

**RAINCOAST RESEARCH SOCIETY**

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**What has gone wrong with salmon farming in the Broughton Archipelago**

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When salmon farming first appeared in the Broughton Archipelago it seemed a good idea. The local micro-community of Echo Bay was promised jobs, new families to help keep the one-room school open and relief from fishing pressure on wild fish. The community was advised they could decide where farms would not be allowed. The future looked rosy.

**Siting**

Under the Coastal Resource Interest Study, the provincial ministries of Environment and Agriculture, Fisheries and Food, toured the archipelago in 1988. Public meetings were held for fishermen, tourism operators and other local interest groups to mark where they would NOT like to see fish farms. Raincoast was asked what were essential to humpback whales, orca and other species of whales and dolphins. In 1989, the province produced a map dividing the archipelago waters into green (go for fish farming), yellow (go with caution) and red (where no applications for finfish farming would be accepted). These red zones highlighted where wild salmon schooled, prawns were most abundant, where whales summered and rock cod lived. However, within a year there were *more salmon farms in red zones* than in any other colour. In a breach of public trust, fishermen's hard-won knowledge had been used by the salmon farmers to find the places their fish would survive the best.

When queried the government gave three different answers as to why this had happened. First they said all interest groups had been contacted and differences settled sufficiently to allow the farms into the red zones. But none, including Raincoast, had been contacted. Next they said the red zones had been painted with such a "broad brush" that the little farms could be squeezed in without causing impact. But the farms were so large they covered entire red zones such as Sargeuant's Pass and spilled out into the surrounding waters. Finally the Province admitted wherever fish farm applications pre-dated the red zones, they had been permitted. As a result, tax-dollars were wasted on meaningless "consultation" with local communities, and the archipelago harmed by the study because the richest waters had been highlighted in red for exploitation. During this process a

*memorandum of understanding* passed down from Ottawa prohibited leases for residents to live on the coast in their floating houses.

### **Whales**

Harbour seals learned quickly how to eat farm salmon. The large fatty fish could be spooked into diving to the bottom the net pens in a typical Atlantic salmon response to predation. The tons of fish pressed so heavily against the net floor, seals found they could bite and suck the soft farmed flesh through the net without even making a hole. Despite the fact that gunfire over water is prohibited in B.C., Fisheries and Oceans Canada handed out permits and thousands of seals were shot. Soon the farmers discovered seals are smart - they were only killing naïve seals. The masters at farm fish predation learned to stay out of gunfire range.

In 1993, a new anti-seal measure was introduced - acoustic harassment devices (AHDs). These devices, dubbed acoustic brooms by whale researcher Dr. Jon Lien, work by broadcasting 198 db (the level of a jet engine at take-off) to cause pain in the seal's ears. Manufacturers warned local farmers not to turn the devices on when the seals were close, because the seal would be instantly deafened and the AHD no longer be effective against that seal.

The moment the devices were turned on harbour porpoise evacuated the archipelago and tried to move into Dall porpoise territory in the deeper waters of Blackfish Sound and Queen Charlotte Strait. The orca left, displaced from over 150 square kilometers of their traditional territory. It was as if a door had been slammed in their faces. Fisheries and Oceans Canada was contacted by Raincoast. In 1995, Fisheries did an experiment in the archipelago. Using top researchers, whale scientist Dr. John Ford and their own seal expert Dr. Peter Olesiuk they alternately played and silenced an AHD in the heart of harbour porpoise territory. The study produced dramatic results. When the AHD was on harbour porpoise abundance declined "*precipitously*," when they were off the diminutive porpoise returned. Section 78 of the *Fisheries Act* prohibits disturbance and displacement of cetaceans (whales, dolphins and porpoises). But Fisheries Canada and Oceans shelved the study for 7 years and granted more licenses to the salmon farmers for acoustic harassment.

Sadly, there was great debate over whether the devices were even effective. The study used an AHD in the absence of any farm salmon and found seals were actually attracted to the noise in a "dinner bell" effect. Many farmers agreed and told Raincoast they only used them because they were required by insurance companies. Raincoast co-published a study on the impact of these devices on orca. The farmers turned the devices off in 1999 and while orca occurrence is up, whale use of the area is highly sporadic and disrupted.

### **Disease transfer**

Salmon farms differ fundamentally from terrestrial farms because their effluent flows directly, untreated into contact with wild species. While scientist have dubbed salmon farms *pathogen culturing facilities* (Bakke and Harris 1998), both provincial and federal governments in British Columbia refuse to examine the fate of bacteria, parasites and viruses emanating from salmon farms. Salmon are designed to move. Epidemics in wild fish are extremely rare, because, when pathogens strike - the sick drop out of the school and are eaten by predators.

Intensive farming, however, breaks natural laws of density, distribution bio-diversity and survival of the fittest. Disease is nature's relentless response to over-crowding

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and so the farmers have to resort to drugs. Small bays which might support a few hundred salmon in intermittent bursts throughout the year, are now filled with up to 1,000,000 - 2,000,000 stationary salmon. This is the best thing to happen to fish pathogens on this coast since the glaciers receded. In such close proximity, the feces of the crowded fish pass over each other's gills. Because the fish are confined and unable to migrate, pathogens accumulate into a rich broth. Antibiotics can keep most farm salmon alive long enough to reach market size, but leave the fish contagious, shedding pathogens into marine currents.

In 1991, IBEC brought Atlantic salmon eggs into Canada from the Landcatch hatchery in Scotland. This hatchery had experienced trouble with furunculosis, shipping stock to Norway that triggered an outbreak of the disease which spread into 70 Norwegian Rivers (Johnsen and Jensen 1994). When IBEC put their Atlantic salmon into the Broughton Archipelago - the wild coho returned to a local enhancement hatchery with furunculosis. Over 28% of the adult coho died in this hatchery disease-free for the previous ten years.

When Raincoast became aware that the nearby salmon farms were experiencing an epidemic of the same disease after introducing diseased stock (pers comm. Dale Blackburn farm manager). Fisheries and Oceans refused to identify the farm strain so no comparison could be made with the coho. Fisheries and Oceans permitted the farmers to leave the infected farm salmon in the water where they were treated with large amounts of the antibiotic Oxytetracycline.

In 1993, Scanmar put furunculosis infected Atlantic salmon into the archipelago again. But this time it was a highly antibiotic resistant strain. It spread in days to infect the B.C. Packer fish farms (Needham 1995). In response; B.C. Packers bought Scanmar out, Fisheries and Oceans released the drug Erythromycin previously banned for use in food fish (DFO Streamtips 1992) and permitted the farmers to leave the fish in the water. Raincoast urged Fisheries and Oceans to test the wild fish between the two companies. They did test a wild pink salmon and found furunculosis, but claimed to have lost the culture before they could test for antibiotic resistance, preventing identification of the strain once again (pers com. Dorothee Keiser). Raincoast volunteered to provide them with another wild fish for testing, but Fisheries and Oceans declined. The next spring all age classes of wild chinook in the area crashed (Kingcome Inlet).

Over-fishing kills successively older fish, poor logging practices kill successive juvenile generations, but disease kills all age-classes. The fishing lodges closed and the legendary spring run of chinook vanished without effort by Fisheries and Oceans to find out why.

The disease legacy continues with the 2002 extermination of 1.5 million Atlantic smolts approximately 9 weeks after they entered the archipelago. The fish reportedly were infected with infectious hematopoietic necrosis (IHN). Dubbed the sockeye disease, there are no sockeye runs in the area of this farm, so the source of the disease remains a mystery. The farmers would not use their own boats to remove the fish, local wild fish packers would not take the fish, finally three or four boats were commissioned from Vancouver. IHN is highly contagious. When it was learned that bloodwater from the infected fish would enter the Fraser River (a major sockeye river), during off-loading the David Suzuki Foundation won an injunction to prevent unloading of the fish. The fish were finally taken ashore, with spillage, on eastern Vancouver Island at French Creek and composted. The fish farmers posted guards

around the composting pile, to prevent the public from taking samples of these fish for independent testing but were not successful in this.

Over the next few weeks IHN broke out in two additional, widely separated locations - the Central coast and Clayoquot Sound. All the infected fish were the same size suggesting they had perhaps come from the same hatchery. Raincoast received samples and will be examining whether or not these strains of IHN may be identical. Several weeks after the IHN broke out in the Broughton Archipelago, the disease appeared in a another nearby farm. Instead of destroying these fish *Heritage* salmon farm is attempting to grow them to market size. Research by Fisheries and Oceans Canada has found 25% of herring exposed to IHN in water die. As well wild salmonids have been found susceptible. The entire juvenile population of some runs of herring and salmon are passing the infected pens. Fisheries and Oceans requires enhancement hatcheries to kill IHN infected stocks, but champions the rearing of IHN infected farm fish with the argument that IHN is endemic and therefore harmless. This denies the lethal amplification of the virus by salmon farms. If you stand on a football field with someone with a cold your risk of infection is less than if you stand in an elevator for 6 hours with ten people with colds.

### **Parasites**

Wherever there are salmon farms, there have been epidemic outbreaks of the salmon-specific salmon louse *Lepeophtheirus salmonis*. Entire runs of salmonids, (Atlantic salmon, sea trout and Arctic charr) have been impacted by sea lice proliferation near salmon farms in Ireland, Scotland and Norway. While the second greatest economic loss to salmon farmers, sea lice have historically been considered harmless to wild fish. Wild Pacific salmon become infected with sea lice in the open ocean. When they return to spawn, the lice die as the salmon enters freshwater. In spring, juvenile salmon pass through marine coastal water free of lice until they mix with older schools in the open Pacific.

But salmon farms have dramatically altered sea louse ecology giving them access to an entirely new environment - inshore over-wintering habitat. As adult river-bound wild salmon pass fish farms, their lice shed larvae. Some of these attach to the farm salmon. Over the winter months these lice reproduce exponentially, finding hosts easily in the unnaturally crowded pens, with new generations hatching monthly. By spring the farm salmon are covered with lice and shedding billions of lice larvae just as the tender young wild salmon pass through the farm nets migrating out to sea.

Raincoast documented the first epidemic of this lice species on juvenile wild Pacific salmon. Over 850 juvenile pink salmon, as well as chum, coho, and chinook salmon and adult local sea run cutthroat trout were examined in the summer of 2001. 77% of these fish were infected at or above the lethal level as defined by Norwegian scientists to be 1.6 lice/gram of fish. The epidemic was epicentered around active salmon farms, with very few to no lice where there were no farms.

In response, Fisheries and Oceans did a survey of seven pink salmon, none near active salmon farms and declared there was no sea louse problem in the Broughton Archipelago (FOCS anon 2001), even as the combined use of delousing medications Slice and Ivermectin have risen 3.5 fold in recent years.

Raincoast presented this research in June 2002 at the meeting of the American Society of Limnology and Oceanography (see Appendix, Abstract).

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Other parasitic copepods are also proliferating near salmon farms included a rare eyeball affixing species in sole.



Rex sole parasite (© Alexandra Morton)

### **Human Health**

***Anti-foulant paint*** Many of the net pens in the Broughton Archipelago are red. They have been painted with *Flexgard XI* active ingredient 26.5% Cuprous Oxide, to prevent growth of seaweeds, barnacles and mussels. The label for this paint sports a skull and cross bones . "Notice to user: *Product to be used only in accordance with the directions.*" "*Toxic to aquatic organisms. Do not contaminate water. Do not allow chips or dust generated during paint removal to enter water.*"

However, it is painted onto the nets submerged in water, and has to be re-applied periodically because it all flakes off while they are in the ocean. As densely crowded farm salmon competitively gulp pellets they will ingest this toxic paint drifting from all sides of the pen.

***Ivermectin*** Ivermectin is coveted by salmon farmers to rid their crowded fish stocks of sea lice. While, B.C. salmon farmers are not allowed to put Ivermectin directly into the water as a "pesticide", they may soak it into a food pellet, which many wild marine organisms will find attractive, and throw it into the water as a "pharmaceutical."

On February 7, 2000 - 7,000 farm salmon died from an over-dose of Ivermectin, in a pen in Wells Passage in the Broughton Archipelago, illustrating the narrow margin between efficacy and toxicity for this drug. The problem is not so much that a vet made a mistake, but that this lethal chemical is being used at all in a fish farm sited on commercial and sport fishing grounds. Nearby this farm the exclusive fishing lodge at Sullivan Bay attracts luxury yachts with helicopters on the upper decks and these people go out and trap prawns near the salmon farms using Ivermectin. In addition, a commercial fishing fleet works in that area harvesting prawns and other species and ships them to Japan, the U.S. and places in Canada.

Prawns are bottom feeders, inhabiting places where currents slacken and particulate matter settles. Ivermectin-laced pellets have likely now collected in some of those locations as well. If the prawns don't die outright, they will carry this persistent pesticide for a long time. Four nanograms of Ivermectin per liter of water kills shrimp (that's one ounce per 10,000 Olympic-sized swimming pools) and 1000 degree days

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are required to withdraw salmon from Ivermectin. It is so toxic its manufacturer, Merck, has not approved or even tested the drug for use in water. It was found to kill all life in the sediments underneath salmon farms, preventing decomposition thus creating seriously toxic dumpsites.

Scotland, 11% of farm fish tested positive for Ivermectin in 1994, but who is testing the wild food chain adjacent to the farms in B.C., particularly for sport fishermen? There are not even warnings posted during Ivermectin treatment.

### **Escapes**

Tens of thousands of Atlantic salmon have escaped into the Pacific waters of the Broughton Archipelago. Thousands of Scammar's furunculosis infected fish escaped into Wells Pass in 1993 when the tide twisted a pen set just as the Fraser River sockeye were migrating past in adjacent Queen Charlotte Strait. 30,000 thousand escaped on a calm September day in 1997 when a Stolt farm in Fife Sound failed - just as the coho were migrating past. And unknown tens of thousands were discovered escaping from Stolt's Sargeant Pass during the pink salmon run by commercial fishermen who caught many of them in their nets in August 2000. These are the known escapes, persistent, chronic escapes are considered - business as usual.

Three escaped Atlantics were caught in the Scott Cove Creek - days after the Fife Sound escape, by coho hatchery workers catching broodstock. Red-rimmed, pus encrusted sores were on these fish. Raincoast rushed one to a provincial vet, and sent another out of province for independent analysis. The province report the sores were due to sticks, but this was improbable as some were under the fish's pectoral fins - the most protected area of the fish's body. The other lab reported *Serratia*. Raincoast further tested another fish in the stream, but found it clean. A query on the Internet regarding *Serratia* in fish brought a response from Scotland that this bacteria, common to human sewage had been found in farmed Atlantic salmon there when the crew sewers leak. A provincial report released in April 2000 on compliance in B.C.'s salmon farms found 75% of salmon farms were not disposing of their human sewage at a safe distance from the farms. Raincoast received an anonymous call (one of many from people inside the industry and government) saying when they flushed dye down their toilets, it came up *inside* the pens!

Raincoast took three Atlantic salmon out of the Wakeman River with the help of sportfishermen. One of these had a swollen and gray mottled kidney - a classic symptom of some fish diseases. After this sample was sent to the lab for analysis - the lab refused to further communicate with Raincoast again - ever. This is a common reaction. When a local lab was contacted for testing, arrangements went smoothly until the species of fish was identified as Atlantic salmon. At that point the lab refused to accept the samples saying they would never work for industry or government again if they tested for disease in escaped farm salmon.

In the summer of 2000 Raincoast conducted a study to count the number of Atlantic salmon caught in the Archipelago and adjacent waters. In a 30 day period 10,826 Atlantic salmon were recorded by this study. 774 whole or partial Atlantic salmon were examined and 2.1% were found to have consumed wild food, even though several thousand had only been free for a matter of days. Report under review.

### **Feed the world?**

Farming fish has been practiced for thousands of years, but not in the manner now underway on many temperate coasts worldwide today. Traditionally, fish that eat vegetable matter were used, such as carp or tilapia. For thousands of years Chinese fish farms have cycled waste from vegetable crops through their fish and then used the waste from the fish to fertilize the next vegetable crop. This sustainable, closed loop system created protein. In the late 1970's however, a Norwegian hydro company, Norsk Hydro initiated the first corporate effort to farm salmon.

Salmon are carnivores. No one has successfully farmed a carnivore. A terrestrial equivalent would feed chickens to dogs and eat the dog. The underlying equation in farming carnivores is a net loss in protein, and would not be profitable if full price is paid for the feed. Salmon farming takes two - five pounds of wild fish to produce one pound of farm salmon. This represents a net global protein loss as most of the fish used to make pellets are high quality food fit for human consumption. In 1999, 189,000 tons of Chilean whiting was sold to make fish farm pellets for \$12.9 million, when it could have produced \$102.9 million if sold for human consumption. Salmon farming is not sustainable. It starves one ocean of fish, and pollutes another with the same fish. Its profit margin is so slight it can not afford to deal with its own waste. Its product is of questionable food quality being high in PCBs, low in omega oils and dyed pink. It is favoured politically because it produces salmon without a river, leaving the resource rich watersheds of British Columbia open for exploitation. It is a classic example of destruction of the commons to promote the privately owned.

### **References**

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## APPENDIX

### ABSTRACT OF PRESENTATION TO THE AMERICAN SOCIETY OF LIMNOLOGY AND OCEANOGRAPHY VICTORIA, B.C.

#### **SS1.01 Assessing Potential Environmental Impacts of Aquaculture**

Date: Thursday, June 13, 2002

Time: 12:00:00 PM

Location: Lecture Theatre

Morton, A, B, Raincoast Research, Simoom Sound, Canada, wildorca@island.net

HIGH NUMBERS OF *LEPEOPHTHEIRUS SALMONIS* ON JUVENILE PINK SALMON IN

BRITISH COLUMBIA, CANADA

Although historically an innocuous parasite, sea lice infections of wild salmon have become a critical issue in areas where wild and farm salmon share marine habitat. It is generally believed that farm salmon initially acquire sea lice (*Lepeophtheirus salmonis*) from adult wild salmon stocks returning from the sea to spawn. Under natural conditions, this species of sea louse dies when wild salmon enter freshwater to spawn, depriving this salmon-specific parasite of a host. Now it would appear salmon farms could offer sea lice artificial, inshore, over-wintering habitat.

Widespread reports of *Lepeophtheirus salmonis* infestation of farm salmon suggests that sea lice respond favourably to the ideal parasitic conditions i.e. dense crowding, stationary hosts and 24-hour lighting, found on salmon farms. Sea louse egg-production peaks in spring just as wild salmon smolts encounter the farms on their out-migration, making infection possible. The number, age class, sex and species of lice were examined on 923 juvenile wild salmon caught from June 5 through August 15th, 2001 at 48 sites in the heavily salmon-farmed Broughton Archipelago. The data presented in this paper indicate the highest infection rates by early chalimus stage lice occurred at and immediately west of aquaculture pens containing adult Atlantic salmon.