



**EXCLUSIVE  
REPORT**

## **Norwegian Salmon Farm Virus Threatens Clayoquot Chinook**

February 2020

# **GOING VIRAL**

**Clayoquot  
Action .org**

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### **ABOUT CLAYOQUOT ACTION**

Clayoquot Action is a Tofino-based conservation society committed to protecting the biocultural diversity of Clayoquot Sound. Our goals are accomplished through public education, citizen science, and advocacy. Clayoquot Action stands for democratic rights, Indigenous rights, and the rights of Mother Earth.

### **ABOUT CLAYOQUOT SOUND**

Clayoquot Sound is the Last Great Rainforest on Vancouver Island. The battle to protect these forests culminated in the largest act of civil disobedience in Canadian history in 1993, with close to one thousand people arrested. The global significance of this ecosystem was recognized with its designation as a UNESCO Biosphere Reserve.

The shallow soils of coastal rainforests lack nutrients, yet the ancient cedars grow to majestic proportions. The missing nitrogen is transported from the sea by wild salmon returning to spawn.

All of the conservation gains in Clayoquot Sound are being put at risk by industrial salmon farming. It's time to remove salmon farms from the waters of Clayoquot Sound, and allow wild salmon populations to rebound to create abundance for everyone.

### **RIGHTS & TITLE**

Clayoquot Action recognizes and supports the Indigenous rights and title of the Hesquiaht, Ahousaht, and Tla-o-qui-aht First Nations—stewards since time immemorial of the lands and waters now called Clayoquot Sound.

### **ABOUT CLAYOQUOT SALMON INVESTIGATION**

Clayoquot Salmon Investigation (CSI) is Clayoquot Action's citizen science program. The focus is on monitoring and assessing the impacts of salmon farms in the Clayoquot Sound UNESCO Biosphere Reserve.



## EXECUTIVE SUMMARY

Gazing north from the village of Tofino towards the rainforest-covered mountains of the Clayoquot Sound UNESCO Biosphere Reserve, the view is spectacular. But who would imagine that just out of sight, 20 salmon farms are tucked away along the wild salmon migration corridors, polluting the pristine waters?

There is a dangerous, highly-contagious virus plaguing salmon farms here on Canada's west coast. It comes from the Atlantic Ocean.

The virus is called piscine orthoreovirus (PRV). Scientific evidence is mounting that PRV is harmful to wild salmon—a Department of Fisheries study concluded “migratory Chinook salmon may be at more than a minimal risk of disease from exposure to high levels of PRV occurring on salmon farms.” (Di Cicco & Miller 2018)

An infected salmon farm can release as many as 65 billion viral particles an hour, which are spread far and wide by tidal currents. Because fish breathe by passing water over their gills, it is dead easy for PRV to enter the blood stream of wild fish.

The goal of Going Viral was to establish the presence or absence of PRV on salmon farms in Clayoquot Sound. Samples were collected adjacent to stocked farms and sent to the Atlantic Veterinary College for testing by Dr. Fred Kibenge, one of the world's leading salmon virologists.

**The results: we found 90% of Cermaq's active farms were PRV-infected; 100% of Creative Salmon's farms were infected as well.**

Some within DFO claim that PRV is endemic to British Columbia, yet no-one has provided the genetic sequence to support this claim. Our study shows that the PRV being found in Clayoquot Sound is the Atlantic PRV-1a sequence variant, a sequence variant also found in Norway and Iceland.

Three court battles have been waged (and won) to stop the transfer of PRV-infected fish into open-net pen salmon farms. A 2015 judgment stated “The evidence suggests that the disease agent (PRV) may be harmful to the protection and conservation of fish, and therefore a lack of full scientific certainty should not be used [as] a reason for postponing measures to prevent environmental degradation”. Nonetheless, PRV-infected farmed salmon continue to be transferred into open net pens.

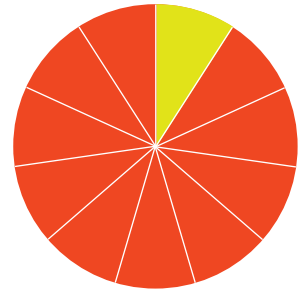
During the International Year of Salmon in 2019, salmon returns to rivers in British Columbia were the lowest in the history of Canada. Clayoquot Sound Chinook are on the brink of extinction.

Everything in Clayoquot Sound depends on wild salmon: they feed orcas, bears, wolves and over a hundred other species. Indigenous Peoples and cultures have depended on wild salmon for millennia.

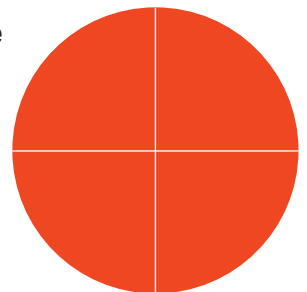
The government of Canada has pledged to move salmon farms into closed containment by 2025. In the interim, it is time to implement the Precautionary Principle and stop the transfer of PRV-infected fish into BC salmon farms, as Washington State has done.

### PRV-1a infection rates on salmon farms in Clayoquot Sound

**Cermaq**  
**90%**  
10/11  
active sites  
tested



**Creative Salmon**  
**100%**  
4/4  
active sites  
tested



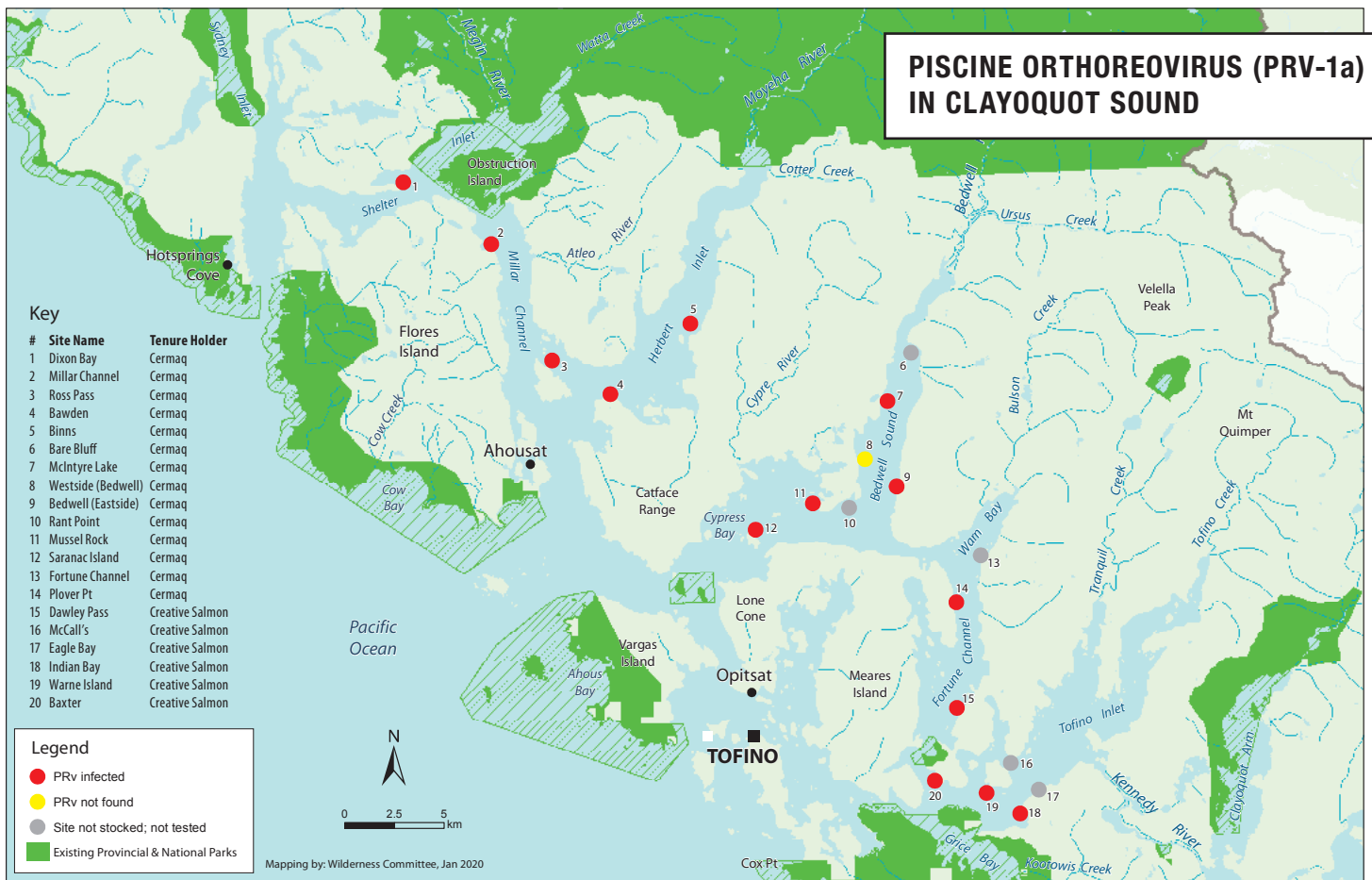
## TIMELINE: PRV IN BRITISH COLUMBIA

- 1999** HSMI (Heart Skeletal Muscle Inflammation) appears in Norway.
- 2004** Creative Salmon in Tofino begins experiencing jaundice on their Clayoquot Sound operations.
- 2010** PRV documented on Norwegian salmon farms. (Palacios et al 2010)
- 2011** Creative Salmon invites Department of Fisheries genomic scientist Dr. Kristi Miller to help them with their jaundice problem. Miller finds PRV.
- 2013** Morton and Kibenge publish first report of PRV In British Columbia. (Kibenge et al 2013)
- BC Provincial Veterinarian Gary Marty reports that PRV occurs in about 80% of farmed Atlantic salmon.
- Alexandra Morton takes Marine Harvest to court, arguing they are violating Section 56 of the *Fisheries (General) Regulations* by transferring PRV-infected juveniles into their open-net pens. Marine Harvest states that if the policy to allow fish with PRV to be transferred is successfully challenged, it would “severely impact” their business.
- 2015** Morton wins her case.
- The industry does not comply—rather, they appeal. DFO joins appeal on industry’s side.
- Appeal adjourned by DFO due to “new information.”
- 2017** Study establishes that PRV causes Heart Skeletal Muscle Inflammation. (Wessel et al 2017)
- DFO study reports the disease HSMI in salmon farms in BC. (Di Cicco et al 2017)
- 2018** A DFO study confirms that PRV in Pacific Chinook is strongly associated with the rupture of red blood cells, overwhelming the vital organs, resulting in jaundice, organ failure and death. (Di Cicco & Miller 2018)
- New court case brought by Alexandra Morton, based on new evidence.
- Parallel case brought forward by ‘Namgis First Nation to prevent transfer of PRV-infected smolts into fish farms in their territories.
- 2019** Morton and ‘Namgis win. DFO ordered to revise their PRV policy to reflect the precautionary principle by June 4th.
- June: DFO asks the court for an extension—they are given 4 months.
- October: During the federal election when there is no sitting Minister of Fisheries, the Department announces they would not be screening for PRV, and even if they were informed that the fish were infected they would not prohibit the transfer.
- 2020** ‘Namgis First Nation take DFO to court once again, asking for a review of the October 2019 decision not to prohibit the stocking of salmon farms with PRV-infected fish.

## BANNED IN WASHINGTON STATE

In 2018 the state of Washington, immediately to the south of BC, banned open-net pen salmon farms from their waters by 2025. In the interim period, they are not allowing salmon infected with PRV to be put into the water. They have ordered that 1.8 million farm fish be destroyed rather than put their wild salmon at risk.

British Columbia is the only remaining jurisdiction on the west coast of North America permitting open-net pens in ocean waters. In Alaska—where open-net pen salmon farms have never been permitted—2019 salmon harvests were some of the largest on record. Meanwhile, just over the border in BC, wild salmon numbers are crashing.



## WHAT IS PRV?

Piscine orthoreovirus (PRV) is a salmon virus which appears to come from the northern Atlantic Ocean. No PRV genetic sequence had been found in BC prior to 2011—now most farmed salmon for sale in markets test PRV positive, and the evidence suggests PRV is spreading to wild salmon. The most likely way it got here is via the 30 million Atlantic salmon eggs imported to BC.

A causal relationship has been established between PRV and Heart Skeletal Muscle Inflammation (HSMI). (Wessel et al 2017)

In Pacific Chinook salmon, DFO scientists report that PRV is strongly associated with the rupture of red blood cells, overwhelming the vital organs, resulting in jaundice, organ failure and death. The study on the effect of PRV on Sockeye salmon was terminated before the heart damage had run its course, so we don't know how severely PRV damages the hearts. Damaging a salmon's heart reduces its ability to catch food, evade predators and swim up river to spawn. **Of particular concern, PRV-1a is replicating in Creative Salmon's operations near Tofino, adapting to a Pacific species (Chinook), and spreading through the waters of Clayoquot Sound UNESCO Biosphere Reserve—where wild Chinook are on the brink of extinction.**

DFO testimony at Canada's 2010 Cohen Commission revealed that an infected salmon farm can shed 65 billion viral particles per hour. BC's strong tidal currents are spreading this farm virus far and wide. Fish breathe by passing water over their gills, making it dead easy for PRV to enter their bloodstream.

Research has already shown that wild salmon exposed to salmon farms are much more likely to be infected with PRV. As well, PRV infection levels are lower in the higher reaches of the Fraser River than near the mouth, suggesting PRV-infected fish are not making it up the river—perhaps because the virus weakens wild salmon. (Morton et al 2017)

## TIMELINE: CREATIVE SALMON



### 2004-2011

Creative Salmon's farmed Chinook salmon become inexplicably jaundiced.

### Early 2011

Creative Salmon invites Department of Fisheries genomic scientist Dr. Kristi Miller to help them diagnose the problem.



### Fall 2011

Cohen Commission into the Decline of the Sockeye in the Fraser River orders the province of BC to provide farm salmon health records. Dr. Miller takes the stand and reveals that her study found that Creative Salmon's fish farms are infected with PRV, a new virus for Canada which Norwegian fish farmers were just beginning to understand.

### 2012

There are no repercussions for Creative Salmon; DFO takes no action.

### November 2017

Wildlife photographer Tavish Campbell dives under the fish plant used by Creative Salmon and films blood water effluent billowing out into Tofino Harbour. Effluent samples are infected with the Atlantic PRV-1a sequence variant.





**December 2017**  
Campbell's images go viral, with three million online views and coverage by CTV (left) and The Guardian.



**December 2017**  
The newly-minted government in BC begins a review of compliance at all fish processing plants in the province—a win for people power!

**June 2018**  
The government review concludes that plants should have a finer mesh on effluent pipes to filter out more tissue, and treatment to remove the red colour of the bloodwater.



**June 2018**  
A DFO study confirms that PRV in Pacific Chinook is strongly associated with the rupture of red blood cells, resulting in jaundice, organ failure and death.

**November 2018**  
Tofino Bloodwater 2. Campbell again dives under the Tofino fish plant. Samples test positive for PRV again—a year after the BC government began addressing the problem.

**No response**  
from BC government to second bloodwater PRV findings.

**February 2019**  
Tofino fish plant begins installing new treatment system to clean up their effluent.



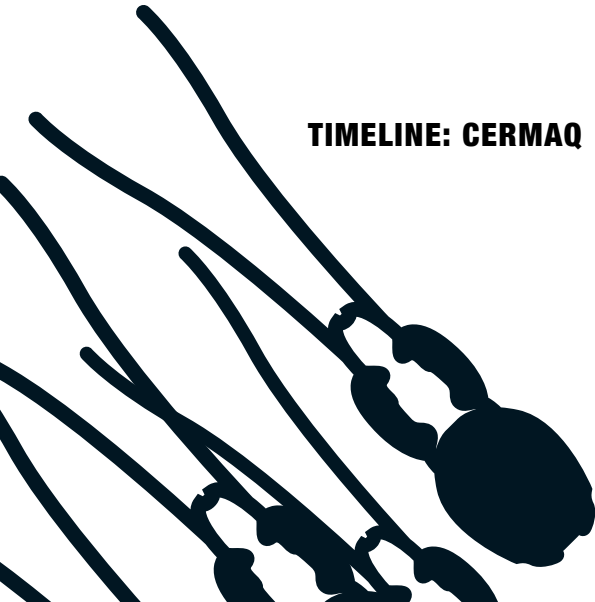
**June 2019**  
Ongoing concerns prompt members of Tla-o-qui-aht First Nation to board Creative Salmon farms with the support of Sea Shepherd Conservation Society. GoPro cameras inserted into the open-net pens at Creative's Warne Island and Indian Bay farms capture images of jaundiced farmed Chinook, and schools of juvenile wild salmon and herring.

**June 2019**  
Clayoquot Action joins with Sea Shepherd to sample the same two farms on the same day—results show they are both infected with the Atlantic PRV-1a sequence variant.



**November 2019**  
Bloodwater 3. Campbell's third dive under Tofino fish plant reveals that the bloodwater effluent is no longer bright red—but it's still PRV-infected.

**TIMELINE: CERMAQ**



**Spring 2018**

Cermaq's Clayoquot Sound operations experience a massive salmon lice outbreak. Farmed fish carry lice loads over ten times above the treatment threshold. Juvenile wild salmon are sampled carrying lice loads as high as 50 per fish.



**February 2019**

Lice numbers begin to rise again. Cermaq uses controversial chemical bath to treat for lice. This treatment is known to trigger viral outbreaks.

**April 2019**

Cermaq's Bedwell East fish farm tests positive for the Atlantic PRV-1a sequence variant.



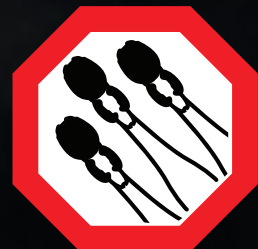
**Throughout Spring 2019**

For the second year in a row, Cermaq has a serious lice outbreak on their Clayoquot operations.



**May 2019**

During harvest of Bedwell East, the waters around the pens were filled with gravid (egg-bearing) lice that had been dislodged from the farmed fish during harvesting. CSI samples one of the lice; there is PRV in the sample.



**Throughout Spring 2019**

Cedar Coast Field Station sampling of juvenile wild salmon again reveals high lice infection rates with lice loads as high as 50 per fish.



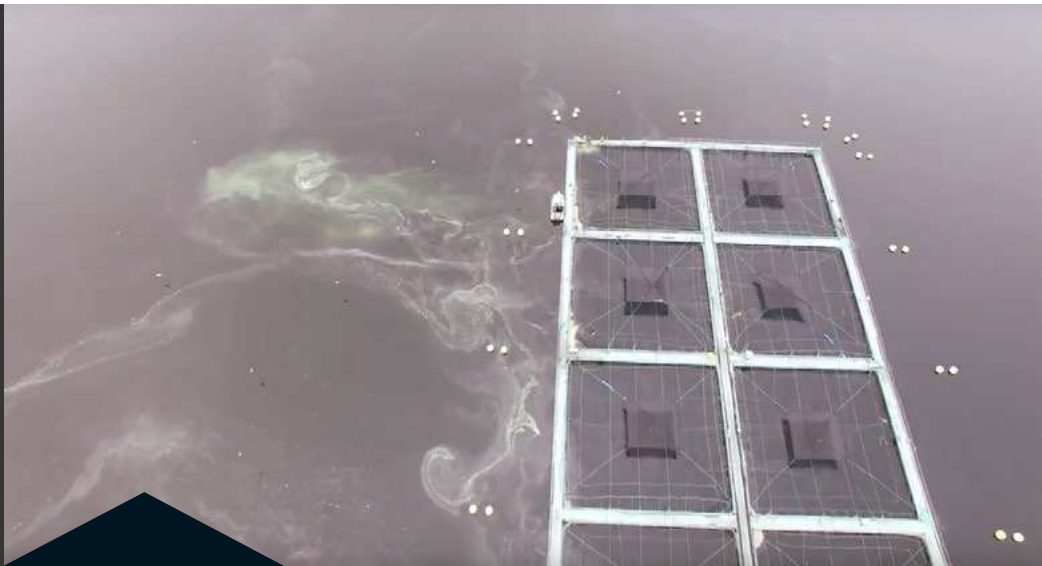


### August 2019

Cermaq's Binns Island fish farm found to be infected with the Atlantic PRV-1a sequence variant.

### November 2019

Unseasonal hazardous algae bloom causes a mass die-off at Cermaq's northern Clayoquot operations. CSI breaks the story and samples Binns Island farm, which is again found to be PRV-infected.



### November 2019

Over 200,000 farmed salmon die. A massive slick of fat and decomposing flesh flows out of Binns Island and spreads over many kilometres. CSI samples some of this organic matter; it tests positive for PRV.



## SEA LICE IN CLAYOQUOT SOUND

Fish farms provide millions of hosts for sea lice—year round—so lice populations on salmon farms boom. Because BC salmon farms are open-net pens, the lice can pass through the nets and drift far and wide on tidal currents.

A tiny juvenile wild salmon leaving the river to live at sea has to run a gauntlet of salmon farms along wild salmon migration corridors. Too young to have developed protective scales, they are extremely vulnerable—one to three lice is a fatal load.

In 2018 and 2019, Cermaq experienced unprecedented sea lice outbreaks at their Clayoquot operations.

Sea lice cannot themselves be infected with PRV, but they can carry it on the exterior of their body, and in their gastrointestinal tract. Salmon lice (*Lepeophtherius salmonis*) tend to find a host and stick with them, but herring lice (*Caligus* species) move from host to host, and could act as a vector for spreading the disease.

## CONCLUSION

There are two important reasons why we should not allow PRV-infected salmon into BC open-net pens:

- **Salmon farms amplify viruses and broadcast them to the surrounding environment; and**
- **Salmon farms allow the virus to breed, mutate, and become more virulent—as happened in Norway. (Dhamotharan et al. 2019)**

The government of Canada has pledged to move salmon farms into closed containment by 2025. In the interim, as we have demonstrated in this report, it is past time to implement the Precautionary Principle and stop the transfer of PRV-infected fish into salmon farms.





## CITIZEN SCIENCE IN ACTION

The method we used was developed by biologist Alexandra Morton. Because BC fish farms use open-net pens, things flow in and out. Sea lice, bits of decomposing farmed fish, and viral particles flow out freely to pollute the marine environment. This means we can take samples from fish farms and test them for pathogens.

Teams of staff and volunteers conducted twenty five field trips from May through December 2019. We approached the farm, standing on the prow of the boat with aquarium nets on poles, and scooped up bits of flesh, fat, feces or fish scales. Sometimes this takes just minutes; other times we strained our eyes for an hour in order to fill a couple of vials.

Research samples were taken from stocked farms and sent to the Atlantic Veterinary College for testing by Dr. Fred Kibenge, one of the world's leading salmon virologists.




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Project coordinated by Bonny Glambeck.

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**Clayoquot  
Action**

Box 511, Tofino BC V0R 2Z0 • 1-877-422-WILD

[Facebook.com/ClayoquotAction](https://Facebook.com/ClayoquotAction)

Twitter @ClayoquotAction

Instagram @Clayoquot.Action

Email/Web: [dan@clayoquotaction.org](mailto:dan@clayoquotaction.org)