



Photo by Bill Pennell

CONNECTIONS AND LEADERSHIP

There is a connection between nature and the well-being of society. Pacific salmon link forests, streams, estuaries, and the entire North Pacific Ocean through their complex life cycle. There are thousands of years of Indigenous culture and a substantial commercial and recreational fishing and tourism economy built upon the ecosystem benefits of Pacific salmon.

Pacific salmon require healthy freshwater and marine habitats to survive and flourish. Management of salmon habitat falls to a myriad of international, federal, and provincial jurisdictions that crisscross marine and freshwater habitats.

According to DFO, "During the past decade, the management of Pacific salmon has become progressively more challenging for various reasons. Supreme Court decisions, varying ocean productivity, conservation concerns, habitat loss, international agreements, new Canadian legislation governing species at risk, shifts in global markets, and altered public expectations have all contributed to this dynamic operating context." (3).

Conserving wild Pacific salmon requires effective leadership that understands the importance of connections and collaboration. There are some recent initiatives in Canada to help wild Pacific salmon:

Canada's Wild Salmon Policy has three objectives: safeguard genetic diversity of wild salmon, maintain habitat and ecosystem integrity and manage fisheries for sustainable benefits.

- o In 1987, the [Pacific Salmon Foundation](#) (PSF) was established as an independent foundation that could complement the community-based work of the federal Fisheries Ministry. The PSF believes there are three major opportunities to positively impact salmon: habitat, harvest/fishing, and hatcheries (4).
- o In 2005, Canada's [Policy for the Conservation of Wild Pacific Salmon](#) (the 'Wild Salmon Policy') was enacted with the goal to restore and maintain healthy and diverse salmon populations and their habitats for the benefit and enjoyment of the people of Canada in perpetuity. Importantly, Principle 2 of the Wild Salmon Policy includes honouring obligations to First Nations (5).
- o In 2017, a major international collaboration called "[International Year of the Salmon](#) (IYS)", began its work to encourage international cooperation to better understand the ocean ecology of salmon (6). It is governed by the North Pacific Anadromous Fish Commission (NPAFC) in the North Pacific. It focuses on understanding oceanic habitats and the extreme and uncertain climate conditions that threaten the survival of wild salmon from all five Pacific salmon-producing countries (Canada, USA, Japan, Russia, and the Republic of Korea).
- o In 2019, the Province of British Columbia partnered with the federal government to co-fund the \$285.7M [British Columbia Salmon Restoration and Innovation Fund](#) to protect and restore Pacific salmon and other priority wild fish stocks (7). The fund also supports projects that will ensure the fish and seafood sector in British Columbia is positioned for long-term environmental and economic sustainability.
- o In 2021, DFO committed an additional \$647M to the [Pacific Salmon Strategy Initiative](#) (PSSI) to reverse historic declines in key salmon stocks. The PSSI will focus on four key areas: conservation and stewardship, salmon enhancement, harvest transformation, and integration and collaboration (i.e., partnerships and collaborations) (8).
- o In March 2023, the provincial government committed an additional \$100M to the [Watershed Security Strategy](#) – Government of British Columbia to restore abundant wild salmon populations (9). This was boosted by an additional \$17.25M in



June 2023 primarily to help support wild salmon recovery and Indigenous People's capacity through the Pacific Salmon Foundation and First Nations Fisheries Council.

First Nations communities connect the wild salmon initiatives together. Their governance provides a pathway to unite efforts and rekindle focus toward preserving and restoring Pacific salmon and their habitats. The Coastal First Nations Great Bear Initiative is one such example of advanced land and marine spatial planning on a massive scale (10).

The [First Nations Fisheries Council](#) (FNFC) represents communities from 14 geographic regions of British Columbia (11). They share a collective vision to increase First Nations access, allocation, and involvement in fisheries management

and decision-making, pursuant to their Aboriginal Title and Rights and Treaty Rights. The FNFC Salmon Coordinating Committee has worked directly with DFO to jointly draft the 2018-2022 Wild Salmon Policy Implementation Plan (WSPIP), which outlines nine overarching approaches and 48 actions DFO has committed to over this 5-year period.

There are many other initiatives, including hundreds of smaller organizations and thousands of volunteers working to help wild salmon in British Columbia. BC salmon farmers share this passion for wild salmon and have been actively involved in Pacific salmon conservation projects with First Nations, the scientific community, DFO, and local coastal communities for many years.



Photo by Bill Pennell

CONNECTING WITH FIRST NATIONS, THE ORIGINAL STEWARDS OF THE COAST



New ways of thinking, new governance models, and new collaborations are required to safeguard the future of wild salmon. First Nations, as the original stewards of Pacific salmon, are uniquely positioned to lead conservation efforts through governance connections and traditional knowledge.

First Nations have been the stewards of their lands, waters, and elements since time immemorial. They are the original environmentalists and have been successfully managing environmental stressors and changes to their ecosystems for thousands of years.

Harmonizing Indigenous knowledge, stewardship, and Western methods is the path toward ecological health while encouraging economic growth on the coast. It will give wild salmon their best chance to survive climate change and human impact stressors now and in the future.

Some ways in which coastal First Nations are protecting their marine spaces and the wildlife within it are by implementing:

- o Guardian Watchmen and Indigenous Stewardship programs
- o Traditional Ecological Knowledge (TEK) and Indigenous-led Western Science
- o Indigenous Marine Protected Conservation Areas
- o Wild salmon revitalization efforts (hatchery programs, watershed restoration, recreational fishing restrictions).

These initiatives are described in detail in "Chapter 4 - Caring for Indigenous Stewardship - Connecting with the Original Guardians of the Coast".

In a period of new challenges collaboration of traditional and new knowledge will help ensure a future of responsible stewardship.



THE OVERARCHING STRESSOR - CLIMATE CHANGE

Researchers generally agree that climate change may now be the major influence affecting the production of wild Pacific salmon in fresh water and the ocean. In fresh water, temperature increases and decreased water flows are of major concern. Temperature changes and increasing heat are directly and indirectly of concern in the ocean, but impacts are poorly understood because factors affecting ocean survival are poorly understood. Hatchery salmon provide important opportunities to study mechanisms in the ocean that influence

survival as climate-related impacts on hatchery salmon will be in the ocean.



Photo by Brian Kingzett

Climate changes occurred in past centuries and salmon adapted to these changes by establishing stocks that were genetically adapted to specific conditions in fresh water and the ocean ecosystems. As changes occurred, there would always be some stocks that were better adapted to the new habitat. The issues today are that the climate-related changes are occurring substantially faster than in the past, and salmon were not managed over the past 100 years to protect their evolved

ability to adapt to rapid ecosystem change. However, if we had a much better understanding of exactly how the rapidly changing ecosystems are now affecting salmon survival, we could manage the existing populations to optimize their collective productivity. Teams that integrate their biological and oceanographic abilities will be one way to expedite acquiring the necessary understanding quickly.

HELPING UNDERSTAND OCEAN HABITAT FOR WILD SALMON

Salmon farmers are concerned about the impacts of climate change on oceanic habitats for both wild and farm-raised fish. The BC Salmon Farmers Association (BCSFA) has been a major funder of the winter high-seas expeditions of the International Year of the Salmon (IYS) (6). This research group is comprised of an international group of scientists from Canada, Japan, the Republic of Korea,

Russia, and the USA who are mapping the distribution of salmon throughout the North Pacific Ocean in the winter and working to discover the mechanisms that regulate survival. This work is important to understanding wild Pacific salmon, considering that the Pacific Ocean where wild salmon spend much of their lives, remains largely a mystery.



Photo by Bill Pennell



On a more local scale, we need to understand how ocean food webs for salmon in the ocean are shifting with climate change. Evidence is accumulating that the availability and quality of food for salmon during their first few weeks in the ocean affects their ability to store fats needed to grow and survive (12).

The Strait of Georgia is now 1.5°C warmer than 60 years ago which results in reduced upwelling and, ultimately, less zooplankton for salmon (13). The effects of temperature changes in freshwater spill over into smolt migrations, which occur earlier due to warmer stream waters, when ocean and estuary conditions have not caught up (14).



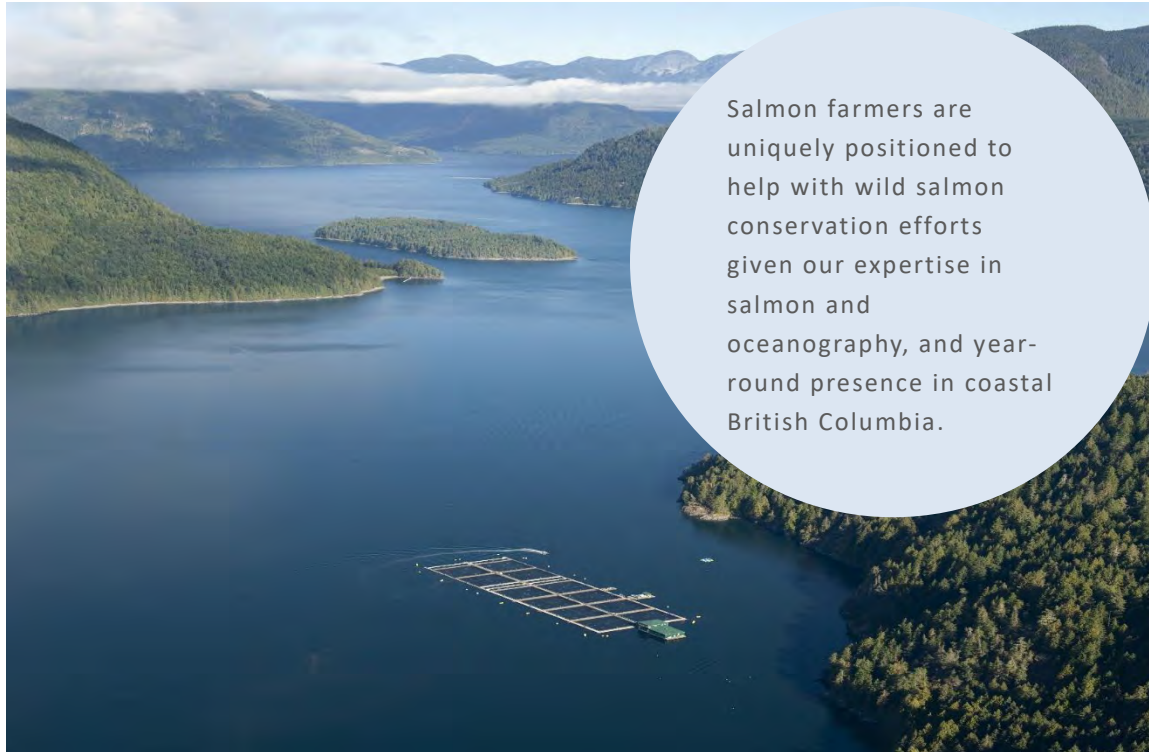
Photo Chris Walling aka Steel_Snorkel

Salmon farmers have important information to contribute to these conservation efforts. Data collection at farms is currently undergoing a digital revolution. With the arrival of in-sea data loggers, wireless point-to-point communication towers and artificial intelligence, farmers are installing technology that collects millions of data points each day, recording oceanic conditions.

Salmon farmers have monitored plankton daily at each active farm and remote areas prone to plankton blooms for at least two decades.

Projects can be developed with others to utilize this data to monitor and evaluate climate change in the nearshore ocean environment. One such project is the multi-year Discovery Passage plankton monitoring program which provided needed insight into matching the salmon release with available food in the ocean

for coho salmon from the Quinsam River (15). This important project was a collaboration between the A-Tlegay Fisheries Society, BC Center for Aquatic Health Sciences, Campbell River Salmon Foundation, DFO Quinsam River Hatchery, and funders such as BC salmon farmers.



Salmon farmers are uniquely positioned to help with wild salmon conservation efforts given our expertise in salmon and oceanography, and year-round presence in coastal British Columbia.

HELPING MAP SALMON WATERSHEDS, SALMON RUNS, AND MIGRATIONS

A critical step in potentially reversing the declining trend in salmon is to improve the understanding of the present state of salmon returns, the migration routes of both juvenile and adult salmon from and to their natal streams, and the condition of stream habitats. Salmon farmers, using GIS systems, have been building summaries of these topics in many of the coastal areas where salmon farming occurs. Ultimately, these datasets can help with the second step of DFO's Wild Salmon Policy, where deepening the understanding of habitats and runs will inform strategies to conserve and restore salmon populations (5).



The GIS database includes information layers for fish farm locations, stream locations and associated salmon returns, out-migration routes, and other industrial activities such as deforestation. This is a valuable tool to assist with understanding

salmon returns and human activities through time. For example, Figures 1(a), 1(b), and 1(c) indicate the progression of forest harvesting along the mainstem of the Quatam River watershed from 1951 – 2000.

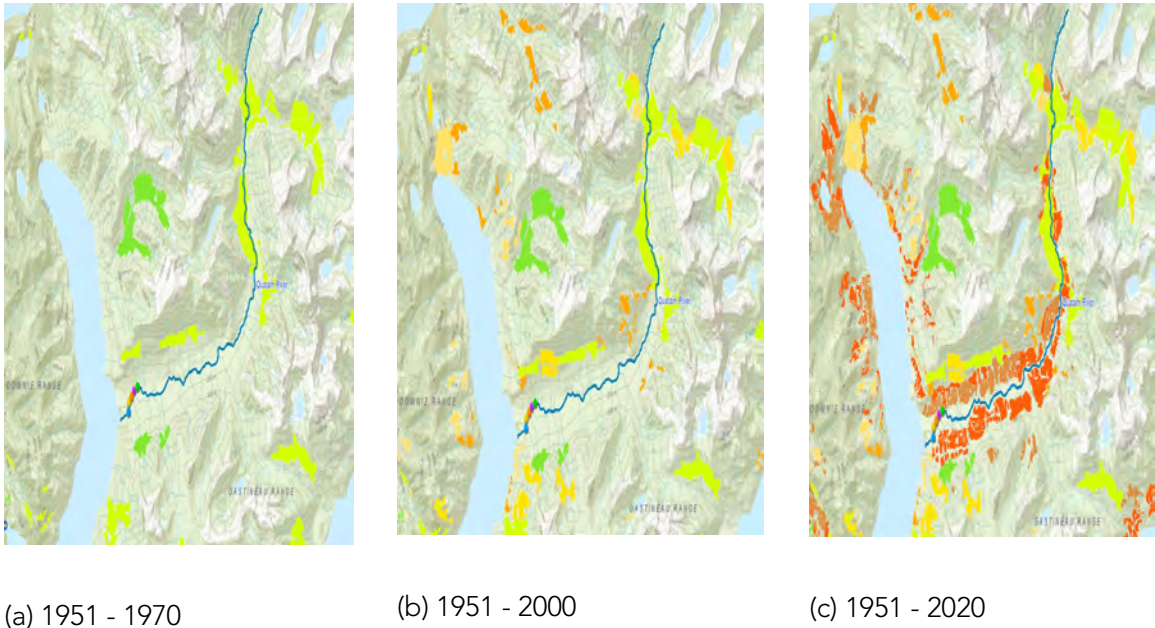


Figure 1. Quatam River watershed cumulative forest harvesting cut-blocks.
Progression shown by years: (a) 1951 – 1970; (b) 1951 – 2000; and (c) 1951 -2020(16).

The development of salmon farms and salmon returns have been assessed for many watersheds and coastal areas. For example, the total chum salmon spawner returns to streams in the Discovery Islands from 1953 to 2021 is shown in Figure 2.



Photo by Bill Pennell

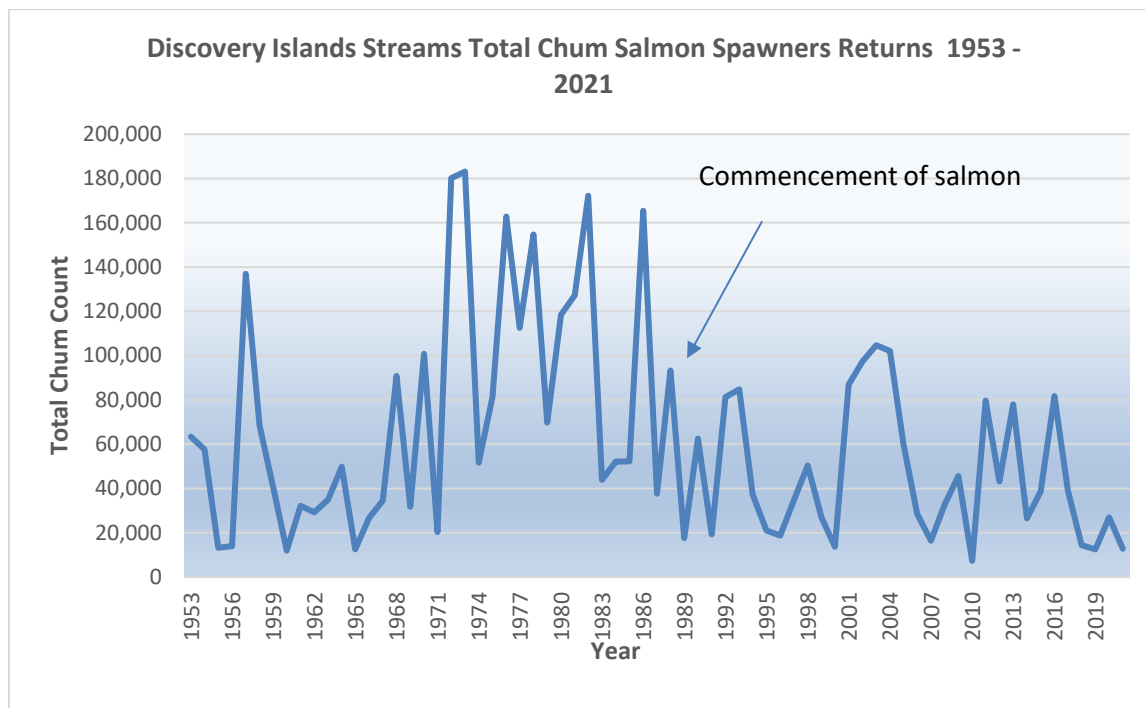


Figure 2. Discovery Islands area cumulative chum salmon spawner returns (1953 – 2021) and the commencement of commercial salmon farms.
Source DFO Open Data NuSEDS(17).



The GIS tool can also be used to map major out-migration routes that juvenile wild salmon follow when leaving their natal streams. Salmon farmers have developed juvenile out-migration route

maps for several production areas based upon knowledge from First Nations. An example is Figure 3 which shows the major out-migration routes in the Discovery Islands as described by First Nations.

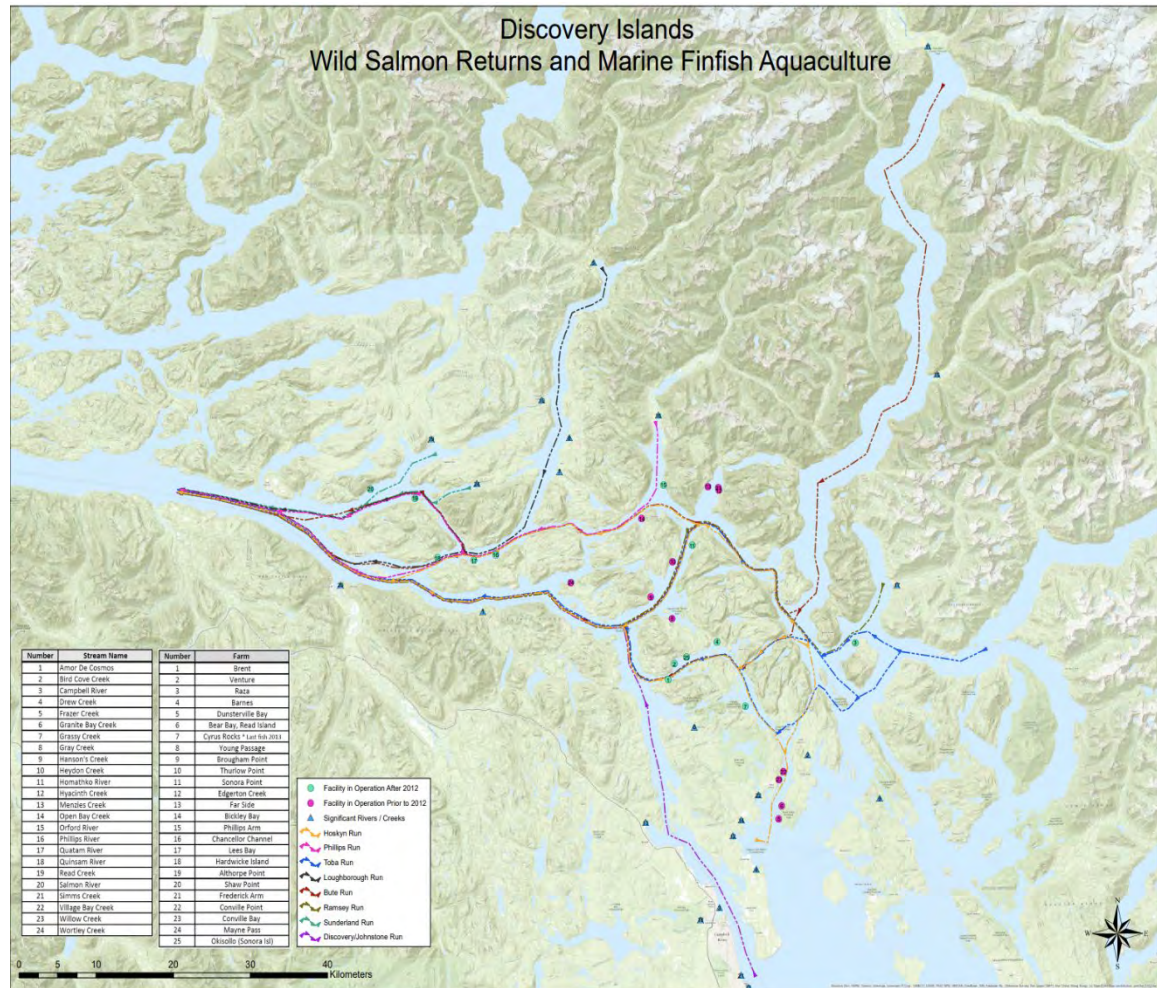


Figure 3. Discovery Islands wild juvenile salmon outmigration routes.

LOCAL HABITAT STRESSORS AND POTENTIAL REMEDIES

There are many stressors to freshwater habitats including the effects of climate change, hydroelectric dams, water and gravel extraction, urbanization, road crossings, pollution, residues from rubber tires, agriculture, forestry, mining, stream removals/blockages, loss of stream-side vegetation, changes in hydrology and precipitation (rainfall and snowpack), invasive species and others.

HUMAN POPULATION GROWTH

Pacific salmon populations and habitats have degraded considerably over the past 100 years following the migration of people to the province. In 1900 the province had less than 200,000 people, by 1951, about 1.2 million, (18) and as of July 2021, 5,214,805 people were living in BC(19). Most people live along the coastline and within watersheds – the very places that are essential for Pacific salmon.

Experts predict that the Pacific Northwest population of Canada and the USA will grow from 14 million to 85 million by 2100. This will put enormous pressure on salmon habitat.

The population growth is expected to continue, with some experts predicting that the Pacific Northwest population of Canada and the USA will grow from 14

million to 85 million by 2100 (20).

Inevitably, this will bring additional stress to salmon habitat and likely more pressure on capture fisheries. Maintaining sustainable populations of Pacific salmon over the next hundred years will require strong leadership, governance, and the collective knowledge of all British Columbians.

Salmon aquaculture has the potential to feed this growing population without adding additional pressure to capture fisheries.





Photo by Brian Kingzett

LAND DEVELOPMENT

The Fraser River watershed, greater Vancouver area and east coast of southern Vancouver Island have experienced the bulk of land development in BC over the past century (21). Along with these areas, there are other rivers and estuaries in the province that have sustained habitat impacts. Estuaries are important habitats for juvenile

Using 170-year-old field manuals, scientists have concluded that 85% of the lower Fraser River salmon habitat is no longer accessible to declining fish populations, from Delta to Hope, BC.

salmon emerging from their natal streams, and dredging, dike construction, and the smothering of the sea floor by woody

debris from booming grounds can impact wild salmon.

Forest harvesting is the primary land development elsewhere along the British Columbia coast and its effects on freshwater habitat have been well documented. These include changes to stream hydrology as the removal of trees reduces the uptake of water from the soil resulting in an increase of run-off to streams. In coastal BC, this results in an increase in high flows and flooding events during the wet times of year and lower stream flows in the dryer parts of the year. Water quality is also degraded due to increased sedimentation from erosion.

Depending on the extent of the harvesting, there could also be changes to the instream habitat through decreased shading, leading to an increase in water temperature.

The provincial government passed the [Riparian Areas Protection Act](#) in 2004 (formerly the Fish Protection Act of July 1997) (22) and the Forest and Range Practices Act (23) in 2002 to protect stream flow and habitat for fish. There have been vast improvements in awareness, knowledge, and practices since these protections came into effect. Many forestry companies are working with local First Nations to restore watersheds, and numerous salmon runs are now recovering from these disturbances.

It should be noted that salmon farms do not have the potential to impact habitat in estuarine or freshwater areas as they are anchored in marine waters, typically over 40m in depth. Typically, farms only contact the shoreline through a series of anchor pins that help hold the cages in place. This does not block passage for fish, birds, and other marine life.

The average size of a cage array and grid at a marine fish farm is about four hectares; overall BC salmon farms occupy less space than Stanley Park in Vancouver.



Photo by Brian Kingzett



Figure 4. Eelgrass meadow.

HELPING RESTORE ESTUARIES AND EELGRASS MEADOWS

Restoring estuaries and eelgrass meadows are other ways to help juvenile salmon in the early marine phase (Figure 4). Eelgrass meadows provide important habitat for migrating salmon and many other fish and invertebrates such as crab. The plant also stabilizes the shoreline, cleans the water, and helps offset the impacts of climate change by storing carbon. Many First Nation communities have been actively restoring both estuaries and eelgrass meadows. Salmon farmers have also been active in this initiative. For example, salmon farmers have supported eelgrass restoration in Klemtu and Sechelt.

WATER EXTRACTION

Water extraction from streams to supply domestic drinking water, to support industrial activities such as pulp mills, and for agricultural purposes occurs in many areas of the province. Extraction can occur by pumping water directly from a stream or lake or by pumping groundwater from freshwater aquifers.

In the last few years, low or historically low flows have occurred in areas of the

province including parts of Vancouver Island and the south coast due to changes in temperature and precipitation, leading to droughts and minimal snowpack in the mountains. As a result, once water is extracted for the purposes listed above, there are times when there is not enough water left to support both juvenile salmon and adults returning to spawn. The water that remains in the streams is likely to have a higher temperature which also negatively affects salmon.

Salmon farmers currently have minimal freshwater uses at marine sites; their primary use of water is for hatcheries. There are thirteen hatcheries that grow fish for marine farms. Three of the hatcheries have fully developed recirculating aquaculture systems (RAS) which have a water reuse efficiency of 95-99%.

An additional six hatcheries have partially transitioned to RAS. Nine hatcheries use groundwater, one hatchery obtains water from a combination of groundwater and surface water, and three hatcheries rely on surface water sources to grow fish.



Freshwater use would substantially increase if salmon farmers were land-based and would put pressure on surface and/or groundwater resources. It is estimated that the average land-based RAS farm producing 5,000 tonnes per year would use 10,000 m³ of water per day (1). This is an enormous amount of water, considering the City of Campbell River provides approximately 21,917 m³ of drinking water to its residents each day. Approximately 33,600,000 m³ of additional water would be required to depurate each crop of fish for two weeks to remove the off taste from tank production prior to sale. [This is about four times the annual water use of the City of Campbell River.](#) (2)



STOCK MANIPULATION

Stock manipulation occurs both by removing fish through capture fisheries and adding fish through enhancement activities.

CAPTURE FISHERIES

The commercial fishery for salmon has collapsed in BC despite efforts to double catches. Collapses have also occurred in Japan. This is an alarming situation for people and communities that depend upon Pacific salmon. See Chapter 2, Caring for Wild Salmon – The Big Picture for a summary of what is happening to Pacific salmon throughout the North Pacific Ocean.

Commercial fishing has been and is critically important for coastal communities. Gill net, seine, and troll fisheries have historically occurred in the waters surrounding Vancouver Island, including Discovery Passage/Johnstone Strait. Most fisheries are mixed stock and focus on larger rivers such as the Fraser and Columbia system runs.

There are some directed fisheries that primarily focus on specific runs associated with enhanced stocks, such as those from the Somas River and Conuma River hatcheries. Having a directed fishery on non-enhanced runs in the Vancouver Island/ south coast region is rare. There have been some terminal fisheries (focused on one species from a specific river) for pink salmon in Johnstone Strait when there are abundances, with the last fishery being in 2014.

The recreational fishery for salmon occurs in both the marine and freshwater ecosystems throughout Vancouver Island and the south coast. The following excerpts from a Pacific Fisheries Resource Conservation Council article provide context on this fishery:

"The recreational fishery for salmon plays an important role in the social and economic life of British Columbia...While the overall recreational share of the total salmon catch is small, at 3%, anglers catch larger proportions of chinook (35%) and coho (30%) and recreational fishing accounts for 40% of the total economic contribution of British Columbia's fishing and aquaculture sector...anglers have to recognize that much of their activity takes place in areas and at times when stocks are mixed, and their fishery can have an adverse impact on small and weak runs" (24).

Salmon aquaculture, while legally considered to be a commercial fishery in British Columbia, does not extract wild salmon from the ocean. Farm-raised salmon are not fed wild Pacific salmon (see "Chapter 7 - Caring for the Environment – Feed Sustainability") and rarely (if ever) eat wild fish that may become trapped within the sea pens (see "Chapter 6 - Caring for the Environment – Minimizing Incidental Catch").



Photo by Bill Pennell

SALMON ENHANCEMENT

DFO's website describes the purpose of [Salmon Enhancement Program](#) (SEP) (25) as follows:

"Our Salmonid Enhancement Program aims to rebuild vulnerable salmon stocks, provide harvest opportunities, work with Indigenous and coastal communities in economic development, and improve fish habitat to sustain salmon populations."

Specifically related to salmon enhancement and habitat restoration, the website states:

"Pacific salmon hatcheries play a key role in our efforts to conserve vulnerable salmon stocks; provide recreational, commercial, and Indigenous fishing opportunities; and support regional and

The Pacific Salmon Foundation recently completed an analysis of 25 hatchery experiments and found that although

international stock assessment programs."

About 300 million salmon are released each year from enhancement hatcheries in BC. Four other countries (USA, Russia, Japan and the Republic of Korea) also release fish into the North Pacific Ocean, totalling about 5 billion fish per year from all countries.

As described in "Chapter 2 - Caring for Wild Salmon - the Big Picture", hatchery fish returns have declined in BC and Japan, suggesting a declining ability of the coastal ocean to produce salmon. This is a major concern for the thousands of people working or volunteering in enhancement facilities and those relying on wild Pacific salmon.

there is some variation in trends across hatcheries, generally releasing larger smolts improved survival rates, rather than



only changing release dates (26). See their recent report, "[Review of Hatchery Release Strategies in British Columbia](#)"

(26) that identifies hatcheries with the greatest opportunities for improvement.

HELPING SALMON ENHANCEMENT

Salmon farmers grow millions of fish each year in BC. Their skills are directly transferrable to enhancement facilities. Many First Nations and community-led enhancement hatcheries have been helped by the sector by donating time, equipment, feed, and funding. Several "hatchery-in-a-box" enhancement equipment have recently been purchased and installed in local communities (Figure 5).



Figure 5. "Hatchery-in-a-box" equipment donated for community-led enhancement.

Despite the overall decline in hatchery returns in BC, some hatcheries have experienced resounding success. For example, after about 40 years of operation, the Marble River hatchery has successfully helped restore Chinook salmon to the river, from a low of about 500 spawners to 5,000 – 7,000 fish per year. For several years the hatchery has

improved early marine survival by about 3% by holding some of the smolts in a net pen, donated by salmon farmers, for their first month in the sea. Fish are fed and protected from predators, giving them a strong start before they migrate to feeding grounds. The project is supported by more than 100 volunteers and many local businesses (Figure 6).



Figure 6. Salmon babies in safe haven on Vancouver Island before hitting open ocean.

Source: [Trail Times](#) (27)

Other key enhancement projects and conservation associations that salmon farmers have supported over the years are listed in Figure 7. Veterinarians and fish health teams from individual companies have provided advice and donated their time to help ensure the success of these initiatives.



SUMMARY OF WILD SALMON CONSERVATION PROJECTS PARTNERED WITH SALMON FARMERS

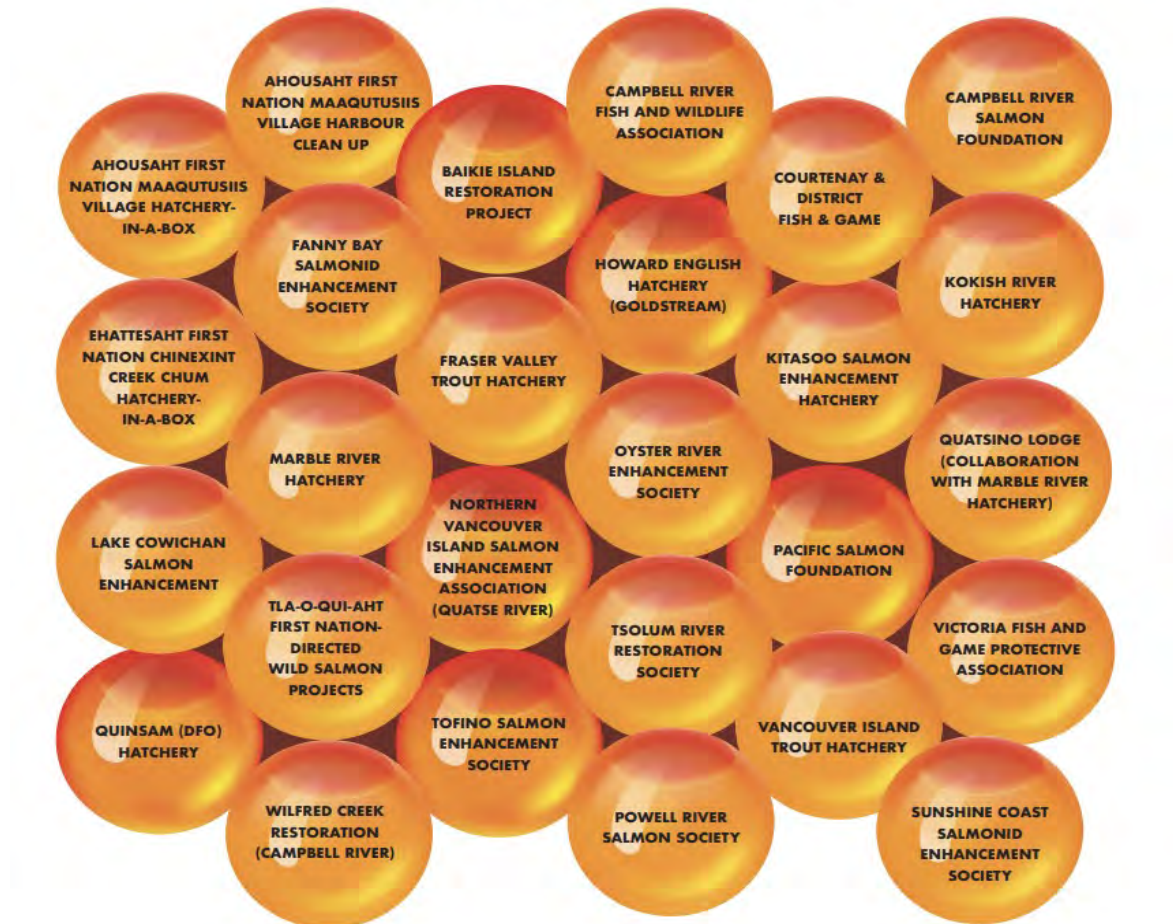


Figure 7. Key enhancement projects and conservation associations that have been supported by salmon farmers in BC.

WE CAN ALL CONTRIBUTE TO CONSERVATION



Photo by Bill Pennell

We believe everyone in British Columbia has a role in respecting, understanding, and conserving wild salmon. As salmon farmers, we have a lot to contribute, given our expertise in salmon and oceanography and year-round presence in coastal BC waters.

That is why we support past, present, and future research to understand Pacific salmon in the high seas, monitor nearshore oceanography, collaborate on mapping and restoring estuaries and watersheds and are involved in numerous enhancement projects throughout coastal BC. While this is a start, there is much more to do.



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CHAPTER 4

CARING FOR INDIGENOUS STEWARDSHIP

CONNECTING WITH THE ORIGINAL GUARDIANS OF THE COAST



This document describes some of the history of First Nations stewardship of coastal British Columbia, and discusses how conservation and guardianship initiatives can support marine-based economic opportunities for Indigenous communities

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CHAPTER HIGHLIGHTS CARING FOR INDIGENOUS STEWARDSHIP- CONNECTING WITH THE ORIGINAL GUARDIANS OF THE COAST



Coastal First Nations have been the stewards of their lands, waters, and elements since time immemorial and are currently advancing their inherent rights to manage their territories while being active participants in Canada's economy.

This includes marine management planning that varies from Nation to Nation, but generally involves Traditional Ecological Knowledge, Western science methodology, Indigenous oversight, conservation, and economic opportunities.

Wild salmon are the lifeblood of coastal First Nations and remain top of mind when Nations build their ocean

management planning and explore new projects.

Resource sectors across British Columbia are evolving in terms of respectful partnerships with the Nations in whose territories they operate, including salmon farming.

When empowered to lead the management of their territories and the resources within them, First Nations in BC are finding exciting pathways and business opportunities that improve the human well-being of their communities.

The future of salmon farming in BC will be led by First Nations.



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