



# ARTIFICIAL INTELLIGENCE

New tech advances First Nations-led salmon monitoring

## INVASIVE SPECIES ALERT

Researchers mitigate the spread of European green crabs



Piloting emergency measures to help salmon adapt to drought

## SALMON Steward

SUMMER/FALL 2023



#### 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 Canadians for generations to come.

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CEO'S MESSAGE

## The future of salmon depends on our collective ability to work collaboratively.

This is particularly true of the need to build relationships with First Nations leaders and Indigenous Guardians throughout the province — a top priority for the Pacific Salmon Foundation (PSF). I want to recognize and thank Murray Ned and Gord Sterritt, members of PSF's Board of Directors for their leadership and support in helping PSF build connections and working relationships with First Nations fisheries organizations, Nations, and individuals.

A feature story on page eight highlights collaborative salmon monitoring efforts underway with First Nations on the North and Central Coast.

This work will continue to grow at PSF as we build and prioritize connections with Indigenous communities. We hope relationships built can help spark further collaborative action for salmon recovery, as we've seen firsthand through the rapid drought response work PSF's been undertaking with First Nations, the Province of B.C., and Fisheries and Oceans Canada (DFO) this summer. With local eyes on the ground identifying climate change issues for fish and habitat, we can help salmon adapt to drought and other changing conditions (read more on page four). These timely climate response initiatives highlight the benefits of working together, collaboratively, to advance work with the shared interests of salmon recovery.

PSF received another opportunity to build relationships with Indigenous communities this summer when I had the privilege of attending the Nanwakolas Guardians and Indigenous Protected and Conserved Area (IPCA) Tours, where we visited Campbell River, Port McNeill, Village Island, Klaoitsis Island, Minstrel Island, and the Mamalilikulla IPCA.

The tours were a meaningful experience and an honour for PSF to be invited. Our organization is fortunate to witness the leadership of member Nations in activating and running Guardians programs and leading the establishment of an IPCA that will benefit salmon and their habitats for generations to come.

Michael Meneer President & CEO, Pacific Salmon Foundation



Photo (top): Peter Olsen

#### **COMMUNITY CORNER**



#### ALL-TIME FUNDS RAISED FOR PERCY WALKUS

The tenth annual Duncanby Lodge fundraiser in June brought in a record \$524,000 to support the Percy Walkus Hatchery in Rivers Inlet, B.C. Thank you to this incredible, generous community for your continued support of the hatchery.



#### HEART OF THE FRASER RIVER

In July, PSF toured the Heart of the Fraser River from Mission to Harrison. The visit with Hon. Nathan Cullen, Minister of Water, Land, and Resource Stewardship, along with Parliamentary Secretaries Kelly Greene and Fin Donnelly, highlighted the complex issues and opportunities for collaborative action in the highly-developed region.

#### PARTNER SPOTLIGHT

Totem Design House created a unique t-shirt print titled *'The Return'* with a salmon design by artist Andy Everson for B.C. Wild Salmon Day 2023. This collaboration — which raised funds to support salmon recovery in collaboration with local First Nations — was a huge success.

totemdesignhouse.com

#### SAVE THE DATE: VANCOUVER GALA

PSF's flagship Vancouver Gala Dinner and Auction, presented by Wheaton Precious Metals, will take place on Friday, April 26, 2024 at the Vancouver Convention Centre.



#### **BOARD OF DIRECTORS UPDATE**

PSF sincerely thanks its Board of Directors for their service and leadership. Retiring in 2023, we thank Kevin Nugent (Past Chair). Thank you to our current Board: Russell Ball, Ross J. Beaty, Susan Farlinger, Brenda Gaertner, Jeff Giesbrecht (Chair), Pamela Goldsmith-Jones, Tim Gudewell, George Iwama, Peter Lister, Murray Ned, Cam Proctor, Jason Quigley, Gord Sterritt, and Shauna Towriss for their ongoing service.



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## Drought Strikes B.C.

### Again.

For the third consecutive year, British Columbia has endured extreme drought. In response, PSF and partners trial innovative solutions to help salmon survive.

Photo: Brandon Deepwell

#### British Columbia is no stranger to drought.

In 2021, 2022, and now 2023, B.C. has faced extreme drought conditions. However, so far in 2023, the province has experienced some of the most severe drought conditions on record.

By August, more than three-quarters of B.C.'s water basins were designated as Level Four or Level Five drought, the most severe drought classifications where adverse ecological and socio-economic impacts are likely or certain.

The Fraser River, renowned for its salmon run, had record low flows and experienced water temperatures up to five degrees above normal — conditions that spell trouble for salmon.

"Past droughts in B.C. were isolated to specific areas and watersheds. But this year, drought is an everywhere problem. Even the wettest areas in B.C. are seeing dry and hot conditions," says Jason Hwang, PSF's VP of Salmon.

"We are seeing significant impacts on salmon-bearing rivers and streams. Salmon returning to their freshwater habitats are facing these extreme drought stressors. It's the equivalent of trying to run a marathon in a sauna."

Drought increases overall stress for salmon. Warm water temperatures and low flows — typical drought characteristics — can be devastating for juvenile and adult salmon.

Climate change is expected to increase the intensity and frequency of extreme climate-related events — including floods, wildfires, heatwaves, and droughts.



#### BRITISH COLUMBIA DROUGHT LEVELS



"Climate change is shifting what 'normal' looks like in B.C. ecosystems," says Jane Pendray, the manager of PSF's Climate Adaptation Program. **"The scale of climate issues is ramping up. Extreme events like drought are getting bigger than we're used to, creating new challenges for salmon."** 

When the Province of B.C. forecasted a high risk of provincewide drought in June, PSF saw an opportunity to act fast. Anticipating likely effects on salmon, PSF convened a rapid response working group with DFO, the Province, and technical experts to start planning for in-season solutions.

#### SALMON ARE HIGHLY VULNERABLE TO DROUGHT.

Warm waters, low flows, and low oxygen levels induced by drought can:

- Reduce water levels and therefore habitat availability
- Strand salmon in disconnected pools
- Cause on-route mortalities for adult salmon swimming to their spawning grounds
- Delay the timing of the salmon reproductive cycle and desynchronize their overlap with seasonal foods

Together, PSF and partners mobilized efforts and funding, thanks to the Province of B.C., to coordinate new monitoring initiatives and activate emergency response projects to help salmon survive challenging conditions.

"We piloted brand-new strategies that have never been done before because we need to do everything we can to help salmon adapt to climate change," says Pendray. "Drought is more intense, longer lasting, and more extensive across B.C. than it has been in the past, so we can no longer rely on plans and actions that used to be effective. We need to think outside the box and build new tools into the toolkit."

#### RAPID RESPONSE TO DROUGHT CRISIS

By Sept. 1, PSF provided \$76,000 for projects approved by the rapid response working group, enabling local entities to activate drought emergency projects on the ground to support salmon. Looking beyond projects on fish salvage and focusing on improving habitat, examples of projects include:

- Digging deeper refuge pools where existing water inputs are too shallow
- Creating temporary overhead shading for key habitat areas to limit warming
- Increasing functionality of cold-water inputs and natural thermal refugia
- Supporting fish passage needs where flows are too low or where habitat is cut off

The mouth of the **Tranquille River**, approximately 15 kilometres west of

Kamloops, went dry by early August. An early and intense spring freshet deposited excess sediment at the river mouth, which was then followed by Level Five drought conditions in the summer, creating a barrier for fish passage that would limit salmon spawning to the lower sections of the river. As pink and coho salmon spawners were set to return in September, DFO developed a plan to repair the habitat by using an excavator to re-establish water flow between the upper and lower sections of the river and enable salmon to migrate to their spawning grounds upstream.

With funding from the rapid response working group, the emergency repair took place in early September just in time for local salmon returns. Additionally, water licence holders, with assistance from Secwepemc Fisheries Commission and provincial staff, enacted plans to release extra water from upper watershed storage to support returning salmon during their critical migration.

### INNOVATION ON EASTERN VANCOUVER ISLAND

In July, the **Tsolum River** on eastern Vancouver Island near Courtenay reached Level Five drought. The Tsolum is also one of four streams in the province where temporary protection orders limiting water use to protect flows for fish were introduced in August. The Tsolum River Restoration Society (TRSS) noted dangerously low flows and high water temperatures that threatened juvenile salmon survival and the spawning success of returning pink salmon.

Low dissolved oxygen induced by drought conditions was a major challenge for survival in the refuge pools in the river. TRSS proposed an innovative solution: installing solarand generator-powered aeration units in the pools to improve salmon survival during the drought.

TRSS requested funding in August from the rapid response working

#### Thermal refugia are

discrete cold-water patches in streams that are critical for salmon survival during droughts when surrounding water temperatures are too high. Refugia occur naturally by groundwater seepage, inputs from cool tributaries, water mixing from the streambed, and riparian shading.



Photo: Peter Olsen

group to initiate the project with support from K'omok's First Nation and DFO. The rapid response group approved the application within days, allowing the partners to get started immediately.

In addition to aerating the refuge pools, TRSS and local collaborators improved connectivity between side channels caused by low flows, installed overhead shading where riparian cover was low, and added natural materials near refugia to provide shade and cover.

#### CROWDSOURCING DROUGHT CONDITIONS

PSF also launched an online tool for the public to report local drought conditions that are impacting salmon survival or migration. Since the tool was launched in August, issues across B.C. have been identified by concerned citizens for salmon and shared with DFO and the Province, who connect with staff on the ground, local First Nations, and streamkeepers to assess problems, monitor conditions, and intervene when necessary.

After the drought season, PSF's data specialists will compile the submissions into a publicaccess map or summary report to serve as a reference resource when planning for future drought years.

#### YOU CAN HELP TOO!

Thanks to the Province of B.C., PSF was able to fund time-sensitive projects to help salmon survive drought conditions. With your help, we can grow our Climate Adaptation Fund enabling timely, nimble responses to climate events impacting salmon and their habitats.

Donate today at
psf.ca/DROUGHTRESPONSE <

## RESEARCHERS PROPOSE ROAD MAP TO IMPROVE TRUST IN DFO SCIENCE ADVICE

A quarter-century after scientists questioned the political and bureaucratic influences on science advice used to manage Canada's fisheries, another group of researchers has found that science advice continues to be influenced by non-science interests. They recommend creating an independent fisheries-science advisory body.

It's been more than 30 years since the collapse of the Atlantic cod fishery in Canada. The collapse devastated communities and economies, but generated insight that remains relevant today in the context of Pacific salmon.

Following the cod collapse, Jeffrey Hutchings, a fisheries scientist and professor at Dalhousie University, and collaborators raised the issue that Canada's federal fisheries department, DFO, was allowing "non-science influences" in critical decision-making.

"There is a clear and immediate need for Canadians to examine very seriously the role of bureaucrats and politicians in the management of Canada's natural resources," they wrote at the time.

Since then, despite changes to the science advice process within DFO, issues have persisted in the processes that generate advice and how that advice influences decisions.

A team of researchers — including Dr. Andrew Bateman, PSF's Salmon Health Manager —

recently published a paper that calls for an independent scientific body to provide fisheries science advice that would help DFO fulfill its legal duty to protect and conserve fish for Canadians.

Their research was driven by the desire to see positive change in the system, for the benefit of Pacific salmon and the ecosystems they support.



The peer-reviewed "perspective" paper, published in the Canadian Journal of Fisheries and Aquatic Sciences, examines the modern-day example of DFO science advice about open-net pen salmon aquaculture in British Columbia.

"Still, today, we see that non-science interests can shape the science advice that DFO gives to decision makers," says Bateman. "Our paper documents current examples of systemic issues, similar to those from a quarter century ago, in which political and bureaucratic interference can compromise fisheries science advice in Canada for the sake of industry interests."

The authors detail examples in which DFO's science advice has failed to be impartial, evidence-based, transparent, and independently reviewed.

"Focusing on past challenges lets us think constructively about how the same mistakes can be avoided in the future," says co-author Dr. Gideon Mordecai, a researcher at the University of British Columbia. "Science needs to be just science. Robust processes are needed to ensure that science advice remains free of political and economic influences, and that science can play its role, among other important considerations, at the decisionmaking table."

The authors' main recommendation for structural change — to implement a truly independent science-advice body for Canadian fisheries management would bolster the credibility of the science advice being provided to decision makers and help to rebuild trust in DFO.

An independent body would be a reason for optimism, as Bateman says, "this paper and its recommendation highlight opportunities for improved scientific independence, integrity, and transparency for fisheries science advice in Canada."

### **OPEN-NET PEN DECISION**

"We believe strongly that moving the open-net pen farms out of the water is urgent and essential in order to rebuild wild Pacific salmon stocks in B.C." — Michael Meneer in a recent letter to the Minister of Oceans, Fisheries and Canadian Coast Guard.



Chinook and chum salmon. Photo: Tavish Campbell

## PEOPLE FOR SALMON

PSF is proud to introduce one of the latest Stewardship Community Bursary recipients, Kate J. Mussett.



"I am very grateful for all the Indigenous Peoples who have been generous enough to share their salmon knowledge with me." Growing up in Halifax, N.S., Mussett has cultivated a strong relationship with the ocean since childhood. As her passion for coastal ecosystems grew, so did her goals to support and protect bodies of water and the aquatic creatures within.

"My overall aspiration has always been to spend as much time on the water as possible," says Mussett, making a career as an ecologist specializing in fish — especially salmon — the perfect fit.

She appreciates the iconic species for their ability to bring people together and is always fascinated by the fact that salmon can "smell" their way home and use the Earth's electrical field orientation for navigation.

Throughout her undergraduate degree, which focused on fisheries co-management, Kate steadily learned that her conservation goals were intrinsically tied to the support of Indigenous Peoples, Knowledges, and rights, which influenced her continued education.

With the support of PSF's Stewardship Community Bursary, Kate obtained a master of science in oceans and fisheries at the University of British Columbia in partnership with the Centre for Indigenous Fisheries. Her thesis focused on co-developing a culturally relevant framework for fish, particularly salmon, and fish habitat health assessments. Kate worked with the First Nations Fisheries Legacy Fund and partner First Nations: dicey (Katzie), d'wa:n\'en (Kwantlen), kwikwe\'am (Kwikwetlem), xwm\textbf{ward\textbf{b}} m (Musqueam), salilwatał (Tsleil-Waututh), and scawa\textbf{a} m masteyax (Tsawwassen).

Kate's shift in focus toward the research of and protection of salmon has also largely been the result of her efforts to build relationships with Indigenous Peoples during her studies.

"I am very grateful for all the Indigenous Peoples who have been generous enough to share their salmon knowledge with me," says Mussett.

Through her master's degree, Kate aimed to gain further skills in ecological methods while working with Indigenous Peoples to support sovereignty and rights-based efforts in environmental spaces. Kate strives to use her western-science based education to support the movement toward decolonizing scientific practices.

"I look forward to helping shift the ways in which we, as settler Canadians, look at science and research," says Mussett.

The PSF bursary was instrumental in supporting Mussett throughout her 2.5-year degree, allowing her to dedicate more time to analysis, writing, reporting back to community partners, and developing community deliverables. She is now working on various fish-related projects with the Centre for Indigenous Fisheries.

#### WANT TO BE PSF'S NEXT BURSARY RECIPIENT?

If you or someone you know might be able to benefit from this bursary, applications are open until Oct. 30, 2023. A successful bursary applicant must be a full-time student in good standing in at least the second year of an accredited program that leads to a career supporting Pacific salmon. Preference will be given to applicants with stewardship and/or conservation volunteer experience. psf.ca/BURSARY

## ARTIFICIAL INTELLIGENCE

TO MONITOR AND ASSESS WILD SALMON ABUNDANCE

British Columbia's extensive coastline, numerous salmon-bearing rivers, and remote wilderness areas create significant challenges for monitoring salmon populations. This is particularly true on British Columbia's North and Central coast where many salmon streams are only accessible by boat or aircraft.

However, the importance of monitoring the health and abundance of Pacific salmon has never been more urgent. The rapid pace of climate change is challenging the ability of Pacific salmon to adapt to an increasingly unpredictable environment. Monitoring the returns of adult salmon is essential for understanding the status of salmon populations and informing conservation and management actions. This is currently hindered by a lack of timely information on returning adult salmon.

Artificial intelligence (AI) provides a novel and cost-effective solution. By building AI tools that leverage computer vision models, PSF's Salmon Watersheds Program in collaboration with the Wild Salmon Center is partnering with



First Nations to address the critical challenge of monitoring wild salmon and collecting in-season data in remote salmon-bearing watersheds.

Since 2020, PSF and the Wild Salmon Center have been working with Simon Fraser University, and the Heiltsuk, Haida, and Kitasoo Xai'xais First Nations, as well as the Gitanyow Fishery Authority and the Skeena Fisheries Commission to develop computer-vision models for automating the identification and real-time counting of salmon using videos and sonar cameras.

#### FIRST NATIONS-LED STEWARDSHIP

Christina Service, a biologist with Kitasoo Xai'xais Stewardship Authority (KXSA), supports the design and operation of the Kwakwa River weir — a fence (or weir) installed across a salmon-bearing stream to help count (in this case using automous counting via AI) the number of adult spawners that are passing through. She notes that the Kwakwa is not classified as a high-value river because the salmon that spawn there do not support any major commercial fisheries. As such, DFO does not monitor returns of local populations, and the AI technology is very helpful for resourcing a monitoring program that would otherwise not be funded.

"The reality is, the Kitasoo Xai'xais are a nation of 350 to 400 people in a very large area. We simply couldn't get this scale of information on important indicator stocks without the AI tool," says Service. "We get really high resolution, high-quality data that doesn't exhaust our local capacity."



William Housty, conservation manager with the Heiltsuk Integrated Resource Management Department, uses the technology to automate in-season video counting at the Koeye River weir.

"Heiltsuk has always had a vested interest in their territory and sustainably managing the resources within it. Sockeye has always been a targeted species for food, social, and ceremonial purposes, and Koeye has always been a top producer of sockeye for the community," he says.

He notes that despite the importance of sockeye, Heiltsuk and DFO previously had little information on the Koeye sockeye numbers. The lack of data prompted questions around the overall health of the local population and what a sustainable harvest to ensure that the sockeye population stays stable is.

"Answering these questions was beyond our capacity, so we developed this partnership to start to answer some of them," says Housty. "These tools have helped create more certainty with respect to harvesting sockeye from the system, and more confidence in the management practices that we have in play."





A pink salmon (left) and a coho salmon (right) swim through a counting fence and are tracked by the computer-vision model.

#### HOW IT WORKS

1. Computer-vision models are developed by scientists to enable rapid, automated detection, tracking, and identification of objects.

2. Thousands of frames of pre-labelled images or videos are used to 'train' the model, teaching it what to look for.

3. As the amount of training data increases, the model learns and becomes increasingly reliable at identifying objects.

4. Once the model has been trained and tested, and its accuracy is confirmed, the model can be used to automate counting salmon, a task that is especially valuable in remote sites.

"The reality is, the Kitasoo Xai'xais are a nation of 350 to 400 people in a very large area. We simply couldn't get this scale of information on important indicator stocks without the machine learning tool."

— Christina Service

## TRADITIONAL KNOWLEDGE BRAIDED WITH COMPUTER VISION

From the project's onset, the Salmon Watersheds team connected with Dr. Will Atlas, a post-doctoral fellow at UVic at the time.

Atlas says an interesting element of the AI monitoring is the incorporation of weirs, a traditional First Nations method for salmon management used for thousands of years before colonialism. He notes that weirs were banned by the original Canadian Fisheries Act in order to protect the financial interests of canneries.

"Braiding the ancient technology of weirs with computer vision allows for selfdetermination. Now First Nations hold the data to inform decision making in-season and out," says Atlas. He notes that the technology enables cost-effective data collection in places that were previously inaccessible.

"The truth of the matter is, you can't hire enough people to do the work that four hours of data will validate," he says. "Computer vision is a very powerful tool. It is time to build AI to empower local people those in remote and Indigenous communities — for decision making and co-governance."

#### OUTCOMES

During the initial pilot project, funded by the BC Salmon Restoration and Innovation Fund (BCSRIF), the team collected and labelled 530,000 images, developed and trained a computer-vision model which achieved 90 per cent accuracy for automated counts of coho and similarly high performance for sockeye, creating an open-source software for identifying and counting salmon. They are also developing a transferable package of tools and instructions that enable the widespread use of automated video monitoring technology.

A research paper *Indigenous Systems of Management for Culturally and Ecologically Resilient Pacific Salmon* published in BioScience (February 2021) was another important outcome that highlights the importance of traditional First Nations technologies for monitoring.

With the success of the pilot project, the team plans to expand work with 12 First Nations and develop an app for users to train models for their watersheds. Additionally, PSF's Community Salmon Program recently granted funding to Gitanyow, Heiltsuk, and Kitasoo First Nations to advance work on autonomous weirs with video counting technology.

Special thanks to the RBC Foundation's Tech for Nature program, which recently provided \$200,000 to expand this project.

The BC Salmon Restoration and Innovation Fund is funded by the Government of Canada and the Province of British Columbia.



The EGC likely spread to North and South America, Japan, South Atrica, and Australia in the ballast of ships. EGCs can rapidly colonize new grounds as they drift further in warming ocean currents.

Photo: Maria Catanzaro

## **INVASIVE SPECIES ALERT**

Prolific across the Pacific Northwest, invasive European green crabs threaten salmon habitat. Early detection and monitoring efforts can help minimize their spread.

## Native to Europe and North Africa, the European green crab (EGC) first arrived in British Columbia in 1998.

European green crabs are considered one of the 10 most unwanted invasive species by DFO due to their ability to tolerate a wide range

of temperatures and salinities and outcompete native crabs. They disrupt estuarine and marine ecosystems in a variety of ways. Burrowing into eelgrass beds, they destabilize vital habitat, devastating juvenile salmon dependent on these meadows.

Juvenile salmon and forage fish use eelgrass meadows as habitat to attract their preferred food and find refuge from predators.

However, early-detection monitoring and mass trappings are solutions to prevent EGC takeover. PSF, Coastal Restoration Society (CRS), and First Nations communities are collaborating to identify EGCs and safeguard critical salmon habitat.

"I have seen more than 10,000 green crabs pulled out of Cypre River estuary in Ahousaht territory, critical juvenile salmon habitat, in one day using only 40 traps. The most startling part is that there was virtually no bycatch, demonstrating just how intensely overrun these critical nearshore habitats are with EGC and emphasizing the need for widespread control and management efforts as soon as possible," says Crysta Stubbs, science department director with CRS.



Despite the name, EGCs are not always green! They can be identified by **three rostoral bumps** and **five marginal teeth**.



Illustration (top): Anisha Parekh. Photo: Maria Catanzaro

#### "I have seen more than 10,000 green crabs pulled out of Cypre River estuary in Ahousaht territory, critical juvenile salmon habitat, in one day."

Without intervention, the EGC harbours the potential to weaken fisheries for shellfish, bivalves, and salmon. But before populations establish, there are clues to find them.

"When European green crabs are trying to invade a new place, they are typically higher up in the intertidal in lagoons, side channels or small standing pools, and are often found in a muddy substrate near freshwater influence. They want cover and food. If you see vegetation in or near the water, sculpins, and native shore crabs, that is a space they would typically be found in first. If they are able to establish, they often move to deeper areas and could potentially disrupt eelgrass beds," says Maria Catanzaro, a PSF biologist.

Early detection monitoring remains paramount in stopping EGC from establishing populations. The team identifies sites to monitor for EGC using a PSF geospatial tool that points researchers to the most likely habitats they may invade first.

From there, the Early Detection Monitoring Team from PSF and CRS, along with community members, scout areas of interest, placing traps and looking for indications of EGCs. Sites

are continually checked monthly from April to September. If EGCs are detected, the next steps are to determine the level of capacity of PSF, CRS, communities, or DFO to conduct more frequent trapping work to try to eliminate them.

DFO staff initially trained PSF and CRS on green crab monitoring and identification to expand capacity for detection and removal work.

Now, the PSF-CRS team hosts training sessions with First Nations and stewardship groups to build their own capacity in early detection monitoring.

PSF and CRS aim to continue strengthening partnerships with communities and mitigate EGC populations across Vancouver Island, and ultimately limit the ecological and socio-economic impacts on coastal ecosystems.

This project is funded by a three-year \$700,000 grant from DFO's Aquatic Invasive Species Prevention Fund to train coastal communities within the Salish Sea, northern portions of the South Coast, and the Central and North Coasts of B.C. to identify these invasive species.

## WHAT'S KILLING COHO?

B.C. RESEARCHERS STUDY URBAN POLLUTION WASHING INTO LOCAL CREEKS AND THE IMPACTS ON PACIFIC SALMON.

#### When it rains, it pours.

In urban areas, roads collect a medley of contaminants – from tires, brake pads, car washes, vehicle exhaust, and road salts among others – that can wash into salmon-bearing streams during storms.

In some cases, urban pollution can be lethal for salmon.

A common tire preservative chemical, known as 6-PPD, oxidizes when exposed to ozone and transforms into a new compound called 6PPD-quinone, which is acutely toxic and causes "urban run-off mortality syndrome" in some fish species, with coho salmon being the most vulnerable.

Toxicity of 6PPD-quinone is an evolving research topic, but existing evidence suggests that not all salmon species are equally affected and that further research is needed to understand variability in vulnerability, sub-lethal effects, and methods of exposure.

Scientists across the province are working to answer burning questions about 6PPD-quinone. Where is the compound present and at what concentrations? Where are the most problematic inputs into streams? How should researchers target mitigation efforts?

PSF is supporting the British Columbia Conservation Foundation (BCCF) with their efforts to monitor 6PPD-quinone





Preliminary data collected in 2022 by BCCF/VIU AERL and volunteers. The size and colour of the circle reflects the highest concentration of 6-PPDQ detected in the streams.

Map: Joseph Monaghan

in salmon streams during storm events on the east coast of Vancouver Island in collaboration with First Nations and volunteer stewardship groups. Additionally, BCCF has partnered with the Applied Environmental Research Lab at Vancouver Island University, as they have developed a method to rapidly analyze samples to detect 6PPD-quinone in streams.

"There are still a lot of unknowns with regards to 6PPD-quinone, the catalogue of species that it may impact, and which systems in B.C. are the most impacted," says Haley Tomlin, a BCCF biologist.

In 2022, BCCF and partners sampled 13 different waterways during rain events on Vancouver Island, detecting 6PPDquinone in 10 streams. Of those, three waterways showed 6PPD-quinone concentrations above the lethal concentration limit for juvenile coho.

Recent research shows that green infrastructure – like rain gardens – are effective at removing 6PPD-quinone. Research published out of UBC in 2023 found that rain gardens can effectively filter out more than 90 per cent of 6PPD-quinone inputs to streams during a typical storm.

Research on pollutants and their impacts on fish and freshwater habitat is rapidly expanding. PSF is working with partners to support funding and coordination in the hopes of rapidly applying research findings to activate mitigation strategies.

#### ROAD SALTS AND SALMON

Road salts, another substance that spills into streams, are used to de-ice roads across Canada every year. Canadians use nearly five million tonnes of road salts annually.

Previous research suggests that juvenile salmon exposure to road salts in their freshwater habitat before they've adapted to saltwater is associated with mortality and growth issues. A five-year project led by researchers from UBC, SFU, and BCIT, and in partnership DFO and 13 local community groups, is studying the impact of road salts in more than 15 urban creeks across the Lower Mainland.

PSF's Community Salmon Program funds Still Moon Arts Society, a community group that is surveying benthic invertebrates, a salmon food source, in Still Creek. "Twice a year, we will collect data in sections of the creeks that are both impacted and unimpacted by road salts to gather baseline information of the effects of road salts on the salmon food web," says Adrian Avendaño, the stewardship programs manager at Still Moon Arts. "We will develop public education resources to raise awareness of the road salt issue."

Visit *psf.ca/DONATE* to support the Community Salmon Program.

### PACIFIC SALMON FOUNDATION

## EXPERIENCE ONE OF NATURE'S WONDERS!

This fall, witness one of nature's greatest migrations as salmon come home to spawn.

PSF's **#SalmonSpotting map** highlights the best spots in B.C. to see them.

### FIND A LOCATION NEAR YOU: PSF.CA/ SALMONSPOTTING



Photo: Eiko Jones