State of Washington
Department of Fish and Wildlife
Fish Management Program
Conservation Biology - Genetics Unit

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To: Tim Flint

From: Todd W. Kassler and Anne Marshall

Subject: GSI Estimate of stock group contributions to the 2003 Willapa Bay Chinook Fishery

We have completed the allozyme analysis of 225 Chinook salmon samples (03XA) collected from the Willapa Bay Chinook fishery between July 22 and August 8 (Table 1). Allozyme-based maximum likelihood estimates of stock contributions to this fishery were calculated using the program SPAM (version 3.6; Debevec et al. 2000) and results are presented in Table 2.

Thirty-nine loci (includes three pairs of isoloci) were screened in all sampled fish and 30 loci (includes 2 pairs of isoloci) were used for mixture analyses (Table 1). A 112-stock baseline was used for the simulations and in calculating the fishery estimates (Table 3). The baseline stocks data were a subset of the coast-wide, 265-stock Chinook salmon data set produced by a consortium of agencies and maintained by National Marine Fisheries Service staff (Teel et al. 1999). Nine loci were excluded from mixture analysis because they could not be resolved in all fishery samples or baseline data did not support them for all stocks.

Results of the stock composition analysis revealed that the highest portion of the catch was from the south Washington coast stock group (70.8% ± 5.1%). This south Washington coast stock group was divided into two independent reporting groups (Grays Harbor and Willapa Bay) for a re-analysis, which resulted in estimates of 13.2% ± 5.5% for Grays Harbor and 57.7% ± 7.1% for Willapa Bay stock groups. The second highest portion of the catch was from lower Columbia River (14.7% ± 2.9%) stocks. This reporting group was divided into the lower Columbia River ESU group and a group including Spring Creek Hatchery, Big Creek Hatchery, and Abernathy Hatchery "tule" fall stocks. Results from the second analysis revealed that 2.4% ± 2.7% of the catch was from the lower Columbia ESU group and 12.2% ± 3.2% was from the hatchery Spring Creek-origin tules group. Four other major stock groups (California, Oregon Coast, upper Columbia River Summer/Fall and Snake River Fall, Puget Sound ESU) had estimates below 5.0%.

These results indicate that greater than half of the Chinook harvested in this fishery were from Willapa Bay while approximately 20% of the harvest was Chinook heading for Columbia Basin areas.

We conducted a small number of simulations to evaluate the ability of the baseline to estimate stock-group contributions in specific mixtures. The results of these simulations gave us confidence that the fishery composition estimates documented in Table 2 were likely to be both reliable and reasonably accurate.

Also, we initially calculated the fishery stock composition by including 17 additional baseline stocks from three major stock groups (mid-Columbia spring-run, lower Fraser River and Vancouver Island fall-run, and Thompson River summer-run). No contributions (0% $\pm$ 0%) were estimated from these three stock groups; therefore the 17 baseline stocks were removed from the final data set.

A more detailed presentation of the methods and results of this analysis will be available as a WDFW Genetics Laboratory Report in the near future.

WDFW regional staff collected the tissues from multiple commercial fishermen who participated. Norm Switzler and Shelley Peterson contributed to laboratory activities. Funds from the Pacific Salmon Commission supported this work effort.

References:

Debevec, E. M., R. B. Gates, M. Masuda, J. Pella, J. Reynolds, and L. W. Seeb. 2000. SPAM [Version 3.2]: Statistics program for analyzing mixtures. J. Heredity 91:509-511.

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Table 1. Sampling dates and number of Chinook collected from the Willapa Bay fishery in 2003 and the 30 loci used for the analysis.

Date	Number of Samples Collected
22-Jul	12
23-Jul	2
30-Jul	55
31-Jul	42
7-Aug	65
8-Aug	49
Total	225

Loci Screened
mAAT-1
sAAT-1,2
sAAT-3
ADA-1
ADA-2
mAH-4
FDHG
GPI-A
GPI-B2
GPI-r
GR
mIDHP-2
sIDHP-1
sIDHP-2
LDH-C
mMDH-2
sMDH-B1,2
sMEP-1
MPI
PEP-A
PEPB-1
PEP-LT
PGDH
PGK-2
PGM-1
PGM-2
sSOD-1
TPI-4

Table 2. Stock composition estimates (percent contribution ± 1 standard error) for Chinook salmon sampled from the 2003 Willapa Bay fishery. Genetic data were analyzed using the SPAM computer program (Debevec et al. 2000) to estimate the contributions of major stock groups using 30 loci and a 112-stock baseline (Table 3).

Stock Groups	Year (collection code) Total N=	**2003 (03XA)** 225
Sacramento River		0.1% (± 1.2)
California Coast and Klamath River		3.0% (± 2.3)
Oregon Coast		4.8% (± 3.4)
Lower Columbia River ESU		2.4% (± 2.7)
Spring Creek Hatchery Tule's		12.2% (± 3.2)
Willamette River SP run ESU		0.4% (± 0.9)
Upper Columbia River SU/F and Snake River F		4.6% (± 2.2)
North Washington Coast and Hoko River		0.0% (± 0.0)
Puget Sound ESU		1.6% (± 1.4)
Grays Harbor		13.2% (± 5.5)
Willapa Bay		57.7% (± 7.1)

Estimates using combined stock reporting groups- California (Sacramento River and California Coast + Klamath River); Lower Columbia River Total (Lower Columbia River ESU and Spring Creek Hatchery Tule's); and South Washington Coast (Grays Harbor and Willapa Bay.

Stock Groups	Year (collection code) Total N=	**2003 (03XA)** 225
California		3.2% (± 2.6)
Oregon Coast		4.8% (± 3.4)
Lower Columbia River Total		14.6% (± 2.9)
Willamette River SP run ESU		0.4% (± 0.9)
Upper Columbia River SU/F and Snake River F		4.6% (± 2.2)
North Washington Coast and Hoko River		0.0% (± 0.0)
Puget Sound ESU		1.6% (± 1.4)
South Washington Coast		70.8% (± 5.1)

Table 3. The 11 stock groups and 112 baseline collections used for the analysis.

Stock Group	Basline Stock
Sacramento River	Mokelumne and Nimbus Hatcheries
	Merced Hatchery
	Feather Hatchery Fall
	Feather Hatchery Spring
	Coleman Hatchery
	Upper Sacramento River Winter
California Coast and Klamath River	Mattole River
	Van Duzen River
	Salmon Creek
	Redwood Creek
	Benbow Creek
	Hollow Tree Creek
	Mid Fork Eel River
	Mad River Hatchery
	North Fork Mad River
	Redwood Creek
	Iron Gate Hatchery
	Trinity Hatchery Fall
	Trinity Hatchery Spring
	Salmon and Scott Rivers
	Shasta River and Bogus Creek
	South Fork Trinity River
	Rowdy Creek Hatchery
	Mid fork Smith River
Oregon Coast	Winchuck River
	Chetco River
	Pistol River
	Hunter Creek
	Cole Rivers Hatchery
	Applegate River
	Rogue River at Gold Hill
	Euchre Creek
	Elk River and Elk River Hatchery
	Sixes River
	South Fork Coquille River
	Coquille River and Bandon Hatchery
	Millicoma River
	Morgan Creek Hatchery
	Noble Creek Hatchery
	Rock Creek Hatchery Spring
	Rock Creek Hatchery Fall
	West Fork Smith River (Umpqua Basin)
	Siuslaw River
	Alsea River
	Fall Creek Hatchery
	Siletz River

Table 3. Continued

Stock Group	Basline Stock
Oregon Coast continued	Trask Hatchery Spring
	Trask Hatchery Fall
	Nehalem River
Lower Columbia River ESU	Cowlitz Hatchery Spring
	Cowlitz Hatchery Fall
	Kalama Hatchery Spring
	Kalama Hatchery Fall
	Lewis Hatchery Spring
	Lewis River Fall
	Sandy River Spring
	Sandy River Fall
Spring Creek Hatchery Tule's	Spring Creek and Big Creek Hatcheries
Willamette River SP run ESU	Mckenzie and Dexter Hatcheries
	Mckenzie River
	North Santiam River
	Clackamas Hatchery
	North Fork Clackamas River
	Marion Forks Hatchery
Upper Columbia River SU/F and Snake River F	Klickitat River Summer
	Klickitat River Fall
	Bonneville Hatchery
	Little White Salmon Hatchery
	Deschutes River
	Yakima River
	Marion Drain
	Hanford Reach
	Priest Rapids Hatchery
	Wells Hatchery
	Wenatchee River
	Similkameen River
	Methow River
	Lyons Ferry Hatchery (Snake R. Fall)
North Washington Coast and Hoko River	Quinault Hatchery
	Queets River
	Hoh River
	Sol Duc Spring
	Hoko River

Table 3. Continued

Stock Group	Basline Stock
Puget Sound ESU	Elwha River
	North Fork Nooksack Hatchery and River
	South Fork Nooksack River
	Skagit Hatchery Spring
	Skagit River Fall
	Sauk River Summer
	Suiattle River
	Sauk River Spring
	Cascade River
	Skagit River Summer
	North Fork Stilliguamish River
	Skykomish River Summer
	Bridal Veil Creek
	Skykomish Hatchery Fall
	Wallace River
	Sultan River
	Snoqualmie River
	Green River Hatchery
	Puyallup Hatchery
	White River Hatchery Spring
	South Prairie Creek
	Deschutes Hatchery
	Hoodsport Hatchery
Grays Harbor	Wynoochee River and Hatchery
	Wishkah River
	East Fork Satsop River
	Skookumchuck River Spring
	Humptulips Hatchery
Willapa Bay	Naselle Hatchery