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Application of Mixed-Stock Analysis for Yukon River Fall Chum Salmon, 2008

Annual Report for Study 06-205

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Abstract

Here we report interim results for genetic mixed-stock analysis (MSA) of Yukon River chum salmon harvested from the Pilot Station sonar and Mountain Village test fisheries in 2008; this is a continuation of previous work by Flannery et al. (2007). Fall chum salmon did not outnumber summer chum salmon until the July 28 to August 5 time period, well after the start of the fall management season. Overall, the largest contribution to the 2008 fall chum salmon return came from the U.S. border region (38.6%). Contributions of fall chum salmon from other regions were: Tanana 25.4%, Canada mainstem 14.4%, Canada Porcupine 4.4%, White 16.4%, and Teslin 0.8%.

The abundance estimates derived from combining the results from genetic and sonar estimates continued to be less than those from the escapement and harvest estimates. The level of agreement between the methods appears to be related to the run timing in a given year, with better agreement when the fall run is not late. For 2008, the comparison was hampered by the discontinuation of the Tanana River mark and recapture project. Nevertheless, while the 2008 fall run was nine days late as in 2006, the disparity between genetic/sonar and escapement/harvest was slightly less.

Key Words: chum salmon, Yukon River, mixed-stock analysis, microsatellites.

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Introduction

Determining stock structure and the relative contribution of stocks to harvests are essential for effective management (Larkin 1981). This is a difficult task, greatly simplified through the use of genetic mixed-stock analysis (MSA; Cadrin et al. 2005). Here we provide an interim report documenting the 2008 results of an ongoing MSA study of Yukon River chum salmon harvested from the Pilot Station sonar test fishery where regional stock composition estimates are distributed in-season to assist in management decisions. This work represents a continuation of a study initiated in 2004 under the U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, project 04-228. The final report for that study (Flannery et al. 2007) should be referenced for additional details.

The Yukon River flows 3,200 km through Alaska and Canada, and chum salmon are an important resource for subsistence users in both countries. Two seasonal races of chum salmon, termed “summer” and “fall”, return to spawn in the Yukon River. Summer chum salmon spawn only in the Alaska portion of the Yukon River, whereas fall chum salmon spawn in both Alaska and Canada. Both runs are managed to meet escapement goals and provide maximum harvest opportunities. Furthermore, fishery managers have additional obligations to conserve and equitably share fall chum salmon with Canada, per the Yukon River Salmon Agreement, an annex of the 1985 U.S./Canada Pacific Salmon Treaty (PST).

Methods

Sample collection and laboratory analysis—Tissue samples (axillary process) were collected from every chum salmon caught in the Pilot Station sonar test fishery, located 197 km upriver of the Yukon River mouth, from the start of the run until the end of test fishing, June 9, 2008 to September 7, 2008. Fall chum salmon typically begin entering the Yukon River mouth sometime in early July, but the fall management season does not officially begin until July 19 at Pilot Station. Sampling began at the start of the summer run in order to accurately reflect the overall seasonal passage of fall chum salmon and to provide stock composition estimates of summer chum salmon for a related project funded by the Yukon River Panel Research and Management Fund. Fall chum salmon enter the river in pulses, or surges of fish, that are associated with offshore wind events, high tides, or both. Samples were stratified by pulse of fish or time period, and 192 samples were selected for each stratum, with the daily sample size proportional to the daily sonar passage estimate. Samples were genotyped as in Flannery et al. (2007) for the following loci: *Oki1, Oki2* (Smith et al. 1998); *Oki100* (Miller unpublished); *Omy1011* (Spies et al. 2005); *One102, One103, One104, One114* (Olsen et al. 2000); *Ots103* (Beacham et al. 1998); *OtsG68* (Williamson et al. 2002); and *Ssa419* (Cairney et al. 2000).

Data analysis—The stock compositions of the mixtures were estimated using Bayesian mixture modeling (Pella and Masuda 2001) with the baseline data (Figure 1) described in Flannery et al. (2007). The estimates were summed by seasonal race, region, and country (Figure 1) and then distributed to fishery managers within 24-48 hours after the samples were received in the lab. The stock composition for the entire Pilot Station sampling period was calculated by taking a weighted average of each stratum’s estimate of stock composition based on the stratum's relative abundance for the entire period as determined from Pilot Station sonar passage estimates (Seeb et al. 1997). Stock specific abundance estimates were derived by combining the Pilot Station sonar passage estimates with the Pilot Station genetic stock composition estimates.

A post season analysis was conducted to compare the fall stock specific abundance estimates from the genetic/sonar method against the escapement/harvest method estimates. No comparison was possible for Tanana River due to the discontinuation of the Tanana River mark and recapture project. Escapements from the following projects were compiled: Chandalar River sonar (JTC 2009), Sheenjek River sonar (JTC 2009), Canada border sonar (JTC 2009), and Fishing Branch weir with Old Crow harvest (JTC 2009). Harvest estimates (upriver of Pilot Station) by river location were obtained from a post season survey of subsistence fishers conducted by the Alaska Department of Fish and Game (ADFG; Busher et al. 2009). Harvest was apportioned to the U.S. and Canada fall stocks in a stepwise downstream fashion by using the escapements to estimate the relative proportions of these stocks available at various locations and multiplying these proportions by the harvest at each location. These stock specific harvest estimates were then added to the appropriate escapements in order to allow a direct comparison between data sources.

Results and Discussion

In 2008, 12 strata of chum salmon were analyzed from the Pilot Station sonar test fishery. All strata were analyzed with a sample size of 192, except stratum six, where 138 samples were analyzed. Summer chum salmon comprised the majority of the harvest through July 27 and were detected with a 10% or greater contribution until the middle of August (Table 1). Fall chum salmon were first detected with a significant contribution in stratum six, the week prior to the fall management season, and were in the majority by stratum eight (July 28 – August 5). The presence of both summer and fall chum salmon before and after the switch in management seasons is consistent with data from previous studies (Wilmot et al. 1992; ADFG 2003; Flannery et al. 2007, 2008).

Stock compositions and timing vary significantly from year to year. Nevertheless, there are some apparent consistencies. Fall chum salmon from the U.S. border region continued to have the earliest run timing, followed by fall chum salmon from the Porcupine, mainstem, and White regions (Figure 2). Teslin fall chum salmon were not appreciable contributors, and Tanana fall chum salmon continued to migrate last, slowly building until they comprised the majority of the final strata (Figure 2). Fall chum salmon from the U.S. border region were again sustained throughout the run, with contributions ranging from 11.0 – 38.9% for strata 6 – 12 (Table 1), accounting for 38.6% of the total fall run (Table 2). The Tanana region was the next largest contributor at 25.4%, and overall, U.S. chum salmon accounted for 64% of the fall run (Table 2). The rest of the fall run was comprised of 14.4% mainstem, 4.4% Porcupine, 16.4% White, and 0.8% Teslin (Table 2). All of these contributions are within reported ranges (Table 2). Canada border fall fish, which includes the Porcupine and mainstem regions, continued to return in greater numbers than upper Canada fall fish, which includes the White and Teslin regions. The contribution of Canada border fall fish was 1.1 times larger than upper Canada, a slight decrease from previous years (Table 2).

Overall, stock abundance estimates, the products of estimates of Pilot Station genetic stock composition (Table 1) and Pilot Station sonar passage (Table 3), ranged from 4,433 to 2,083,880 fish (Table 4). Escapement totals from the upriver monitoring projects ranged from 23,491 to 180,397 fish (Table 5). Subsistence harvests from the fishing districts, upriver of Pilot Station, were added to the escapement totals (Table 6). The genetic/sonar estimates continued to be less than the escapement/harvest estimates, as expected (Pfisterer and Maxwell 2000), though the discrepancy has increased since 2005 (Figure 4; Flannery et al. 2007, 2008, 2009). The Pilot Station sonar abundance estimate during the fall management season, July 19 – August 31, was 615,127 (Table 3, strata 7-12), but the genetic/sonar estimate indicated that only 546,602 were actually fall chum salmon (Table 4).

The level of agreement between the genetic/sonar and escapement/harvest methods appears to be related, in part, to the run timing. There was better agreement in 2004 and 2005 (Flannery et al. 2007). In those years, fall chum salmon comprised the majority of the run after the transition date. Less agreement was found in 2006 when the fall run was 9 days late (Flannery et al. 2008), and even less agreement in 2007 (Flannery et al. 2009) when the fall run was 16 days late, but poor counting conditions throughout the 2007 fall run likely exacerbated the disagreement. These results are consistent with the hypothesis that a significant number of late returning fish are missed after the sonar shuts down, and that some escapement projects are counting summer chum as fall chum salmon during the overlap between runs. For 2008, the comparison was hampered by the discontinuation of the Tanana River mark and recapture project. Nevertheless, while the 2008 fall run was nine days late as in 2006, the disparity between genetic/sonar and escapement/harvest was slightly less. This decrease in disparity may just be natural random variance, but extending Pilot Station sonar a week past the normal termination date of August 31 may have played a role as well.

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Table 1. 2008 Pilot Station test fishery chum salmon stock composition estimates with associated standard deviations and 95% confidence intervals by stratum and management group. A. see Figure 1 for management groups. B. contains allocations to various combinations of management groups; Summer represents allocations to Lower, Upp Koy+Main, and Tanana Summer; Fall represents allocations to U.S. Border, Porcupine, Mainstem, White, and Teslin; Middle represents allocations to UppKoy+Main and Tanana Summer; Canada Border represents allocations to Porcupine and Mainstem; Upper Canada represents allocations to White and Teslin; Fall U.S. represents allocations to the Tanana Fall and U.S. Border; U.S. Border + Canada represents allocations to the U.S. Border, Porcupine, Mainstem, White, and Teslin; Mainstem + Upper Canada represents allocations to the Mainstem, White, and Teslin.

Management Group	Stratum 1			
	6/9 - 6/15			
	Estimate	SD	95% CI	
A.				
Lower	0.766	0.070	0.624	0.893
UppKoy+Main	0.224	0.070	0.095	0.367
Tanana Summer	0.002	0.007	0.000	0.023
Tanana Fall	0.001	0.003	0.000	0.011
U.S. Border	0.003	0.007	0.000	0.024
U.S. total	0.997	0.006	0.980	1.000
Porcupine	0.001	0.003	0.000	0.011
Mainstem	0.002	0.004	0.000	0.014
White	0.001	0.002	0.000	0.007
Teslin	0.000	0.001	0.000	0.002
Canada total	0.003	0.006	0.000	0.020
B.				
Summer	0.992	0.009	0.967	1.000
Fall	0.008	0.009	0.000	0.033
Middle	0.226	0.070	0.098	0.369
Canada Border	0.003	0.005	0.000	0.018
Upper Canada	0.001	0.003	0.000	0.008
Fall U.S.	0.004	0.007	0.000	0.026
U.S. Border + Canada	0.007	0.009	0.000	0.031
Mainstem + Upper Canada	0.003	0.005	0.000	0.017

Continued

Table 1. Continued.

Management Group	Stratum 2 6/16 - 6/22 Estimate	SD	95% CI	
A.				
Lower	0.716	0.068	0.576	0.843
UppKoy+Main	0.231	0.068	0.106	0.372
Tanana Summer	0.048	0.030	0.000	0.110
Tanana Fall	0.001	0.003	0.000	0.011
U.S. Border	0.001	0.003	0.000	0.010
U.S. total	0.998	0.003	0.988	1.000
Porcupine	0.000	0.001	0.000	0.003
Mainstem	0.001	0.002	0.000	0.008
White	0.000	0.002	0.000	0.005
Teslin	0.000	0.001	0.000	0.003
Canada total	0.002	0.003	0.000	0.012
B.				
Summer	0.996	0.006	0.980	1.000
Fall	0.004	0.006	0.000	0.020
Middle	0.280	0.068	0.153	0.420
Canada Border	0.001	0.003	0.000	0.009
Upper Canada	0.001	0.002	0.000	0.006
Fall U.S.	0.002	0.005	0.000	0.016
U.S. Border + Canada	0.003	0.005	0.000	0.016
Mainstem + Upper Canada	0.002	0.003	0.000	0.011

Continued

Table 1. Continued.

Management Group	Stratum 3 6/23 - 6/29 Estimate	SD	95% CI	
A.				
Lower	0.684	0.076	0.535	0.830
UppKoy+Main	0.298	0.079	0.146	0.452
Tanana Summer	0.010	0.019	0.000	0.066
Tanana Fall	0.001	0.004	0.000	0.013
U.S. Border	0.004	0.008	0.000	0.029
U.S. total	0.997	0.005	0.982	1.000
Porcupine	0.001	0.003	0.000	0.007
Mainstem	0.001	0.004	0.000	0.013
White	0.000	0.002	0.000	0.005
Teslin	0.000	0.002	0.000	0.004
Canada total	0.003	0.005	0.000	0.018
B.				
Summer	0.992	0.010	0.963	1.000
Fall	0.008	0.010	0.000	0.037
Middle	0.308	0.077	0.162	0.457
Canada Border	0.002	0.005	0.000	0.016
Upper Canada	0.001	0.002	0.000	0.007
Fall U.S.	0.005	0.009	0.000	0.033
U.S. Border + Canada	0.007	0.009	0.000	0.034
Mainstem + Upper Canada	0.002	0.004	0.000	0.015

Continued

Table 1. Continued.

Management Group	Stratum 4 6/30 - 7/6 Estimate	SD	95% CI	
A.				
Lower	0.912	0.058	0.771	0.992
UppKoy+Main	0.060	0.059	0.000	0.204
Tanana Summer	0.021	0.023	0.000	0.074
Tanana Fall	0.002	0.005	0.000	0.016
U.S. Border	0.002	0.005	0.000	0.016
U.S. total	0.996	0.007	0.975	1.000
Porcupine	0.000	0.001	0.000	0.003
Mainstem	0.003	0.007	0.000	0.024
White	0.000	0.002	0.000	0.005
Teslin	0.000	0.001	0.000	0.002
Canada total	0.004	0.007	0.000	0.025
B.				
Summer	0.992	0.009	0.966	1.000
Fall	0.008	0.009	0.000	0.034
Middle	0.080	0.058	0.000	0.224
Canada Border	0.003	0.007	0.000	0.024
Upper Canada	0.001	0.002	0.000	0.006
Fall U.S.	0.004	0.007	0.000	0.023
U.S. Border + Canada	0.006	0.008	0.000	0.030
Mainstem + Upper Canada	0.004	0.007	0.000	0.025

Continued

Table 1. Continued.

Management Group	Stratum 5 7/7 - 7/13 Estimate	SD	95% CI	
A.				
Lower	0.643	0.070	0.498	0.772
UppKoy+Main	0.215	0.077	0.079	0.380
Tanana Summer	0.101	0.043	0.017	0.189
Tanana Fall	0.016	0.024	0.000	0.080
U.S. Border	0.020	0.024	0.000	0.081
U.S. total	0.995	0.009	0.968	1.000
Porcupine	0.001	0.005	0.000	0.013
Mainstem	0.003	0.007	0.000	0.024
White	0.001	0.003	0.000	0.008
Teslin	0.000	0.002	0.000	0.005
Canada total	0.005	0.009	0.000	0.032
B.				
Summer	0.959	0.031	0.888	1.000
Fall	0.041	0.031	0.000	0.112
Middle	0.316	0.074	0.177	0.472
Canada Border	0.004	0.008	0.000	0.029
Upper Canada	0.001	0.003	0.000	0.011
Fall U.S.	0.036	0.031	0.000	0.107
U.S. Border + Canada	0.025	0.024	0.000	0.085
Mainstem + Upper Canada	0.004	0.008	0.000	0.027

Continued

Table 1. Continued.

Management Group	Stratum 6 7/14 - 7/18 Estimate	SD	95% CI	
A.				
Lower	0.644	0.071	0.500	0.771
UppKoy+Main	0.078	0.067	0.000	0.227
Tanana Summer	0.115	0.043	0.041	0.207
Tanana Fall	0.009	0.018	0.000	0.064
U.S. Border	0.110	0.051	0.005	0.212
U.S. total	0.956	0.041	0.858	1.000
Porcupine	0.013	0.024	0.000	0.085
Mainstem	0.031	0.034	0.000	0.113
White	0.001	0.002	0.000	0.006
Teslin	0.000	0.002	0.000	0.005
Canada total	0.044	0.041	0.000	0.142
B.				
Summer	0.837	0.042	0.749	0.914
Fall	0.163	0.042	0.086	0.251
Middle	0.193	0.073	0.068	0.347
Canada Border	0.043	0.041	0.000	0.141
Upper Canada	0.001	0.003	0.000	0.009
Fall U.S.	0.119	0.051	0.019	0.222
U.S. Border + Canada	0.154	0.042	0.077	0.242
Mainstem + Upper Canada	0.032	0.034	0.000	0.114

Continued

Table 1. Continued.

Management Group	Stratum 7 7/19 - 7/27 Estimate	SD	95% CI	
A.				
Lower	0.334	0.061	0.220	0.459
UppKoy+Main	0.125	0.066	0.000	0.257
Tanana Summer	0.271	0.047	0.182	0.367
Tanana Fall	0.003	0.007	0.000	0.025
U.S. Border	0.184	0.056	0.067	0.284
U.S. total	0.917	0.040	0.822	0.972
Porcupine	0.026	0.037	0.000	0.118
Mainstem	0.005	0.011	0.000	0.041
White	0.051	0.017	0.022	0.089
Teslin	0.001	0.004	0.000	0.013
Canada total	0.083	0.040	0.028	0.178
B.				
Summer	0.730	0.042	0.646	0.811
Fall	0.270	0.042	0.189	0.354
Middle	0.396	0.067	0.266	0.526
Canada Border	0.031	0.038	0.000	0.124
Upper Canada	0.052	0.018	0.023	0.091
Fall U.S.	0.187	0.056	0.071	0.287
U.S. Border + Canada	0.267	0.042	0.187	0.351
Mainstem + Upper Canada	0.057	0.021	0.024	0.105

Continued

Table 1. Continued.

Management Group	Stratum 8 7/28 - 8/5 Estimate	SD	95% CI	
A.				
Lower	0.053	0.028	0.001	0.112
UppKoy+Main	0.094	0.056	0.000	0.205
Tanana Summer	0.006	0.016	0.000	0.058
Tanana Fall	0.111	0.054	0.000	0.216
U.S. Border	0.389	0.078	0.244	0.547
U.S. total	0.654	0.066	0.522	0.779
Porcupine	0.004	0.014	0.000	0.051
Mainstem	0.204	0.064	0.085	0.334
White	0.138	0.027	0.089	0.193
Teslin	0.000	0.002	0.000	0.005
Canada total	0.346	0.066	0.221	0.478
B.				
Summer	0.154	0.049	0.063	0.253
Fall	0.846	0.049	0.747	0.937
Middle	0.101	0.053	0.000	0.209
Canada Border	0.208	0.064	0.089	0.337
Upper Canada	0.138	0.027	0.090	0.194
Fall U.S.	0.500	0.079	0.346	0.652
U.S. Border + Canada	0.735	0.056	0.622	0.842
Mainstem + Upper Canada	0.342	0.067	0.216	0.474

Continued

Table 1. Continued.

Management Group	Stratum 9 8/6 - 8/14 Estimate	SD	95% CI	
A.				
Lower	0.087	0.030	0.032	0.148
UppKoy+Main	0.017	0.023	0.000	0.080
Tanana Summer	0.033	0.034	0.000	0.112
Tanana Fall	0.135	0.045	0.054	0.231
U.S. Border	0.354	0.074	0.219	0.511
U.S. total	0.626	0.066	0.497	0.758
Porcupine	0.060	0.067	0.000	0.211
Mainstem	0.158	0.067	0.020	0.284
White	0.156	0.030	0.102	0.217
Teslin	0.000	0.002	0.000	0.004
Canada total	0.374	0.066	0.242	0.503
B.				
Summer	0.136	0.037	0.073	0.215
Fall	0.864	0.037	0.785	0.927
Middle	0.049	0.036	0.000	0.131
Canada Border	0.218	0.065	0.093	0.347
Upper Canada	0.156	0.030	0.102	0.218
Fall U.S.	0.490	0.072	0.353	0.632
U.S. Border + Canada	0.728	0.051	0.623	0.823
Mainstem + Upper Canada	0.314	0.073	0.165	0.449

Continued

Table 1. Continued.

Management Group	Stratum 10 8/15 - 8/18 Estimate	SD	95% CI	
A.				
Lower	0.014	0.017	0.000	0.057
UppKoy+Main	0.030	0.026	0.000	0.090
Tanana Summer	0.003	0.009	0.000	0.030
Tanana Fall	0.240	0.045	0.154	0.330
U.S. Border	0.291	0.069	0.158	0.427
U.S. total	0.577	0.064	0.447	0.699
Porcupine	0.014	0.030	0.000	0.109
Mainstem	0.227	0.056	0.124	0.342
White	0.181	0.032	0.123	0.248
Teslin	0.000	0.002	0.000	0.004
Canada total	0.423	0.064	0.301	0.553
B.				
Summer	0.047	0.025	0.008	0.106
Fall	0.953	0.025	0.894	0.992
Middle	0.033	0.027	0.000	0.094
Canada Border	0.241	0.061	0.131	0.368
Upper Canada	0.181	0.032	0.123	0.249
Fall U.S.	0.531	0.069	0.391	0.660
U.S. Border + Canada	0.714	0.046	0.623	0.802
Mainstem + Upper Canada	0.408	0.060	0.294	0.527

Continued

Table 1. Continued.

Management Group	Stratum 11 8/19 - 8/26 Estimate	SD	95% CI	
A.				
Lower	0.033	0.015	0.010	0.067
UppKoy+Main	0.004	0.010	0.000	0.035
Tanana Summer	0.004	0.009	0.000	0.034
Tanana Fall	0.354	0.051	0.258	0.455
U.S. Border	0.374	0.070	0.238	0.506
U.S. total	0.769	0.056	0.650	0.863
Porcupine	0.026	0.037	0.000	0.123
Mainstem	0.028	0.039	0.000	0.130
White	0.176	0.032	0.118	0.241
Teslin	0.001	0.004	0.000	0.015
Canada total	0.231	0.056	0.137	0.350
B.				
Summer	0.041	0.019	0.013	0.088
Fall	0.959	0.019	0.912	0.987
Middle	0.008	0.013	0.000	0.048
Canada Border	0.054	0.047	0.000	0.160
Upper Canada	0.177	0.032	0.119	0.243
Fall U.S.	0.728	0.058	0.605	0.827
U.S. Border + Canada	0.605	0.051	0.504	0.704
Mainstem + Upper Canada	0.203	0.049	0.126	0.315

Continued

Table 1. Continued.

Management Group	Stratum 12 8/27 - 9/7 Estimate	SD	95% CI	
A.				
Lower	0.023	0.017	0.000	0.062
UppKoy+Main	0.010	0.019	0.000	0.067
Tanana Summer	0.048	0.028	0.000	0.107
Tanana Fall	0.405	0.047	0.314	0.497
U.S. Border	0.229	0.057	0.122	0.343
U.S. total	0.715	0.055	0.607	0.824
Porcupine	0.102	0.050	0.001	0.203
Mainstem	0.002	0.007	0.000	0.023
White	0.151	0.029	0.099	0.212
Teslin	0.031	0.022	0.000	0.079
Canada total	0.285	0.055	0.175	0.393
B.				
Summer	0.081	0.031	0.028	0.148
Fall	0.919	0.031	0.852	0.972
Middle	0.059	0.029	0.008	0.124
Canada Border	0.103	0.050	0.001	0.205
Upper Canada	0.182	0.036	0.117	0.255
Fall U.S.	0.634	0.059	0.519	0.751
U.S. Border + Canada	0.514	0.050	0.417	0.611
Mainstem + Upper Canada	0.283	0.055	0.174	0.392

Continued

Table 1. Continued.

Management Group	Overall 6/9 - 9/7 Estimate	SD	95% CI	
A.				
Lower	0.556	0.025	0.507	0.605
UppKoy+Main	0.159	0.027	0.107	0.211
Tanana Summer	0.046	0.011	0.024	0.067
Tanana Fall	0.061	0.007	0.047	0.075
U.S. Border	0.092	0.010	0.073	0.111
U.S. total	0.914	0.008	0.899	0.929
Porcupine	0.010	0.004	0.002	0.019
Mainstem	0.035	0.006	0.022	0.047
White	0.039	0.003	0.033	0.046
Teslin	0.002	0.001	0.000	0.005
Canada total	0.086	0.008	0.071	0.101
B.				
Summer	0.760	0.008	0.745	0.776
Fall	0.240	0.008	0.224	0.255
Middle	0.204	0.026	0.153	0.255
Canada Border	0.045	0.007	0.031	0.059
Upper Canada	0.041	0.004	0.034	0.048
Fall U.S.	0.153	0.010	0.133	0.174
U.S. Border + Canada	0.179	0.008	0.163	0.195
Mainstem + Upper Canada	0.081	0.007	0.066	0.096

Table 2. Overall estimates of fall chum salmon stock proportions.

Year	Tanana	U.S. Border	Mainstem	Porcupine	White	Teslin
2004	0.370	0.312	0.116	0.079	0.118	0.004
2005	0.209	0.494	0.117	0.048	0.108	0.024
2006	0.206	0.438	0.189	0.033	0.127	0.007
2007	0.283	0.330	0.184	0.030	0.171	0.002
2008	0.254	0.386	0.144	0.044	0.164	0.008
Average	0.264	0.392	0.150	0.046	0.138	0.009

Table 3. Pilot Station sonar chum salmon passage estimates for 2008.

Year	Strata	Date	Passage
2008	Stratum 1	6/9 to 6/15	26,026
	Stratum 2	6/16 to 6/22	215,492
	Stratum 3	6/23 to 6/29	514,303
	Stratum 4	6/30 to 7/6	415,855
	Stratum 5	7/7 to 7/13	423,297
	Stratum 6	7/14 to 7/18	70,694
	Stratum 7	7/19 to 7/27	71,871
	Stratum 8	7/28 to 8/5	173,262
	Stratum 9	8/6 to 8/14	65,903
	Stratum 10	8/15 to 8/18	109,131
	Stratum 11	8/19 to 8/26	76,837
	Stratum 12	8/27 to 9/7	118,123
	Total	6/9 to 9/7	2,280,794

Table 4. Total abundance estimates derived from Pilot Station genetic stock composition and sonar chum salmon passage estimates for 2008. The standard deviations and 95% confidence intervals are based on the variances of the genetic estimates only. A. see Figure 1 for management groups. B. contains allocations to various combinations of management groups; Summer represents allocations to Lower, Upp Koy+Main, and Tanana Summer; Fall represents allocations to U.S. Border, Porcupine, Mainstem, White, and Teslin; Middle represents allocations to UppKoy+Main and Tanana Summer; Canada Border represents allocations to Porcupine and Mainstem; Upper Canada represents allocations to White and Teslin; Fall U.S. represents allocations to the Tanana Fall and U.S. Border; U.S. Border + Canada represents allocations to the U.S. Border, Porcupine, Mainstem, White, and Teslin; Mainstem + Upper Canada represents allocations to the Mainstem, White, and Teslin.

Management Group	2008 6/9 - 9/7 Estimate	SD	95% CI	
A.				
Lower	1,268,406	57,330	1,156,040	1,380,773
UppKoy+Main	361,995	60,739	242,946	481,044
Tanana Summer	103,801	24,508	55,764	151,837
Tanana Fall	138,844	16,695	106,123	171,566
U.S. Border	210,830	22,109	167,497	254,163
U.S. total	2,083,880	17,562	2,049,458	2,118,302
Porcupine	23,882	9,745	4,781	42,983
Mainstem	78,908	14,715	50,068	107,749
White	89,692	7,684	74,632	104,753
Teslin	4,433	3,000	0	10,313
Canada total	196,914	17,562	162,493	231,336
B.				
Summer	1,734,191	18,292	1,698,339	1,770,044
Fall	546,602	18,292	510,750	582,455
Middle	465,778	59,383	349,388	582,168
Canada Border	102,776	16,603	70,234	135,317
Upper Canada	94,127	8,199	78,056	110,198
Fall U.S.	349,669	23,687	303,242	396,096
U.S. Border + Canada	407,753	18,504	371,486	444,020
Mainstem + Upper Canada	184,686	16,941	151,481	217,891

Table 5. Preliminary chum salmon escapement project estimates for 2008.

Escapement project	Estimate
Chandalar Sonar	178,278
Sheenjek Sonar	50,353
Eagle Sonar Border Passage (Mainstem + Upper)	180,397
Fishing Branch weir + Old Crow harvest	23,491

Table 6. Chum salmon subsistence harvest estimates for 2008. Bold numbers indicate escapements estimated by the monitoring projects. Harvest was apportioned to the U.S. and Canada fall stocks in a stepwise downstream fashion by using the escapements to estimate the relative proportions of these stocks available at the river locations and multiplying these proportions by the harvest at the river locations.

		Abundance of contributing stocks			
Location	Harvest	Canada Mainstem + Upper	Canada Porcupine	Sheenjek	Chandalar
Chandalar (w/ Black)	1,563				**178,278**
Y5D Above Porcupine	21,620	**180,397**			
Ft. Yukon	14,252	202,017	**23,491**	**50,353**	
Y5D Below Chandalar	686	212,454	24,705	52,954	179,841
Y5C	1,659	212,764	24,741	53,032	180,104
Y5B	15,900	213,514	24,828	53,219	180,738
Y4 (excluding Koyukuk River)	6,645	220,702	25,664	55,010	186,823
Y3	1,821	223,706	26,013	55,759	189,366
Y2 (Marshall + half Pilot Station)	1206	224,529	26,109	55,964	190,063
Total	64,894	225,074	26,172	56,100	190,524

Continued

Table 6. Continued.

Location	Proportion of contributing stocks			
	Canada Mainstem + Upper	Canada Porcupine	Sheenjek	Chandalar
Chandalar (w/ Black)	0.000	0.000	0.000	1.000
Y5D Above Porcupine	1.000	0.000	0.000	0.000
Ft. Yukon	0.732	0.085	0.183	0.000
Y5D Below Chandalar	0.452	0.053	0.113	0.383
Y5C	0.452	0.053	0.113	0.383
Y5B	0.452	0.053	0.113	0.383
Y4	0.452	0.053	0.113	0.383
Y3	0.452	0.053	0.113	0.383
Y2 (Marshall + half Pilot Station)	0.452	0.053	0.113	0.383

Location	Harvest Apportionment			
	Canada Mainstem + Upper	Canada Porcupine	Sheenjek	Chandalar
Chandalar (w/ Black)	0	0	0	1,563
Y5D Above Porcupine	21,620	0	0	0
Ft. Yukon	10,437	1,214	2,601	0
Y5D Below Chandalar	310	36	77	263
Y5C	750	87	187	635
Y5B	7,188	836	1,792	6,085
Y4	3,004	349	749	2,543
Y3	823	96	205	697
Y2 (Marshall + half Pilot Station)	545	63	136	462
Total	44,677	2,681	5,747	12,246

Figure 1. Baseline sampling locations, 1 = Andreafsky, 2 = Chulinak, 3 = Anvik, 4 = California, 5 = Nulato, 6 = Gisasa, 7 =Henshaw, 8 = Jim, 9 = South Fork Koyukuk Early, 10 = South Fork Koyukuk Late, 11 = Melozitna, 12 = Tozitna, 13 = Chena, 14 = Salcha, 15 = Delta, 16 = Kantishna, 17 = Toklat, 18 = Big Salt, 19 = Chandalar, 20 = Sheenjek, 21 = Black, 22 = Fishing Branch, 23 = Big Creek, 24 = Minto, 25 = Pelly, 26 = Tatchun, 27 = Donjek, 28 = Kluane, and 29 = Teslin. Pilot Station is located on the Yukon River mainstem near sample location 2. The grey shaded areas delineate fishery management regions, with summer regions outlined by dashed lines and fall regions by solid lines. The middle region encompasses the upper Koyukuk and middle mainstem and Tanana summer regions. The Canada border encompasses the Porcupine and mainstem regions, and upper Canada encompasses the White and Teslin regions.

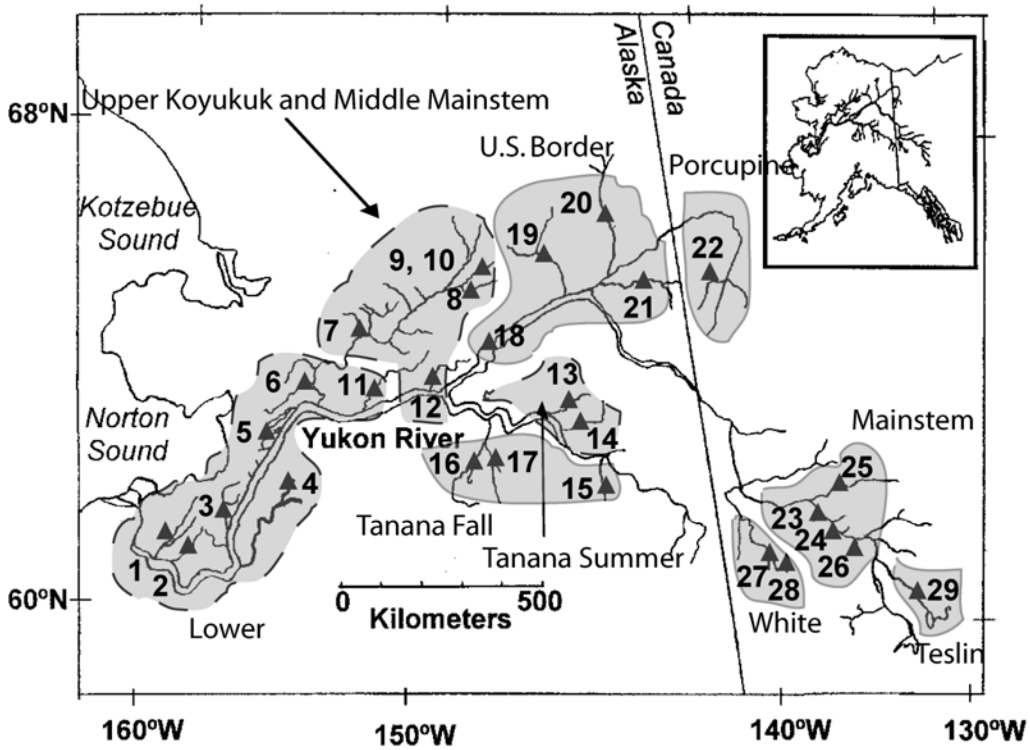


Figure 2. Pilot Station test fishery chum salmon stock composition estimates for 2008. Error bars represent one standard error.

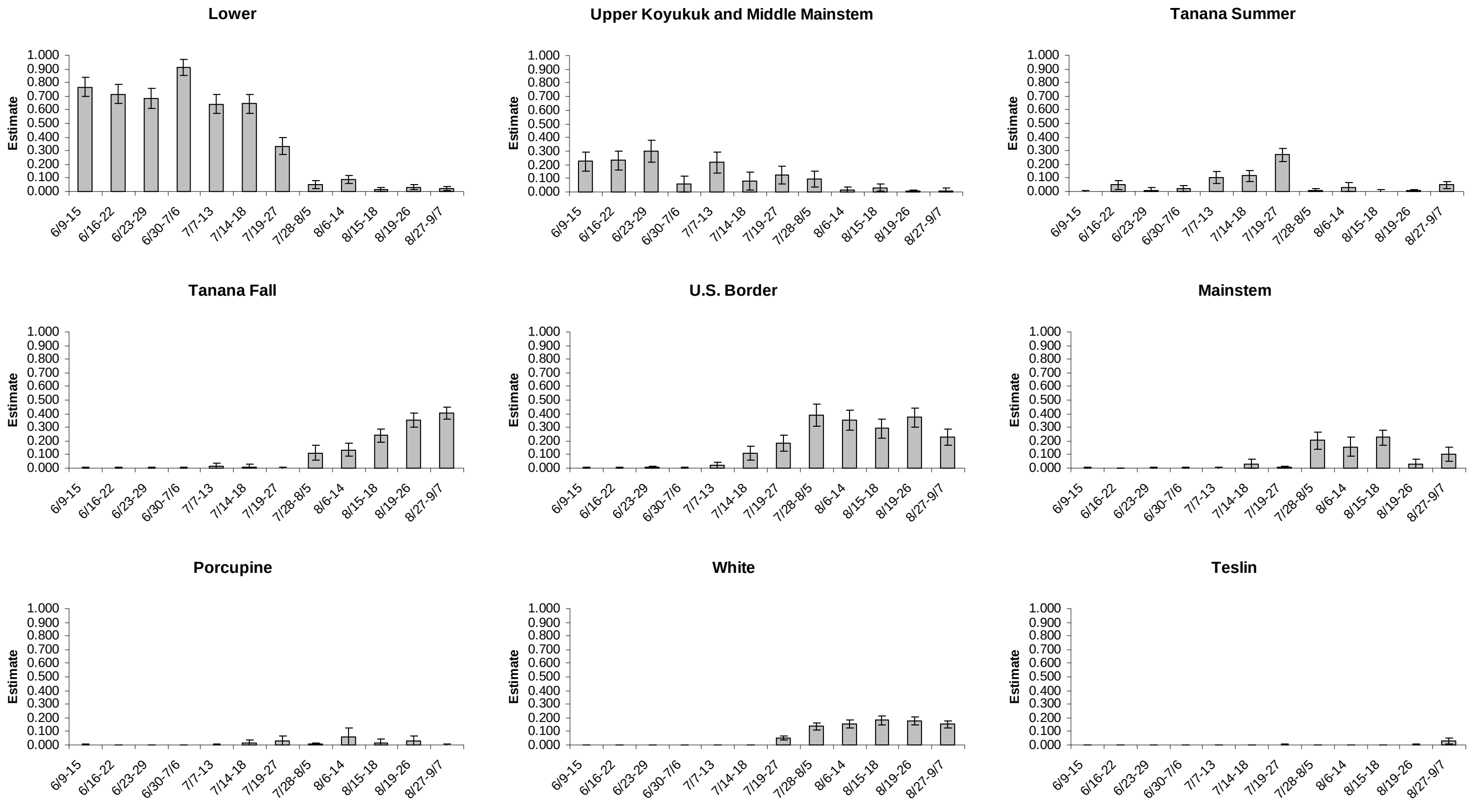


Figure 3. Pilot Station stock composition estimates for Yukon River chum salmon.

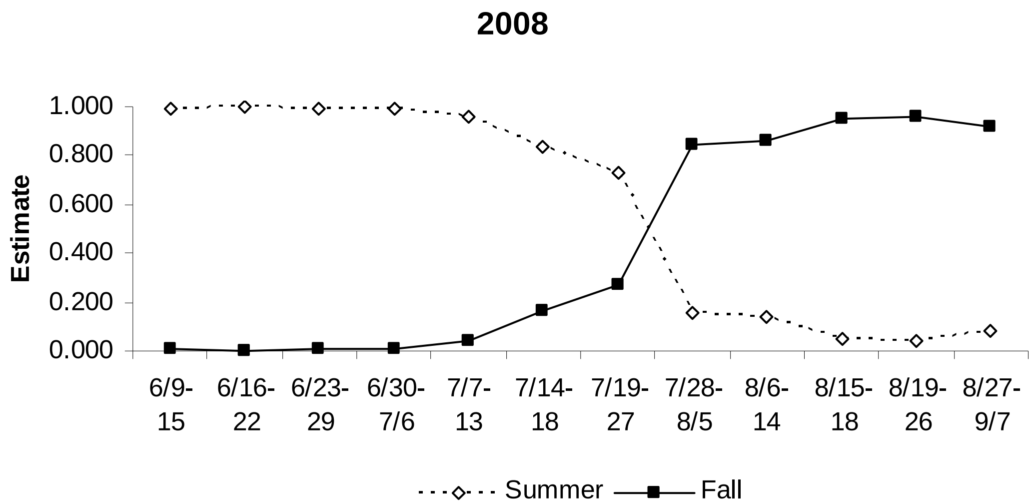
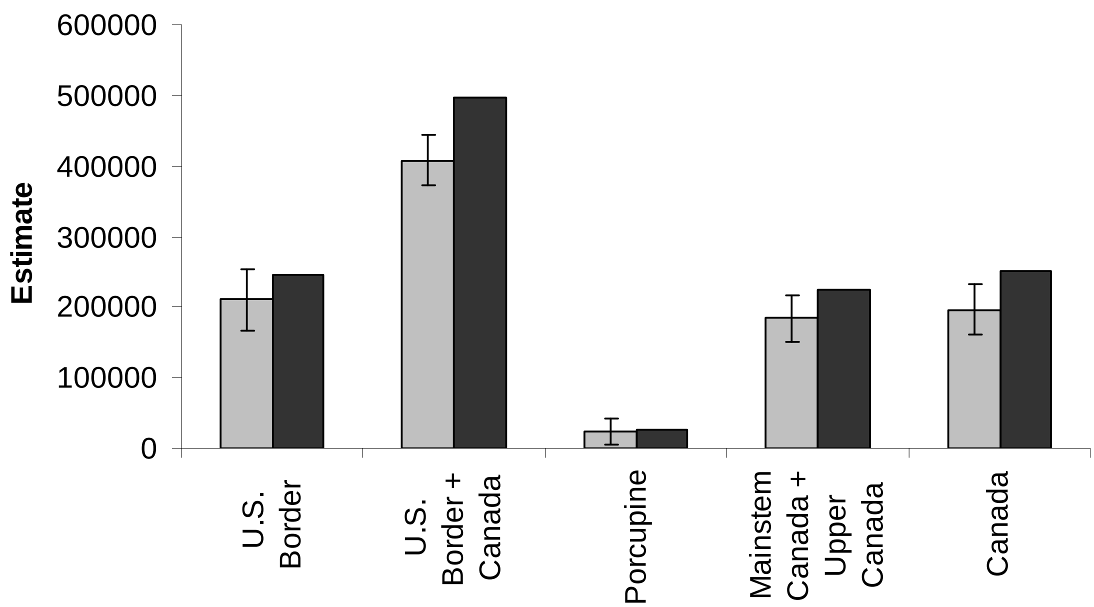


Figure 4. Comparisons of chum salmon stock abundance estimates from genetic/sonar (grey bars) and escapement/harvest (black bars) methods for 2008. The 95% confidence intervals are based on the variances of the genetic estimates only.



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