Pacific Salmon Commission

600 - 1155 Robson Street
Vancouver, B.C.
V6E 1B5
(604)684-8081
(604)666-8707 (fax)

To: Dalton Silver, Chief Sumas First Nation
Murray Ned, Councilor, Sumas First Nation

Our file: 63001

From: Mike Lapointe, Pacific Salmon Commission staff

cc: Diana Trager, Area Chief, Sheldon Evers, Resource Manager, Jordan Point, Aboriginal Coordinator (all DFO lower Fraser), Kyle Adicks, Chair Fraser River Panel, Barry Rosenberger, Vice Chair Fraser River Panel and Area Director, DFO Fraser Interior.

Date: November 17, 2009

Re: Importance of the location of the Mission acoustics program

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The purpose of this memo is to respond to the Sumas First Nation's request for information documenting the importance of the location for the Mission acoustics program. In addition, I have summarized the importance and main uses of the data from Mission program to help ensure a common understanding. The major factors related to the importance of current site location are:

a) Consistency with historical data series (see 3 and 5 below).
b) Downstream of confluence of virtually all Fraser River sockeye tributaries (exceptions: Pitt and Widgeon; see 2, 3 and 4, below).
c) Upstream of commercial fishery boundary (Area E) and downstream of largest First Nation's catch areas (see 1 and 2 below).
d) Timeliness of estimates relative to location of catch allocations (see 5 below).

In addition to the above issues related to the scientific information obtained from the site and its importance to fisheries management, there are a number of practical issues that would be impacted by relocation. First, sites downstream of the present location have obstacles associated both with their suitability for acoustics (e.g. braided river channel, irregular bottom, eddy's creating turbulence, etc.) and fish behavior (milling). Second, a 7-year joint DFO/PSC research program was conducted at the current site following the 1995 Fraser sockeye review. This led to significant improvements to methods which included the change to shore-based systems using split-beam technology and imaging sonars. Third, we have secured leases from landholders (GVRD and CP rail) to allow us to operate facilities on the shores at this location. Fourth, we have made significant capital investments in structures on both banks to facilitate improvements related to shore based sampling and on site processing of data. Fifth, a large part of our ability to provide scientifically defensible estimates at the site is related to our familiarity with physical site characteristics (bottom profile, turbulence zones, tidal influences, changes with water flows, etc.) that has resulted from our years of experience at the site. Consequently, it would be unrealistic to expect we could move to an alternate site and generate high quality estimates in a short period. Significant capital investment, research effort and time would be required before estimates from an alternate site would be acceptable. However, defending such investments would be difficult unless assurances could be provided that the scientific objectives would be satisfied at an alternate site. The scientific objectives along with the relevance of site are provided in more detail below.

Historical Context

The International Pacific Salmon Fisheries Commission (IPSFC, predecessor to PSC) began monitoring lower river escapements in 1958 using river test fisheries at Whonnock and Cottonwood. Samples of fish scales were also taken to determine age and stock composition. Beginning in the 1970's, acoustics monitoring methods were investigated to improve the accuracy and precision of escapement estimates. Surveys were made to look for appropriate sites. The Mission site was selected for a two main reasons. First, it was upstream of the commercial fishery boundary (Mission Railway Bridge), and thus escapements at Mission would not be subject to any further removals associated with the commercial fishery. Second, several sites lower down in the Fraser were either not suitable for acoustics (e.g. braided river channel, irregular bottom profile, eddy's creating turbulence, etc.) or were far enough downstream that there were concerns about milling behavior. For example, a program was conducted for a few years at the Cottonwood site near Deas Island, but it was evident from stock composition and acoustic results

that sometimes fish would migrate upstream past the site on a flood tide, but then migrate back downstream on the ebb (e.g. Adams river/Late Shuswap populations). Thus researchers could not be sure that acoustic estimates of fish at these lower river sites would provide estimates of escapement for fish that were certain to be headed upstream to spawn. Therefore, the Mission site was selected as the preferred site and the continuous monitoring at that site has been ongoing since 1977.

Program objectives and principal uses of monitoring data

While the main objective of monitoring lower river escapements has remained, the principal uses of lower river escapement data have expanded since 1978. Below I review each of these uses and comment on how changing the location of monitoring site could impact them.

(1) **Monitoring gross escapement.** One of the primary purposes of monitoring escapements in the lower river is to provide in-season information on progress toward "gross" escapement goals, where gross escapement is defined as the number of fish needed for spawning escapement plus any in-river catch requirements (primary for First Nations' FSC needs). The progress toward gross escapement goals is very actively monitored in-season to ensure that sufficient fish are passing upstream for the combination of spawning escapement, management adjustments (see (3) below) and any in-river catch requirements.

> **Importance of the site location:** The most ideal site for estimation of gross escapement would be near the river mouth as assessments there would provide an estimate of the numbers of fish entering the river. However, practical limitations outlined above preclude implementing a program at downstream locations. The advantage of the Mission site is that it is upstream of the commercial fishery boundary, but downstream of the most significant First Nations harvest areas. If the site was moved upstream of the Harrison/Fraser confluence, escapement estimates would exclude some major stocks (e.g. Birkenhead, Harrison and Weaver; see (3) & (4) below).

(2) **Planning in-river fisheries.** The Aboriginal Fisheries Strategy increased catch allocations of Fraser River sockeye to First Nations. Planning the sequence of fisheries needed to achieve these allocations has increased the importance of lower river escapement estimates in scheduling in-river fisheries. In some cases, total estimates may be used to determine timing and duration of lower river fisheries to anticipate catch levels and escapements to fisheries further upstream. In other cases, more stock specific information may be used to determine when weak stocks (e.g. Early Stuart) have passed the lower river so that fisheries directed at stronger stocks (e.g. Early Summer) can begin. Note that fisheries tactics based on some level of stock proportion (e.g. Early Stuart <5% in samples), do not require Mission estimates, but tactics based on protecting a certain fraction of the total run (e.g. protecting 90% of the total Early Stuart migration from harvest) require the combination of abundance estimates from Mission and stock proportions from test fisheries.

> **Importance of the site location:** Movement of the site downstream is problematic primarily for practical reasons discussed above (e.g. see Historical Context). If the site was moved upstream, estimates of the abundance of fish entering the larger catch areas in the lower river would have to be projected from test fisheries, reducing the accuracy and precision of escapement estimates. If the site was moved upstream of the Harrison/Fraser confluence, projection of abundances entering Chehalis and Mt. Currie areas would be problematic.

(3) **Estimation of Management adjustments**: Management adjustments are increments that are added on to the escapement targets to compensate for either systematic assessment errors, or en-route losses that cause upper river escapement estimates to be less than lower river estimates. The Fraser River Panel adopts these adjustments to increase the likelihood that escapement targets are achieved. Compensation for systematic differences observed in Early Stuart and Early Summer run sockeye estimates began in 1995. In 1998, extremely warm river temperatures led the Fraser River Panel to increase escapement targets for Summer-run sockeye by 25% to compensate for potential pre-spawning mortality that was expected to occur in spawning areas as a result of the warm river temperatures. Although estimates of pre-spawning mortality were much lower than predicted, there was a 1.5 million fish discrepancy between lower and upper river escapement estimates. An extensive post-season review was conducted to determine the causes of this discrepancy and one of the recommendations was that PSC and DFO staff develop models to predict what future adjustments to escapement targets would be needed in response to

adverse river conditions (high temperatures, high flows). These "Environmental" Management Adjustment (EMA) models relate differences between estimates (e.g. Fig. 1below) to historical and forecast river conditions.

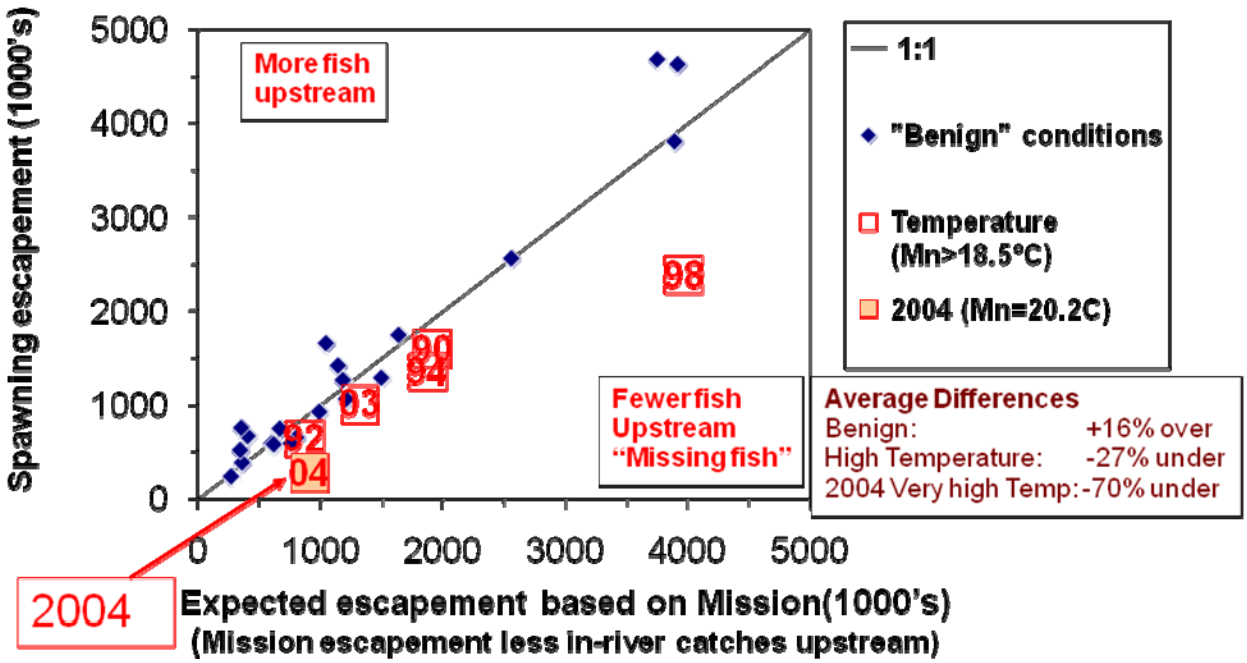

Figure 1. Comparison of lower and upper river escapement estimates for Summer-run sockeye.

EMA models were first used to predict expected differences based on in-season forecasts of river flow and temperatures in 2001. In 2009, nearly 300,000 fish were added to the escapement targets of Early Stuart, Early Summer and Summer-run sockeye to compensate for expected differences. Given the increased frequency of warm water years that have been observed in the last 15 years and future increases anticipated as a result of climate change, management adjustments are likely to become increasing important for ensuring the long term sustainability of the stocks.

Importance of the site location: The pattern of differences shown in Figure 1 comes from over 30 years of observations at consistent lower (Mission) and upper (spawning areas) sites. Changing the lower river site could change the nature of the relationship in two ways. First, differences related to river conditions are likely related to the duration of exposure (migration time and distance between monitoring sites in the lower and upper river). Second, differences related to stock assessment errors will likely be site dependent.

(4) **Best estimates of total return.** For most of the historical time series, the total Fraser sockeye return was estimated by summing the catches in all areas with the spawning escapements. However in the last 15 years lower river escapement estimates (instead of spawning escapement plus in-river catches) have been used for some stocks in several years, because of concerns about in-river losses. For Early Stuart, Early Summer and Summer-run stocks, en-route losses have been associated with adverse river conditions (e.g. Fig 1). High en-route losses of Late-run stocks have been associated with the abnormally early upstream migration that began in 1995. Conservation actions taken in response to these en-route losses and other sources of declining productivity of Fraser River sockeye salmon, have resulted in a significant decline in exploitation rates in fisheries seaward of Mission. The declining catches have increased the importance escapement estimates in total return calculations. For example, since 1998, on average 80% of the total run is estimated to have passed the Mission program.

Importance of the site location: The site needs to be far enough downstream to capture all of the en-losses that could occur during the migration. While the most significant losses associated with migration stress might not occur until the Fraser canyon area, losses associated with fishery effects (e.g. net drop out), likely occur in

any areas where significant fisheries occur. Such fishery induced losses are not typically accounted for in catch estimates.

(5) **In-season estimates of total return.** Currently in Canada, more than 80% of the commercial sockeye and most of the pink catches in Canada are allocated to marine area fisheries. In the United States all of the catch is taken in marine areas. The ability to achieve catch allocations in these areas is highly dependent on timely and accurate assessments of return abundance in marine areas. Up until about 1994, the best models for assessment of return abundance in marine areas used data from the weekly purse seine commercial fisheries. The peak catches were well related to abundance because relatively large fractions of the fish available were removed from the run, fleet sizes and opening times were fairly consistent over time (i.e. stable fishing effort) and the regular weekly fishing pattern ensured that one of the weekly openings would be timed near the peak abundance of the each of the major management groups. However, since the mid 1990's commercial fisheries have occurred less frequently and the pattern of openings has become more irregular. In addition, fleet sizes have decreased substantially through area licensing, vessel by-backs and attrition. These factors have greatly limited the usefulness of commercial catch data for run size estimation. In contrast, test fisheries remove very small fractions of the total run which results in large uncertainty about the daily abundances. These daily abundances are estimated from expansion factors derived from the relationships between test fishing catches and Mission escapements in past years. Thus, since about 1995, test fishery data, coupled with estimates of escapement from Mission acoustic program become the primary source for in-season assessments of return abundance and timing of Fraser River sockeye. Furthermore, because of variation in the historical expansion factors that related test fishing data to abundance, the Fraser River Panel and PSC staff have frequently wanted to see confirmation of the daily abundance suggested by test fisheries in the escapements estimated at Mission before significant changes to return abundances are either recommended and/or accepted. The need for confirmation from Mission greatly decreases the timeliness of assessments relative to marine area fisheries as fish take about 1week to travel from marine areas to Mission. If Mission confirms an abundance increase, these increased abundances have typically passed thru the area where ideally, based on allocations, they should have been caught. The post-season reviews in 2002 and 2006 were in part a result of this lack of timeliness to the assessment information.

Importance of the site location: The historical expansion factors that related the lower river escapement estimates to test fishing catches have been derived from many years of observations at a consistent site. Changing the site would introduce another source of variation into these relationships. Moving the site upstream would create increased delay between test fishery assessment and confirmation of abundance by acoustics. This would decrease the timeliness of abundance assessments relative to marine area fisheries. While moving downstream would be desirable from the perspective of increase timeliness, problems associated with milling behavior of the fish increase as you move downstream from Mission.

I hope the above is helpful with respect to your information request. I will gladly help clarify any questions you may have when we meet on Friday.

Mike Lapointe

Sincerely, Mike Lapointe,

Chief Biologist, Fisheries Management Division, Pacific Salmon Commission Staff