Juvenile Sockeye Use of the Lower Fraser River and its Estuary

A note for submission to the Cohen Commission.

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Dec 15, 2010 DRAFT

Background:

Many biologists and other individuals have been interviewed by Cohen Commission lawyers during the past several months as the Commission determines its bearings, priorities and witnesses that will be called before it. Some of the potential witnesses that have been interviewed have been left with the impression that the Lower Fraser and its estuary are not critical habitats for sockeye salmon in that they just migrate through this vast habitat area extending form Hope to Steveston BC as juvenile salmon migrating to the ocean and as adults returning to spawn in their natal streams.

Even if this misconception was correct, the migratory channel must be maintained so as to allow the free movement of these fish as they move upstream or downstream. However, the young sockeye and the adults must undergo great changes in the lower river and its estuary as its physiology must change or acclimate from a saline to freshwater environment (adult salmon) and from a freshwater bodily functions to a saline existence (juvenile salmon). In this transition, they must have the time to adjust their physiological mechanisms and the habitat in which to undergo that transition.

Channelizing those habitats or lining them with training walls have been of special concern in that these structures would inject the freshwater juvenile fish directly out into the saltwater phase with little transition opportunity. Like wise, the adult fish returning from the ocean must acclimate to the freshwater regime of the river. In addition the upstream migration is done against high velocity currents over most of their upstream journey.

Habitat issues related to the chemical quality of the habitat is covered by Section 36 of the Fisheries Act. Any fish whether it lives in this area or migrates through it must have high water quality in this bottleneck environment. Water Quality has always been an issue in the Lower Fraser River and its estuary. The water that enters this area has large amounts of waste dumped into it form many cities and towns and several pulpmills in Prince George, Quesnel, and Kamloops areas.

Once the river reaches Hope it is subjected to the wastes produced of almost two million more people and their industrial base including more paper and pulpmills. The large industrial discharges of Metro Vancouver form the Annacis, Lulu and Iona sewage treatment plants are of special concern. Also over the years many industries have polluted many sites (e.g. pole treating plants and landfills) that continue to discharge or leach their toxic and often bio-accumulative wastes into the river.

Although over the past decade plants such as Iona, Annacis and Lulu have upgraded their sewage treatment or outfall systems, the constant growth of the human population always adds more waste to the river and it would be foolhardy that any body or regulatory agency should be of the opinion that water quality is not as significant issue as it was in the 1970s when many hearings and protests were held to relate to the pollution problem in the river.

Further to the above, many experts feel sockeye salmon are not greatly threatened by estuary and lower river water quality issues in that they do not reside in the area i.e. they just migrate through it very quickly and their upstream and ocean habitats where they spend most of their life are rather pristine habitats. This to a small degree is correct but largely, it is a myth and can mislead the reader into ignoring the many problems these fish must face.

Adult sockeye Use of the Lower River and Estuary:

The water quality issue and concern has been touched upon. That will have to suffice but it must be noted that no salmon run or large Salmon River in BC is exposed to a greater water quality \ pollution concern than the salmon that must return to and head out of the Fraser River. In addition to the pollution loading caused by the population in the Fraser River Basin, it must be noted that a much larger industrial and population in Puget Sound adds very significantly to the pollution loading in the Puget Sound – Gulf of Georgia complex i.e. the Sea.

The Sea is about the size of Lake Ontario and does have about the same population around it. However, the Sea gets a fraction of the water quality concerns seen for Lake Ontario. Despite that, the problems in Lake Ontario are far form resolved and form that we must relate to the future of water quality in the lower Fraser, and its estuary and out estuary which includes much of the Salish Sea...

As noted in the Background section, the protection of the lower Fraser as a migratory corridor probably receives less than adequate attention.

Many sockeye experience high pre-spawn mortality for a number of reasons. Some biologists are concerned that the fish may exhaust their energy supplies in warmer water or when dealing with high velocity migration bottle necks. When the Alex Fraser Bridge was built in 1985 the IPSFC was concerned that he narrowing of the river would increase river velocities and that would additionally stress the fish in their first upstream leg of their migration. It alone would not be an obstruction but each additional energy need is cumulative and a weakened fish can succumb more easily to predation or disease or fail to make it up on of their more significant velocity barriers.

Studies have shown that sockeye are very selective of lower velocity areas in high velocity sections of the stream and studies have shown that a large migration of sockeye to the Adams follows a very narrow band of lower and more desirable velocity flow zones along the river as it migrates up the Fraser and Thompson Rivers.

To address these concerns related to the constant encroachment into the river channel for railroads, highways, ports, bridges, dykes and rock groins were installed on the Alex Fraser island footing structures to reduce and disturb more laminar rapid flow velocities to allow migration past those points more easily. The issue of the backing up of flows at channel restrictions was not fully appreciate in the Lower Fraser River until the old Fraser River Harbor Commission noted that the river elevations at New Westminster dock areas had increase by 11 inches over the years in the 1970-1990 time period.

The precaution of slowing flows for salmon migration was also done at another site in the Thompson River where CN Twin Tracking encroached into the Thompson River.

A key tenant of gravel removal from a river to address flood risk is the straightening and channelization of the braided river sections so as to speed flows along and hopefully lower the river's flood elevation level. This does precisely what the IPSFC was concerned about over the years. This is an activity that will increase river flow higher than historic speeds and that will require greater energy resources form the salmon to pass those velocity bottlenecks in the system.

Juvenile Sockeye Use of the Lower Fraser River and Estuary:

It is true that years of estuary studies have shown that sockeye salmon smolt do pass through the estuary and do not depend upon the estuary for prolonged periods of rearing like chum and Chinook juveniles before taking up a saltwater existence. However, to conclude that they do not use the estuary other than for migration is misleading.

The monitoring of many suction dredge operations in the 1970's clearly shows that the flounder, pink and chum salmon and eulachon are prime victims of those operations. It is believed that this is the case because some of these fish live in that habitat and are found near the bottom of the river. Over the years some have noted that the dredges were not a threat to sockeye and Chinook smolt in that they were larger fish and they avoided the dredges and sockeye were especially able to survive such operations because they just passed through the estuary. However, a close examination of the old dredge monitoring reports show that sockeye smolt and fry are also caught or entrained in fairly large quantities by some of the dredges.

For instance in 1975 form April 18 to May 26 a large DPW dredge (Dredge 322) operated in the Iona area of the North Arm and during that time period was responsible for killing 4620 chum fry, 132 sockeye smolt, 15, 708 stickleback, 4884 flounder, millions of shrimp, 572 eulachons, 4576 sculpins and many lamprey, perch, etc. The authors determined that 66 non-parr marked fry were also killed and speculated that they

could be pink fry. However the pink only spawn in the Fraser River in odd years and pink fry could only be found in an even year i.e. not 1975 and one can only conclude that these fry were indeed sockeye fry in that the authors were well experienced in identifying chum fry. If this dredge had been monitored in an even year, thousands of pink fry would have been entrained by these dredges in addition to those species outlined above.

This extended dredge operation was in the foreshore area of the north Arm and its work resulted in the removal of foreshore habitat used by salmonids and other species as a key living and rearing area.

Of the five tradition species of salmon, only Chinook, coho and sockeye enter the estuary as a parr-smolt type juvenile and dredge monitoring shows that Chinook and Coho parr-smolts did not get entrained by the dredges. It is also know that a proportion of the Chinook and sockeye do enter the Lower Fraser River and its Estuary as fry and do have to rear in freshwater type environment before being ready to enter the ocean and survive in that saltwater environment.

Many such dredge operations were monitored in the 1971 to 1980 time period. Monitoring of the dredge return water to determine fish kill was seen as a way of allowing the dregs to continue to get approvals to work during this sensitive time of the year especially for salmonids. However in the early 1980s DFO took action to force dredges to shut down during this time of the year and that saved millions of fish form being destroyed each year.

The years of dredging monitoring results do indicate that sockeye fry do enter the Lower Fraser River and its estuary and do have to depend upon those habitats to prepare themselves for their transition and survival in the ocean environment. The finding of sockeye fry shows that these fish probably do have to depend upon the Lower Fraser River and its estuary if they are to survive. They can be described as ‘creek sockeye’ in that they must depend upon the river environment versus the majority of their species that rear for a year in an upstream like environment. The existence of creek sockeye that rear in upstream freshwater lotic (riverine) environments is well known.

Why sockeye smolt would be caught in a hydraulic dredge in this specific operation. They are not caught in dredging operations in the deeper river environments in the main channel sand type areas. One can conclude that when they are entrained by a dredge in a foreshore marsh environment they are found there because they are using that environment by feeding along the marsh face as they move towards their ocean to begin their saltwater existence. Unfortunately none of gut contents of these fish were analyzed to confirm their feeding on estuarine organisms.

The years of sampling by the Westwater Institute (UBC) also showed that one can catch sockeye juveniles in near shore environments by means of gill and seine netting operations. Although portrayed as a mainstem out migratory fish that just passes through the Lower Fraser and Estuary, the sampling shows that sockeye juveniles probably do rear to some degree in the lower river. It must be noted that no study has ever been

undertaken to document sockeye juvenile use of the lower river and its estuary. Evidence that they use this area only comes form some general studies (e.g. Westwater) or from the monitoring of impacts form industrial operations (hydraulic dredges).

It is obvious why we find sockeye smolt in the Lower Fraser and Estuary. The question is, how much do these fish depend upon this habitat to survive? Even if we look at Chinook smolt that spend extended periods of time in the estuary rearing, one can pose the same question – how much do these fish depend upon this habitat and if it was lost would they disappear? No good studies have been or probably will be done to answer that question with 100% certainty. However one must look at the anecdotal information.

In the early 1970s the Squamish estuary was greatly compromised by BC Rail. Much of the estuary was trained behind wall and a vast part of the estuary was filled in with sand by the rail way as it prepared the estuary as its rail- ocean port facility in Squamish. This unauthorized work caused a great conflict that carried on for many years and BC rail unwittingly noted that their fill project couldn't have harmed Chinook salmon stocks in the Squamish River because they did not collapse (decline dramatically) until four years after the fill occurred and much of the estuary intertidal marsh areas was lost. The Chinook had a 4-5 year cycle and the loss of estuary rearing and impact on those fry\smolt would not bee seen until the adults returned in diminished numbers some 4 years later.

When a fish such as the Chinook salmon uses a specific habitat, it probably has evolved to depend upon that habitat. Salmon have evolved to subdivide resource use so as to avoid competition but lifestyles or life cycle strategies are bound to not be fully separated. Most conclude that sockeye spawn in larger streams and rear in lakes and do not appear to be a riverine rearing fish and generally pas through the estuary very quickly and do not need it for rearing purposes. Most juvenile sockeye depend upon most of their juvenilie caloric intake and growth while in a lake environment. However, some do depend upon a river environment to rear in and that river environment can extend from the Upper Fraser River down to Steveston. Indeed, although a smaller portion of sockeye spawners, sockeye do spawn in rivers\streams with no lake in them and their progeny have little choice but to rear in that and downstream riverine areas so as to feed and grow and prepare themselves for the transition to an ocean existence. Many of these so called 'creek sockeye' are smaller runs but they are sustainable and are often unique and warrant special consideration in terms of their needs and protection.

Creek Sockeye Spawning Sites in the Fraser River System.

A review of a 1989 study by ex-IPSFC staff for the Fraser River, Northern BC and Yukon Division 's strategic Fraser River Management and Enhancement Plan as prepared by the Fraser River Sockeye Task Force in 1988- 1989 shows that many Fraser river streams support sockeye that do not have access to a lake for traditional sockeye rearing. They are in a sense comparable to their opposites i.e. lake beach spawning sockeye. In both cases the lake spawning and lake rearing and the creek spawning and

creek rearing are small populations of sockeye in comparison to the traditional larger river spawning and large lake rearing runs (.e.g. Adams River – Shuswap Lake).

Some runs of sockeye that spawn in the river immediately downstream of a lake (e.g. Chilko River), the sockeye fry migrate upstream to the lake to rear. Such streams are not included in this list. Those progeny are lake rearing sockeye and the ones listed below are populations of 'creek sockeye'.

During the past 40 years DFO and others have mainly sampled for fish in the spring downstream and summer time period. This is because of the peak biological activity at that time of the year and often due to the ease of sampling. Due to this sampling regime, a bias has at times appeared as to the fall and winter use of certain habitats by salmonids. It is well known that Chinook juveniles hide under the larger gravels upstream of Mission and even in the Prince George area. This is their overwintering habitat. It has been concluded that few other salmonids live in this habitat during the fall and winter. Downstream of Mission i.e. in the sand reach, next to no salmonids are found in the late fall and winter time period.

Sampling on November 2007 did much to add to the Chinook salmon rearing knowledge base. It was known that Chinook will be found rearing or over wintering in almost any gravel bar area upstream of Mission. Sampling by the Fraser River Gravel Stewardship Committee on November 7, 2007 at several gravel bars in the Agassiz area including Spring and Tranmar Bars showed that in addition to Chinook salmon over wintering in that gravel bar habitat area, the second most abundant salmonid fish over wintering in that area were juvenile sockeye salmon.

In that most juvenile sockeye salmon would be expected to over winter in their natal lake rearing environments, it is believed that the significant numbers o sockeye juveniles found in these Lower Fraser Gravel environments must be creek sockeye and this habitat area is essential for their over wintering survival before they migrate down to the estuary and into the ocean in the next spring time period.

Non - Lake Assessable Sockeye Spawning Streams in the Lower Fraser Valley include:

Hopedale Slough – minor spawning in lower 8km.

Coquihalla River – some spawning in lower river.
Kawkawa Creek – tributary of Coquihalla River below Kawkawa Lake

Weaver Creek – spawning throughout to the falls 3.5km form mouth in Harrison River

Evans Creek – sockeye spawning thoughout.

East creek – some spawning near mouth at Morris Slough

Sakwi Creek – spawning to 1.2 km above mouth with Weaver Ck.

Maria Slough – spawning scattered form first culvert to Camp Road. Up to 200 sockeye spawners counted in this spawning habitat.

Mahood Creek – spawning on gravel bars

Douglas Creek – tributary to Harrison River. Spawning in lower 750m.

Non- lake spawning areas in the Lillooet Area.

Bridge River – spawning form Camoo Creek to 14km upstream of Yalakum River. Last remaining habitat since Terzaghi Dam destroyed 90km of habitat.

Yalakum River – occasional sockeye spawning.

Seton River – spawning scattered throughout below the dam.

Cayoosh Creek – tributary to Seton Ck.

Non-lake Spawning areas in the South Thompson Area:

South Th0mpson River – spawning throughout. Main area Chase Riffle to Hoffman's Bluff.

Non-lake Spawning areas in the North Thompson Area:

North Thompson River – spawning throughout river between Little Fort and Black Pool.

Lemieux creek – occasional spawning.

Mann Creek – tributary of North Thompson River. Spawning in lower 1.6km.

Clearwater River – spawning in lower 1.6km.

Raft River – spawning in lower 4km.

Finn Creek – spawning near confluence with North Thompson River.

Non-lake spawning sockeye in the Upper Fraser Basins

Nechako and Stuart Rivers – some spawning in large mainstem rivers in the Vanderhoof area and the lower Stuart River.

Conclusions:

In terms of overall numbers, a smaller portion of overall sockeye runs in the Fraser River depends on the riverine environment for spawning and rearing purposes. These sockeye are often referred to as 'creek sockeye' in that they do not rely upon the adjacent lake for rearing purposes. Although they do not use the lower river as extensively as juvenile Chinook salmon, they do rear to a significant degree in the lower river and over winter in its cobble gravel beds in the Hope to Mission gravel reach.

Some sockeye fry and of course sockeye smolt can be found in the estuary but do not appear to depend upon the estuarine environment as extensively as juvenile chum and Chinook salmon.

As one proceeds up the watershed (i.e. to the Nechako-Stuart system) it is believed that the creek sockeye rear in the mainstem rivers in that area. However, as you proceed downstream, it is logical to assume that the sockeye fry must rear in the mainstem of the Fraser River in that the rearing habitat is simply not available in the smaller tributary streams such as the Coquihalla River or Maria Slough and rearing sockeye have never been caught rearing in such streams.

However, sockeye fry can be found in the Fraser River especially in its lower reaches. In that creek sockeye are unique and do not make up a major portion of the runs that are dominated by lake rearing runs, they are often overlooked and the value of the mainstem river habitat such as the Lower Fraser River to rearing sockeye is also overlooked and ignored. These fish are more than just transient i.e. they will take advantage of food and shelter produced in this section of the river. It is more than just a migratory corridor.

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