



Why Alaska's Bristol Bay Rivers Produce More Sockeye Salmon than the Fraser River.

**Otto E. Langer
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I. Introduction:

In the past several years many have raised questions and drawn conclusions concerning the demise of Fraser River salmon runs – especially that of the sockeye salmon. The unfortunate recent decline in Fraser River sockeye runs are often compared to the spectacular returns now seen in certain Alaska rivers, i.e. those flowing into Bristol Bay. Why the difference?

The questions and assertions made by some can be put into a better perspective so more can understand what challenges salmon are facing in the Fraser River and most Pacific West Coast environments. In coastal British Columbia, fishers, conservationists and the public constantly seek answers and demand action to reverse what is seen as a continuing degradation of the Fraser and its large urban and industrial estuary. Most can recall that the Fraser was recently a once great sockeye salmon river. Who is to blame for creating the constant stream of problems that we see and who is responsible for resolving its protection, conservation and restoration needs?

The questions and frustrated comments of a conservationist recently stated: *“Why do Fraser River sockeye collapse while those in Alaska thrive? All these fish come from the same Pacific Ocean. Why has the Alaskan fishery expanded to something like 100 Million sockeye, and growing while the BC fishery is now shrunk to under one million sockeye, and shrinking...”*

Further the issue of the possible impacts of climate change as manifested by global warming is added to the debate. If you do not believe in climate change and increasing water temperatures, you will deny that has anything to do with reduced salmon survival. After all, the Alaska and BC salmon come from the same ocean and should they not all be affected to the same degree?

In 2017 the Alaskan fishery landed over 225 million (M) salmon of all species – of which 52M were sockeye. Of that Bristol Bay produced a return of about 58M sockeye – 38M catch and 20M escapement. The Alaska salmon fishery was even greater in 2018. In the Fraser the total 2017 salmon run was 1.5M sockeye. Peak recent Fraser River run was about 30M sockeye in 2010 but dipped to a low of 300,000 in 2020.

If the numbers cause confusion, ‘landed’ salmon is what is caught in the fishery. ‘Total run’ or ‘return’ is the catch and escapement. The escapements are those fish allowed to escape the fishery and spawn.

These questions and comments go on and on due to the extreme frustrations we see in the public and fisheries communities in that the Fraser was always been sold as the world’s most productive salmon river. In reality, the six major rivers flowing into Bristol Bay do now produce much larger runs of sockeye than Fraser River. Can one properly compare the

production of six rivers to the Fraser that is just a single river? Despite that, the Fraser and its tributaries drain over two times the area of all Bristol Bay rivers. At its peak production (the Fraser produced about 40 million(M) sockeye (prior to Hell's Gate CPR rock dumping and a post Hell's Gate slide record of about 30M in 2010) whereas the Bristol Bay rivers now produce about 60,000,000 sockeye. Those numbers includes the total catch and escapement.

The answers of the decline in Fraser River salmon (especially sockeye) are few despite Federal Government's various inquiries on declining salmon stocks in the Fraser. Despite the 2009 to 2012 Cohen Commission (*Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River*) into sockeye stocks in the Fraser, sockeye runs have actually been worse off in recent years and in 2020 were at a point of collapse.

In the past, many issues, scientific and pseudo-scientific, are raised as related to this salmon run failure controversy and the truly unfortunate loss of what is a spectacular event of nature and an important part of our economy and culture. The debates related to what some call the 'salmon shortage' issues have gone in circles for decades. The B.C. forest industry, in a vain attempt to protect their clear cut and poor logging practices, blamed the overfishing by the commercial fishers. In turn those fishers would blame the loggers for harming the watersheds and salmon spawning grounds. The sports fishers would blame the commercial fishers and the Aboriginal fishery for over-fishing.

The Aboriginal fishers could blame everyone for the changes caused since non-indigenous peoples first settled British Columbia. Since the 1970s conservation groups blamed over development of the Fraser River and its estuary habitats for salmon losses. The blame merry-go-round always continued into the next year except when some greater than expected returns occurred. Given that run returns are predictably erratic from one year or cycle to another and appreciating the dominance of some cycles, the Canada Department of Fisheries and Oceans (DFO) most often did not know why the fishery failed in some years and why it was spectacular in others.

The \$37,000,000 Cohen Commission could shed little real light on many of those issues. In the past two decades we had new issues to blame - that of the open net fish farms along the BC coast and of climate change. Also there was a general consensus that DFO could have and now should more diligently manage the conservation of fish habitat and the fishery

Most parties in the debate have often been correct at one time or another. In the 2019 to 2021 time period our Fraser River fishery and its successes or lack of it are compared to the highly successful fishery we now see in at least the Bristol Bay part of the sockeye fishery in Alaska. This discussion paper will go over the various issues that can account for the overall sockeye shortage we have in the Fraser and why we probably see such good runs in Bristol Bay rivers.

A few deny that climate change is a factor in our low sockeye returns and insist that climate change and global warming is just a "red herring". That is despite the vast amount of science that has allowed most to accept climate change as a real and man-made phenomenon that is now affecting life on this planet. Others of course blame salmon declines on the open net cage fish farms and the associated diseases and sea lice problems that have bloomed along parts of the coast since 1995.

It is hoped that this paper will at least provide some partial answers and general observations to the above questions and assertions that anyone can understand without a fisheries scientist's

background. The paper will not attempt to review the vast amount of literature on climate change or argue whether it is an issue or not. There is little doubt that climate change is occurring and evidence indicates that we are moving into an era of global warming at this time.

Hopefully this paper will end the various debates and denials so we can better spend our time on convincing our governments that they have to do a better job in addressing the many issues that are assuring the destruction of our Fraser River salmon runs and indeed their ecosystems with all the other forms of life found in them. Salmon run success has to be more than the number of fish caught in a fishery. They must be treated as one of our best indicators of our ecosystem health along with other icon and ecologically significant species such as our migratory birds, wolves, caribou, grizzly bears, cougar or eagles. Salmon have done a great deal for humans – it is now time for humans to do something meaningful for salmon survival!

The answers to the questions posed above are both simple and complex. Although I have reviewed dozens of scientific and lay articles for this paper, I have not referenced most materials as this is a review for the lay reader and it should not be treated as a scientific paper. However, I did rely on my many years as a salmon biologist to make this a defensible information and discussion document.

II. Fraser River vs. Bristol Bay Rivers – a comparison of the drainage basins and their governance.

From a biophysical point of view the Fraser River and most streams that are tributary to it and several rivers that are tributary to Bristol Bay do have a great capacity to produce salmon. The rivers and the lakes found in each basin area are ideally suited for supporting healthy populations of sockeye salmon. That conclusion at least did apply to the Fraser before the CPR 1917 rock dumping into the river at Hell's Gate. That was the river's first big shock to sockeye production in the past 150 years and many feel it marked a downward spiral for many of the river's salmon runs.

There is absolutely no doubt that many things greatly changed in the Fraser Basin in the past 150 years due to with human activity and settlements occurring throughout the vast Fraser basin. Fortunately for Alaskans, most Bristol Bay streams today look very similar to what they looked like some 150 years ago. The most notable exception was probably the impacts that the Novarupta Volcano ash fallout may have caused in 1912.

The simple question is – why does the Bristol Bay area produce so many more sockeye salmon while the Fraser River runs are at a point of near collapse?

The simple answer -- Bristol Bay and its watersheds/rivers do have a great advantage over the production and conservation challenges we now see facing Fraser River salmon. The Bering Sea (Bristol Bay) waters are cold and next to no one lives in the Bristol Bay river watersheds and that is essential for salmon to thrive in providing the fishery is managed to not allow 'serial over-fishing'.

The more complex answer -- The brutal reality is that salmon do not get along with human activities that allow over-fishing, harms water quality, fills their clean gravel spawning beds with sediment, builds dams, alters river flows, alters watershed forests and practices activities that causes raises in water temperatures and so on. Next to no industry exists in the Bristol Bay

watersheds such as logging, mines, pulp mills, dams, railways, pipelines and there are few roads or power lines and no railways.

The Bristol Bay watersheds are in a near pristine state with a very low human population and industrial base whereas the Fraser River watershed is highly developed with a much larger human population i.e. 400 times greater (**Table 1**). Also most Bristol Bay residents are fishers and work hard with state and federal governments to protect their fishery stocks. This is most evident in the recent U.S. federal government decision in rejecting the high risk giant Pebbles mine in the Bristol Bay Basin.

The support for salmon and the sustainability of nature and wilderness in the Fraser River is less focused and not as strongly driven as seen in Bristol Bay. Too few in the Fraser Basin (especially in the major urban areas and outside the basin) now depend upon the Fraser River sockeye or other salmon for a living and fishers and conservationists often cannot rally significant and successful public support for better protection of salmon and their habitats. Many in the Fraser Basin depend on many of its other resources (farmland, hydro power, trees, minerals, water, etc.) whose exploitation is most often the cause of multiple and cumulative negative impacts on salmon.

In B.C. the province owns 94 percent of BC lands and governs business, land and water use and waste management whereas fish and habitat protection is a federal DFO responsibility. It is the management of business, land, water and waste management (a B.C. mandate) that most affects salmon and their habitat. DFO is then left holding the bag to protect fish and their habitat while another level of government promotes and manages business and issues the permits to divert water, clear land, build roads, etc. that can most impact fish and fish habitat.

This type of a split jurisdiction to protect and manage fish and their habitat is often at odds between economic growth promotion and conservation of fish and wilderness. This often does not allow for an effective long term form of coordinated ecosystem management and conservation when two senior and three other different levels of government (i.e. First Nations and local and regional municipal governments) operate within different mandates and on differing wave lengths.

Alaska also does have split jurisdiction between the federal, native and state government and most land is owned by the federal government (i.e. 94% ownership), state and native residents. However, there has been an awakening that if the state does not take the lead and better protect their salmon from resource development projects, their salmon resource, which is a leading economic resource and priority, will disappear as it has in the U.S. lower Pacific coastline states. If future Alaskan fossil fuel extraction yields less to the economy, relative fishery values may indeed see an increase in the Alaskan GDP.

Recently 50,000 Alaskans signed a petition to greatly strengthen Alaska's fish habitat protection laws. This was brought about by the great risks caused by the proposed Pebble mine in the Bristol Bay watershed. Unfortunately those citizens are now disappointed by the present governor of Alaska who has legally challenged the right of the U.S. federal government to make rulings that can harm the state's demand to protect their right to promote the exploitation of their mineral resources such as at the proposed Pebble Mine site.

When it comes to such resource conflicts some still feel that old concepts of cooperative resource and integrated resource development will allow us to have it all. Those concepts often

have failed conservation needs. When a port is planned for construction in the middle of the greatly compromised Fraser River’s estuary or the world’s largest proposed open pit mine and tailings ponds will be in the headwaters of an extremely productive Bristol Bay, should one not protect nature and life in that we need it to survive in perpetuity? Port terminals can be built elsewhere and the copper can sit and wait for future generations and maybe then it can then be mined in a safe manner. There is little or no proof that once a sockeye run is lost that it can ever be restored.

Table 1. Comparison of various watershed parameters affecting sockeye salmon production in the Fraser River, B.C. and Bristol Bay Rivers, Alaska. (Statistics compiled by O. Langer 2021).

Comparison Parameters	Fraser River Watershed	Bristol Bay Watersheds
Watershed area (sq. km)	240,000	103,000
Parks and refuges	<10% of area	42%
Rivers and estuaries	1	more than 12 (6 major rivers)
Estuary status	highly developed	in pristine state
Human population	3,000,000 residents	7,500 residents
Salmon farms	>20 (in ocean migration routes)	0
Pulp mills	8	0
Dams (all irrigation and hydro dams)	2000	0
Roads (km)	7000	200
RR length (km)	2245	0
Metal Mines	20	1 proposed (Pebble Mine - rejected?)
Forest cut	14,000,000 m³/yr.	No logging (stunted forest)
Fishery Employment- % of basin population.	0.2%	75.0 %

III. Climate Change

A newer and over-riding key issue that some will overlook and fewer will insist is not a real concern is global climate change. There is little doubt that climate change will and is harming salmon and their habitats through physical and chemical impacts. Climate change as caused by greenhouse gas (GHG) emissions has been shown to cause air and water warming, streamflow changes, sea level rise and ocean acidification. The main GHG culprit is fossil fuel production and burning resulting in the emission of methane, carbon dioxide and other gases.

Global warming in the North Pacific (water temperature rise) presently has a lessor negative impact in Alaska's Bristol Bay than on B.C.'s Fraser River sockeye salmon. The rivers that flow into Bristol Bay discharge into the very cold Bering Sea. Also Bristol Bay rivers and their key sockeye rearing lakes are most often subject to seasonally colder weather than found in B.C. This is a special concern in the summer when the B.C. Interior complex of Fraser Basin tributaries and lakes are exposed to weeks of very warm weather. However, Arctic areas are now subject to relatively more rapid warming than southern areas but their waters are still generally much colder than those in the Fraser Basin.

Of even greater consequence is that the ocean rearing stage of sockeye from smolt to adults are very sensitive to warming North Pacific Ocean waters. Each summer they have to migrate back and forth within the North Pacific to stay within regions of colder waters i.e. waters equal to or lower than 7.0 degrees C. Sockeye are very sensitive to warm ocean water temperatures but they do have greater tolerance to warmer temperatures in their freshwater habitats.

Decades of sampling by U.S.A., Canada, Japan and Russia have shown that it is near impossible to catch a rearing ocean sockeye in waters warmer than 7 degrees C. Much of the North Pacific is therefore too warm in the summer for sockeye salmon to rear in and they annually migrate to the more northern colder waters of the North Pacific and Bering Sea region. Fraser sockeye are therefore at a disadvantage as they now must travel much farther to find those cooler temperatures than Bristol Bay fish have to. Here they do have to compete for food in a more crowded region of the ocean.

The below abstract from **Welch, Ishida and Nagasawa (*Canadian Journal of Fisheries and Aquatic Sciences* 55(4) 937-948 April 1998)** well summarizes the critical temperature tolerance issue for sockeye salmon. This work is 23 years old and that demonstrates that the higher ocean temperature limits has been known for many years.

*"Ocean surveys show that extremely sharp thermal boundaries have limited the distribution of sockeye salmon (*Oncorhynchus nerka*) in the Pacific Ocean and adjacent seas over the past 40 years. These limits are expressed as a step function, with the temperature defining the position of the thermal limit varying between months in an annual cycle. The sharpness of the edge, the different temperatures that define the position of the edge in different months of the year, and the subtle variations in temperature with area or decade for a given month probably all occur because temperature-dependent metabolic rates exceed energy intake from feeding over large regions of otherwise acceptable habitat in the North Pacific. At current rates of greenhouse gas emissions, predicted temperature increases under a doubled CO₂ climate are large enough to shift the position of the thermal limits into the Bering Sea by the middle of the next century. Such an increase would potentially exclude sockeye salmon from the entire Pacific Ocean and severely restrict the overall area of the marine environment that would support growth."*

Although these are approximate numbers for relative comparison, juvenile Fraser River sockeye swim over 1500 km to get to their ocean rearing grounds. They then must swim a

further 3000 km each summer to the North Pacific – Bering Sea area and back (repeated over two consecutive years) to avoid warmer summer ocean temperatures. Then in their adult return year they must swim least 1500 km back to the Fraser estuary and up to 1000 km or more against strong river currents, a gantlet fishery and several major river rapids and obstructions to get to their spawning grounds.

Bristol Bay salmon do not have to swim up a long swift river with large barriers in it such as Hells Gate, Bridge River Rapids or the recent Big Bar slide. Bristol Bay rivers and their spawning grounds are much closer to the ocean and not up a long treacherous canyon often with fisheries all along it. From the Bristol Bay estuaries to their river spawning grounds and lake rearing habitats it's a maximum of about 500 km. Bristol Bay salmon may just have to swim 3000 kms while Fraser salmon have to swim at least 10,000 km to complete their life cycle migrations - and in warmer waters.

With warmer waters salmon metabolism increases and they will then require more food and oxygen to survive. Unfortunately, warm water does hold lower levels of dissolved oxygen. As with other issues facing salmon, as one thing changes, other complications and setbacks may often occur.

The heating of freshwater habitats in the Interior of B.C. (especially in the Interior –Shuswap, Nechako, Fraser mainstem, etc.) during long warm summer days are especially critical for salmon. These warm waters are a critical issue in the 70 year old Kemano II / Kenny Dam salmon conflict when Alcan created a reservoir and diverted cold Nechako River water out of the Fraser Basin into the coastal Kemano River to produce power for their Kitimat smelter.

The water they now release is from the surface of a giant reservoir and it is warmer than in comparison to the historic wild run river flows that existed prior to 1954. Here RioTinto - Alcan probably continues to exacerbate what global warming is adding to salmon water temperatures in the Fraser River with each passing decade.

High Fraser Basin water temperatures are also a detriment to other species of salmon. DFO studies show that low water flows and overly high water temperatures affected coho and chinook fry rearing in the Nicola River and Bessette Creek and other Interior streams in the past several decades. In the 1990s DFO examined thermal impacts on Nicola River chinook salmon. Downstream of Nicola Lake salmon were unable to live in the warm waters flowing from that lake during the warm summer months.

Salmon fry (most rear in the river for a year before migrating to the ocean) could only be found in isolated cold springs entering the river. The springs created cold enough water for them to survive in but did not supply adequate cold water habitat and a food supply for survival of healthy Nicola River runs. This obviously indicates that temperatures are key to salmon survival but in the case of the Nicola and other arid zone interior streams, the problem is greatly aggravated by low flows often caused by water diversions for irrigation purposes. Global warming will greatly aggravate that situation.

In 1991 DFO commissioned an independent Fraser River climate change water temperature review (*D. Levi. 1992. Potential Impacts of Global warming on Salmon Production in the Fraser River Watershed, DFO Tech. rpt.1889*) to raise a temperature red flag for those planning a future for Fraser River salmon survival in that any additional water temperature increases would be detrimental to salmon. At the time some DFO staff and others believed that

warm stream temperatures were just warm weather anomalies and not climate change. At that time the climate change denials were maybe innocent due to a lack of good longer term trend data but time has shown that it's a real issue for salmon.

At the time the DFO Minister's office tried to block the publication of this report because the government did not want to go on the record as to admitting that global warming was a real issue that Canada had to treat seriously. At the time Canada was involved in early U.N. discussions on climate change to prepare for the 1997 Kyoto Protocol. Despite that, it was in 1991 that a Conservative, Liberal and NDP all party committee determined that global warming was an issue and Canada had to reduce its carbon dioxide emissions by 20% (*Out of Balance –The Risks of Irreversible Climate Change – An All Party Report on Global Warming, House of Commons, Ottawa. March,1991*).

In 2018 biologist Mike LaPointe (*Pacific Salmon Commission, Vancouver, B.C.*) in a presentation to the American Fisheries Society concluded that impacts of global warming is a factor adding to sockeye salmon productivity declines in the Fraser. He concluded that since 1950 the Fraser River water temperatures have increased by 2°C and the consequences of warming has increased the percentage of mortality of the Fraser summer sockeye from about 17% to 65% in the 1992 to 2008 time period. From 1900 to 2013 the air temperature in the Upper Fraser Basin increased by some 1.8°C (*Indicators of Climate Change for British Columbia 2016 Update. Min. of Envir. Victoria, B.C. 57p*).

Despite our concern for high water temperatures in the Fraser Basin and North Pacific, it is not just a southern concern. Alaska biologists and climate experts are concerned about recent signs of warming of waters in the Bristol Bay area. For instance in 2018 and 2019, there were record high temperatures and historic low ice coverage in Bristol Bay. Warm surface lake waters flowing into Bristol Bay streams were reported to be as high as 21°C. Although this data is preliminary it has raised great concerns in the lucrative Alaska fisheries community – and rightly so.

Simply put, salmon are cold water fish and without dramatic reductions in our GHG emissions we may not see any sockeye salmon rearing in the Pacific Ocean by 2050. **That probably means no sockeye salmon in the Fraser River 30 years from now.**

High water temperatures in the North Pacific may account for recent record numbers of Pacific salmon ending up in the colder Arctic Ocean and spawning in the tributaries of the Mackenzie River and Coppermine Rivers. Since 1980 record catches of chum and pink salmon have been made in the Mackenzie River system on a more frequent basis. It is possible that the Bering Sea and Arctic Ocean may have to be our future refugia for Pacific salmon. Do we then rename them as 'Arctic salmon'?

In 2019 the first salmon shark was caught in Kugluktuk (hamlet at the mouth of the Coppermine River). It was sent to Dr. Hussy (Univ. of Windsor) for examination and he noted that "*With sea temperatures rising, Pacific salmon are becoming more common in northern waters. This phenomenon could possibly be attracting predators such as sharks.*" In that salmon sharks are a major predator of salmon, one can find a more general review of the salmon shark concern in the Alaska Fish and Game News, June 2005 - www.adfg.alaska.gov.

We should not draw great comfort that our salmon can at least survive in Arctic or Bering Sea waters. In terms of global climate change temperature records and models, the Arctic areas of our planet are now warming up more quickly than in other global regions.

Higher water temperature is now a very limiting factor for cold water fish and the birds and mammals that depend upon them for food. Warm water conditions in the past few decades has resulted in large fish kills on the Fraser River (see **Figure 1**). In July 2019 warm water salmon kills have even occurred in the Koyukuk River, a major tributary of the Yukon River that drains areas north of the Arctic Circle in Alaska.

Temperature impacts directly on salmon are just one part of the GHG conundrum. Warmer sea water means thermal expansion of those waters and therefore sea level rise and flooding of marshes such as the few remaining marshes in the Fraser Estuary. Overall, sea level rise in this region of B.C. has been about 20cm since 1880 and of that, 7.6cm has occurred in the past 25 years.

With sea level rise, marsh areas could move inland to higher ground but that is impossible in that dykes have been built around all Fraser delta areas to keep urban and industrial areas from being flooded. Loss of marshes means loss of food and protection for young salmon and that will give rise to their further demise. However, sockeye juveniles do not depend upon marsh rearing as intensively as do juvenile chum and chinook salmon.

If that is not enough - the excessive amounts of carbon dioxide absorbed into ocean waters (i.e. ocean acidification) has harmed calcium carbonate bone building processes in all forms of fish and plankton. Indeed, large juvenile oyster kills have occurred in Washington State and the east coast of Vancouver Island. Newly developing oysters simply cannot develop a shell due to the lowered pH in their waters. The Washington Department of Ecology has recently stated that acidification is a special concern in Puget Sound and the Salish Sea.

As the more corrosive nature of ocean waters becomes greater that will impact the production of many plankton species that serve as fish food in the ocean. The salmon are being exposed to multiple impacts from GHG production i.e. water warming, sea level rise, acidification and altered stream flows. The continued burning of fossil fuels will exacerbate this real and present threat. Some will deny this but the scientific literature on this is voluminous and very defensible.

IV. The Fisheries.

The sockeye salmon in Bristol Bay are subject to a different fishery than that of Fraser River runs. Fraser River stocks run a longer gauntlet fishery involving significant commercial, recreational and First Nations fisheries. As part of the sockeye (and pink) fishery U.S.A. fishers are entitled to catch a portion of the Fraser River sockeye and pink runs. Canadians do not take part in any Bristol Bay fishery. The Fraser fishery involves many fishers not living in the basin and includes 91 First Nation Bands on the river. That accounts for at least 30,000 aboriginal residents that can partake in the fishery.

Bristol Bay has a minimal gauntlet type of fishery and only 5,100 native peoples* (31 villages or bands of Eskimo, Aleut and Indians) in the Bristol Bay area depend on the salmon fishery. Catches of Bristol Bay sockeye by other nations was largely reduced by the U.S. declaring

their 200 mile economic – management limit in 1976 thereby eliminating Japanese, Korean etc. offshore fisheries of U.S. salmon. Offshore fishing curtailment of course also reduced foreign fishery pressure on Canadian salmon rearing in open Pacific waters.

DFO often did not manage salmon in as a diligent manner as they should have. One of the problems is that they always tried to keep fishing industry happy by allowing excessive openings until there are now next to no fishery openings. This was complicated by excessive numbers of fishing boats and then buy-backs attempted to reduce excessive fishing pressure on the resource. Historically resource governance in B.C. restricted the commercial fishery to non-aboriginals and Aboriginal peoples were largely relegated to a food fishery and could not sell their catches. This policy gave rise to decades of conflict and many court actions until court decisions changed the system to allow greater Aboriginal rights in the fishery in recent years.

One of DFO's less than sustainable policies was that key fisheries (e.g. sockeye commercial fisheries) were managed with a "maximum sustainable yield" guiding mentality and policy. When some challenged that in the 1990s they were told that running of the valuable commercial fisheries would be directed by the maximum number of salmon that could be put into cans. The major fishing companies held great sway over fisheries management.

To harvest the maximum numbers of salmon some smaller and less valuable salmon fisheries would have to suffer i.e. like mid Vancouver Island pinks or Cultus Lake sockeye or Thompson and Skeena steelhead. Ecosystem needs for salmon such as food for bears, eagles, lake fertilization, etc. did not enter into the equation. In fact DFO began to fertilize select lakes with water bombers to replace the salmon sourced nutrients that could never reach the lakes due to over fishing or other causes. Such experiments have also been attempted in Alaska to improve the nutrient regime in oligotrophic lakes.

V. Where are the salmon protection champions?

When looking at a very remote area like Bristol Bay there is another reality we on the Fraser River have to accept. Although Alaska has a much smaller population, there is a much greater interest in protecting Alaska's pristine salmon waters and wilderness area due to the fact that many fishers and outdoor types in Alaska, Washington, Oregon and other areas depend upon Alaska salmon catch for a livelihood or for recreation.

Those in the hunting and sports fishery and tourism industries of Bristol Bay also seem to have a louder voice and maybe stronger will to protect their wilderness. Fortunately for those connected to a remote pristine environment, competing uses for conflicting resource development is nowhere as great as in the Fraser Basin. Since the 1980s there has not been a significant public outpouring of support for better protection of Fraser River salmon and salmon habitats than recently seen for the Bristol Bay supporters to oppose the Pebble Mine.

Although public opposition to developments may not appear to be as great as seen in the Pebble Mine case, several significant projects in BC fishery waters during the same time period did give rise to significant public opposition including efforts to ban open net fish farms on the B.C. coast, opposition to the New Prosperity Mine on Fish Lake, the Petronas LNG facility in the middle of the Skeena Estuary and the jet fuel terminal and a new Robert's Bank container port in the Fraser Estuary. This emphasizes some of the differences between salmon threats in Alaska versus those in British Columbia. Significant cumulative effort did go into opposing

high ecological risk projects in B.C. sensitive habitats but the efforts had to be spread over several projects

There are some success stories for salmon protection in B.C. but they most often do not occur without years of efforts by First Nations and public conservation groups. Recently the DFO Minister announced the termination of open net fish farming in the Discovery Islands area of the B.C. coastline. Fraser River salmon do migrate through and rear in the Discovery Islands where there has been documentation of Atlantic farmed salmon contaminating wild juvenile salmon with disease and sea lice parasites.

In the Prosperity mine example, the federal government did indeed reject the mine twice but B.C. did approve it. This high lights the issue of split jurisdictions with the public illusion that Canada and B.C. has a coordinated environmental review process. The company proposing that mine is still working on another attempt to get a federal approval for that project.

Compare the joint efforts to protect the Fraser Estuary's Roberts Bank habitats from the RBT2 container port proposal versus the coalition built in Alaska and Seattle to protect Bristol Bay from the Pebble Mine. When it came to submitting presentations to the RBT2 or the Vancouver Airport jet fuel tanker projects in the Fraser Estuary it was a near rag tag group of independent ENGOS and citizens that had to make their presence felt. No united effort could be assembled on the Fraser to have such high risk projects rejected such as was organized in Alaska and some of the Lower 48 States to oppose the Pebble Mine. In the jet fuel terminal project in the heart of the Fraser River Estuary, the Province took the lead on a 'voluntary review' and did not hold a single public hearing before approving the project.

The Wild Salmon Policy of DFO and now and again federal and provincial announcements and millions of dollars in grant offerings to restore select habitat areas are hit and miss and are not part of any known salmon ecosystem restoration and protection plan. Bristol Bay and its watersheds and people and minimal industrial pressures and possibly with better government cooperation can maybe generate greater conservation successes. However, even in Alaska the split jurisdictions and conservation versus development agenda of different levels of government can be a real concern.

It is entirely possible that Alaska and their federal salmon counterparts are doing a better job of protecting and managing salmon than our BC and federal DFO and ECCC are doing on Canada's West Coast. For instance, Alaska never allowed fish farms in their waters. DFO Ottawa and the B.C. government approved Atlantic salmon fish farms in B.C. as long as it could be done "safely". That was like telling your kids to go swimming - but do not get wet! In a bad assumption of legal mandates, B.C. felt they were the managers of fish farming and did their best to promote fish farms at almost any location. Again political decisions favored what was a myopic initiative to "grow the economy" without giving the value and survival of the natural environment the importance it deserves.

The Alaska salmon fishery was not always as prosperous as it is of the past few decades. Prior to 1959 the U.S.A. federal government managed Alaska salmon and Alaska being a frontier territory, fishery management, research, etc. was neglected and cannery greed resulted in massive over fishing. By 1953 the Alaska economy (a largely fishery economy) was in a mess and President Eisenhower declared the territory a disaster area. Alaska became a state in 1959 and they took over management and conservation of the fishery. Better 'local' management

allowed runs and the fishery to recover but by 1972 overfishing again caused greatly depressed salmon stocks resulting in fishery closures.

The state moved into massive salmon stock rebuilding and brought in a limited entry fishery and the conservation needs of fish were politically separated from fishery allocations. A large hatchery program began in the 1970s but many saw that as counter-productive and a waste of money and the hatcheries were later privatized. However, they are still a controversial issue as they are run as ocean ranching projects and can still harm wild salmon runs.

VI. Discussion and Conclusions.

Wherever humans have had a very significant impact on watersheds and maximized the fishery, wild salmon stocks have always suffered. In fact, even less than significant watershed changes can have significant harmful alterations of fish habitat and fish populations.

This began on the California - Mexican border and spread up the coast like a cancer to the Sacramento, then the Columbia River and now its advancing along the BC coast without any demonstrable let-up. It is obvious that the plight of the sockeye and other salmon species is not just a Fraser River issue.

Where we have human settlements, excessive fishing pressures and too much human activity in the form of logging, farming, roads, dams, fish farms etc., salmon are usually one of the first species in nature to suffer. They are somewhat akin to the demise of the mountain caribou or our grizzly - they need undisturbed habitat and very conservative management that respects intact and healthy ecosystems. That can be found in Bristol Bay but not in the Fraser Basin.

Also, when we consider the issue of climate change, the future of salmon in BC waters seems even more depressing. There is absolutely no doubt that issues related to climate change such as increasing water temperatures, sea level rise and ocean acidification will continue to impact salmon survival. Government and societal planned changes are inadequate at this time and even if more effective than what is now apparent will not reverse these global impacts (e.g. water temperature rise) until sometime in the distant future. The salmon cannot wait until that happens.

It may be only a few minutes before midnight for Fraser River sockeye and other salmon species but even at this late date we have to cross our fingers, hope for a miracle and work to ensure that our salmon runs and habitat protection find a new soul and champion at the community and senior political levels in B.C. and Canada..

In the past few decades the on again and off again initiatives of senior governments are largely designed to show support for public concerns but in reality rarely examine and support overall ecosystem health needs that salmon recovery depends on. Cumulative impacts have to be assessed, accepted and addressed. Some would say that many initiatives to date are piecemeal and amount to little less than window dressing or green washing. Many stewardship type projects that government likes to fund can often benefit local habitats and help species survival in that specific part of the life cycle but most often does not will not fit into an overall plan to reverse the downhill trends as we see for Fraser River sockeye or that seen in more and more other species as each decade passes.

Unfortunately government is often very contradictory and even hypocritical in its priorities. Ministers present the well-rehearsed environmental press lines and sometimes release millions of dollars in coastal protection, grants to stewardship groups and have inquiries into missing salmon. Meanwhile the present B.C. and federal government environmental assessment processes, both recently updated, are not based on an adverse risk management approach to environmental sustainability. They approve high risk projects subject to dozens of conditions in locations where those habitats should be protected in perpetuity e.g. such as in the middle of an estuary e.g. Petronas LNG in the Skeena Estuary or the VAFFC jet fuel tanker facility or the RBT2 in the heart of the Fraser Estuary. The Fraser River and its globally significant estuary is a prime victim of that type of economic growth.

Also our BC and our federal government now and again hand out millions in grants to citizen's groups while those groups will continue to complain that no one is doing any effective habitat protection enforcement work. When some of the first watershed stewardship concepts were promoted by DFO in the 1990s one of the biggest criticisms DFO received was – "...where are the Fishery Officers that should protect what we are restoring"? It is less effective and more costly to attempt to restore an environment than to initially offer it proper protection. However, restoration does have political 'sex appeal' whereas protection and enforcement is often not supported by industry and in government environmental enforcement often becomes an anemic last resort activity.

If society was more serious about climate change we would at least put as much effort into restoring and protecting our environment for future generations of humans and other life on this planet as one would put into a war effort. A war effort such as that the government launched in 1939 or that being waged against COVID 19 is needed. However, it cannot be as disjointed as the latter effort is in that a multitude of on again and off again half actions by a multitude of jurisdictions will not successfully address ecosystem recovery needs.

When one examines the large shocks delivered to the Fraser River and its salmon, the Kenny Dam and its water diversion impacts on river temperatures likely equals the impacts caused by the Hell's Gate blockage, the Big Bar slide, the use of the Fraser as a waste dumping ground and the never ending conversion of the estuary into an industrial and shipping corridor.

Some say that salmon and nature are resilient. That may be the case in certain instances but it most often does not apply to overall ecosystem health in a meaningful time scale as government believe their own propaganda that we must treat nature and the economy as a balancing act. Unfortunately they always ignore what we have done to nature in the past 150 years. How do we find balance when the scales have been totally tipped in favor of industrial development and growth?

One may conclude that Bristol Bay salmon presently have almost everything working for them and they apparently now may have harnessed high risk economic growth and greed in excessive fishing pressures and the rejection of the Pebble Mine. President Obama and now Biden opposed the Pebble Mine. Even Donald Trump Jr. joined that chorus despite the anti-environment views and actions of his father. Despite that even in the Bristol Bay area, whose economy is driven by the fishery and wilderness values, the state governor has now appealed the federal government's rejection of this high risk mine i.e.

"Alaska Gov. Mike Dunleavy said the state will appeal the U.S. Army Corps of Engineers' rejection of a key permit for a proposed copper and gold mine in a region that supports the world's largest sockeye

salmon runs. Dunleavy, in a statement Friday, called the corps' decision flawed and said the state has to keep a federal agency "from using the regulatory process to effectively prevent the State from fulfilling a constitutional mandate to develop its natural resources." - Globe and Mail; January 8, 2021.

Despite the world's record runs of sockeye in Bristol Bay that area maybe is just a step or two away from certain high risk economic development and high water temperatures that could put it into the type of downward spiral seen in more southerly salmon populations such as in the Fraser River. Perhaps we can hope that Alaska's politicians can continue to learn from what has happened to California, Oregon, Washington and B.C. rivers and salmon populations.

It is hoped this paper answers the question of why Alaska sockeye do better than those in the Fraser River. Unfortunately Bristol salmon production dwarfs what we now see in the Fraser River system and it seems little can or will be done to change that in the foreseeable future with presently prevailing conditions in the Fraser River, its estuary, the North Pacific Ocean and in Victoria and Ottawa.

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FIGURE 1.
Photograph of
thousands of
mature
unspawned
dead sockeye
salmon found
on the
beaches of
Shuswap
Lake near the
Adams River
spawning
grounds –
Oct. 12, 2010.
Photo by O.
Langer.

*In this paper the terms used to reference First Peoples such as Indians, Eskimoes, Natives, First Nations, Aboriginal Peoples and Indigenous peoples are used interchangeably. The terms used most often follow the terms used in the papers read in my research for this paper. Some terms are out of date but legal names versus recent popular names will always be up for debate. Also Alaska terms are used differently from those accepted in B.C. and Canada. If this is an issue, the reader is encouraged to refer to *Indigenous Peoples: A Guide to Terminology – Usage Tips and Definitions. Indigenous Corporate Training Inc., Port Coquitlam, B.C.*

Biography of Otto E. Langer BSc(Zool) MSc

Otto Langer has a BSc (Zool) and MSc (Fisheries Biology) from the University of Alberta. In 1969 he began work in DFO and Environment Canada in fish habitat protection, contaminants control and enforcement. He has been an expert witness in over 100 habitat and pollution trials across Canada. He was a leader in the development of the ‘no net loss’ principle and pioneered its first use in the Fraser Estuary habitats.

He was involved in the working of Fraser River Estuary Study and Fraser River Estuary Management Program and central in the development of the first Fraser Estuary harbour environmental management plans. He was also a key participant in the development of the Fraser River Action Plan during the Canada Green Plan initiative. There he directed many studies including those on water quality, urban stream protection and the development of watershed stewardship groups and the Stewardship Series of land development guides.

In 2001 he moved to the David Suzuki Foundation and developed their Marine Directorate. He was an advisor to the London based Marine Stewardship Council and retired in 2005. He has published numerous articles and co-authored *Stain Upon the Sea* which in 2005 won a BC Best Book Prize. In 2009 and 2010 he was respectively awarded the BCWF and the Canadian Wildlife Federation’s B.C. and Canadian Conservationist of the Year Awards and the 2016 BC Totem Flyfishers’ Outstanding Conservationist Award.

In 2012 Mr. Langer exposed the Harper government’ plans to remove habitat protection from the Fisheries Act and weaken environmental protection legislation in Canada. He lives in Richmond B.C. and is active in providing volunteer expertise to environmental organizations.