Stock Structure and In-Season Mixed-Stock Analysis of Yukon River Chum Salmon

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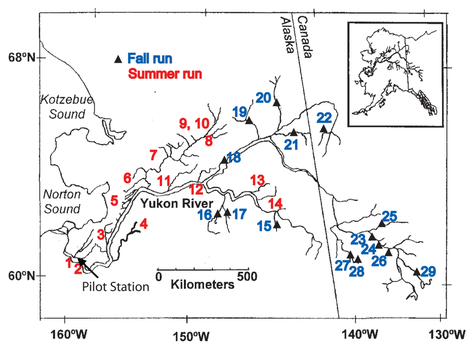
1. Introduction

Chum salmon spawn throughout the Yukon River and enter in two distinct runs, summer and fall. The management of the Yukon River chum salmon fishery is difficult because of the need to address a variety of complex issues, such as meeting escapements, while still providing harvest opportunities in a mixed-stock and mixed-species fishery. The fall run is of special concern because of additional Pacific Salmon Treaty obligations requiring the conservation and equitable sharing of the resource with Canada. Knowledge of chum salmon origin as they enter the river would assist in addressing these issues. Mixed-stock analysis (MSA) using genetic data has been established as an efficient and effective method for determining stock origin. Therefore, we have initiated this project to develop an extensive microsatellite baseline for in-season Yukon River chum salmon MSA.

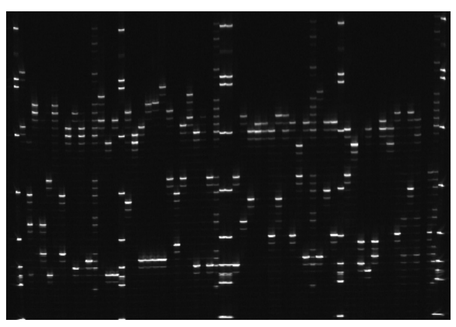
2. Methods

Baseline Development

+ Over 5000 samples were collected from 15 summer and 14 fall Yukon River chum salmon populations.



+ Samples were genotyped at 21 microsatellite loci.



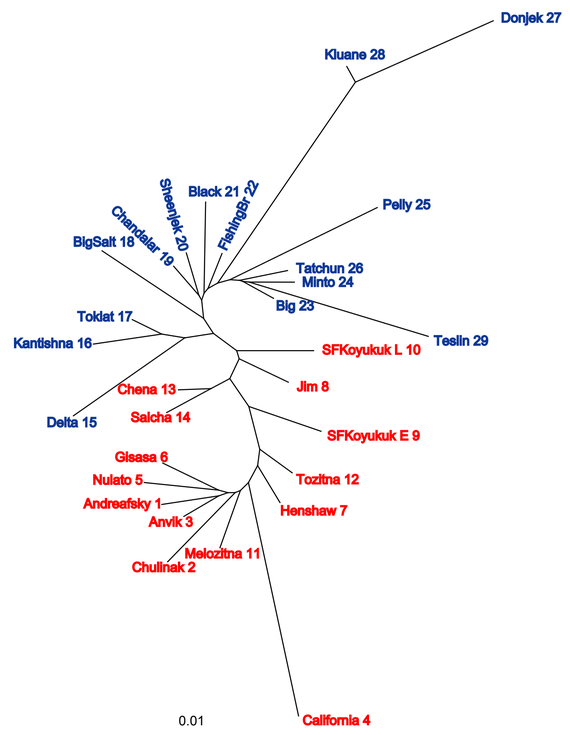
Baseline Application

+ Chum salmon from the Pilot Station sonar test fishery (see above map) were sampled proportional to daily passage from July 1 to August 31. Samples were stratified by date and genotyped at the 12 most informative loci. Stock compositions were estimated using Bayes (Pella and Masuda 2001) and reported by email within 24-48 hours of receiving the samples.

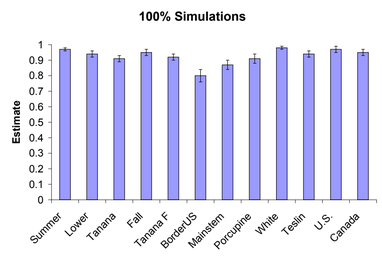
+ Stock abundance estimates, derived from the product of stock proportion and sonar abundance, were compared to escapement and harvest data.

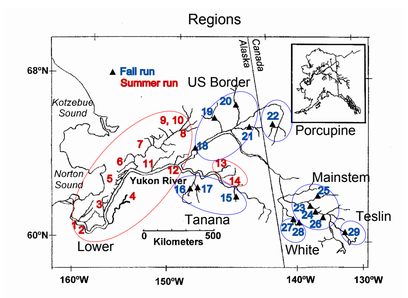
3. Results - Baseline Development

+ Neighbor-joining tree revealed a spatial and temporal component to the distribution of genetic diversity. Summer stocks are distinct from fall stocks, with further subdivision within run time.



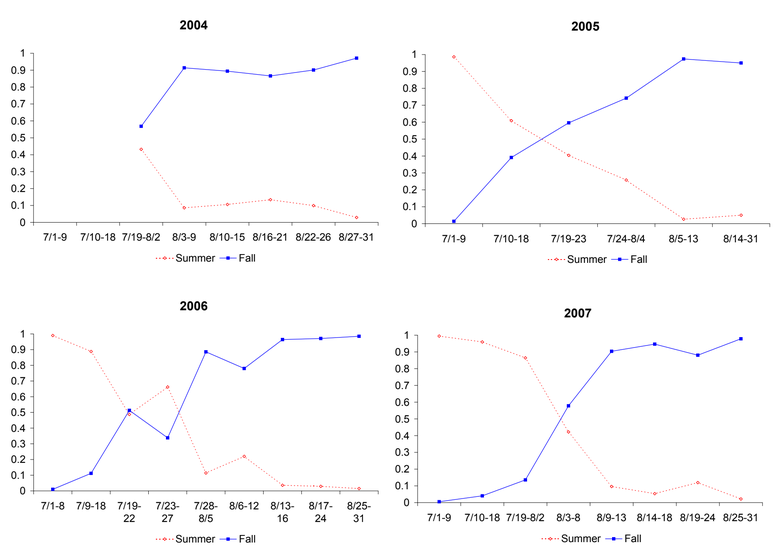
+ Using the 12 most informative loci, 100% MSA simulations revealed that accurate and precise estimates were possible to regions of management interest. Estimates for 10 of 12 regions exceeded 90%, with a range of 80-98% accuracy.





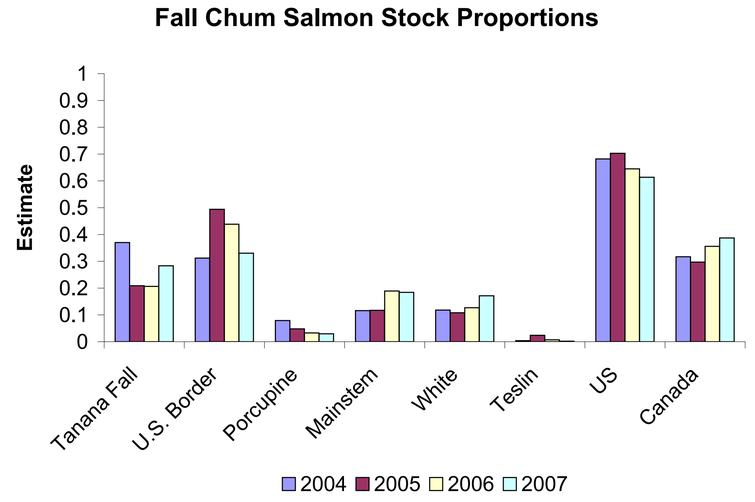
3. Results - Baseline Application

+ Stock proportions for the summer and fall runs varied around the transition date of July 19 between the summer and fall management seasons at Pilot Station sonar. For 2004 and 2005, fall chum salmon comprised the majority of the run after the transition, but in 2006 and 2007 fall chum salmon were not in the majority until the end of July to the first week in August.

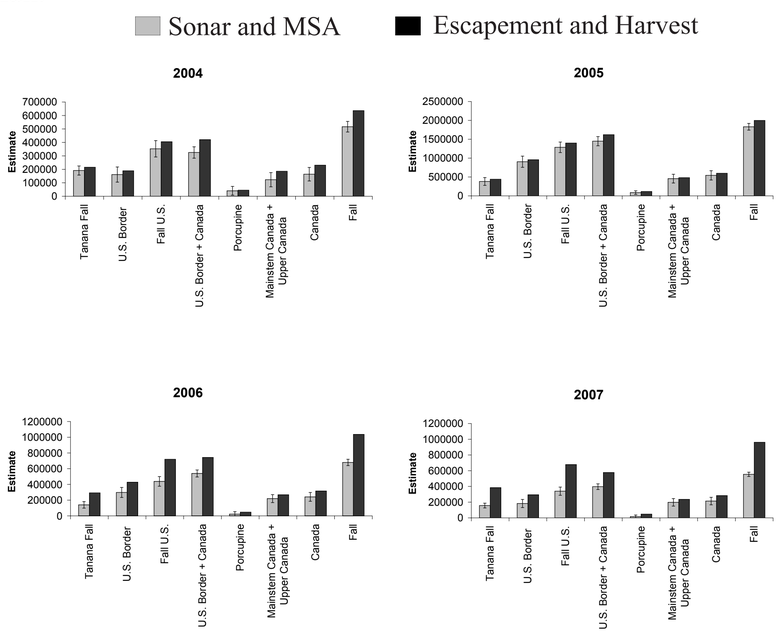


3. Results - Baseline Application

+ U.S. origin chum salmon consistently comprised approximately two-thirds of the fall run.



+ There is close agreement between estimates of stock abundance, although it appears that either Pilot Station sonar is underestimating or escapement projects are overestimating total upriver passage of fish. There was closer agreement when the fall run was not late (2004 and 2005), which suggests that the sonar may be missing the late returning fish after it shuts down or that escapement projects may be counting summer chum salmon as fall.



4. Conclusions

+ Accurate and precise stock composition estimates are attainable with the current microsatellite baseline.

+ Can be used for apportionment of harvests, characterization of run timing and migratory patterns, stock run reconstruction, stock recruitment models, and risk assessment.

+ Rapid turn around allows in-season management.

+ Combination of MSA and sonar provides a convenient and cost effective method to monitor all stocks simultaneously.