PSF.CA • THE PACIFIC SALMON FOUNDATION MAGAZINE • WINTER 2021

PACIFIC SALMON FOUNDATION

SALMON STEWARD

PLUS:

PSF'S FOREST FIRE PLAYBOOK

MAPPING SALMON DANGER ZONES

CITIZEN SCIENCE

A RETIRED COUPLE GOES TO WORK FOR SALMON

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SALMON STEWARD

PSF.CA | WINTER 2021

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On the cover: Gail and Ted Newell, citizen scientists with the Steveston Patrol. Photo courtesy of Rob Newell.

CEO's MESSAGE

Michael Meneer (right) helps BCCF fisheries technician Aaron Androsoff with a PIT tagging project in the Englishman River.

THE HEAT, DROUGHT AND WILDFIRES that blanketed B.C. in recent months made the challenging situation for many Pacific salmon stocks even more difficult. But salmon are resilient and there are bright spots, including better-than-expected returns of Sockeye and Pink salmon in the Fraser River. What's more, thousands of people across B.C. again mobilized this past summer with PSF support to undertake vital conservation and science work to help Pacific salmon adapt to climate change.

As we welcome Vancouver Quadra MP Joyce Murray as Canada's new minister of fisheries and oceans, we are keen to work with her and the entire DFO team to develop a coordinated, long-term salmon recovery strategy. Minister Murray has been a vocal and longtime supporter of Pacific salmon conservation and PSF.

Restoring Pacific salmon is complex, but the lack of a plan that encompasses local, regional and provincial scales has been a major hindrance.

PSF is showing leadership by being a catalyst to bring together Crown and Indigenous governments and conservation stakeholders. Priorities include:

- **A Coordinated Recovery Plan:** PSF is vocal about the need for a concerted and enduring action plan across prioritized watersheds – a plan that is inclusive of all salmon life stages.
- **Climate Adaptation:** Forward-thinking strategies are required to advance action to support salmon adaptation in the face of variable conditions and habitat changes resulting from climate change.
- **The Proposed Federal "Pacific Salmon Strategy Initiative" Must Incorporate Habitat, Hatchery and Harvest:** There are no silver bullets; addressing all of these issues will take time, as well as billions of dollars in investments over the next 10 to 20 years.
- **Removal of Open-Net Fish Farms:** PSF science shows that these farms pose serious health risks to migrating salmon. We must keep pushing for the phase-out of open-net aquaculture in coastal B.C. by 2025, as promised by the federal government.
- **Big Bar:** Ongoing focus on recovery from the 2019 Big Bar landslide to allow for continued passage of the most endangered salmon stocks through Canada's greatest fish migration highway.

In this issue of the magazine, we're pleased to share updates from PSF and our partners who are tackling these priorities, helping salmon adapt to changing climate and environmental realities. ■

Michael Meneer
President & CEO, Pacific Salmon Foundation

ABOUT US

AT THE PACIFIC SALMON FOUNDATION, 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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MITCH MILLER

BLIGHT UNSEEN:

MICROPLASTICS IN THE PACIFIC RIM

Since 2017, the Ucluelet Aquarium has rallied citizen scientist volunteers in a project aimed to better understand the distribution of microplastics across beaches in the Pacific Rim.

Through monthly surveys, they've collected 1,150 ml of microplastics on Wickaninnish Beach. That's the equivalent of approximately 1,500 basketballs.

Microplastics are tiny 1 ml-5 ml fragments of plastic that can severely harm the local ecosystem, acting as pollutants within the food web that endanger wildlife in marine environments. These particles can be mistaken for food, resembling eggs or other small marine organisms that salmon consume. Once ingested, they may cause a false sensation of being full and can starve the animal.

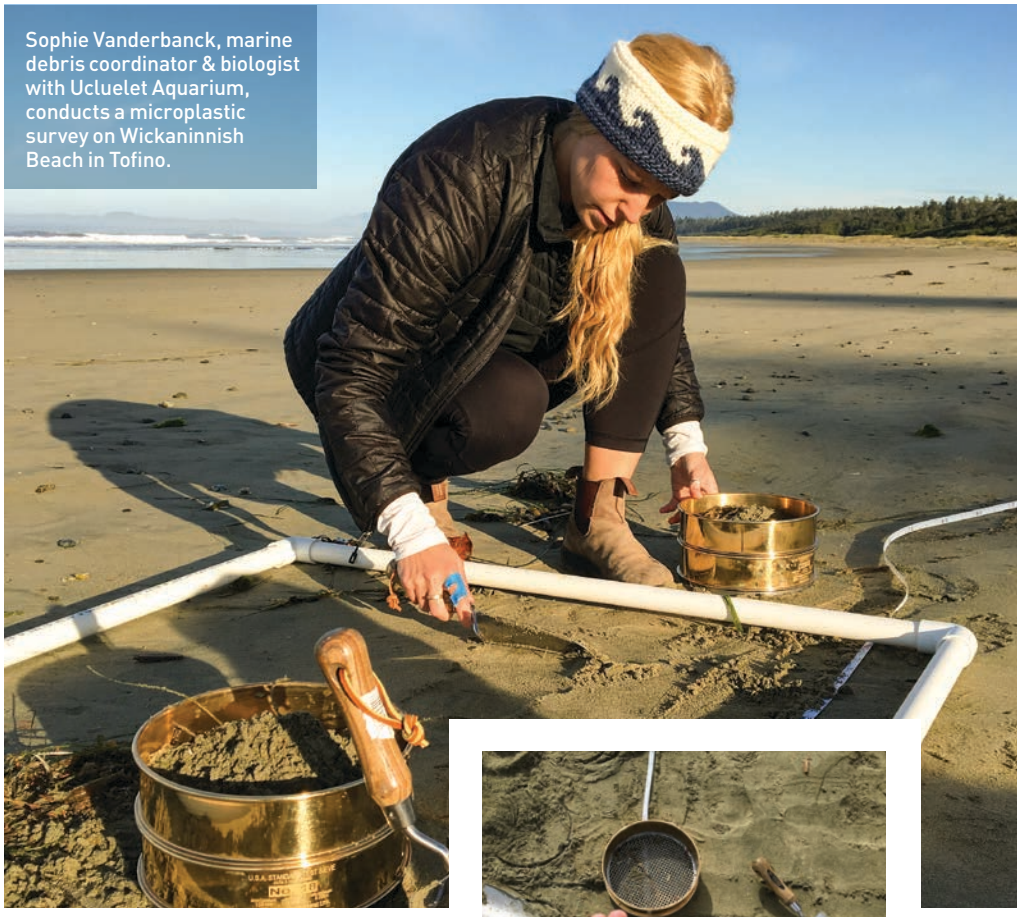
"Microplastics are a real danger to salmon, the species that support them, as well as their habitats," says Laura Griffith-Cochrane, curator of Ucluelet Aquarium.

She adds that microplastics can also interrupt the life cycles of important prey species that salmon eat.

"It's vitally important for salmon to eat nutritious food that will allow them to put on muscle, fat, and store energy for their future offspring. If they're eating plastic particles instead, they're not going to succeed, and neither will their future fry," Griffith-Cochrane explains.

The Pacific Salmon Foundation's Community Salmon Program, with funding from Return-It, supports this project, enabling continued engagement with citizen scientist volunteers' sampling efforts. The monthly collection and analysis of microplastics has identified potential patterns of debris on this section of coast, such as higher volumes in the winter months, when the tides are higher and ocean currents are stronger.

The trends are helping the team understand what types of microplastics are most commonly present, how seasonality affects the amount of plastic washing up on shore and the optimal time for beach clean-ups to remove microplastic debris.



Sophie Vanderbanck, marine debris coordinator & biologist with Ucluelet Aquarium, conducts a microplastic survey on Wickaninnish Beach in Tofino.

This study was the first of its kind, and as a citizen science project, has not only been able to find valuable data, but has engaged and educated hundreds of people along the way.

Griffith-Cochrane and her team hope that their research, public engagement and raising awareness to the negative impacts of marine pollution will help create positive changes for our shared environment.

"Salmon aren't just vital to the ecology of our home lands and waters, they're a keystone species of our culture and economy," she says. "It is important that we tackle marine microplastic pollution, because we are all connected to it." ■

HOW CAN I HELP?

START SMALL. Choose one item, such as a reusable shopping bag or a reusable "to go" coffee cup, and make the switch to support sustainable, plastic-free habits. Once you've succeeded, move on to another item.

FOREST FIRE PLAYBOOK

AFTER ONE OF THE PROVINCE'S MOST DEVASTATING WILDFIRE SEASONS YET, PSF PUTS A PLAN IN PLACE TO ENSURE SALMON ECOSYSTEMS CAN ALWAYS REBOUND

Sunday, August 15, 2021: A helicopter carrying a water bucket flies past a pyrocumulus cloud (also known as a "fire cloud") produced by the Lytton Creek wildfire.

THE CANADIAN PRESS/DARRYL DYCK

B.C.'s 2021 wildfire season was the third-worst on record in terms of total area impacted. Compounded with this summer's heat waves and droughts, Pacific salmon certainly felt the burn.

Wildfires can cause major changes to forests and soils, which leads to shifts in watersheds that have serious consequences for salmon and their habitat. Experts and climatologists forecast that Canada will endure increasingly intense and frequent wildfires in the coming years. As we all learn how to live with this new reality, planning for salmon is essential.

Wildfires burn the vegetation holding soil together and destabilize the surrounding landscape. As a result, loose mud, debris and sediment flow into critical habitat. Once excess sediment reaches a stream, it can plug salmon gills and make it difficult for fish to breathe, prevent salmon from accessing food, degrade critical riffle and pool habitat, and bury salmon eggs. "These fires are massive. When they burn, entire watersheds fall apart. The efforts put into salmon recovery become swamped by the effects of these large wildfires," notes Jason Hwang, Pacific Salmon Foundation's VP of salmon. "These fires can affect salmon for years or even decades."

Unfortunately, at the moment, there is no plan that considers the effects of major fires on aquatic ecosystems. PSF is working to change that by developing a Forest Fire Playbook that will explore landscape strategy options for salmon during the wildfire season. "If these fires are going to continue happening, how can we mitigate effects, accelerate recovery and try to prevent some of these consequences to support salmon populations?" says Hwang.

PSF's Playbook will engage experts in fields such as forest management, urban development and fish habitat restoration to identify common erosion-control and sedimentation-prevention measures. Applying these techniques to salmon ecosystems could stabilize soils and the areas that feed water into sensitive salmon habitat, preventing sediment and

Erosion, sedimentation, lack of vegetation and elevated turbidity in Shackan Creek following B.C.'s 2021 wildfire season. Below: Jason Hwang, PSF's VP of salmon.

> **"These fires are massive. When they burn, entire watersheds fall apart."**

debris from smothering them. This year's wildfire season demonstrates the scale of instability that massive fires can inflict on aquatic ecosystems. Shackan Creek, which feeds the Nicola River and supports at-risk populations of Steelhead trout and Coho salmon, was devastated by the summer fires. Heavy rainfalls in mid-August likely triggered wildfire-induced sediments to wash into Shackan Creek, according to Paul Mozin, biologist with the Nicola Watershed Stewardship and Fisheries Authority.

Recent surveys of Shackan Creek have revealed significant destabilization characterized by bank erosion, high sediment loads, a lack of riparian vegetation and elevated water turbidity. And yet, "most of the damage is still to come," Mozin explains. "The system is still extremely unstable and it will be for a number of years. It could be over a decade."

As B.C.'s wildfires intensify in the wake of climate change, planning around how fires impact watersheds and salmon will be critical, especially for watersheds most prone to fires. PSF's emerging Forest Fire Playbook will act as a catalyst to equip streamkeepers, scientists and officials with tools to mitigate the impact on salmon and advance recovery.

Planning and development for the Playbook is currently underway, and PSF expects to have a first draft available by March of 2022. ■

WHAT KIND OF "PLAYS" COULD THIS PLAYBOOK INCLUDE?

- **HYDROSEEDING** – a common erosion-control technique employed on construction sites, using mulch and grass seed to stabilize bare soils.
- **DESIGNING AREAS** to catch sediment before it can enter streams, a method that is used mostly in urban development.
- **ACCELERATING RECOVERY** of riparian vegetation via techniques like replanting or willow stakes, which could speed up the recovery of ecosystems and reduce erosion in the short term.
- **POST-FIRE LOGGING** practices that minimize impacts on watershed hydrology and recovery.
- **REFORESTATION** that, more than just regrowing timber, strives to restore hydrological and geomorphological processes, with the goal of restoring the ecological function of watersheds; this should be reflected in tree species selection and silviculture practices.

THE BIG PICTURE

OUR DEVELOPING FOREST FIRE PLAYBOOK for salmon recovery is part of PSF's larger Climate Adaptation Program, which is working on several projects that will help salmon in the face of climate change. To learn about PSF's critical climate work, made possible by the British Columbia Salmon Restoration and Innovation Fund, visit *psf.ca/work/climate*.

PAUL MOZIN, REID HWANG

BREAKING THE BOTTLENECKS

A PSF INITIATIVE SEEKS TO IDENTIFY THE DANGER ZONES IN THE SALMON LIFE CYCLE

Over this past decade, the abundance of Chinook and Coho salmon and Steelhead trout in the Salish Sea has declined. There is growing consensus that the first year of marine life plays a key role in regulating productivity for juvenile salmon, and that competition, climate change and predation all contribute to poor salmon and Steelhead returns in southern B.C.

Now, the Pacific Salmon Foundation and the British Columbia Conservation Foundation (BCCF) are investigating survival bottlenecks for salmon and Steelhead throughout the Salish Sea.

The four-year project, which is supported by the B.C. Salmon Restoration and Innovation Fund, began in 2020 and aims to provide new information on bottlenecks for Chinook, Coho and Steelhead. The project involves tagging fish with small Passive Integrated Transponder (PIT) tags, which help track the survival of populations.

"Each PIT tag has a unique identification code associated with it that allows us to monitor fish at different life stages – as they migrate out through the freshwater, into the marine environment and then again as they return as adults. We'll use this information to piece together survival estimates at these different points," says project co-manager Collin Middleton, a PSF biologist.

In the first year of the project alone, BCCF staff, other partners and volunteer anglers have tagged more than 100,000 fish in hatchery, freshwater and marine environments. Tagging fish in the marine environment is done via micro-trolling, a method developed by our partners at the University of Victoria and BCCF, which involves using specialized miniature trolling equipment to catch juveniles in the ocean.

PIT antennas and arrays, which passively read tags when tagged individuals swim over or through them, were installed this summer in more than half a dozen priority freshwater areas and hatchery systems in central and eastern Vancouver Island, including: Cowichan River, Nanaimo River, Englishman River, Big Qualicum River, Little Qualicum River, Puntledge River and Quinsam River.

A PIT antenna-array system in the Nanaimo River tracks tagged salmon as they swim by.

DANNY SWAINSON

"This project requires building collaborations with a multitude of partners from governments (First Nations, federal and provincial), streamkeeper groups and fishing guides, among others," says project co-manager Jamieson Atkinson, senior fisheries biologist with BCCF. "I hope this is the start of something big." With the current partnerships and interest in the program, expansion into the Fraser River, Sunshine Coast and other Vancouver Island systems is not out of the question.

This initiative will also examine the ecology of juveniles during their first ocean winter, monitor recreational fishery catches and predation mortality, and evaluate alternative hatchery strategies as conservation tools for Steelhead.

The bottlenecks project emerged after an earlier study revealed the importance of critical mortality periods during the early marine period and the first winter of marine life, and the lower survival of hatchery-produced salmon relative to wild

Clockwise from left: Staff from BCCF and the Ministry of Forests, Lands, Natural Resource Operations and Rural Development add housing to protect connection and communication cables on a PIT system panel in the Englishman River; anesthetized juvenile Chinook are injected with PIT tags at the Nanaimo River Hatchery; juvenile Chinook in a net pen at the Big Qualicum Hatchery.

> **“It’s important to keep an eye on these systems where there is considerable hatchery production alongside wild and naturally spawning fish.”**

fish in the Cowichan River. “The Cowichan study showed that, through early life stages of Chinook, wild fish survived twice as well as their hatchery counterparts,” Atkinson explains. “We know there are differences in survival between hatchery and wild fish in the Cowichan. Now, we’re applying what we learned from this study to other watersheds on Vancouver Island.”

Middleton adds: “It’s important to keep an eye on these systems where there is considerable hatchery production alongside wild and naturally spawning fish, and to try to come up with ways to set up both for success.”

Through the project, PSF and BCCF along with partners will conduct research that helps us better understand the factors affecting the performance of hatchery and wild stocks, and gather data that informs adaptive management of hatchery programs, harvest fisheries, and conservation and sustainability objectives.

Currently, PIT tagging for the bottlenecks project is scheduled to finish in March 2024, with data collection and analyses to begin in the years following, as the final tagged fish return to freshwater ecosystems. ■

WHAT EXACTLY IS A BOTTLENECK?

A SALMON SURVIVAL BOTTLENECK is any event (or series of events) that results in a sharp decline in a given population over a relatively short period of time, ultimately limiting future production.

HOW BIG IS A PIT TAG?

EACH TAG is about the size of a grain of rice, measuring 12 mm-by-2.5 mm. PIT tags employ the same Radio-Frequency Identification (RFID) technology used to tap bank cards or scan microchipped pets at the veterinarian.

DANNY SWAINSON

PEOPLE FOR SALMON

A HUSBAND AND WIFE DEVOTE THEIR RETIREMENT TO BIRDING, BANJOS AND CITIZEN SCIENCE

Gail and Ted Newell are salmon folk. Based in Deep Cove, North Vancouver, the couple volunteers with PSF's Citizen Science Oceanographic Program.

It all began in 2016 when Ted started volunteering as a deckhand with the Steveston Patrol after retiring. He's continued the gig ever since, owing mainly to his love of the water.

"It's a good place to be," he says.

In his lifetime, Ted has worked in the engine division of a construction equipment manufacturer, ran a fabrication shop that built boats in Parksville, B.C., and led his own Vancouver-based construction design engineering company. Now, as a volunteer in the Citizen Science Program, he's refocusing his energy to help bring salmon back.

"We've done a lot of salmon fishing throughout our lives and it has really changed," says Ted. "We used to visit Campbell River and there always used to be Coho there. When we lived in Nanaimo, we could catch salmon any time of year. That's not the case anymore. Things have really gone downhill with salmon."

In 2019, three years after Ted joined the Citizen Science Program, he recruited his wife Gail. It was a natural fit. She shares Ted's connection to the water – in fact, it runs in her family.

Gail's grandfather, great-grandfather and great-great-grandfather were all skippers on Fraser River tugs. In her youth, she would go fishing with her grandparents in an old boat in Pender Harbour. "My earliest memories are on the water, being in a rowboat as a kid," says Gail. "I like the water. After 27 years as a lifeguard/swimming instructor, I'm very comfortable in the water and around it... if it's calm!"

As citizen scientists, Gail and Ted take their boat into the Strait of Georgia roughly 20 times a year to collect phytoplankton and nutrient samples and to measure oceanographic conditions of conductivity, temperature and depth at eight separate stations.

Running the Steveston Patrol together affords this couple quality time on the open water while allowing them to observe wildlife and collect data that contributes to our collective knowledge of Pacific salmon and their ecosystems. "We're both retired. We've got time. It's good to be out on the water and see what's out there," says Ted.

When they're not gathering salmon intel, Ted and Gail visit their cabin in Johnson Bay, Indian Arm, often doing maintenance work or paddling their kayaks, canoes and the rowboat Ted built with his dad when he was 15 years old. Ted has also taken up the bluegrass banjo. Gail recently started a birding course with Cornell University.

Yet despite ample hobbies at their disposal, the Newells have no intention of retiring from the Steveston Patrol. "We're going to keep doing it for as long as we can," says Gail. ■

LEARN HOW CITIZEN SCIENTISTS like the Newells are helping to advance our understanding of Coho and Chinook diets, forage fish spawning habitat and more at *marinescience.ca*.

Gail and Ted Newell gather samples and take measurements across the Strait of Georgia.

ROB NEWELL

RESEARCH MATTERS

THE INFECTIOUS FALLOUT OF RAISING ATLANTIC SALMON IN THE PACIFIC

PSF salmon scientists Dr. Emiliano Di Cicco and Dr. Andrew Bateman study the connection between aquaculture and the spread of pathogens.

Piscine orthoreovirus (PRV) is continually being transmitted between open-net salmon farms and wild juvenile Chinook, according to new genomics research jointly supported by the University of British Columbia and the Strategic Salmon Health Initiative.

The study, published in *Science Advances* this past May, highlights the role of salmon farming in introducing novel pathogens to new regions, where they then spread to wild fish. The research found evidence that farming Atlantic salmon in Pacific waters introduced PRV to the region, and that PRV is now exceedingly common on B.C. salmon farms, and is then passed on to wild fish.

The study used virus surveillance and genomic sequencing to reveal that:

- PRV originates from Atlantic salmon farms in Norway, thus supporting the wide consensus established by previous research.
- Today, the virus is almost ubiquitous in B.C. salmon farms.
- Wild Chinook caught closer to salmon farms are more likely to be infected with PRV. Additionally, both wild and farmed salmon with PRV are infected by the same variants of the virus. Considered together, these two findings indicate that viral spillover from farms to wild salmon continually occurs.
- The ancestor of the PRV lineage currently in B.C. salmon arrived roughly 30 years ago. This suggests that the introduction of PRV to B.C. and infection of wild Pacific salmon is a relatively recent phenomenon and coincides with the arrival of Atlantic salmon aquaculture in the region.
- The number of PRV infections in British Columbia has grown in recent decades, corresponding with the regional growth in salmon aquaculture and high rates of viral infection in salmon farms.

> **“PRV... originated in the Atlantic Ocean and has been spread around the world through salmon aquaculture.”**

“There has been much confusion about where PRV is originally from and whether it is transmitted between farmed and wild salmon,” says Dr. Gideon Mordecai, a viral ecologist at UBC, who led the study. “This study’s genome sequencing clearly indicates PRV is not native to B.C. waters – it originated in the Atlantic Ocean and has been spread around the world through salmon aquaculture.” ■

The Strategic Salmon Health Initiative is a partnership between the Pacific Salmon Foundation, Fisheries and Oceans Canada, and Genome BC. Dr. Gideon Mordecai was funded by the Liber Ero Fellowship.

VIRAL CONSEQUENCES

PRV TRIGGERS Heart and Skeletal Muscle Inflammation (HSMI) in Atlantic salmon. A recent Norwegian study found that a B.C. isolate of the virus causes heart lesions in Atlantic salmon. More relevant to Pacific salmon, research led by PSF scientist Dr. Emiliano Di Cicco found that PRV is associated with jaundice/anemia in Chinook, a potentially fatal disease that results from red blood cells bursting, leading to liver and kidney damage.

AMY ROMER

CONSERVING AND RESTORING THE NATURAL HABITATS OF WILD PACIFIC SALMON

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WHAT'S A FISH TO EAT?

TURNING DATA INTO ACTION TO RESTORE A KEY SALMON FOOD SOURCE

Teams conduct estuary research during the Salish Sea Marine Survival Project.

Forage fish in B.C. waters play a key role for juvenile salmon survival in the Salish Sea. Forage fish, primarily herring, not only represent an essential food source for juvenile salmon, but also feed harbour seals – which effectively reduces predation pressures on salmon. But many Salish Sea populations of forage fish have declined, likely contributing to decreasing survival rates of young salmon.

The Salish Sea was once a highly productive place for salmon. But starting in the 1970s, marine survival rates for Chinook, Coho and Steelhead plummeted. Despite major conservation efforts, salmon have not recovered. Some populations have dropped by 90 per cent.

The Salish Sea Marine Survival Project (SSMSP), a research collaboration co-led by the Pacific Salmon Foundation, identified two primary sets of factors impacting the survival of young Chinook, Coho and Steelhead in the Salish Sea – and both are linked to forage fish. Firstly, the research prioritized climate-driven changes to the salmon food supply – such as decreases in forage fish populations. Secondly, the project determined that a dramatic increase in salmon predators, such as harbour seals, is reducing juvenile salmon survivability.

"PSF's Marine Science Program, together with many partners, are transforming the landmark SSMSP findings into salmon conservation efforts," says Dr. Isobel Pearsall, director of the Marine Science Program. "Given the clear link between juvenile salmon survival and the marine food web, many of our projects specifically target forage fish and their habitat."

Several PSF-led projects are addressing the emerging challenges surrounding forage fish. The Resilient Coasts for Salmon initiative, for instance, enhances the naturalization of shorelines around the east coast of Vancouver Island. Forage fish rely on healthy shorelines for survival, but manmade structures such as dykes, seawalls and jetties degrade key habitat like spawning beaches. This project will boost retention of forage fish habitat.

Another key effort is PSF's Nearshore and Estuary Program, which is restoring estuaries surrounding the Strait of Georgia. Some forage fish, such as Pacific herring, spawn en masse in marine vegetation like eelgrass and kelp. Under the program, a Climate Adaptation Strategy is being developed to protect forage fish and other species that rely on nearshore habitat. ■

STRONGER TOGETHER

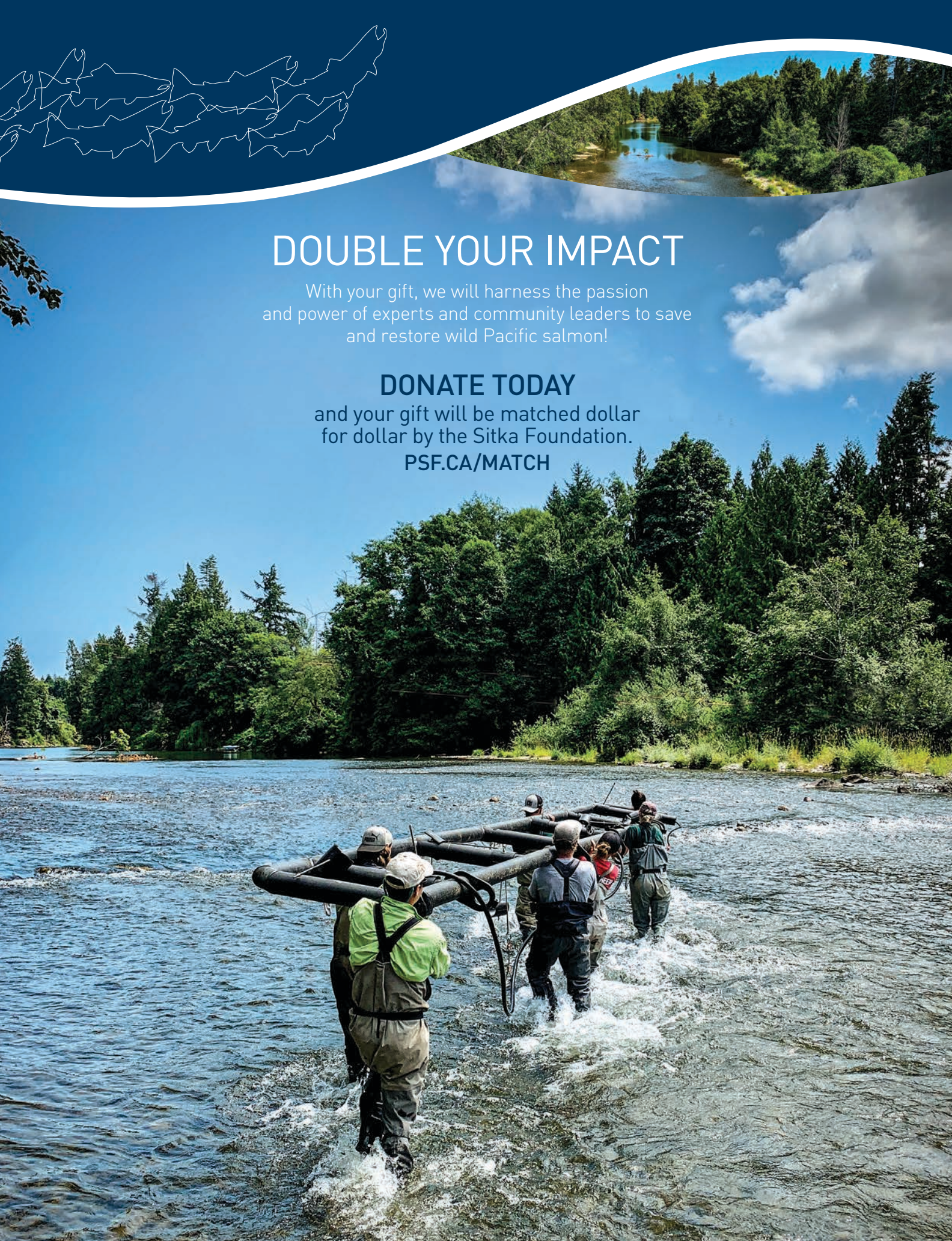
PSF IS ALSO supporting major projects led by partner groups.

1. A citizen science program run by the University of Victoria is assessing the diets of Chinook and Coho in the Strait of Georgia to better understand the dynamics of salmon diets, providing new information on fluctuations of forage fish.

2. World Wildlife Fund – Canada and the Mount Arrowsmith Biosphere Region Research Institute are conducting beach spawning surveys for forage fish embryos, which help identify at-risk spawning beaches. "This project fills in critical knowledge gaps on forage fish and allows us to advocate for the changes we need to better conserve the Salish Sea marine food web through these really important forage fish that bridge the gap between primary producers and large predators," says project lead Jacklyn Barrs, forage fish and marine conservation specialist at WWF – Canada. Check out the interactive map on beaches vital to Pacific sand lance and surf smelt from PSF's Strait of Georgia Data Centre at *psf.ca/foragefishmap*.

Bringing them back, sample by sample.

MATT HAGEN



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