



THE PACIFIC SALMON FOUNDATION MAGAZINE

SALMON STEWARD

SPRING 2025 | PSF.CA

CLEANER WATERS AHEAD

Scientists investigate how a lethal contaminant enters salmon streams

ENVIRONMENTAL DNA RESULTS ARE IN

New study sheds light on pathogens from open-net pen salmon farms

SURVIVAL SECRETS

Tagging and tracking salmon to fill in knowledge gaps on survival across the life cycle



SALMON STEWARD

SPRING 2025



PACIFIC SALMON
FOUNDATION

ABOUT US

We're salmon first, salmon always. Our vision is healthy, sustainable, and naturally diverse populations of Pacific salmon for the benefit of ecosystems and people for generations to come.

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Left to right: Michael Meneer (PSF), Hon. Randene Neill (B.C. Ministry of Water, Land and Resource Stewardship), Stu Barnes (First Nations Fisheries Council of B.C.)

CEO'S MESSAGE

More than 70 per cent of Pacific salmon in British Columbia and the Yukon are below their historical average abundance.

This number adds fuel to the Pacific Salmon Foundation (PSF)'s mission to advance salmon recovery and resilience. To succeed, we must take a strategic approach, fostering innovation, forming thoughtful partnerships, and challenging the status quo in salmon management.

Today's challenges, ranging from climate change, pollution, and habitat loss, demand bold action. We need to transform the system of how we work together, which was designed more than 50 years ago during times of salmon abundance and stability. This dated system no longer serves today's challenges. Instead, we need a new way of working together that supports coordinated efforts to scale up the broader movement to restore and save Pacific salmon.

This need for change resonates with British Columbians.

Polling reveals that 85 per cent of British Columbians are concerned about declining salmon, and nearly 70 per cent support government investment into salmon recovery.

PSF is taking action by strengthening relationships with partners. In February, PSF and the First Nations Fisheries Council of B.C. brought together Members of the Legislative Assembly representing communities across B.C. to discuss the need for coordinated salmon recovery planning and efforts to rebuild salmon and their habitats.

And this important on-the-ground work is already underway. At PSF's Salmon Recovery and Resilience Conference in December of 2024, more than 450 salmon experts convened to share their work around restoration, science, and innovation. First Nations leaders, streamkeepers, biologists, technical practitioners, government representatives, and other experts came together at this conference to share knowledge and make connections, strengthening our collective efforts toward salmon recovery.

At the conference, we repeatedly heard about the value of coming together for salmon. In our eyes, the federal government's recent decision to ban open-net pen salmon farms in B.C. by 2029 is a major win that illustrates this concept in action. During the last decade, more than 120 First Nations leaders, as well as researchers, called for the removal of open-net pens given the risks they present to wild Pacific salmon, proven by a growing body of research on pathogens and disease. This was made possible by years of science and collaborative partnerships in the salmon community (read more on page 10).

Progress is possible. Together, we are working to achieve positive results for Pacific salmon across British Columbia and the Yukon.

Michael Meneer
President & CEO,
Pacific Salmon Foundation



ON THE COVER:

Sam James from the Bottlenecks to Survival project.

Photo (top): Brandon Deepwell, Oscar Beardmore-Gray

COMMUNITY CORNER



30 YEARS OF SUPPORT FOR SALMON

Thank you to everyone who joined us for the 2025 South Vancouver Island Gala Dinner & Auction on March 8. This special evening marked the 30th anniversary of celebrating Pacific salmon and the people hard at work to restore them on the Island. Together, we raised more than \$150,000 toward a healthy future for salmon! Special thanks to our generous donors, sponsors, dinner committee, and volunteers.



WILD SALMON DAY

Mark your calendar for June 1! What began in British Columbia in 2019 has inspired a global movement. This year, Wild Salmon Day will bring together communities around the world to celebrate wild salmon and advocate for their recovery.

psf.ca/WILDSALMON

KNOWLEDGE SHARING ON VANCOUVER ISLAND

In February, PSF hosted two gatherings for technical experts and practitioners! More than 80 kelp experts convened in Victoria for the third and final 'Greening the Salish Sea' symposium. Backed by DFO's Aquatic Ecosystems Restoration Fund, the event explored the state of kelp in B.C., along with best practices for monitoring and restoration.

In Nanaimo, PSF brought together 55 partners for a workshop on community-led salmon habitat monitoring. Co-hosted by the Snuneymuxw First Nation, participants discussed innovative freshwater monitoring methods, Indigenous perspectives on monitoring, and ways to strengthen collaboration for climate-resilient salmon ecosystems.



STEELHEAD BEER

Steamworks Brewing is supporting PSF with the launch of a one-of-a-kind B.C. beer: Steelhead Lager! With two per cent of every sale supporting PSF, this collaboration funds vital initiatives supporting salmon and their habitats.

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Turquoise herring spawn in the Strait of Georgia.

Photo: Kieran Brownie

Photo: Loïc Dallaire

THE HERRING COMEBACK IN HOWE SOUND

In Átl'ka7tsem (Howe Sound), north of Vancouver, the silver forage fish known as *silhawt'* (herring) by the Skwxwú7mesh Úxwumixw (Squamish Nation) **were once so abundant** that specialized rakes were used to harvest them.

But a century of industrial activity, along with overfishing, devastated biodiversity in Howe Sound. Herring numbers plummeted, and formal monitoring efforts ended in 2001, leaving little data to guide conservation efforts.

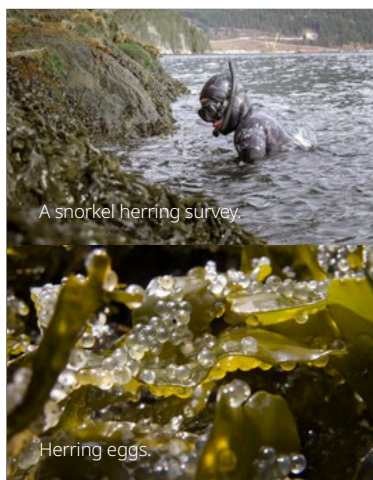
Now, three decades of environmental restoration efforts in the fjord are showing results.

Among these, a community-led initiative is shedding new light on herring in Howe Sound. Since 2020, dozens of volunteers have joined the Átl'ka7tsem / Howe Sound Marine Stewardship Initiative (MSI) and Skwxwú7mesh Ta na wa Yúus ta Stitúyntsarh (Rights & Titles Department) to monitor herring spawn.

"We've gotten really good at finding herring. Many of our surveys are done by snorkeling, which lets us access remote locations and work at any tide, unlike boat or foot surveys," says Matthew Van Oostdam, who coordinates MSI's herring program.

Every spring, herring spawn in massive, synchronized events that give coastal waters a milky turquoise hue visible from space. A vital subsistence food for Squamish People, herring are also a cornerstone of the marine food web and a key prey species for Pacific salmon.

With support from the Pacific Salmon Foundation (PSF)'s Community Salmon Program, MSI is expanding its long-term dataset on herring spawn distribution, abundance, and timing in Howe Sound. Weekly surveys from February to April cover 16 sites across 33 kilometers of shoreline in the Squamish Estuary and northern Howe Sound. This work complements PSF's multi-year research on herring-salmon interactions throughout the Strait of Georgia.



A snorkel herring survey.

Herring eggs.

Photo: (top) Kieran Brownie
(bottom) Matthew Van Oostdam

HERRING FOR SURVIVAL

Herring are crucial to salmon survival. Both juvenile and adult salmon rely on them for food, and many herring spawning habitats in Howe Sound double as rearing grounds for young coho and Chinook.

"Over the last five years, we've collected baseline data showing that spawn events occur along almost every section of the estuary's shoreline, including industrial areas and previously unsurveyed remote sites," notes Van Oostdam.


"When people connect with herring, and see evidence like egg photos and spawning maps, decision-makers can make more informed, responsible choices."

In 2025, more than 80 volunteers signed up to support herring spawn monitoring efforts. Squamish Nation has used the survey data over the years to inform decisions on land, water, and resource management.

In addition to monitoring, MSI partners with Squamish Nation and St'a7mes School for an annual public celebration during Tem Lhawt' (time of herring). This gathering creates space for intergenerational learning and the rebuilding of Skwxwú7mesh sníchim (Squamish language).

Generations after rakes were used to harvest herring in Howe Sound, local students placed cedar and hemlock boughs in the fjord in 2019, at the request of Squamish Elders. Within a week, herring returned, coating the branches in *ch'em'esh* (eggs) — the first time in living memory that community members tasted roe from the Sound.

"These past few decades, all the work that's happened to bring the Sound back to health has brought back our culture," says Charlene Williams, a Skwxwú7mesh member who served on MSI's Steering Committee to guide this project.

"The most amazing thing about this reclamation of our connection to herring has been the opportunity for hope." 

KEEPING INVASIVE THREATS TO SALMON OUT OF B.C.



Invasive mussels on native mussels.

Photo: Todd J. Morris/DFO

A parasitic disease that can be lethal for juvenile salmon has been recently detected in British Columbia.

Whirling disease — named after the erratic spinning behaviour of infected fish — was first detected in Canada in 2016 in Alberta.

In December 2023, whirling disease was first found in B.C. at Emerald Lake in Yoho National Park. A year later, it was found in Kootenay Lake, a vital habitat for Kokanee sockeye salmon.

In extreme cases in the western U.S., whirling disease has resulted in fish populations collapsing by more than 90 per cent. There is currently no known treatment.

Whirling disease often leads to blackened or deformed tails and skull deformities in fish. While there is no threat to human health, activities like swimming, boating, and fishing are catalysts for introducing the disease to new areas.

To stop the spread of whirling disease, the Province of B.C. is leading campaigns to encourage **cleaning, draining, and drying all boats or equipment when transferring between water bodies**. Recent regulation changes have also made it illegal to transport a boat with the drain plug still in place, as undrained boats can spread larval or microscopic invasive species.

SURVEILLANCE OF INVASIVE MUSSELS

Another looming threat to salmon in B.C. is invasive mussels.

Zebra and quagga mussels, originally from Europe, found a home in the Great Lakes in the 1980s. Since then, they've spread west, hitching a ride in the ballast water of boats, trailers, and equipment.

These shellfish have established in eastern Canada, but have also been found in western U.S. states. Concerningly, quagga mussels were recently discovered in Idaho — which connects to the Pacific Northwest through the Columbia River system.

“For 10 years, the Government of British Columbia has been working with our many partners to support the Invasive Mussel Defence Program,

a vital effort to protect our waterways and communities,” says Hon. Randene Neill, Minister of Water, Land and Resource Stewardship.

“We’re committed to stepping up enforcement at the borders, which represent the highest risk of entry into our province, including developing better regulatory tools. These collective measures will also help reduce the spread of whirling disease in our waterways.”


The mussels have not yet been detected in B.C., but to mitigate the spread, the Pacific Salmon Foundation (PSF) contributed \$50,000 to the Province of B.C.’s Invasive Mussel Defence Program in 2024.

“The establishment of invasive zebra and quagga mussels in British Columbia could be devastating for Pacific salmon. It would become a top threat for salmon populations and their habitats,” says Jason Hwang, Chief Programs Officer and Vice President, Salmon, PSF. “We need to be proactive in surveillance efforts at entry points into the province to prevent invasive mussels from establishing in British Columbia and wreaking havoc on local ecosystems.”

Invasive zebra and quagga mussels disrupt aquatic ecosystems in several ways. They aggressively filter water, depleting essential food sources like plankton, and contribute to the growth of toxic algal blooms. Furthermore, the establishment of large mussel colonies in salmon habitats can disrupt spawning and threaten egg survival.

The province has already seen close calls. In 2024, the B.C. Invasive Mussel Defence Program intercepted 199 high-risk watercraft entering the province. Of those, 63 were decontaminated and 37 were quarantined. 12 were confirmed to carry invasive mussels.

PSF continues to work closely with the Province of B.C. to mitigate these threats to salmon and their habitat.

For further information, contact WhirlingDisease@gov.bc.ca about whirling disease and COS.Aquatic.Invasive.Species@gov.bc.ca about invasive mussels. 

To prevent the spread of invasive whirling disease and mussels, it is essential to properly clean, drain, and dry boats and gear before moving to new waters.



Photo: Brandon Deepwell



Photo: Vancouver Island University

Collecting a water sample at Chase River, near Nanaimo, B.C.

TIRE CONTAMINANT RESEARCH HITS THE ROAD

When rain hits the east coast of Vancouver Island, Haley Tomlin and Erik Krogh might have to pull an all-nighter — all for salmon.

“We do it in the name of science,” says Krogh, a chemistry professor and director of the Applied Environmental Research Laboratories at Vancouver Island University (VIU). “It’s challenging, but timing is important.”

Krogh and his research counterpart Tomlin, a biologist with the BC Conservation Foundation (BCCF), collect data on a contaminant found in rubber tires that washes into salmon-bearing streams when it rains. For accuracy, they must collect samples within hours of the peak rain.

“It’s entirely weather-dependent. When the rain falls, that’s when we’re out,” Tomlin says. “It seems to always happen on the weekend at night. The rain never wants to happen at 11 a.m. on a Tuesday.”

Since 2022, Tomlin and Krogh have been monitoring 6PPD-quinone, a toxic by-product of a tire additive known as 6PPD that prevents cracking. As tires wear, this chemical builds up on roads and washes into rivers via stormwater runoff. Research from the University of Washington linked 6PPD-quinone to, ‘urban runoff mortality syndrome’ in coho salmon. Other studies suggest it also harms Chinook salmon and rainbow and steelhead trout.

VIU and BCCF aim to determine where 6PPD-quinone is present in rivers on the east coast of Vancouver Island, and at what concentrations, to determine how to best mitigate its impacts and prevent Pacific salmon die-offs.

A network of **35 volunteer stewardship groups and First Nations** collect samples at nearly **200 unique sample locations** at **73 streams** between Victoria and Campbell River. These samples are processed using a rapid method pioneered by VIU, which allows researchers to quickly and accurately detect 6PPD-quinone in waterways.

WHAT WE’VE LEARNED

As of January 2025, VIU has processed nearly 5,000 water samples, creating the largest 6PPD-quinone dataset to date.

Researchers have detected 6PPD-quinone exceeding the lethal concentration limit for juvenile coho salmon in 22 waterways on Vancouver Island.

Krogh says early findings indicate that the time of sampling is extremely important and that smaller urban streams are more affected by 6PPD-quinone than larger ones.

“This is likely because smaller creeks have weaker capacity to dilute stormwater runoff, which is especially concerning for coho salmon that rear in these habitats,” he explains.

Additionally, coho salmon are most vulnerable to 6PPD-quinone exposure in the fall, because water levels tend to be at their lowest at the end of the summer, increasing the concentration of any toxic chemicals. This is exacerbated by drought and climate change. When rain finally arrives, built-up 6PPD-quinone on the streets washes into local waterways.

“Climate change influences when 6PPD-quinone appears in streams,” says Krogh. “To mitigate its effects on Vancouver Island, we should focus on stormwater management, especially in small urban streams during major rainfall events in October and November.”

“It’s daunting to think that these fish are living in these creeks that have a lot of pollution in them. If we can prevent this harmful toxin from entering local waterways, it’s something we should work toward,” says Tomlin.

GREEN SOLUTIONS

Green infrastructure like rain gardens can help filter 6PPD-quinone before it reaches salmon habitat. A study from the University of British Columbia found that rain gardens can remove more than 90 per cent of 6PPD-quinone from stormwater.

AN INNOVATIVE LAB

A key component of this research is a rapid 6PPD-quinone sampling and analysis method developed by VIU.

This method is quicker and more efficient than conventional approaches, enabling trace analysis of 6PPD-quinone within hours or days, whereas a standard lab can take weeks or months. Results are reported in an interactive database.

In 2024, the Pacific Salmon Foundation (PSF) provided \$100,000 to VIU to support the purchase of a second mass spectrometer, a vital tool for identifying and measuring 6PPD-quinone.

“This spectrometer essentially doubled our capacity,” says Angelina Jaeger, a M.Sc. student at VIU. “With two spectrometers, we can easily run 100 samples per day.”

The acquisition of a second mass spectrometer has also enabled the team to measure 6PPD-quinone directly in a stream for the first time. With two instruments, one can remain at the lab to process samples while the other is mounted in their mobile lab, which is parked streamside during a rainfall event to collect continuous, real-time data. This provides unique insights into how quickly 6PPD-quinone appears in waterways and how long it persists.

“This is really critical for fish because they will be negatively affected if there is a high concentration for an extended period of time,” says Jaeger.



Left to right: Angelina Jaeger, Haley Tomlin, Erik Krogh.

Photo: Brandon Deepwell, Oscar Beardmore-Gray


“It’s daunting to think that these fish are living in these creeks that have a lot of pollution in them. If we can prevent this harmful toxin from entering local waterways, it’s something we should work toward.”

— Haley Tomlin

MORE THAN MONITORING

In 2024, VIU and BCCF hosted a workshop in Nanaimo, bringing together researchers and practitioners to collaborate on understanding the distribution of 6PPD-quinone and explore potential remediation strategies. To help expand attendance, PSF provided travel subsidies for First Nations groups and environmental and stewardship organizations. A second workshop is planned for May 2025.

Also in 2024, PSF joined Raincoast Conservation Foundation, Watershed Watch Salmon Society, and Ecojustice in formally requesting that Environment and Climate Change Canada investigate the toxicity of 6PPD. In response, the federal government committed to prioritizing an environmental assessment of the chemical — an important first step toward regulating this harmful tire additive.

PSF remains committed to supporting efforts that protect salmon in urban waterways and identifying science-based solutions that reduce the impacts of 6PPD-quinone on wild salmon. 



Collecting a water sample at a bridge crossing at Chase River.

Photo: Vancouver Island University



Angelina Jaeger processes samples at VIU. The lab team members include Jaeger, Krogh, Lily Eggert, Joseph Monaghan, and Chris Gill.

Photo: Brandon Deepwell, Oscar Beardmore-Gray



Photo: Fernando Lessa

PUTTING SUSTAINABLE B.C. SALMON FISHERIES FIRST

Choosing sustainable, wild-caught salmon in British Columbia just got easier for Canadians, thanks to new Ocean Wise recommendations.

In 2024, Ocean Wise identified 14 sustainable wild-caught salmon fisheries in B.C., representing all five species of Pacific salmon. While wild salmon from B.C. generates up to \$250 million in annual sales, consumers had no way to identify sustainable options until now. Unlike Alaskan fisheries, which are commonly recognized by international eco-labels, many small-scale and First Nations-run fisheries in B.C. faced cost and capacity barriers to certification.

To bridge this gap, Ocean Wise developed a two-step approach. First, they identified potential sustainable fisheries using publicly available data, including assessments from the Pacific Salmon Explorer (salmonexplorer.ca), a Pacific Salmon Foundation (PSF) resource that houses the most comprehensive data on salmon and their habitats in B.C. Then, a six-member Salmon Advisory Panel refined the list, ensuring it reflected the complexities of local salmon sustainability and the role of First Nations and small-scale fisheries.

“Consumers want to make sustainable choices and eat locally, but it wasn’t possible to do that before these recommendations. We were relying on non-Canadian salmon for certified sustainable choices. Now, we have local options,” says Dr. Eric Hertz, an analyst at PSF and member of the Ocean Wise Salmon Advisory Panel.

“Consumers want to make sustainable choices and eat locally, but it wasn’t possible to do that before these recommendations. We were relying on non-Canadian salmon for certified sustainable choices. Now, we have local options,”

— Eric Hertz

Beyond benefiting consumers, these recommendations support sustainable fishing practices and expand market opportunities and competitive pricing for local fisheries.

INGREDIENTS FOR A SUSTAINABLE FISHERY

Lake Babine Nation, located in central B.C., oversees the largest commercial sockeye fishery in the province in recent years. In 2024, its sockeye fishery received sustainability certification through Ocean Wise. A year later, it became one of the first certified Indigenous fishery to launch a branded product in grocery stores across Canada.


“The Babine Lake sockeye fishery is well-monitored and managed. Both of those pieces come together to form a sustainable fishery,” says Greg Taylor, a member of the Ocean Wise Salmon Advisory Panel and a fisheries advisor for Lake Babine Nation.

Taylor adds that Babine Lake sockeye are harvested through a terminal fishery, meaning they are caught at the end of their migration, reducing bycatch of species following a similar route.

“There’s a sustainability challenge with mixed-stock fisheries where abundant pink salmon can co-migrate with depressed chum populations, for example. How do you catch one without hurting the other? It’s impossible,” explains Taylor. “But terminal fisheries like Babine Lake sockeye are highly selective. That’s how more fisheries should be managed.”

Another example is the pink salmon fishery near Masset, Haida Gwaii — an Ocean Wise-recommended terminal fishery with minimal bycatch.

Until now, local B.C. fisheries like Masset pinks and Babine Lake sockeye lacked access to an eco-label. Ocean Wise has paved a new path into Canadian markets, including grocery stores and restaurants.

The Salmon Advisory Panel will reconvene in 2025 to assess recommendations for the upcoming fishing season. The panel will be looking across the province for any new fisheries that meet Ocean Wise’s criteria for a sustainable fishery. 

WHAT MAKES A SALMON SURVIVOR?

The salmon life cycle is one of nature's most extraordinary spectacles. Pacific salmon are anadromous, meaning they are born in freshwater, migrate to the ocean and then make the long and arduous return to their natal rivers to spawn before they die.

Yet the migratory nature of salmon is both its greatest marvel and its biggest mystery — this vast journey makes studying salmon survival at different life stages incredibly challenging.

“Salmon survival is like a black box because we can see the salmon leaving, and we can see the salmon coming back, but we can't see what happens in between when they're in the ocean,” explains Samantha James, Bottlenecks to Survival project manager at the Pacific Salmon Foundation (PSF).

In a bid to learn more about salmon survival, PSF and BC Conservation Foundation (BCCF) tagged more than a quarter million Chinook, coho, and steelhead in hatcheries, rivers, estuaries, and in the ocean on eastern Vancouver Island since 2020.

The team uses Passive Integrated Transponder (PIT) tags to follow salmon movement. These chips are similar to those used to keep track of pets or inserted in credit cards.

In freshwater, 26 antenna installations in 11 rivers across Vancouver Island pick up a signal when salmon swim out to sea as juveniles and when they return home as adults.

“I get excited about this project because I feel like we're finally peeling up the edges of that black box and peering underneath. We're starting to answer some of those questions around what's happening to the salmon,” says James.

2,500 SALMON SURVIVORS AND COUNTING

Since 2020, the Bottlenecks to Survival project has focused primarily on tagging fish — something that wouldn't have been possible without the support of DFO, First Nations, community volunteers, and students across Vancouver Island.

Now the focus has shifted to tracking those salmon they tagged as juveniles, as they return to rivers across the Island, including the Cowichan, Nanaimo, Goldstream, Quinsam, Big and Little Qualicum, Puntledge and Englishman.

In 2024, researchers counted 2,500 salmon they tagged up to four years ago return home as adults.

Nearly two-thirds of the returning fish were traced to Quinsam, Goldstream, and Cowichan Rivers.

A new dashboard helps visualize in-season results — allowing users to learn about the project and explore



PSF's Sam James, who co-leads the Bottlenecks project with BC Conservation Foundation, at Goldstream River.



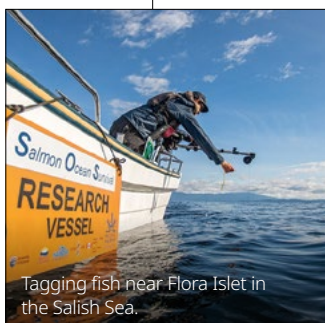
An in-river detection system at the Englishman River on Vancouver Island is used by the Bottlenecks team to track salmon returns.

“It's amazing to see these tagged fish show up and light up our systems all across the east coast of Vancouver Island.”

— Sam James

the data on salmon returns in individual rivers, as well as age, stock, and species composition: psf.ca/bottlenecks-data.

“The fall is a really exciting time, because we see which fish survived and what made a survivor,” says James. “It's amazing to see these tagged fish show up and light up our systems all across the east coast of Vancouver Island.”



Tagging fish near Flora Islet in the Salish Sea.

Photo: Danny Swainson

TAG TEAMING


300,000+ fish tagged in 13 rivers on Vancouver Island since 2020:

- 196,031 CHINOOK
- 175,437 COHO
- 17,108 STEELHEAD

Now, PSF and BCCF will dissect the data to determine what makes a salmon survivor. With this information, the team will then be able to direct conservation efforts where salmon need the most help.

James and team expect to see thousands more tagged salmon return to rivers across Vancouver Island until 2030.

They will also study Chinook migration patterns in the Strait of Georgia, Chinook winter diets and health, and begin investigating interactions of salmon with seals and sea lions in estuaries.

This project is supported by the British Columbia Salmon Restoration and Innovation Fund — a joint program from the Government of Canada and Province of British Columbia (BCSRIF). 

STUDY SHOWS HEIGHTENED PRESENCE OF PATHOGENS NEAR SALMON FARMS

The Government of Canada has **announced a ban on open-net pen Atlantic salmon farms** in British Columbia by 2029, aimed at protecting wild salmon.

As a leader in research on pathogen transmission from farmed fish to wild salmon, the Pacific Salmon Foundation (PSF) supports this decision to prioritize the health of wild salmon. Since 2013, PSF and its partners have built a growing body of independent, peer-reviewed research on the risks open-net pen salmon farms pose to wild salmon.

Seven years have passed since PSF first stated that open-net pen salmon farms should be removed based on scientific evidence, announcing that “British Columbia and Canada must put wild Pacific salmon first...The removal of open net-pen farms along migratory routes of wild Pacific salmon, particularly for those stocks of greatest concern, should occur as soon as possible.”

Since then, research has continued. With collaborators, PSF has been studying the impacts of open-net pen salmon farms on wild fish. Notably, studies have shown that three pathogens in particular — sea lice, *Tenacibaculum*, and Piscine orthoreovirus (PRV) — are amplified by open-net pens and can have negative effects on wild salmon.

Under the leadership of the Broughton Aquaculture Transition Initiative (BATI), a project led by the Mamalilikulla, ‘Namgis, and Kwikwasut’inux Haxwa’mis First Nations, a new study published in *Scientific Reports* in December 2024 reveals that open-net pens in B.C. release elevated levels of infectious agents.

“For decades, our salmon have been in decline, and this study provides critical answers as to why. The eDNA results will help guide our Nations in making informed decisions about our lands, waters, and territories, ensuring we are able to protect wild salmon for future generations,” says Chief Rick Johnson of Kwikwasut’inuxw Haxwa’mis First Nation.

Researchers collected water samples from inside and outside Atlantic salmon farms in the Broughton Archipelago, east of Port McNeill, to measure environmental DNA (eDNA). This method detects genetic traces of organisms, including wild fish and harmful infectious agents.



Wild juvenile salmon in B.C. swimming past an Atlantic salmon open-net pen on their journey to the ocean.

“Our decision to withhold consent to salmon farms reflects our unwavering commitment to protecting and restoring wild salmon populations, backed by our traditional knowledge, science, and research.”

— Don Svanvik

They determined that the odds of detecting infectious agents were, on average, 4.3 times higher near active salmon farms relative to inactive sites. This finding provides rigorous scientific validation that Atlantic salmon farms transmit pathogens to B.C. waters and introduce exposure risks for Pacific salmon migrating through those waters.

Chinook salmon, which often spend their first year in coastal bays and inlets where salmon farms are also located, appeared more likely to linger around active open-net pen sites. This behaviour, which the researchers hypothesized was a result of Chinook being attracted to active farms, could increase the chances of Chinook encountering harmful bacteria, such as *Tenacibaculum maritimum*. This pathogen can cause high mortality in Chinook salmon and has the highest release levels near active farms, aligning with similar research published in 2020.

SALMON FARM REMOVALS IN THE BROUGHTON

From 2019 to 2023, **20 of the 23 Atlantic salmon fish farms in the Broughton Archipelago** were closed by the efforts of the Mamalilikulla, ‘Namgis, and Kwikwasut’inux Haxwa’mis First Nations and the Gwawaenuk Tribe. These Nations have never consented to having the fish farms in their territories and have spent decades fighting for their closure.

“The impacts of Atlantic salmon farms in our territories, particularly the spread of pathogens from farmed to wild salmon, have long been a concern. We have witnessed a devastating decline in wild salmon in our territories,” says Hereditary Chief Don Svanvik of ‘Namgis First Nation. “Our decision to withhold consent to salmon farms reflects our unwavering commitment to protecting and restoring wild salmon populations, backed by our traditional knowledge, science, and research.”

PATHOGENS OF CONCERN

Led by BATI, PSF, and Fisheries and Oceans Canada, the eDNA sampling was conducted over an 18-month period at seven active and four inactive net-pen aquaculture sites in the Broughton Archipelago, all of which have since been closed.



Photo: Tavish Campbell



Dr. Emiliano Di Cicco (centre) sampling in the Broughton Archipelago.

Photo: Brandon Deepwell

“Our research clearly indicates that active open-net pen Atlantic salmon farms in British Columbia amplify infection risks for wild Pacific salmon.”

— Emiliano Di Cicco

The authors assessed dozens of infectious agents and pathogens — bacteria, viruses, fungi, and parasites — near Atlantic salmon farms that may pose risks to wild salmon.

The results indicate that 11 of the infectious agents are more prevalent at active open-net pen sites than at inactive sites. Of those agents, the authors identified *Tenacibaculum maritimum*, *Tenacibaculum finnmarkense*, *Ichthyobodo* spp., and Piscine orthoreovirus as pathogens of concern due to their elevated presence near active salmon farms and previous research linking these agents to conservation risks for Pacific salmon.

For example, Piscine orthoreovirus has been documented to spread from Atlantic salmon farms to wild salmon in B.C. Experts worry due to the risks it poses to wild Pacific salmon, particularly Chinook.

“Our research clearly indicates that active open-net pen Atlantic salmon farms in British Columbia amplify infection risks for

wild Pacific salmon,” says Emiliano Di Cicco, co-author of the study and fish health researcher at PSF. “We also saw confirmation that open-net pens can attract wild salmon with fish feed and shelter. This proximity exposes them to pathogens released by the pens, heightening the risk of infection and disease.”

THE FUTURE OF FISH FARMING IN B.C.

While the federal government has pledged to ban salmon farms in B.C. by 2029, the details of this commitment remain uncertain. Following consultations, a final transition plan is currently being developed.

The federal government has stated that open-net pens will not be permitted past 2029, but ‘closed containment’ salmon aquaculture will be considered. However, the government has yet to formally define closed containment in regulation.

During the consultation, PSF highlighted the importance of eliminating pathogen transmission in proposed closed containment aquaculture.

Even if salmon farms are relocated to land or into enclosed structures in the water, pathogens can still spread from farmed salmon to wild salmon through wastewater and effluent if it’s released into the environment untreated.

“The Pacific Salmon Foundation supports the federal government’s decision to ban open-net pens in British Columbia, but it is imperative that the final transition plan reflects the goal of protecting wild salmon by ending pathogen transmission risks,” says Michael Meneer, PSF’s CEO and president.

The consultation period on the draft transition plan has closed, and the final plan has yet to be released. 🐟

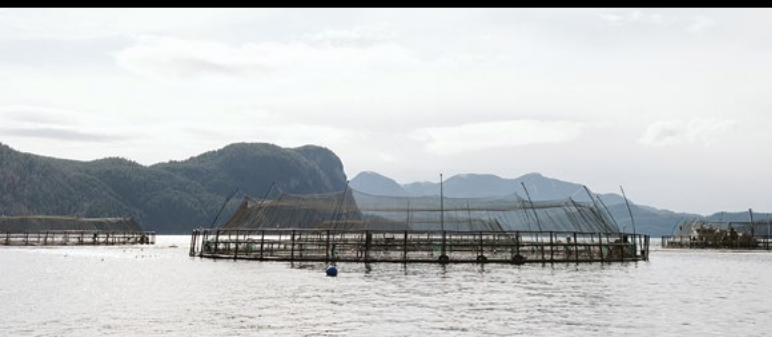


Photo: Brandon Deepwell

OPEN-NET PEN UPDATE

To date, 45 Atlantic salmon open-net pen farms have been removed in British Columbia and 55 farms remain. The remaining active open-net pens are clustered on the west coast of Vancouver Island, the Queen Charlotte Strait, and the Central Coast.

Conserving and restoring the natural habitats of wild Pacific salmon

Wheaton Precious Metals is proud to support the Pacific Salmon Foundation. Together, we are making a difference in preserving the salmon populations for future generations through conservation, restoration and research.



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