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Application of Mixed-Stock Analysis for Yukon River Chum Salmon, 2010

Annual Report for Study 10-205

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Table of Contents

List of Tables

List of Figures

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; this is a continuation of previous work by Flannery et al. (2007). For the 2010 season, 84% of the chum salmon were from summer run stocks and 16% from fall run stocks. Summer chum salmon comprised the majority of the harvest through July 27. Within the summer run component, apportionments were 77% to the lower river stock group and 23% to the middle river stock group (20% upper Koyukuk and middle mainstem, 3% Tanana). These genetic proportions for lower and middle summer chum salmon were in close agreement to proportions estimated from escapement projects.

Fall chum salmon did not outnumber summer chum salmon until the July 28 to August 10 time period, well after the start of the fall management season. Within the fall run component, the largest contribution of fall chum salmon came from the Tanana region (31%). Contributions of fall chum salmon from other regions were: U.S. Border 28%, Canada mainstem 15%, Canada Porcupine 10%, White 16%, and Teslin 0%. The abundance estimates for fall chum salmon derived from the genetic and sonar method continued to be less than those from the escapement and harvest method. 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.

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 2010 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. 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 laboratory. 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 estimates from the escapement/harvest method. No comparison was possible for fall chum salmon from the Tanana River due to the discontinuation of the Tanana River mark and recapture project. No absolute comparisons were possible for summer chum salmon because escapements are only partially monitored; however, the relative proportions of the summer stock groups estimated from genetics and the index tributaries monitored for escapement were compared. Escapements from the following projects were compiled: Anvik River sonar (JTC 2012), Gisasa River weir (JTC 2012), Henshaw Creek weir (JTC 2012), Chena River counting tower (JTC 2012), Salcha River counting tower (JTC 2012), Chandalar River sonar (JTC 2012), Sheenjek River sonar (JTC 2012), Canada border sonar (JTC 2012), and Fishing Branch weir with Old Crow harvest (JTC 2012). 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

Sampling occurred from June 11 through September 7 at Pilot Station, with July 19 designated by the Alaska Department of Fish and Game as the transition date between summer and fall management seasons. There were 10 strata of chum salmon analyzed for stock composition from the Pilot Station sonar test fishery. Strata 1 – 5 were from the summer management season, and strata 6 – 10 were from the fall management season. Strata 5, 8, and 10 were analyzed with sample sizes of 160, 229, and 278 due to low passage and catch. All other strata were analyzed with a sample size of 288 that was proportional to the passage of chum salmon.

For the 2010 season, 84% of the chum salmon were from summer run stocks and 16% from fall run stocks. Summer chum salmon comprised the majority of the harvest through July 27 (Table 1, Figure 2). Within the summer run component, apportionments were 77% to the lower river stock group and 23% to the middle river stock group (20% upper Koyukuk and middle mainstem, 3% Tanana; Table 2). These genetic proportions for lower and middle summer chum salmon were in close agreement to proportions estimated from escapement projects (Table 3). Lower river escapement (Anvik and Gisasa) accounted for 77% of the total, while middle river escapement (Henshaw, Chena, and Salcha) accounted for 23% (18% upper Koyukuk and middle mainstem, 5% Tanana).

Run timing differences among the summer stock groups were apparent. Lower river chum salmon were present throughout the run and were the largest contributing stock (≥66%) until the stratum six, July 19 – 27, whereupon their contribution dropped to 27% and the largest contribution then came from the middle river summer stock group (33%). Tanana River summer chum salmon, like their fall counterpart, had late migration timing.

Fall chum salmon were first detected with a significant contribution in stratum five (July 13 – 18), a week prior to the fall management season, and were in the majority by stratum seven (July 28 – August 10; Table 1, Figure 3). 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). Based on the fall season management start date of July 19 at Pilot Station, this represents a delayed summer to fall run transition and continues a trend observed since 2006 (Flannery et al. 2008). This may be caused by delayed fall run timing or by a production shift increasing late summer chum salmon returns. The delayed run transition and presence of summer chum salmon well into August are issues that should be accounted for by fishery managers in order to sustain overall production and biodiversity.

Fall chum salmon from the U.S. border region were the earliest to migrate, 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 sustained throughout the run, with contributions ranging from 12% – 27% for strata 6 – 10 (Table 1), accounting for 28% of the total fall run (Table 4). The Tanana region was the largest contributor at 31%, and overall, U.S. chum salmon accounted for 59% of the fall run (Table 4). The rest of the fall run was comprised of 15% mainstem, 10% Porcupine, and 16% White (Table 4). The contribution by Porcupine was a new high for this region. All of the other contributions were within reported ranges (Table 4). 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 1.6 times larger than upper Canada (Table 4).

Stock abundance estimates, the products of estimates of Pilot Station genetic stock composition (Table 1) and Pilot Station sonar passage (Table 5), ranged from 1,026 to 1,396,920 fish (Table 6). Escapement totals from the upriver monitoring projects for fall chum salmon ranged from 22,053 to 121,580 fish (Table 7). Subsistence harvests of fall chum salmon from the fishing districts, upriver of Pilot Station, were added to the fall escapement totals (Table 8). The genetic/sonar estimates of fall chum salmon 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 – September 7, was 340,856 (Table 5, strata 6 – 10), but genetics estimated that only 255,755 of these fish were actually fall chum salmon. The total fall chum salmon passage for the entire season, June 11 – September 7, was estimated by genetics and sonar at 271,036 fish (Table 6).

The level of agreement between the genetic/sonar and escapement/harvest methods for fall chum salmon 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. Additional experimental error (e.g. incomplete sonar coverage) by all of the monitoring projects will also affect the level of agreement.

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Table 1. 2010 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 6/11 – 6/21 Estimate	SD	95% CI	
A.				
Lower	0.691	0.073	0.554	0.845
UppKoy+Main	0.302	0.074	0.141	0.440
Tanana Summer	0.003	0.007	0.000	0.025
Tanana Fall	0.001	0.003	0.000	0.009
U.S. Border	0.002	0.004	0.000	0.013
U.S. total	0.998	0.003	0.990	1.000
Porcupine	0.000	0.001	0.000	0.003
Mainstem	0.001	0.002	0.000	0.007
White	0.000	0.001	0.000	0.003
Teslin	0.000	0.001	0.000	0.002
Canada total	0.002	0.003	0.000	0.010
B.				
Summer	0.996	0.006	0.980	1.000
Fall	0.004	0.006	0.000	0.020
Middle	0.305	0.073	0.149	0.442
Canada Border	0.001	0.002	0.000	0.008
Upper Canada	0.001	0.001	0.000	0.005
Fall U.S.	0.001	0.003	0.000	0.009
U.S. Border + Canada	0.003	0.005	0.000	0.017
Mainstem + Upper Canada	0.003	0.005	0.000	0.017

Continued

Table 1. Continued.

Management Group	Stratum 2 6/22 – 6/28 Estimate	SD	95% CI	
A.				
Lower	0.852	0.068	0.712	0.969
UppKoy+Main	0.125	0.072	0.000	0.273
Tanana Summer	0.017	0.019	0.000	0.063
Tanana Fall	0.002	0.004	0.000	0.014
U.S. Border	0.001	0.002	0.000	0.006
U.S. total	0.997	0.005	0.983	1.000
Porcupine	0.000	0.001	0.000	0.002
Mainstem	0.002	0.004	0.000	0.016
White	0.000	0.001	0.000	0.003
Teslin	0.000	0.001	0.000	0.002
Canada total	0.003	0.005	0.000	0.017
B.				
Summer	0.995	0.006	0.977	1.000
Fall	0.005	0.006	0.000	0.023
Middle	0.142	0.068	0.025	0.285
Canada Border	0.002	0.004	0.000	0.016
Upper Canada	0.001	0.001	0.000	0.004
Fall U.S.	0.002	0.004	0.000	0.016
U.S. Border + Canada	0.003	0.005	0.000	0.018
Mainstem + Upper Canada	0.003	0.005	0.000	0.017

Continued

Table 1. Continued.

Management Group	Stratum 3 6/29 – 7/5 Estimate	SD	95% CI	
A.				
Lower	0.733	0.055	0.623	0.838
UppKoy+Main	0.248	0.056	0.142	0.359
Tanana Summer	0.001	0.004	0.000	0.013
Tanana Fall	0.001	0.003	0.000	0.009
U.S. Border	0.014	0.012	0.000	0.043
U.S. total	0.998	0.003	0.988	1.000
Porcupine	0.000	0.002	0.000	0.004
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	0.002
Canada total	0.002	0.003	0.000	0.012
B.				
Summer	0.983	0.013	0.953	0.999
Fall	0.017	0.013	0.000	0.047
Middle	0.249	0.056	0.144	0.361
Canada Border	0.002	0.003	0.000	0.011
Upper Canada	0.001	0.002	0.000	0.005
Fall U.S.	0.015	0.012	0.000	0.044
U.S. Border + Canada	0.016	0.012	0.000	0.045
Mainstem + Upper Canada	0.002	0.003	0.000	0.011

Continued

Table 1. Continued.

Management Group	Stratum 4 7/6 – 7/12 Estimate	SD	95% CI	
A.				
Lower	0.895	0.035	0.814	0.948
UppKoy+Main	0.021	0.029	0.000	0.095
Tanana Summer	0.079	0.021	0.041	0.124
Tanana Fall	0.001	0.003	0.000	0.009
U.S. Border	0.002	0.005	0.000	0.017
U.S. total	0.998	0.004	0.987	1.000
Porcupine	0.000	0.001	0.000	0.003
Mainstem	0.001	0.003	0.000	0.011
White	0.000	0.001	0.000	0.004
Teslin	0.000	0.001	0.000	0.002
Canada total	0.002	0.004	0.000	0.013
B.				
Summer	0.995	0.007	0.976	1.000
Fall	0.005	0.007	0.000	0.024
Middle	0.099	0.035	0.047	0.182
Canada Border	0.002	0.003	0.000	0.012
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	0.004	0.006	0.000	0.021
Mainstem + Upper Canada	0.002	0.003	0.000	0.012

Continued

Table 1. Continued.

Management Group	Stratum 5 7/13 – 7/18 Estimate	SD	95% CI	
A.				
Lower	0.664	0.060	0.534	0.769
UppKoy+Main	0.116	0.067	0.000	0.263
Tanana Summer	0.142	0.051	0.050	0.249
Tanana Fall	0.013	0.019	0.000	0.066
U.S. Border	0.043	0.039	0.000	0.134
U.S. total	0.978	0.025	0.913	1.000
Porcupine	0.012	0.020	0.000	0.069
Mainstem	0.008	0.016	0.000	0.058
White	0.003	0.007	0.000	0.024
Teslin	0.000	0.002	0.000	0.003
Canada total	0.022	0.025	0.000	0.086
B.				
Summer	0.922	0.038	0.837	0.984
Fall	0.078	0.038	0.015	0.163
Middle	0.258	0.064	0.144	0.394
Canada Border	0.020	0.025	0.000	0.084
Upper Canada	0.003	0.007	0.000	0.025
Fall U.S.	0.056	0.041	0.000	0.149
U.S. Border + Canada	0.065	0.038	0.004	0.152
Mainstem + Upper Canada	0.010	0.017	0.000	0.062

Continued

Table 1. Continued.

Management Group	Stratum 6 7/19 – 7/27			
	Estimate	SD	95% CI	
A.				
Lower	0.265	0.039	0.190	0.344
UppKoy+Main	0.215	0.061	0.094	0.337
Tanana Summer	0.115	0.045	0.031	0.209
Tanana Fall	0.035	0.028	0.000	0.097
U.S. Border	0.215	0.049	0.122	0.314
U.S. total	0.846	0.041	0.756	0.917
Porcupine	0.069	0.033	0.000	0.137
Mainstem	0.028	0.031	0.000	0.105
White	0.057	0.016	0.030	0.091
Teslin	0.000	0.001	0.000	0.002
Canada total	0.154	0.041	0.082	0.244
B.				
Summer	0.595	0.043	0.507	0.679
Fall	0.405	0.043	0.321	0.493
Middle	0.330	0.052	0.231	0.434
Canada Border	0.097	0.039	0.031	0.184
Upper Canada	0.057	0.016	0.030	0.091
Fall U.S.	0.250	0.054	0.146	0.358
U.S. Border + Canada	0.370	0.044	0.287	0.457
Mainstem + Upper Canada	0.085	0.035	0.036	0.166

Continued

Table 1. Continued.

Management Group	Stratum 7 7/28 – 8/10 Estimate	SD	95% CI	
A.				
Lower	0.197	0.035	0.132	0.270
UppKoy+Main	0.078	0.047	0.000	0.175
Tanana Summer	0.030	0.036	0.000	0.116
Tanana Fall	0.137	0.040	0.062	0.215
U.S. Border	0.160	0.063	0.050	0.293
U.S. total	0.601	0.059	0.487	0.720
Porcupine	0.014	0.029	0.000	0.103
Mainstem	0.225	0.057	0.112	0.336
White	0.159	0.025	0.113	0.211
Teslin	0.001	0.002	0.000	0.007
Canada total	0.399	0.059	0.280	0.513
B.				
Summer	0.305	0.044	0.222	0.392
Fall	0.695	0.044	0.608	0.778
Middle	0.107	0.047	0.019	0.205
Canada Border	0.239	0.058	0.126	0.350
Upper Canada	0.160	0.025	0.113	0.211
Fall U.S.	0.296	0.070	0.167	0.437
U.S. Border + Canada	0.558	0.044	0.473	0.643
Mainstem + Upper Canada	0.385	0.059	0.266	0.500

Continued

Table 1. Continued.

Management Group	Stratum 8 8/11 – 8/17 Estimate	SD	95% CI	
A.				
Lower	0.070	0.022	0.033	0.117
UppKoy+Main	0.006	0.013	0.000	0.047
Tanana Summer	0.001	0.004	0.000	0.014
Tanana Fall	0.262	0.044	0.179	0.354
U.S. Border	0.270	0.062	0.152	0.395
U.S. total	0.609	0.057	0.497	0.718
Porcupine	0.055	0.055	0.000	0.173
Mainstem	0.139	0.048	0.051	0.239
White	0.197	0.028	0.144	0.255
Teslin	0.001	0.003	0.000	0.009
Canada total	0.391	0.057	0.282	0.503
B.				
Summer	0.077	0.025	0.037	0.132
Fall	0.923	0.025	0.868	0.963
Middle	0.007	0.014	0.000	0.049
Canada Border	0.193	0.054	0.095	0.301
Upper Canada	0.197	0.028	0.145	0.256
Fall U.S.	0.532	0.059	0.415	0.646
U.S. Border + Canada	0.661	0.047	0.565	0.748
Mainstem + Upper Canada	0.336	0.054	0.236	0.447

Continued

Table 1. Continued.

Management Group	Stratum 9 8/18 – 8/22 Estimate	SD	95% CI	
A.				
Lower	0.018	0.014	0.000	0.051
UppKoy+Main	0.048	0.033	0.000	0.119
Tanana Summer	0.007	0.013	0.000	0.046
Tanana Fall	0.361	0.045	0.274	0.450
U.S. Border	0.198	0.050	0.106	0.301
U.S. total	0.632	0.048	0.539	0.724
Porcupine	0.147	0.039	0.073	0.227
Mainstem	0.083	0.041	0.004	0.170
White	0.138	0.023	0.096	0.186
Teslin	0.000	0.002	0.000	0.004
Canada total	0.368	0.048	0.276	0.461
B.				
Summer	0.073	0.032	0.019	0.143
Fall	0.927	0.032	0.857	0.981
Middle	0.055	0.033	0.001	0.127
Canada Border	0.230	0.046	0.142	0.323
Upper Canada	0.138	0.023	0.096	0.187
Fall U.S.	0.559	0.051	0.458	0.660
U.S. Border + Canada	0.566	0.044	0.479	0.650
Mainstem + Upper Canada	0.221	0.044	0.139	0.314

Continued

Table 1. Continued.

Management Group	Stratum 10 8/23 – 9/7 Estimate	SD	95% CI	
A.				
Lower	0.064	0.020	0.028	0.107
UppKoy+Main	0.011	0.016	0.000	0.055
Tanana Summer	0.001	0.004	0.000	0.014
Tanana Fall	0.475	0.041	0.395	0.554
U.S. Border	0.119	0.037	0.053	0.195
U.S. total	0.670	0.045	0.579	0.755
Porcupine	0.001	0.003	0.000	0.007
Mainstem	0.191	0.043	0.111	0.280
White	0.126	0.022	0.086	0.170
Teslin	0.012	0.014	0.000	0.048
Canada total	0.330	0.045	0.245	0.421
B.				
Summer	0.077	0.022	0.039	0.124
Fall	0.923	0.022	0.876	0.960
Middle	0.012	0.017	0.000	0.058
Canada Border	0.192	0.043	0.112	0.280
Upper Canada	0.138	0.026	0.092	0.193
Fall U.S.	0.593	0.047	0.498	0.682
U.S. Border + Canada	0.449	0.040	0.372	0.527
Mainstem + Upper Canada	0.329	0.045	0.245	0.420

Continued

Table 1. Continued.

Management Group	Overall 6/11 – 9/7 Estimate	SD	95% CI	
A.				
Lower	0.647	0.026	0.596	0.697
UppKoy+Main	0.166	0.027	0.113	0.219
Tanana Summer	0.025	0.006	0.012	0.037
Tanana Fall	0.051	0.004	0.042	0.059
U.S. Border	0.046	0.006	0.034	0.058
U.S. total	0.934	0.005	0.924	0.944
Porcupine	0.016	0.004	0.009	0.024
Mainstem	0.024	0.004	0.015	0.032
White	0.026	0.002	0.022	0.030
Teslin	0.001	0.001	0.000	0.002
Canada total	0.066	0.005	0.056	0.076
B.				
Summer	0.838	0.005	0.827	0.848
Fall	0.162	0.005	0.152	0.173
Middle	0.190	0.026	0.139	0.242
Canada Border	0.040	0.005	0.030	0.049
Upper Canada	0.027	0.002	0.022	0.031
Fall U.S.	0.096	0.007	0.083	0.109
U.S. Border + Canada	0.112	0.006	0.101	0.123
Mainstem + Upper Canada	0.050	0.005	0.041	0.059

Table 2. Estimates of summer chum salmon stock proportions for 2010. Proportions were calculated by dividing the region proportion by the total summer contribution in Table 1.

Year	Lower	UppKoy+Main	Tanana
2008	0.75	0.19	0.06
2009	0.86	0.06	0.07
2010	0.77	0.20	0.03
Average	0.80	0.15	0.05

Table 3. Preliminary summer chum salmon escapement project estimates for 2010.

Escapement project	Estimate
Anvik sonar	396,173
Gisasa weir	47,669
Henshaw weir	105,398
Chena tower	7,560
Salcha tower	22,183

Table 4. Estimates of fall chum salmon stock proportions for 2010. Proportions were calculated by dividing the region proportion by the total fall contribution in Table 1.

Year	Tanana	U.S. Border	Mainstem	Porcupine	White	Teslin
2004	0.37	0.31	0.12	0.08	0.12	0.00
2005	0.21	0.49	0.12	0.05	0.11	0.02
2006	0.21	0.44	0.19	0.03	0.13	0.01
2007	0.28	0.33	0.18	0.03	0.17	0.00
2008	0.25	0.39	0.14	0.04	0.16	0.01
2009	0.26	0.38	0.20	0.04	0.11	0.01
2010	0.31	0.28	0.15	0.10	0.16	0.00
Average	0.27	0.38	0.16	0.05	0.14	0.01

Table 5. Preliminary Pilot Station sonar chum salmon passage estimates for 2010.

Year	Season	Strata	Date	Passage
2010	Summer	Stratum 1	6/11 to 6/21	245,314
	Summer	Stratum 2	6/22 to 6/28	444,768
	Summer	Stratum 3	6/29 to 7/5	435,826
	Summer	Stratum 4	7/6 to 7/12	152,578
	Summer	Stratum 5	7/13 to 7/18	48,614
	Fall	Stratum 6	7/19 to 7/27	93,237
	Fall	Stratum 7	7/28 to 8/10	48,234
	Fall	Stratum 8	8/11 to 8/17	45,870
	Fall	Stratum 9	8/18 to 8/22	111,319
	Fall	Stratum 10	8/23 to 9/7	42,196
		Total	6/11 to 9/7	1,667,956

Table 6. Total abundance estimates derived from Pilot Station genetic stock composition and sonar chum salmon passage estimates for 2010. 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	2010 6/11 – 9/7 Estimate	SD	95% CI	
A.				
Lower	1,078,980	43,068	994,566	1,163,394
UppKoy+Main	276,113	45,077	187,762	364,463
Tanana Summer	41,005	10,835	19,768	62,242
Tanana Fall	84,451	6,985	70,760	98,142
U.S. Border	76,652	10,240	56,581	96,724
U.S. total	1,557,647	8,373	1,541,236	1,574,058
Porcupine	26,955	6,254	14,698	39,211
Mainstem	39,448	7,149	25,436	53,459
White	43,324	3,659	36,152	50,496
Teslin	1,026	964	0	2,914
Canada total	110,309	8,373	93,898	126,720
B.				
Summer	1,396,920	8,990	1,379,301	1,414,540
Fall	271,036	8,986	253,423	288,649
Middle	317,208	43,732	231,493	402,922
Canada Border	66,286	8,031	50,546	82,026
Upper Canada	44,241	3,774	36,844	51,638
Fall U.S.	160,608	10,903	139,239	181,977
U.S. Border + Canada	186,618	9,601	167,799	205,437
Mainstem + Upper Canada	83,902	7,811	68,593	99,210

Table 7. Preliminary fall chum salmon escapement project estimates for 2010.

Escapement project	Estimate
Chandalar sonar	157,998
Sheenjek sonar	22,053
Eagle Sonar Border Passage (Mainstem + Upper)	121,580
Fishing Branch weir + Old Crow harvest (expanded count)	28,044

Table 8. Subsistence harvest apportionments for 2010. 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	Sheenjek	Chandalar	M.S. CA	Porcupine	Sheenjek	Chandalar	M.S. CA	Porcupine	Sheenjek	Chandalar
Chandalar (w/ Black)	1,496				**157,998**	0.0000	0.0000	0.0000	1.0000	0	0	0	1,496
Y6	18,341					0.0000	0.0000	0.0000	0.0000	0	0	0	0
Y5D Above Porcupine	13,159	**121,580**				1.0000	0.0000	0.0000	0.0000	13,159	0	0	0
Ft. Yukon	6,908	134,739	**15,773**	**22,053**		0.5716	0.1416	0.1278	0.0000	5,394	631	883	0
Y5D Below Chandalar	641	140,133	16,404	22,936	159,494	0.3222	0.0798	0.0677	0.4705	265	31	43	302
Y5C	1,845	140,398	16,435	22,979	159,796	0.3222	0.0798	0.0677	0.4705	763	89	125	868
Y5B	20,547	141,161	16,525	23,104	160,664	0.3222	0.0798	0.0677	0.4705	8,494	994	1,390	9,668
Y4	6,555	149,655	17,519	24,494	170,332	0.2215	0.0549	0.0489	0.3398	1,957	229	320	2,227
Y3	749	151,612	17,748	24,815	172,559	0.2215	0.0549	0.0489	0.3398	224	26	37	254
Y2 (Marshall only)	503	151,835	17,774	24,851	172,813	0.2215	0.0549	0.0489	0.3398	150	18	25	171
Total	70,744	151,985	17,792	24,876	172,984					30,405	2,019	2,823	14,986

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.

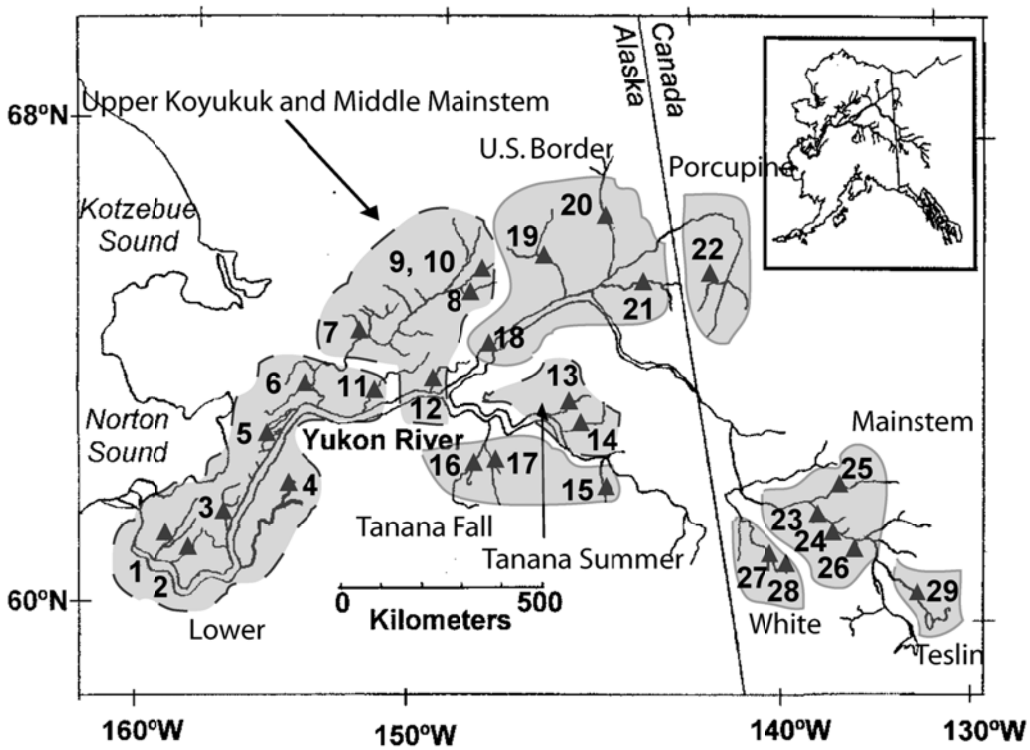


Figure 2. Pilot Station test fishery chum salmon stock composition estimates for 2010. Error bars represent one standard error.

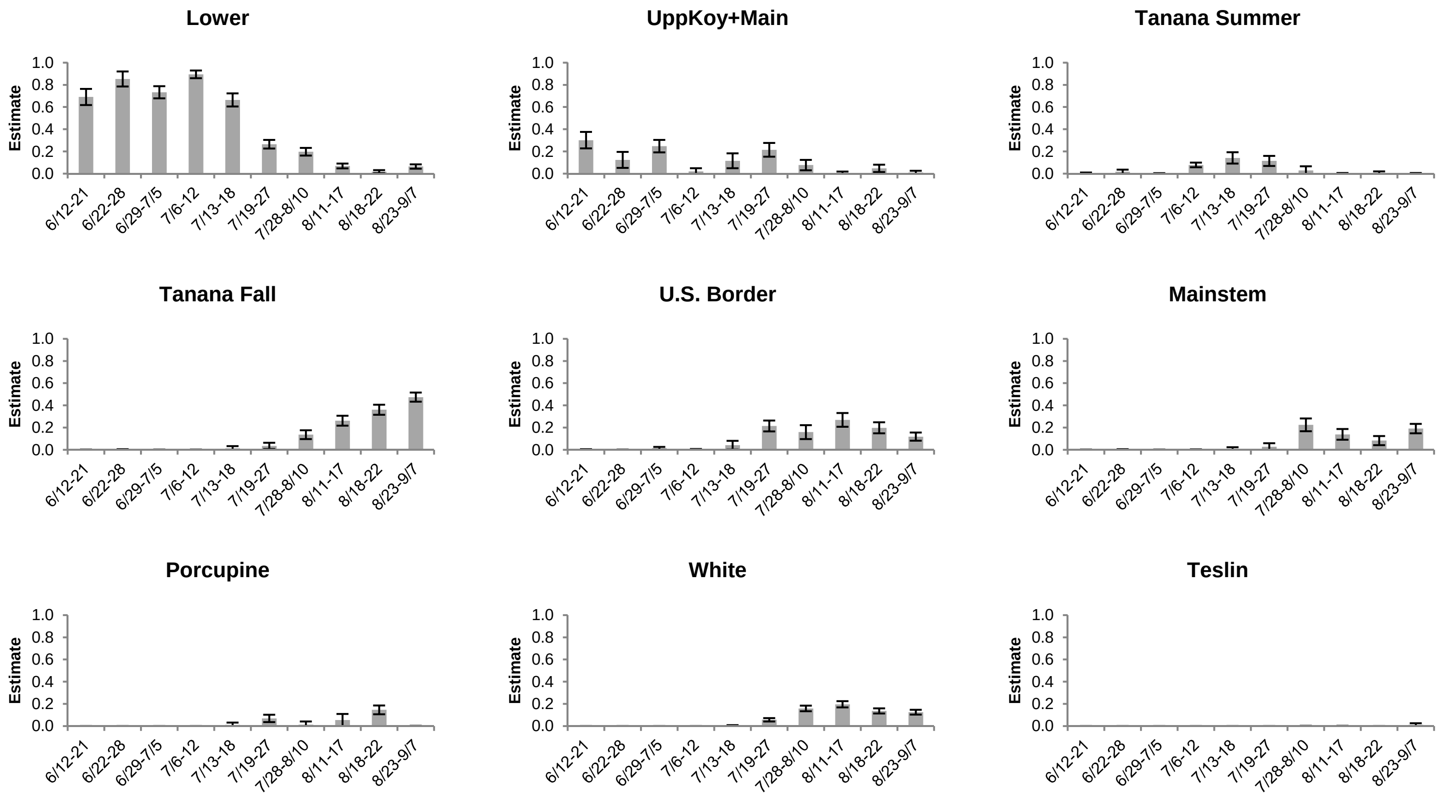


Figure 3. 2010 Pilot Station stock composition estimates for Yukon River chum salmon.

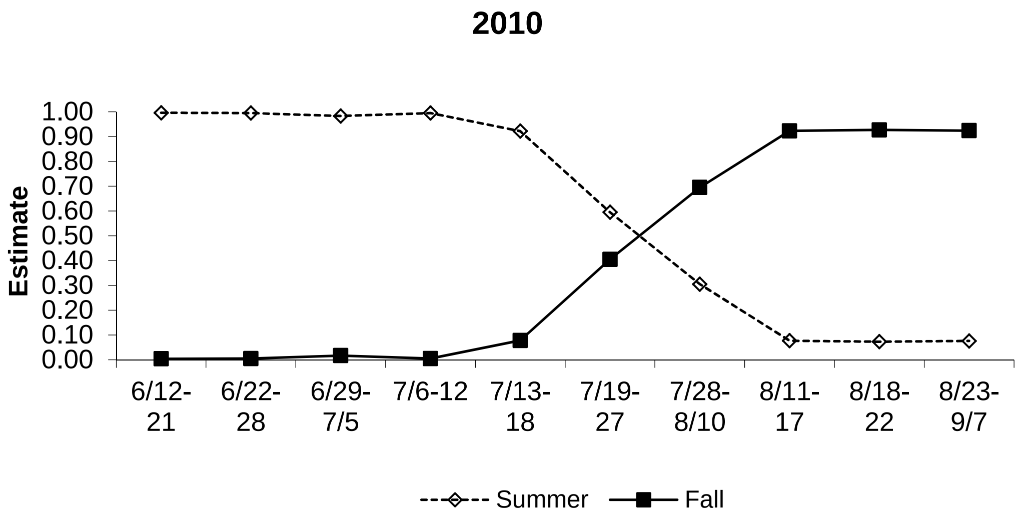
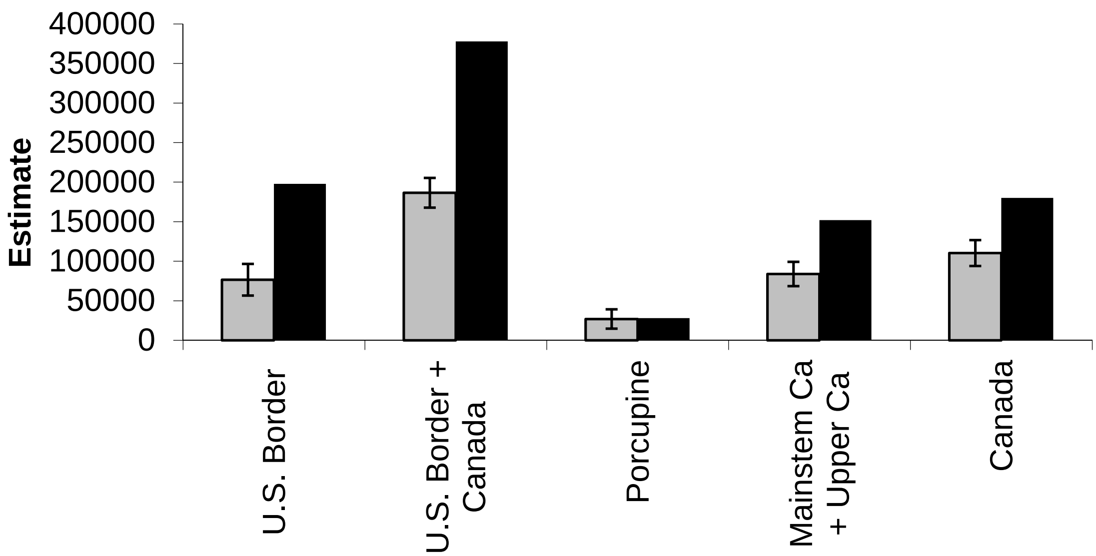


Figure 4. Comparisons of chum salmon stock abundance estimates from genetic/sonar (grey bars) and escapement/harvest (black bars) methods for 2010. The 95% confidence intervals are based on the variances of the genetic estimates only.



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