Pacific Salmon Commission's Response to IUCN's Status Assessment of Fraser Sockeye

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The purposes of this document are to address the status concerns, causal factors, and recommendations raised by the IUCN report and press release with particular reference to Fraser River sockeye salmon. Each of the issues is addressed below in Q& A format following a brief review of the IUCN report.

Background

The International Union for the Conservation of Nature (IUCN) issued a press release on October 8th with the Title "One-Quarter of the World's Sockeye Salmon Face Extinction". See

http://www.stateofthesalmon.org/IUCN/downloads/PressRelease_IUCN_Sockeye_Red_List.pdf

Among the statements in the release are the following:

"The International Union for the Conservation of Nature (IUCN) today placed Pacific sockeye salmon on the IUCN Red List of Threatened Species. The Red List is the international standard for measuring species' risk of extinction. " … "Most of the critically endangered sockeye runs are in British Columbia, where dramatic declines have occurred in stretches of the Fraser and Skeena Rivers."

Data from 243 individual spawning sites were evaluated and aggregated into 49 subpopulations. Among these 49 subpopulations, 17 were assessed threatened (either vulnerable, endangered, or critically endangered) and 5 of the threatened subpopulations are from the Fraser River. The 5 Fraser River subpopulations include Chilliwack (endangered; includes Cultus and Chilliwack sockeye), Widgeon Creek (vulnerable), Gates Creek (critically endangered), Bowron (endangered),and a subpopulation called Fraser_Middle (endangered). The last subpopulation is a very large complex of 33 spawning sites including populations from Early Stuart, Late Stuart, Stellako, Chilko, Horsefly, Portage and others.

The report highlights mixed stock fishing, poor marine survival rates and enhancement activities as key factors threatening the viability of populations and contributing to the current declines in abundance.

The press release also recommended specific steps for how the "threatened Canadian sockeye runs" can be conserved including: "

- Fully implement and fund Canada's Fisheries and Oceans (DFO) Wild Salmon Policy immediately.
- Shift fishing from coastal and lower river reaches to upriver reaches. This will avoid capturing too many individuals originating from small, wild populations during the times and places they are mixing with individuals from larger, dominant runs.
- Address the impacts of hatcheries and artificial spawning channels on wild salmon, including how hatchery fish contribute to declines in neighboring, wild populations through mixed stock fishing, loss of fitness through interbreeding, and the spread of diseases to wild salmon.
- Increase investment in state-of-the-art monitoring of fish catch composition.
- Expand current monitoring to measure population abundance on local spawning grounds and geographic areas that are not currently monitored.
- Direct research on the causes of mortality, particularly during the important early ocean period in sockeye's life history."

Fraser River sockeye status

Q. What is the status of Fraser River populations that were identified as threatened by the IUCN?

A. Cultus sockeye are endangered as assessed by COSEWIC. Neither Gates, Bowron nor the Fraser_Middle sockeye sub-populations are at high risk of extinction, though the latter

subpopulation does include some populations of conservation concern (e.g. Early and Late Stuart). Widgeon sockeye populations are a serious conservation concern.

The IUCN divided the Fraser sockeye watershed into 11 subpopulations and the following 5 were identified having threatened status: (1) Fraser_Chill (subpopulation 62; endangered; Chilliwack and Cultus lakes), (2) Fraser_Middle (subpopulation 68; endangered;multiple stocks see below), (3) Fraser_Gat (subpopulation 67;critically endangered;Gates creek and spawning channel), (4) Fraser_Bowron (subpopulation 70;endangered; Bowron), and (5) Fraser_Widg (subpopulation 60;vulnerable;Widgeon creek) (see Table 4 of the IUCN report; http://www.iucnredlist.org/documents/attach/sockeye_salmon_v1223422179.pdf).

The Fraser_Chill subpopulation includes Cultus and Chilliwack lake populations. The endangered status of Cultus sockeye is well known as assessed by COSEWIC and multiple actions are being taken to assist with population recovery including: (1) restrictions to fishery exploitation rates, (2) removal of northern pike minnow predators in Cultus lake (3) fry supplementation (4) captive brood program (see recovery plan at: http://www-sci.pac.dfo-mpo.gc.ca/mehsd/projects/Cultus%20Conservation%20Strategy%20pdf%20Feb%2008.pdf).

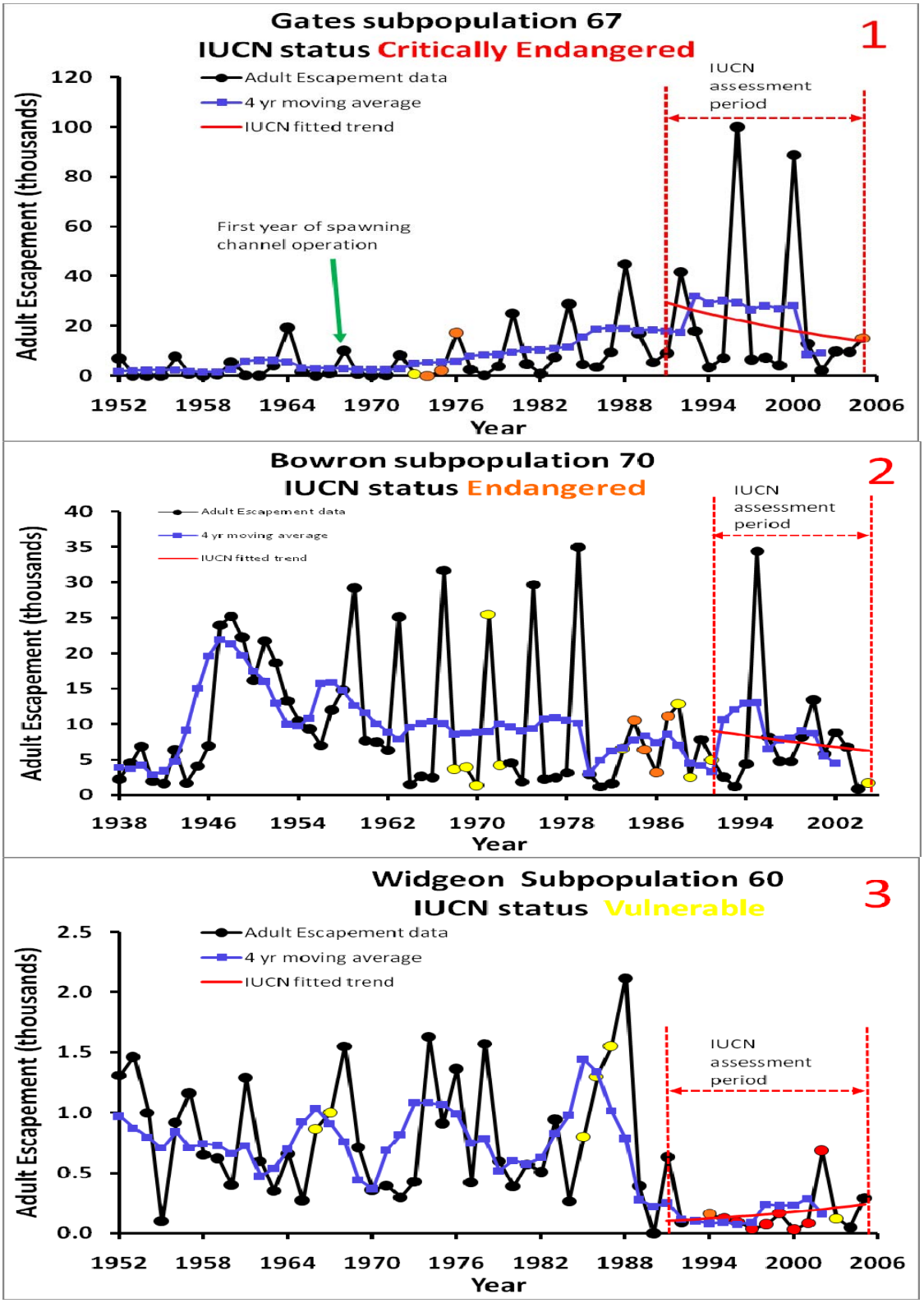
We disagree with the aggregation of Cultus and Chilliwack as one subpopulation because of the high degree of temporal isolation in their spawning time (peak spawning periods for these two populations differ by 2-3 months). As a consequence of this isolation they should be treated as distinct subpopulations in status evaluations and they have been assigned to distinct conservation units under Canada's Wild Salmon Policy.

We believe the assignment of Endangered to the Fraser_Middle subpopulation is misleading because this subpopulation is an aggregate of several populations and it encompasses a very large geographic region including most of the Fraser watershed upstream of the Thomson confluence. This subpopulation encompasses 14 of Canada's sockeye Conservation units (CU's; http://www-comm.pac.dfo-mpo.gc.ca/pages/consultations/wsp/Presentations/PublicForum_CU%20list%20handout_v1c_24Mar08.pdf

Data from 33 sites and 11 CUs were included in the evaluation. Of the 33 sites 25 are from the 4 Stuart area CU's, and the remaining 8 sites include populations such as Chilko, Stellako and Horsefly, which are of non-threatened status.

Thus, the overall status of this large aggregate is being driven by populations in the Early (20/33 sites) and Late Stuart group (5/33 sites, and Portage (1 site). All 3 of these groups have well known conservation concerns and are the target of significant research and management actions related to understanding and improving their status.

In order to understand the reasons behind the status assignments for the remaining 3 subpopulations, we need to briefly explain the methods used by the ICUN to evaluate status. The IUCN assignments relied heavily on a measure called the 3 generation change. The determination of the 3 generation change followed three steps (1) a 4-year moving average was fit to the most recent 15 years of adult escapement estimates (1991-2005; blue squares in Figs. 1-3), (2) a trend line was fit to the time series of 4-year averages (solid red line in Figs. 1-3), and (3) the predicted escapements at the beginning and end of the trend line are used to determine the 3 generation change. For example, in Figure 2 the trend slopes downward indicating a decline in escapements and the predicted escapement at the end of the trend (2005) is 31% lower than at the beginning (1991), resulting in the -31% 3 generation change for Bowron shown in the IUCN document (see Table 4). The estimates of 3 generation change at then compared against threshold values to determine status assignments. Under A2 criteria, the threshold and status assignments are as follows. Declines greater than 80% over 3 generations are assigned critically endangered status. Declines between 50% and 80% are assigned endangered status, and declines between 50% and 30% generate a vulnerable status assignment.



Figures 1-3. Time series of Gates (top), Bowron (middle) and Widgeon (bottom) sockeye escapements. Black, yellow, orange, and red circles ***after 1965*** denote the end of assessment periods where A2 criteria applied to the previous 15 years would have resulted in least concern, vulnerable, endangered and critically endangered status assignments respectively. Red dashed lines denote the start (1991) and end (2005) periods used in the IUCN assessments.

Figures 1-3 show the escapement time series for Gates, Bowron and Widgeon sockeye that were assessed by the IUCN as Critically Endangered, Endangered and Vulnerable respectively.

The Gates population has two components, a wild component that spawns in Gates Creek and a second component that uses an artificial spawning channel that began operation in 1968. Because variable portions of the fish that enter the creek are diverted to the channel each year these two components are not genetically distinct and thus must be combined in status assessments. We were unable to replicate the median value nor the trend shown for Gates in the IUCN report. Table 4 of the report shows a -82% change within 3 generations. The data in Figure 1 result in a -52% change. Nonetheless, it is clear from Figure 1 that the sharp declining trend is being generated by the 3 record escapements that occurred during the assessment period. For most of the assessment period, the 4-year average escapements (blue squares, Fig. 1) are the highest in the time series. The recent escapements have declined, but these declines are from historic maxima and therefore do not reflect extinction risk. Thus we do not believe the data support the conclusion of IUCN's assessment that Gates sockeye face an "extremely high risk of extinction in the wild", the IUCNs definition for Critically Endangered.

Figure 2 shows the long term escapement data set for Bowron sockeye. We were able to replicate the trend shown in Table 4 of the IUCN report (-31% change). However, similar to Gates sockeye, it is clear from Figure 2 that the declining trend is being generated by the 1995 escapement which was the second largest escapement in the time series. For most of the assessment period the 4-year average escapements (blue squares, Fig. 2) are the larger than the prior decade. Also, the fitted trend (red line; Fig. 2) suggests an opposite percent change in abundance (-31% decline) than the change estimated for the 4-yr average escapements at the beginning (1991-1993) and end (2002-2005) of the assessment period (38% increase). Thus, we do not believe that the data support the conclusion of IUCN's assessment that Bowron sockeye face a "very high risk of extinction in the wild", the IUCNs definition for Endangered. Nonetheless, the very low escapements for Bowron in the last 2 years of the evaluation have persisted through to 2006 and 2007 and thus constitute a conservation concern.

For Widgeon sockeye, the trend criteria generated a Least Concern status assignment because of the increasing trend(Fig. 3). However the positive trend was generated by the relatively large escapement (681 fish) in 2001. Widgeon did receive a vulnerable rating based on criteria D (average absolute abundance < 1000 individuals). However, this would appear to be incorrect as the average adult abundance over the most recent generation and entire evaluation period are both less than 200 individuals (Fig. 3) which would correspond to an IUCN rating of Endangered under criteria D. Widgeon sockeye have persisted at a very low abundance since 1995 coincident with the beginning of the abnormally early upstream migration of most stocks in the Late-run aggregate. This low abundance has continued in 2006 and 2007 and thus the population status of Widgeon sockeye constitutes a serious conservation concern. Widgeon sockeye co-migrate with other Late-run stocks such as Cultus sockeye and they should benefit from severe harvest restrictions in place to protect these populations. However, additional actions may be required if low escapements persist.

Our examination of Figures 1-3 led us to rank the Gates, Bowron and Widgeon populations in increasing order from lowest to highest level of conservation concern. The IUCN methods result in a reverse ranking with Widgeon of least and Gates of greatest conservation concern. Such reverse ranking causes us concern about the accuracy of status assignments based on the IUCN evaluation methods. Similarly, when we applied IUCN methods retrospectively to past years, we were concerned that threatened designations occurred rather randomly in the time series (see yellow orange and red circles in Figs. 1-3). The one exception was Widgeon where assessments would have consistently resulted in a Critically Endangered assignment for the period 1994-2002(red circles in Fig. 3). We have pointed these issues out to the IUCN assessors as part of a more detailed scientific review of their assessment in hopes of improving the accuracy of future assessments of sockeye salmon and other species.

Q. What is the status of other Fraser sockeye salmon populations?

A. With the exception of a few specific regions, the escapements of the vast majority of Fraser sockeye populations are at sustainable levels. Many Fraser sockeye populations exhibit a marked 4- year cycle in annual abundance, with one large return year followed by a somewhat less abundant year and two subsequent years of very low abundance. In addition, over the 50 yr periods beginning in 1948 for which comprehensive data have been collected on escapement and returns, there have been longer periods of relatively low and high returns that have corresponded roughly to times of poor and good marine survival conditions. The years 1990, 1991, 1992 and 1993 were each years of maximum total returns for their respective cycles over the 50 yr data set. Since these historic maxima, Fraser sockeye have gone through a period of persistent low marine survival (Fig. 5)

Thus, the total returns to many Fraser sockeye populations have indeed declined quite markedly from these historic maximums (Fig. 4). Escapements have also declined but at a much lower rate, primarily because of drastic reductions in fishery exploitation rates (Fig. 4). These fishery actions have maintained the vast majority of Fraser sockeye populations at sustainable levels. However, continued harvest restrictions will be necessary to protect stocks with conservation concerns identified above and to ensure adequate escapement levels to all populations in years of poor returns. In addition, there will be continued need to protect other populations in the Late-run aggregate (e.g. Weaver, Late Shuswap) due to their continued early upstream migration and resulting high en-route and pre-spawn mortality.

Q. What factors are NOT major causes of declines in abundance

A. a) Mixed stock harvest rates ARE NOT the cause of recent declines

During the period of the IUCN assessment, total fishery exploitation rates have been halved (average<40% since 1995) relative to the historical values in response to declining total returns (Fig 4). Exploitation rates on many of the stocks identified as declining by the IUCN assessment have either followed a similar pattern (e.g. Bowron, Gates) or been even lower (e.g. fishery harvest rates on Early Stuart sockeye averaged <20% during the IUCN assessment period). Stock specific rates have been reduced through harvest tactics that take advantage of differences in migration timing for many of the weaker stocks compared to the more abundant populations. In cases of significant overlaps in migration timing of strong and weak stock components, moving time-area fishery closures been also used in some years to minimize harvest of weak stocks. These harvest reductions effectively ruled out mixed stock harvest rates as a key factor in the recent declines of Fraser sockeye populations.

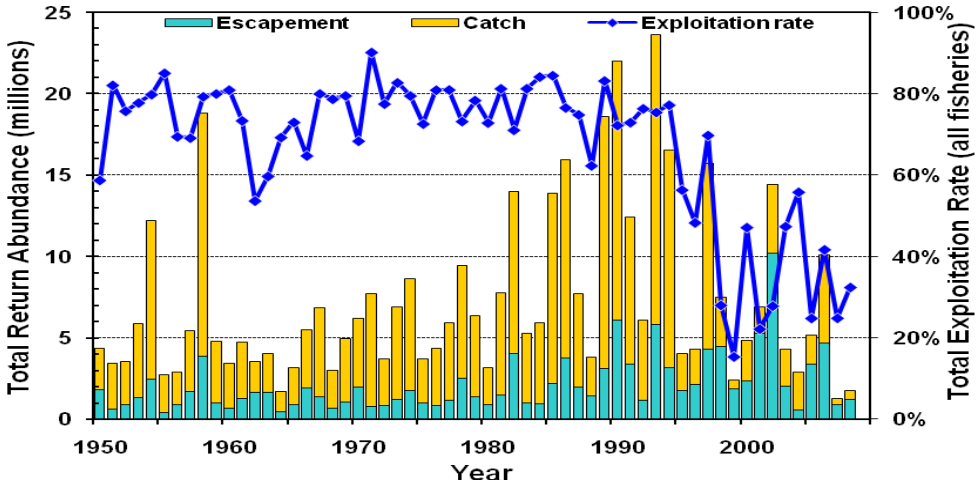


Figure 4. Total return (total height of bars, left hand axis), spawning escapement (light blue bars) and catches (yellow bars) and exploitation rates (blue diamonds; right hand axis) for Fraser River sockeye 1950-2007.

A. b) Enhancement IS NOT a major causal factor.

We disagree with the IUCN's contention that sockeye in the Fraser basin are "strongly influenced by enhancement activities, and that these activities likely represent a key factor threatening many neighboring subpopulations." With the exception of the Cultus captive brood program, there is only one hatchery (in the Pitt River) producing Fraser River sockeye salmon. The hatchery production of Pitt sockeye accounts for a small proportions of the total production in most years and is intended to mitigate against the impacts of poor spawning success and egg-to-fry survival associated with an unstable spawning habitat of the wild population. We are not aware of any significant negative effects of the 4 spawning channels (Weaver, Gates, Nadina, and Horsefly) in the Fraser on the fitness or spread of disease to neighboring wild populations. The Weaver Creek channel is the only sockeye enhancement operation in the Fraser that has been implicated in creating mixed stock harvest pressure in the past (i.e. on Cultus sockeye). These mixed stock exploitation rates have been greatly reduced in the last decade to protect Cultus and other Late-run sockeye populations.

Q. What are the main factors causing declines in abundance?

A. a) Poor marine survival rates are one of the major causes.

We agree that poor marine survival rates are one of the major causes of the recent declining trends in abundance (Fig. 5).

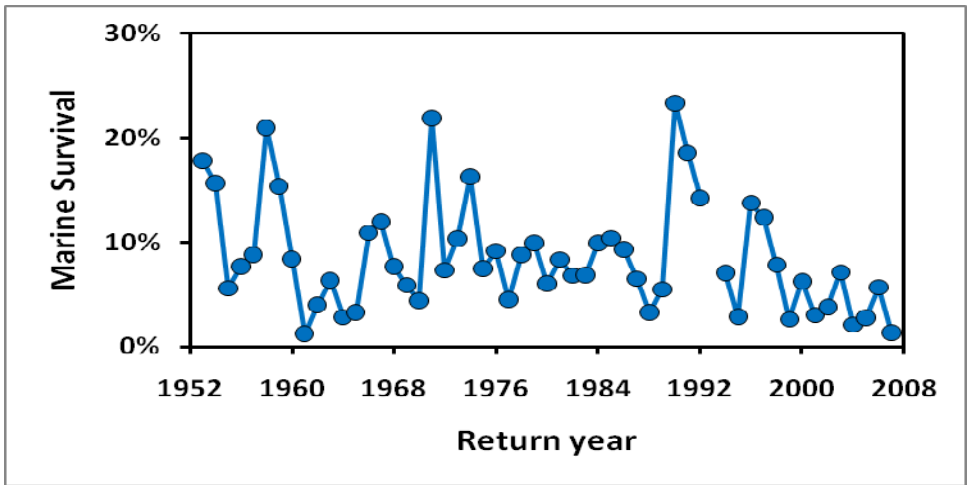


Figure 5. Time series of Chilko sockeye marine survival estimates.

In fact, for many Fraser River sockeye the impacts of the persistent low marine survival in the past decade on escapement has been minimized because significant fishery actions are only permitted when intra-seasonal assessments confirm that abundances are sufficient to sustain harvests. This approach greatly reduces likelihood of overharvest that could occur if significant harvests were taken on the basis of pre-season forecasts, which frequently assume average survival. For example, the 2007 Fraser sockeye return was forecast pre-season to reach 6.2M, which under the pre-season plan would have generated a total harvest of 2.5M fish. Prior to any significant fisheries, in-season assessments detected that the returns were much less than forecast (1.5M) resulting in the closure of most commercial fisheries and a total harvest of only 370,000 , most of was allocated to Canada's First Nations' food, social and ceremonial needs.

A. b) River migration conditions have caused declines in specific years.

Eight of the ten warmest Fraser summer water temperatures in the last 60 years have occurred in the last decade. These warm river temperatures have led to significant en-route losses in some recent years including 1998 (See appendix B of the 1998 Fraser Panel Annual Report; http://www.psc.org/pubs/Frp98-webb.pdf) and 2004 (See appendix F of the 2004 Fraser Panel Annual Report; http://www.psc.org/pubs/FRP2004AnnualReport.pdf). In addition, high river flows have been a concern in some years especially for populations like Early Stuart that migrate upstream the earliest and thus are more likely to encounter periods of peak flows (e.g. 1997). The increased frequency of adverse river conditions in recent years is consistent with climate change and if it continues may pose the single greatest threat to long term sustainability of Fraser sockeye populations. In order to minimize the impacts of these adverse migration conditions on spawning escapements, the Fraser River Panel has increased escapement targets to compensate for the expected en-route losses. The increased escapements or ***management adjustments*** are based on models that relate historical river conditions and losses and they are updated regularly during the summer based on observed and forecast river temperatures and flows from DFO's Environmental Watch program (http://www-sci.pac.dfo-mpo.gc.ca/fwh/index_e.htm). For more information on management adjustments click on the below link and open the presentation call "Management adjustments" (http://www.psc.org/info_runsizeworkshop.htm).

A. c) Abnormally Early Upstream migration has caused declines in Late-run sockeye escapement

Beginning in 1995, populations in the Late-run aggregate (e.g. Cultus, Harrison, Widgeon, Weaver, Portage, Late Shuswap) suspended their normal 4-6 week delay in Georgia Strait and began migrating upstream much earlier than normal. This abnormal behavior has resulted in extremely high en-route and pre-spawn mortality in some years with consequent effects on escapements. (see http://www.psc.org/info_laterunsockeye.htm).

To conserve the Late-run stocks, mixed stock exploitation rates have been cut to less than one third of historic levels resulting in large foregone harvests of abundant Summer-run populations. Multi- million dollar research efforts have been conducted to determine the causes and consequences of this unusual migration behavior. Many of the publications resulting from this research including other research related to Fraser River sockeye are listed on our website (http://www.psc.org/pubs/LateRun/PeerReviewedPapers.pdf). A workshop conducted in June 2008 reviewed the status of Late-run research efforts and proceedings will be published by the Pacific Fisheries Resource Conservation Council this winter.

Q. What are the IUCN recommendations relative to past and present actions?

A. The IUCN press release made 6 recommendations with respect to what should be done to "conserve threatened Canadian sockeye runs". Below we provide a brief evaluation and response to these recommendations with respect to Fraser sockeye.

Recommendation 1:

Fully implement and fund Canada's Fisheries and Oceans (DFO) Wild Salmon Policy immediately.

Evaluation and response

- Fraser sockeye are the most advanced with respect to Wild Salmon Policy implementation.
    - Conservation units have been indentified
    - Benchmarks are expected to be identified by next spring
- Fraser sockeye have been managed and assessed as stock-groups in a Wild Salmon Policy style framework for over 50 yrs.

- The escapements to virtually all streams (i.e. deme level) have been assessed annually since 1948, many since the 1930's.
- Pre-season forecasts of return abundance for most conservation units have been made since the 1960's.
- In-season assessments have been made for aggregates of conservation units based on scale patterns since the early 1950's.
- State of the art microsatellite DNA has been used in the in-season management since 2000. These techniques permit sub CU level assessment of relative return strength.

Recommendation 2:

Shift fishing from coastal and lower river reaches to upriver reaches. This will avoid capturing too many individuals originating from small, wild populations during the times and places they are mixing with individuals from larger, dominant runs.

Evaluation and response

- There has already been a significant transfer of harvest from coastal areas to the Fraser River. Fraser River First Nations catches have increased from an average of 5% of the total catch prior to 1995 to an average of 31% since 1995.
- The movement of a significantly greater fractions of harvest to upriver reaches will pose a significant challenge to Canada given that:
  - A significant fraction of the total First Nations harvest is taken by First Nations whose traditional territories are located in coastal and lower Fraser mixed stock areas.
  - Treaty obligations to the United States whose fishermen can only harvest Fraser River sockeye in mixed stock areas.
  - Canada's current area licensing scheme allocates all of the Non-First Nations commercial harvest to mixed stock areas.
- The intensive in-season management and assessment activities conducted on Fraser River sockeye permit adjustments to mixed stock fisheries in time and space to minimize impacts on less productive populations. In fact, to conserve weak stocks, mixed stock exploitation rates were cut in half in recent years (see Fig. 4 above).

Recommendation 3:

Address the impacts of hatcheries and artificial spawning channels on wild salmon, including how hatchery fish contribute to declines in neighboring, wild populations through mixed stock fishing, loss of fitness through interbreeding, and the spread of diseases to wild salmon.

Evaluation and response:

- With the exception of the Cultus captive brood program, there is only one hatchery (in the Pitt River) producing Fraser River sockeye salmon. We are not aware of any significant negative effects of the 4 spawning channels (Weaver, Gates, Nadina, and Horsefly) in the Fraser on the fitness or spread of disease to neighboring wild populations. Mixed stock impacts of higher production associated with the Weaver creek channel have been mitigated through stock specific assessments and in-season management actions. For example, mixed stock exploitation rates have been severely restricted to protect Cultus sockeye and the resulting surplus escapements to the Weaver channel have been harvested terminally.

Recommendation 4:

Increase investment in state-of-the-art monitoring of fish catch composition.

Evaluation and response:

- The catch composition of Fraser sockeye populations has been estimated by using state of the art genetic techniques (Micro satellite DNA markers) since 2000.

Recommendation 5:

Expand current monitoring to measure population abundance on local spawning grounds and geographic areas that are not currently monitored.

Evaluation and response:

- The escapements to virtually all Fraser sockeye spawning streams have been monitored annually every year since 1948.

Recommendation 6:

Direct research on the causes of mortality, particularly during the important early ocean period in sockeye's life history.

Evaluation and response:

- Canada has a very significant research program directed at early life history of salmon. http://www.dfo-mpo.gc.ca/science/Publications/article/pacific/hs_pacific_salmon_e.htm Such research may advance our understanding of early ocean life history, and provide improved forecasting precision. However, solely focusing on this early ocean period will not be sufficient to ensure long term sustainability of sockeye populations.
- We suggest that additional benefits to conservation could be derived from the development of improved in-season monitoring schemes and policy decision tools that take the uncertainty of assessments into account. In addition, we suggest research efforts be directed toward long term strategic planning regarding the implications of climate change for the conservation of sockeye salmon particularly in the southern portion of the species range.