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

Version: Addendum 2

Title: Addendum 2 to Technical Document 15 "Chum salmon reporting group evaluations using simulated fishery mixtures"

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

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Introduction

The background and purpose for this simulation study are presented in the original document, Technical Document 15 "Chum salmon reporting group evaluations using simulated fishery mixtures." The results of the first set of simulations (South Peninsula) and some evaluation by the ADF&G Gene Conservation Laboratory (GCL) were provided to the *ad hoc* committee as Addendum 1 to Technical Document 15 on October 10, 2011. This document serves as a second addendum to the original document describing the results of the first three sets of simulations.

Methods

Developing mixture compositions

As described earlier, the AP asked the GCL to start with a simulation based on a hypothetical fishery mixture labeled "S. Pen June (B)" ("As run"; Table 1) while the committee developed 5 additional fishery-based stock compositions for proof testing. These fishery compositions covered 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.

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Testing mixture compositions

The methods used in the simulation study are described in the original document and Addendum 1.

Reporting mixture compositions and performance of reporting groups

Results for each set of mixtures were tabulated for two sets of reporting groups: 1) the 9 reporting groups that where coastal western Alaska populations (CWAK) are a single reporting group, and 2) the 12 reporting groups where CWAK is subdivided into Norton Sound, lower Yukon River, Kuskokwim River, and Bristol Bay reporting groups (see Table 2 of original document).

The results from the first three sets of proportions are reported here.

Results

Developing mixture compositions

The *ad hoc* committee modified the stock proportions in the hypothetical fishery mixture labeled "S. Pen June (B)", created 5 additional fishery-based stock compositions for proof testing, and provided a priority order, which were sent out by the chairman, Michael Link, in an email to all *ad hoc* committee members on October 10, 2011 (Table 1). These fishery compositions covered 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. GCL is analyzing proof tests based on these proportions following the priority order. Results for the "S. Pen June (B) as run" were released on October 10, 2011. After these results were released, and during the analysis of the next mixtures, an error was discovered relating to the baseline used for each iteration, so the "S Pen June (B) as run" was reanalyzed with the error corrected. Here we present results from the corrected "S. Pen June (B) as run", and the next two hypothetical fishery mixtures: "Bristol Bay" and "Kusko Bay".

Testing mixture compositions

SPAM results that served as priors for the BAYES analyses are reported for each analysis (Tables 2 - 4).

Reporting mixture compositions and performance of reporting groups

BAYES stock composition estimates and 90% credibility intervals along with absolute deviations and relative percent deviations for each of the 5 replicates are presented for both the 9 and 12 reporting-group sets (Tables 2 - 4). Stock compositions and 90% credibility intervals are also presented graphically in Figures 1 – 6. Root mean square error and relative root mean square error across repetitions for each reporting group for each mixture were not provided because they were not available when the document was distributed.

Discussion

Error in previously reported results

The error detected in the original analysis of the hypothetical fishery mixture "S. Pen June (B) as run" and released in Addendum 1 of this report, resulted in some changes to the point estimates and CI's, especially for the BristolBay and NorthPenn reporting groups (Table 2 and Figure 1 and 2). Deviations from the Actual proportions were much higher and more biased in the reanalysis for the BristolBay and the NorthPenn reporting groups than reported in Addendum 1. These changes are consistent with expectations based on the error made during the original analysis where the baseline used for the mixture analysis included the individuals used in the mixture (not a true proof test). Since the mixture was made up of a large portion of BristolBay fish (26%) and because some BristolBay populations are genetically similar to some NorthPenn populations, the depopulation of the baseline in the new analysis reduced the ability of the model to allocate BristolBay fish correctly. However, the overall patterns of wider CI and high divergence from the actual proportions for the CWAK reporting groups relative to the reporting groups that met the 90% correct allocation in 100% proof tests remain similar.

Comparison of the 9 and 12 reporting group sets

In all three fishery-based proof tests, the stock composition estimates for the 9 reporting groups (CWAK as a single reporting group) were more precise and had smaller 90% CI than for the reporting groups of the subdivided CWAK (Norton Sound, lower Yukon River, Kuskokwim River, and Bristol Bay reporting groups) (Tables 2 - 4 and Figures 1 - 6). In the "Bristol Bay"

and the "Kusko Bay" proof tests, these differences among two groups were more exaggerated (Tables 3 and 4, Figures 3 - 6) than for the "South Pen June (B) as run" proof test (Table 2, Figures 1 and 2). The estimates for the 9 reporting groups were within 0.07 of the actual in every case and averaged 0.01, whereas for the 4 reporting groups within CWAK, the deviations were as high as 0.38 from the actual, and averaged 0.11. Credibility interval widths averaged 0.04 and 0.21 for the 9 and 12 reporting groups, respectively.

Despite these much higher CI widths of the 4 less-identifiable CWAK reporting groups, they still appear to underestimating the true widths, whereas the widths of CIs for the highly identifiable 9 reporting groups appear appropriate. For the 9 reporting groups, the actual (correct) proportion was included within the 90% CI 94% of the time. In contrast, for the 4 CWAK reporting groups, the actual proportion was included in the 90% CI only 68% of the time. This indicates that the wider CI's for the CWAK reporting groups are still underestimating of the true 90% CI widths. This discrepancy may be due to the lack of genetic variation among these 4 reporting groups which leads to large biases in the point estimates.

As described in Addendum 1, the large 90% CI for estimates of the 4 CWAK reporting groups in each of the 3 fishery-based proof tests are not explained by statistics alone. A more likely hypothesis to explain these wider CI within the CWAK group is a lack of genetic distinctiveness among these reporting groups.

Consistent and relatively large biases were observed for some reporting groups in these fishery-based proof tests. The largest average biases were seen in the CWAK reporting groups with consistent downward biases for BristolBay (11 of 15 replicates, average -13%) and upward biases in Norton (12 of 15 replicates; average 6%). The other CWAK reporting groups had biases within each fishery-based proof test, but these biases changed in magnitude and direction across the proof tests (Figures 2, 4 and 6). For example, the Kuskokwim reporting group was biased upward in the "Bristol Bay" mixture (5 of 5 replicates; average 14%) and downwardly biased in the "Kusko Bay" mixture (5 of 5 replicates, average -21%). Among the reporting groups that met the 90% correct assignment in the 100% proof tests, the highest average bias was 1% and the highest average bias within a fishery-based proof test was 2%. One bias that was

consistent with the mixture that contained a large proportion of BristolBay fish and smaller proportion of NorthPenn fish was an upward bias for the estimated proportion of NorthPenn fish ("South Pen June (B)" and "Bristol Bay" mixtures; Figures 2 and 4). These results might be expected due to the genetic similarity between some BristolBay and NorthPenn populations.

Comparing the relative percent deviations between the 4 CWAK reporting groups and the remaining reporting groups is confounded because this measure is affected by both the absolute deviation and the Actual composition estimate. Small absolute deviations on a small Actual composition estimate can lead to a large relative percent deviation (i.e. a 2% deviation with an actual composition of 2% is a 100% relative deviation; whereas a 2% deviation with an actual composition of 50% is a 4% relative deviation). Since most of the Actual estimates for the reporting groups that met the 90% correct allocations in the 100% proof tests were small and the Actual estimates for the 4 CWAK reporting groups were large, testing the effects of the two types of reporting groups (4 CWAK vs. the 9 identifiable reporting groups) on the model performance is confounded by differences in Actual estimates between the two types of reporting groups.

As pointed out during the September joint AP/TC meeting, determining the acceptable level of precision requires weighing the benefits of adding more reporting groups with the risks of providing less precise and more biased estimates. These fishery-based proof tests provide insights into the magnitude of errors and magnitude and direction of biases resulting from the division of CWAK into 4 reporting groups. These can be summarized in four main observations:

1) The 4 CWAK reporting groups that did not meet the standard 90% correct-allocation metric had 90% CI ranges that were 5.25 times as wide as the reporting groups that did meet the metric.
2) These much wider confidence intervals appear to be biased low for these 4 reporting groups, with the correct proportion being contained within the 90% CI in only 68% of estimates across replicates and sets. This can be compared with the 94% rate for the other reporting groups.
3) Average deviations from the actual stock composition were 11 times higher for the 4 CWAK reporting groups than for the reporting groups that met the metric.

4) The largest biases were among the 4 CWAK reporting groups and they averaged 30 times larger than the biases observed for the reporting groups that met the metric.

Questions for the ad-hoc committee

1) Do these results provide the information needed for the committee to make a recommendation on the definition of reporting groups to the WASSIP AP?
2) If not, will addition of the fourth fishery-based proof test based on expected Norton Sound proportions provide the information required to make this decision?
3) If so, what is the committee's recommendation on the definition of reporting groups for mixed stock analysis of chum salmon in WASSIP?

Tables

Table 1. Six hypothetical mixtures, and their priority, provided by the ad-hoc committee on 10/10/11 to be used in proof tests to examine the performance of a divided Coastal Western Alaska (CWAK) group for chum salmon for WASSIP. "S. Pen June (B) As run" proportions were provided by the Advisory Panel (AP) at the conclusion of the September 21-22 joint AP/Technical Committee meeting for the Gene Conservation Laboratory to start proof testing. The "Modified" numbers were provided after this mixture was analyzed and therefore not used.

	Composition of Hypothetical Mixtures (%)						
	S. Pen June (B)						
Reporting Group	As run	Modified	Bristol Bay	Kusko Bay	Norton Sound	S. Pen June (A)	S. Pen Post June
Asia	25	30		2	3	30	15
Kotzebue	2	2		2	5	2	1
CWAK	56	51	93	86	92	51	4
Norton	*5*	*5*		*7*	*76*	*0*	*1*
YukonCoastal	*10*	*10*	*5*	*20*	*15*	*25*	*1*
Kuskokwim	*15*	*15*	*10*	*55*	*1*	*10*	*1*
BristolBay	*26*	*21*	*78*	*4*		*16*	*1*
UpperYukon	2	2	2	5		2	
NorthPenn	2	2	5	2		2	5
NWPenn	6	6		2		6	10
SouthPenn	1	1		1		1	45
ChignikKod	1	1				1	5
EastKodiak	5	5				5	15
Priority/order	1	1	2	3	4	5	6

Table 2. SPAM and BAYES estimates from 5 replicate samples for the "South Pen June (B) as run" fishery-based proof test. The 5 replicate samples consisted of different sets of individuals drawn from the baseline in the same reporting group proportions (Actual). These fish were removed from the baseline and used as mixtures. SPAM estimates were used as priors for the BAYES analysis. BAYES estimate (BAYES), standard deviation (sd), lower (CI 5) and upper (CI 95) 90% credibility interval values, absolute deviation from the known (ABS dev; proportion) and relative absolute deviation from the known (Rel ABS dev; percent) for each estimate are provided. Estimates for coastal western Alaska (CWAK) are shown both for a single reporting group and that proportion divided among the 4 reporting groups (italics) that make up CWAK.

Replicate 1

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.25	0.25	0.26	0.02	0.22	0.30	0.01	3.31
Kotzebue	0.02	0.01	0.00	0.00	0.00	0.00	0.02	98.6
CWAK	0.56	0.56	0.59	0.03	0.53	0.64	0.03	4.59
Norton	*0.05*	*0.05*	*0.02*	*0.04*	*0.00*	*0.11*	*0.03*	*59*
YukonCoastal	*0.10*	*0.14*	*0.25*	*0.06*	*0.16*	*0.34*	*0.15*	*150*
Kuskokwim	*0.15*	*0.12*	*0.14*	*0.06*	*0.01*	*0.24*	*0.01*	*9.1*
BristolBay	*0.26*	*0.25*	*0.18*	*0.05*	*0.10*	*0.27*	*0.08*	*31*
UpperYukon	0.02	0.03	0.01	0.01	0.00	0.03	0.01	49.4
NorthPenn	0.02	0.02	0.02	0.02	0.00	0.07	0.00	3.4
NWPenn	0.06	0.06	0.06	0.02	0.04	0.09	0.00	1.25
SouthPenn	0.01	0.02	0.02	0.01	0.00	0.05	0.01	105
ChignikKod	0.01	0.01	0.00	0.01	0.00	0.02	0.01	68.8
EastKodiak	0.05	0.04	0.04	0.01	0.03	0.06	0.01	13.1

Replicate 2

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.25	0.25	0.25	0.02	0.21	0.29	0.00	0.88
Kotzebue	0.02	0.02	0.01	0.00	0.00	0.01	0.01	73.6
CWAK	0.56	0.54	0.55	0.04	0.48	0.61	0.01	2.64
Norton	*0.05*	*0.08*	*0.11*	*0.05*	*0.02*	*0.20*	*0.06*	*112*
YukonCoastal	*0.10*	*0.12*	*0.14*	*0.07*	*0.04*	*0.28*	*0.04*	*44*
Kuskokwim	*0.15*	*0.14*	*0.18*	*0.07*	*0.04*	*0.30*	*0.03*	*21*
BristolBay	*0.26*	*0.20*	*0.11*	*0.04*	*0.05*	*0.19*	*0.15*	*56*
UpperYukon	0.02	0.02	0.03	0.01	0.01	0.05	0.01	26.5
NorthPenn	0.02	0.03	0.04	0.03	0.00	0.09	0.02	95.7
NWPenn	0.06	0.06	0.06	0.01	0.04	0.09	0.00	2.52
SouthPenn	0.01	0.01	0.01	0.01	0.00	0.04	0.00	36.1
ChignikKod	0.01	0.02	0.01	0.02	0.00	0.05	0.00	45.5
EastKodiak	0.05	0.05	0.05	0.01	0.03	0.07	0.00	4.82

186

Replicate 3 Table 2 (continued)

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.25	0.25	0.24	0.02	0.21	0.28	0.01	2.62
Kotzebue	0.02	0.02	0.01	0.00	0.00	0.02	0.01	58.7
CWAK	0.56	0.55	0.53	0.04	0.48	0.60	0.03	4.57
Norton	*0.05*	*0.09*	*0.13*	*0.05*	*0.05*	*0.22*	*0.08*	*166*
YukonCoastal	*0.10*	*0.11*	*0.08*	*0.05*	*0.00*	*0.17*	*0.02*	*22*
Kuskokwim	*0.15*	*0.16*	*0.22*	*0.06*	*0.13*	*0.32*	*0.07*	*47*
BristolBay	*0.26*	*0.19*	*0.10*	*0.06*	*0.02*	*0.20*	*0.16*	*61*
UpperYukon	0.02	0.03	0.02	0.01	0.01	0.04	0.00	15.6
NorthPenn	0.02	0.02	0.05	0.03	0.00	0.09	0.03	130
NWPenn	0.06	0.06	0.06	0.01	0.04	0.09	0.00	6.52
SouthPenn	0.01	0.01	0.00	0.00	0.00	0.01	0.01	84.8
ChignikKod	0.01	0.02	0.04	0.01	0.02	0.06	0.03	258
EastKodiak	0.05	0.05	0.04	0.01	0.03	0.06	0.01	12.9

Replicate 4

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.25	0.25	0.25	0.02	0.21	0.28	0.00	1.87
Kotzebue	0.02	0.02	0.00	0.00	0.00	0.01	0.02	95
CWAK	0.56	0.56	0.59	0.03	0.55	0.63	0.03	5.66
Norton	*0.05*	*0.06*	*0.10*	*0.05*	*0.00*	*0.18*	*0.05*	*99*
YukonCoastal	*0.10*	*0.12*	*0.11*	*0.06*	*0.01*	*0.22*	*0.01*	*15*
Kuskokwim	*0.15*	*0.19*	*0.25*	*0.06*	*0.15*	*0.35*	*0.10*	*66*
BristolBay	*0.26*	*0.20*	*0.13*	*0.03*	*0.09*	*0.18*	*0.13*	*50*
UpperYukon	0.02	0.02	0.02	0.01	0.01	0.03	0.00	14.7
NorthPenn	0.02	0.01	0.00	0.01	0.00	0.02	0.02	85.9
NWPenn	0.06	0.06	0.06	0.01	0.04	0.09	0.00	7.62
SouthPenn	0.01	0.01	0.01	0.01	0.00	0.03	0.00	4.25
ChignikKod	0.01	0.02	0.01	0.01	0.00	0.03	0.00	20.5
EastKodiak	0.05	0.06	0.06	0.01	0.04	0.08	0.01	11.8

187
188
189
190

191

Replicate 5 Table 2 (continued)

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.25	0.25	0.25	0.02	0.21	0.28	0.00	1.14
Kotzebue	0.02	0.03	0.02	0.01	0.01	0.05	0.00	22.5
CWAK	0.56	0.53	0.54	0.03	0.49	0.59	0.02	3.9
Norton	*0.05*	*0.08*	*0.05*	*0.05*	*0.00*	*0.13*	*0.00*	*2.2*
YukonCoastal	*0.10*	*0.11*	*0.14*	*0.05*	*0.05*	*0.24*	*0.04*	*39*
Kuskokwim	*0.15*	*0.14*	*0.21*	*0.09*	*0.06*	*0.34*	*0.06*	*38*
BristolBay	*0.26*	*0.21*	*0.14*	*0.04*	*0.08*	*0.22*	*0.12*	*45*
UpperYukon	0.02	0.03	0.02	0.01	0.01	0.04	0.00	10.9
NorthPenn	0.02	0.03	0.04	0.02	0.01	0.07	0.02	114
NWPenn	0.06	0.05	0.06	0.02	0.03	0.08	0.00	3.35
SouthPenn	0.01	0.01	0.01	0.01	0.00	0.02	0.00	25.5
ChignikKod	0.01	0.01	0.00	0.00	0.00	0.01	0.01	61.6
EastKodiak	0.05	0.05	0.06	0.01	0.04	0.08	0.01	11.88

192
193
194

Table 3. SPAM and BAYES estimates from 5 replicate samples for the "Bristol Bay" fishery-based proof test. The 5 replicate samples consisted of different sets of individuals drawn from the baseline in the same reporting group proportions (Actual). These fish were removed from the baseline and used as mixtures. SPAM estimates were used as priors for the BAYES analysis. BAYES estimate (BAYES), standard deviation (sd), lower (CI 5) and upper (CI 95) 90% credibility interval values, absolute deviation from the known (ABS dev; proportion) and relative absolute deviation from the known (Rel ABS dev; percent; "na" if Actual = 0) for each estimate are provided. Estimates for coastal western Alaska (CWAK) are shown both for a single reporting group and that proportion divided among the 4 reporting groups (italics) that make up CWAK.

Replicate 1

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na
Kotzebue	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na
CWAK	0.93	0.80	0.88	0.03	0.82	0.92	0.05	5.6
Norton	*0.00*	*0.13*	*0.21*	*0.08*	*0.07*	*0.33*	*0.21*	*na*
YukonCoastal	*0.05*	*0.11*	*0.02*	*0.03*	*0.00*	*0.08*	*0.03*	*68.3*
Kuskokwim	*0.10*	*0.23*	*0.23*	*0.09*	*0.09*	*0.40*	*0.13*	*131.3*
BristolBay	*0.78*	*0.33*	*0.42*	*0.06*	*0.31*	*0.52*	*0.36*	*46.2*
UpperYukon	0.02	0.03	0.02	0.01	0.01	0.03	0.00	*5.8*
NorthPenn	0.05	0.12	0.10	0.03	0.06	0.15	0.05	*104.2*
NWPenn	0.00	0.01	0.00	0.00	0.00	0.01	0.00	na
SouthPenn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
ChignikKod	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na
EastKodiak	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na

Replicate 2

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.00	0.02	0.00	0.00	0.00	0.00	0.00	na
Kotzebue	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na
CWAK	0.93	0.80	0.94	0.03	0.87	0.98	0.01	0.8
Norton	*0.00*	*0.09*	*0.02*	*0.02*	*0.00*	*0.07*	*0.02*	*na*
YukonCoastal	*0.05*	*0.09*	*0.22*	*0.06*	*0.13*	*0.32*	*0.17*	*342.0*
Kuskokwim	*0.10*	*0.19*	*0.15*	*0.08*	*0.00*	*0.27*	*0.05*	*48.1*
BristolBay	*0.78*	*0.43*	*0.55*	*0.07*	*0.44*	*0.66*	*0.23*	*29.2*
UpperYukon	0.02	0.03	0.02	0.01	0.01	0.04	0.00	9.0
NorthPenn	0.05	0.08	0.04	0.03	0.01	0.11	0.01	*11.4*
NWPenn	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na
SouthPenn	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na
ChignikKod	0.00	0.02	0.00	0.00	0.00	0.00	0.00	na
EastKodiak	0.00	0.02	0.00	0.00	0.00	0.00	0.00	na

Replicate 3 Table 3 (continued)

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
Kotzebue	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
CWAK	0.93	0.85	0.86	0.05	0.79	0.94	0.07	7.5
Norton	*0.00*	*0.07*	*0.04*	*0.04*	*0.00*	*0.11*	*0.04*	*na*
YukonCoastal	*0.05*	*0.08*	*0.05*	*0.07*	*0.00*	*0.20*	*0.00*	*9.7*
Kuskokwim	*0.10*	*0.18*	*0.28*	*0.09*	*0.13*	*0.41*	*0.18*	*180.7*
BristolBay	*0.78*	*0.53*	*0.49*	*0.07*	*0.37*	*0.61*	*0.29*	*37.3*
UpperYukon	0.02	0.03	0.02	0.01	0.01	0.04	0.00	17.5
NorthPenn	0.05	0.10	0.12	0.04	0.04	0.19	0.07	131.6
NWPenn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
SouthPenn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
ChignikKod	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
EastKodiak	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na

Replicate 4

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
Kotzebue	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
CWAK	0.93	0.88	0.94	0.02	0.90	0.96	0.01	*1.0*
Norton	*0.00*	*0.07*	*0.07*	*0.05*	*0.00*	*0.16*	*0.07*	*na*
YukonCoastal	*0.05*	*0.06*	*0.02*	*0.03*	*0.00*	*0.10*	*0.03*	*69.0*
Kuskokwim	*0.10*	*0.18*	*0.33*	*0.07*	*0.22*	*0.43*	*0.23*	*226.1*
BristolBay	*0.78*	*0.57*	*0.52*	*0.05*	*0.45*	*0.61*	*0.26*	*32.8*
UpperYukon	0.02	0.03	0.02	0.01	0.01	0.03	0.00	5.4
NorthPenn	0.05	0.08	0.04	0.02	0.02	0.07	0.01	16.6
NWPenn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
SouthPenn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
ChignikKod	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
EastKodiak	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na

206
207

208

Replicate 5 Table 3 (continued)

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na
Kotzebue	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na
CWAK	0.93	0.85	0.92	0.04	0.83	0.97	0.01	0.8
Norton	*0.00*	*0.10*	*0.06*	*0.05*	*0.00*	*0.15*	*0.06*	*na*
YukonCoastal	*0.05*	*0.10*	*0.11*	*0.07*	*0.00*	*0.23*	*0.06*	*125.9*
Kuskokwim	*0.10*	*0.19*	*0.20*	*0.09*	*0.07*	*0.36*	*0.10*	*103.5*
BristolBay	*0.78*	*0.46*	*0.55*	*0.08*	*0.41*	*0.67*	*0.23*	*29.4*
UpperYukon	0.02	0.03	0.02	0.01	0.01	0.04	0.00	2.6
NorthPenn	0.05	0.08	0.06	0.04	0.02	0.15	0.01	13.4
NWPenn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
SouthPenn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
ChignikKod	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na
EastKodiak	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na

209
210

Table 4. SPAM and BAYES estimates from 5 replicate samples for the "Kusko Bay" fishery-based proof test. The 5 replicate samples consisted of different sets of individuals drawn from the baseline in the same reporting group proportions (Actual). These fish were removed from the baseline and used as mixtures. SPAM estimates were used as priors for the BAYES analysis. BAYES estimate (BAYES), standard deviation (sd), lower (CI 5) and upper (CI 95) 90% credibility interval values, absolute deviation from the known (ABS dev; proportion) and relative absolute deviation from the known (Rel ABS dev; percent; "na" if Actual = 0) for each estimate are provided. Estimates for coastal western Alaska (CWAK) are shown both for a single reporting group and that proportion divided among the 4 reporting groups (italics) that make up CWAK.

Replicate 1

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.02	0.03	0.02	0.01	0.01	0.04	0.00	8.7
Kotzebue	0.02	0.03	0.02	0.01	0.00	0.05	0.00	19.5
CWAK	0.86	0.79	0.84	0.03	0.79	0.88	0.02	2.8
Norton	*0.07*	*0.16*	*0.05*	*0.05*	*0.00*	*0.15*	*0.02*	*25.7*
YukonCoastal	*0.20*	*0.22*	*0.26*	*0.08*	*0.13*	*0.39*	*0.06*	*28.8*
Kuskokwim	*0.55*	*0.34*	*0.47*	*0.09*	*0.31*	*0.62*	*0.08*	*15.0*
BristolBay	*0.04*	*0.08*	*0.06*	*0.06*	*0.00*	*0.16*	*0.02*	*46.9*
UpperYukon	0.05	0.07	0.06	0.02	0.03	0.09	0.01	23.1
NorthPenn	0.02	0.03	0.03	0.01	0.00	0.05	0.01	27.1
NWPenn	0.02	0.02	0.02	0.01	0.00	0.04	0.00	5.9
SouthPenn	0.01	0.01	0.01	0.01	0.00	0.02	0.00	43.9
ChignikKod	0.00	0.02	0.01	0.01	0.00	0.02	0.01	na
EastKodiak	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na

Replicate 2

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.02	0.03	0.02	0.01	0.01	0.04	0.00	11.8
Kotzebue	0.02	0.02	0.01	0.01	0.00	0.02	0.01	65.8
CWAK	0.86	0.84	0.88	0.02	0.85	0.91	0.02	2.6
Norton	*0.07*	*0.13*	*0.10*	*0.04*	*0.03*	*0.17*	*0.03*	*36.6*
YukonCoastal	*0.20*	*0.23*	*0.29*	*0.08*	*0.16*	*0.42*	*0.09*	*46.5*
Kuskokwim	*0.55*	*0.37*	*0.47*	*0.08*	*0.33*	*0.61*	*0.08*	*15.1*
BristolBay	*0.04*	*0.10*	*0.03*	*0.03*	*0.00*	*0.10*	*0.01*	*34.0*
UpperYukon	0.05	0.05	0.04	0.01	0.02	0.07	0.01	19.7
NorthPenn	0.02	0.02	0.02	0.01	0.00	0.04	0.00	20.3
NWPenn	0.02	0.02	0.03	0.01	0.01	0.05	0.01	34.0
SouthPenn	0.01	0.01	0.00	0.00	0.00	0.01	0.01	63.2
ChignikKod	0.00	0.01	0.00	0.00	0.00	0.01	0.00	na
EastKodiak	0.00	0.01	0.00	0.00	0.00	0.00	0.00	na

222

Replicate 3 Table 4 (continued)

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.02	0.02	0.02	0.01	0.01	0.03	0.00	11.0
Kotzebue	0.02	0.02	0.01	0.01	0.00	0.02	0.01	66.1
CWAK	0.86	0.84	0.89	0.02	0.85	0.92	0.03	3.1
Norton	*0.07*	*0.15*	*0.24*	*0.07*	*0.11*	*0.36*	*0.17*	*243.3*
YukonCoastal	*0.20*	*0.28*	*0.44*	*0.09*	*0.29*	*0.58*	*0.24*	*117.6*
Kuskokwim	*0.55*	*0.31*	*0.17*	*0.08*	*0.05*	*0.31*	*0.38*	*68.8*
BristolBay	*0.04*	*0.10*	*0.04*	*0.03*	*0.01*	*0.10*	*0.00*	*0.1*
UpperYukon	0.05	0.06	0.05	0.01	0.03	0.07	0.00	3.9
NorthPenn	0.02	0.02	0.00	0.01	0.00	0.01	0.02	92.2
NWPenn	0.02	0.02	0.03	0.01	0.02	0.05	0.01	53.0
SouthPenn	0.01	0.01	0.00	0.00	0.00	0.01	0.01	88.2
ChignikKod	0.00	0.01	0.01	0.01	0.00	0.02	0.01	na
EastKodiak	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na

Replicate 4

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.02	0.02	0.02	0.01	0.01	0.03	0.00	3.5
Kotzebue	0.02	0.01	0.00	0.00	0.00	0.00	0.02	99.2
CWAK	0.86	0.85	0.86	0.02	0.82	0.90	0.00	0.4
Norton	*0.07*	*0.15*	*0.19*	*0.08*	*0.04*	*0.31*	*0.12*	*165.7*
YukonCoastal	*0.20*	*0.24*	*0.30*	*0.09*	*0.16*	*0.45*	*0.10*	*51.1*
Kuskokwim	*0.55*	*0.36*	*0.31*	*0.12*	*0.11*	*0.51*	*0.24*	*43.4*
BristolBay	*0.04*	*0.11*	*0.06*	*0.06*	*0.00*	*0.17*	*0.02*	*60.0*
UpperYukon	0.05	0.07	0.07	0.02	0.04	0.10	0.02	38.1
NorthPenn	0.02	0.02	0.02	0.01	0.00	0.04	0.00	12.5
NWPenn	0.02	0.01	0.01	0.01	0.00	0.02	0.01	55.1
SouthPenn	0.01	0.01	0.02	0.01	0.00	0.04	0.01	83.7
ChignikKod	0.00	0.01	0.00	0.01	0.00	0.01	0.00	na
EastKodiak	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na

223

224

Replicate 5 Table 4 (continued)

Reporting group	Actual	SPAM	BAYES	sd	CI 5	CI 95	ABS dev	Rel ABS dev
Asia	0.02	0.02	0.02	0.01	0.01	0.03	0.00	1.1
Kotzebue	0.02	0.01	0.01	0.00	0.00	0.01	0.01	70.3
CWAK	0.86	0.87	0.89	0.02	0.85	0.92	0.03	3.6
Norton	*0.07*	*0.16*	*0.13*	*0.07*	*0.02*	*0.26*	*0.06*	*92.6*
YukonCoastal	*0.20*	*0.22*	*0.38*	*0.10*	*0.21*	*0.53*	*0.18*	*88.6*
Kuskokwim	*0.55*	*0.34*	*0.29*	*0.09*	*0.16*	*0.45*	*0.26*	*47.3*
BristolBay	*0.04*	*0.15*	*0.09*	*0.05*	*0.00*	*0.18*	*0.05*	*124.1*
UpperYukon	0.05	0.06	0.05	0.02	0.02	0.08	0.00	5.9
NorthPenn	0.02	0.01	0.00	0.01	0.00	0.01	0.02	90.3
NWPenn	0.02	0.02	0.03	0.01	0.01	0.05	0.01	42.1
SouthPenn	0.01	0.01	0.01	0.01	0.00	0.02	0.00	49.8
ChignikKod	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na
EastKodiak	0.00	0.00	0.00	0.00	0.00	0.00	0.00	na

225
226
227

Figures

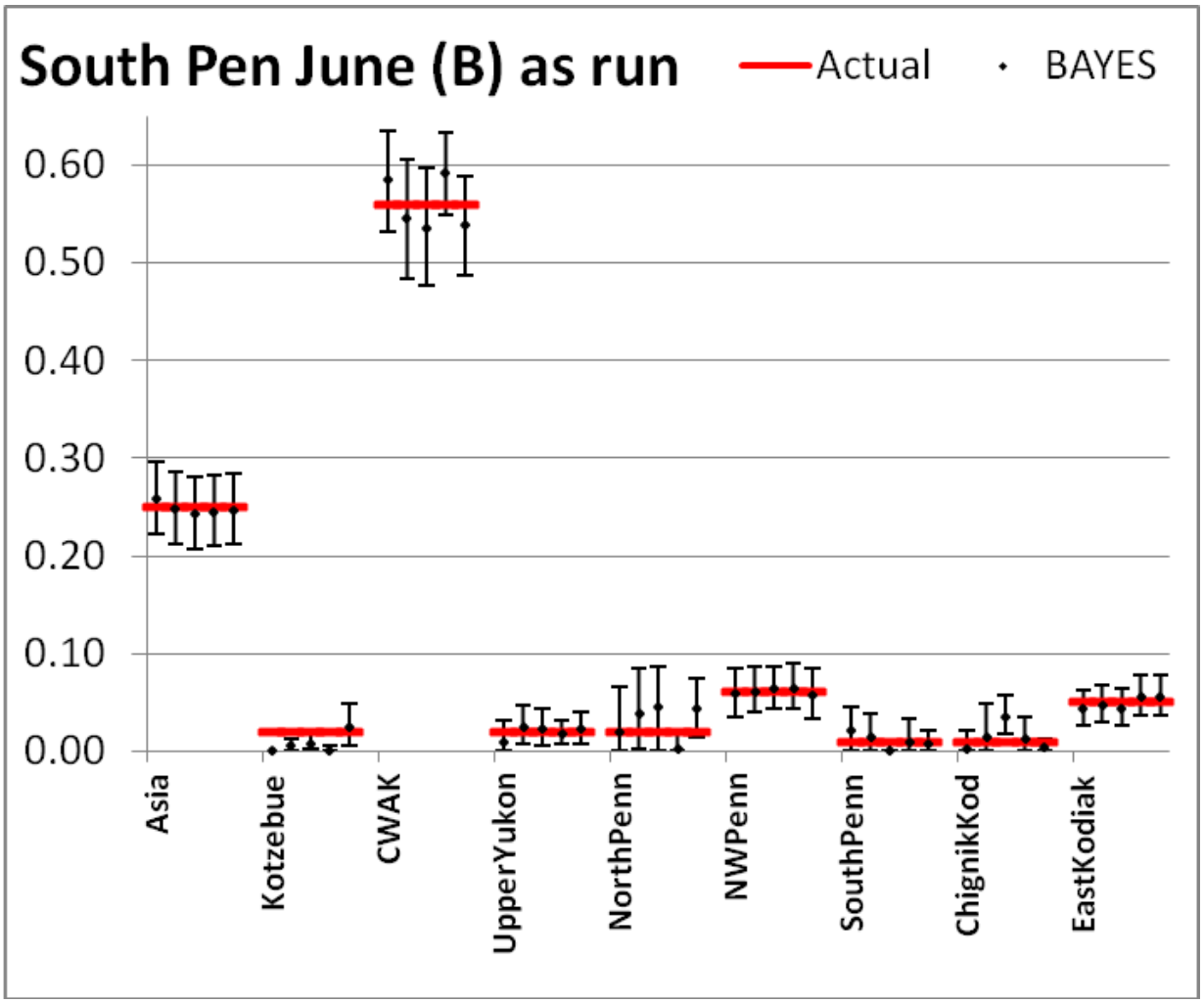

Figure 1. BAYES estimates for 5 replicate samples for the fishery-based proof test "South Pen June (b) as run" (see Table 1) for 9 reporting groups where coastal western Alaska (CWAK) is a single reporting group. The actual stock composition of the replicate samples is shown as a red horizontal line. For each replicate sample, the estimate (dot) and lower and upper 90% credibility interval (vertical line) are provided.

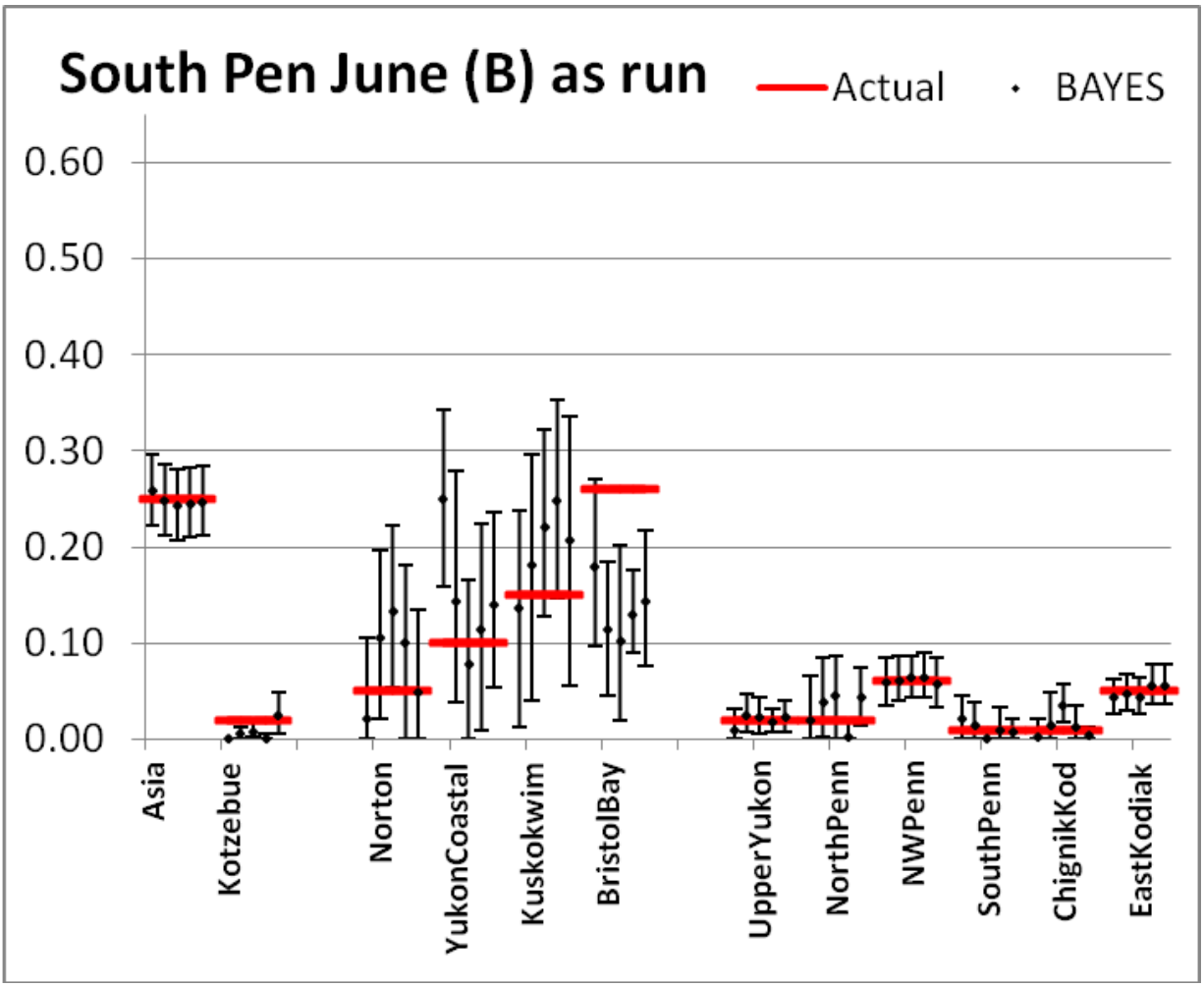

Figure 2. BAYES estimates for 5 replicate samples for a fishery-based proof test "South Pen June (b) as run" (see Table 1) for 12 reporting groups where coastal western Alaska (CWAK) divided into 4 reporting groups (Norton, YukonCoastal, Kukokwim, BristolBay). The actual stock composition of the replicate samples is shown as a red horizontal line. For each replicate sample, the estimate (dot) and lower and upper 90% credibility interval (vertical line) are provided.

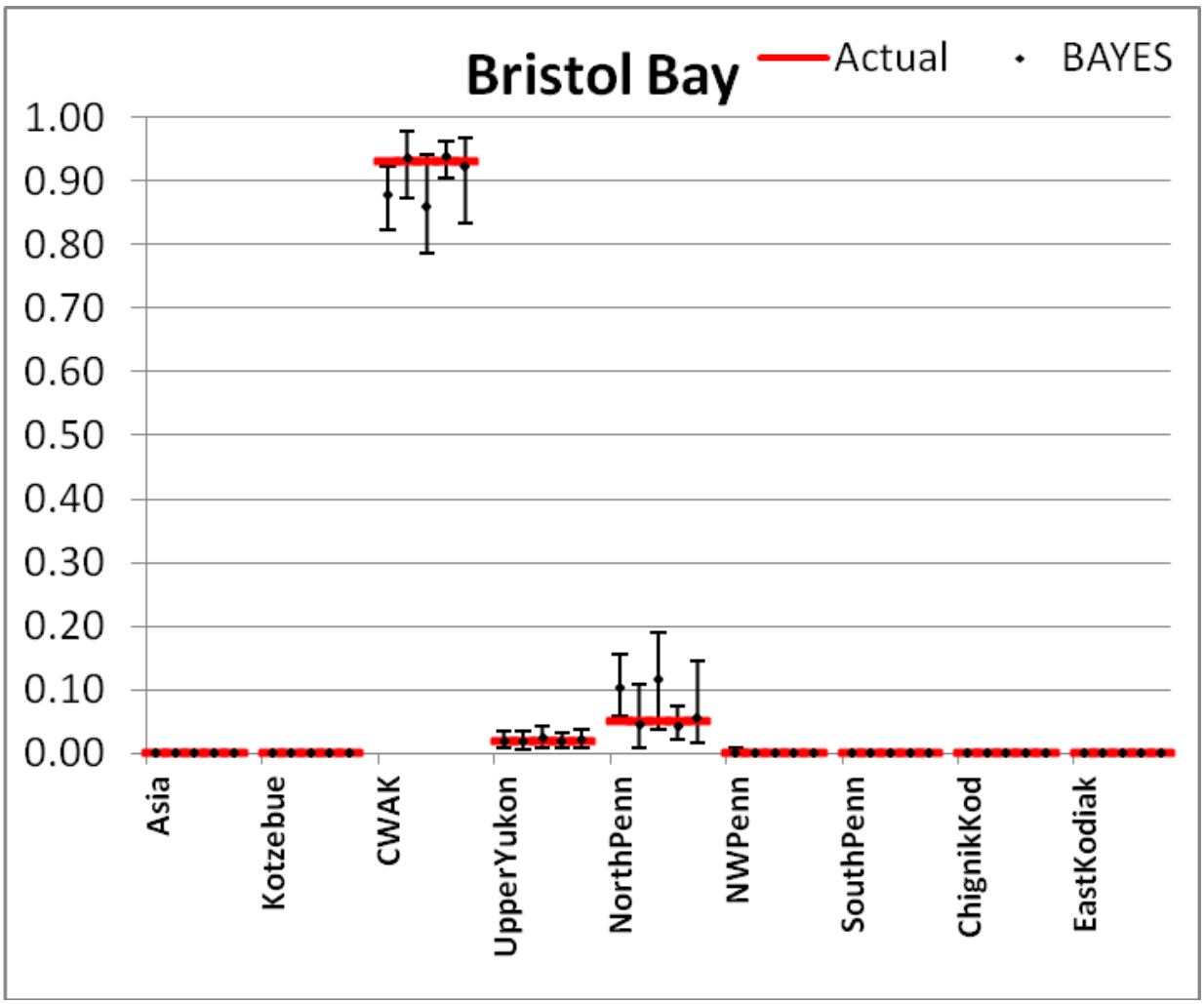

Figure 3. BAYES estimates for 5 replicate samples for the fishery-based proof test "Bristol Bay" (see Table 1) for 9 reporting groups where coastal western Alaska (CWAK) is a single reporting group. The actual stock composition of the replicate samples is shown as a red horizontal line. For each replicate sample, the estimate (dot) and lower and upper 90% credibility interval (vertical line) are provided.

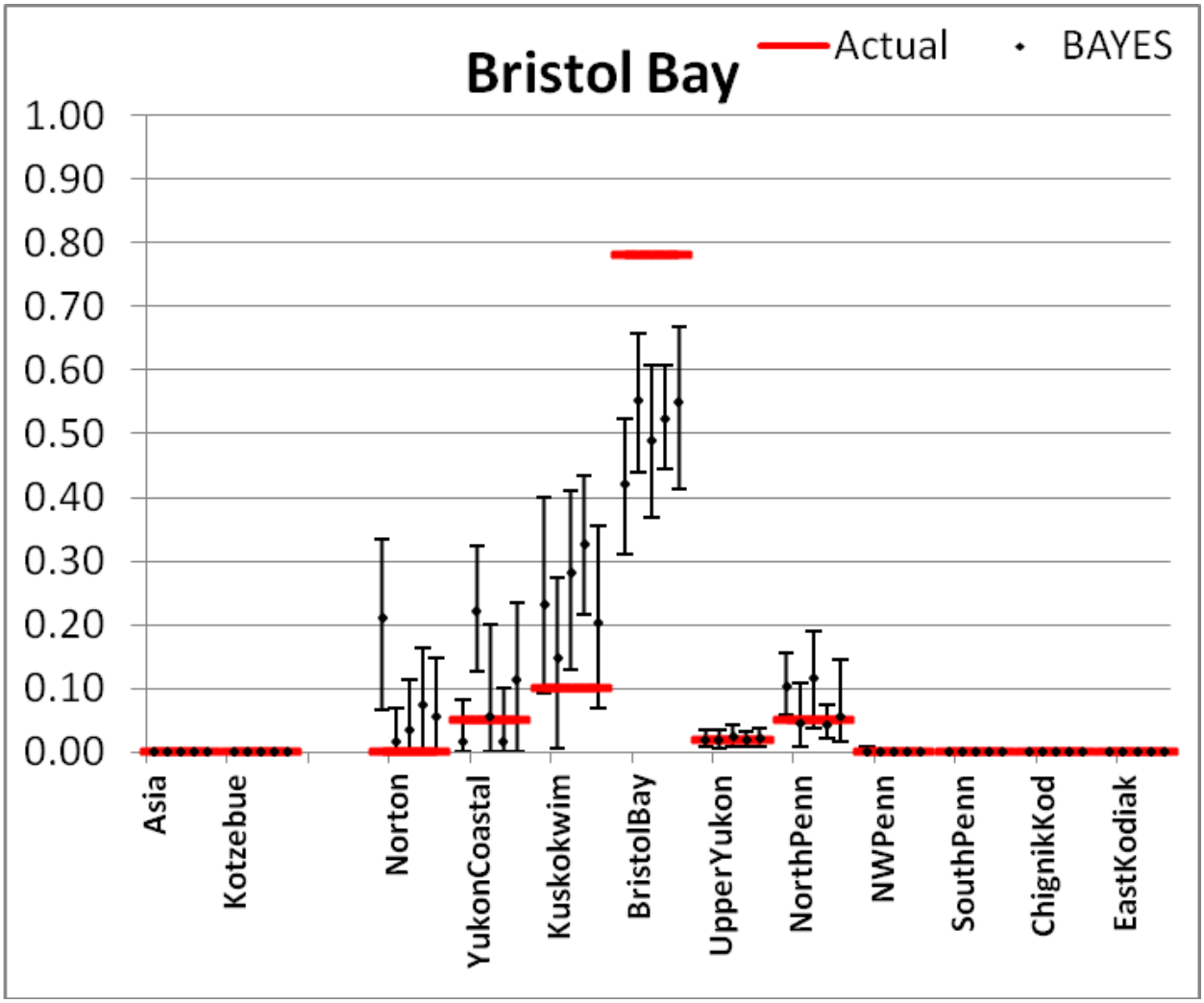

Figure 4. BAYES estimates for 5 replicate samples for a fishery-based proof test "Bristol Bay" (see Table 1) for 12 reporting groups where coastal western Alaska (CWAK) divided into 4 reporting groups (Norton, YukonCoastal, Kuskokwim, BristolBay). The actual stock composition of the replicate samples is shown as a red horizontal line. For each replicate sample, the estimate (dot) and lower and upper 90% credibility interval (vertical line) are provided.

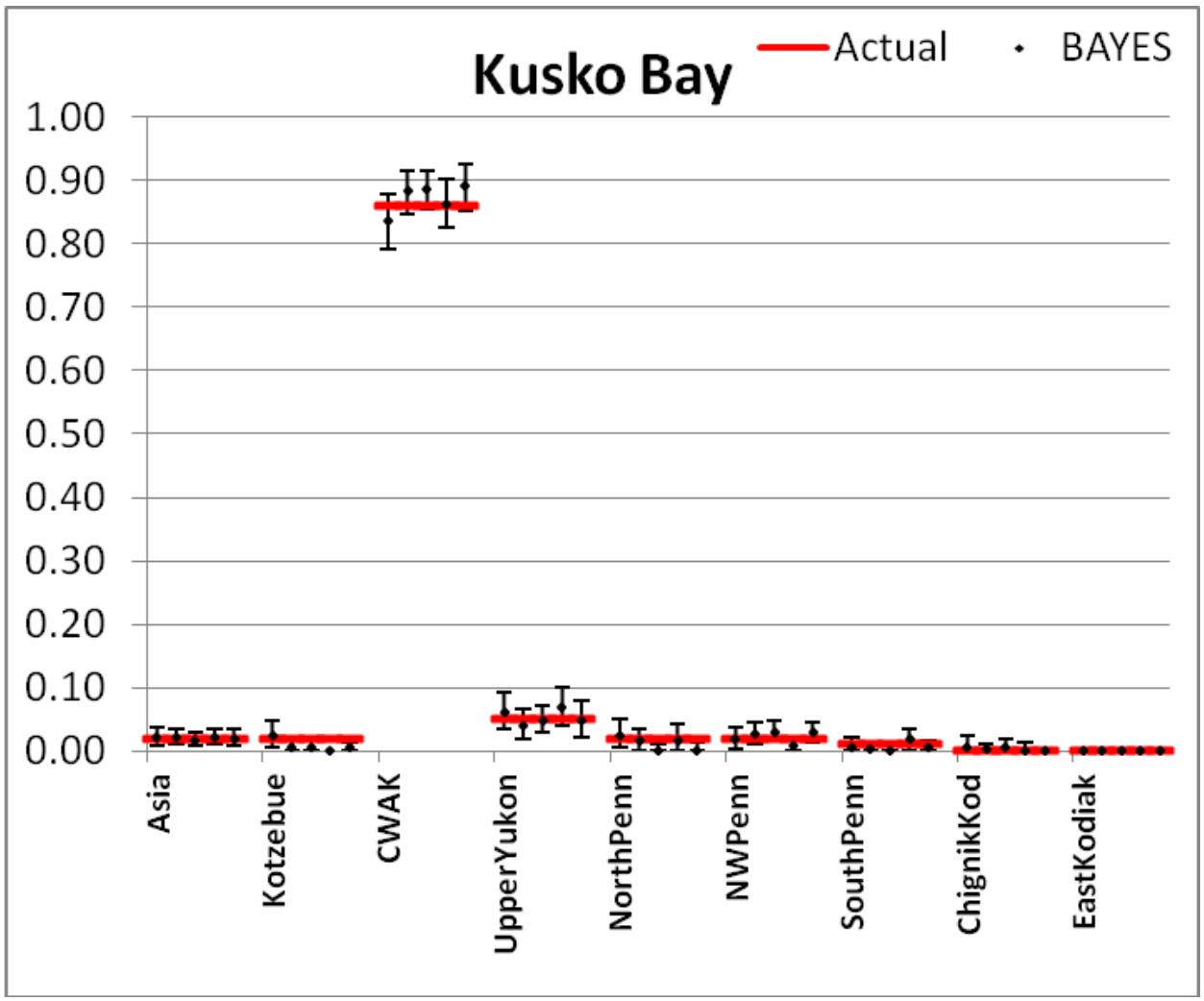

Figure 5. BAYES estimates for 5 replicate samples for the fishery-based proof test "Kusko Bay" (see Table 1) for 9 reporting groups where coastal western Alaska (CWAK) is a single reporting group. The actual stock composition of the replicate samples is shown as a red horizontal line. For each replicate sample, the estimate (dot) and lower and upper 90% credibility interval (vertical line) are provided.

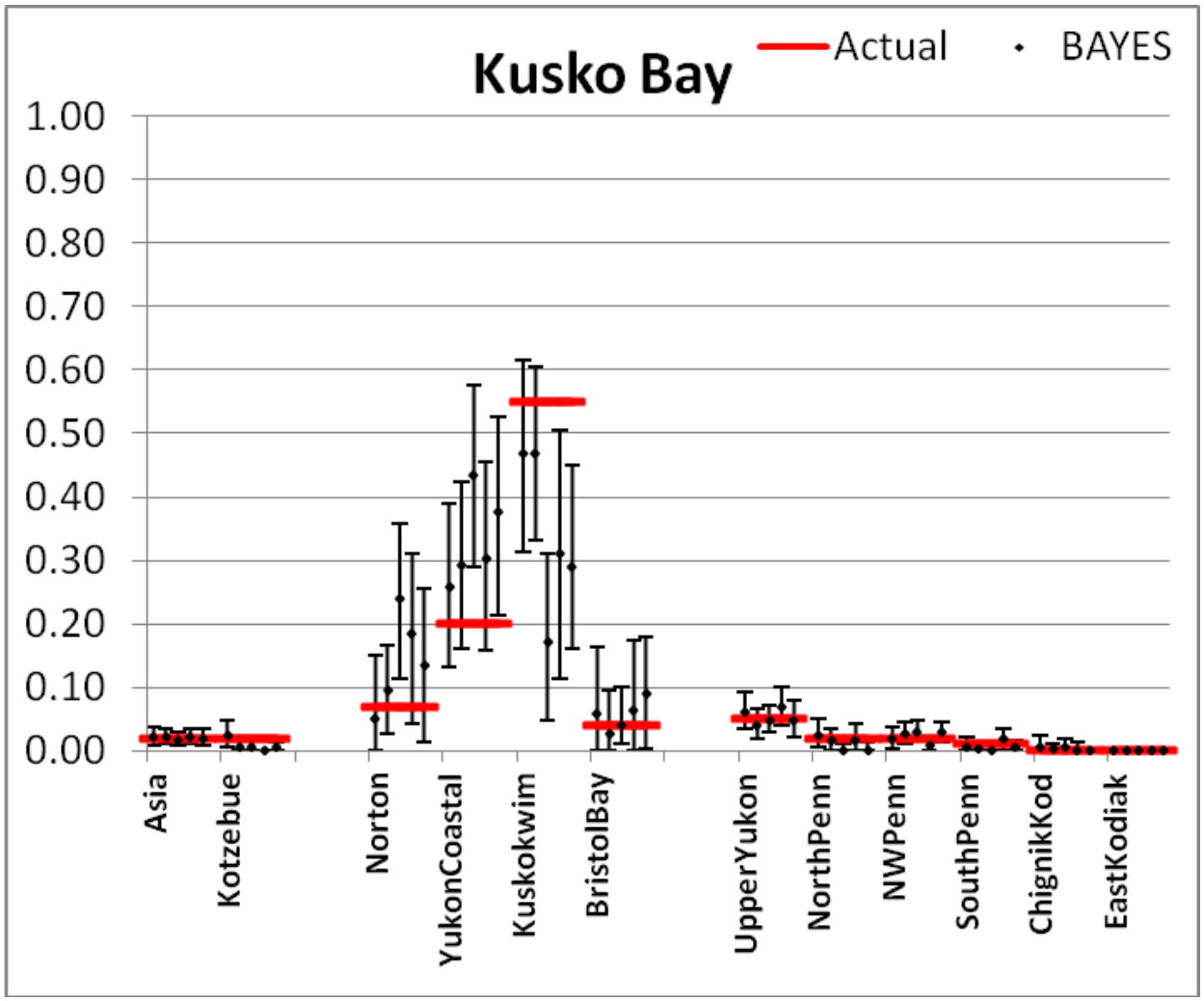

Figure 6. BAYES estimates for 5 replicate samples for a fishery-based proof test "Kusko Bay" (see Table 1) for 12 reporting groups where coastal western Alaska (CWAK) divided into 4 reporting groups (Norton, YukonCoastal, Kuskokwim, BristolBay). The actual stock composition of the replicate samples is shown as a red horizontal line. For each replicate sample, the estimate (dot) and lower and upper 90% credibility interval (vertical line) are provided.