



## *A Backgrounder from*

### **Atlantic Salmon Federation**

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### **SEARCHING FOR ORIGINS OF SALMON DISEASE:**

- People have reasoned that mortality from disease plays a significant role in the health of wild Atlantic salmon populations, but until recently scientists have not possessed the tools to analyze whether this is accurate. Sick fish died and disappeared.
- Following the Cohen Commission of Inquiry into the Decline of Sockeye Salmon in B.C.'s Fraser River, which concluded in 2012, emphasis was placed in developing tools to screen for salmon disease and analyze the influence of open net-pen salmon aquaculture.
- Dr. Kristina M. Miller, a research scientist at DFO's Pacific Biological Station acquired a Fluidigm BioMark system to conduct high-throughput polymerase chain reaction analysis, an advanced genomic tool that detects the presence of DNA in tissue samples. Miller's laboratory then developed an assay panel of 44 infectious agents (viruses, parasites, and bacteria) believed to cause disease in worldwide, establishing a foundation for comparison.
- Her team's work, focused on Pacific salmon, has resulted in dozens of publications and a fundamental shift in human understanding of infection and pathways for transmission in fish. The study published April 24th in the peer-reviewed journal *Facets* is the first instance of this knowledge and technology being applied to wild and aquaculture salmon on Canada's east coast.

### **WHERE WE LOOKED:**

- Tissue samples from three rivers and off the coast of two west Greenland communities were collected in 2016 and 2017. They include:
- Paamiut and Maniitsoq, Greenland: Samples taken from 73 Atlantic salmon caught in the domestic commercial fishery in 2016
- Magaguadavic River (N.B.): 17 aquaculture escapees lethally sampled in 2017
- St. John River (N.B.): 30 wild or hatchery origin salmon non-lethally sampled in 2017
- Restigouche River (N.B./Quebec): 30 wild origin Atlantic salmon captured by Listuguj First Nation lethally sampled in 2017

Total: 150 salmon

### **WHAT WE FOUND:**

From an assay panel of 44 infectious agents believed to cause salmon disease worldwide, 14 were found in tissue samples taken for this study, including five not previously described in peer-reviewed literature in Atlantic waters, and two found only in government reports and grey literature.

#### **Parasites**

**Parvicapsula pseudobranchicola\***: associated with gill infections, can impact swimming ability and possibly vision. It can cause heavy losses in aquaculture settings when hatchery fish are transferred to the sea.

**Tetracapsuloides bryosalmonae**: freshwater-transmitted agent causing prolific kidney disease generally at high water temperatures. Its pathogenic effects could increase with climate change.

**Paranucleospora theridion\***: associated with gill inflammation and prolific gill disease in Norway. Sea lice are reservoirs for this parasite.

**Ichthyophonus hoferi:** endemic in eastern Canada. Transmitted from prey (herring) to predator. It can affect swimming ability of the fish. Has low prevalence in Labrador Sea but higher in river samples suggest infections near coastal zones.

**Sphaerothecum destruens:** can cause high mortality in salmon farms. The spores can infect multiple organs and cells.

## Bacteria

**Aeromonas salmonicida:** pathogenic agent that causes furunculosis. Detected in St. John and Restigouche systems.

**Flavobacterium psychrophilum:** agent of bacterial coldwater disease, which can develop at low temperatures. Can impair osmoregulation and trigger ion imbalance, potentially leading to high mortality rates.

**Candidatus Piscichlamydia salmonis\*:** associated with gill disease and epitheliocystis at high spore densities.

**Candidatus Syngnamydia salmonis\*:** also associated with gill disease (epitheliocystis) at high spore densities.

## Viruses

**Infectious salmon anemia virus (ISA):** Endemic in Atlantic Canada and present in wild and aquaculture salmon, ISAV is a federally reportable animal disease agent first detected in Canada in 1996 when an outbreak occurred in New Brunswick based sea-cages. ISAV can cause severe illness and death and affects multiple species. It is a leading cause of on-going mass mortalities in the Atlantic Canadian salmon aquaculture industry.

**Piscine orthoreovirus (PRV)\*\*:** Widespread in aquaculture salmon with variants also detected in wild Atlantic salmon, PRV is associated with heart and skeletal muscle inflammation, a deadly salmon disease, and can lead to reduced fitness in infected individuals. One strain of PRV was detected in two wild Atlantic salmon sampled off Greenland, and another in aquaculture escapees. PRV was not detected in any salmon returning to the St. John and Restigouche rivers.

**Salmon gill poxvirus\*\*:** affects the gills, causing lethargy, respiratory distress and mortality.

**Atlantic salmon calicivirus\*:** infects fish organs, but not associated with heart disease. Found in Norway farms, but not previously reported in western Atlantic

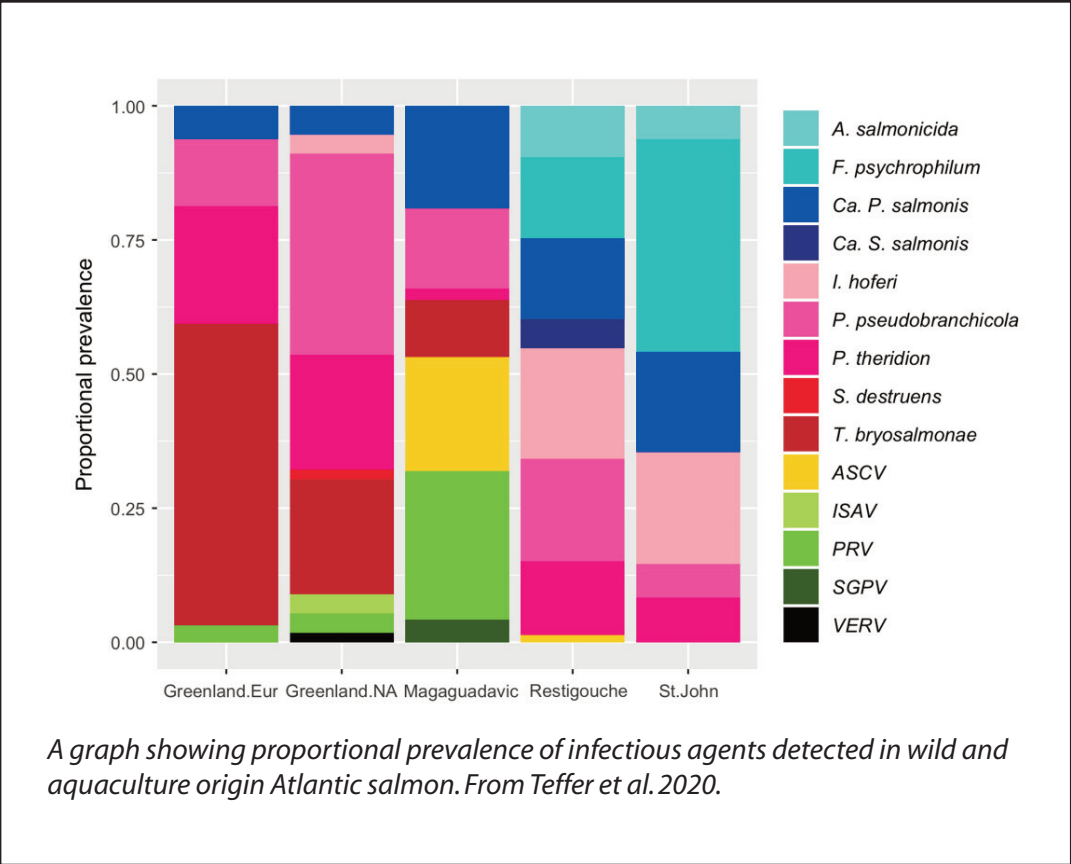
**Viral encephalopathy and retinopathy virus:** a nodavirus with wide geographic range but low prevalence. Unknown impacts and transmission among wild salmon, which warrants monitoring.

*\*indicates infectious agents not previously described as occurring in Eastern North America*

*\*\*indicates infectious agents described in reports and grey literature, but not in peer reviewed studies pertaining to Eastern North America*

## Infection versus disease:

The transmission of infectious agents like viruses, parasites, and bacteria may not result in reduced fitness and disease in hosts. Our study did not assess fish health outcomes, but rather scanned samples for the presence or absence of agents known to cause disease in salmon. As the authors state, "understanding if and where pathogen exchange occurs is a crucial first step toward characterizing impacts on wild Atlantic salmon across their range, including the influence of human activities like aquaculture."



**RESEARCH PARTNERS**



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