Western Alaska Salmon Stock Identification Program **Technical Document**:[1] 15

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Title: Chum salmon reporting group evaluations using simulated fishery mixtures

Authors: C. Habicht, W.D. Templin, N. Decovich, J. Jasper

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Introduction

During the joint Advisory Panel (AP)/Technical Committee (TC) meeting held in Anchorage on September 21 and 22, 2011, Gene Conservation Laboratory (GCL) presented results of tests evaluating reporting groups for the chum salmon baseline. GCL followed the AP recommendations from the joint AP/TC meeting on March 17, 2011 and developed a flow chart for testing the viability of reporting groups. The viability of reporting groups was tested using 100% proof tests described in Technical Document (TD) 5, "*Status of the SNP baseline for sockeye salmon*." The results from these tests indicated that the addition of new SNPs and populations to the baseline did not provide the level of resolution expected by many of the AP, including ADFG, especially for the Coastal Western Alaska (CWAK) area.

At the meeting, the AP requested tests using fishery-based proof tests to inform decisions about the determination of appropriate reporting groups for CWAK populations. The fisheries-based proof tests would be more analogous to mixtures associated with WASSIP than the 100% proof tests used to test reporting groups. In particular, they would 1) contain fish originating from more than one reporting group; 2) contain 400 fish (200 fish were used in the 100% proof tests); and 3) have a prior more similar to the prior likely to be used for WASSIP mixtures (the 100% proof tests used a uniform prior giving equal weight to each regional-reporting group). These proof tests would provide a better picture of the magnitude and direction of biases and magnitude of errors of using Norton Sound, lower Yukon River, Kuskokwim River, and Bristol Bay as separate reporting groups or as a single CWAK reporting group.

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A committee was assembled, chaired by Michael Link and including Art Nelson, Pat Martin, Doug Eggers and Denby Lloyd. The committee was tasked with developing 6 fishery-based mixture compositions for testing, reviewing the results and providing recommendations to the AP and TC. The timeframe for this exercise is short due to the time constraints of the project. The committee will provide the mixture compositions to GCL by September 30 and the conclusion of this work is scheduled for October 15.

Prior choice for proof tests

In order to provide fishery-based proof tests that are useful for interpreting bias and error in stock composition estimates associated with WASSIP, it is important that the analysis methods follow, as closely as possible, those proposed for WASSIP mixtures. The priors that we anticipate using to analyze WASSIP mixtures will use information from strata within each fishery (addendum to TD 13, "*Selection of a Prior for Mixed Stock Analysis*"; sent to the TC September 26, 2011). Since we do not have this information for this exercise, we will use a surrogate for these priors based on estimates of stock composition for the same mixtures derived from the maximum likelihood-based method implemented in SPAM version 3.7b (Debevec et al. 2000).

The other prior options considered were to use the regional-reporting group uniform prior or to use the known stock composition; both options are problematic. The regional-reporting group uniform prior would likely inflate biases compared to estimates using the methods anticipated for WASSIP mixtures because no fishery-based information would be incorporated in the prior. This is especially pronounced for reporting groups that are genetically less distinct, such as the potential reporting groups within CWAK, where the effects would be more pessimistic. On the other hand, using the known stock composition as the prior would likely produce less bias than we might expect from the methods anticipated for WASSIP mixtures. The effect would be more optimistic for reporting groups that are genetically less distinct, such as the CWAK reporting groups.

Kuskokwim River reporting group

During the meeting, the AP requested that the upper Kuskokwim River populations be moved into the CWAK reporting group rather than being included in the upper Yukon/Kuskokwim reporting group. For these proof tests, the upper Kuskokwim River populations will be added to the lower Kuskokwim River reporting group and this new reporting group will be referred to as the "Kuskokwim River" reporting group. The upper Yukon River reporting group will be maintained separately.

Methods

Developing mixture compositions

The committee will develop 6 fishery-based stock compositions for testing. These fishery compositions will cover a wide range of stock compositions for evaluating the magnitude and direction of biases and the magnitude of error for reporting groups present from high to low proportions within fisheries. Final stock compositions for proof tests will be provided to the GCL by September 30.

Testing mixture compositions

A set of 400 fish will be randomly selected and removed from the baseline in proportion to the mixture compositions provided by the committee. The process will be repeated 5 times for each set of fishery-based mixture compositions. SPAM will be used to produce stock composition estimates for each set of selected fish. These estimates will serve as priors for the BAYES analyses. BAYES will be performed as described in TD 5, except that we will use the SPAM results as the prior, with a prior weight of 1 fish. Estimates and 90% credibility intervals will be determined from the posterior distribution formed from 3 chains with different starting conditions. Each chain will perform 40,000 iterations with the first 20,000 discarded.

For any mixtures that contain Kuskokwim River, fish from only the coastal populations will be selected for the mixtures. This will be done to avoid overoptimistic simulation results that could be an artifact of the genetic divergence between upper Kuskokwim River fish and other coastal western Alaska fish. Upper Kuskokwim River fish are represented by a few small populations

and these fish are unlikely to be in any WASSIP mixture in appreciable numbers. If we included fish in mixtures in proportion to the number of populations represented in the baseline, the proof tests could appear inappropriately optimistic in estimating Kuskokwim River components.

Reporting mixture compositions and performance of reporting groups

Results will be tabulated for two sets of reporting groups. The first set will be the 9 reporting groups that passed the 90% correct allocation tests using the 100% proof tests (CWAK as a single reporting group). The second set will be the 12 reporting groups where the CWAK reporting group is subdivided into Norton Sound, lower Yukon River, Kuskokwim River, and Bristol Bay reporting groups (Table 1). Tabulation of results will include a table of four related measures:

1) absolute deviations (range: 0 to 1) from known proportions

;

2) relative percent deviations (range: 0% to infinity%) from known proportion

—— ;

3) root mean square error (range 0 to 1)

– , and;

4) relative root mean square error (range 0 to infinity)

– .

The first two measures will be provided for each reporting group, , for each fishery mixture, , and for each repetition *i* , whereas the second set of measures are summaries across repetitions for each reporting group for each mixture. Results will be provided to the committee as they become available so that the committee can review them to determine if a recommendation can be made to the AP/TC before all the proof tests are complete.

Literature Cited

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. Journal of Heredity 91: 509–510.

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118 **Questions for Technical Committee**

1) Is this method to investigate the possibility of separating the CWAK reporting group into 4 separate groups reasonable and acceptable for the purposes of WASSIP?

2) Are there better ways to determine whether this is possible?

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3) Do you recommend other ways of comparing the error and bias from the 9 reporting groups we believe to be acceptably identifiable to the error and bias of the 12 groups described above?

Tables

Table 1. Populations associated with the 9 reporting groups that met the 90% correct allocation criteria based on 100% proof tests and the 12 reporting groups where coastal western Alaska (CWAK) is divided into 4 reporting groups. Mixture sets of 400 individual fish will be randomly selected and removed from the baseline in proportion to the mixture compositions provided by the committee. These mixtures will be analyzed using both the 9 and 12 reporting groups to examine bias and error of the two sets of reporting groups.

Reporting groups		Population	N
"9"	"12"		
Asia		Namdae River	90
		Gakko River - early	78
		Abashiri River	80
		Sasauchi River	77
		Yurappu River - early	80
		Yurappu River - late	80
		Teshio River	78
		Shinzunai River	80
		Tokachi River	78
		Kushiro River	79
		Nishibetsu River	80
		Shari River	75
		Tokoro River	69
		Tokushibetsu River	80
		Naiba	98
		Tym River	53
		Bolshaya River	59
		Paratunka River	94
		Amur River - summer run	88
		Bistraya River	66
		Hairusova River	85
		Ozerki Hatchery	93
		Pymta	147
		Penzhina	43
		Kol River	123
		Vorovskaya	101
		Kamchatka River	50
		Palana River	90
		Magadan	77
		Ossora	87
		Ola River - Hatchery	78
		Oklan River	75

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		Kanchalan	77
		Udarnitza River	43
Kotzebue Sound		Inmachuk River	91
		Kiana River	95
		Kobuk - Salmon River (Mile 4)	99
		Noatak River - above hatchery	47
		Selby Slough	90
		Agiapuk River	94
CWAK	Norton Sound	Eldorado River	89
		Nome River	94
		Pilgrim River	75
		Snake River	90
		Solomon River	62
		Fish River	92
		Kwiniuk River	94
		Niukluk River	93
		Tubutulik River	93
		Shaktoolik River	94
		Pikmiktalik River	95
		Koyuk River	43
		Unalakleet	188
		Ungalik River	144
	Coastal Yukon River	Black River	93
		Andreafsky River - East Fork	94
		Chulinak	92
		Beaver Creek - Anvik	110
		Yellow River - Anvik	80
		Innoko River	85
		Kaltag River	92
		Nulato River	189
		Gisasa River	95
		Melozitna River	91
		South Fork Koyukuk R. - Early	90
		Henshaw Creek - early	94
		Huslia River, Koyukuk	95
		Tozitna River	92
	Kuskokwim River	Mekoryuk River	104
		Kwethluk River	143
		Tuluksak River Weir	92

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	Kisaralik River	93
	Aniak River	92
	Salmon River	95
	Holokuk River	103
	Kogrukluk River weir	95
	Kasigluk River - (Set G)	55
	George River	95
	Stony River - Early	95
	Stony River - Late	55
	Necons River	95
	Tatlawiksuk River weir	95
	Nunsatuk River - (Set A)	92
	Takotna River	94
	Kanektok River weir	94
	Goodnews River - North Fork	43
	Big River	94
	South Fork Kuskokwim - fall	95
	Windy Fork Kuskokwim	93
Bristol Bay	Osviak River	88
	Sunshine Creek	47
	Iowithla River	95
	Snake River	48
	Upper Nushagak	97
	Stuyahok River	86
	Klutuspak Creek	70
	Alagnek River	92
	Whale Mountain Creek	189
	Pumice Creek	95
	Wandering Creek	50
Upper Yukon River	Henshaw Creek - late	60
	South Fork Koyukuk R.- Late	92
	Jim River	92
	Tanana River Mainstem	95
	Toklat River	95
	Kantishna River	94
	Chena River	77
	Salcha River	83
	Delta River - Fairbanks	149
	Bluff Cabin	99
	Big Salt River	70

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	Chandalar River	92
	Sheenjek River	93
	Black River	95
	Old Crow - Porcupine River	92
	Fishing Branch	90
	Kluane River	114
	Pelly River	84
	Minto Slough	91
	Tatchun Creek	92
	Big Creek - Canadian Mainstem	100
	Teslin River	92
Northern District Peninsula	Wiggly Creek - Cinder	177
	Meshik River	78
	Plenty Bear Creek	138
	Meshik Braided	94
	Ilnik River - "Three Hills River"	49
	North of Cape Seniavin	96
	Right Head Moller Bay	189
	Lawrence Valley Creek	190
	Coal Valley	94
	Deer Valley	91
	Sapsuk River, Nelson Lagoon	144
Northwest District Peninsula	Moffet Creek (Cold Bay)	95
	Joshua Green	186
	Frosty Creek	190
	Alligator Hole	183
	Traders Cove (AK. Peninsula)	76
	St. Catherine Cove	171
	Peterson Lagoon	181
South Peninsula	Little John Lagoon	80
	Sandy Cove	186
	Little John Lagoon	92
	Russell Creek	185
	Delta Creek (Cold Bay)	95
	Belkovski River	87
	Volcano Bay (Cold Bay)	189
	Ruby's Lagoon (Cold Bay)	92
	Canoe Bay	186
	Zachary Bay	76
	Foster Creek - Balboa Bay	182

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	Coleman Creek	95
	Chichagof Bay	180
	Stepovak Bay - Big River	143
	Stepovak River	189
Chignik/ Kodiak (includes K. Island)	Ivanoff River	181
	Portage Creek	190
	Kujulik - North Fork	93
	North Fork Creek, Kujulik Bay	71
	North Fork Creek, Aniakchak R.	94
	Main Creek	174
	Northeast Creek	94
	Ocean Bay	78
	Nakililock River	95
	Chiginagak Bay River	159
	Kialagvik Creek (Wide Bay)	177
	Pass Creek - Wide Bay	94
	Dry Bay River	71
	Bear Bay Creek	187
	Alagogshak River	94
	Big River	95
	Big River (Hallo Bay)	92
	Karluk Lagoon	83
	Sturgeon River	109
	Big Sukhoi	189
	Deadman River	95
	Sitkinak Island	93
	NE Portage - Alitak	94
	Barling Bay Creek	92
	West Kiliuda Creek	87
	Dog Bay	95
	Coxcomb Creek	89
	Gull Cape Creek	92
	Gull Cape Lagoon	94
	Eagle Harbor	94
	Rough Creek	77
	American River	95
	Russian River	185
	Kizhuyak River	174
	Uganik River	175
	Spiridon River - Upper	89
	Zachar River	66
	Kitoi Hatchery	194

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East of Kodiak	McNeil River Lagoon	108
	Chunilna River	83
	Susitna River (Slough 11)	94
	Talkeetna River	50
	Little Susitna River weir	95
	Willow Creek	89
	Carmen Lake	67
	Williwaw Creek	67
	Siwash	97
	Wally Noerenberg Hatchery	189
	DIPAC Hatchery	94
	Dry Bay Creek	94
	Ford Arm Lake - fall	95
	Hidden Falls Hatchery	95
	Long Bay	94
	Medvejie Hatchery	95
	Nakwasina River	93
	Ralph's Creek	95
	Sanborn Creek	94
	Saook Bay	94
	Sawmill Creek - Berners Bay	95
	Taku River - fall	93
	West Crawfish	92
	Wells Bridge	46
	Disappearance Creek - fall run	181
	Fish Creek - Hyder	83
	Fish Creek - early	49
	Fish Creek - late	49
	Karta River	56
	Lagoon Creek - fall run	78
	Nakat Inlet - summer	95
	North Arm Creek	94
	Carroll River	85
	Neets Bay - fall	95
	Neets Bay - summer	95
	Traitors Cove Creek	91
	Sample Creek	74
	Kitwanga River	74
	Elwha River	93
	Nisqually River Hatchery	94