

**YUKON RIVER JOINT TECHNICAL COMMITTEE REPORT**

**YUKON RIVER SALMON RUN OUTLOOKS FOR 2002  
and  
PREPARATION FOR RESEARCH PLANNING**

**Prepared by**

**THE CANADA/UNITED STATES  
YUKON RIVER JOINT TECHNICAL COMMITTEE**

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## 1.0 INTRODUCTION

The 2002 spring meeting of the Canada/U.S. Yukon River Joint Technical Committee (JTC) was held on February 20-22 in Anchorage. This report contains specific products of that meeting, namely salmon outlooks for the upcoming season, and preparations for strategic research planning with respect to Yukon River salmon.

Participants at the meeting included the following:

**Executive Secretary, Yukon River Panel**

Hugh Monaghan (via teleconference)

**Alaska Department of Fish and Game (ADF&G)**

Linda Brannian (co-chair)

Dan Bergstrom

Bonnie Borba

Audra Brase

Fred Bue

Toshihide Hamazaki

Tracy Lingnau

Susan McNeil

Holly Moore

Paul Salomone

Ted Spencer

Charles Swanton

Tom Vania

**Fisheries and Oceans Canada (DFO)**

Sandy Johnston (co-chair)

Ian Boyce

Brian Ferguson

**U.S. Fish and Wildlife Service (USFWS)**

Jeff Adams

Jeff Bromaghin

Ray Hander

Russ Holder

Tevis Underwood

**U.S. National Marine Fisheries Service (NMFS)**

John Eiler

Richard Wilmot

**U.S. Bureau of Land Management (BLM)**

Bob Karlen

**Association of Village Council Presidents (AVCP)**

Jennifer Hooper

**U.S. Geological Survey (USGS)**

Jim Finn

Chris Zimmerman

**Bering Sea Fishers Association (BSFA)**

Karen Gillis

**U.S. National Parks Service (NPS)**

Fred Anderson

**Tanana Chiefs Conference (TCC)**

George Yaska

**Yukon River Drainage Fishermen's Association (YRDFA)**

Jill Klein

## 2.0 2002 YUKON RIVER SALMON RUN OUTLOOKS

### 2.1 ALASKA

#### 2.1.1 Chinook Salmon

Yukon River chinook salmon return primarily as age-5 and age-6 fish, although age-4 and age-7 fish also contribute to the run. Spawning ground escapements in 1996, the brood year producing 6-year-old fish returning in 2002, were judged to be average in magnitude. However, the return of salmon since 1998 has been well below average in

strength indicating abnormally poor production from parent year escapements. Assuming continued below-average trends in survival rates of parent year escapements, the return of 5- and 6-year-old fish in 2002 is expected to be below average.

Overall, the 2002 chinook salmon run is anticipated to be below average to poor in strength for the fifth year in a row. Given the uncertainties associated with recent declines in productivity, it is anticipated the run will support an average subsistence harvest and possibly a small commercial harvest. The fishery is managed based upon inseason assessments of the actual returns. If inseason qualitative indicators of run strength suggest sufficient abundance exists to have a commercial fishery, the commercial harvest in Alaska could range from 0 to 20,000 chinook salmon (0 to 18,000 fish in the Lower Yukon Area and 0 to 2,000 fish in the Upper Yukon Area). This represents a range of catch well below all other years with the exception of 2000 (9,000 chinook salmon harvested in the commercial fishery) and 2001 (fishery closed) during the previous 30-year period.

In January 2001, the Alaska Board of Fisheries (BOF) modified the Yukon River King Salmon Management plan by altering the fishing schedule for the subsistence salmon fisheries. In prior years, subsistence fishing for most areas of the Alaska portion of the Yukon River was open seven days per week until the opening of the commercial fishing season. The BOF judged that the newly adopted subsistence-fishing schedule should provide a reasonable opportunity within each district, subdistrict or area within the Alaskan portion of the Yukon River drainage, for the subsistence fishery during a normal to below average chinook salmon run in order to improve the quality of the escapement. The schedule contains periods of subsistence closures to reduce the harvest on any one particular pulse of fish as it migrates to its spawning grounds.

### **2.1.2 Summer Chum Salmon**

Yukon River summer chum salmon return primarily as age-4 and age-5 fish therefore the returns in 2002 will be from the parent years 1997 and 1998. Summer chum salmon spawning escapements to selected tributaries in 1997 ranged from adequate to below average. In 1998, spawning escapements were slightly above the low end of the recently established BEG ranges in the Anvik and East Fork Andreafsky Rivers. Escapements into other monitored tributaries did not meet minimum goals or were considered inadequate. In addition, it appears that recent declines in the productivity of Yukon River summer chum salmon are continuing. This trend is similar to the declines seen in many chinook and chum salmon stocks in the Bering Sea region. Specifically, production of Anvik River chum salmon, which represent the largest spawning stock of Yukon River summer chum salmon, has fallen well below one return per spawner for the most recent returning broods. Causes for the observed decrease in productivity are still largely unknown. There is uncertainty as to how long this trend will continue, and whether productivity could be reduced even further. While exact reasons for the run failures are unknown, it is widely speculated that poor marine survival related to localized weather and ocean conditions in the Bering Sea are primary factors. Weakness in Yukon River salmon runs has been attributed to reduced productivity and not the result of low levels of parent year

escapements. Nearly all stocks are continuing to exhibit decreased production levels, in some cases bordering on production failure.

Overall, the 2002 summer chum salmon run is anticipated to be poor in strength. Given the uncertainties associated with recent declines in productivity, and the beginning of below average parent-year escapements, it is unlikely the run will support a commercial harvest. If necessary, subsistence harvest opportunity may also require reductions to provide for escapements. If inseason qualitative indicators of run strength suggest sufficient abundance exists to have a commercial fishery, the commercial harvest in Alaska could range from 0 to 150,000 summer chum salmon.

### 2.1.3 Fall Chum Salmon

Drainage-wide, Yukon River fall chum salmon escapements for the period 1974 through 1995 have been estimated to have ranged from approximately 180,000 (1982) to 1,500,000 (1975), based upon expansion of escapement assessments for selected stocks to approximate overall escapement abundance (Eggers 2001). Escapements in these years resulted in subsequent returns that ranged in size from approximately 315,000 (1995 production) to 1,400,000 (1975 production) fish, using the same approach to approximating overall escapement. Corresponding return per spawner rates ranges from 0.3 to 3.2, averaging 1.9 for all years combined.

Yukon River fall chum salmon return primarily as age-4 or age-5 fish, although age-3 and age-6 fish also contribute to the run. A Ricker spawner-recruit model was used to predict the returns from the 1996 to 1999 parent years that will contribute to the 2002 run. This process resulted in a projection of 646,000 fall chum salmon with the following approximate age composition:

Brood Year	Escapement	Est'd prod'n (R/S)	Est'd Prod'n	Contribution based on age	2002 Return
1996	807,593	1.29	1,038,816	2.4%	15,194
1997	478,867	1.89	904,643	40.0%	258,481
1998	246,411	2.48	610,881	56.2%	362,818
1999	280,224	2.38	667,778	1.4%	9,113
<b>Total</b>					<b>646,000</b>
<b>Total, adjusted by average shortfall (32%)</b>					<b>209,000</b>

There is a level of uncertainty associated with the 2002 Yukon River fall chum salmon outlook. Very dramatic declines in salmon returns to western Alaska were realized in 1997 through 2000. This trend continued to most areas in 2001. While exact reasons for

the region-wide failure are unknown, it has been speculated that it is likely an artifact of poor marine survival resulting from or accentuated by localized conditions in the Bering Sea. Weakness in the salmon runs at the beginning of this downward trend has been attributed to reduced productivity and not completely the result of low levels of parental escapement.

Although a very strong fall chum salmon run was realized in 1996 it contributes little to the projection as age-6 fish. The return in 1997 was below the odd-year average run size. The lower ends of the escapement goal ranges were met in all areas with exception of the Fishing Branch River in 1997. The major contributor to the 2002 fall chum salmon run is anticipated to be age-4 fish returning from the parent year 1998. Since 1998 the majority of the escapement goals have not been met, particularly in the upper Yukon River drainage. Should the factor(s) that affected the productivity of fish from the parent years that returned in 1997 and 1998 carry over to fish expected to return in 2002, then a weak return is once again likely to materialize.

Beginning in 1999 the projection has been presented as a range that includes the normal point projection as the high end. The low end for 2002 was determined by reducing the normal point projection by the average ratio of observed to predicted returns for 1998 through 2001. During this time period the observed return averaged only 32% of the predicted. The 2002-projected range of return is 209,000 to 646,000 fall chum salmon.

<b>Year</b>	<b>Expected Run Size</b>	<b>Observed Run Size</b>	<b>Shortfall</b>
1998	880,000	317,000	36%
1999	1,197,000	411,000	34%
2000	1,137,000	238,000	21%
2001	962,000	367,000	38%
<b>Average</b>			<b>32%</b>

The potential for another weak return is not unreasonable given there has been speculation that longer-term climatic changes taking place in the North Pacific Ocean and Bering Sea may result in lowering future salmon production. The return of age-4 fish from even-numbered brood years during the most recent decade typically averages 412,000 chum salmon, and ranges from 175,000 for brood year 1988 to a high of 668,000 for brood year 1992. The average run size for even-numbered years is 651,000 chum salmon and the total run size has only reached one million chum salmon in one year, 1996. Should the productivity continue to be poor it is likely that total run size in 2002 will materialize toward the lower end of the projected range.

At a projected run size of less than 646,000 fall chum salmon the run is unlikely to support a commercial harvest. Run assessment will primarily be based on inseason indicators and subsistence harvest opportunities may be reduced to provide for escapement based on the levels stipulated in the Alaska Yukon River Drainage Fall Chum Salmon Management Plan.

### 2.1.4 Coho Salmon

Although comprehensive escapement information on Yukon River drainage coho salmon is lacking, it is known that coho salmon primarily return as age-4 fish and overlap in run timing with fall chum salmon. An average return of coho salmon would be anticipated in 2002, based upon parental escapement levels observed in several spawning streams in 1998 and assuming average survival. However, should mortality factors that contributed to recent Western Alaska salmon run failures in recent years also affect marine survival of coho salmon from the 1998 brood year, then a below average run of coho salmon could be expected in 2002.

The Alaska Yukon River coho salmon management plan allows a directed commercial coho salmon fishery, but only under very unique conditions. Directed coho salmon fishing is dependent on the assessed levels of return for both coho and fall chum salmon since they commonly return mixed together. A directed commercial coho salmon fishery is not likely to occur in 2002 because of the poor outlook for fall chum salmon combined with an average coho salmon return.

## 2.2 CANADA

### 2.2.1 Upper Yukon Chinook Salmon

The total run size of Canadian-origin upper Yukon<sup>2</sup> River chinook salmon in 2002 is expected to be approximately 49,000 fish. The forecast is based on an initial stock-recruitment projection of 95,000 fish, reduced by the 1998-2001 average run shortfall (52%):

Year	Expected Run Size	Observed Run Size	Shortfall
1998	143,000	70,000	49%
1999	136,000	83,000	61%
2000	128,000	41,000	32%
2001	124,000	82,000	66%
<b>Average</b>			<b>52%</b>

This approach was used to account for recent declines in upper Yukon chinook salmon return per spawner. Despite good brood year escapements, runs from 1998-2001 were relatively low. Available information suggests that this is the result of poor marine survival. The upper Yukon chinook run size averaged approximately 93,000 fish during the recent six-year cycle from 1996 to 2001<sup>3</sup>. The 2002 expected run size is therefore below average.

<sup>2</sup> The upper Yukon River, for the purpose of Sections 2 and 3 of this report, is defined as the Canadian portion of the Yukon River drainage excluding the Porcupine River drainage.

<sup>3</sup> The preliminary estimate of the 2001 run size is 82,350 fish.

The interim escapement goal range for rebuilt upper Yukon chinook (excluding the Porcupine) is 33,000 to 43,000 chinook salmon. In recognition that chinook escapements were depressed, the Yukon River Panel developed a rebuilding goal of >28,000<sup>4</sup> for the 1996 through 2001 period which both Parties have been endeavouring to manage towards. All three of the principal brood years for the 2002 run exceeded the 28,000 rebuilding goal, although only one of the principle brood years exceeded the lower end of interim escapement goal range for rebuilt stocks.

The 2002 run outlook is based on escapement data for 1994 through 1999 and calculated returns per spawner for the individual brood year escapements based on a spawner-recruitment relationship developed for the 1982 to 1994 brood years. Production estimates incorporated age composition data from escapements, and from harvests of Canadian-origin chinook salmon in the U.S. and Canada. Annual returns were reconstructed using ADF&G scale pattern data and Fisheries and Oceans Canada tagging results. Total escapements for 1980-81 and 1984 were estimated by expanding a cumulative five-area escapement index (Tatchun Cr., Big Salmon R., Nisutlin R., Wolf R., and the non-hatchery returns to the Whitehorse Fishway) by the average proportion the index represented of the total escapement estimates. Mark-recapture results were used to estimate the escapement in 1982, 1983 and 1985 onwards.

The relationship between the natural logarithm of the return per spawner (R/S) and number of spawners (S) for the 1982 to 1994 brood years is described as follows:

$$\text{Equation [1]: } \ln(R/S) = 2.895 - 0.000058(S);$$

where: S = # spawners (in thousands), R = returns.

The coefficient of determination ( $r^2$ ) of this regression is 0.47 and the relationship is significant ( $p < 0.05$ ).

The 2002 return was estimated by first, calculating the total expected return from each brood year escapement based on equation [1] and then, apportioning it by the average age composition of brood year returns. For example, the escapement of 28,409 chinook in 1996 is expected, under normal survival conditions, to produce 102,196 chinook, all ages combined. However, only age-6 chinook will be returning in 2002 from the 1996 brood year. To calculate the number of age-6 chinook expected from the 1996 brood year, the expected total production of 102,196 was apportioned by the average age composition of brood year returns. Over the 1982-1994 period, the average age composition of brood year returns is as follows: <0.1% age-3, 4.6% age-4, 24.0% age-5, 56.8% age-6, 14.1% age-7, and 0.4% age-8. Therefore, it is expected that 56.8% of the production from 1996 will return as age-6 chinook in 2002; this equals 58,078 fish. The calculations for this and the other brood years are summarised in the table below:

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<sup>4</sup> Since the 2001 run outlook was poor and there was a perceived requirement to provide some harvest opportunities to the subsistence fishery in Alaska and the aboriginal fishery in Canada, the Yukon Panel expected that >18,000 chinook salmon would spawn in 2001.

Brood Year	Escapement	Calc'd R/S	Est'd prod'n	Contribution based on age	2002 Return
1994	25,890	4.04	104,519	0.4%	387
1995	32,262	2.86	92,150	14.1%	13,021
1996	28,409	3.60	102,196	56.8%	58,078
1997	37,683	2.02	76,153	24.0%	18,254
1998	16,740	6.78	113,624	4.6%	5,181
1999	11,153	9.59	106,933	0.1%	139
<b>Total</b>					<b>95,000</b>
<b>Total, adjusted by average shortfall (52%)</b>					<b>49,000</b>

The point estimate of 95,000 chinook salmon does not incorporate the wide 95% confidence interval range for the Yukon chinook stock recruitment relationship or the recent trend towards decreased marine survival. It is therefore considered to be optimistic. Stock recruitment relationships are usually developed from density dependent relationships developed for a single stock rather than the aggregate of a number of stocks as is used for Yukon River outlooks.

Chinook run outlooks based on stock-recruitment data have been included in the Canadian Yukon management plans since 1991. To examine how well this method has performed, annual run outlooks based on stock-recruitment data as described in respective plans since 1991, were compared to actual estimated run sizes. Over the period 1991 to 1999, the mean absolute percent error was 25%. In other words, for this period of time, the annual outlooks were off by an average of 25% (range = 3% to 112%). If the 1998 and 1999 forecasts are ignored, the mean absolute percent error is reduced to about 10%. Run outlooks over-estimated the actual run sizes in four years, and underestimated them in five years. Not surprisingly, the years with the greatest discrepancies included 1998 and 1999 when the outlooks overestimated the runs. This pattern was also consistent for the both the 2000 and 2001 returns. As inferred previously, a significant reduction in marine survival can explain the poor performance of the forecasts from 1998-2001.

### 2.2.2 Upper Yukon Chum Salmon

On average, 65% of upper Yukon adult fall chum salmon return as age-4 and 33% return as age-5. This suggests that the major portion of the 2002 fall chum run should originate from escapements of 85,400 in 1997 and 46,300 in 1998.

For the 1982-2001 period, the average escapement was 67,700 fish; for the 1992 to 2001 period, it was 74,100 fish. The escapement for the principle brood year (1998) for the

2002 return falls below both the historic and recent averages. The escapement goal for rebuilt upper Yukon chum salmon is >80,000 fish.

A return rate of 2.5 adults per spawner (R/S) has been used in the joint Canada/U.S. upper Yukon chum salmon rebuilding model for a number of years by Fisheries and Oceans Canada for developing pre-season run expectations. This return rate is very close to the estimated 1982 to 1995 long-term average R/S rate of 2.6. The average R/S rate for the 1990-1995 brood years is also estimated to have been 2.6, however the estimated R/S for the two most recent brood years (1994 and 1995) is only 0.8, a value below that which is required for replacement.

The relationship between the natural logarithm of the return per spawner (R/S) and number of spawners (S) for the 1982 to 1995 brood years is described as follows:

$$\text{Equation [1]: } \ln(R/S) = 1.544 - 0.000011(S);$$

where: S = # spawners (in thousands), R = returns.

The coefficient of determination ( $r^2$ ) of this regression is 0.48 and the relationship is significant ( $p < 0.05$ ).

Upper Yukon fall chum returns have consistently failed to meet forecasted levels over the recent cycle. The forecast error is as follows:

Year	Expected Run Size	Observed Run Size	Shortfall
1998	198,000	61,500	31%
1999	336,000	106,600	32%
2000	334,000	64,500	20%
2001	245,000	48,200	20%
<b>Average</b>			<b>26%</b>

It is reasonable to assume that in 2002 poor marine conditions may again prevail. The 2002 run size expectation is therefore adjusted by the recent average run shortfall of 26%.

Brood Year	Escapement	Est'd prod'n (R/S)	Contribution based on age	2002 Return
1996	122,429	1.29	1.3%	2,061
1997	85,439	1.91	32.8%	53,587
1998	46,255	2.88	64.8%	86,451
1999	66,060	3.24	1.1%	1,698
<b>Total</b>				<b>144,000</b>
<b>Total, adjusted by average shortfall (26%)</b>				<b>37,000</b>

Insufficient stock identification data are available for accurately estimating annual run sizes of upper Yukon chum salmon. However, rough estimates can be made, based on the following assumptions:

- 1/ 30% of the total U.S. catch of fall chum salmon is composed of Canadian-origin fish;
- 2/ the U.S. catches of Canadian-origin upper Yukon and Porcupine River fall chum are proportional to the ratio of their respective border escapements; and,
- 3/ the Porcupine River border escapement consists of the Old Crow aboriginal fishery catch plus the Fishing Branch River escapement.

Based on the above, the recent four-year cycle (1998-2001) return of upper Yukon Canadian-origin chum salmon is estimated to have been approximately 70,200 fish. In comparison, the 2002 upper Yukon chum salmon expectation of 28,000 to 144,000 fish ranges from poor to above average. Since recent runs have had decreased production (falling below one return per spawner), the lower end of the outlook range (37,000 fish) is considered most likely. The 2002 run is therefore expected to be poor.

### 2.2.3 Porcupine River Chum Salmon

The fall chum salmon run to Canadian portions of the Porcupine River drainage in 2002 should originate primarily from the 1997 and 1998 escapements. For these years, the Fishing Branch River weir counts were 26,959 and 13,564 chum salmon respectively. These counts were both above the 1998-2001 cycle average of 13,264 fish but they are lower than all counts recorded for the 1985-1996 period, and the lower end of the interim escapement goal range (50,000 to 120,000 chum salmon).

As with upper Yukon chum, run sizes have consistently failed to meet forecasted levels over the recent cycle. The forecast error is as follows:

Year	Expected Run Size	Observed Run Size	Shortfall
1998	112,000	24,800	22%
1999	124,000	23,300	19%
2000	150,000	12,900	9%
2001	101,000	32,200	32%
<b>Average</b>			<b>20%</b>

The productivity of the Fishing Branch River chum stocks appears to be lower than that of both the drainage-wide stock aggregate and the upper Yukon stock aggregate, particularly when averaged over the 1988 to 1991 brood years. (The returns from the 1992 to 1995 brood years have not yet been estimated.) A stock-recruitment brood table prepared using the assumptions listed above suggests that the average R/S for brood years 1982 through 1991 was 2.2. This was used to develop a forecast that was reduced by the average of the shortfalls for 1998-2001, in order to obtain the lower end of an expectation range.

grant requests. The first planning session is tentatively scheduled to occur in Fairbanks the week of April 15; it will last three days and will cover chinook and summer chum salmon. Planning related to fall chum and coho salmon will tentatively occur in a second planning session prior to initiation of the field season. Working drafts of plans will be submitted to the Yukon Panel during the fall 2002 meeting for review; public review will be solicited through the Yukon Panel's established information dissemination route. The plan will project three to five years into the future and will cover the complete life cycle of salmon, including freshwater, estuarine and marine life stages. Information needs for salmon stocks throughout the drainage will be discussed.