Vancouver Island - avoiding all the fish feedlots - is the one Fraser run with above average returns the past two decades, while productivity of all other stocks plummeted.



Morton (2011) - status of Fraser salmon runs relative to fish feedlots; blue line shows Harrison sockeye do not migrate north along eastern Vancouver Island; red line shows all other runs



Data updated from Dorner et al. 2008, by Michielsans. While productivity of most Fraser sockeye stocks declined beginning exactly one sockeye salmon generation after salmon feedlots were sited on the Fraser River sockeye migration route (expanding yellow bubbles), the Harrison River stock, which does not migrate through the fish feedlots, increased over the same time period.

Dr. Alexandra Morton of the Pacific Coast Wild Salmon Society summarized the current scientific knowledge regarding causes of the escalating pre-spawn mortality of Fraser River sockeye salmon in an August 2011 publication for the Aquaculture Coalition, titled *What is Happening to the Fraser Sockeye?* The report, which relies on documents submitted to the Cohen Commission, notes that only sockeye which migrate through salmon feedlots on the narrowest portion of the Fraser sockeye migration route off eastern Vancouver Island are fluctuating unpredictably, in contrast with healthy sockeye runs in the Columbia River, western Vancouver Island that migrate through Port Alberni Inlet where there are no salmon feedlots, and even in the Harrison sockeye which originate from the Fraser River but avoid the clusters of salmon feedlots by migrating to sea around southern Vancouver Island. The report concludes that Fraser sockeye appeared to be dying of pathogens that originated in salmon feedlots on the Fraser sockeye migration route, and provides evidence that the geography, pathology, fluctuations and timing all fit perfectly. This report is attached as Appendix A. The Aquaculture Coalition also submitted evidence before the Cohen Commission that Infectious Salmon Anemia virus is present in British Columbia and that the federal government does not take a precautionary or responsible approach to the risk and presence of disease in salmon in British Columbia. This evidence is attached as Appendix B.

II. CANADA'S FISHERIES ACT

The Canadian Constitution gives the federal parliament exclusive authority to make laws concerning "sea coast and inland fisheries" (Constitution Act, 1982, § 91(12), being Schedule B to the Canada Act 1982 (U.K.), 1982, c. 11). This authority is exercised principally through the Fisheries Act and its regulations. The Fisheries Act requires "the proper management and control of sea coast and inland fisheries" and "the conservation and protection of fish" (*Fisheries Act*, §§ 43(a), 43(b)). The two most often used sections of the Fisheries Act are section 35, which prohibits the harmful alteration of fish habitat, and section 36, which makes it illegal to introduce a "deleterious substance" into fish-bearing waters. These sections are critical to preserving the ecological integrity of wild fish habitat and are described in detail below.

A. Section 35

Under section 35 of the Fisheries Act, DFO is responsible for ensuring that no projects undertaken in aquatic environments result in the harmful alteration, disruption, or destruction of fish habitat without authorization. Section 35 therefore prohibits any unauthorized change in fish habitat that would reduce its capacity to support one or more life processes of fish (Fisheries and Oceans Canada, 1998a).

Fish habitat encompasses components of the environment on which the survival of fish directly or indirectly depends. It includes spawning grounds, nursery and rearing areas, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life processes (*Fisheries Act*, 34(1)). Fish habitat possesses physical, chemical and biological attributes that are essential to the life processes of fish. Any water body or watercourse, permanent or intermittent, including stream banks as well as any area located in a flood zone, is considered a fish habitat (*Fisheries Act*, § 2).

The Policy for the Management of Fish Habitat adopted in 1986 defines the terms of reference for the consistent administration of DFO's fish habitat management program. The policy explains the guiding principle of "no net loss" of habitat productive capacity in order to achieve the habitat conservation goal. When a project is expected to cause harmful alteration, disruption, or destruction of fish habitat, the policy encourages an examination of alternative solutions and changes to the proposed project (construction methods, location of work, schedules, etc.) to avoid adverse effects on fish habitat, or if this is not possible, to reduce them.

As a last resort, if residual impacts cause harmful alteration, disruption, or destruction of fish habitat, an authorization to modify fish habitat under Subsection 35(2) of the Fisheries Act may be issued. This authorization allows the harmful alteration, disruption, or destruction of fish habitat by the means or under the circumstances authorized by DFO. One of the principal conditions of authorization is implementation by the project proponent of a habitat compensation program which complies with the principle of no net loss of fish habitat productive capacity. It is important to note that DFO may refuse to issue an authorization when it deems that harmful effects on fish habitat are unacceptable. Any harmful alteration, disruption, or destruction of fish habitat that is not authorized by DFO constitutes an offense under the *Fisheries Act*.

B. Section 36

Subsection 36(3) of the Fisheries Act prohibits the deposit of deleterious substances into Canadian waters. Unlike Subsection 35(2), there is no provision to authorize the deposit of deleterious substances except by Regulation or an Order in Council. A deleterious substance is defined by the Fisheries Act as "any substance that, if added to water, makes the water deleterious to fish or fish habitat or any water containing a substance in such quantity or concentration . . . that if added to water makes that water deleterious to fish or fish habitat."

The Federal Cabinet can pass regulations allowing the introduction of particularly harmful substances into fish habitat, and has exercised that authority on more than one occasion. For example, the Cabinet enacted regulations authorizing introduction of harmful substances for effluents from pulp and paper, metal mines, petroleum refineries, meat and poultry plants, and potato processing plants. Conspicuously absent, however, is any regulation authorizing the introduction of the neurotoxin emamectin benzoate, or SLICE.

III. CSEM PROCEDURE NEEDED TO ADDRESS VIOLATIONS

A. Petitioners and the CSEM Process

The Citizen Submission on Enforcement Matters process under Articles 14 and 15 of the North American Agreement on Environmental Cooperation (NAAEC) is the primary tool by which citizens may file a submission for environmental enforcement matters under NAFTA (CEC 2007). The process allows any "non-governmental organization or person…residing or established in the territory of a Party" (Mexico, U.S. or Canada) to make submissions to the NAAEC Secretariat asserting "that a Party is failing to effectively enforce its environmental law." The submission process can lead to the development of a factual record. A factual record seeks to provide detailed factual information allowing interested persons to assess whether a Party is failing to effectively enforce its environmental law in connection with the matter raised in the submission.

This submission is made pursuant this process by the Center for Biological Diversity, Pacific Coast Wild Salmon Society and Pacific Coast Federation of Fishermen's Associations.

The Center for Biological Diversity is a non-profit, public-interest conservation organization dedicated to the protection of endangered species and wild places. The Center is a U.S. non-profit corporation incorporated under the laws of the State of New Mexico. The Center "resides" in the State of Arizona. The Center has offices across the U.S., including in Tucson, San Francisco, Anchorage, Portland, and Seattle.

Center for Biological Diversity
Contact: Jeff Miller
351 California Street, Suite 600
San Francisco, CA 94104
Phone: (415) 436.9682 x303
E-mail: jmiller@biologicaldiversity.org

The University of Denver's Environmental Law Clinic is representing the Center for Biological Diversity in this submission. The Environmental Law Clinic provides a real world experience for students interested in environmental law who wish to develop practical legal skills. Under the supervision of Michael Harris and Kevin Lynch, students represent community groups and environmental advocacy organizations before courts and administrative agencies in a broad range of environmental matters.

Environmental Law Clinic
University of Denver Sturm College of Law
Contacts: Assistant Professor Michael Harris and Clinical Fellow Kevin Lynch
2255 East Evans Avenue
Denver, CO 80208
Phone: (303) 871-6140
E-mail: mharris@law.du.edu; klynch@law.du.edu

The Pacific Coast Wild Salmon Society is a non-profit society engaged in raising public awareness of impacts of salmon feedlots. PCWSS was a participant in the Cohen Commission on the decline of the Fraser sockeye and reviewed thousands of internal government documents on salmon feedlots. PCWSS was also involved in the successful jurisdictional challenge against Canada and the Province of BC that removed provincial management of salmon feedlots as farms and returned them to federal jurisdiction as a fishery.

Pacific Coast Wild Salmon Society
Contact: Alexandra Morton
Box 399
Sointula, BC V0N 3E0
Phone: (250) 973-2306
E-mail: gorbuscha@gmail.com

The Kwikwasu'tinuxw Haxwa'mis First Nation is an indigenous Canadian tribe whose territory is within the Broughton Archipelago, a formerly salmon-rich area of mainland coast, islands and bays east of the northern tip of Vancouver Island. The Kwikwasu'tinuxw Haxwa'mis have long advocated for aquaculture industry reforms to protect wild salmon, since numerous fish farms are authorized by the B.C. Government to operate in their traditional territories.

The Kwikwasu'tinuxw Haxwa'mis First Nation
Contact: Chief Bob Chamberlin
P.O. Box 10, 1 Front Street
Alert Bay, BC V0N 1A0
Phone: (250) 974-8282
E-mail: bobbyc@telus.blackberry.net

The Pacific Coast Federation of Fishermen's Associations is the largest trade association of commercial fishermen on the west coast. PCFFA works to assure the rights of individual fishermen and fights for the long-term survival of commercial fishing as a productive livelihood and way of life.

Pacific Coast Federation of Fishermen's Associations
Contact: Zeke Grader
991 Mason Street
San Francisco, CA 94129
Phone: (415) 561-5080
E-mail: zgrader@ifrfish.org

The petitioners and their members are suffering harm from Canada's failure to effectively enforce the Fisheries Act with regard to salmon feedlot impacts on wild salmon habitat and populations. The petitioners and their members have commercial, conservation, educational and scientific interests in protecting and restoring wild salmon runs in British Columbia and the United States that are jeopardized by Canada's failure to properly protect wild salmon.

The petitioners formally request that the NAAEC Secretariat to create a factual record pertaining to Canada's failure to enforce its environmental laws in connection with salmon feedlots, parasites, disease and wild salmon declines. The petition provides sufficient information and evidence, not drawn exclusively from mass media reports, to allow the Secretariat to determine whether a factual record should be developed. Evidence is drawn primarily from formal Canadian government documents and published scientific studies. The Submission on Enforcement Matters procedure requested is appropriate and necessary because it is both objective and comprehensive; the two characteristics absent from other ongoing legal and inquiry actions. The Submission on Enforcement Matters procedure is indispensable for proper resolution of the matter.

Furthermore, this matter is appropriate for the NAAEC to consider because it meets the criteria for citizen submission:

- It is in written in English and provides notification to the Secretariat;
- It clearly identifies the petitioners, Center for Biological Diversity, Pacific Coast Wild Salmon Society, Kwikwasu'tinuxw Haxwa'mis First Nation and Pacific Coast Federation of Fishermen's Associations, which are making the submission;
- It provides sufficient information to allow the Secretariat to review the submission;
- It is aimed at promoting enforcement rather than at harassing industry;
- It indicates that the matter has been communicated in writing to the relevant authorities of the Party (Minister of Fisheries and Oceans) by letter and e-mail dated December 29, 2011, in which petitioners explained how Canada is failing to effectively enforce the Fisheries Act by allowing salmon feedlots to harm and jeopardize wild salmon runs; and indicates the Party's response (see Appendix C);
- It is filed by the Center for Biological Diversity, Pacific Coast Wild Salmon Society, Kwikwasu'tinuxw Haxwa'mis First Nation and Pacific Coast Federation of Fishermen's Associations, which are established in the United States of America and in Canada;
- The Secretariat may consider a submission from any non-governmental organization or person asserting that a Party is failing to effectively enforce its environmental law.

This petition was submitted to the Commission for Environmental Cooperation, Submission on Enforcement Matters Unit, on February 7, 2012, to the following address:

Commission for Environmental Cooperation, SEM Unit
393 St-Jacques Street West, Suite 200
Montreal (Quebec) H2Y 1N9 Canada

B. The Canadian Government Has Failed to Enforce the Fisheries Act

Under the Submission on Enforcement Matters procedure, the NAAEC Secretariat may consider a submission from any non-governmental organization or person asserting that a Party is failing to effectively enforce its environmental laws. The Canadian Government is failing to effectively enforce the Fisheries Act by failing to conserve and protect wild salmon. Specifically, the Canadian government is failing to enforce sections 35 and 36 of the Fisheries Act.

1. Violations of Section 35

The DFO is failing to enforce § 35 of the Fisheries Act because it is failing to ensure that salmon aquaculture does not harmfully alter, disrupt, or destroy fish habitat.

Fish habitat includes components of the environment upon which a fish directly or indirectly depend in order to carry out their life processes. Juvenile wild salmon depend on the safety and habitability of the British Columbia coastlines to gain size and strength enough to contend with the currents and predators of the open ocean. Thus, the British Columbia coastline is fish habitat that should be protected by the DFO.

However, DFO has allowed over 100 salmon feedlots to operate in this same habitat, despite the fact that salmon feedlots harmfully alter and degrade this environment.

Harmful alteration, disruption, or destruction of fish habitat is defined as any unauthorized change in fish habitat that would reduce the habitat's capacity to support one or more life processes of fish. By anchoring millions of sea lice infested salmon in pens along wild salmon migratory corridors, salmon feedlots reduce the habitat's capacity to provide young salmon with safety and respite. Instead, susceptible young salmon are subjected to sea lice infection rates at approximately seventy times greater than natural levels. Thus, each salmon feedlot is responsible for creating a harmful alteration, disruption, or destruction of fish habitat.

Despite § 35(1)'s prohibition on harmful alteration, disruption, or destruction of fish habitat, the DFO may issue a § 35(2) authorization for harmful alteration, disruption, or destruction of fish habitat. Authorizations are available if the residual impacts of a project cause, or result in harmful alteration, disruption, or destruction of fish habitat. Because each salmon feedlot is responsible for creating harmful alteration, disruption, or destruction of fish habitat, each feedlot in operation must be authorized by DFO. In 2009, there were more than 130 salmon feedlot sites in operation in British Colombia. The productive capacity of fish habitat is suffering great losses as evidenced by the millions of missing wild salmon from British Columbia rivers.

One of the principal conditions of authorization is the implementation of a habitat compensation program, which complies with the principle of "no net loss" of fish habitat productive capacity. "No net loss" encourages an examination of alternative solutions and changes to the proposed project to avoid adverse effects on fish habitat.

One way DFO could enforce this requirement is by mandating the use of land-based salmon aquaculture or closed-containment tanks. Closed containment uses barrier technologies that ensure no contact between wild and aquaculture fish, thus eliminating the most harmful impacts of net-cage operations and significantly reducing others. Options for closed-containment systems include Recirculation Aquaculture Systems, where fish are grown in tanks, primarily on land, with up to 98% of the water being filtered, cleaned and reused; and Flow-Through Ocean Based Systems, where fish are grown in large floating tanks and ocean water is drawn from a depth determined to eliminate disease and pathogen transfer, oxygenated, then pumped into the tank where it can be treated and filtered to ensure high quality rearing water and that discharge water is returned to the ocean clean. The solid waste (fish feces and uneaten feed) is collected, treated

and available for use as compost. The benefits of closed containment salmon aquaculture systems include: eliminating or greatly reducing the risk of disease and parasite transfer to wild salmon; eliminating solid waste dispersal and resulting contamination of the marine environment; eliminating escapes; eliminating deaths of sea lions, dolphins and other marine mammals entangled in fish feedlot nets; and significantly reducing water column pollution, feed use and the need for antibiotics and chemical treatments to raise fish.

In 2007 and 2011, CAAR submitted full budget briefings and encouraged the Ministry of Agriculture and Lands and the Provincial government to establish the Closed System Aquaculture Innovation and Development Fund. This $10 million fund would provide investment to entrepreneurs who demonstrate the ability to build and operate closed system salmon aquaculture projects. Government support would enable private operators to prove systems without carrying the full costs and without forcing existing businesses into an immediate, capital-intensive transition to technology with which they are not familiar. Yet the 2008, 2009, 2010 and 2011 Provincial budgets did not contain any funding commitments for closed containment.

In sum, § 35 of the Fisheries Act prohibits harmful alteration, disruption, or destruction of fish habitat. The location of the salmon feedlots reduces the coastlines' ability to support the natural life cycle of wild salmons by introducing unnaturally high levels of disease and sea lice, to which young wild salmon are particularly vulnerable. The result is the rapid decline and predicted local extinction of British Columbia wild salmon. By failing to authorize harmful alteration, disruption, or destruction of fish habitat for each individual salmon feedlot and enforce the "no net loss" of fish habitat principle, the Canadian government is failing to enforce § 35 of the Fisheries Act.

2. Violations of Section 36

In addition to the link between sea lice, salmon feedlots, and the wild salmon, the Canadian government is failing to enforce section 36 of the Fisheries Act. This failure to enforce the Fisheries Act stems from the government's failure to prohibit the use of the neurotoxic chemical emamectin benzoate, used to treat infestations of sea lice, despite evidence that this substance is deleterious to natural fish habitat.

A deleterious substance is defined as "any substance that, if added to water, makes the water deleterious to fish or fish habitat or any water containing a substance in such quantity or concentration . . . that if added to water makes that water deleterious to fish or fish habitat." SLICE, the neurotoxic chemical treatment applied to fish feed used to fatten feedlot salmon in their pens, fits the statutory definition of a substance which is added to the waters that affects the environment.

There is a lack of conclusive evidence that SLICE does not harm or kill crustaceans other than sea lice, which may come in contact with the excess treated fish feed, excrement or the remains of deceased feedlot salmon with SLICE residue still in their tissue. Decapod crustacean such as crabs, lobsters, and shrimp are important scavengers that tend to be drawn to the sea bed beneath finfish aquaculture operations, where the tainted refuse collects. These species perform an

important role of breaking down biomass and releasing nutrients, and therefore comprise the "fish habitat" as the term is defined by § 34 of the Fisheries Act. In fact, wild salmon get their pink color from the carotenoids in decapods such as krill. A negative impact on these species can harm wild populations of salmon as well.

DFO indicates that SLICE may soon be replaced by Alphamax, triggered by the growing resistance sea lice are exhibiting towards SLICE in commercial fisheries around the world. Alphamax is described as being acutely toxic to all crustaceans. If DFO allows salmon feedlots to add Alphamax to the water it will again be failing to enforce the Fisheries Act.

Because there is no evidence provided that SLICE is not deleterious to the wild salmon's "fish habitat," and there is evidence that SLICE can accumulate in the sediments beneath the feedlot raised salmon pens, it follows that SLICE should be classified as a deleterious substance. Therefore, the Canadian government should prohibit the use of SLICE in the wild salmon's habitat, pursuant to section 36 of the Fisheries Act.

C. Previous Attempts to Address the Problems Associated with Fish Feedlots Domestically Have Failed

Wild salmon have long been at the heart of both the history and culture of Canadian coastal dwellers. First Nations, local communities, fishermen and environmentalists in Canada have long attempted to get the federal and provincial governments to address the impacts of salmon feedlots in British Columbia, due to concern about impacts to wild salmon. Extensive, ongoing scientific evidence about the threats feedlot salmon pose to wild salmon and DFO's failure to protect wild salmon populations has drawn extensive public notice and alarm in Canada. Public concern over the impact of British Columbia's salmon feedlot disaster is not confined to British Columbia. Prominent U.S. fish retailers and chefs are boycotting Canadian "farmed" salmon.

The protection of wild salmon is primarily the responsibility of Fisheries and Oceans Canada (DFO). DFO's mandate to manage and protect fisheries resources includes responsibility for marine and freshwater environments. Yet DFO has also been mandated to promote aquaculture in Canada, which undermines its ability to protect wild salmon resources. DFO appears to be unwilling and unable to enforce the Fisheries Act (See Morton v. Marine Harvest Canada Inc., 2009 BCCA 481 (CanLII); BC Aquaculture Regulation 78/2002; Fisheries Act, RSBC 1996, c 149).

At present, Canada's federal government and the British Columbia provincial government both support, promote and favor the continuation and expansion of the open net-cage salmon aquaculture industry. Despite abundant scientific evidence that use of this technology is unsustainable and is implicated in the decline of wild salmon stocks and other environmental hazards not just in British Columbia, but worldwide, both governments continue to advocate for and support the continuation and expansion of open net-cages. Published, peer-reviewed research on the impacts of net-pen aquaculture on ecosystems is debated and dismissed by DFO while scientists, businesses and management regions around the world increase their acceptance of the scientific weight of evidence and are taking steps to address these same impacts.

The regulatory regime governing aquaculture in Canadian coastal waters has failed to address some of the most fundamental aspects of the industry's impacts on the marine environment and on coastal communities for over 25 years. Public confidence in the ability of the Canadian government to protect wild fish and the marine ecosystems upon which many sectors depend has been substantially eroded by continued reliance on scientifically weak regulatory measures, failure to objectively investigate knowledge gaps and the absence of a process for resolving conflicts among resource users affected by net-pen aquaculture. Basic requirements for sound management, such as science-based regulations, are largely absent for Canadian net-pen aquaculture. While the industry is dominated by global companies, global best practices are not implemented in Canada.

The British Columbia provincial government, Canadian government and DFO have made a huge mistake by allowing industrial feedlots onto the path of every significant wild salmon migration of southern British Columbia, in contravention of international warnings, their own studies and recommendations going back 20 years.

In 1986, due to massive losses of feedlot salmon, poor placement of salmon feedlots and growing complaints from First Nations, local communities, fishermen and environmentalists, the provincial government in British Columbia was forced to impose a month-long moratorium against approving new salmon feedlot sites and initiate the first environmental review of the aquaculture industry, the Gillespie Inquiry.

In 1988 the British Columbia provincial government was given jurisdiction over fish feedlots, without any mandate or responsibility to protect wild fish. The provincial government conducted a Coastal Resource Interest Study, ostensibly to create feedlot-free zones in British Columbia based on local knowledge of wild fish abundance. In 1989 the province produced a map with input from local stakeholders dividing the Broughton Archipelago waters into green (go for fish feedlots), yellow (go with caution) and red (where no applications for finfish aquaculture would be accepted). The red zones highlighted where wild salmon schooled, prawns were most abundant, whales summered and rock cod lived. However, fish feedlots were then placed in these very locations and within a year there were more salmon feedlots in red zones than in any other areas (BC Legislative Assembly 1988).

As a result of the Gillespie Inquiry, the provincial government implemented a moratorium on new fish feedlots in 1995 and capped the number of feedlots at 121. However, the size of fish feedlots and intensity of production were allowed to increase so that fish production in British Columbia salmon feedlots actually increased during the "moratorium."

From 1995 to 1997 a second environmental review of the aquaculture industry (the Salmon Aquaculture Review) was initiated by the provincial government to address public concerns. The review's 49 recommendations were made public in 1997 and the provincial government and the British Columbia Salmon Farmers Association announced plans to implement them (EAO 1997).

In 2000, a Federal Auditor General report identified a conflict of interest between DFO's promotion of salmon aquaculture and its mandate to protect wild fish and wild fish habitat (AGC 2000). In 2001, a Standing Senate Committee on Fisheries issued a report revealing that DFO

disregards its mandate to protect wild fish stocks (SSCF 2001). Also in 2001, the David Suzuki Foundation sponsored a review that critiqued the many failings of the British Columbia aquaculture industry (Leggatt 2001). In 2002 the provincial government lifted the 1995 moratorium on new salmon feedlots.

In 2002, Broughton Archipelago pink salmon stocks crashed. The Pacific Fisheries Resource Conservation Council released an advisory to federal and provincial fisheries ministers, urging the immediate removal of Broughton Archipelago salmon feedlots in order to protect outward-bound juvenile pink salmon (PFRCC 2002), which was ignored by the provincial and federal governments.

In 2003, DFO developed a Pink Salmon Action Plan to determine the cause of low 2002 pink salmon returns. The plan recommended fallowing salmon feedlots on the pink salmon migration route and a marine monitoring program to determine where and how badly sea lice infect juvenile salmon in the Broughton Archipelago, identifying migration corridors more clearly, and a strategic fallowing plan to create a safe juvenile pink salmon migratory corridor. The Provincial Pink Salmon Action Plan did a good job of clearing the major pink salmon migration route of sea lice in 2003. Pink salmon survival from 2003 was better than any other year ever recorded, but the provincial government never announced the spectacular result nor ever repeated the fallowing plan.

The PFRCC also issued a series of recommendations for research, monitoring, management practices and comprehensive policy in 2003. Many meetings of experts occurred 2003-2004, such as the SFU Sea Lice Summit, SFU Sea Lice Action Plan Meeting and UBC Sea Lice Summit. All made recommendations concerning the management of sea lice. In 2004, the Georgia Strait Alliance published a government report card assessing the regulation of salmon aquaculture in British Columbia and its successes, failures and shortcomings (GSA 2004). In 2007, the team updated the report card and found British Columbia still lacking in the development of sustainable salmon aquaculture (GSA 2007). The government has never responded to the recommendations.

Another 2007 report from the provincially-funded Pacific Salmon Forum compared British Columbia's regulations with salmon aquaculture regions around the world and found Canada's aquaculture regulations and management practices to be sub-par. British Columbia scored 5.1 out of 10, compared to Iceland and Norway with 9.6 and 9.0 respectively (BCPSF 2007). Essential sea lice recommendations from the 2009 Pacific Salmon Forum were never enacted. Canada was especially weak on zoning, monitoring and enforcement of regulations. In 2007 the provincial government's Special Committee on Sustainable Aquaculture delivered a report with a long list of recommendations, including a strong recommendation to remove salmon feedlots from the ocean in a "rapid, phased transition to ocean-based closed containment" that should be in place within 5 years (LABC 2007). The government failed to respond to this recommendation.

Also in 2007, the Special Legislative Committee on Sustainable Aquaculture recommended removing salmon feedlots from the ocean environment into tanks (LABC 2007).

In 2009, the Office of the Auditor General of Canada issued a report stating: "Fisheries and

Oceans Canada and Environment Canada cannot demonstrate that fish habitat is being adequately protected as the Fisheries Act requires…there has been little progress since 2001, when we last reported on this matter" (AGC 2009).

In 2008, one salmon aquaculture company, Marine Harvest Canada, began to develop a six year Coordinated Area Management Plan (CAMP) for their salmon feedlots in the Broughton Archipelago. The CAMP established an area management approach (using timing and location of wild smolt entry, coordinated harvesting and fallowing, sea lice monitoring, and therapeutic treatment) aimed at reducing the potential for sea lice from feedlot salmon to infect wild juvenile pink and chum salmon during the out migration season (March 1st to June 30th) in the Tribune-Fife and lower Knight Inlet corridors. However, the CAMP has not been fully implemented nor have out-migration corridors been adequately protected. In 2010 the federal government and salmon aquaculture companies announced a new Broughton Archipelago Monitoring Plan, a multiyear sea lice monitoring and research program. This management plan does nothing to address the potential impacts of viruses and bacteria amplification and introduction.

Two legal cases were brought in 2009 addressing the wild salmon decline and the government's inaction. The first case, *Morton v. B.C.* (Agriculture and Lands, 2009 BCSC 136) was brought by Canadian scientist and biologist Dr. Alexandra Morton. Morton and co-plaintiffs from the eco-tourism and commercial fishing industries successfully challenged the British Columbia government's legal and constitutional authority to license and regulate salmon feedlots. The Supreme Court of B.C. ruled that the federal government, not the province, has exclusive jurisdiction over the regulation of aquaculture. A second case addressing salmon feedlots, *Kwicksutaineuk/Ah-Kwa-Mish First Nation v. British Columbia (Agriculture and Lands)* was certified by the court as a class action suit on December 21, 2010 and is pending litigation. The case was brought by eight First Nations in the Broughton Archipelago against the British Columbia government over the negative impact of commercial salmon feedlots on wild salmon. The class-action certification explains that wild salmon are fundamental to the cultural and spiritual integrity of the First Nations.

In addition to these cases, public political pressure caused the Canadian government to take a closer look at the disappearance of wild sockeye salmon from the Fraser River. Three years of disturbingly low sockeye returns to the Fraser River from 2007 to 2009 led the Prime Minister to appoint a "Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River," the Cohen Commission, to investigate the declines. The Cohen Commission inquiry began in 2010 and concluded in early 2012; the Commission has not yet released findings or conclusions, but will produce recommendations in June 2012. The Commission heard testimony that DFO suppressed critical information on presence of a reportable virus, ISAv, in wild salmon. It also heard evidence that a newly emerging Norwegian virus, heart and skeletal muscle inflammation (HSMI) has been found in a salmon feedlot and in wild sockeye salmon. Testimony was also recorded that the Fraser sockeye migration route was never considered when the salmon feedlots were sited, nor when jurisdiction for these operations was transferred from provincial to federal control.

The most significant finding of the Cohen Commission into the decline of salmon in the largest salmon-producing river in the world may be the absence of any government willingness to

protect wild salmon, due to a higher prioritization of international trade, at any cost. The Aquaculture Coalition submitted evidence before the Cohen Commission that the federal Canadian government does not take a precautionary or responsible approach to the risk and presence of disease in salmon in British Columbia (see Appendix B).

Infectious Salmon Anemia virus is perhaps the most lethal salmon disease known and has become a problem in every major Atlantic salmon farming region in the world, yet ISA virus testing has never been requested on Canada's "Fish Health Certificate" which must be signed for each importation of salmon eggs. Dr. Are Nylund with the University of Bergen testified that 80-90% of North Atlantic salmon broodstock test positive for ISA virus at egg-take (Cohen Commission testimony, December 15, 2011). British Columbia has imported 30 million Atlantic farm salmon eggs since 1986 (DFO 2011c). Dr. Nylund's testimony raises the question whether there any truly any Atlantic salmon eggs that are free of ISA virus.

The Canadian Fish Health Protection Regulations (CFHPR) were waived in 2003, on request by the Norwegian salmon farming companies operating in British Columbia, to allow Atlantic salmon eggs to be imported from an Icelandic hatchery that does not meet the CFHPR standards. The reason given for the waiver was that "failure to provide permission for egg importation may trigger a trade challenge under the WTO…" (Cohen Exhibit #1683).

When independent scientists in British Columbia reported positive test results for ISA virus in wild Pacific Salmon in the fall of 2011, the Canadian Food Inspection Agency (CFIA) took over responsibility for the virus, removing it from the jurisdiction of DFO (Cohen Exhibit # 2137). CFIA representative Dr. Klotins testified that the CFIA has never heard of the federal Wild Salmon Policy, which was written to protect wild salmon populations (Cohen Commission testimony, December 19, 2011). This suggests there is no mechanism currently in place to protect critical wild salmon populations as per the Wild Salmon Policy from the impact of the most lethal salmon virus known.

Several United States Senators reacted strongly to the 2011 ISAv positive test results and expressed concern about the potential impacts on salmon in the United States. In response, the Office of the Canadian Minister of Fisheries gave instructions for letter to be sent to U.S. Senators and/or members of Congress to "confirm that all samples which have previously been reported as infected with ISA have tested negative in our lab" (Cohen Exhibit # 2137). However, testimony by the scientist that performed these tests, Ms. Nelle, with the DFO Moncton Laboratory, states there was a weak <u>positive</u> result and that generally the samples were too degraded to confirm either negative or positive results. She did not "confirm" all samples were negative for the virus.

Chile recently closed its border to imports of Washington State Atlantic salmon eggs, and it is important to determine whether this was in response to the positive test results for ISA virus in British Columbia in October and November 2011. The timing is suggestive that Chile took these test results more seriously more seriously than the Canadian government. Chile recently experienced a massive outbreak of ISA virus causing $2 billion in losses, and thus is acutely is aware of the destructive potential of the virus.

Dr. Klotins of the CFIA testified that if ISA virus is confirmed in British Columbia, markets for farmed salmon could suddenly close. The CFIA's stated top priority is "bolstering economic prosperity" (CFIA 2012). The Cohen Commission learned that the CFIA contemplated prohibiting all independent testing for ISA virus, a step that would have given an agency with little interest in protecting wild salmon complete control over the scientific evaluation of the presence and impact of ISA virus in British Columbia (Cohen Exhibit #2104). Given that the CFIA attributes enormous negative trade implications to a confirmed presence of this virus and views economic trade as its top priority, there appears to be no Canadian government mechanism to protect wild salmon from the requirements of international trade. The information revealed at the Cohen Commission also raises the question whether Canada's trade partners have an accurate understanding of the risk of ISA virus contamination from British Columbia to virus-free areas.

IV. CONCLUSION

Salmon feedlots are dangerous to wild salmon because they create a place where viruses, bacteria and parasites can be introduced and breed and mutate. Locating them near the mouths of rivers in open pens on migration routes of wild salmon is the height of irresponsibility. Severe collapses in the numbers of wild Pacific salmon in British Columbia have been linked to diseases and parasites amplified and spread by the salmon feedlots.

The findings and recommendations of dozens of government and non-governmental processes and inquiries into poor aquaculture practices and threats from salmon feedlots over the past quarter century have largely been ignored by the Canadian government. As a result, the Canadian government has failed to adequately evaluate, monitor or address the problems and threats caused by British Columbia's salmon aquaculture practices or to enforce the Fisheries Act.

For all of the reasons set forth above, the Petitioners respectfully request the NAAEC Secretariat to find that this submission satisfies the requirements of Article 14(1) of the NAAEC and that this submission merits requesting a response from Canada under Article 14(3), and to develop a factual record on the matter. Please contact us if any additional argument, evidence or documentation would assist the Secretariat in evaluating this submission.

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