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Application of Mixed-Stock Analysis for Yukon River Fall Chum Salmon, 2009

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 test fishery in 2009; 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 4 time period, well after the start of the fall management season. Overall, the largest contribution to the 2009 fall chum salmon return came from the U.S. border region (38.5%). Contributions of fall chum salmon from other regions were: Tanana 25.7%, Canada mainstem 20.2%, Canada Porcupine 3.9%, White 11.1%, and Teslin 1.0%.

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 2009, the comparison was hampered by the discontinuation of the Tanana River mark and recapture and Chandalar River sonar projects.

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 2009 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 8, 2009 to September 7, 2009. 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 288 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 the Tanana and Chandalar rivers due to the discontinuation of the monitoring projects for these rivers. Escapements from the following projects were compiled: Sheenjek River sonar (JTC 2010), Canada border sonar (JTC 2010), and Fishing Branch weir with Old Crow harvest (JTC 2010). The latest five year average 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 2009, 11 strata of chum salmon were analyzed from the Pilot Station sonar test fishery. Only strata 1 – 5 were analyzed with a sample size of 288; the fall run had a weak return and samples sizes for the remaining strata ranged from 53 – 180. This precluded sampling proportional to the passage of fall chum salmon, so the stock composition estimates may not be representative of the fall run. Summer chum salmon comprised the majority of the harvest through July 27 and were detected with a 10% or greater contribution until the third week of August (Table 1). Fall chum salmon were first detected with a significant contribution in stratum five, a week and a half prior to the fall management season, and were in the majority by stratum eight (July 28 – August 4). 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 11.6 – 39.6% for strata 8 – 11 (Table 1), accounting for 38.5% of the total fall run (Table 2). The Tanana region was the next largest contributor at 25.7%, and overall, U.S. chum salmon accounted for 64.1% of the fall run (Table 2). The rest of the fall run was comprised of 20.2% mainstem, 3.9% Porcupine, 11.1% White, and 1.0% Teslin (Table 2). The contribution by mainstem was a new high for this region. All of the other contributions were 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 2.0 times larger than upper Canada, an increase 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 1,977 to 1,448,496 fish (Table 4). Escapement totals from the upriver monitoring projects ranged from 26,726 to 94,739 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 235,891 (Table 3, strata 7-11), but the genetic/sonar estimate indicated that only 195,838 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 has been observed since 2006 as a result of later fall run timing. 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 2009, the disagreement in abundance between the sonar and escapement estimates was unusually high and is believed to be related to difficulties encountered with the sonar operation (JTC 2010). In addition, the comparison of stock abundance estimates was hampered by the discontinuation of the Tanana River mark and recapture and Chandalar River sonar projects.

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Table 1. 2009 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 6/8 - 6/15 Estimate	SD	95% CI	
A.				
Lower	0.599	0.090	0.425	0.776
UppKoy+Main	0.385	0.091	0.205	0.562
Tanana Summer	0.004	0.011	0.000	0.037
Tanana Fall	0.006	0.012	0.000	0.042
U.S. Border	0.002	0.006	0.000	0.019
U.S. total	0.997	0.006	0.978	1.000
Porcupine	0.000	0.001	0.000	0.003
Mainstem	0.002	0.006	0.000	0.020
White	0.001	0.002	0.000	0.005
Teslin	0.000	0.001	0.000	0.003
Canada total	0.003	0.006	0.000	0.022
B.				
Summer	0.989	0.014	0.948	1.000
Fall	0.011	0.014	0.000	0.052
Middle	0.389	0.090	0.211	0.563
Canada Border	0.003	0.006	0.000	0.021
Upper Canada	0.001	0.002	0.000	0.007
Fall U.S.	0.008	0.013	0.000	0.047
U.S. Border + Canada	0.006	0.009	0.000	0.031
Mainstem + Upper Canada	0.003	0.006	0.000	0.021

Continued

Table 1. Continued.

Management Group	Stratum 2 6/16 - 6/22 Estimate	SD	95% CI	
A.				
Lower	0.933	0.055	0.801	0.995
UppKoy+Main	0.052	0.055	0.000	0.186
Tanana Summer	0.004	0.009	0.000	0.031
Tanana Fall	0.003	0.006	0.000	0.020
U.S. Border	0.004	0.007	0.000	0.023
U.S. total	0.996	0.006	0.979	1.000
Porcupine	0.000	0.002	0.000	0.004
Mainstem	0.003	0.005	0.000	0.020
White	0.001	0.001	0.000	0.004
Teslin	0.000	0.001	0.000	0.003
Canada total	0.004	0.006	0.000	0.021
B.				
Summer	0.990	0.010	0.965	1.000
Fall	0.010	0.010	0.000	0.035
Middle	0.056	0.055	0.000	0.190
Canada Border	0.003	0.006	0.000	0.020
Upper Canada	0.001	0.002	0.000	0.006
Fall U.S.	0.006	0.008	0.000	0.029
U.S. Border + Canada	0.007	0.009	0.000	0.030
Mainstem + Upper Canada	0.003	0.006	0.000	0.021

Continued

Table 1. Continued.

Management Group	Stratum 3 6/23 - 6/29 Estimate	SD	95% CI	
A.				
Lower	0.919	0.026	0.861	0.963
UppKoy+Main	0.010	0.018	0.000	0.064
Tanana Summer	0.066	0.023	0.023	0.114
Tanana Fall	0.002	0.004	0.000	0.014
U.S. Border	0.002	0.004	0.000	0.012
U.S. total	0.998	0.003	0.988	1.000
Porcupine	0.000	0.001	0.000	0.002
Mainstem	0.001	0.003	0.000	0.009
White	0.000	0.001	0.000	0.003
Teslin	0.000	0.001	0.000	0.003
Canada total	0.002	0.003	0.000	0.012
B.				
Summer	0.995	0.007	0.976	1.000
Fall	0.005	0.007	0.000	0.023
Middle	0.076	0.026	0.031	0.134
Canada Border	0.001	0.003	0.000	0.010
Upper Canada	0.001	0.002	0.000	0.005
Fall U.S.	0.003	0.006	0.000	0.020
U.S. Border + Canada	0.003	0.005	0.000	0.017
Mainstem + Upper Canada	0.002	0.003	0.000	0.012

Continued

Table 1. Continued.

Management Group	Stratum 4 6/30 - 7/6 Estimate	SD	95% CI	
A.				
Lower	0.840	0.070	0.687	0.939
UppKoy+Main	0.075	0.073	0.000	0.238
Tanana Summer	0.081	0.025	0.035	0.132
Tanana Fall	0.001	0.002	0.000	0.008
U.S. Border	0.001	0.003	0.000	0.011
U.S. total	0.998	0.003	0.989	1.000
Porcupine	0.000	0.001	0.000	0.002
Mainstem	0.001	0.002	0.000	0.007
White	0.000	0.001	0.000	0.003
Teslin	0.001	0.002	0.000	0.007
Canada total	0.002	0.003	0.000	0.011
B.				
Summer	0.996	0.005	0.982	1.000
Fall	0.004	0.005	0.000	0.018
Middle	0.156	0.070	0.057	0.309
Canada Border	0.001	0.002	0.000	0.007
Upper Canada	0.001	0.002	0.000	0.007
Fall U.S.	0.002	0.004	0.000	0.014
U.S. Border + Canada	0.003	0.004	0.000	0.016
Mainstem + Upper Canada	0.002	0.003	0.000	0.010

Continued

Table 1. Continued.

Management Group	Stratum 5 7/7 - 7/13 Estimate	SD	95% CI	
A.				
Lower	0.814	0.048	0.710	0.894
UppKoy+Main	0.045	0.046	0.000	0.158
Tanana Summer	0.107	0.032	0.047	0.173
Tanana Fall	0.002	0.005	0.000	0.018
U.S. Border	0.003	0.006	0.000	0.023
U.S. total	0.971	0.014	0.940	0.995
Porcupine	0.001	0.004	0.000	0.013
Mainstem	0.027	0.014	0.002	0.058
White	0.001	0.001	0.000	0.004
Teslin	0.000	0.002	0.000	0.004
Canada total	0.029	0.014	0.004	0.060
B.				
Summer	0.966	0.015	0.931	0.990
Fall	0.034	0.015	0.010	0.069
Middle	0.152	0.047	0.075	0.257
Canada Border	0.028	0.014	0.004	0.059
Upper Canada	0.001	0.002	0.000	0.007
Fall U.S.	0.005	0.008	0.000	0.029
U.S. Border + Canada	0.032	0.014	0.009	0.064
Mainstem + Upper Canada	0.028	0.014	0.002	0.059

Continued

Table 1. Continued.

Management Group	Stratum 6 7/14 - 7/18 Estimate	SD	95% CI	
A.				
Lower	0.778	0.073	0.619	0.903
UppKoy+Main	0.036	0.059	0.000	0.211
Tanana Summer	0.142	0.063	0.025	0.273
Tanana Fall	0.007	0.017	0.000	0.059
U.S. Border	0.031	0.040	0.000	0.135
U.S. total	0.995	0.009	0.968	1.000
Porcupine	0.001	0.004	0.000	0.007
Mainstem	0.003	0.007	0.000	0.022
White	0.001	0.004	0.000	0.011
Teslin	0.001	0.002	0.000	0.006
Canada total	0.005	0.009	0.000	0.031
B.				
Summer	0.957	0.043	0.848	1.000
Fall	0.043	0.043	0.000	0.152
Middle	0.178	0.074	0.057	0.348
Canada Border	0.003	0.008	0.000	0.025
Upper Canada	0.002	0.005	0.000	0.015
Fall U.S.	0.039	0.043	0.000	0.147
U.S. Border + Canada	0.036	0.040	0.000	0.142
Mainstem + Upper Canada	0.004	0.008	0.000	0.028

Continued

Table 1. Continued.

Management Group	Stratum 7 7/19 - 7/27 Estimate	SD	95% CI	
A.				
Lower	0.535	0.098	0.320	0.709
UppKoy+Main	0.106	0.099	0.000	0.346
Tanana Summer	0.218	0.069	0.091	0.362
Tanana Fall	0.003	0.009	0.000	0.028
U.S. Border	0.080	0.058	0.000	0.208
U.S. total	0.942	0.051	0.823	1.000
Porcupine	0.004	0.016	0.000	0.055
Mainstem	0.052	0.049	0.000	0.167
White	0.002	0.005	0.000	0.016
Teslin	0.001	0.003	0.000	0.008
Canada total	0.058	0.051	0.000	0.177
B.				
Summer	0.859	0.053	0.744	0.949
Fall	0.141	0.053	0.050	0.256
Middle	0.324	0.098	0.159	0.542
Canada Border	0.056	0.050	0.000	0.174
Upper Canada	0.002	0.006	0.000	0.020
Fall U.S.	0.083	0.059	0.000	0.211
U.S. Border + Canada	0.138	0.053	0.048	0.252
Mainstem + Upper Canada	0.054	0.049	0.000	0.171

Continued

Table 1. Continued.

Management Group	Stratum 8 7/28 - 8/4 Estimate	SD	95% CI	
A.				
Lower	0.277	0.057	0.172	0.390
UppKoy+Main	0.130	0.084	0.000	0.298
Tanana Summer	0.040	0.049	0.000	0.161
Tanana Fall	0.006	0.015	0.000	0.053
U.S. Border	0.269	0.103	0.086	0.487
U.S. total	0.722	0.086	0.555	0.895
Porcupine	0.151	0.089	0.000	0.316
Mainstem	0.048	0.065	0.000	0.219
White	0.078	0.033	0.026	0.152
Teslin	0.001	0.004	0.000	0.008
Canada total	0.278	0.086	0.104	0.445
B.				
Summer	0.447	0.076	0.299	0.595
Fall	0.553	0.076	0.405	0.701
Middle	0.170	0.076	0.021	0.325
Canada Border	0.199	0.086	0.020	0.366
Upper Canada	0.079	0.033	0.026	0.153
Fall U.S.	0.275	0.103	0.092	0.491
U.S. Border + Canada	0.547	0.076	0.399	0.693
Mainstem + Upper Canada	0.127	0.072	0.033	0.304

Continued

Table 1. Continued.

Management Group	Stratum 9 8/5 - 8/14 Estimate	SD	95% CI	
A.				
Lower	0.049	0.027	0.001	0.106
UppKoy+Main	0.041	0.041	0.000	0.141
Tanana Summer	0.031	0.032	0.000	0.105
Tanana Fall	0.197	0.050	0.105	0.301
U.S. Border	0.396	0.078	0.251	0.553
U.S. total	0.714	0.064	0.582	0.833
Porcupine	0.004	0.014	0.000	0.056
Mainstem	0.181	0.060	0.071	0.305
White	0.096	0.024	0.053	0.149
Teslin	0.004	0.009	0.000	0.033
Canada total	0.286	0.064	0.167	0.418
B.				
Summer	0.122	0.043	0.049	0.218
Fall	0.878	0.043	0.782	0.951
Middle	0.072	0.046	0.001	0.176
Canada Border	0.185	0.061	0.074	0.310
Upper Canada	0.101	0.026	0.056	0.158
Fall U.S.	0.592	0.074	0.445	0.734
U.S. Border + Canada	0.681	0.060	0.563	0.795
Mainstem + Upper Canada	0.282	0.064	0.163	0.411

Continued

Table 1. Continued.

Management Group	Stratum 10 8/15 - 8/24 Estimate	SD	95% CI	
A.				
Lower	0.046	0.029	0.003	0.115
UppKoy+Main	0.077	0.062	0.000	0.217
Tanana Summer	0.007	0.016	0.000	0.060
Tanana Fall	0.260	0.064	0.141	0.391
U.S. Border	0.312	0.088	0.153	0.492
U.S. total	0.701	0.081	0.537	0.852
Porcupine	0.004	0.014	0.000	0.045
Mainstem	0.189	0.076	0.052	0.348
White	0.105	0.035	0.046	0.184
Teslin	0.001	0.006	0.000	0.017
Canada total	0.299	0.081	0.148	0.462
B.				
Summer	0.129	0.061	0.031	0.267
Fall	0.871	0.061	0.733	0.968
Middle	0.083	0.061	0.000	0.221
Canada Border	0.193	0.077	0.054	0.353
Upper Canada	0.107	0.036	0.047	0.186
Fall U.S.	0.571	0.097	0.380	0.759
U.S. Border + Canada	0.611	0.071	0.467	0.744
Mainstem + Upper Canada	0.296	0.080	0.146	0.457

Continued

Table 1. Continued.

Management Group	Stratum 11 8/25 - 9/7 Estimate	SD	95% CI	
A.				
Lower	0.027	0.035	0.000	0.121
UppKoy+Main	0.031	0.050	0.000	0.177
Tanana Summer	0.006	0.018	0.000	0.063
Tanana Fall	0.561	0.112	0.331	0.769
U.S. Border	0.116	0.094	0.000	0.347
U.S. total	0.742	0.106	0.515	0.917
Porcupine	0.018	0.043	0.000	0.159
Mainstem	0.093	0.100	0.000	0.328
White	0.116	0.051	0.034	0.230
Teslin	0.030	0.042	0.000	0.146
Canada total	0.258	0.106	0.082	0.486
B.				
Summer	0.065	0.059	0.000	0.217
Fall	0.936	0.059	0.783	0.999
Middle	0.037	0.053	0.000	0.186
Canada Border	0.111	0.103	0.000	0.345
Upper Canada	0.146	0.064	0.045	0.291
Fall U.S.	0.678	0.114	0.435	0.873
U.S. Border + Canada	0.374	0.111	0.171	0.601
Mainstem + Upper Canada	0.239	0.104	0.074	0.466

Continued

Table 1. Continued.

Management Group	Overall 6/8 - 9/7 Estimate	SD	95% CI	
A.				
Lower	0.753	0.020	0.714	0.792
UppKoy+Main	0.053	0.019	0.015	0.090
Tanana Summer	0.065	0.012	0.042	0.088
Tanana Fall	0.033	0.005	0.023	0.043
U.S. Border	0.050	0.007	0.035	0.064
U.S. total	0.954	0.006	0.941	0.966
Porcupine	0.005	0.003	0.000	0.011
Mainstem	0.026	0.006	0.014	0.038
White	0.014	0.002	0.010	0.019
Teslin	0.001	0.001	0.000	0.004
Canada total	0.046	0.006	0.034	0.059
B.				
Summer	0.871	0.006	0.860	0.882
Fall	0.129	0.006	0.118	0.140
Middle	0.118	0.020	0.079	0.157
Canada Border	0.031	0.006	0.019	0.043
Upper Canada	0.016	0.003	0.010	0.021
Fall U.S.	0.083	0.007	0.068	0.097
U.S. Border + Canada	0.096	0.006	0.084	0.108
Mainstem + Upper Canada	0.041	0.006	0.029	0.054

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	0.255	0.385	0.144	0.044	0.164	0.008
2009	0.257	0.385	0.202	0.039	0.111	0.010
Average	0.263	0.391	0.159	0.045	0.133	0.009

Table 3. Preliminary Pilot Station sonar chum salmon passage estimates for 2009.

Year	Strata	Date	Passage
2009	Stratum 1	6/8 to 6/15	51,148
	Stratum 2	6/16 to 6/22	98,691
	Stratum 3	6/23 to 6/29	598,198
	Stratum 4	6/30 to 7/6	320,904
	Stratum 5	7/7 to 7/13	184,864
	Stratum 6	7/14 to 7/18	29,401
	Stratum 7	7/19 to 7/27	17,408
	Stratum 8	7/28 to 8/4	39,726
	Stratum 9	8/5 to 8/14	113,802
	Stratum 10	8/15 to 8/24	37,708
	Stratum 11	8/25 to 9/7	27,247
	Total	6/8 to 9/7	1,519,097

Table 4. Total abundance estimates derived from Pilot Station genetic stock composition and sonar chum salmon passage estimates for 2009. 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	2009 6/8 - 9/7 Estimate	SD	95% CI	
A.				
Lower	1,143,520	30,091	1,084,541	1,202,499
UppKoy+Main	79,798	28,774	23,400	136,196
Tanana Summer	99,108	17,755	64,307	133,908
Tanana Fall	50,242	7,577	35,392	65,092
U.S. Border	75,388	11,118	53,596	97,180
U.S. total	1,448,496	9,777	1,429,333	1,467,658
Porcupine	7,708	4,219	0	15,976
Mainstem	39,555	8,967	21,979	57,131
White	21,794	3,696	14,550	29,038
Teslin	1,977	1,920	0	5,740
Canada total	70,601	9,779	51,434	89,768
B.				
Summer	1,323,259	8,450	1,306,696	1,339,821
Fall	195,838	8,451	179,274	212,403
Middle	178,971	30,450	119,290	238,652
Canada Border	47,144	9,358	28,803	65,486
Upper Canada	23,679	4,132	15,580	31,778
Fall U.S.	125,405	11,392	103,076	147,734
U.S. Border + Canada	145,777	9,595	126,970	164,583
Mainstem + Upper Canada	63,023	9,501	44,401	81,644

Table 5. Preliminary chum salmon escapement project estimates for 2009.

Escapement project	Estimate
Sheenjek Sonar	54,126
Eagle Sonar Border Passage (Mainstem + Upper)	94,739
Fishing Branch weir + Old Crow harvest	26,726

Table 6. Subsistence harvest apportionments. Bold numbers indicate escapements estimated by the monitoring projects. Harvest estimates are averages from 2003-2007 (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 the river locations and multiplying these proportions by the harvest at the river locations.

		Abundance		**Proportion**		**Apportionment**	
Location	**Harvest**	M.S. CA	Porcupine	M.S. CA	Porcupine	M.S. CA	Porcupine
Chandalar (w/ Black)	1,496			0.0000	0.0000	0	0
Y6	18,341			0.0000	0.0000	0	0
Y5D Above Porcupine	13,159	**94,739**		1.0000	0.0000	13,159	0
Ft. Yukon	6,908	107,898	**26,726**	0.5716	0.1416	3,949	978
Y5D Below Chandalar	641	111,847	27,704	0.3222	0.0798	207	51
Y5C	1,845	112,053	27,755	0.3222	0.0798	594	147
Y5B	20,547	112,648	27,903	0.3222	0.0798	6,620	1,640
Y4	6,555	119,268	29,542	0.2215	0.0549	1,452	360
Y3	749	120,719	29,902	0.2215	0.0549	166	41
Y2 (Marshall only)	503	120,885	29,943	0.2215	0.0549	111	28
Total	70,744	120,997	29,971			26,258	3,245

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.

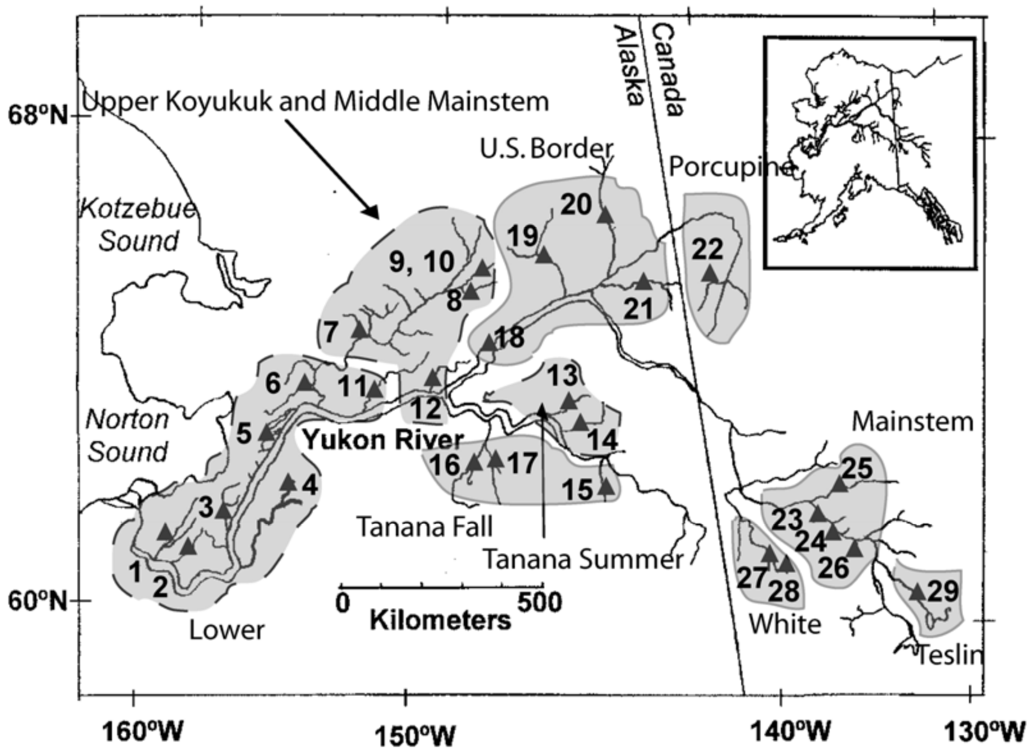


Figure 2. Pilot Station test fishery chum salmon stock composition estimates for 2009. Error bars represent one standard error.

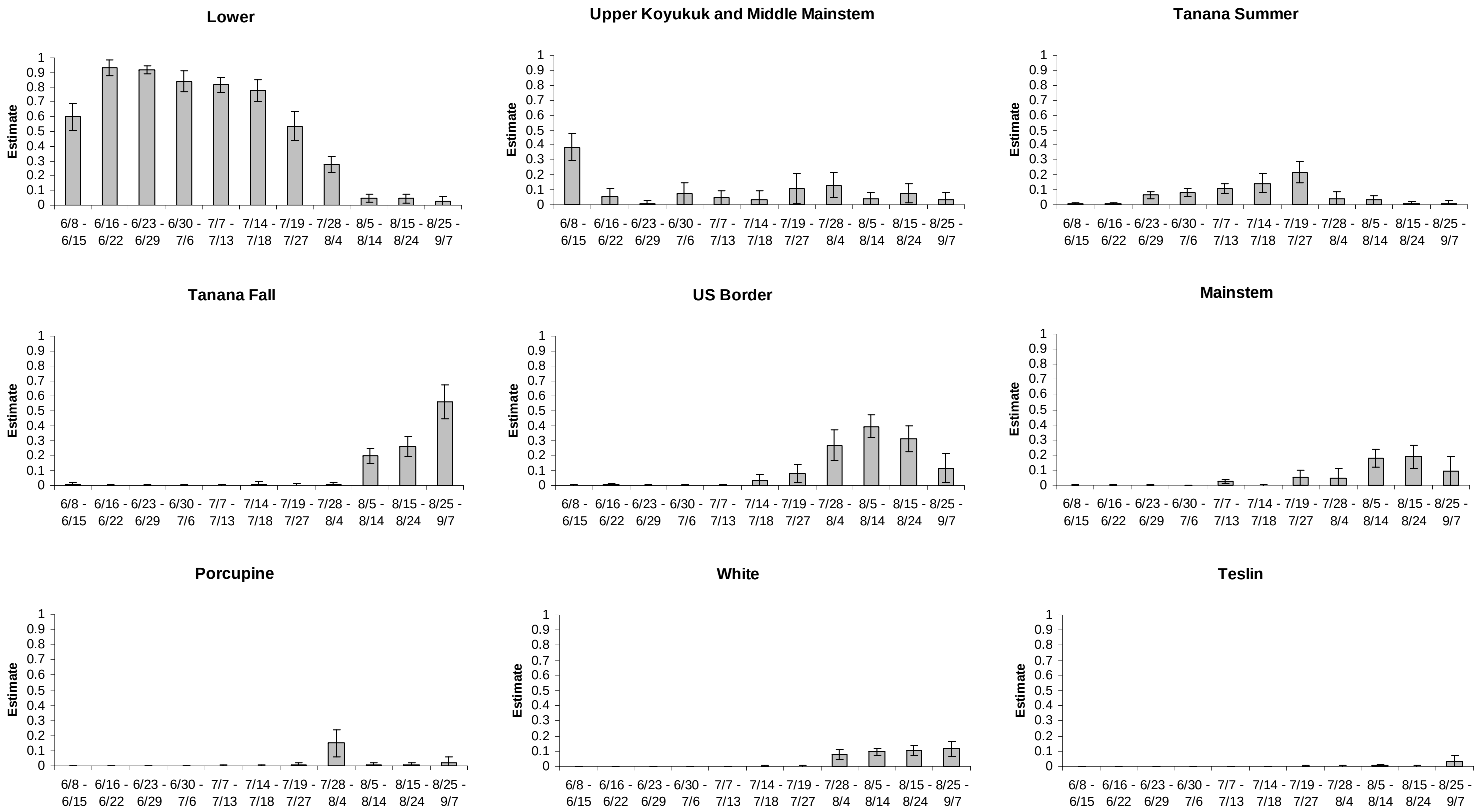


Figure 3. Pilot Station stock composition estimates for Yukon River chum salmon.

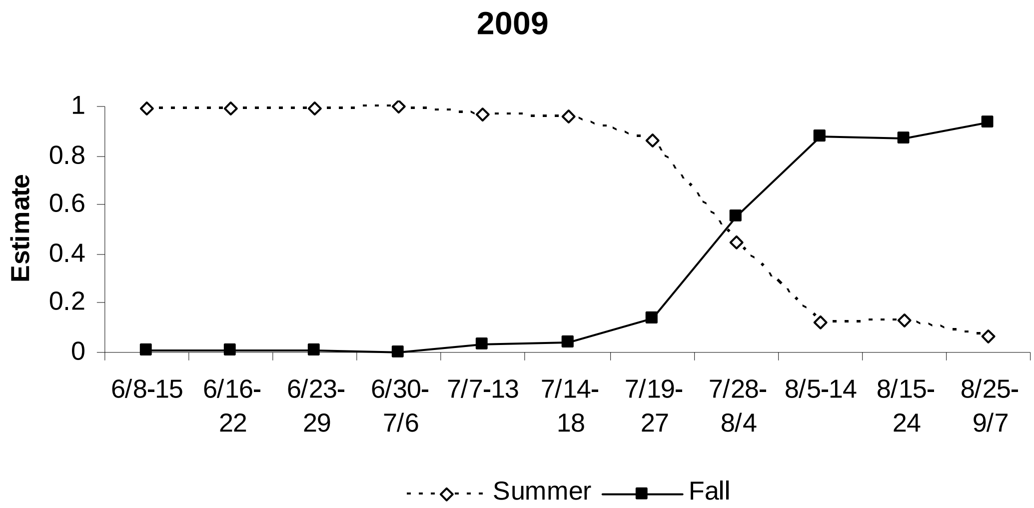
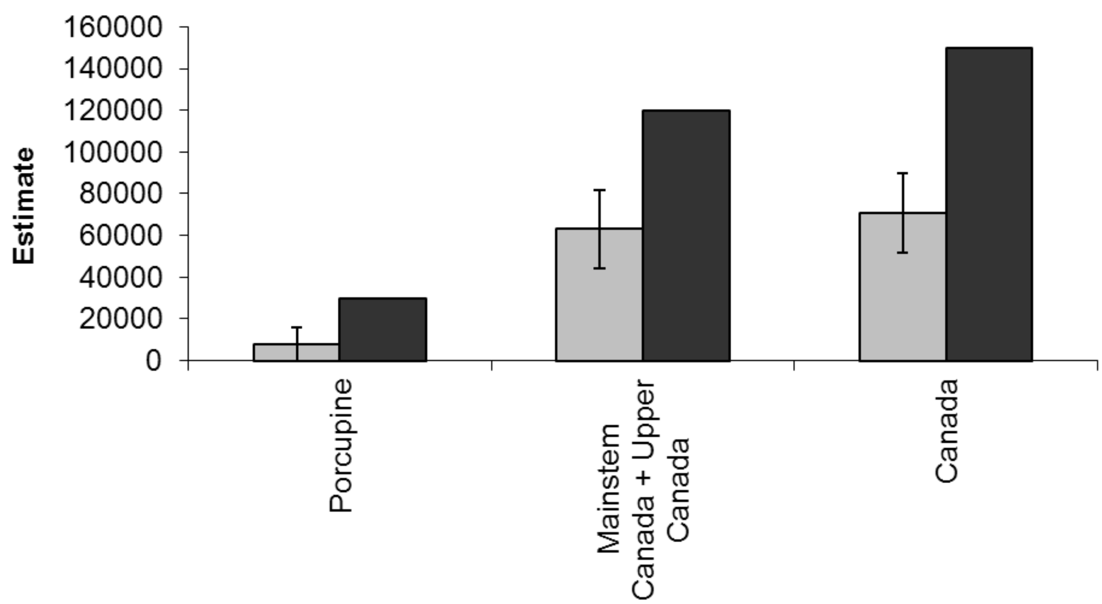


Figure 4. Comparisons of chum salmon stock abundance estimates from genetic/sonar (grey bars) and escapement/harvest (black bars) methods for 2009. The 95% confidence intervals are based on the variances of the genetic estimates only.



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