SALMON FARMING IS GOING VIRAL: SEA LICE EDITION

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Sea lice are out of control at open net-pen aquaculture sites in Canada. Wild salmon pay the price.

Across the world, the open-net pen salmon farming industry is stuck in an intractable battle against sea lice. Recognized as one of the top challenges facing the sustainability of wild salmon in fish farming nations today[1 2 3 4], sea lice breed by the millions at sea-cage sites where hundreds of thousands of cultured salmon are grown in tightly enclosed conditions. From there, they flow freely into the natural environment where they can attach themselves to wild fish. These tiny ectoparasites feed on the blood, skin and mucus of the host fish, causing a variety of physiological impacts, including an increased susceptibility to disease[5 6], and often leading to death. With outbreaks now occurring regularly at open net-pen sites across Canadian waters, sea lice pose a dire threat to depleted or near-extirpated wild salmon populations in British Columbia and Atlantic Canada alike – a threat that continues to expand due to the declining effect of treatment[7 8] and increasingly warm seas[9].

A wild juvenile pink salmon, captured on the B.C. coast and covered in sea lice. *Photo: Tavish Campbell*

SEA LICE IN THE PACIFIC

On the Pacific coast, studies have shown a greater number and distribution of sea lice in waters surrounding active salmon farms, with a corresponding increase in the number of wild juvenile salmon carrying sea lice nearby[10 11 12 13]. The abundance of sea lice on fish farms has been linked directly to decreased survival rates in coho salmon populations[14], and researchers have sounded the alarm about the vulnerability of juvenile sockeye salmon, reporting on profound stress responses[15], behavioural change[16 17] and reduced growth[18]. Juvenile pink and chum salmon are very vulnerable even to low levels of farm-derived sea lice due to their small size and underdeveloped scales when out-migrating[19 20]. Compounding the challenge of protecting wild salmon, industry has routinely underreported sea lice numbers in B.C., meaning that mandated (and expensive) delousing treatments are not always triggered when they should be[21].

A TROUBLING CASE STUDY IN CLAYOQUOT SOUND

- In the spring of 2018, sea lice infection rates in Cermaq's Clayoquot Sound salmon farms peaked between five and 54 lice per fish[22].
- Industry-commissioned sea lice counts on wild juvenile chum salmon ranged as high as 43 lice per fish with a 40% infection rate[23].
- Independent research conducted on the same wild salmon populations peaked at 50 lice per fish with a 96% infection rate[24].
- Cermaq admitted an inability to manage sea lice citing SLICE resistance.
- **Wild salmon returns have reached historic lows in Clayoquot Sound**, down to tens of fish from thousands in some cases, with sea lice continuing to act as a primary threat year after year.

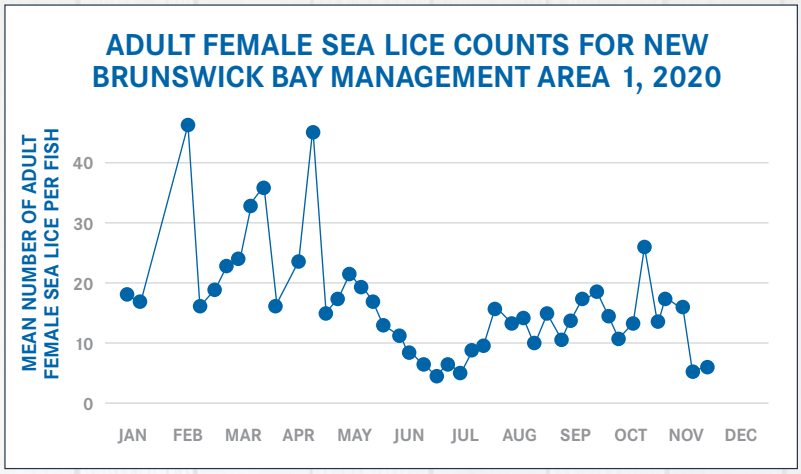
SEA LICE IN THE ATLANTIC

In the Fundy Isles region of New Brunswick, Atlantic Canada's most productive fish farming area, 2020 industry reporting at several salmon aquaculture sites recorded upwards of 40 *adult female* sea lice per fish on average during certain times of year[25] *. These high numbers may not capture the full extent of proliferation in the region, as they do not include counts for pre-adult or adult male lice[26]. Studies suggest that industry counters may be more likely to report lower lice counts than auditors when pre-adult and adult male lice numbers are high[27].

Canada has been relatively slow to invest in studying the risks that sea lice pose to marine ecosystems in Atlantic waters, and a full picture of impact is still emerging[28 29]. Three wild Atlantic salmon populations (Outer Bay of Fundy, Nova Scotia Southern Uplands and Southern Newfoundland) listed as threatened or endangered by the Committee on the Status of Endangered Wildlife in Canada[30] and the near-extirpated Inner Bay of Fundy salmon population, listed under the federal Species at Risk Act (SARA), all migrate in dangerous proximity to open net-pen sites[31 32 33 34].

TRACKING SEA LICE AND SALMON ON THE MAGAGUADAVIC: WHAT WE KNOW

- On the Magaguadavic River, River, near a high density salmon farming area in Passamaquoddy Bay, about one fifth of returning wild salmon carried sea lice between 1992 and 2013[35].
- The greatest potential for transfer from fish farms to juvenile wild salmon occurs when farm lice loads are elevated[36]; lice loads in the Passamaquoddy region are some of the highest in New Brunswick[37].
- Down from wild returns of 900 fish in 1992, **only one salmon of wild origin was recorded in the Magaguadavic in 2019**[38].



Sea lice counts in parts of New Brunswick skyrocketed in 2020, showing more than 40 female lice per fish at certain times of year. The data above show sea lice counts for NB-Bay Management Area 1, including most of Passamaquoddy Bay, Deer Island and parts of Campobello Island.

SEA LICE SCIENCE FROM NORWAY: CLEAR EVIDENCE OF IMPACT ON WILD FISH

Norwegian independent and governmental researchers have long agreed that the evidence is clear: farm-derived sea lice represent one of the greatest threats to wild salmon and trout populations today[40 41 42 43]. Studies have helped to quantify this threat by measuring mortality rates for wild Atlantic salmon smolts based on the size of the fish and the number of sea lice attached[44]. The smallest smolts are the most vulnerable, whereas larger fish can survive greater lice loads.

Sea lice induced mortality rates for a wild Atlantic salmon smolt weighing 20 grams[45] **:

- **0% chance of mortality** with fewer than 2 lice attached;
- **20% chance of mortality** with 2-3 lice attached;
- **50% chance of mortality** with 4-6 lice attached;
- **100% chance of mortality** with more than 6 lice attached.

* *Sea lice counts for Nova Scotia are currently not made public. The Government of Newfoundland and Labrador mandated public reporting as of January 2021[39], and industry reports have been made available as of May 2021.*

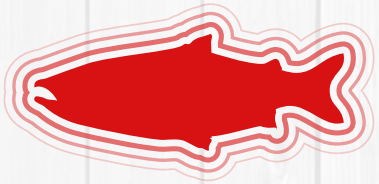
** ***DFO has not established*** *similar risk assessment frameworks for Pacific salmon species. Many Pacific salmon species are much smaller than Atlantic salmon when they first enter the marine environment. Pink and chum salmon, for example, migrate to sea immediately or very soon after hatching, weighing as little as one gram, and have no protective scales for defence against sea lice infection.*

TRICKS OF THE TRADE: SEA LICE TREATMENTS ON SALMON FARMS

SLICE™: THE INDUSTRY'S DRUG OF CHOICE HAS LOST ITS EDGE

To combat sea lice, for years farmed salmon in Canada were commonly fed a compound called SLICE™. Through their feed, the salmon absorb a pesticide called emamectin benzoate in the gut, where it begins to circulate through their bodies and ultimately into the skin. Attached sea lice ingest the toxin while feeding on the salmon, inducing paralysis and death, at least in theory. In reality, generations of lice on farms have build up a resistant to SLICE™ [46] – a problem found across the industry, globally. As a result, farmers are now using an increasing array of chemicals.

A VERY TOXIC BATH: FISH FARMING CHEMICALS

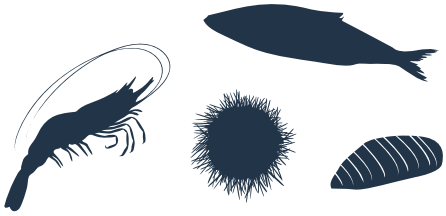


Salmon farmers hold fish in tarped cages or well boats where they are bathed in products like Paramove® 50 (hydrogen peroxide) or Salmosan Vet® (azamethiphos) for a period of time in efforts to rid fish of lice. Afterwards, operators commonly discharge the treatment water into the open sea[47 48]. Safety data sheets list both products as toxic or very toxic to aquatic life, with long-lasting effects[49 50]. As recently as 2016, 99% of sea lice treatment in New Brunswick involved chemical compounds[51]. More than 1185 sea lice treatments were applied across 57 sites in the Bay of Fundy between 2010 and 2016[52]. While the industry states they have moved toward more mechanical treatments, **the Atlantic Canada Fish Farmers Association reports that 22.7% of sea lice treatments in New Brunswick still used Paramove® 50 or Salmosan® products in 2020**[53].

Sea lice treatments applied at open net-pen aquaculture sites in Atlantic Canada are extremely harmful to the American lobster. The fish farming industry relies on the dilution of chemical products in seawater to stay below lethal levels. *Photo: Nick Hawkins*

CHEMICAL BATH TREATMENTS & LOBSTER IN THE NORTH ATLANTIC

- Paramove® 50 (hydrogen peroxide) and Salmosan Vet® (azamethiphos) can cause death, delayed spawning, neurotoxicity, immobility and behavioural change in North Atlantic lobster at varying levels of exposure[54 55 56].
- Both chemicals have been associated with lethal and non-lethal impacts in other marine organisms including algae and aquatic plants[57], herring, shrimp, mussels, snails, sea stars and sea urchins[58].



Lobster larvae (shown here) and molting female lobsters are extremely vulnerable to chemical sea lice treatments[59 60]. *Photo: Jessica Waller*

CYPERMETHRIN: STILL QUIETLY IN USE?

- The industry's struggle to control sea lice has even resulted in emergency use of Cypermethrin - a chemical considered "very toxic to crustaceans" and deemed "not accepted to be used" by Canadian authorites.
- In 2013, Kelly Cove Salmon was charged $500,000 under the Fisheries Act for killing hundreds of lobsters in the Fundy Isles region with the illegal use of Cypermethrin.
- Canadian Food Inspection Agency laboratory results obtained through an Access to Information request show that Cypermethrin has been used by the Canadian salmon farming industry as recently as 2018[61].

MECHANICAL TREATMENT: THERMAL & HYDRO PROCEDURES AREN'T WORKING AND POSE NEW PROBLEMS

- Bath and mechanical delousing treatments (e.g., Hydrolicer®) have been unable to control sea lice outbreaks in British Columbia[62]. They commonly release surviving lice, larvae or eggs back into the sea[63].
- Thermal and mechanical delousing practices can kill farmed fish via heat-induced or physical trauma, raising significant animal welfare concerns[64].
- New research suggests that frequent treatments using freshwater could lead to freshwater tolerance in sea lice[65]. Freshwater represents one of the only natural defences that wild salmon have against sea lice in the wild.

New thermal and mechanical treatment options involve vessels like the Hydrolicer, where fish are put through pressurized freshwater or warm water baths. Despite the hype, these novel methods have been unable to control sea lice outbreaks to-date. *Photo: Hydrolicer*

A losing battle for the salmon farming industry

On both of Canada's fish farming coasts, sea lice continue to build resistance to traditional treatments through generations of proliferation on salmon farms. Today's salmon farming industry is hemorrhaging an estimated $1 billion annually due to the costs of sea lice outbreaks[66]. Sea lice resistance to current treatment options are forcing businesses to reach for dangerous treatment options with unreliable efficacies or the potential to cause even more harm.

In short, there is no right way to do the wrong thing.

As long as open net-pen salmon farming persists, the threats to wild salmon from sea lice will only continue to grow. Removing these farms from the water is a sure step that we can take to protect dwindling wild salmon stocks, existing fisheries, localized ecosystems and the livelihoods that they support.

WE URGE A CONTINUED COMMITMENT TO THE REMOVAL OF OPEN NET-PEN FINFISH FARMS ON CANADA'S PACIFIC COAST BY 2025 AND SIMILAR TRANSITION COMMITMENTS FOR CANADA'S ATLANTIC COAST.

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