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Genetic Stock Composition of the Commercial Harvest of Sockeye Salmon in Bristol Bay, Alaska, 2006–2008

by

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Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye to fork	MEF
mideye to tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY MANUSCRIPT SERIES NO. 09-06

GENETIC STOCK COMPOSITION OF THE COMMERCIAL HARVEST OF SOCKEYE SALMON IN BRISTOL BAY, ALASKA, 2006–2008

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ABSTRACT

Bristol Bay Management Area supports the largest sockeye salmon *Oncorhynchus nerka* fishery in the world. A key to the sustainability of the fishery has been conservation of sockeye salmon biodiversity, which is derived from a wide variety of life history types and multiple distinct, locally adapted populations. Alaska Department of Fish and Game is responsible for managing commercial fisheries in Bristol Bay under the sustained-yield principal. Accurately estimating the stock composition of catch within the fishing districts is critical to determining the total run (catch and escapement) of each stock, especially considering that sockeye salmon stocks in Bristol Bay can be exploited at rates up to 80%. In recent years, the department has developed a genetics program for sockeye salmon in Bristol Bay to develop and apply genetic methods to identify the stock composition of mixtures (mixed stock analysis; MSA). Here we investigate where fish from different stocks are captured in the commercial fishing districts during 2006, 2007, and 2008 and compare these results to those based on the traditionally used method of age-based MSA. Results from genetic MSA support results from previous studies showing that high proportions of the stocks captured in fishing districts were of fish returning to the rivers draining into the districts. However, these data also show that some stocks were harvested in districts other than their district of origin, that the catch of some stocks within fishing districts were under- or over-estimated by large amounts (2%–435%), and that these new estimates resulted in considerably different estimates of total run by stock (1%–164%) compared to traditional methods. The magnitude of these differences varied among years, highlighting the difficulties for developing standardized adjustment of results from the age-composition method. Future analyses will combine the genetic estimates presented in this report with data from other years to produce more accurate estimates of total run, which will likely lead to changes in escapement goals for stocks in Bristol Bay.

Key words: Pacific salmon, *Oncorhynchus* spp., sockeye salmon, *Oncorhynchus nerka*, harvest, catch, allocation, commercial fishery, stock, composition, genetics, populations, Bristol Bay, Kvichak River, Alagnak River, Naknek River, Egegik River, Ugashik River, Wood River, Igushik River, Nushagak River, Togiak River.

INTRODUCTION

Bristol Bay Management Area supports the largest sockeye salmon *Oncorhynchus nerka* fishery in the world. It encompasses all coastal and inland waters from Cape Menshikof to Cape Newenham (Figure 1). Commercial harvests of sockeye salmon have occurred since the late 1800s and, since 1956, have ranged in size from 760,000 in 1973 to 45 million fish in 1995. The average harvest during 2006–2008 was approximately 28.6 million fish (Table 1). There are 9 major sockeye salmon-producing drainages in Bristol Bay: the Ugashik, Egegik, Naknek, Alagnak, Kvichak, Nushagak, Wood, Igushik, and Togiak rivers (Figure 1). Almost 50% of all sockeye salmon produced in the world originate from Bristol Bay drainages alone (Eggers and Irvine 2007; Bugaev et al. 2008). Since 1956, Bristol Bay escapements have varied from approximately 1.7 million in 1973 to 38.7 million in 1980, averaging approximately 14.1 million fish from 2006–2008 (Table 1).

A key to the success of the sustainability of Bristol Bay sockeye salmon and fisheries that depend on them has been conservation of biodiversity, which is derived from a wide variety of life history types and multiple distinct, locally adapted populations (Hilborn et al. 2003). Numerous discrete populations of sockeye salmon have been identified within each of the drainages in Bristol Bay (Habicht et al. 2007a). A population is defined as a spawning aggregation that has little interbreeding with other spawning aggregations other than the natural background stray rate, is uniquely adapted to a spawning habitat, and has inherently unique attributes (Ricker 1958) that result in different productivity rates (Pearcy 1992; NRC 1996). This population definition is analogous to the spawning aggregations described by Baker et al. (1996) and the demes by NRC (1996). For purposes of fisheries management, a "stock" in

Bristol Bay is defined as a composite of all populations within each of the 9 major rivers within Bristol Bay. This stock definition is analogous to the definition of a "salmon stock" as defined in the *Policy for the Management of Sustainable Salmon Fisheries* (SSFP; 5 AAC 39.222). In addition to the fish from the 9 major rivers listed above, fish originating from drainages along the North Alaska Peninsula and Aleutian Islands and from Kuskokwim Bay and River may also be captured in Bristol Bay fisheries.

Alaska Department of Fish and Game (department), Division of Commercial Fisheries (division), is responsible for managing commercial fisheries in Bristol Bay under the sustained-yield principal. To accomplish this objective, the department opens and closes fishing districts with the primary goal of achieving spawning escapement for each stock within a specified goal range. Sockeye salmon are harvested in 5 terminal fishing areas in Bristol Bay, referred to as "fishing districts" (Figure 1), that are designed to harvest salmon shortly before they escape to major Bristol Bay watersheds. The Naknek-Kvichak, Egegik, and Ugashik districts are referred to as the Eastside fisheries, and the Nushagak and Togiak districts are referred to as the Westside fisheries. Individual escapement goals have been in place for each stock in Bristol Bay since the early 1960s. Escapement goal ranges were recently reviewed based on the *Policy for the Management of Sustainable Salmon Fisheries* (SSFP; 5 AAC 39.222) and *Policy for Statewide Salmon Escapement Goals* (EGP; 5 AAC 39.223) (Baker et al. 2009). These policies were adopted by the Alaska Board of Fisheries (board) to ensure that the state's salmon stocks are conserved, managed, and developed using the sustained-yield principle. The sustained-yield principal requires an understanding of the relationship between the number of fish that spawn in a drainage and the number of their offspring that make it to adulthood (i.e., brood table). The numbers of fish that escape into the drainages in Bristol Bay are counted by the department using counting towers or hydroacoustics (sonar). The numbers of offspring that return are calculated by adding the number of spawners and the number of fish harvested before reaching the spawning grounds. These calculations are done on a stock-by-stock basis.

Accurately estimating the stock composition of catch within the fishing districts is critical to determining the total run of each stock, especially considering that sockeye salmon stocks in Bristol Bay can be exploited at rates up to 80%. Although the fishing districts in Bristol Bay are terminal, some of the districts straddle multiple drainages and therefore catch multiple stocks (Figure 1). For example, Naknek-Kvichak and Nushagak districts target 3 stocks each. The department currently uses age composition estimates from the harvest and escapement, run timing, and escapement strength to allocate harvest to each stock (Bernard 1983). The current method assumes that the stocks present in a district are equally exploited. This assumption may not be correct (Baker et al. 2006). Violating this assumption would cause underestimation of productivity for some stocks and overestimation of productivity for others. In addition, although most of the catch in the single-drainage districts (Ugashik, Egegik, and Togiak districts) are assumed to be fish from those drainages, estimates of interceptions of stocks outside their district of origin, based on differences in scale growth patterns, have shown that this is probably not true (Menard and Miller 1997). Although the use of interception estimates obtained from scale pattern analysis during 1983 through 1995 did not substantially change spawner-recruit relationships (Menard and Miller 1997), estimates of interceptions within Bristol Bay have not been obtained since 1996. It should be noted that scale pattern analysis in Bristol Bay had various issues that ultimately led to the project's termination, some of which included: (1) the exclusion of all Alagnak River and all Westside stocks; (2) temporal instability in scale patterns used to separate stock components; and (3) classification accuracy generally far less than 90%.

In recent years, the department has developed a genetics program for sockeye salmon in Bristol Bay. The primary goal of the Bristol Bay genetics program was to develop and apply genetic methods to identify stock composition of mixtures (mixed stock analysis; MSA). The first comprehensive baseline using genetic markers in Bristol Bay employed microsatellites. This baseline was capable of separating some, but not all, stocks within Bristol Bay (Habicht et al. 2007a). The need to better differentiate among all the stocks led to development of methods that screen single nucleotide polymorphism (SNP) loci under positive selection. The addition of 2 major histocompatibility complex (MHC) SNP loci provided the power to distinguish among all stocks. The advantages of higher throughput speeds, lower labor costs, and higher reproducibility of SNPs led to development of additional SNPs for sockeye salmon (Elfstrom et al. 2006) to replace the microsatellite baseline. Starting in 2005, the department's Gene Conservation Laboratory (GCL) developed a sockeye salmon genetic baseline in Bristol Bay using SNP markers which were capable of distinguishing among all the stocks and among numerous population groupings within stocks.

One of the first applications of genetic MSA in Bristol Bay was the Port Moller test fishery project (Flynn and Hilborn 2004). Genetic sampling was first added to the Port Moller test fish project in 2004 and continues to date. The intent was to use inseason genetic analyses to identify components of the aggregate annual run in time to assist management decisions about individual stocks. GCL staff have been able to provide stock composition estimates within 3 to 5 days using microsatellites (2004 and 2005) and within 2 to 4 days using SNPs (2006 through present), depending on several factors (e.g., timing of airline flights and weather on the fishing grounds). The ability to provide genetic stock composition estimates in such a short period of time has improved the usefulness of the Port Moller test fishery by providing managers with stock composition estimates for migrating fish prior to their arrival at fishing districts within Bristol Bay.

A related project, the Western Alaska Salmon Stock Identification Project (WASSIP), has significant overlap with the Bristol Bay genetics program. WASSIP sampling and analysis goals include substantially larger numbers of samples than this program was funded to analyze. As a result, this program has integrated sample collection using its funds to collect its samples, in addition to funds from WASSIP to collect samples needed to satisfy WASSIP sockeye salmon sampling goals. Moreover, because the objectives of the program and the project were different, sample selection for analysis may overlap but will not be identical. Finally, the Bristol Bay genetics program will analyze only a subset of samples collected because samples selected for analysis were selected postseason in proportion to harvest. All samples in the WASSIP sampling plan collected under this program will be available for analysis with WASSIP funding.

This report summarizes the current Bristol Bay sockeye salmon SNP baseline and its performance in mixed stock analysis. We report estimates of stock composition and stock-specific catch for commercial harvest in the 5 commercial fishing districts in Bristol Bay during 2006, 2007, and 2008. Stock composition estimates of commercial harvest within districts were used to estimate the total run for each of the major river drainages in Bristol Bay (referred to hereafter as "inshore run size"). In doing so, this report describes the fulfillment of 2 (Objectives 1 and 3) of the 4 objectives outlined in the Bristol Bay genetics program.

OBJECTIVES

The objectives of the Bristol Bay genetics program were to:

1. Develop a baseline consisting of SNP allele frequencies from all major populations of sockeye salmon in Bristol Bay, North Peninsula, and Kuskokwim Bay and test the baseline's representation of the genetic diversity of the region and the baseline's ability to distinguish among stocks;
2. Provide inseason estimates of stock composition of sockeye salmon in the Port Moller test fishery;
3. Provide postseason estimates of stock compositions of sockeye salmon harvested in commercial salmon fisheries by district within Bristol Bay; and
4. Provide postseason estimates of stock composition of sockeye salmon samples designed to test the efficacy of changing variables under management control within districts to manipulate the stock composition of the commercial catch.

DEFINITIONS

To reduce confusion associated with the methods, results, and interpretation of this study, basic definitions of commonly used genetic and salmon management terms are offered here.

Allele. Alternative form of a given gene or DNA sequence.

Bootstrapping. A method of resampling data with replacement to assess the variation of parameters of interest.

Brood (year). All salmon in a stock spawned in a specific year.

Credibility Interval. In Bayesian statistics, a credibility interval is a posterior probability interval. Credibility intervals differ from the confidence intervals in frequentist statistics in that they are a direct statement of probability: i.e. a 90% credibility interval has a 90% chance of containing the true answer.

District. Waters open to commercial salmon fishing. Commercial fishing districts, subdistricts and sections in Bristol Bay are defined in 5 AAC 06.200.

Escapement (or Spawning Abundance or Spawners). The annual estimated size of spawning salmon stock; quality of escapement may be determined not only by numbers of spawners, but also factors such as sex ratio, age composition, temporal entry into the system, and spatial distribution with the salmon spawning habitat from 5 AAC 39.222(f)).

F_{ST}. Fixation index, estimates the reduction in heterozygosity due to random genetic drift among populations; the proportion of the variation at a locus attributable to divergence among populations.

Gametic Disequilibrium. A state that exists in a population when alleles at different loci are not distributed independently in the population's gamete pool, often because the loci are physically linked.

Genetic Marker. A known DNA sequence that can be identified by a simple assay.

Genotype. The set of alleles for one or more loci for a fish.

Harvest. The number of salmon or weight of salmon taken of a run from a specific stock.

Harvest Rate. The fraction harvest from a stock taken in a fishery.

Hardy-Weinberg Expectations (H-W). The genotype frequencies that would be expected from given allele frequencies assuming: random mating, no mutation (the alleles do not change), no migration or emigration (no exchange of alleles between populations), infinitely large population size, and no selective pressure for or against any traits.

Heterozygosity. The proportion of individuals in a population that are heterozygous at a particular marker; a measure of variability.

Locus (Loci, plural). A fixed position or region on a chromosome that may contain more than one genetic marker.

MSA. Mixed Stock Analysis: Method using allele frequencies from populations and genotypes from mixture samples to estimate stock compositions of mixtures.

Microsatellites. DNA sequences containing short (2–5 base pairs) tandem repeats of nucleotides (e.g., GTGTGTGT).

PCR. The polymerase chain reaction or PCR amplifies a single or few copies of a locus across several orders of magnitude, generating millions of copies of the DNA.

Reporting Group. A group of populations in a genetic baseline to which portions of a mixture are allocated during mixed stock analyses; constructed based on a combination of management needs and genetic distinction.

Run. The total number of salmon in a stock surviving to adulthood and returning to the vicinity of the natal stream in any calendar year, composed of both the harvest of adult salmon plus the escapement; the annual run in any calendar year With the exception of pink salmon *O. gorbuscha*, the run would be composed of several age classes of mature fish from the stock, derived from the spawning of a number of previous brood years (from 5 AAC 39.222(f)).

SNP. Single nucleotide polymorphism; DNA sequence variation occurring when a single nucleotide (A, T, C, or G) differs among individuals or within an individual between paired chromosomes.

Salmon Stock. A locally interbreeding group of salmon that is distinguished by a distinct combination of genetic, phenotypic, life history, and habitat characteristics or an aggregation of two or more interbreeding groups, which occur in the same geographic area and is managed as a unit (from 5 AAC 39.222(f)). For purposes of this study, a "stock" in Bristol Bay has been defined as a composite of all populations within each of the 9 major rivers within Bristol Bay and 2 for the adjacent regions (North Peninsula, Kuskokwim) that represent other populations that might be observed in Bristol Bay.

METHODS

COMMERCIAL HARVEST AND ESCAPEMENT

Commercial Harvest

Commercial harvests in numbers of salmon by district were taken from summaries of fish tickets (sales receipts given to fishermen from buyers at the time of delivery). The final harvest numbers used for this report were from the final fish ticket reports compiled by the department as of September 30, 2009.

Escapement

Bristol Bay salmon escapements were estimated with various methods (including counting towers and sonar) by division personnel. Sockeye salmon escapement estimates were based on visual counts made from counting towers on the banks of the Ugashik, Egegik, Naknek, Alagnak, Kvichak, Wood, Igushik, and Togiak rivers. At all tower projects, counts were made for 10 minutes every hour on each riverbank. Counting began on 1 bank at the start of each hour, followed by counting on the opposite bank. Each 10-minute count was expanded into an hourly estimate (x6) and these were added together to arrive at a total daily escapement (West et al. 2009). Side-looking sonar located in the lower Nushagak River near Portage Creek was used to estimate salmon escapements for the entire Nushagak River drainage (Brazil 2008).

TISSUE SAMPLING

Baseline Sampling

Baseline samples for SNP analysis were collected from spawning populations of sockeye salmon from throughout Bristol Bay by the department, University of Washington Alaska Salmon program, U.S. Geological Survey, National Park Service, and one lodge owner (Appendix A1). A minimum target sample size for baseline collections was 95 individuals summed across all years for each population to achieve acceptable precision for the allele frequency estimates (Allendorf and Phelps 1981; Waples 1990a) and to accommodate our genotyping platform. Heart tissue, fin tissue, or axillary processes were collected from adult sockeye salmon and placed on wet ice or in ethanol. Samples on ice were frozen and stored at -80ºC. Samples in ethanol were stored at room temperature.

Escapement Sampling

Genetic samples were collected as part of the regular age, sex, and length (ASL) escapement sampling program at some or all of the 9 enumeration sites from 2002 to 2007 (Table 2). All enumeration sites, except for the Togiak River tower, are located well below spawning grounds, but above the tidal influence in each system and most likely only capture fish destined to spawn within the river being enumerated.

District Catch Sampling

We placed axillary fins collected from sockeye salmon into individually labeled 2 ml tubes or 48-well trays (with 5 ml wells) filled with ethanol as part of the regular ASL catch sampling program. The goal of sampling was to representatively sample sockeye salmon harvested in each fishing district throughout the fishing season. In general, we collected samples from sockeye salmon in the harvest in each district from June 20 to July 20. Due to the nature of the

Bristol Bay fishery, representatively sampling with 100% coverage in each district was not always possible. The actual sampling locations where commercial catch samples were obtained were a function of fish availability. Considerable coordination was needed among the catch sampling crew and Bristol Bay area processors to identify when and where fish from the appropriate districts were available for sampling. To the extent possible, samples were obtained from as many different processors as possible to minimize potential bias from sampling in limited heterogeneous locations within districts (Reynolds and Templin 2004). For example, many processors often have purchasing agreements with a set number of commercial fishermen who consistently fish the same locations; thus, obtaining commercial catch samples from limited processors may not be representative of the entire district.

Postseason, district-specific time period strata were identified that represented different fishing areas, fishing times, tidal conditions, and/or fishing methods that might affect the stock composition of the catch. A minimum target sample size of 190 fish was used for each analyzed district-period stratum and was constructed in proportion to preliminary harvest estimates occurring on each day included in the stratum. In cases where inadequate numbers of samples were available for analysis on a given day within a stratum, all the samples collected that day were analyzed and the remainder (number selected minus number available) was selected from other days within the same strata where adequate numbers of samples were available. These additional fish were selected from nearby samples. In the absence of genetic error, a sample size of 190 should provide estimates within 7% of its true value 90% of the time, based on the "worst-case" parameter value for the multinomial distribution (Thompson 1987). Multiple periods may be combined within districts to produce overall stock composition estimates with tighter confidence intervals (e.g., N=380: within 5%, 90% of the time). Preliminary harvest estimates were used to select the number of samples to analyze. However, final harvest estimates were used in the genetics stock composition analysis and are presented in this report.

LABORATORY ANALYSIS

Assaying Genotypes

Genomic DNA was extracted using a DNeasy® 96 Tissue Kit by QIAGEN® (Valencia, CA)[1]. SNP markers were assayed for 45 sockeye salmon; 3 mitochondrial and 42 nuclear DNA (Appendix B1). While baseline collections and commercial catch samples collected in 2007 and 2008 were screened for all SNPs, the commercial catch samples collected in 2006 were screened for 39 of the 45 SNPs (Appendix B1). Genotypes for these SNPs were screened using 2 platforms, depending on when they were assayed and the performance of assays on the different platforms.

For some baseline collections and commercial catch samples collected in 2006, all SNP genotyping was performed in 384-well reaction plates. Each reaction was conducted in a 5μL volume consisting of 5-40ng of template DNA, 1x TaqMan® Universal PCR Master Mix (Applied Biosystems), and 1x TaqMan® SNP Genotyping Assay (Applied Biosystems). Thermal cycling was performed on a Dual 384-Well GeneAmp® PCR System 9700 (Applied Biosystems) as follows: an initial denaturation of 10 min at 95°C followed by 50 cycles of 92°C for 1s and annealing/extension temperature for 1.0 or 1.5 min. The plates were scanned on an

[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

Applied Biosystems Prism 7900HT Sequence Detection System after amplification and scored using Applied Biosystems' Sequence Detection Software (SDS) version 2.2.

SNP genotyping was accomplished as described above for only 2 assays on the remaining baseline collections and commercial catch samples collected in 2007 and 2008. For 2007 samples these assays were *One_MHC2_251* and *One_STC-410* and for 2008 samples they were *One_MHC2_190* and *One_STC-410*. The additional 43 markers were genotyped using Fluidigm® 48.48 Dynamic Arrays (http://www.fluidigm.com Accessed November 10, 2009). The Fluidigm® 48.48 Dynamic Array contains a matrix of integrated channels and valves housed in an input frame. On one side of the frame are 48 inlets to accept the sample DNA from each individual fish and on the other are 48 inlets to accept the assays for each SNP marker. Once in the wells, the components are pressurized into the chip using the IFC Controller MX (Fluidigm). The 48 samples and 48 assays are then systematically combined into 2,304 parallel reactions. In this study, 43 assays were loaded. Each reaction is a mixture of 4µl of assay mix (1x DA Assay Loading Buffer (Fluidigm), 10x TaqMan® SNP Genotyping Assay (Applied Biosystems), and 2.5x ROX (Invitrogen)) and 5µl of sample mix (1x TaqMan® Universal Buffer (Applied Biosystems), 0.05x AmpliTaq® Gold DNA Polymerase (Applied Biosystems), 1x GT Sample Loading Reagent (Fluidigm) and 60-400ng/µl DNA) combined in a 6.75nL chamber. Thermal cycling was performed on an Eppendorf IFC Thermal Cycler as follows: an initial denaturation of 10 min at 96°C followed by 40 cycles of 96° for 15 s and 60° for 1 min. The Dynamic Arrays were read on a BioMark™ Real-Time PCR System (Fluidigm) after amplification and scored using Fluidigm® SNP Genotyping Analysis software. Genotypes collected from both instruments were entered into the GCL Oracle database, LOKI.

Laboratory Failure Rates and Quality Control

Overall failure rate was calculated by dividing the number of failed single-locus genotypes by the number of assayed single-locus genotypes.

Quality control measures were instituted to identify laboratory errors and to determine the reproducibility of genotypes. The process involved reanalysis of 8 out of every 96 fish (one row per 96-well plate; 8%) for all markers, by staff not involved with the original analysis. Assuming that the inconsistencies among analyses were due equally to errors in original genotyping and errors during quality control, error rates in the original genotyping can be estimated as one-half the rate of inconsistencies. Because baseline collections were genotyped on many projects and have been subject to many quality control analyses, we report quality control results for 32 Bristol Bay baseline collections comprising 2,599 individuals (~18% of current baseline) that were genotyped as part of a recent baseline supplemental project. This project genotyped fish on the Fluidigm Dynamic Array platform, and was typical of our current genotyping process.

STATISTICAL ANALYSIS

Data Retrieval and Quality Control

Genotypic data were retrieved from LOKI and were imported into S-Plus (TIBCO Software Inc. 2005; Somerville, MA). Unless otherwise noted, all analyses were performed in S-Plus. Two quality control measures were conducted once genotypes were retrieved from LOKI. The first quality control analysis identified and excluded duplicate fish within collections. Duplicate fish can occur as a result of sampling or extracting the same fish twice and were detected and defined

by identifying pairs of individuals sharing the same alleles in at least 38 out of the 45 loci screened. This criterion was chosen because the proportion of fish with identical genotypes decreases sharply with each additional locus screened and very few fish were expected to have identical genotypes at 38 loci. For each pair of duplicate fish, the fish with the most number of loci scored or, if both fish have equal number of scored loci, the first fish in the collection was retained for further analyses.

The second quality control analysis excluded mixture individuals with an excessive rate of unscorable markers, or dropouts. A threshold of 80% scorable markers per individual was established and all individuals that did not meet this threshold were excluded from MSA. This threshold was set to exclude individuals with poor quality DNA. Poor quality DNA leads to lower reproducibility and, therefore, adds error to the multi-locus genotype. The value of 80% was chosen based upon the observation that many individuals with high quality DNA had some dropouts, but generally less than 20% of markers, while those with poor-quality DNA had higher dropout rates. As a result, there was little difference in which individuals were excluded from analysis when picking the threshold as long as it was within the 70% to 90% range. This rule (referred to as the "80% rule") was used for samples from mixtures to decrease errors and estimate variances caused by poor quality DNA and missing data. This approach was an attempt to balance the benefits from better data with the loss of power to accurately and precisely estimate stock proportions due to smaller sample sizes.

Baseline Development

Hardy-Weinberg and Gametic Disequilibrium

Observed heterozygosity (H_o), expected heterozygosity (H_e), and F_{ST} (Weir and Cockerham 1984) were calculated for all markers using the program GDA (Lewis and Zaykin 2001). Allelic frequencies for each locus were calculated, and tests for deviation from Hardy-Weinberg expectations (H-W) and gametic equilibrium (between all pairs of markers) were performed using GENEPOP (version 4.0; updated version of Raymond and Rousset 1995; Rousset 2008). These tests were repeated once collections were pooled into populations. For H-W, critical values (α=0.05) were adjusted for multiple tests within markers among collections and multiple tests across markers within collections (Rice 1989).

All pairs of nuclear markers were tested for gametic disequilibrium within each collection. We defined a pair of markers to be significantly out of gametic equilibrium if tests for gametic disequilibrium were significant ($P<0.01$) for greater than half of all collections. When gametic linkage was significant, we produced composite genotypes by ordering the alleles within each marker alphabetically and then stringing the alleles together by marker ordered alphanumerically. Markers that did not exhibit gametic disequilibrium with any other markers and markers that were combined were defined as loci for the remaining analyses. All mtDNA markers were combined into a single locus.

Pooling Collections into Populations and Testing for Temporal Stability

Collections taken at the same location at similar calendar days in different years were pooled as suggested by Waples (1990b). Samples taken at the same location, but at substantially different calendar days and samples taken from geographically proximate locations were tested for homogeneity using a chi-square test of allele frequency distributions across all loci. Groups of collections that failed to demonstrate significant departures from homogeneity ($P>0.01$, not

corrected for multiple tests) were pooled. The pooled and the remaining unpooled collections were defined as populations in further analyses.

We examined the temporal stability of allele frequencies with a 3-level Analysis of Variance (ANOVA) treating the temporal samples as sub-populations based on the method described in Weir (1996). Use of this method allows quantification of the sources of total allelic variation and permits calculation of the between-collection component of variance and assessment of its magnitude relative to the between-population component of variance. This analysis was conducted using the software package GDA (Lewis and Zaykin 2001).

Population Structure Visualization

To visualize genetic population structure, Nei's (1972) standard distances between all pairs of populations were calculated from allele frequencies with the program Gendist in the PHYLIP software (version 3.68; Felsenstein 2004). These distances were clustered in a Neighbor-Joining (N-J) tree with the program Neighbor in the PHYLIP software and plotted using the APE package (Paradis et al. 2004) in the program R (R Development Core Team 2008). The stability of the tree nodes were assessed by bootstrapping 1,000 replicate data sets and trees using the programs Seqboot and Consense in the PHYLIP software. While we also examined pair-wise F_{ST}'s plotted using the N-J method and Cavalli-Sforza and Edwards chord distances (CSE; Cavalli-Sforza and Edwards, 1967) plotted using the unweighted pair group arithmetic mean method (UPGMA), we report the N-J of Nei's distance.

Baseline Evaluation for MSA

Reporting groups were defined based on stocks (the 9 major drainages to Bristol Bay described above and 2 adjacent regions that represent other populations that might be observed in Bristol Bay fisheries). The reporting groups representing 3 of the 9 major drainages correspond to management districts (Ugashik, Egegik, and Togiak) while the 2 other management districts are represented by 6 reporting groups (Naknek, Alagnak, and Kvichak within Naknek-Kvichak District; and Nushagak, Wood, and Igushik within Nushagak District). The 2 adjacent regions included collections from drainages between the Aleutian Islands and Meshik River (defined as the "North Peninsula" reporting group) and drainages in Kuskokwim Bay and River (defined as the "Kuskokwim" reporting group). During estimation of stock composition, populations were maintained separately within these reporting groups as recommended by Wood et al. (1987). Reporting group estimates were calculated by summing population estimates. We then assessed the potential of the baseline to identify these reporting groups for MSA applications with proof tests and escapement samples.

Stock compositions of all baseline evaluation tests were analyzed using the program BAYES (Pella and Masuda 2001). The Bayesian model implemented by BAYES places a Dirichlet distribution as the prior distribution for stock proportions, and parameters for this distribution must be specified. Prior parameters for each reporting group were defined to be equal (i.e., a "flat" prior) with the prior for a reporting group divided equally to populations within that reporting group for population prior parameters. We set the sum of all prior parameters to be 1 (prior weight), which is equivalent to adding 1 fish to each mixture (Pella and Masuda 2001). We ran 3 independent Markov Chain Monte Carlo (MCMC) chains of 15,000 iterations with different starting values and discarded the first 7,500 iterations to remove the influence of initial start values. Estimates and 90% credibility intervals from the second half of three 15,000 iteration chains were tabulated. Credibility intervals differ from confidence intervals in that they

are a direct statement of probability: i.e. a 90% credibility interval has a 90% chance of containing the true answer (Gelman et al. 2000). We repeated this procedure for each reporting group. A critical level of 90% correct allocation was used to determine if the reporting group was acceptably identifiable (Seeb et al. 2000).

We examined the adequacy of burn-in for each chain with the Rafferty and Lewis (1996) diagnostic. We did not extend the length of chains that this diagnostic suggested should be run further, but these were few (~5% of all chains run in the baseline evaluation tests and mixed stock analysis), and the focus of our concern was among-chain convergence. To ensure that the BAYES output was an acceptable approximation of the stationary posterior distribution and that the stock composition estimates were valid, we assessed the 3 independent (MCMC) chains for convergence among chains. We assessed among-chain convergence using the Gelman-Rubin shrink factors that are computed for all stock groups in the program BAYES. This shrink factor compared the variation within a chain to the total variation among chains (Gelman and Rubin, 1992). If a shrink factor for any stock group in a mixture was greater than 1.2 we reanalyzed the mixture with 30,000 iteration chains, discarding the first 15,000 iterations; if a shrink factor greater than 1.2 was observed in the reanalysis we did not run chains out further, but reported the Gelman-Rubin shrink factor for the stock group in question.

Proof Tests

Proof tests were used as the first examination of baseline performance for MSA. In these tests, we created a test mixture by sampling approximately 200 fish from 1 reporting group; we rebuilt the baseline excluding the sampled fish. These tests provided an indication of the power of the baseline for MSA assuming that all the populations were represented in the baseline.

Escapement Samples

Testing the ability of a baseline to correctly assign fish collected from within rivers was a more stringent MSA test because it did not assume that the fish in the mixture were from populations represented in the baseline. We estimated the stock composition of mixtures of fish captured at 8 of the 9 escapement enumeration sites that represent inriver mixtures. We did not include samples from the Togiak River counting tower in these tests because its location at the outlet of Togiak Lake is upstream of other Togiak baseline populations. The expected stock composition of these mixtures was 100% to the drainage from which the mixture originated.

Mixed Stock Analyses

We estimated the stock composition of all district-time strata mixtures using the same BAYES protocol described above for the baseline evaluation tests except for the definition of prior parameters. We used an informative Dirichlet prior distribution based upon the best available information for each mixture analysis. We believe the best available information for the prior to be the results of MSA of similar mixtures. This information was not always available, so we developed what we termed a "step-wise" prior protocol to standardize our methodology. Our protocol was as follows: for the first time strata within a district in 2006, the prior was based upon information from our traditional catch allocation method. For subsequent time strata within the same district in the same year, the priors were the posterior means (i.e., the stock composition estimates) of the previous time strata. For the first time strata in subsequent years, the prior parameters were the posterior means from the first period of the same fishery from the previous year. For all priors we defined a minimum value of 0.01 for each reporting group. Reporting

groups with estimates below this value were set to 0.01 by normalizing the sum of priors for all reporting groups to 1 after adjusting the value of the small proportion stocks. For all mixtures, the prior for a reporting group was divided equally to populations within that reporting group for population prior parameters.

This protocol was based on previous assumptions we made regarding catch allocation. One overall assumption regarding the first prior in all districts was that most of the catch was from rivers within that district. If there were fish from other rivers within a district, they were most likely from nearby rivers. The first prior for Naknek-Kvichak and Nushagak districts was based on catch allocation using age composition in the catch and escapements (Bernard 1983). The first prior for Ugashik and Egegik districts was based on the assumption that most of the fish in each district were from their respective rivers and some information that there were sockeye salmon from nearby rivers in these districts based on scale pattern analysis (Menard and Miller 1997). The prior for Togiak District was based on the assumption that most of the catch was from Togiak River.

The stock compositions of district mixtures from 2007 and 2008 were estimated using the full set of SNPs, while the stock compositions of district mixtures from 2006 were estimated using the subset of SNPs that 2006 samples were screened for (Appendix B1). Unless otherwise noted, the stock composition estimates were applied to the combined harvest of the drift and set gillnet fisheries in all the districts.

Inshore Run Size

Stock proportion estimates and errors for each temporal stratum within each district within each year were calculated by taking the mean and 5% and 95% quantiles of the combined posterior distribution from the 3 chain outputs (Gelman et al. 2000). Harvest estimates and confidence intervals for each temporal stratum were calculated by multiplying the harvest from that stratum by its unrounded reporting group stock proportion estimate and upper and lower bounds.

Temporal strata were combined within districts into yearly estimates by weighting them by their respective harvests according to the following equation:

$$p_{y,g} = \frac{\sum_{i=1}^{S} H_{y,i} p_{y,g,i}}{\sum_{i=1}^{S} H_{y,i}} \tag{1}$$

where $H_{y,i}$ was the harvest in year y and stratum i; $p_{y,g,i}$ was the proportion of reporting group g fish in year y and stratum i; and $p_{y,g}$ was the overall proportion of reporting group g fish in year y with S strata. To calculate confidence intervals for $H_{y,g}$, the overall harvest of reporting group g in year y, its distribution was estimated via Monte Carlo by re-sampling 100,000 draws of the posterior output from each of the constituent temporal strata and applying the harvest to the draws according to this slight modification of equation 1:

$$H_{y,g} = \sum_{i=1}^{S} H_{y,i} p_{y,g,i} \tag{2}$$

This method yielded the same point estimate for number of harvested fish within a district and year as would be obtained by simply summing the point estimates from each constituent temporal strata, but it produced a more appropriate credibility interval than simply summing the lower and upper bounds of credibility intervals together (c.f. Piston 2008). This method also accommodated non-symmetric credibility intervals.

Stock proportion estimates were reported rounded to the nearest one-tenth of a percent. For convenience, we rounded harvest estimates to the nearest fish after all calculations were performed, recognizing that this level of precision is optimistic. Any discrepancies between the sum of the regional harvest estimates and the total harvest for each stratum were due to unavoidable rounding errors.

RESULTS

COMMERCIAL HARVEST AND ESCAPEMENT

Commercial Harvest and Escapement

2006

Combined inshore harvest and escapement in Bristol Bay was 42,928,810 sockeye salmon in 2006 (Table 1). A total of 28,491,168 sockeye salmon were commercially harvested in 2006. The largest number of harvested sockeye salmon was in Nushagak District (10,876,357); followed by Egegik (7,408,233), Naknek-Kvichak (7,150,540), Ugashik (2,429,597), and Togiak (626,441) districts. The Togiak District harvest includes the Kulukak Section harvest of 51,812 sockeye salmon. The total sockeye salmon escapement was 14,437,642 in 2006. The sockeye salmon escapement to the 9 major rivers ranged from 305,268 in Igushik River to 4,008,102 in Wood River.

2007

Combined inshore harvest and escapement of sockeye salmon in Bristol Bay was 44,750,563 in 2007 (Table 1). A total of 29,765,726 sockeye salmon were commercially harvested in 2007 with the largest number harvested in Naknek-Kvichak District (9,022,511); followed by Nushagak (8,404,111), Egegik (6,495,908), Ugashik (5,026,615), and Togiak (816,581) districts. The Togiak District harvest includes the Kulukak Section harvest of 57,845 sockeye salmon. The escapement of sockeye salmon was 14,984,837 sockeye salmon in 2007; ranging from 269,646 in Togiak River to 2,810,208 in Kvichak River.

2008

Combined inshore harvest and escapement of sockeye salmon in Bristol Bay was 40,418,833 in 2008 (Table 1). A total of 27,674,223 sockeye salmon were commercially harvested in 2008. Sockeye salmon were harvested in Naknek-Kvichak (10,381,844), Egegik (7,403,885), Nushagak (6,903,157), Ugashik (2,334,022), and Togiak (651,315) districts. The Togiak District harvest includes the Kulukak Section harvest of 24,523 sockeye salmon. The escapement of sockeye salmon in Bristol Bay was 12,744,610 in 2008; ranging from 205,680 in Togiak River to 2,757,912 in Kvichak River.

TISSUE SAMPLING

Baseline Sampling

A total of 14,236 sockeye salmon were captured in 144 collections from 1998 to 2008 (Appendix A1). Average sample size for each collection was 99 fish with a range from 30 to 192 fish. For all collections with less than 68 fish, additional collections were made in other years at the same sites to bring the total for any given site above 95 fish. Sampling locations ranged from Summer Bay Lake on Unalaska Island to Necons River of the upper Kuskokwim River drainage and included 28 collections from North Alaska Peninsula river drainages, 8 collections from Ugashik River drainage, 10 collections from Egegik River drainage, 9 collections from Naknek River drainage, 12 collections from Alagnak River drainage, 24 collections from Kvichak River drainage, 11 collections from Nushagak River drainage, 23 collections from Wood River drainage, 4 from Igushik River drainage, 6 from Togiak River drainage, and 9 from Kuskokwim River and Bay drainages (Appendix A1; Figure 2).

Escapement Sampling

A total of 4,886 sockeye salmon from 17 samples representing escapement enumeration mixtures were captured to provide tests of the baseline (Table 2). These included 192 fish from the Ugashik River counting tower site sampled in 2004; 574 fish from the Egegik River counting tower site sampled in 2004 and 2007; 288 fish from the Naknek River counting tower site sampled in 2002; 192 fish from the Alagnak River counting tower site sampled in 2004; 1,875 fish from the Kvichak River counting tower site sampled in 2005 and 2006; 546 fish from the Nushagak sonar counting site sampled in 2005 and 2006; 190 fish from the Nuyakuk River counting tower site sampled in 2004; 650 fish from the Wood River counting tower site sampled in 2003, 2004, 2006, and 2007; and 379 fish from the Igushik River counting tower site sampled in 2005 and 2007.

District Catch Sampling

2006

A total of 16,059 sockeye salmon were sampled for tissue suitable for genetic analysis from the commercial harvest throughout Bristol Bay in 2006 (Table 3). Twenty-two periods were used to select genetic samples to estimate the stock composition of the harvest in each of the districts. Selected sample sizes for each period ranged from 143 to 287 fish. It should be noted that the selection of samples within periods in 2006 was not in proportion to the harvest occurring on each day within each period. Samples were representatively selected in approximately equal numbers from all samples collected in district-period strata (Appendices C1, C4, C7, C10, and C13). A total of 4,428 samples were selected to be included in the analysis (Table 3). Of the fish selected, 4,358 were successfully screened and included in MSA. Final samples sizes for these mixtures ranged from 143 to 278 fish.

2007

A total of 14,409 sockeye salmon were sampled for tissue suitable for genetic analysis from the commercial harvest throughout Bristol Bay in 2007 (Table 4). Twenty-two periods were used to select genetic samples to estimate the stock composition of the harvest in each of the districts. Selected sample sizes for each period were 190 fish. Samples were selected in each period generally proportional to the harvest occurring on the same day the sample was collected

(Appendices C2, C5, C8, C11, and C14). A total of 4,180 samples were selected to be included in the analysis (Table 4). Of the fish selected, 4,084 were successfully screened and included in MSA. Final samples sizes for these mixtures ranged from 180 to 190 fish.

2008

A total of 15,553 sockeye salmon were sampled for tissue suitable for genetic analysis from the commercial harvest throughout Bristol Bay in 2008 (Table 5). Twenty-seven periods were used to select genetic samples to estimate stock composition of the harvest in each districts. Selected sample sizes for each period ranged from 189 to 191 fish. Samples were selected in each period proportional to the harvest occurring on the same day the sample was collected (Appendices C3, C6, C9, C12, and C15) A total of 5,131 samples were selected to be included in the analysis (Table 5). Of the fish selected, 4,992 were successfully screened and included in MSA. Final samples sizes for these mixtures ranged from 172 to 189 fish.

LABORATORY ANALYSIS

Laboratory Failure Rates and Quality Control

For the representative baseline project, the overall failure rate for Bristol Bay baseline genotypes at the 45 SNP markers was 2.3%. The quality control process demonstrated a low discrepancy rate of 0.52%. Assuming an equal error rate in the original and quality control genotyping process, and that this project accurately represents our genotyping process, our baseline collections were genotyped with a process that produced genotypes with an error rate of 0.26%.

For commercial harvest samples, failure rates among years ranged from 1.1% to 4.5% and discrepancy rates were uniformly low and ranged from 0.02% to 0.49% (0.01% to 0.25% estimated error rate in the database).

STATISTICAL ANALYSIS

Data Retrieval and Quality Control

An average of 0.42 (0.4%) and 0.14 (0.1%) putative duplicate fish per collection was removed from baseline and district harvest collections, respectively, based upon the 38 loci criterion. One hundred and 8 baseline collections (75%) and 85 district mixture collections (89%) had no duplicate individuals.

An average of 2.7 fish per collection (1.8%) was removed based upon the 80% rule for collections from district harvest fish. Forty-five collections (47%) had no fish removed. Five collections (5%) had 20 or more fish removed based upon this rule, indicating low quality DNA. A total of 253 fish (1.8%) were removed based on the 80% rule.

Baseline Development

Hardy-Weinberg and Gametic Disequilibrium

Observed heterozygosities among markers ranged widely from 0.007 to 0.482. Observed heterozygosity was often lower than expected heterozygosity at nuclear markers with averages of 0.234 and 0.259, respectively (Table 6).

The overall F_{ST} estimate over all loci was 0.090, but a few nuclear loci had considerably higher values. F_{ST} estimates for *One_MHC2_190* and *One_MHC2_251* were 0.315 and 0.311,

respectively. One other marker had an F_{ST} estimate greater than 0.200 (*One_HpaI-99*, 0.239), while the remaining loci had F_{ST} values below 0.190 and 22 loci had values below 0.050.

Significant departures from H-W equilibrium were not found in any populations for the 42 nuclear SNP loci after correcting for multiple tests. However, before correcting for multiple tests, we did find some patterns in the distribution of departures from H-W equilibrium. *One_KPNA-422*, *One_p53-534*, and *One_Tf_ex11-750* were out of H-W in 6 populations (Appendix B1). Five populations would be expected to be out of H-W equilibrium for each locus by chance at α=0.05.

We also detected 10 populations with more loci out of H-W equilibrium than would be expected by chance (Appendix A1). Two markers would be expected to be out of H-W equilibrium for each population by chance at α=0.05. All but 1 of these 10 populations had 3 loci out of H-W, 1 greater than that expected by chance. The other was Goodnews River (5 loci out of H-W) in Kuskokwim Bay. In 26 of the 32 cases, the significant departure from H-W at markers for these populations was due to an excess of homozygotes (i.e., positive F_{IS} values).

Significant gametic disequilibrium was found between 1 pair of nuclear SNP markers (*One_MHC2_190* and *One_MHC2_251*) in more than 50% of the collections. Other pairs of markers exhibited gametic disequilibrium within some collections, but were below the threshold of 50% (Table 7).

For the pair of linked nuclear SNP markers and the triplet of mitochondrial SNP markers (*One_CO1*, *One_Cytb_17*, and *One_Cytb_26*), genotypes from each locus were pooled to form haplotype loci: *One_MHC2_190_251* and *One_CO1_Cytb17_26*, respectively. After combining the pair of linked nuclear markers and the 3 mtDNA markers, the final analyses included 41 independent nuclear loci and 1 mitochondrial locus (described by 3 SNPs). F_{ST} of the combined MHC locus was high (0.251) and the F_{ST} estimate for the combined mtDNA locus was intermediate (0.132; Table 6).

Pooling Collections into Populations and Testing for Temporal Stability

The 144 collections reduced to a total of 96 unique populations after pooling collections taken from similar locations over multiple years and from nearby sites that exhibited genetic homogeneity (Appendix A1). After removing duplicate individuals, the average sample size per population was 148 fish (SD=112), with 63 populations having sample sizes between 90 and 100 and 11 populations having sample sizes greater than 200 fish.

Allele frequency estimates within populations appeared to be temporally stable. The 3-level ANOVA indicated that the ratio of variation among temporal collections to the variation among populations was not different from 0. There was virtually no variation among collections from the same populations across years relative to the variation among populations.

Population Structure Visualization

Genetic relationships among baseline populations are shown schematically in the N-J tree (Figure 3). Patterns observed on all 3 trees that we examined (CSE on UPGMA and pair-wise F_{ST} on N-J not shown) were similar and are concordant with patterns of sockeye salmon population structure described in other studies (Varnavskaya et al. 1994; Wood et al. 1994; Beacham et al. 2006; Habicht et al. 2007a). Populations generally cluster in groups based upon river system and a common nursery lake (Wood et al. 1994). For example, all Alagnak River populations cluster together; these populations grouped together below this node in 59.6% of all

bootstrap trees. Similarly, all Naknek River populations grouped together. Wood River populations cluster into 2 groups, 1 of which contains the 4 Igushik River populations. The Wood-Igushik cluster was split from Nuyakuk River populations of the Nushagak River, and together these 3 groups comprised a significant node (53.2% of bootstrap trees). Kuskokwim Bay and Togiak River populations cluster together, although this grouping was relatively weak. All of the Lake Clark populations cluster together; this set of populations grouped together in all of the bootstrap trees that we examined. This cluster was markedly distinct from the cluster of Iliamna Lake populations. The genetic structure of Bristol Bay sockeye populations observed in this study is similar to that derived from microsatellite data (Habicht et al. 2007a).

In a few cases, very distant populations clustered together. For example, the upper Nushagak River populations clustered with middle Kuskokwim River populations. This node was strongly supported by our bootstrap analysis (71.5% of bootstrap trees). Similarly, the nearest cluster of populations to the Lake Clark group was the upper Kuskokwim River cluster of populations, which grouped in 98.7% of bootstrap trees.

There was some interweaving of Egegik, Ugashik, and North Peninsula populations on the tree, although none of these nodes were significant. This lack of strong genetic divergence among populations in southeastern Bristol Bay has been previously described (Habicht et al. 2007a). The remainder of the tree was North Peninsula populations that were diffusely grouped together throughout the tree, indicating high levels of genetic variation within this group.

Baseline Evaluation for MSA

Proof Tests

All 11 reporting groups (stocks) met the critical level of 90% correct allocation in the 100% proof tests (Figure 4; Table 8), with correct allocations above 95% for 8 reporting groups. The 3 reporting groups with correct allocations between 90% and 95% included Nushagak, Wood, and Kuskokwim. When fish were misallocated in the Nushagak proof test, 3% of the total samples were allocated to the Wood River reporting group, 2% were allocated to the Alagnak reporting group and 1% to the Igushik reporting group. When fish were misallocated in the Wood proof tests, 6% were allocated to the Igushik reporting group. When fish were misallocated in the Kuskokwim proof tests, 7% were allocated to the Togiak reporting group and 1% to the Nushagak reporting group. In general, the proof tests indicated that most reporting groups can be distinguished from one another with a high degree of accuracy (mean = 96%).

Escapement Samples

All of the 17 escapement enumeration sample tests met the critical level of 90% correct allocation back to their reporting group of origin (Figure 5; Table 9). The worst performing escapement enumeration sample test was the 2004 Nuyakuk tower sample, which barely met the 90% criterion with 5% of the mixture being allocated to the Igushik reporting group and 1% being allocated to the Alagnak, Wood, Togiak, and Kuskokwim reporting groups. In general, the escapement enumeration sample tests indicated that most reporting groups can be distinguished from one another with high accuracy (mean = 95%). For both proof tests and escapement sample tests, when fish were misallocated they were often allocated to adjacent reporting groups or reporting groups with populations with similar allele frequencies as evidenced by the clustering of populations on the tree of genetic distances.

Mixed Stock Analyses

We estimated the stock composition of all district-time strata mixtures in Bristol Bay for 2006, 2007, and 2008. The mixed stock analyses required us to provide a prior distribution for each mixture. We chose what we consider to be an informative Dirichlet prior distribution that was based upon the best available information for each mixture analysis (Table 10). We followed the protocol discussed in the methods in selecting priors. For the first time strata within a district in 2006, the prior was based upon information from: 1) our existing catch allocation method (i.e., age composition) for Naknek-Kvichak and Nushagak districts; 2) historical information such as the presence of stocks in different districts based on scale pattern analysis (Menard and Miller 1997) for Ugashik and Egegik districts; 3) the assumption that most of the fish in Togiak District were from Togiak River. For subsequent time strata within the same district, the priors were the posterior means (i.e., the stock composition estimates) of the previous time strata. For the first time strata in subsequent years, the prior parameters were the posterior means from the first time period of the previous year. For example, the prior for the July 1–11, 2006 Ugashik District mixture was based on stock composition estimates based upon scale pattern analysis; the prior for the July 13–21, 2006 Ugashik District mixture was the stock composition estimates from the July 1–11, 2006 mixture; and the prior for the June 12–July 1, 2007 mixture was also the stock composition estimates from the July 1–11, 2006 mixture.

Ugashik District

The Ugashik District harvest in 2006 (2,429,597) was mostly comprised of sockeye salmon from the following stocks: Ugashik (89.6%; 2,176,965) followed by Egegik (6.5%; 158,759), Kvichak (2.2%; 52,616), Wood (0.8%; 19,383), and smaller percentages (<0.2%) of North Peninsula, Naknek, Alagnak, Nushagak, Igushik, Togiak, and Kuskokwim (Table 11). The Ugashik stock contribution to the mixtures ranged from 83.8% to 94.2% in different periods of 2006 (Appendix D1).

The Ugashik District harvest in 2007 (5,026,615) was mostly comprised of sockeye salmon from the following stocks: Ugashik (76.9%; 3,867,819) followed by Egegik (22.0%; 1,108,158), Kvichak (0.4%; 22,005), and smaller percentages (<0.2%) of North Peninsula, Naknek, Alagnak, Nushagak, Wood, Igushik, Togiak, and Kuskokwim (Table 12). The Ugashik stock contribution to the mixtures ranged from 63.0% to 89.3% while the Egegik stock contribution to the mixtures ranged from 8.1% to 36.5% in different periods of 2007 (Appendix D2).

The Ugashik District harvest in 2008 (2,334,022) was mostly comprised of sockeye salmon from the following stocks: Ugashik (81.4%; 1,900,544) followed by Egegik (13.4%; 313,374), Alagnak (3.0%; 69,058), Kvichak (0.7%; 16,682), and smaller percentages (<0.4%) of North Peninsula, Naknek, Alagnak, Nushagak, Wood, Igushik, Togiak, and Kuskokwim (Table 13). The Ugashik stock contribution to the mixtures ranged from 60.6% to 83.5% while the Egegik stock contribution to the mixtures ranged from 9.3% to 33.6% in different periods of 2008 (Appendix D3).

Egegik District

The Egegik District harvest in 2006 (7,408,233) was mostly comprised of sockeye salmon from the following stocks: Egegik (85.9%; 6,360,780) followed by Ugashik (7.6%; 560,716), Kvichak (3%; 223,118), Naknek (2.2%; 161,657), Wood (0.6%; 40,952), and smaller percentages (<0.3%) of North Peninsula, Alagnak, Nushagak, Igushik, Togiak, and Kuskokwim

(Table 11). The Egegik stock contribution to the mixtures was highly variable ranging from 50.2% in the district to 93.1% when fishing in Egegik River District Special Harvest Area (ERSHA) in different periods of 2006 (Appendix D4).

The Egegik District harvest in 2007 (6,495,908) was mostly comprised of sockeye salmon from the following stocks: Egegik (77.0%; 5,000,914) followed by Ugashik (8.2%; 531,909), Naknek (6.7%; 436,138), Kvichak (3.7%; 238,169), Alagnak (2.9%; 188,243), and smaller percentages (<0.5%) of North Peninsula, Nushagak, Wood, Igushik, Togiak, and Kuskokwim (Table 12). The Egegik stock contribution to the mixtures was variable ranging from 69.1% in the district to 91.1% in the ERSHA in different periods of 2007 (Appendix D5). The Wood stock contribution to the Egegik District June 20 to 23 mixture did not converge at 15,000 iterations (Gelman-Rubin shrink factor estimate = 1.2), so we reanalyzed the mixture with 30,000 iteration chains. The estimate converged after this reanalysis (Gelman-Rubin shrink factor estimate = 1.08). Similarly, the Kuskokwim stock contribution to the Egegik District July 10 to 14 mixture did not converge at 15,000 iterations (Gelman-Rubin shrink factor estimate = 1.24), so we reanalyzed the mixture with 30,000 iteration chains. The estimate converged after this reanalysis (Gelman-Rubin shrink factor estimate = 1.00).

The Egegik District harvest in 2008 (7,403,885) was mostly comprised of sockeye salmon from the following stocks: Egegik (72.6%; 5,373,957) followed by Naknek (13.8%; 1,020,078), Kvichak (10.4%; 771,051), Alagnak (1.5%; 112,141), Ugashik (1.3%; 93,361), and much smaller percentages (<0.1%) of North Peninsula, Nushagak, Wood, Igushik, Togiak, and Kuskokwim (Table 13). The Egegik stock contribution to the mixtures was variable ranging from 50.5% to 87.6% in different periods of 2008 (Appendix D6). The North Peninsula stock contribution to the Egegik District July 6 to 8 mixture did not converge at 15,000 iterations (Gelman-Rubin shrink factor estimate = 1.22), so we reanalyzed the mixture with 30,000 iteration chains. The estimate converged after this reanalysis (Gelman-Rubin shrink factor estimate = 1.03).

Naknek-Kvichak District

The Naknek-Kvichak District harvest in 2006 (7,150,540) was comprised of sockeye salmon from the following stocks: Naknek (40.3%; 2,881,441), Kvichak (34.8%; 2,488,505), Alagnak (20.0%; 1,432,091), Egegik (4.1%; 296,591), Wood (0.5%; 34,882) and smaller percentages (<0.1%) of North Peninsula, Ugashik, Nushagak, Wood, Igushik, Togiak, and Kuskokwim (Table 11). The Naknek stock contribution to the mixtures ranged from 10.3% in Naknek-Kvichak District, to 39.8% in Naknek Section, to 91.7% in Naknek River Special Harvest Area (NRSHA) in different periods of 2006 (Appendix D7). The Kvichak stock contribution to the mixtures ranged from 2.7% in NRSHA to 42.4% in the Kvichak Section setnet area to 58.6% in Naknek-Kvichak District. The Alagnak stock contribution to the mixtures ranged from 5.2% in NRSHA to 56.6% in Alagnak River Special Harvest Area.

The Naknek-Kvichak District harvest in 2007 (9,022,511) was mostly comprised of sockeye salmon from the following stocks: Naknek (54.2%; 4,886,102), followed by Kvichak (24.9%; 2,248,707), Alagnak (19.6%; 1,764,829) and smaller percentages (<0.4%) of North Peninsula, Ugashik, Egegik, Nushagak, Wood, Igushik, Togiak, and Kuskokwim (Table 12). The Naknek stock contribution to the mixtures ranged from 30.9% in Naknek-Kvichak District to 80.2% in NRSHA in different periods of 2007 (Appendix D8). The Kvichak stock contribution to the mixtures ranged from 9.9% in NRSHA to 42.7% in Naknek-Kvichak District. The Alagnak

stock contribution to the mixtures ranged from 9.6% in NRSHA to 35.5% in Naknek-Kvichak District. The Nushagak, Wood and Igushik stock contribution for the Naknek-Kvichak June 21 to 25 mixture did not converge at 15,000 iterations (Gelman-Rubin shrink factor estimates = 1.26, 1.70, and 1.46, respectively), so we reanalyzed the mixture with 30,000 iteration chains. All estimates converged after this reanalysis (Gelman-Rubin shrink factor estimates = 1.09, 1.09, and 1.03, respectively).

The Naknek-Kvichak District harvest in 2008 (10,281,844) was mostly comprised of sockeye salmon from the following stocks: Naknek (52.5%; 5,452,131), followed by Kvichak (23.2%; 2,404,378), Alagnak (17.5%; 1,818,972), Egegik (6.1%; 632,403) and smaller percentages (<0.3%) of North Peninsula, Ugashik, Nushagak, Wood, Igushik, Togiak, and Kuskokwim (Table 13). The Naknek stock contribution to the mixtures ranged from 4.2% to 74.9%, while the Kvichak stock contribution to the mixtures ranged from 12.2% to 49.7% and the Alagnak stock contribution to the mixtures ranged from 4.5% to 45.3% in different periods of 2008 (Appendix D9).

Nushagak District

The Nushagak District harvest in 2006 (10,876,357) was comprised of sockeye salmon from the following stocks: Wood (73.3%; 7,969,419), Nushagak (24.1%; 2,619,780), Igushik (2.2%; 239,651), Togiak (0.2%; 16,823) and much smaller percentages (<0.1%) of North Peninsula, Ugashik, Egegik, Naknek, Alagnak, Kvichak, and Kuskokwim (Table 11). The Wood stock contribution to the mixtures ranged from 26.8% in Igushik Section to 80.4% in Nushagak District in different periods of 2006 (Appendix D10). The Nushagak stock contribution to the mixtures ranged from 1.1% in Igushik Section to 29.7% in Nushagak District. The Igushik stock contribution to the mixtures ranged from 0.2% in Nushagak District to 71.9% in Igushik Section.

The Nushagak District harvest in 2007 (8,404,111) was comprised of sockeye salmon from the following stocks: Wood (72.9%; 6,127,262), Nushagak (22.6%; 1,901,142), Igushik (2.1%; 178,262), Togiak (0.9%; 79,060) and smaller percentages (<0.4%) of North Peninsula, Ugashik, Egegik, Naknek, Alagnak, Kvichak, and Kuskokwim (Table 12). The Wood stock contribution to the mixtures ranged from 38.3% to 84.1% in Nushagak District in different periods of 2007 (Appendix D11). The Nushagak stock contribution to the mixtures ranged from 11.2% to 27.8% in Nushagak District. The Igushik stock contribution to the mixtures ranged from 0.1% in Nushagak District to 17.0% in Igushik Section. The Igushik stock contribution to the Nushagak June 29 to July 1 mixture did not converge at 15,000 iterations (Gelman-Rubin shrink factor estimate = 1.20), so we reanalyzed the mixture with 30,000 iteration chains. The estimate converged after this reanalysis (Gelman-Rubin shrink factor estimate = 1.15). The Egegik and Kuskokwim stock contribution estimate for the Nushagak July 13 to 21 mixture did not converge at 15,000 iterations (Gelman-Rubin shrink factor estimates = 1.33 and 1.23, respectively), so we reanalyzed the mixture with 30,000 iteration chains. While the Egegik stock contribution converged after this reanalysis (Gelman-Rubin shrink factor estimate = 1.12), the Kuskokwim stock contribution did not (Gelman-Rubin shrink factor estimate = 1.27; 97.5% quantile = 2.05). However, being such a low value (close to 1.2) this is not highly significant and does not represent a great departure from convergence among the 3 chains.

The Nushagak District harvest in 2008 (6,903,156) was comprised of sockeye salmon from the following stocks: Wood (80.5%; 6,127,262), Nushagak (14.8%; 1,019,226), Igushik (3.6%; 251,446), Kuskokwim (0.8%; 53,548) and much smaller percentages (<0.1%) of North

Peninsula, Ugashik, Egegik, Naknek, Alagnak, Kvichak, and Togiak (Table 13). The Wood stock contribution to the mixtures ranged from 75.5% to 89.1% in Nushagak District in different periods of 2008 (Appendix D12). The Nushagak stock contribution to the mixtures ranged from 5.2% to 23.6% and the Igushik stock contribution to the mixtures ranged from 0.1% to 12.4%. The Kuskokwim stock contribution estimate for the Nushagak June 26 to 30 mixture did not converge at 15,000 iterations (Gelman-Rubin shrink factor estimate = 1.23), so we reanalyzed the mixture with 30,000 iteration chains. The estimate converged after this reanalysis (Gelman-Rubin shrink factor estimate = 1.02). Similarly, the Igushik stock contribution estimate for the Nushagak July 8 to 9 mixture did not converge at 15,000 iterations (Gelman-Rubin shrink factor estimate = 1.23), so we reanalyzed the mixture with 30,000 iteration chains. The estimate converged after this reanalysis (Gelman-Rubin shrink factor estimate = 1.01).

Togiak District

The Togiak District harvest in 2006 (626,441) was mostly comprised of sockeye salmon from the following stocks: Togiak (69.8%; 437,259) followed by Kuskokwim (27.8%; 174,206), Nushagak (2.2%; 13,707) and smaller percentages (<0.1%) of North Peninsula, Ugashik, Egegik, Naknek, Alagnak, Kvichak, and Nushagak (Table 11). There was only 1 sampling period in Togiak District. Therefore, we could not look at changes in stock composition in 2006 (Appendix D13).

The Togiak District harvest in 2007 (816,581) was mostly comprised of sockeye salmon from the following stocks: Togiak (86.2%; 703,604) followed by Kuskokwim (13.5%; 110,442) and much smaller percentages (<0.1%) of North Peninsula, Ugashik, Egegik, Naknek, Alagnak, Kvichak, Nushagak, Wood, and Togiak (Table 12). The Togiak stock contribution to the mixtures ranged from 70.0% to 99.5% in different periods of 2007 (Appendix D14).

The Togiak District harvest in 2008 (651,315) was mostly comprised of sockeye salmon from the following stocks: Togiak (74.2%; 483,497) followed by Kuskokwim (25.3%; 165,015), with much smaller percentages (<0.2%) of North Peninsula, Ugashik, Egegik, Naknek, Alagnak, Kvichak, Nushagak, Wood, and Togiak (Table 13). The Togiak stock contribution to the mixtures ranged from 58.6% to 81.9% while the Kuskokwim stock contribution to the mixtures ranged from 17.9% to 40.4% in different periods of 2008 (Appendix D15).

Bristol Bay

The overall Bristol Bay harvest in 2006 (28,491,168) was comprised of sockeye salmon from the following stocks: Wood (28.3%; 8,064,728), Egegik (23.9%; 6,817,407), Naknek (10.7%; 3,051,306), Kvichak (9.7%; 2,766,502); Ugashik (9.7%; 2,755,129), Nushagak (9.3%; 2,641,842); Alagnak (5.1%; 1,462,546); Togiak (1.6%; 462,796), Igushik (0.9%; 248,660), Kuskokwim (0.7%; 209,233), and North Peninsula (~0.0%; 11,018) (Table 11).

The overall Bristol Bay harvest in 2007 (29,765,726) was comprised of sockeye salmon from the following stocks: Wood (20.7%; 6,168,894), Egegik (20.6%; 6,140,178), Naknek (18.0%; 5,370,224), Ugashik (15.0%; 4,451,672), Kvichak (8.4%; 2,511,706), Nushagak (6.6%; 1,961,778); Alagnak (6.6%; 1,954,946); Togiak (2.7%; 792,388), Igushik (0.8%; 251,686), Kuskokwim (0.5%; 142,831), and North Peninsula (0.1%; 19,423) (Table 12).

The overall Bristol Bay harvest in 2008 (27,674,222) was comprised of sockeye salmon from the following stocks: Naknek (23.4%; 6,478,239), Egegik (22.8%; 6,322,141), Wood (20.2%; 5,578,787), Kvichak (11.6%; 3,199,214), Ugashik (7.3%; 2,025,063), Alagnak (7.2%;

2,001,883), Nushagak (3.8%; 1,047,198), Togiak (1.8%; 502,426), Igushik (1.0%; 277,366), Kuskokwim (0.8%; 225,133), and North Peninsula (0.1%; 16,771) (Table 13).

Inshore Run Size

North Peninsula Stock

In 2006, 11,018 North Peninsula stock sockeye salmon were incidentally harvested in Bristol Bay (Table 14). Very small harvests occurred in Ugashik (2,959), Egegik (2,270), Naknek-Kvichak (2,415), Nushagak (3,289), and Togiak (86) districts.

In 2007, 19,423 North Peninsula stock sockeye salmon were incidentally harvested in Bristol Bay (Table 15). Very small harvests occurred in Ugashik (1,724); Egegik (1,170), Naknek-Kvichak (4,058), Nushagak (12,278), and Togiak (192) districts.

In 2008, 16,771 North Peninsula stock sockeye salmon were incidentally harvested in Bristol Bay (Table 16). Very small harvests occurred in Ugashik (2,609); Egegik (7,854), Naknek-Kvichak (4,551), Nushagak (1,566), and Togiak (191) districts.

North Peninsula drainages were outside the scope of this program, therefore total run and harvest rates were not estimated.

Ugashik Stock

Inshore run of the Ugashik stock was 3,758,287 sockeye salmon in 2006 (Table 14). Harvest was 2,755,129 and escapement was 1,003,158 in Ugashik River. The overall harvest rate was 73.3% with district-specific harvest rates as follows: Ugashik (57.9%), Egegik (14.9%), Naknek-Kvichak (0.1%), Nushagak (0.3%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 9% less than the inshore run estimate based on genetics (Table 14).

Inshore run of the Ugashik stock was 7,050,858 sockeye salmon in 2007 (Table 15). Harvest was 4,451,672 and escapement was 2,599,186 in Ugashik River. The overall harvest rate was 63.1% with district-specific harvest rates as follows: Ugashik (54.9%), Egegik (7.5%), Naknek-Kvichak (0.2%), Nushagak (0.5%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 8% greater than the inshore run estimate based on genetics (Table 15).

Inshore run of the Ugashik stock was 2,621,395 sockeye salmon in 2008 (Table 16). Harvest was 2,025,063 and escapement was 596,332 in Ugashik River. The overall harvest rate was 77.3% with district-specific harvest rates as follows: Ugashik (72.5%), Egegik (3.6%), Naknek-Kvichak (1.1%), Nushagak (0.5%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 9% less than the inshore run estimate based on genetics (Table 16).

Egegik Stock

Inshore run of the Egegik stock was 8,282,565 sockeye salmon in 2006 (Table 14). Harvest was 6,817,407 and escapement was 1,465,158 in Egegik River. The overall harvest rate was 82.3% with district-specific harvest rates as follows: Ugashik (1.9%), Egegik (76.8%), Naknek-Kvichak (3.6%), Nushagak (~0.0%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 7% greater than the inshore run estimate based on genetics (Table 14).

Inshore run of the Egegik stock was 7,572,678 sockeye salmon in 2007 (Table 15). Harvest was 6,140,178 and escapement was 1,432,500 in Egegik River. The overall harvest rate was 81.1% with district-specific harvest rates as follows: Ugashik (14.6%), Egegik (66.0%), Naknek-Kvichak (0.3%), Nushagak (0.1%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 5% greater than the inshore run estimate based on genetics (Table 15).

Inshore run of the Egegik stock was 7,581,709 sockeye salmon in 2008 (Table 16). Harvest was 6,322,141 and escapement was 1,259,568 in Egegik River. The overall harvest rate was 83.4% with district-specific harvest rates as follows: Ugashik (4.1%), Egegik (70.9%), Naknek-Kvichak (8.3%), Nushagak (~0.0%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 14% greater than the inshore run estimate based on genetics (Table 16).

Naknek Stock

Inshore run of the Naknek stock was 5,004,534 sockeye salmon in 2006 (Table 14). Harvest was 3,051,306 and escapement was 1,953,228 in Naknek River. The overall harvest rate was 61.0% with district-specific harvest rates as follows: Ugashik (0.1%), Egegik (3.2%), Naknek-Kvichak (57.6%), Nushagak (0.1%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 8% greater than the inshore run estimate based on genetics (Table 14).

Inshore run of the Naknek stock was 8,315,528 sockeye salmon in 2007 (Table 15). Harvest was 5,370,224 and escapement was 2,945,304 in Naknek River. The overall harvest rate was 64.6% with district-specific harvest rates as follows: Ugashik (~0.0%), Egegik (5.2%), Naknek-Kvichak (58.8%), Nushagak (0.5%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 5% greater than the inshore run estimate based on genetics (Table 15).

Inshore run of the Naknek stock was 8,950,929 sockeye salmon in 2008 (Table 16). Harvest was 6,478,239 and escapement was 2,472,690 in Naknek River. The overall harvest rate was 72.4% with district-specific harvest rates as follows: Ugashik (0.1%), Egegik (11.4%), Naknek-Kvichak (60.9%), Nushagak (~0.0%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 30% less than the inshore run estimate based on genetics (Table 16).

Alagnak Stock

Inshore run of the Alagnak stock was 3,236,512 sockeye salmon in 2006 (Table 14). Harvest was 1,462,546 and escapement was 1,773,966 in Alagnak River. The overall harvest rate was 45.2% with district-specific harvest rates as follows: Ugashik (0.1%), Egegik (0.8%), Naknek-Kvichak (44.2%), Nushagak (~0.0%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 13% less than the inshore run estimate based on genetics (Table 14).

Inshore run of the Alagnak stock was 4,421,360 sockeye salmon in 2007 (Table 15). Harvest was 1,954,946 and escapement was 2,466,414 in Alagnak River. The overall harvest rate was 44.2% with district-specific harvest rates as follows: Ugashik (~0.0%), Egegik (4.3%), Naknek-Kvichak (39.9%), Nushagak (~0.0%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 3% less than the inshore run estimate based on genetics (Table 15).

Inshore run of the Alagnak stock was 4,182,385 sockeye salmon in 2008 (Table 16). Harvest was 2,001,883 and escapement was 2,180,502 in Alagnak River. The overall harvest rate was 47.9% with district-specific harvest rates as follows: Ugashik (1.7%), Egegik (2.7%), Naknek-

Kvichak (43.5%), Nushagak (~0.0%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 41% greater than the inshore run estimate based on genetics (Table 16).

Kvichak Stock

Inshore run of the Kvichak stock was 5,834,728 sockeye salmon in 2006 (Table 14). Harvest was 2,766,502 and escapement was 3,068,226 in Kvichak River. The overall harvest rate was 47.4% with district-specific harvest rates as follows: Ugashik (0.9%), Egegik (3.8%), Naknek-Kvichak (42.6%), Nushagak (~0.0%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 1% less than the inshore run estimate based on genetics (Table 14).

Inshore run of the Kvichak stock was 5,321,914 sockeye salmon in 2007 (Table 15). Harvest was 2,511,706 and escapement was 2,810,208 in Kvichak River. The overall harvest rate was 47.2% with district-specific harvest rates as follows: Ugashik (0.4%), Egegik (4.5%), Naknek-Kvichak (42.3%), Nushagak (0.1%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 21% less than the inshore run estimate based on genetics (Table 15).

Inshore run of the Kvichak stock was 5,957,127 sockeye salmon in 2008 (Table 16). Harvest was 3,199,215 and escapement was 2,757,912 in Kvichak River. The overall harvest rate was 53.7% with district-specific harvest rates as follows: Ugashik (0.3%), Egegik (12.9%), Naknek-Kvichak (40.4%), Nushagak (0.1%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 5% less than the inshore run estimate based on genetics (Table 16).

Nushagak Stock

Inshore run of the Nushagak stock was 3,190,252 sockeye salmon in 2006 (Table 14). Harvest was 2,641,842 and escapement was 548,410 in Nushagak River. The overall harvest rate was 82.8% with district-specific harvest rates as follows: Ugashik (0.1%), Egegik (0.1%), Naknek-Kvichak (0.1%), Nushagak (82.1%), and Togiak (0.4%). The traditional inshore run estimate (based on age composition) was 2% greater than the inshore run estimate based on genetics (Table 14).

Inshore run of the Nushagak stock was 2,479,819 sockeye salmon in 2007 (Table 15). Harvest was 1,961,778 and escapement was 518,041 in Nushagak River. The overall harvest rate was 79.1% with district-specific harvest rates as follows: Ugashik (0.2%), Egegik (0.9%), Naknek-Kvichak (1.3%), Nushagak (76.7%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 4% greater than the inshore run estimate based on genetics (Table 15).

Inshore run of the Nushagak stock was 1,539,744 sockeye salmon in 2008 (Table 16). Harvest was 1,047,198 and escapement was 492,546 in Nushagak River. The overall harvest rate was 68.0% with district-specific harvest rates as follows: Ugashik (0.5%), Egegik (0.3%), Naknek-Kvichak (0.9%), Nushagak (66.2%), and Togiak (0.1%). The traditional inshore run estimate (based on age composition) was 7% greater than the inshore run estimate based on genetics (Table 16).

Wood Stock

Inshore run of the Wood stock was 12,072,830 sockeye salmon in 2006 (Table 14). Harvest was 8,064,728 and escapement was 4,008,102 in Wood River. The overall harvest rate was 66.8% with district-specific harvest rates as follows: Ugashik (0.2%), Egegik (0.3%), Naknek-Kvichak (0.3%), Nushagak (66.0%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 8% less than the inshore run estimate based on genetics (Table 14).

Inshore run of the Wood stock was 7,696,980 sockeye salmon in 2007 (Table 15). Harvest was 6,168,894 and escapement was 1,528,086 in Wood River. The overall harvest rate was 80.1% with district-specific harvest rates as follows: Ugashik (0.1%), Egegik (0.3%), Naknek-Kvichak (0.1%), Nushagak (79.6%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 15% less than the inshore run estimate based on genetics (Table 15).

Inshore run of the Wood stock was 7,303,463 sockeye salmon in 2008 (Table 16). Harvest was 5,578,787 and escapement was 1,724,676 in Wood River. The overall harvest rate was 76.4% with district-specific harvest rates as follows: Ugashik (0.0%), Egegik (0.1%), Naknek-Kvichak (0.1%), Nushagak (76.1%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 28% less than the inshore run estimate based on genetics (Table 16).

Igushik Stock

Inshore run of the Igushik stock was 553,928 sockeye salmon in 2006 (Table 14). Harvest was 248,660 and escapement was 305,268 in Igushik River. The overall harvest rate was 44.9% with district-specific harvest rates as follows: Ugashik (0.6%), Egegik (0.7%), Naknek-Kvichak (0.3%), Nushagak (43.3%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 159% greater than the inshore run estimate based on genetics (Table 14).

Inshore run of the Igushik stock was 667,138 sockeye salmon in 2007 (Table 15). Harvest was 251,686 and escapement was 415,452 in Igushik River. The overall harvest rate was 37.7% with district-specific harvest rates as follows: Ugashik (0.7%), Egegik (4.8%), Naknek-Kvichak (5.5%), Nushagak (26.7%), and Togiak (0.0%). The traditional inshore run estimate (based on age composition) was 164% greater than the inshore run estimate based on genetics (Table 15).

Inshore run of the Igushik stock was 1,332,070 sockeye salmon in 2008 (Table 16). Harvest was 277,366 and escapement was 1,054,704 in Igushik River. The overall harvest rate was 20.8% with district-specific harvest rates as follows: Ugashik (0.4%), Egegik (0.8%), Naknek-Kvichak (0.8%), Nushagak (18.9%), and Togiak (~0.0%). The traditional inshore run estimate (based on age composition) was 147% greater than the inshore run estimate based on genetics (Table 16).

Togiak Stock

Inshore run of the Togiak stock was 774,923 sockeye salmon in 2006 (Table 14). Harvest was 462,797 and escapement was 312,126 in Togiak River. The overall harvest rate was 59.7% with district-specific harvest rates as follows: Ugashik (0.4%), Egegik (0.4%), Naknek-Kvichak (0.3%), Nushagak (2.2%), and Togiak (56.4%). The traditional inshore run estimate (based on age composition) was 21% greater than the inshore run estimate based on genetics (Table 14).

Inshore run of the Togiak stock was 1,062,034 sockeye salmon in 2007 (Table 15). Harvest was 792,388 and escapement was 269,646 in Togiak River. The overall harvest rate was 74.6% with district-specific harvest rates as follows: Ugashik (0.1%), Egegik (0.6%), Naknek-Kvichak

(0.2%), Nushagak (7.4%), and Togiak (66.3%). The traditional inshore run estimate (based on age composition) was 2% greater than the inshore run estimate based on genetics (Table 15).

Inshore run of the Togiak stock was 708,106 sockeye salmon in 2008 (Table 16). Harvest was 502,426 and escapement was 205,680 in Togiak River. The overall harvest rate was 71.0% with district-specific harvest rates as follows: Ugashik (1.3%), Egegik (0.4%), Naknek-Kvichak (0.5%), Nushagak (0.5%), and Togiak (68.3%). The traditional inshore run estimate (based on age composition) was 21% greater than the inshore run estimate based on genetics (Table 16).

Kuskokwim Stock

In 2006, 209,233 Kuskokwim stock sockeye salmon were incidentally harvested in Bristol Bay (Table 14). Incidental harvests occurred in Ugashik (1,566), Egegik (23,389), Naknek-Kvichak (1,931), Nushagak (8,140), and Togiak (174,206) districts.

In 2007, 142,831 Kuskokwim stock sockeye salmon were incidentally harvested in Bristol Bay (Table 15). Incidental harvests occurred in Ugashik (3,366), Egegik (13,375), Naknek-Kvichak (2,242), Nushagak (13,405), and Togiak (110,442) districts.

In 2008, 225,133 Kuskokwim stock sockeye salmon were incidentally harvested in Bristol Bay (Table 16). Incidental harvests occurred in Ugashik (1,192), Egegik (2,321), Naknek-Kvichak (3,057), Nushagak (53,548), and Togiak (165,015) districts.

Kuskokwim River and bay drainages were outside the scope of this program, therefore total run and harvest rates were not estimated.

DISCUSSION

BASELINE AND MSA PERFORMANCE

The baseline used in this study is the most comprehensive genetic baseline for sockeye salmon from drainages likely to contribute to sockeye salmon fisheries within Bristol Bay. This baseline is densely sampled with representatives from 96 populations, multiple-year collections from 10 populations, and has undergone rigorous quality control measures. This represents an increase of 86 collections from the microsatellite baseline reported by Habicht et al. (2007a).

The methods used in this study to screen for genetic variation use a platform that can process large numbers of fish over short periods of time allowing the analysis of samples inseason, as is currently done for Port Moller Test Fishery. Port Moller Test Fishery is conducted as a cooperative program between the department, Bristol Bay Science and Research Institute, University of Washington, and area processors to provide inseason run strength information for sockeye salmon returning to Bristol Bay drainages. The department area managers use this information, in concert with many other sources of information, to decide when and where to open districts to commercial fishing.

The error rates detected in this study were an order of magnitude lower than those detected using similar methods in high-throughput microsatellite analyses (Ewen et al. 2000). The individual genotype failure rate were also low and were unlikely to introduce bias in the stock composition estimates because 1) the number of fish removed from analysis was exceedingly low and 2) fish within mixtures received similar handling prior to sampling – in other words it is unlikely that 1 stock would have systematically received preferential handling over another stock within the same district/time strata.

Deviations from Hardy-Weinberg

Of all the populations investigated, only Goodnews River in Kuskokwim Bay deviated from H-W equilibrium expectations at more than 3 loci (5 loci out of H-W). This deviation may be the result of pooling 2 collections that represented 2 populations or the result of 1 or both collections representing multiple temporal populations (Wahlund effect). No loci were out of H-W equilibrium for more than 6 populations. The low number of populations and loci that deviated from H-W equilibrium should not violate the assumptions of MSA given the sample sizes for the populations within the baseline (Wood et al. 1987).

Handling Linked Loci

Including linked loci into MSA can provide more apparent power than really exists as a result of pseudo-replication (c.f. Rice 1989). The degree of linkage and the relationship among alleles within loci across populations (phasing) can influence how to address the issue of linkage. If the linkage appears in a minority of the populations then including both loci in the analysis should not inflate the estimate of power above the appropriate level. If the linkage between 2 loci is present in many populations and the linkage phase is always the same, then eliminating 1 locus from analysis should eliminate this concern with no inappropriate loss in MSA power. However, if the loci are linked in a majority of populations and the phasing varies among populations then elimination of 1 locus would result in an inappropriate loss of MSA power. Unfortunately, although phasing within populations can be inferred (Stephens et al. 2001), phasing in fish from a mixture of populations cannot. In these circumstances, pooling the loci into a single composite phenotype should result in the conservation of the information that lies in the phasing while guarding against the inappropriate gain of MSA power due to pseudo-replication. Therefore, composite phenotypes were used rather than eliminating 1 of the MHC markers because linkage associations between phasing varied across populations. All other loci were retained despite the detection of linkage within some populations because linkage between the loci was not detected in a majority of populations: *One_Tf_ex10-750* and *One_Tf_ex3-182* (26% of collections); *One_GPDH-201* and *One_GPDH2-187* (13%); and *One_Tf_ex3-182* and *One_Zp3b-49* (3%). The first two of these pairs are thought to be physically linked (Smith et al. 2005, Elfstrom et al. 2006).

Marker F_{ST} and Resolving Power

Beacham et al. (2001) point out that the MHC markers provide a significant portion of the resolving power of MHC/microsatellite databases. The 2 MHC markers in our study had the highest F_{ST} values among all the markers (Table 7), indicative of the resolving power of this locus for MSA. The only other marker with an F_{ST} above 0.2 was *One_HpaI-99* (F_{ST} = 0.239). The high F_{ST} for *One_HpaI-99* was driven by the divergence of allele frequencies at this locus for Lake Clark populations relative to the rest of the baseline. In contrast, the high F_{ST} values for the MHC markers are driven by divergence in allele frequencies for these markers among populations distributed throughout the study area (data not shown).

Temporal Stability of Allele Frequencies.

All loci are appropriate for use in MSA as long as allele frequencies are stable over the time scales of the project. In this study, the ratio of the variation among temporal collections to variation among populations was approximately 0. Other baselines containing much larger relative temporal variation than observed in these baseline collections have been used

successfully for MSA applications. For example, Beacham et al. (2005) used a microsatellite baseline for sockeye salmon from British Columbia that contained larger temporal variation in allele frequencies and yielded high resolution in MSA applications. Both of these studies encompass baseline populations from similarly sized geographic areas. The ratio of variation among temporal collections to the variation among populations in their baseline was approximately 0.08.

Population Structure

In general, we observed shallow genetic structuring in Bristol Bay relative to other sockeye salmon producing regions (Beacham et al. 2006; Habicht et al. 2007b; Habicht et al. *In prep*). This is likely due in part to the large size of many Bristol Bay populations and the relatively short time since colonization following deglaciation, which resulted in low levels of genetic drift. In general, our data support a model of population structure based on the rearing or nursery lake (Wood et al. 1994; Seeb et al. 2000; Habicht et al. 2007a) with populations within drainages and regions more similar to each other than to populations from other drainages. Exceptions to this are for populations that spawn above obstacles to migration such as those in Lake Clark, Brooks Lake, and Alagnak Lake, as previously described by Habicht et al. (2004; 2007a) and Ramstad et al. (2004).

We observed a few cases where populations from very distant drainages grouped together. The populations from upper Nushagak River clustered together with populations from Kuskokwim River. While the mouths of these rivers are distant from one another, the populations spawn close to each other but on opposite sides of the same mountain range (Figure 2) and their clustering may be evidence of a historical stream capture event in which genetic information was exchanged across the current watershed divide. Similarly, Lake Clark populations grouped near the cluster of upper Kuskokwim River populations. While the genetic distance between these 2 clusters is large (as evidenced by long branch lengths between nodes), they are more similar to each other than to any other populations. As with the upper Nushagak and middle Kuskokwim River populations, the Lake Clark and upper Kuskokwim populations spawn geographically proximate to each other and may reflect another stream capture event. While the mouths of the Wood and Nushagak rivers are close, the migration distance between spawning populations of Wood River lakes and Tikchik lakes is great yet they show this same pattern of genetic similarity.

Populations from the North Peninsula reporting group generally did not cluster together and were distributed throughout the tree. This may be the result of small population sizes and distinct, short river systems that drain directly into Bering Sea resulting in increased genetic drift among North Peninsula populations.

Baseline Evaluation

There was high concordance in the correct allocations for the proof tests and for the escapement tests. The combined tests conservatively indicated that the 11 reporting groups can be distinguished from each other with a high degree of accuracy (>90% correct allocation). The 2 methods differ in that proof tests assumed that the baseline was complete (only fish that were in the baseline could be sampled to produce the mixture), while escapement samples could contain fish from populations within the drainage but not included in the baseline. In addition, the escapement samples likely include fish from populations in proportion to the size of escapement of each population, while the proof test assumed all populations in the baseline represented

similar escapements. Finally, both tests produced conservative estimates of the power of the MSA method because flat priors were used in these analyses, while informative priors were used in the analyses of district fisheries. Therefore, the magnitude and direction of misallocations observed in the baseline evaluation tests cannot be applied to adjust estimates of stock composition in district samples.

When fish were misallocated they were most often allocated to neighboring reporting groups and/or reporting groups with populations with very similar allele frequencies. For example, Pick Creek in the Wood River reporting group has allele frequencies similar to all of the Igushik River populations, groups with Igushik River populations on trees (Figure 3), and can cause misallocation between these 2 adjacent reporting groups (Table 9). In another example, the Tikchik Lake system populations group with Wood River populations on trees (Figure 3) which might explain the misallocation of fish from Nuyakuk River (which drains the Tikchik Lake system) escapement enumeration site to the Wood River reporting group (Table 9).

Influence of Priors

The results of our MSA can be influenced by the choice of priors used to inform the analysis. Priors are required in Bayesian analysis and can improve the estimates of stock composition by incorporating additional information. For our baseline evaluation tests we used flat Dirichlet priors to provide a conservative test of our baselines ability to identify reporting groups in a known mixture. For our estimation of stock composition of district harvests we used informative Dirichlet priors that reflect our best information to fully utilize the capabilities of Bayesian analysis to estimate stock composition. While we set the weight of these priors to be low (i.e., the prior parameters sum to 1), the relative influence of the prior distribution is apparent in certain situations. For example, the estimates of the Igushik stock in the Wood River evaluation tests and in the Nushagak District harvest showed a discrepancy that may have been influenced by the use of different priors. In the Wood River evaluation tests (estimated with a flat prior), the contribution of Igushik stock was 2–6%, whereas in the Nushagak District harvest, the Igushik contribution (estimated with an informative prior) was below 6% in three-quarters of Nushagak District strata. The combination of the genetic similarity of Pick Creek (Wood River) and Igushik River populations, and the greater weight given to Igushik River populations with a flat prior, may explain the apparent discrepancy in these results.

We conducted a small sensitivity analysis to examine the influence of priors in district mixtures by running a subsample of district mixtures with a flat prior. This subsample included 5 mixtures with a representative mixture from each year and district and, while small, gives an indication of the magnitude of the influence of priors. The differences were relatively small and, not surprisingly, estimates for the predominant reporting group were always smaller in the flat prior analysis with the difference often allocating to the adjacent and genetically most similar reporting groups. The average difference between reporting group estimates between the two methods was less than 1% (data not shown).

STOCK COMPOSITION AND STOCK-SPECIFIC HARVEST OF COMMERCIAL CATCH

Method Strengths and Caveats

This study represented the most comprehensive investigation of stock composition of sockeye salmon captured in commercial fishing districts within Bristol Bay, Alaska, and was comparable

to an analysis for sockeye salmon returning to Cook Inlet, Alaska (Habicht et al. 2007b). The methods used for determining stock composition far exceeded the accuracy and precision of previous used methods including previous genetic markers, age, scale pattern analysis, and tagging. Unlike previous studies using genetic markers, age and scale pattern analysis, this study was the first to use a method that could provide stock composition estimates that included all potentially contributing stocks including all stocks within Bristol Bay and surrounding areas (Alaska Peninsula and Kuskokwim River and Bay). Unlike the tagging studies, this study provided much more detailed information on the stock proportions whereas the tagging studies provide more qualitative information (presence/absence) due to the lack of statistical power associated with small sample sizes. The sampling design not only included all the districts, but was also stratified by subdistricts, fishing gear, and temporally segregated sampling within years. Finally, this study included information from 3 years so that interannual variation could also be examined.

This study went beyond stock composition estimates and applied them to the harvest to estimate stock-specific harvest by strata, then combined strata within districts to produce districtwide stock-specific harvest, and finally combined all districts to come up with total stock-specific harvest. This method provided a means to investigate where and when fish from each stock were harvested in every district and will eventually provide the basis to re-evaluate brood tables and escapement goals for all sockeye salmon stocks within Bristol Bay.

Although we believe this method provided the most accurate and precise estimates of stock composition to date, there are several issues that need to be taken into account when interpreting the results. Many of these issues are related to model assumptions that may not have been met in the sampling design or to bias in the MSA method. We discuss these issues below.

Errors in Sampling

Stock composition estimates may be affected by errors in sampling. A large number of samples were collected during this study from numerous locations throughout Bristol Bay. It is possible that fish believed to have been harvested in a given district-stratum were actually harvested elsewhere or at a different time. We were often dependent on processors for information defining a specific date and location of catch for the fish we sampled. Results that don't make sense or are out of place are an indication of an error in sampling. For example, MSA results of the harvest on 9 July, 2006 from Alagnak River Special Harvest Area (ARSHA) indicate that 17% of the harvest was Wood River sockeye salmon. ARSHA is within Naknek-Kvichak District. The next highest estimate of the Wood River stock in Naknek-Kvichak District harvests during 2006 through 2008 was 1.9% during the 14–17 July, 2006 period. The 9 July, 2006 result is highly unlikely, given the performance of this baseline to adequately identify reporting groups (especially the highly identifiable Alagnak River populations). It is also highly unlikely that there were actually Wood River fish present in ARSHA, given the remote location of ARSHA compared to Wood River and the low percentage of Wood River fish in other samples collected in Naknek-Kvichak District. Therefore, error due to sampling was the most likely cause of this result.

Bias in Sampling

Sample collections that that were not representative of the harvest may have led to bias in our stock composition estimates. This bias could result from gaps in when and where samples were collected in each of the districts. We attempted to collect genetic samples regularly from the

commercial harvest in each district so that our sample provided the best representation of the true stock composition of the harvest given the size of our sample. If we were unable to collect samples on a given day, then we attempted to collect samples from the next harvest that occurred in that district. There were often difficulties in collecting samples. For example, the harvest in Ugashik District was not delivered to a shore-based processor in Naknek and most of our samplers were stationed at shore-based processors in Naknek and Dillingham. Based on information provided to us from processors, we think approximately (25%) of the harvest in Bristol Bay was processed on floating processors from 2006 through 2008. We don't routinely sample fish from floating processors but do not believe this influenced or systematically biased the stock composition estimates. Samples were still collected as representatively as possible and should provide good representation of the commercial harvest.

The stock composition estimates could also be biased depending on the fishery. The majority (80%–90%) of sockeye salmon are harvested in the drift gillnet fishery in each district (Salomone 2006). We also collected the majority of samples from the drift gillnet fisheries in each of the districts. We did collect some samples from the set gillnet fishery in Kvichak Section and in Nushagak District. The samples collected in Kvichak Section were used to separately estimate the stock composition of that fishery. However, we did combine samples collected from the drift and set gillnet fisheries to estimate the stock composition in Nushagak District.

Selection of Samples for Analysis

The method of selecting samples in 2006 could have impacted the stock composition estimates. Samples in 2006 were representatively selected from all the samples within each period, while in 2007 and 2008 samples were selected in proportion to the harvest that occurred on days that samples were collected in each period. For example, in the first stratum in 2006 for Egegik District, we selected 47–48 samples from each day that samples were collected during 26–30 June, 2006 (237 samples total; Appendix C2). If we would have selected the samples in proportion to harvest, we would have respectively selected 54, 32, 28, 66, and 56 samples on those days. This would have meant selecting more samples on 26, 29–30 June and fewer samples on 27–28 June. We do not think the way the samples were selected in 2006 systematically biased the estimates in any given direction. Samples were still selected representatively from the majority of the samples collected during a period and still provide a good representation of the sockeye salmon in the commercial harvest. Stratified estimates for every year (2006 through 2008) within district within years accounted for the differences in harvest among strata.

Sample Sizes

We set relatively high minimum target sample size for the stratified estimates by district within years (380 fish) in order to minimize sampling error. We generally achieved this goal with a range from 278 to 1,283 fish and an average of 896 fish (Tables 11–13). This relatively high target sample size was chosen because the effective sample size (N_{es}) is always less than the number of fish sampled from a fishery ($N_{fishery}$; Kalinowski 2004) due to error associated with estimating mixture proportions with genetic data. The magnitude of this difference is a function of both error associated with sampling from a fishery (sampling error) and error associated with the quality of genetic data used to estimate stock proportions (genetic error). We believe our genetic error is low based on baseline evaluation tests (Tables 8 and 9), and defining high minimum sample sizes further minimizes error. We set a smaller minimum target sample size

for the individual strata within district within year (190 fish) because we were interested in determining if there were trends in the stock composition of the harvest within each district through the season, rather than in estimating point estimates with small credibility intervals.

Precision and Accuracy

Estimates of stock composition can be biased as observed within the known mixture estimates (Tables 8 and 9). We believe these biases are small and that the true stock composition generally falls within the credibility intervals of the stock composition estimates within strata. However, as strata are combined into larger mixtures and the precision of our estimates increase, the credibility interval typically shrinks and bias may become relatively more important. Using information from all strata increases the sample size and precision of estimates, generally resulting in tighter credibility intervals. There is the potential for these estimates to become more precise around a biased estimate if our methodology or baseline data create bias. Although we do not believe we are observing substantial bias, we are investigating potential improvements to our methodology, including using regional estimate models in place of our current population estimate model that could reduce bias due to differing numbers of populations within reporting groups.

Stock Composition and Inshore Run

Total abundance (or inshore run) of each of the 9 major stocks of sockeye salmon in Bristol Bay has been estimated by the department since statehood. Accuracy and precision of estimated annual harvests and escapements are considered to be excellent (Clark 2005). However, there have been concerns regarding the correct allocation of harvest to each stock. Traditional methods to allocate harvest in each district have relied on a series of largely untested assumptions (Clark 2005). For example, the department has assumed that all of the sockeye salmon harvested within each district originated from rivers within the same district. We know this is not entirely true based on our results and previous studies based on scale pattern analysis (Menard and Miller 1997). However, the bias was considered small by the department and to some extent balanced by similar assumptions in other fishing districts. For example, the department assumed that Ugashik fish being harvested in Egegik District would be offset by Egegik fish being harvested in Ugashik District. In fishing districts that have 2 or more stocks (Naknek-Kvichak and Nushagak districts), the age composition of both the harvest and escapements has been used to allocate the harvest to rivers or stocks within each district (Bernard 1983). A major assumption of this method is that all the stocks within a district have similar harvest rates by age. Harvest allocations using this method will be biased if harvest rates are not similar for the stocks present, with relatively large bias for smaller populations and relatively small bias for larger populations (Bernard 1983).

Recommendations have been made to identify methods that would allow us to accurately and precisely estimate the stock composition of the Bristol Bay sockeye salmon harvest (Clark 2005). GCL has been developing genetics methods since the 1990s that would make this possible. This study is the result of those efforts and provides the first comprehensive set of reliable stock composition estimates for all the districts and stocks in Bristol Bay.

Genetic Stock Composition of the Commercial Harvest

Over 99% of sockeye salmon harvested in Bristol Bay were produced from rivers within Bristol Bay in 2006, 2007, and 2008 (Table 14–16; Figures 6–11). A very small number (<0.1%;

<20,000 annually) of sockeye salmon in the harvest were from the North Peninsula reporting group. A larger number (~0.7%; ~190,000 annually) of sockeye salmon in the harvest were from the Kuskokwim reporting group, with most being harvested in Togiak and Nushagak districts.

The majority of the sockeye salmon harvested within each district originated from rivers within the same district. This finding was similar to previous stock composition studies using scale pattern analysis. Fried and Yuen (1985) found that scale pattern analysis could be used to separate sockeye salmon stocks on the eastside (Kvichak, Naknek, Egegik, and Ugashik) of Bristol Bay and this method was used to estimate the stock composition of the commercial harvest in Ugashik, Egegik, and Naknek-Kvichak districts from 1983–1995 (Menard and Miller 1997). Menard and Miller (1997) found that most sockeye salmon harvested in Eastside districts originated from rivers within the same district. However, they also found sockeye salmon stocks from other districts were present in district harvests.

Districts with the highest percentages of sockeye salmon originating within their own district were: Nushagak District (98%–99% from Nushagak, Wood, and Igushik rivers); and Naknek-Kvichak District (93%–99% from Naknek, Alagnak, and Kvichak rivers); followed by Ugashik District (77%–90% from Ugashik River), Egegik District (73%–86% from Egegik River), and Togiak District (70%–86% from Togiak River) (Tables 11–13; Figures 6–11).

When sockeye salmon originating from rivers in other districts were in the harvest within a district they usually came from rivers in adjacent districts. For instance, the non-local component of the harvest from each district was as follows: Ugashik District non-local fish were mostly Egegik stock (6.5%–22%); Egegik District non-local fish were split between Ugashik (1.3%–8.2%), Naknek (2.2%–13.8%), and Kvichak (3.0%–10.4%) stocks; Naknek-Kvichak District non-local fish were mostly Egegik stock (0.3%–6.1%); Nushagak District non-local fish were Togiak (<1%) and Kuskokwim stock (<1%); and Togiak District non-local fish were mostly Kuskokwim stock (13%–28%; Tables 11–13; Figures 6–11).

We also found that the sockeye salmon stocks from Eastside and Westside of Bristol Bay do not mix to any appreciable amount. Very few (<1%) of the sockeye salmon harvested in the districts on each side of Bristol Bay were from rivers or stocks on the other side. Straty (1975) summarized tagging studies that were conducted in the 1950s and early 1960s and concluded that sockeye salmon stocks from Eastside of Bristol Bay were not mixed with stocks from Westside.

Our results also appear to support previous studies of the movement and location of sockeye salmon in Bristol Bay. Straty (1975) summarized that sockeye salmon stocks were segregated within Bristol Bay by the time they reached the head of the bay, with Ugashik and Egegik stocks located on the east side of the inner bay; Naknek, Alagnak, and Kvichak stocks located offshore in the middle of the bay until they reached Kvichak Bay; and Nushagak, Wood, and Igushik stocks located on the west side of the inner bay. While there was some overlap of stocks in these areas, it appears this was the general pattern of returning sockeye salmon in Bristol Bay. This segregation of stocks has also been observed in mixed stock analyses of the station-specific catch from Port Moller Test Fishery (GCL[2]).

[2] GCL (Gene Conservation Laboratory). Unpublished data on file at: Alaska Department of Fish and Game, 333 Raspberry Road, Anchorage, Alaska 99518, USA.

Variability in Stock Composition Estimates

It was not surprising that the stock composition estimates were highly variable both spatially and temporally both among and within districts. Clearly, stock composition among districts was expected to vary because the fishing districts were designed to harvest fish returning to rivers draining into the district (see differences in stock compositions among districts; Tables 11–13; Figures 6–11). Stock composition within districts also varied both within years and among years (Appendices D1–D15). Multiple factors might explain temporal variation in estimates of stock composition including: differing run timings among stocks, differing run sizes among years among stocks, differing spatial fishing effort within districts (special harvest area or district-wide), differences in fishing gear (set gillnet or drift gillnet), and different migratory routes both within and among years. Migratory routes may be altered by differing environmental conditions within and among years including such variables as the flood stage, temperature and current gradients, and wind direction and speed, or the presence/absence of other stocks.

This study was designed to provide stock composition estimates of the commercial harvest and was designed to incorporate factors that may affect stock composition within districts through time. However, this study was not designed to separately measure the influence of each factor that may have affected the stock compositions within districts. In other words, we did not control for things like the spatial fishing effort within district and determine the stock composition within a district special harvest area relative to the district wide harvest, but rather we determined the stock composition of representative fishing periods, some of which were fished in special harvest areas and some district wide to determine the stock compositions captured in the whole commercial fishery. Because of this study design, many variables that might affect stock composition were changing simultaneously (i.e., time and area) and these variables confound interpretation of the effect of each variable separately.

Because of the high variability in the stock composition estimates from year to year, the department has set a minimum of 3 years of estimates be used in studies of the stock composition of commercial fisheries. We consider this a compromise between having an adequate number of years to detect interannual stability of trends in fishery harvests and providing information that could influence decisions regarding commercial fisheries in Alaska in a timely manner.

Comparison of Inshore Run Estimates

We compared traditional estimates of inshore run to those based on genetic stock composition estimates (Tables 14–16; Figure 12). Assuming the genetic estimates of stock composition are correct, the Ugashik stock inshore run was underestimated by 9% in 2006 and overestimated by 8% and 12% in 2007 and 2008, respectively. The differences in the Ugashik stock inshore run were primarily due to the number of Ugashik stock fish harvested in Egegik District and Egegik stock fish harvested in Ugashik District. For instance, more Ugashik stock fish (560,716) were harvested in Egegik District than Egegik stock fish harvested in Ugashik District (158,759) in 2006 (Table 14). This resulted in an underestimation of Ugashik stock inshore run in 2006. The opposite was true and resulted in an overestimation of Ugashik stock inshore run in 2007 and 2008.

The Egegik stock inshore run was overestimated by 7%, 5%, and 14% in 2006, 2007, and 2008, respectively. The overestimation of the Egegik stock inshore run was primarily due to the harvest of Ugashik, Naknek, and Kvichak stocks in Egegik District (Tables 14–16; Figure 12).

The Naknek stock inshore run was overestimated by 8% and 5% in 2006 and 2007, respectively, and greatly underestimated by 30% in 2008 (Figure 12). The small overestimation of the Naknek stock inshore run in 2006 and 2007 was mainly due to the large number of sockeye salmon harvested in NRSHA (Appendices D7 and D8). The department's historical methods assumed that 100% of the harvest in NRSHA was Naknek River stock. However, we found that 10%–20% of NRSHA harvest was actually from the Alagnak and Kvichak stocks. The large underestimation of the Naknek stock inshore run in 2008 was due in large part to using age composition to allocate the harvest within Naknek-Kvichak District.

The age composition method works best when the stocks present have similar harvest rates by age (Bernard 1983). While we did not estimate age-specific stock composition, our results indicate that the harvest rate for Naknek stock was substantially more (60.9%) than the harvest rates for the Alagnak stock (43.5%) and Kvichak stocks (40.4%) within Naknek-Kvichak District in 2008 (Table 16). The difference in the harvest rates was likely the result of fishing in Naknek Section, where much of the commercial fishing in 2008 occurred.

The Alagnak stock inshore run was underestimated by 13% and 3% in 2006 and 2007, respectively, and overestimated by 41% in 2008 (Figure 12). The inshore run of the Kvichak stock was underestimated by 1%, 21%, and 5% in 2006, 2007, and 2008, respectively. The underestimation of the inshore runs of the Alagnak and Kvichak stocks was most likely due to harvest of these stocks in Egegik District. The large overestimation of the 2008 Alagnak stock inshore run was due to using age composition to allocate the harvest within Naknek-Kvichak District (Bernard 1983). The age composition method works best when the stocks present have different age compositions (Bernard 1983). There were a large number of age-0.3 fish in the Alagnak and Naknek river escapements and in the Naknek-Kvichak District harvest in 2008. This low contrast in age composition data coupled with similar levels of escapement made it difficult to correctly allocate the harvest by the traditional method.

The Nushagak stock inshore run was slightly overestimated by 2%, 4%, and 7% in 2006, 2007, and 2008, respectively. The Wood stock inshore run was underestimated by 8%, 15%, and 28% in 2006, 2007, and 2008, respectively. The underestimation of the Wood stock inshore run was primarily due to the large overestimation of the Igushik stock inshore run (Figure 12). The Igushik stock inshore run was greatly overestimated by 159%, 164%, and 147% in 2006, 2007, and 2008, respectively. The overestimation of Igushik stock run sizes was due in large part to using age composition to allocate the harvest within Nushagak District (Bernard 1983). The age composition method also works best when the stocks present have similar harvest rates by age (Bernard 1983). Our results indicate that the harvest rate for Igushik stock is less than one-half the harvest rates on the Nushagak and Wood stocks. The age composition of Igushik River fish is very similar to that of Wood River fish. The age composition method does not work well when age compositions are similar (Bernard 1983). The potential bias is also much higher for smaller stocks than for larger stocks, and the Igushik stock is a much smaller stock than the Wood stock.

It should be noted that our estimates of the Igushik stock in the Nushagak District harvest, based on MSA, may be underestimated due to bias in sampling. This is especially true in 2007 and 2008. We were able to collect genetic samples from the Igushik Section set gillnet fishery in 2006. We estimated that over 70% of the harvest was Igushik River fish in the Igushik Section set gillnet fishery (Appendix D10). However, we were unable to collect genetic samples from this fishery in 2007 and 2008. Because of this, we did not separately estimate the stock composition in Igushik Section set gillnet fishery. Therefore, our estimate of the Igushik River harvest is underestimated.

Even with this underestimation, our traditional method using age composition is still greatly overestimating the number of Igushik River fish in the harvest. It is our recommendation that additional samples be collected in the Igushik Section set gillnet fishery.

The Togiak stock inshore run was overestimated by 21%, 2%, and 21% in 2006, 2007, and 2008, respectively (Figure 12). The overestimation of the Togiak stock was due to the harvest of Kuskokwim stock fish in Togiak District. There were also some Nushagak stock fish harvested in Togiak District in 2007 (Table 15).

Management Implications

We are aware of the implications to the management of the commercial sockeye salmon fisheries in Bristol Bay that this study raises. This study also provides an opportunity to evaluate some the underlying assumptions and decisions affecting the management of commercial fisheries in Bristol Bay. For instance, the Kvichak River sockeye salmon stock has been designated as a "Stock of Concern" since 2001 (Morstad and Baker 2009). In response to the "Stock of Concern" designation, the board modified management plans to provide additional protection for Kvichak River sockeye salmon. The additional protection was primarily through the creation of Egegik River Special Harvest Area (ERSHA) in Egegik District and Naknek River Special Harvest Area (NRSHA) in Naknek-Kvichak District. Although this study was not designed to investigate the efficacy of special harvest areas to target specific stocks, the overall pattern showing that use of ERSHA and NRSHA reduced the harvest of Kvichak River sockeye salmon, as the board intended, was evident. ERSHA and NRSHA were fished in 2006 and 2007. Harvest of Kvichak River fish was ~1%–3% of the total harvest in ERSHA compared to ~2%–8% of the total harvest in Egegik District in these years (Appendices D4 and D5). Harvest of Kvichak River fish was ~3%–10% of the total harvest in NRSHA compared to ~20%–60% of the total harvest in Naknek Section and Naknek-Kvichak District in these years (Appendices D7 and D8). Additionally, sampling periods that utilized ERSHA and NRSHA tended to target more local stocks and resulted in less harvest from non-local stocks. The harvest in ERSHA was ~90% Egegik River fish (Appendices D4 and D5) while the harvest in NRSHA was 80%–90% Naknek River fish (Appendices D7–D8).

FUTURE WORK AND SUMMARY

This study presents results from the best methodology currently available. We intend to continue to improve upon this work as this project continues. GCL is in the process genotyping additional samples from existing baseline collections to increase sample sizes. In addition, GCL is contracting research to develop a new suite of SNPs that should bring our set of markers available to screen for genetic variation up to 96. These steps will provide even greater power to discriminate among reporting groups. While we will continue to improve the power of our baseline, we also intend to investigate potential improvements to our MSA methodology. For example, we would like to conduct a more thorough sensitivity analysis to assess the effect of different prior distributions on MSA results. We would also like to examine the effect of the Bayesian methodology of allocating genetically similar stocks that comprise very different proportions of a harvest sample. GCL personnel are also investigating alternative, hierarchical models for MSA, which may improve our ability to estimate small proportions in mixtures. We would like to collect district harvest samples from better defined strata, such as Igushik Section of Nushagak District, to better estimate harvest and total run of each stock. Similarly, it will be useful to conduct a controlled experiment that can partition the effects of multiple factors on

stock composition (e.g., stage of the run, location within districts, tidal stage, etc.) to better understand the effect of specific management actions on stock composition (i.e., Objective 4). Finally, additional years of stock composition analyses of commercial catch will be important to test for stability of spatial and intra-annual patterns of stock composition among years.

Many of these improvements, including additional baseline samples, new SNP markers, new statistical methods and increased sample sizes for mixtures, will be used in the WASSIP program. These changes may result in higher precision and accuracy of mixture estimates and could change how we perceive harvests of small stocks in some areas (i.e. districts). The results from WASSIP are scheduled to be available in 2012.

We consider this study to be the first step in a process to accurately and precisely estimate the productivity of sockeye salmon stocks in Bristol Bay. There is currently a study in progress to isolate DNA from previously collected scale samples from harvests dating back to 1964 and determine partial historical harvest stock compositions using MSA. We plan to continue the Bristol Bay genetics program into the future to provide additional years of stock composition estimates. Over the next few years, the data gathered from these studies will be used to reconstruct inshore run and brood tables for each sockeye salmon stock. This will greatly improve our understanding of stock productivity within Bristol Bay.

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TABLES AND FIGURES

Table 1.–Commercial harvest by district and escapement by river for sockeye salmon in Bristol Bay, Alaska, 2006–2008.

District/River	Harvest	Escapement	Total
2006			
Ugashik	2,429,597	1,003,158	3,432,755
Egegik	7,408,233	1,465,158	8,873,391
Naknek-Kvichak	7,150,540		13,945,960
Naknek River		1,953,228	
Alagnak River		1,773,966	
Kvichak River		3,068,226	
Nushagak	10,876,357		15,738,137
Nushagak River		548,410	
Wood River		4,008,102	
Igushik River		305,268	
Togiak	626,441	312,126	938,567
Total	**28,491,168**	**14,437,642**	**42,928,810**
2007			
Ugashik	5,026,615	2,599,186	7,625,801
Egegik	6,495,908	1,432,500	7,928,408
Naknek-Kvichak	9,022,511		17,244,437
Naknek River		2,945,304	
Alagnak River		2,466,414	
Kvichak River		2,810,208	
Nushagak	8,404,111		10,865,690
Nushagak River		518,041	
Wood River		1,528,086	
Igushik River		415,452	
Togiak	816,581	269,646	1,086,227
Total	**29,765,726**	**14,984,837**	**44,750,563**
2008			
Ugashik	2,334,022	596,332	2,930,354
Egegik	7,403,885	1,259,568	8,663,453
Naknek-Kvichak	10,381,844		17,792,948
Naknek River		2,472,690	
Alagnak River		2,180,502	
Kvichak River		2,757,912	
Nushagak	6,903,157		10,175,083
Nushagak River		492,546	
Wood River		1,724,676	
Igushik River		1,054,704	
Togiak	651,315	205,680	856,995
Total	**27,674,223**	**12,744,610**	**40,418,833**
2006-2008			
Annual Average	**28,643,706**	**14,055,696**	**42,699,402**

Table 2.–River, year of collection, type of enumeration project, and sample size of fish included in escapement enumeration tests of the baseline to evaluate for mixed stock analysis using genetic data for sockeye salmon in Bristol Bay, Alaska.

River	Year	Type	n
Ugashik	2004	Tower	192
Egegik	2004	Tower	384
Egegik	2007	Tower	190
Naknek	2002	Tower	288
Alagnak	2004	Tower	192
Kvichak	2005	Tower	194
Kvichak	2006	Tower	1,681
Nushagak	2005	Radio Telemetry	190
Nushagak	2006	Radio Telemetry	166
Nushagak	2006	Sonar	190
Nuyakuk	2004	Tower	190
Wood	2003	Tower	174
Wood	2004	Tower	192
Wood	2006	Tower	94
Wood	2007	Tower	190
Igushik	2005	Tower	190
Igushik	2007	Tower	189
Total			4,886

Table 3.–Sockeye salmon commercial harvest and numbers of samples collected, selected, and successfully screened for genetic analysis by periods in Bristol Bay, Alaska, in 2006.

					Genetics Samples		
Period	Description	Start	End	Harvest	Collected	Selected	Screened
1	Ugashik District	6/12/2006	7/11/2006	1,072,039	1,616	188	182
2	Ugashik District	7/12/2006	8/31/2006	1,357,558	1,040	192	190
Total (2 Periods)		6/12/2006	8/31/2006	2,429,597	2,656	380	372
1	Egegik River Special Harvest Area	6/12/2006	7/1/2006	1,419,201	1,399	237	235
2	Egegik River Special Harvest Area	7/2/2006	7/6/2006	1,781,368	960	190	189
3	Egegik River Special Harvest Area until 7/9; Naknek-Kvichak District 7/10-12.	7/7/2006	7/12/2006	2,146,260	432	190	188
4	Egegik District	7/13/2006	7/15/2006	1,043,036	480	191	191
5	Egegik District	7/16/2006	7/16/2006	154,671	240	190	186
6	Egegik District	7/17/2006	8/31/2006	863,697	480	190	187
Total (6 Periods)		6/12/2006	8/31/2006	7,408,233	3,991	1,188	1,176
1	Naknek River Special Harvest Area	6/19/2006	7/9/2006	2,209,098	2,584	167	162
2	Naknek -Kvichak Section	7/10/2006	7/10/2006	235,526	240	190	188
3	Naknek -Kvichak District	7/11/2006	7/13/2006	2,035,734	940	190	189
4	Naknek -Kvichak District	7/14/2006	7/17/2006	1,335,678	719	192	191
5	Naknek -Kvichak District	7/18/2006	8/25/2006	1,089,931	524	204	202
6	Alagnak River Special Harvest Area	7/7/2006	7/12/2006	45,975	164	164	163
7	Kvichak Section Set Gillnet Only	7/10/2006	8/4/2006	198,598	200	190	188
Total (7 Periods)		6/19/2006	8/25/2006	7,150,540	5,371	1,297	1,283
1	Nushagak District	6/11/2006	6/29/2006	2,577,971	696	190	186
2	Nushagak District	6/30/2006	7/5/2006	3,635,772	547	278	270
3	Nushagak District	7/6/2006	7/10/2006	2,689,416	720	287	277
4	Nushagak District	7/11/2006	7/15/2006	1,322,670	480	190	184
5	Nushagak District	7/16/2006	8/20/2006	472,266	718	143	143
6	Igushik Section Set Gillnet Only	6/22/2006	7/25/2006	178,262	200	190	189
Total (6 Periods)		6/11/2006	8/20/2006	10,876,357	3,361	1,278	1,249
1	Togiak District	6/19/2006	8/9/2006	626,441	680	285	278
Total (1 Period)		6/19/2006	8/9/2006	626,441	680	285	278
Bristol Bay Total (22 Periods)		6/11/2006	8/31/2006	28,491,168	16,059	4,428	4,358

Note: Genetic samples were used to estimate stock composition and stock-specific harvest throughout Bristol Bay.

Table 4.–Sockeye salmon commercial harvest and numbers of samples collected, selected, and successfully screened for genetic analysis by periods in Bristol Bay, Alaska, in 2007.

					Genetics Samples		
Period	Description	Start	End	Harvest	Collected	Selected	Screened
1	Ugashik District	6/12/2007	7/1/2007	344,059	789	190	182
2	Ugashik District	7/2/2007	7/7/2007	1,274,764	700	190	184
3	Ugashik District	7/8/2007	7/11/2007	1,162,109	439	190	186
4	Ugashik District	7/12/2007	8/17/2007	2,245,683	786	190	185
Total (4 Periods)		6/12/2007	8/17/2007	5,026,615	2,714	760	737
1	Egegik District	6/12/2007	6/27/2007	475,947	326	190	186
2	Egegik River Special Harvest Area	6/28/2007	7/3/2007	1,237,701	480	190	186
3	Egegik River Special Harvest Area	7/4/2007	7/8/2007	2,115,321	480	190	183
4	Egegik District	7/9/2007	7/14/2007	1,965,468	809	190	185
5	Egegik District	7/15/2007	8/31/2007	701,471	359	190	184
Total (5 Periods)		6/12/2007	8/31/2007	6,495,908	2,454	950	924
1	Naknek -Kvichak District	6/12/2007	6/27/2007	351,509	300	190	188
2	Naknek River Special Harvest Area	6/28/2007	7/8/2007	3,922,415	720	190	185
3	Naknek -Kvichak District	7/9/2007	7/12/2007	2,428,294	809	190	187
4	Naknek -Kvichak District	7/13/2007	7/16/2007	1,732,003	720	190	187
5	Naknek -Kvichak District	7/17/2007	8/21/2007	588,290	265	190	188
Total (5 Periods)		6/12/2007	8/21/2007	9,022,511	2,814	950	935
1	Nushagak District	6/9/2007	6/28/2007	1,498,165	634	190	180
2	Nushagak District	6/29/2007	7/2/2007	1,875,216	541	190	183
3	Nushagak District	7/3/2007	7/7/2007	2,570,751	754	190	187
4	Nushagak District	7/8/2007	7/12/2007	1,830,266	620	190	190
5	Nushagak District	7/13/2007	8/31/2007	629,713	1,088	190	187
Total (5 Periods)		6/9/2007	8/31/2007	8,404,111	3,637	950	927
1	Togiak District	6/18/2007	7/10/2007	199,823	1,571	190	189
2	Togiak District	7/11/2007	7/21/2007	306,105	820	190	187
3	Togiak District	7/22/2007	8/6/2007	310,653	399	190	185
Total (3 Period)		7/22/2007	8/6/2007	816,581	2,790	570	561
Bristol Bay Total (22 Periods)		6/9/2007	8/31/2007	29,765,726	14,409	4,180	4,084

Note: Genetic samples were used to estimate stock composition and stock-specific harvest throughout Bristol Bay.

Table 5.–Sockeye salmon commercial harvest and numbers of samples collected, selected, and successfully screened for genetic analysis by periods in Bristol Bay, Alaska, in 2008.

					Genetics Samples		
Period	Description	Start	End	Harvest	Collected	Selected	Screened
1	Ugashik District	6/16/2008	6/29/2008	160,422	1,020	190	186
2	Ugashik District	6/30/2008	7/3/2008	364,550	288	190	188
3	Ugashik District	7/4/2008	7/10/2008	1,265,549	860	190	188
4	Ugashik District	7/11/2008	7/13/2008	277,143	395	190	185
5	Ugashik District	7/14/2008	8/31/2008	266,358	432	190	187
Total (5 Periods)		6/16/2008	8/31/2008	2,334,022	2,995	950	934
1	Egegik District	6/9/2008	6/26/2008	600,533	652	190	188
2	Egegik District	6/27/2008	6/29/2008	1,092,595	409	190	188
3	Egegik District	6/30/2008	7/5/2008	3,178,947	706	190	187
4	Egegik District	7/6/2008	7/8/2008	1,233,792	431	190	189
5	Egegik District	7/9/2008	7/11/2008	658,818	282	190	188
6	Egegik District	7/12/2008	8/31/2008	639,200	557	190	188
Total (6 Periods)		6/9/2008	8/31/2008	7,403,885	3,037	1,140	1,128
1	Naknek -Kvichak District	6/1/2008	6/28/2008	426,382	528	191	178
2	Naknek -Kvichak District	6/29/2008	7/1/2008	1,149,807	396	190	184
3	Naknek -Kvichak District	7/2/2008	7/5/2008	2,649,901	528	189	181
4	Naknek -Kvichak District	7/6/2008	7/9/2008	2,545,988	508	190	188
5	Naknek -Kvichak District	7/10/2008	7/14/2008	1,881,391	995	190	186
6	Naknek -Kvichak District	7/15/2008	8/31/2008	1,009,609	809	190	172
7	Kvichak Section Set Gillnet Only	6/19/2008	7/29/2008	718,766	500	190	188
Total (7 Periods)		6/1/2008	8/31/2008	10,381,844	4,264	1,330	1,277
1	Nushagak District	6/9/2008	7/1/2008	1,908,168	768	190	186
2	Nushagak District	7/2/2008	7/3/2008	1,252,366	288	190	178
3	Nushagak District	7/4/2008	7/6/2008	1,097,706	288	190	181
4	Nushagak District	7/7/2008	7/9/2008	1,366,658	556	190	186
5	Nushagak District	7/10/2008	7/15/2008	1,121,769	720	190	174
6	Nushagak District	7/16/2008	8/31/2008	156,489	288	190	183
Total (6 Periods)		6/9/2008	8/31/2008	6,903,156	2,908	1,140	1,088
1	Togiak District	6/18/2008	7/12/2008	197,737	774	190	188
2	Togiak District	7/13/2008	7/19/2008	194,162	877	190	188
3	Togiak District	7/20/2008	8/6/2008	259,416	698	190	189
Total (3 Period)		7/20/2008	8/6/2008	651,315	2,349	570	565
Bristol Bay Total (27 Periods)		6/1/2008	8/31/2008	27,674,222	15,553	5,131	4,992

Note: Genetic samples were used to estimate stock composition and stock-specific harvest throughout Bristol Bay.

Table 6.–Descriptive statistics for SNPs used in the current department's sockeye salmon baseline, including expected (H_e) and observed heterozygosity (H_o) for nuclear loci, and F_{ST} for each locus and for all the 42 used markers (40 nuclear loci and 2 pooled loci).

Marker	H_e	H_o	F_{ST}
One_ACBP-79	0.399	0.381	0.036
One_ALDOB-135	0.264	0.226	0.145
One_ctgf-301	0.022	0.022	0.020
One_E2-65	0.355	0.347	0.038
One_GHII-2165	0.132	0.126	0.028
One_GPDH-201	0.497	0.469	0.045
One_GPDH2-187	0.081	0.079	0.026
One_GPH-414	0.480	0.434	0.099
One_hcs71-220	0.302	0.289	0.037
One_HGFA-49	0.285	0.266	0.051
One_HpaI-71	0.402	0.377	0.057
One_HpaI-99	0.088	0.067	0.239
One_IL8r-362	0.128	0.123	0.057
One_KPNA-422	0.388	0.368	0.052
One_LEI-87	0.499	0.482	0.044
One_MARCKS-241	0.013	0.013	0.035
One_MHC2_190[a]	0.457	0.307	0.315
One_MHC2_251[a]	0.492	0.335	0.311
One_Ots213-181	0.158	0.150	0.050
One_p53-534	0.007	0.007	0.009
One_ins-107	0.498	0.445	0.093
One_Prl2	0.500	0.445	0.105
One_RAG1-103	0.014	0.013	0.037
One_RAG3-93	0.135	0.127	0.068
One_RFC2-102	0.301	0.287	0.045
One_RFC2-285	0.057	0.055	0.068
One_RH2op-395	0.017	0.017	0.013
One_serpin-75	0.076	0.071	0.034
One_STC-410	0.500	0.406	0.180
One_STR07	0.457	0.400	0.124
One_Tf_ex11-750	0.495	0.461	0.066
One_Tf_in3-182	0.110	0.099	0.092
One_U301-92	0.237	0.229	0.044
One_U401-224	0.452	0.439	0.033
One_U404-229	0.076	0.063	0.165
One_U502-167	0.043	0.043	0.021
One_U503-170	0.299	0.280	0.055
One_U504-141	0.358	0.347	0.033
One_U508-533	0.038	0.037	0.017
One_VIM-569	0.162	0.153	0.050
One_ZNF-61	0.486	0.432	0.112
One_zP3b-49	0.118	0.098	0.175
One_CO1[b]	N/A	N/A	0.130
One_Cytb_17[b]	N/A	N/A	0.017
One_Cytb_26[b]	N/A	N/A	0.132
One_CO1_Cytb17_26	N/A	N/A	0.132
One_MHC2_190_251	N/A	N/A	0.251
Minimum	0.007	0.007	0.009
Maximum	0.500	0.482	0.251
Average/Overall	0.259	0.234	0.090

Note: Minimum and maximum values and overall F_{ST} are shown for the 42 used markers, while average heterozygosities include only nuclear loci. Superscripts indicate sets of SNPs which were pooled into a single locus.

[a] These SNP genotypes were combined into a single locus, *One_MHC2_190_251*, and treated as haploid data.

[b] These SNPs were combined into haplotypes and treated together as an mtDNA locus, *One_CO1_Cytb17_26*.

Table 7.–Percent of total baseline collections of sockeye salmon from Bristol Bay, Alaska, exhibiting significant (P<0.01) gametic disequilibrium for the pairs of loci for which disequilibrium was most commonly observed.

Pair of loci		Significant gametic disequilibrium	
		Number of collections	Percentage of total
One_MHC2_190	*One_MHC2_251*	88	61%
One_Tf_ex10-750	*One_Tf_ex3-182*	37	26%
One_GPDH	*One_GPDH2*	19	13%
One_Tf_ex3-182	*One_Zp3b-49*	5	3%

Table 8.–Stock composition estimates, 90% credibility intervals, standard deviations, and sample sizes for mixtures of approximately 200 known fish that were removed from the Bristol Bay, Alaska, baseline populations of sockeye salmon that contribute to each reporting group (100% proof tests) using the program BAYES with a flat prior.

			Reporting Group										
Reporting Group			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
North Peninsula		Proportion	**0.99**	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n		Lower 90% CI	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	196	Upper 90% CI	1.00	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01
		SD	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ugashik		Proportion	0.00	**0.96**	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n		Lower 90% CI	0.00	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	200	Upper 90% CI	0.03	1.00	0.09	0.03	0.01	0.01	0.02	0.01	0.01	0.02	0.01
		SD	0.01	0.04	0.03	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.00
Egegik		Proportion	0.01	0.01	**0.96**	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	199	Upper 90% CI	0.05	0.05	1.00	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.02
		SD	0.02	0.02	0.03	0.02	0.00	0.01	0.00	0.00	0.00	0.01	0.01
Naknek		Proportion	0.00	0.00	0.00	**0.97**	0.00	0.01	0.00	0.00	0.00	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	201	Upper 90% CI	0.01	0.01	0.01	1.00	0.01	0.07	0.02	0.01	0.01	0.02	0.02
		SD	0.00	0.00	0.00	0.03	0.01	0.02	0.01	0.00	0.00	0.01	0.01
Alagnak		Proportion	0.00	0.00	0.00	0.00	**0.99**	0.00	0.00	0.00	0.00	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.00
	201	Upper 90% CI	0.00	0.00	0.00	0.00	1.00	0.00	0.02	0.01	0.01	0.00	0.01
		SD	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Kvichak		Proportion	0.00	0.00	0.00	0.00	0.00	**0.99**	0.00	0.00	0.00	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.00	0.00
	198	Upper 90% CI	0.01	0.02	0.02	0.02	0.00	1.00	0.00	0.00	0.00	0.00	0.00
		SD	0.00	0.01	0.01	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Nushagak		Proportion	0.00	0.00	0.00	0.00	0.02	0.00	**0.93**	0.03	0.01	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.01	0.00	0.83	0.00	0.00	0.00	0.00
	199	Upper 90% CI	0.01	0.01	0.01	0.00	0.05	0.01	0.98	0.12	0.04	0.01	0.01
		SD	0.00	0.01	0.00	0.00	0.01	0.01	0.05	0.04	0.01	0.00	0.00

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Table 8.–Page 2 of 2.

Reporting Group			Reporting Group										
Reporting Group			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
Wood		Proportion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.93**	0.06	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00
	198	Upper 90% CI	0.01	0.01	0.01	0.00	0.01	0.00	0.02	1.00	0.17	0.00	0.00
		SD	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.06	0.00	0.00
Igushik		Proportion	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03	**0.96**	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00
	200	Upper 90% CI	0.02	0.03	0.00	0.00	0.01	0.00	0.01	0.14	1.00	0.01	0.00
		SD	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.05	0.05	0.00	0.00
Togiak		Proportion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.99**	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.97	0.00
	199	Upper 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	1.00	0.01
		SD	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01
Kuskokwim		Proportion	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.07	**0.91**
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84
	200	Upper 90% CI	0.01	0.01	0.00	0.01	0.01	0.01	0.05	0.01	0.01	0.14	0.98
		SD	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.04	0.04

Note: Proportion estimates in bold represent the correct allocations for each reporting group and would be 1.00 if no misallocation occurred.

Table 9.–Stock composition estimates, 90% credibility intervals, standard deviations and sample sizes for mixtures of fish captured at the 8 escapement enumeration sites for sockeye salmon in Bristol Bay, Alaska, in different years using the program BAYES with a flat prior.

		Management Groups										
Escapement Sample		North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
Ugashik 2004	Proportion	0.00	**0.93**	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
n	Lower 90% CI	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
192	Upper 90% CI	0.01	1.00	0.01	0.02	0.02	0.14	0.01	0.01	0.01	0.01	0.01
	SD	0.01	0.05	0.01	0.01	0.01	0.05	0.01	0.00	0.01	0.00	0.01
Egegik 2004	Proportion	0.00	0.06	**0.92**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	Lower 90% CI	0.00	0.00	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
384	Upper 90% CI	0.01	0.16	0.99	0.02	0.00	0.02	0.00	0.01	0.01	0.01	0.00
	SD	0.01	0.05	0.05	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Egegik 2007	Proportion	0.00	0.00	**0.98**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	Lower 90% CI	0.00	0.00	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190	Upper 90% CI	0.01	0.03	1.00	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
	SD	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Naknek 2002	Proportion	0.00	0.00	0.01	**0.98**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
n	Lower 90% CI	0.00	0.00	0.00	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
288	Upper 90% CI	0.01	0.01	0.09	1.00	0.01	0.01	0.00	0.00	0.00	0.01	0.01
	SD	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alagnak 2004	Proportion	0.00	0.00	0.00	0.00	**0.99**	0.00	0.00	0.00	0.00	0.00	0.00
n	Lower 90% CI	0.00	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.00
192	Upper 90% CI	0.01	0.01	0.00	0.01	1.00	0.02	0.01	0.01	0.01	0.01	0.01
	SD	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Kvichak 2005	Proportion	0.00	0.00	0.00	0.00	0.01	**0.98**	0.00	0.00	0.00	0.00	0.00
n	Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00	0.00	0.00
194	Upper 90% CI	0.01	0.01	0.02	0.02	0.03	1.00	0.01	0.01	0.01	0.01	0.01
	SD	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.00
Kvichak 2006	Proportion	0.00	0.01	0.00	0.00	0.00	**0.99**	0.00	0.00	0.00	0.00	0.00
n	Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.97	0.00	0.00	0.00	0.00	0.00
1,681	Upper 90% CI	0.00	0.03	0.00	0.01	0.00	1.00	0.00	0.01	0.01	0.00	0.00
	SD	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00

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Table 9.–Page 2 of 3.

Escapement Sample			Management Groups										
			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
Nushagak 2005 RT		Proportion	0.00	0.00	0.00	0.00	0.00	0.00	**0.93**	0.03	0.01	0.01	0.01
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00	0.00	0.00	0.00
	190	Upper 90% CI	0.01	0.03	0.01	0.01	0.01	0.02	0.98	0.08	0.06	0.03	0.04
		SD	0.00	0.01	0.00	0.01	0.01	0.01	0.04	0.03	0.02	0.01	0.02
Nushagak 2006		Proportion	0.00	0.04	0.00	0.00	0.00	0.00	**0.92**	0.02	0.01	0.00	0.01
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00
	190	Upper 90% CI	0.01	0.07	0.02	0.02	0.01	0.01	0.97	0.07	0.04	0.02	0.04
		SD	0.00	0.02	0.01	0.01	0.00	0.00	0.04	0.02	0.02	0.01	0.01
Nushagak 2006 RT		Proportion	0.00	0.00	0.00	0.00	0.00	0.00	**0.98**	0.01	0.00	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00
	166	Upper 90% CI	0.00	0.01	0.00	0.01	0.01	0.01	1.00	0.03	0.03	0.01	0.03
		SD	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.01	0.00	0.01
Nuyakuk 2004		Proportion	0.00	0.00	0.00	0.00	0.01	0.00	**0.90**	0.01	0.05	0.01	0.01
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00
	190	Upper 90% CI	0.00	0.01	0.00	0.01	0.03	0.00	0.99	0.04	0.16	0.05	0.07
		SD	0.00	0.00	0.00	0.01	0.01	0.00	0.06	0.02	0.06	0.02	0.03
Wood 2003		Proportion	0.00	0.00	0.00	0.00	0.00	0.01	0.02	**0.92**	0.02	0.00	0.02
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00
	174	Upper 90% CI	0.00	0.01	0.01	0.03	0.01	0.05	0.08	0.99	0.13	0.02	0.08
		SD	0.00	0.00	0.00	0.01	0.00	0.02	0.03	0.06	0.05	0.01	0.03
Wood 2004		Proportion	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.94**	0.03	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00
	192	Upper 90% CI	0.01	0.04	0.01	0.02	0.01	0.01	0.01	0.99	0.17	0.02	0.01
		SD	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.06	0.06	0.01	0.01
Wood 2006		Proportion	0.00	0.00	0.00	0.00	0.00	0.01	0.01	**0.94**	0.02	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00
	94	Upper 90% CI	0.01	0.01	0.01	0.01	0.01	0.05	0.06	1.00	0.09	0.01	0.03
		SD	0.01	0.00	0.00	0.01	0.01	0.02	0.02	0.05	0.04	0.01	0.01

Note: RT denotes samples taken during a radio telemetry study, all Nushagak River samples were taken at the sonar site, while all other samples were captured at the counting tower sites. Proportion estimates in bold represent the correct allocations for each reporting group and would be 1.00 if no misallocation occurred and no out-of-drainage fish were captured.

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Table 9.–Page 3 of 3.

Escapement Sample			Management Groups										
			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
Wood 2007		Proportion	0.00	0.00	0.00	0.00	0.00	0.00	0.01	**0.91**	0.06	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00
	190	Upper 90% CI	0.01	0.00	0.00	0.01	0.00	0.01	0.09	1.00	0.26	0.02	0.01
		SD	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.09	0.09	0.01	0.01
Igushik 2005		Proportion	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	**0.95**	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00
	190	Upper 90% CI	0.02	0.02	0.01	0.00	0.00	0.01	0.02	0.16	1.00	0.01	0.01
		SD	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.06	0.06	0.01	0.01
Igushik 2007		Proportion	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	**0.93**	0.00	0.00
n		Lower 90% CI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00
	189	Upper 90% CI	0.02	0.01	0.00	0.01	0.01	0.00	0.04	0.21	1.00	0.01	0.01
		SD	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.08	0.08	0.00	0.00

Table 10.–Predetermined priors based on the best available information for the first strata within each fishery within each district in 2006 for sockeye salmon from Bristol Bay, Alaska.

		Reporting Group										
Fishery	Date	North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
Ugashik	July 1 - 11, 2006	0.02	0.80	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Egegik Special Harvest Area	June 26 - 30, 2006	0.01	0.01	0.90	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Egegik	July 14 - 15, 2006	0.01	0.05	0.75	0.05	0.04	0.05	0.01	0.01	0.01	0.01	0.01
Naknek-Kvichak	June 30 - July 9, 2006	0.01	0.01	0.01	0.85	0.02	0.05	0.01	0.01	0.01	0.01	0.01
Alagnak Special Harvest Area	July 9, 2006	0.01	0.01	0.01	0.01	0.68	0.23	0.01	0.01	0.01	0.01	0.01
Naknek-Kvichak	July 10, 2006	0.01	0.01	0.01	0.28	0.22	0.42	0.01	0.01	0.01	0.01	0.01
Kvichak Section set	July 16, 2006	0.01	0.01	0.01	0.09	0.28	0.55	0.01	0.01	0.01	0.01	0.01
Nushagak	June 25 - 28, 2006	0.01	0.01	0.01	0.01	0.01	0.01	0.18	0.62	0.12	0.01	0.01
Igushik Section set	July 9, 2006	0.01	0.01	0.01	0.01	0.01	0.01	0.15	0.51	0.26	0.01	0.01
Togiak	June 27 - July 26, 2006	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.90	0.01

Note: Strata composed of special harvest areas and set net sections are included. All priors for subsequent district-strata (including subsequent strata in 2006 and all strata in 2007 and 2008) are based upon the posterior distribution (i.e., stock composition estimates) of preceding district-strata. See methods for details.

Table 11.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures (n=number of samples successfully screened) of sockeye salmon harvested in each district in Bristol Bay, Alaska, in 2006.

				Reporting Groups										
District	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
Ugashik District			Proportion	0.1%	89.6%	6.5%	0.2%	0.1%	2.2%	0.1%	0.8%	0.1%	0.1%	0.1%
	Year	2006	Lower 90% CI	0.0%	83.1%	2.1%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.9%	95.0%	12.0%	1.6%	1.0%	6.1%	0.7%	2.3%	1.1%	1.0%	0.2%
	End Date	08/31	Harvest	2,959	2,176,965	158,759	5,023	3,465	52,616	2,275	19,383	3,269	3,316	1,566
	Harvest	2,429,597	Lower 90% CI	0	2,018,165	49,978	0	0	12,088	0	0	0	0	0
	n	372	Upper 90% CI	22,032	2,308,807	291,105	37,938	25,302	147,650	16,272	54,834	27,001	24,813	4,957
Egegik District			Proportion	0.0%	7.6%	85.9%	2.2%	0.3%	3.0%	0.0%	0.6%	0.1%	0.0%	0.3%
	Year	2006	Lower 90% CI	0.0%	4.0%	80.5%	0.2%	0.0%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.2%	12.7%	90.4%	5.3%	0.9%	5.6%	0.3%	1.2%	0.3%	0.3%	1.2%
	End Date	08/31	Harvest	2,270	560,716	6,360,780	161,657	25,459	223,118	3,106	40,952	3,780	3,006	23,389
	Harvest	7,408,233	Lower 90% CI	0	294,451	5,962,040	14,578	245	74,682	0	67	0	0	0
	n	1,176	Upper 90% CI	12,362	944,413	6,694,189	392,824	68,992	416,603	19,711	90,591	24,330	20,142	87,898
Naknek-Kvichak District			Proportion	0.0%	0.1%	4.1%	40.3%	20.0%	34.8%	0.0%	0.5%	0.0%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	2.0%	36.9%	17.2%	31.7%	0.0%	0.1%	0.0%	0.0%	0.0%
	Start Date	06/19	Upper 90% CI	0.2%	0.4%	6.5%	43.7%	23.0%	37.8%	0.2%	1.1%	0.1%	0.2%	0.1%
	End Date	08/04	Harvest	2,415	5,455	296,591	2,881,441	1,432,091	2,488,505	2,974	34,882	1,864	2,392	1,931
	Harvest	7,150,540	Lower 90% CI	0	0	142,203	2,641,433	1,230,491	2,269,987	0	6,953	0	0	0
	n	1,283	Upper 90% CI	13,049	29,673	467,792	3,127,690	1,641,309	2,705,597	13,147	75,643	8,360	11,973	9,516
Nushagak District			Proportion	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	24.1%	73.3%	2.2%	0.2%	0.1%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.8%	68.3%	1.0%	0.0%	0.0%
	Start Date	06/11	Upper 90% CI	0.2%	0.6%	0.1%	0.2%	0.1%	0.1%	28.6%	77.9%	5.1%	0.9%	0.5%
	End Date	08/20	Harvest	3,289	11,447	1,093	3,008	1,489	2,218	2,619,780	7,969,419	239,651	16,823	8,140
	Harvest	10,876,357	Lower 90% CI	0	0	0	0	0	0	2,150,099	7,432,023	110,681	0	0
	n	1,249	Upper 90% CI	20,154	65,820	5,486	16,851	6,215	10,237	3,110,242	8,470,446	556,493	94,464	55,237
Togiak District			Proportion	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%	69.8%	27.8%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	59.3%	16.8%
	Start Date	06/19	Upper 90% CI	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	5.7%	0.0%	0.0%	79.8%	39.4%
	End Date	08/09	Harvest	86	547	183	177	43	46	13,707	91	96	437,259	174,206
	Harvest	626,441	Lower 90% CI	0	0	0	0	0	0	0	0	0	371,614	104,930
	n	278	Upper 90% CI	86	3,983	183	177	43	46	35,733	91	96	500,130	246,659
Bristol Bay Total			Proportion	0.0%	9.7%	23.9%	10.7%	5.1%	9.7%	9.3%	28.3%	0.9%	1.6%	0.7%
	Year	2006	Lower 90% CI	0.0%	8.6%	22.4%	9.7%	4.4%	8.7%	7.6%	26.4%	0.4%	1.3%	0.4%
	Start Date	06/11	Upper 90% CI	0.2%	11.1%	25.3%	11.9%	5.9%	10.8%	11.0%	30.1%	2.0%	2.0%	1.1%
	End Date	08/31	Harvest	11,018	2,755,129	6,817,407	3,051,306	1,462,546	2,766,502	2,641,842	8,064,728	248,660	462,797	209,233
	Harvest	28,491,168	Lower 90% CI	0	2,439,617	6,373,710	2,750,467	1,256,806	2,488,494	2,173,757	7,526,642	115,332	382,724	121,402
	n	4,358	Upper 90% CI	50,443	3,164,266	7,211,767	3,385,782	1,677,434	3,063,137	3,128,048	8,565,576	561,805	563,683	316,192

Table 12.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures (n = number of samples successfully screened) of sockeye salmon harvested in each district in Bristol Bay, Alaska, in 2007.

				Reporting Groups										
District	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
Ugashik District			Proportion	0.0%	76.9%	22.0%	0.0%	0.0%	0.4%	0.1%	0.2%	0.1%	0.0%	0.1%
	Year	2007	Lower 90% CI	0.0%	70.0%	15.3%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.2%	83.7%	29.0%	0.2%	0.1%	1.0%	0.5%	0.7%	0.5%	0.2%	0.4%
	End Date	08/17	Harvest	1,724	3,867,819	1,108,158	2,294	531	22,005	4,722	9,452	4,974	1,569	3,366
	Harvest	5,026,615	Lower 90% CI	0	3,518,650	769,054	0	0	5,309	0	0	0	0	0
	n	737	Upper 90% CI	8,514	4,209,037	1,457,248	12,548	2,531	48,440	23,620	36,932	27,442	10,024	20,645
Egegik District			Proportion	0.0%	8.2%	77.0%	6.7%	2.9%	3.7%	0.4%	0.4%	0.5%	0.1%	0.2%
	Year	2007	Lower 90% CI	0.0%	2.2%	71.6%	3.7%	1.2%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.1%	13.0%	82.5%	10.2%	4.7%	6.7%	1.2%	1.4%	0.9%	0.7%	1.2%
	End Date	08/31	Harvest	1,170	531,909	5,000,914	436,138	188,243	238,169	23,053	24,707	31,903	6,327	13,375
	Harvest	6,495,908	Lower 90% CI	0	145,687	4,652,342	240,962	75,826	110,049	0	0	0	0	0
	n	924	Upper 90% CI	6,202	844,330	5,356,565	663,465	307,360	436,672	80,313	89,401	61,563	46,027	77,061
Naknek-Kvichak District			Proportion	0.0%	0.2%	0.3%	54.2%	19.6%	24.9%	0.4%	0.1%	0.4%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	49.8%	16.4%	21.2%	0.0%	0.0%	0.1%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.2%	1.1%	1.4%	58.4%	23.0%	28.7%	1.2%	0.5%	0.8%	0.1%	0.1%
	End Date	08/21	Harvest	4,058	14,482	24,819	4,886,102	1,764,829	2,248,707	31,768	7,269	36,405	1,828	2,242
	Harvest	9,022,511	Lower 90% CI	0	0	0	4,496,009	1,477,483	1,914,532	0	0	6,716	0	0
	n	935	Upper 90% CI	21,314	94,777	125,652	5,270,849	2,070,954	2,592,001	110,462	42,006	75,395	9,165	11,297
Nushagak District			Proportion	0.1%	0.4%	0.1%	0.5%	0.0%	0.0%	22.6%	72.9%	2.1%	0.9%	0.2%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.0%	67.4%	0.0%	0.3%	0.0%
	Start Date	06/11	Upper 90% CI	0.8%	0.8%	0.5%	1.4%	0.1%	0.2%	26.5%	77.4%	7.0%	1.8%	1.0%
	End Date	08/10	Harvest	12,278	37,312	6,047	45,339	1,259	2,745	1,901,142	6,127,262	178,262	79,060	13,405
	Harvest	8,404,111	Lower 90% CI	0	426	0	0	0	0	1,595,995	5,662,607	0	28,532	0
	n	927	Upper 90% CI	67,812	70,250	39,719	120,175	7,959	18,314	2,229,017	6,504,035	587,547	150,180	80,025
Togiak District			Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	86.2%	13.5%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	80.8%	8.2%
	Start Date	06/18	Upper 90% CI	0.1%	0.1%	0.2%	0.3%	0.0%	0.0%	0.8%	0.1%	0.1%	91.5%	18.9%
	End Date	08/06	Harvest	192	150	240	350	84	80	1,094	203	142	703,604	110,442
	Harvest	816,581	Lower 90% CI	0	0	0	0	0	0	0	0	0	660,136	66,904
	n	561	Upper 90% CI	604	739	1,286	2,107	328	317	6,607	1,147	703	746,984	154,026
Bristol Bay Total			Proportion	0.1%	15.0%	20.6%	18.0%	6.6%	8.4%	6.6%	20.7%	0.8%	2.7%	0.5%
	Year	2007	Lower 90% CI	0.0%	13.3%	19.0%	16.5%	5.5%	7.2%	5.5%	19.2%	0.2%	2.4%	0.3%
	Start Date	06/11	Upper 90% CI	0.3%	16.5%	22.3%	19.6%	7.7%	9.7%	7.7%	22.0%	2.2%	3.0%	0.8%
	End Date	08/31	Harvest	19,423	4,451,672	6,140,178	5,370,224	1,954,946	2,511,706	1,961,778	6,168,894	251,686	792,388	142,831
	Harvest	29,765,726	Lower 90% CI	0	3,959,875	5,645,224	4,924,978	1,644,804	2,145,944	1,644,959	5,702,501	51,923	718,219	77,780
	n	4,084	Upper 90% CI	83,684	4,924,858	6,641,134	5,821,024	2,281,742	2,898,690	2,300,251	6,549,846	663,038	884,141	243,883

Table 13.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures (n=number of samples successfully screened) of sockeye salmon harvested in each district in Bristol Bay, Alaska, in 2008.

				Reporting Groups										
District	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
Ugashik District			Proportion	0.1%	81.4%	13.4%	0.2%	3.0%	0.7%	0.4%	0.1%	0.2%	0.4%	0.1%
	Year	2008	Lower 90% CI	0.0%	75.5%	8.9%	0.0%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/16	Upper 90% CI	0.7%	86.5%	18.8%	0.8%	5.0%	2.4%	0.9%	0.5%	0.6%	2.1%	0.3%
	End Date	08/31	Harvest	2,609	1,900,544	313,374	4,757	69,058	16,682	8,351	2,909	5,678	8,867	1,192
	Harvest	2,334,022	Lower 90% CI	0	1,763,075	208,279	0	29,848	1,132	0	0	0	0	0
	n	934	Upper 90% CI	17,440	2,017,767	439,421	18,114	117,158	57,063	21,865	11,208	14,786	48,912	7,835
Egegik District			Proportion	0.1%	1.3%	72.6%	13.8%	1.5%	10.4%	0.1%	0.1%	0.1%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	67.5%	9.9%	0.4%	7.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/01	Upper 90% CI	0.7%	4.6%	77.2%	17.9%	3.1%	14.1%	0.4%	0.4%	0.6%	0.2%	0.2%
	End Date	08/31	Harvest	7,854	93,361	5,373,957	1,020,078	112,141	771,051	4,292	6,118	10,063	2,648	2,321
	Harvest	7,403,885	Lower 90% CI	0	0	4,995,739	735,656	28,025	521,771	0	0	0	0	0
	n	1,128	Upper 90% CI	50,519	339,045	5,717,823	1,325,010	228,333	1,044,924	26,905	29,399	42,458	16,784	13,397
Naknek-Kvichak District			Proportion	0.0%	0.3%	6.1%	52.5%	17.5%	23.2%	0.1%	0.1%	0.1%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	3.7%	48.4%	15.1%	19.9%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/01	Upper 90% CI	0.2%	1.5%	8.7%	56.6%	20.1%	26.6%	0.6%	0.4%	0.3%	0.2%	0.2%
	End Date	08/31	Harvest	4,551	29,111	632,403	5,452,131	1,818,972	2,404,378	14,326	9,278	10,026	3,611	3,057
	Harvest	10,381,844	Lower 90% CI	0	0	384,464	5,026,414	1,565,941	2,065,885	0	0	0	0	0
	n	1,277	Upper 90% CI	18,644	158,862	903,584	5,872,001	2,084,214	2,763,131	60,781	41,648	32,245	23,316	19,478
Nushagak District			Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	14.8%	80.5%	3.6%	0.1%	0.8%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11.1%	74.4%	0.1%	0.0%	0.0%
	Start Date	06/09	Upper 90% CI	0.2%	0.2%	0.2%	0.1%	0.1%	0.5%	18.7%	85.7%	9.5%	0.3%	1.9%
	End Date	08/31	Harvest	1,566	1,890	2,318	1,152	1,010	6,941	1,019,226	5,560,256	251,446	3,803	53,548
	Harvest	6,903,156	Lower 90% CI	0	0	0	0	0	0	767,191	5,138,323	3,549	0	1
	n	1,089	Upper 90% CI	10,468	12,555	16,073	5,628	5,766	34,548	1,291,382	5,916,087	656,119	19,256	133,527
Togiak District			Proportion	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%	74.2%	25.3%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	68.5%	19.7%
	Start Date	06/18	Upper 90% CI	0.1%	0.1%	0.1%	0.1%	0.6%	0.1%	1.0%	0.2%	0.1%	79.8%	31.1%
	End Date	08/06	Harvest	191	157	88	122	702	162	1,003	227	152	483,497	165,015
	Harvest	651,315	Lower 90% CI	0	0	0	0	0	0	0	0	0	445,932	128,573
	n	565	Upper 90% CI	972	709	326	464	4,051	909	6,581	1,146	755	519,576	202,847
Bristol Bay Total			Proportion	0.1%	7.3%	22.8%	23.4%	7.2%	11.6%	3.8%	20.2%	1.0%	1.8%	0.8%
	Year	2008	Lower 90% CI	0.0%	6.6%	21.2%	21.5%	6.2%	10.0%	2.9%	18.6%	0.1%	1.6%	0.5%
	Start Date	06/01	Upper 90% CI	0.3%	8.4%	24.5%	25.3%	8.3%	13.2%	4.8%	21.4%	2.5%	2.0%	1.1%
	End Date	08/31	Harvest	16,771	2,025,063	6,322,141	6,478,239	2,001,883	3,199,215	1,047,198	5,578,787	277,366	502,426	225,133
	Harvest	27,674,222	Lower 90% CI	1	1,817,785	5,857,188	5,960,012	1,727,683	2,771,858	788,822	5,155,550	26,804	454,691	148,828
	n	4,993	Upper 90% CI	79,016	2,316,180	6,777,980	6,995,621	2,293,261	3,646,473	1,324,253	5,935,719	687,848	562,883	317,400

Table 14.–Stock-specific harvest (including 90% credibility intervals) and harvest rates by fishing districts and summed across districts, escapement, and total run, based on genetic analysis of mixtures of sockeye salmon harvested in Bristol Bay, Alaska, 2006.

		Commercial Fishing Districts						Based on Traditional Methods		
				Naknek-					Difference	
Stock		Ugashik	Egegik	Kvichak	Nushagak	Togiak	Total	Total	Number	Percent
North	Harvest	2,959	2,270	2,415	3,289	86	11,018			
Peninsula	Lower 90% CI	0	0	0	0	0	0			
	Upper 90% CI	22,032	12,362	13,049	20,154	86	50,443			
Ugashik	Harvest Rate	57.9%	14.9%	0.1%	0.3%	0.0%	73.3%	70.8%		
	Harvest	2,176,965	560,716	5,455	11,447	547	2,755,129	2,429,597	-325,532	-12%
	Lower 90% CI	2,018,165	294,451	0	0	0	2,439,617			
	Upper 90% CI	2,308,807	944,413	29,673	65,820	3,983	3,164,266			
	Escapement						1,003,158	1,003,158		
	Total Run						3,758,287	3,432,755	-325,532	-9%
Egegik	Harvest Rate	1.9%	76.8%	3.6%	0.0%	0.0%	82.3%	83.5%		
	Harvest	158,759	6,360,780	296,591	1,093	183	6,817,407	7,408,233	590,826	9%
	Lower 90% CI	49,978	5,962,040	142,203	0	0	6,373,710			
	Upper 90% CI	291,105	6,694,189	467,792	5,486	183	7,211,767			
	Escapement						1,465,158	1,465,158		
	Total Run						8,282,565	8,873,391	590,826	7%
Naknek	Harvest Rate	0.1%	3.2%	57.6%	0.1%	0.0%	61.0%	63.7%		
	Harvest	5,023	161,657	2,881,441	3,008	177	3,051,306	3,432,037	380,731	12%
	Lower 90% CI	0	14,578	2,641,433	0	0	2,750,467			
	Upper 90% CI	37,938	392,824	3,127,690	16,851	177	3,385,782			
	Escapement						1,953,228	1,953,228		
	Total Run						5,004,534	5,385,265	380,731	8%
Alagnak	Harvest Rate	0.1%	0.8%	44.2%	0.0%	0.0%	45.2%	36.7%		
	Harvest	3,465	25,459	1,432,091	1,489	43	1,462,546	1,030,608	-431,938	-30%
	Lower 90% CI	0	245	1,230,491	0	0	1,256,806			
	Upper 90% CI	25,302	68,992	1,641,309	6,215	43	1,677,434			
	Escapement						1,773,966	1,773,966		
	Total Run						3,236,512	2,804,574	-431,938	-13%
Kvichak	Harvest Rate	0.9%	3.8%	42.6%	0.0%	0.0%	47.4%	46.7%		
	Harvest	52,616	223,118	2,488,505	2,218	46	2,766,502	2,687,895	-78,607	-3%
	Lower 90% CI	12,088	74,682	2,269,987	0	0	2,488,494			
	Upper 90% CI	147,650	416,603	2,705,597	10,237	46	3,063,137			
	Escapement						3,068,226	3,068,226		
	Total Run						5,834,728	5,756,121	-78,607	-1%

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Table 14.–Page 2 of 2.

		Commercial Fishing Districts						Based on Traditional Methods		
				Naknek-					Difference	
Stock		Ugashik	Egegik	Kvichak	Nushagak	Togiak	Total	Total	Number	Percent
Nushagak	Harvest Rate	0.1%	0.1%	0.1%	82.1%	0.4%	82.8%	83.1%		
	Harvest	2,275	3,106	2,974	2,619,780	13,707	2,641,842	2,690,436	48,594	2%
	Lower 90% CI	0	0	0	2,150,099	0	2,173,757			
	Upper 90% CI	16,272	19,711	13,147	3,110,242	35,733	3,128,048			
	Escapement						548,410	548,410		
	Total Run						3,190,252	3,238,846	48,594	2%
Wood	Harvest Rate	0.2%	0.3%	0.3%	66.0%	0.0%	66.8%	63.8%		
	Harvest	19,383	40,952	34,882	7,969,419	91	8,064,728	7,056,302	-1,008,426	-13%
	Lower 90% CI	0	67	6,953	7,432,023	0	7,526,642			
	Upper 90% CI	54,834	90,591	75,643	8,470,446	91	8,565,576			
	Escapement						4,008,102	4,008,102		
	Total Run						12,072,830	11,064,404	-1,008,426	-8%
Igushik	Harvest Rate	0.6%	0.7%	0.3%	43.3%	0.0%	44.9%	78.7%		
	Harvest	3,269	3,780	1,864	239,651	96	248,660	1,129,619	880,959	354%
	Lower 90% CI	0	0	0	110,681	0	115,332			
	Upper 90% CI	27,001	24,330	8,360	556,493	96	561,805			
	Escapement						305,268	305,268		
	Total Run						553,928	1,434,887	880,959	159%
Togiak	Harvest Rate	0.4%	0.4%	0.3%	2.2%	56.4%	59.7%	66.7%		
	Harvest	3,316	3,006	2,392	16,823	437,259	462,797	626,441	163,644	35%
	Lower 90% CI	0	0	0	0	371,614	382,724			
	Upper 90% CI	24,813	20,142	11,973	94,464	500,130	563,683			
	Escapement						312,126	312,126		
	Total Run						774,923	938,567	163,644	21%
Kuskokwim	Harvest	1,566	23,389	1,931	8,140	174,206	209,233			
	Lower 90% CI	0	0	0	0	104,930	121,402			
	Upper 90% CI	4,957	87,898	9,516	55,237	246,659	316,192			
Total	Harvest Rate	5.7%	17.3%	16.7%	25.3%	1.5%	66.4%	66.4%		
	Harvest	2,429,597	7,408,233	7,150,540	10,876,357	626,441	28,491,168	28,491,168	0	0%
	Lower 90% CI	2,080,231	6,346,063	6,291,068	9,692,803	476,544	25,628,950			
	Upper 90% CI	2,960,711	8,772,055	8,103,749	12,411,646	787,227	31,688,132			
	Escapement						14,437,642	14,437,642		
	Total Run						42,928,810	42,928,810	0	0%

Note: Traditional estimates of harvest, harvest rates, and total run were compared to the genetic estimates.

Table 15.–Stock-specific harvest (including 90% credibility intervals) and harvest rates by fishing districts and summed across districts, escapement, and total run, based on genetic analysis of mixtures of sockeye salmon harvested in Bristol Bay, Alaska, 2007.

		Commercial Fishing Districts						Based on Traditional Methods		
				Naknek-					Difference	
Stock		Ugashik	Egegik	Kvichak	Nushagak	Togiak	Total	Total	Number	Percent
North	Harvest	1,724	1,170	4,058	12,278	192	19,423			
Peninsula	Lower 90% CI	0	0	0	0	0	0			
	Upper 90% CI	8,514	6,202	21,314	67,812	604	83,684			
Ugashik	Harvest Rate	54.9%	7.5%	0.2%	0.5%	0.0%	63.1%	65.9%		
	Harvest	3,867,819	531,909	14,482	37,312	150	4,451,672	5,026,615	574,943	13%
	Lower 90% CI	3,518,650	145,687	0	426	0	3,959,875			
	Upper 90% CI	4,209,037	844,330	94,777	70,250	739	4,924,858			
	Escapement						2,599,186	2,599,186		
	Total Run						7,050,858	7,625,801	574,943	8%
Egegik	Harvest Rate	14.6%	66.0%	0.3%	0.1%	0.0%	81.1%	81.9%		
	Harvest	1,108,158	5,000,914	24,819	6,047	240	6,140,178	6,495,908	355,730	6%
	Lower 90% CI	769,054	4,652,342	0	0	0	5,645,224			
	Upper 90% CI	1,457,248	5,356,565	125,652	39,719	1,286	6,641,134			
	Escapement						1,432,500	1,432,500		
	Total Run						7,572,678	7,928,408	355,730	5%
Naknek	Harvest Rate	0.0%	5.2%	58.8%	0.5%	0.0%	64.6%	66.3%		
	Harvest	2,294	436,138	4,886,102	45,339	350	5,370,224	5,791,043	420,819	8%
	Lower 90% CI	0	240,962	4,496,009	0	0	4,924,978			
	Upper 90% CI	12,548	663,465	5,270,849	120,175	2,107	5,821,024			
	Escapement						2,945,304	2,945,304		
	Total Run						8,315,528	8,736,347	420,819	5%
Alagnak	Harvest Rate	0.0%	4.3%	39.9%	0.0%	0.0%	44.2%	42.3%		
	Harvest	531	188,243	1,764,829	1,259	84	1,954,946	1,811,084	-143,862	-7%
	Lower 90% CI	0	75,826	1,477,483	0	0	1,644,804			
	Upper 90% CI	2,531	307,360	2,070,954	7,959	328	2,281,742			
	Escapement						2,466,414	2,466,414		
	Total Run						4,421,360	4,277,498	-143,862	-3%
Kvichak	Harvest Rate	0.4%	4.5%	42.3%	0.1%	0.0%	47.2%	33.6%		
	Harvest	22,005	238,169	2,248,707	2,745	80	2,511,706	1,420,384	-1,091,322	-43%
	Lower 90% CI	5,309	110,049	1,914,532	0	0	2,145,944			
	Upper 90% CI	48,440	436,672	2,592,001	18,314	317	2,898,690			
	Escapement						2,810,208	2,810,208		
	Total Run						5,321,914	4,230,592	-1,091,322	-21%

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Table 15.–Page 2 of 2.

		Commercial Fishing Districts						Based on Traditional Methods		
				Naknek-					Difference	
Stock		Ugashik	Egegik	Kvichak	Nushagak	Togiak	Total	Total	Number	Percent
Nushagak	Harvest Rate	0.2%	0.9%	1.3%	76.7%	0.0%	79.1%	79.9%		
	Harvest	4,722	23,053	31,768	1,901,142	1,094	1,961,778	2,061,814	100,036	5%
	Lower 90% CI	0	0	0	1,595,995	0	1,644,959			
	Upper 90% CI	23,620	80,313	110,462	2,229,017	6,607	2,300,251			
	Escapement						518,041	518,041		
	Total Run						2,479,819	2,579,855	100,036	4%
Wood	Harvest Rate	0.1%	0.3%	0.1%	79.6%	0.0%	80.1%	76.6%		
	Harvest	9,452	24,707	7,269	6,127,262	203	6,168,894	4,995,458	-1,173,436	-19%
	Lower 90% CI	0	0	0	5,662,607	0	5,702,501			
	Upper 90% CI	36,932	89,401	42,006	6,504,035	1,147	6,549,846			
	Escapement						1,528,086	1,528,086		
	Total Run						7,696,980	6,523,544	-1,173,436	-15%
Igushik	Harvest Rate	0.7%	4.8%	5.5%	26.7%	0.0%	37.7%	76.4%		
	Harvest	4,974	31,903	36,405	178,262	142	251,686	1,346,839	1,095,153	435%
	Lower 90% CI	0	0	6,716	0	0	51,923			
	Upper 90% CI	27,442	61,563	75,395	587,547	703	663,038			
	Escapement						415,452	415,452		
	Total Run						667,138	1,762,291	1,095,153	164%
Togiak	Harvest Rate	0.1%	0.6%	0.2%	7.4%	66.3%	74.6%	75.2%		
	Harvest	1,569	6,327	1,828	79,060	703,604	792,388	816,581	24,193	3%
	Lower 90% CI	0	0	0	28,532	660,136	718,219			
	Upper 90% CI	10,024	46,027	9,165	150,180	746,984	884,141			
	Escapement						269,646	269,646		
	Total Run						1,062,034	1,086,227	24,193	2%
Kuskokwim	Harvest	3,366	13,375	2,242	13,405	110,442	142,831			
	Lower 90% CI	0	0	0	0	66,904	77,780			
	Upper 90% CI	20,645	77,061	11,297	80,025	154,026	243,883			
Total	Harvest Rate	11.2%	14.5%	20.2%	18.8%	1.8%	66.5%	66.5%		
	Harvest	5,026,615	6,495,908	9,022,511	8,404,111	816,581	29,765,726	29,765,726	0	0%
	Lower 90% CI	4,293,013	5,224,866	7,894,740	7,287,561	727,041	26,516,209			
	Upper 90% CI	5,856,980	7,968,960	10,423,872	9,875,034	914,847	33,292,290			
	Escapement						14,984,837	14,984,837		
	Total Run						44,750,563	44,750,563	0	0%

Note: Traditional estimates of harvest, harvest rates, and total run were compared to the genetic estimates.

Table 16.–Stock-specific harvest (including 90% credibility intervals) and harvest rates by fishing districts and summed across districts, escapement, and total run, based on genetic analysis of mixtures of sockeye salmon harvested in Bristol Bay, Alaska, 2008.

		Commercial Fishing Districts						Based on Traditional Methods		
				Naknek-					Difference	
Stock		Ugashik	Egegik	Kvichak	Nushagak	Togiak	Total	Total	Number	Percent
North	Harvest	2,609	7,854	4,551	1,566	191	16,771			
Peninsula	Lower 90% CI	0	0	0	0	0	1			
	Upper 90% CI	17,440	50,519	18,644	10,468	972	79,016			
Ugashik	Harvest Rate	72.5%	3.6%	1.1%	0.1%	0.0%	77.3%	79.6%		
	Harvest	1,900,544	93,361	29,111	1,890	157	2,025,063	2,334,022	308,959	15%
	Lower 90% CI	1,763,075	0	0	0	0	1,817,785			
	Upper 90% CI	2,017,767	339,045	158,862	12,555	709	2,316,180			
	Escapement						596,332	596,332		
	Total Run						2,621,395	2,930,354	308,959	12%
Egegik	Harvest Rate	4.1%	70.9%	8.3%	0.0%	0.0%	83.4%	85.5%		
	Harvest	313,374	5,373,957	632,403	2,318	88	6,322,141	7,403,885	1,081,744	17%
	Lower 90% CI	208,279	4,995,739	384,464	0	0	5,857,188			
	Upper 90% CI	439,421	5,717,823	903,584	16,073	326	6,777,980			
	Escapement						1,259,568	1,259,568		
	Total Run						7,581,709	8,663,453	1,081,744	14%
Naknek	Harvest Rate	0.1%	11.4%	60.9%	0.0%	0.0%	72.4%	60.5%		
	Harvest	4,757	1,020,078	5,452,131	1,152	122	6,478,239	3,781,303	-2,696,936	-42%
	Lower 90% CI	0	735,656	5,026,414	0	0	5,960,012			
	Upper 90% CI	18,114	1,325,010	5,872,001	5,628	464	6,995,621			
	Escapement						2,472,690	2,472,690		
	Total Run						8,950,929	6,253,993	-2,696,936	-30%
Alagnak	Harvest Rate	1.7%	2.7%	43.5%	0.0%	0.0%	47.9%	63.1%		
	Harvest	69,058	112,141	1,818,972	1,010	702	2,001,883	3,726,652	1,724,769	86%
	Lower 90% CI	29,848	28,025	1,565,941	0	0	1,727,683			
	Upper 90% CI	117,158	228,333	2,084,214	5,766	4,051	2,293,261			
	Escapement						2,180,502	2,180,502		
	Total Run						4,182,385	5,907,154	1,724,769	41%
Kvichak	Harvest Rate	0.3%	12.9%	40.4%	0.1%	0.0%	53.7%	51.0%		
	Harvest	16,682	771,051	2,404,378	6,941	162	3,199,215	2,873,889	-325,326	-10%
	Lower 90% CI	1,132	521,771	2,065,885	0	0	2,771,858			
	Upper 90% CI	57,063	1,044,924	2,763,131	34,548	909	3,646,473			
	Escapement						2,757,912	2,757,912		
	Total Run						5,957,127	5,631,801	-325,326	-5%

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Table 16.–Page 2 of 2.

		Commercial Fishing Districts						Based on Traditional Methods		
				Naknek-					Difference	
Stock		Ugashik	Egegik	Kvichak	Nushagak	Togiak	Total	Total	Number	Percent
Nushagak	Harvest Rate	0.5%	0.3%	0.9%	66.2%	0.1%	68.0%	70.0%		
	Harvest	8,351	4,292	14,326	1,019,226	1,003	1,047,198	1,151,885	104,687	10%
	Lower 90% CI	0	0	0	767,191	0	788,822			
	Upper 90% CI	21,865	26,905	60,781	1,291,382	6,581	1,324,253			
	Escapement						492,546	492,546		
	Total Run						1,539,744	1,644,431	104,687	7%
Wood	Harvest Rate	0.0%	0.1%	0.1%	76.1%	0.0%	76.4%	67.1%		
	Harvest	2,909	6,118	9,278	5,560,256	227	5,578,787	3,511,602	-2,067,185	-37%
	Lower 90% CI	0	0	0	5,138,323	0	5,155,550			
	Upper 90% CI	11,208	29,399	41,648	5,916,087	1,146	5,935,719			
	Escapement						1,724,676	1,724,676		
	Total Run						7,303,463	5,236,278	-2,067,185	-28%
Igushik	Harvest Rate	0.4%	0.8%	0.8%	18.9%	0.0%	20.8%	68.0%		
	Harvest	5,678	10,063	10,026	251,446	152	277,366	2,239,670	1,962,304	707%
	Lower 90% CI	0	0	0	3,549	0	26,804			
	Upper 90% CI	14,786	42,458	32,245	656,119	755	687,848			
	Escapement						1,054,704	1,054,704		
	Total Run						1,332,070	3,294,374	1,962,304	147%
Togiak	Harvest Rate	1.3%	0.4%	0.5%	0.5%	68.3%	71.0%	76.0%		
	Harvest	8,867	2,648	3,611	3,803	483,497	502,426	651,315	148,889	30%
	Lower 90% CI	0	0	0	0	445,932	454,691			
	Upper 90% CI	48,912	16,784	23,316	19,256	519,576	562,883			
	Escapement						205,680	205,680		
	Total Run						708,106	856,995	148,889	21%
Kuskokwim	Harvest	1,192	2,321	3,057	53,548	165,015	225,133			
	Lower 90% CI	0	0	0	1	128,573	148,828			
	Upper 90% CI	7,835	13,397	19,478	133,527	202,847	317,400			
Total	Harvest Rate	5.8%	18.3%	25.7%	17.1%	1.6%	68.5%	68.5%		
	Harvest	2,334,022	7,403,886	10,381,844	6,903,156	651,315	27,674,223	27,674,223	0	0%
	Lower 90% CI	2,002,333	6,281,192	9,042,704	5,909,064	574,505	24,709,222			
	Upper 90% CI	2,771,568	8,834,596	11,977,903	8,101,409	738,336	30,936,634			
	Escapement						12,744,610	12,744,610		
	Total Run						40,418,833	40,418,833	0	0%

*Not*e: Traditional estimates of harvest, harvest rates, and total run were compared to the genetic estimates.

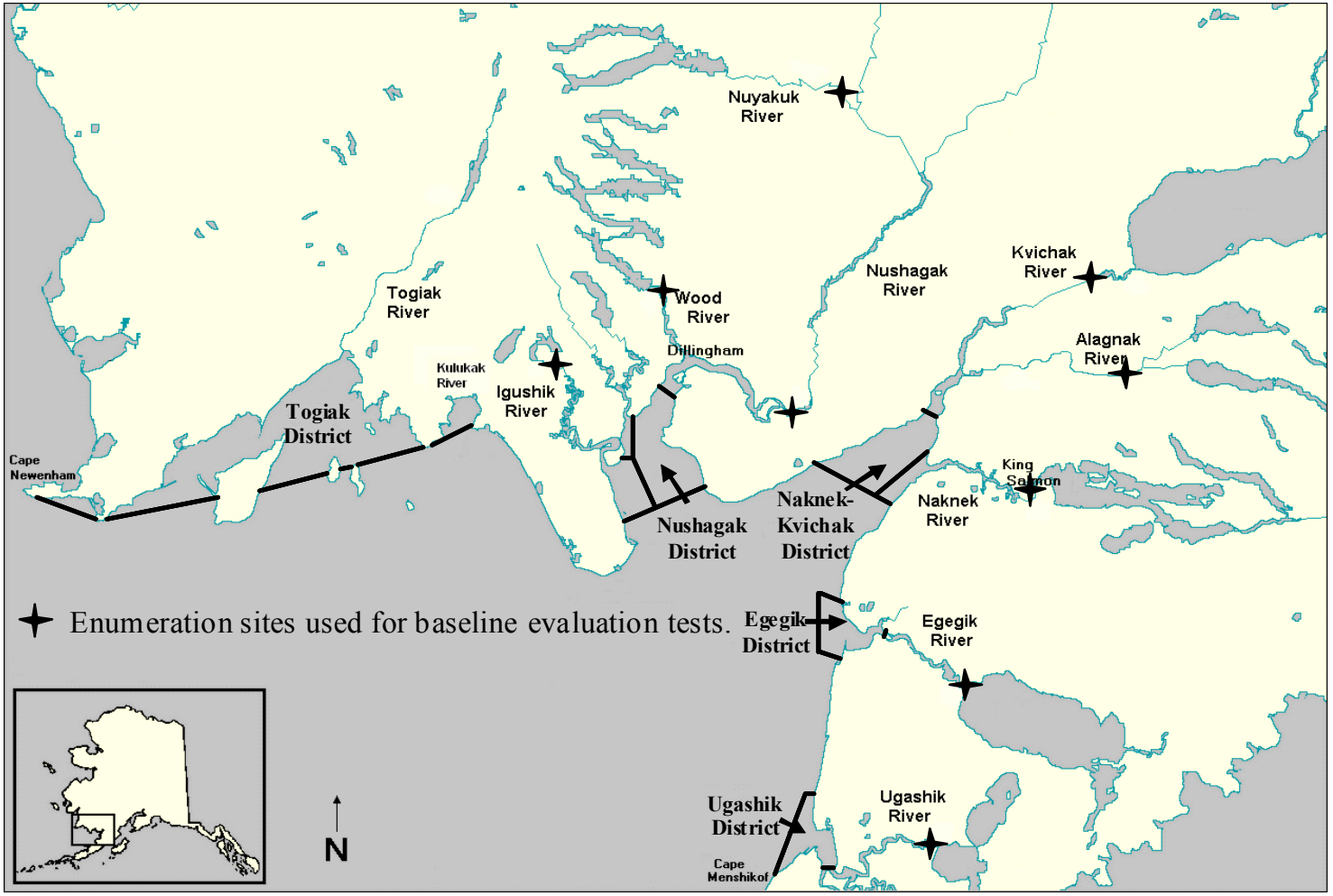
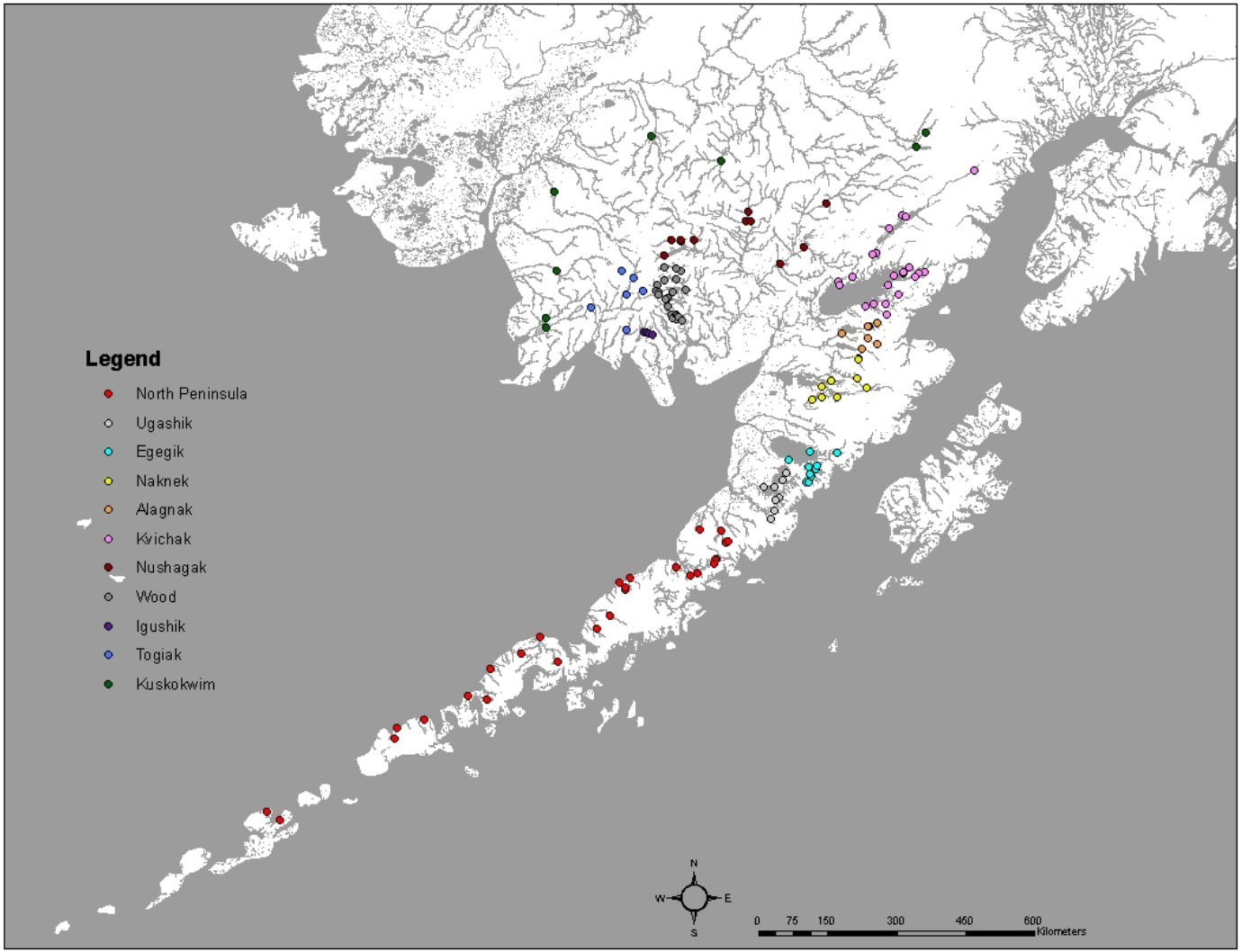
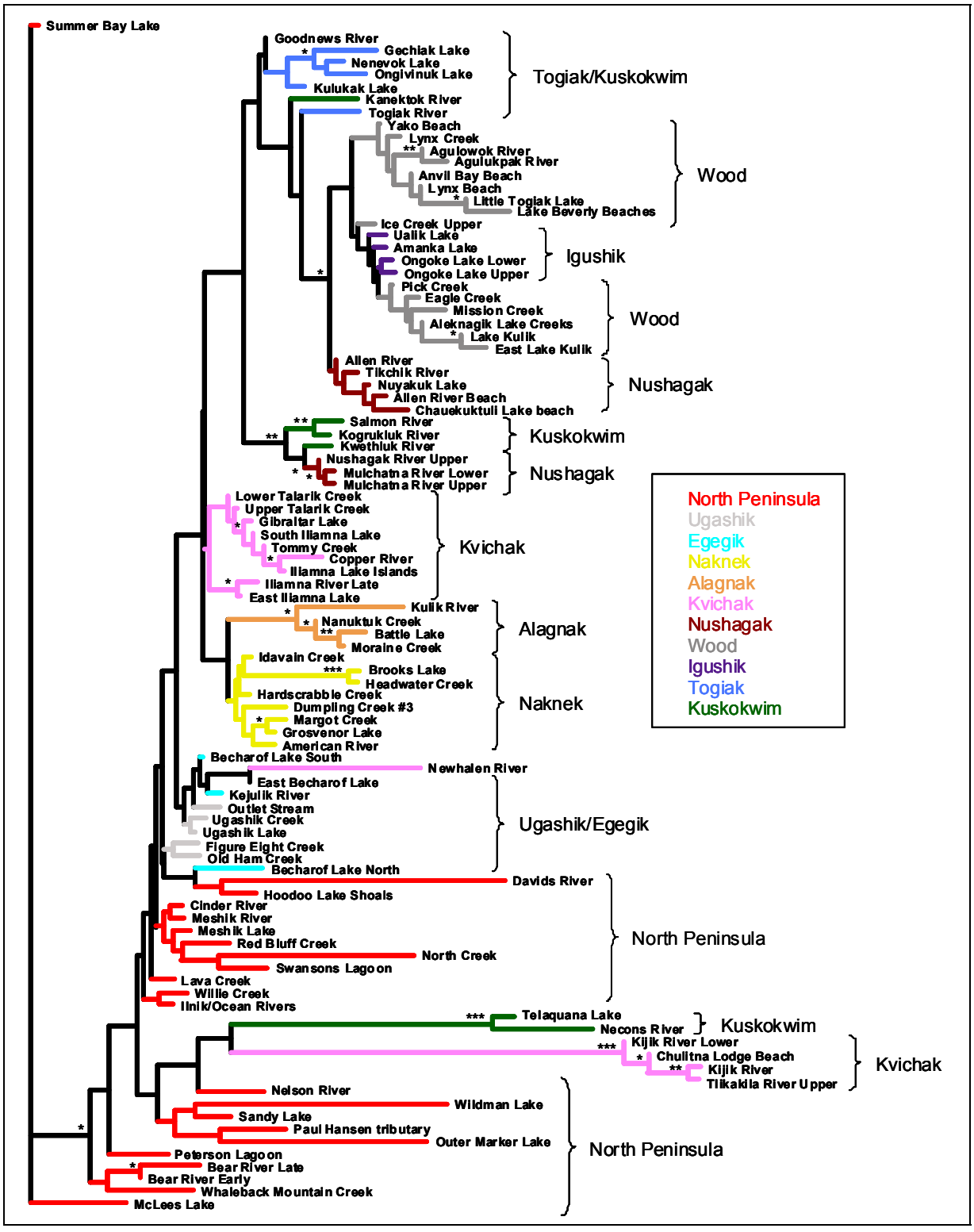


Figure 1.–Commercial salmon fishing districts and major river systems in Bristol Bay, Alaska.



Note: Colors denote the 11 reporting groups.

Figure 2.–Sampling locations for sockeye salmon originating from Bristol Bay, Alaska, and adjacent regions used to compile the Bristol Bay SNP baseline used for estimating stock composition of the commercial fishery harvest.



Note: Colors denote reporting groups as in Figure 2. Bootstrap consensus nodes *** = 95-100%; ** = 70-95%; * = 50-70%.

Figure 3.–Consensus N-J tree based on the Nei (1972) genetic distances between sockeye salmon populations sampled from spawning areas in Bristol Bay, Alaska (see Appendix A for collection details).

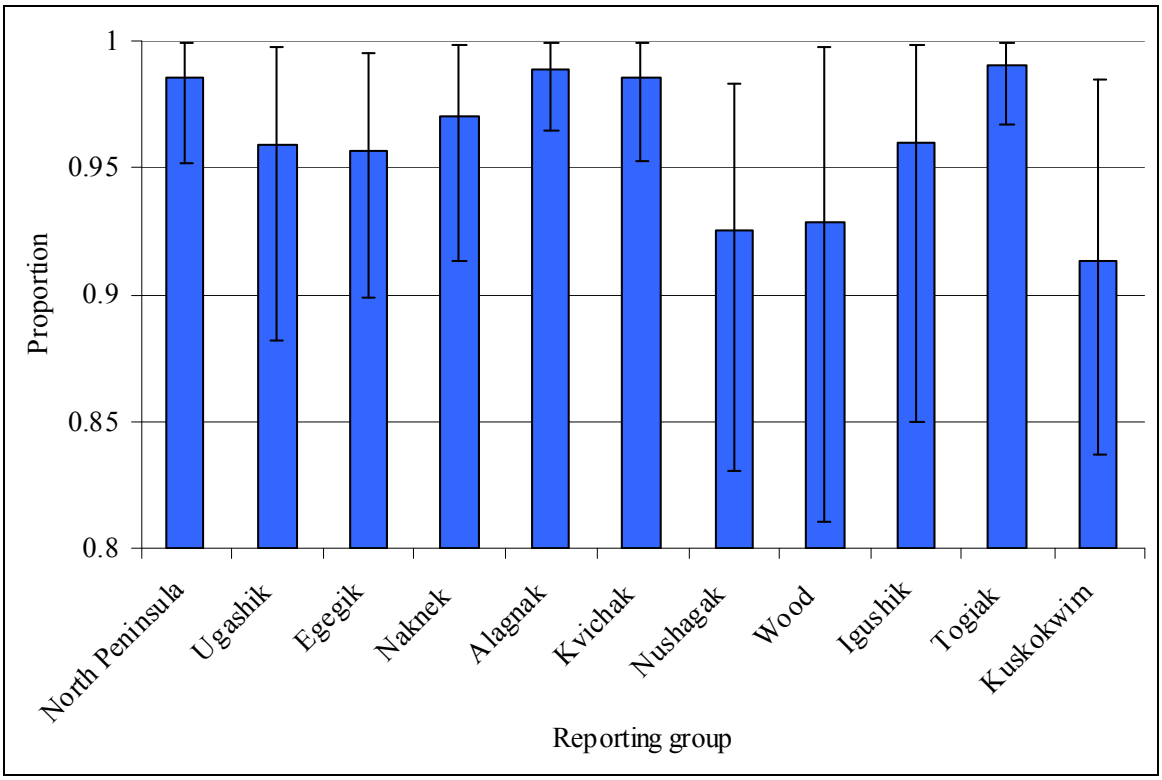
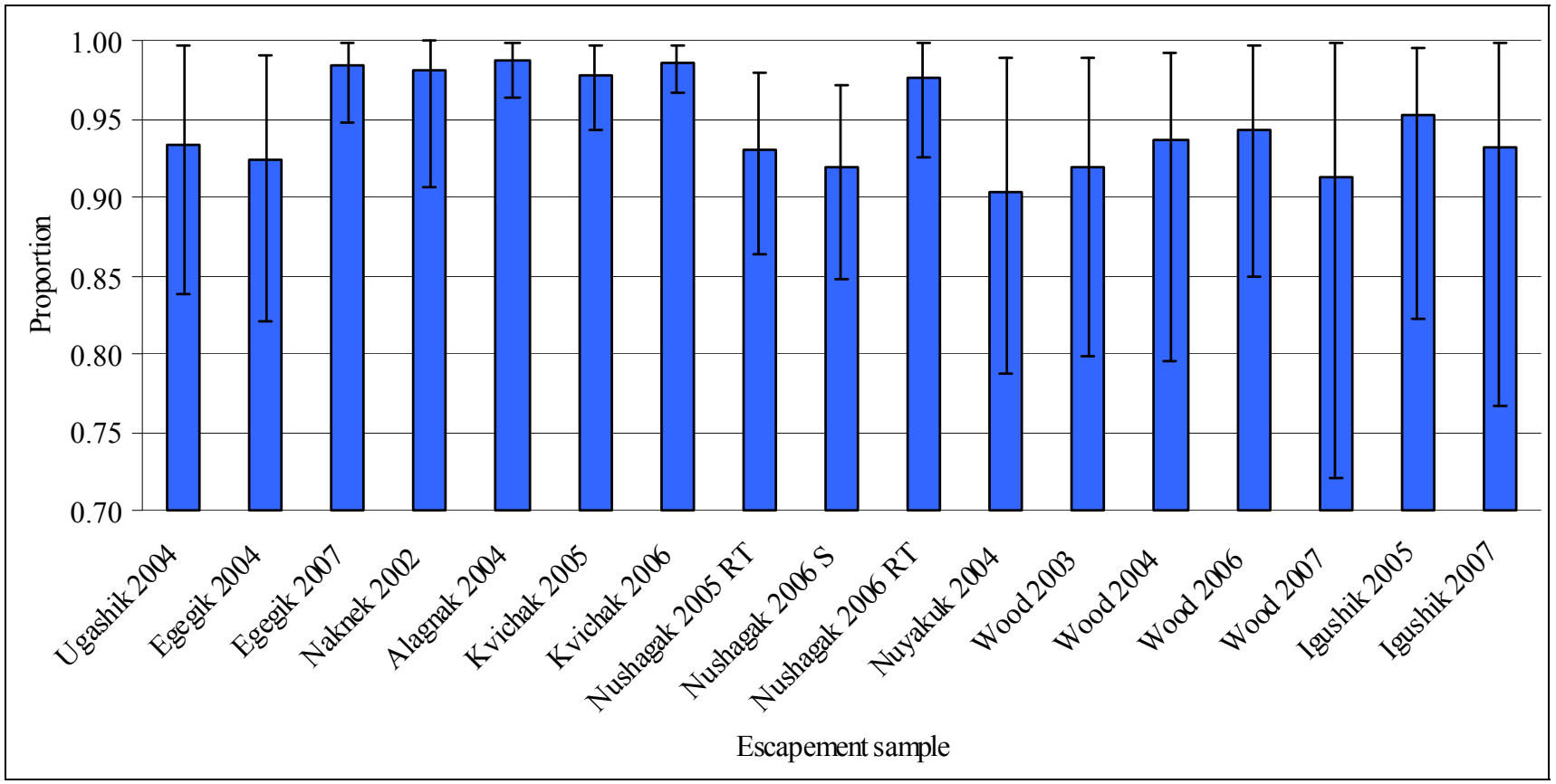


Figure 4.–Proportion of fish correctly allocated back to reporting group of origin and 90% credibility intervals for mixtures of approximately 200 known fish that were removed from the baseline populations that contribute to each reporting region (100% proof tests) using the program BAYES with a flat prior (Table 8).



Note: RT denotes radio telemetry samples, S denotes sonar samples, and all other are counting tower samples (Table 9).

Figure 5.–Proportion of fish correctly allocated back to reporting group of origin and 90% credibility intervals for mixtures of fish sampled at escapement enumeration sites using the program BAYES with a flat prior.

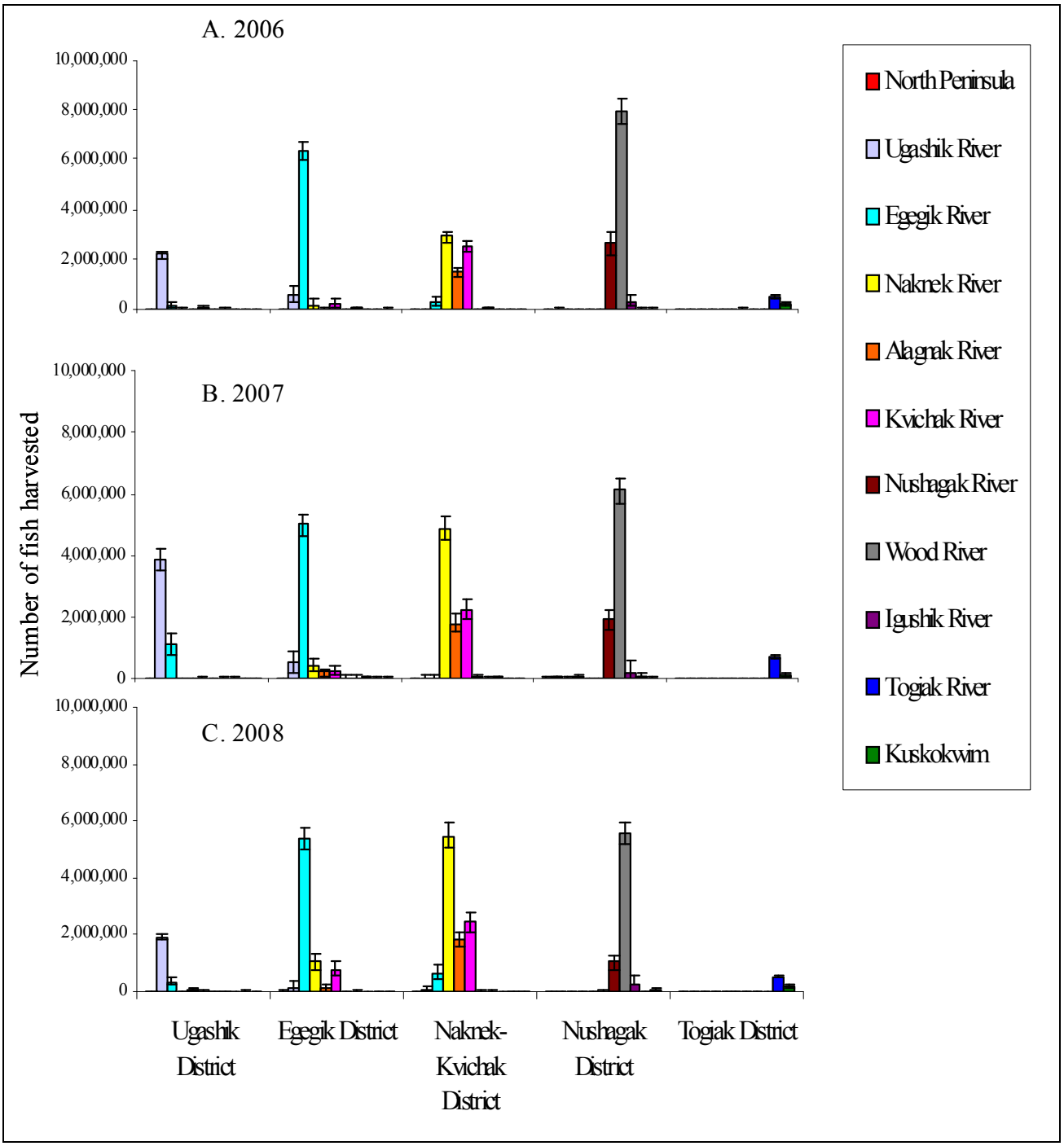


Figure 6.–Estimated number (and 90% credibility intervals) of sockeye salmon from each stock harvested within each commercial fishing district within Bristol Bay, Alaska, in A. 2006, B. 2007, and C. 2008 (Tables 11, 12, and 13).

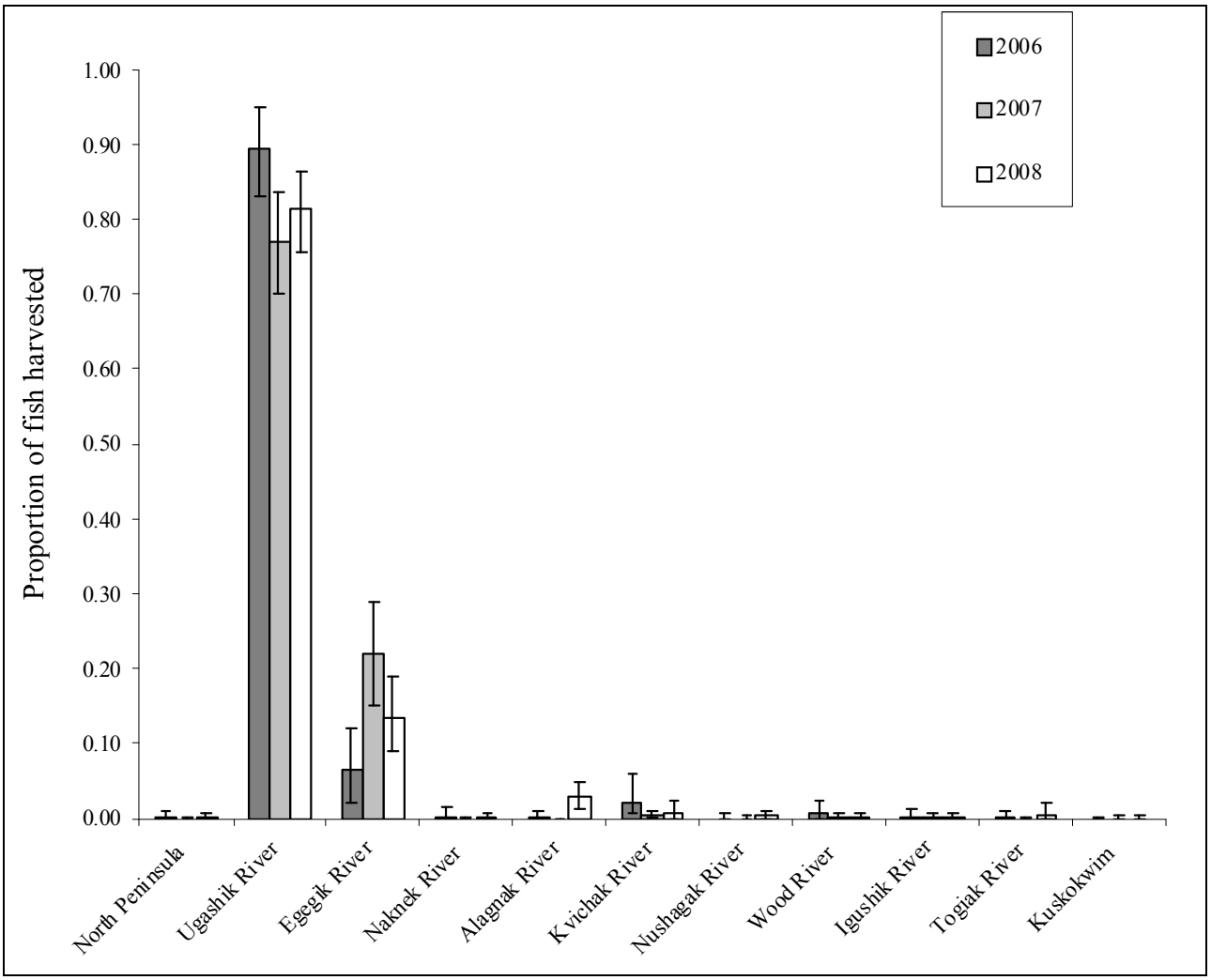


Figure 7.–Estimated proportion (and 90% credibility intervals) of sockeye salmon from each stock harvested within Ugashik District within Bristol Bay, Alaska, in 2006, 2007, and 2008.

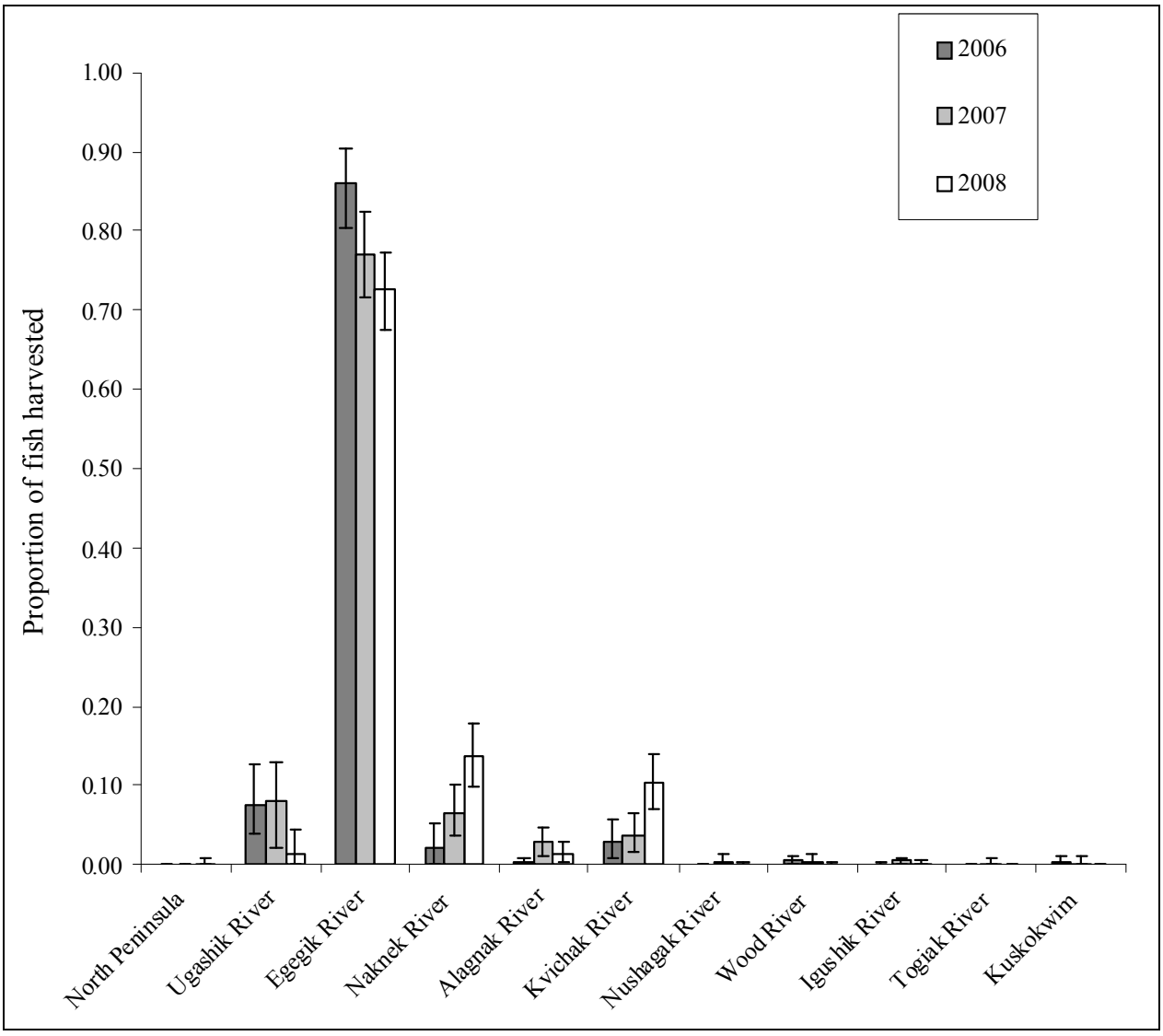


Figure 8.–Estimated proportion (and 90% credibility intervals) of sockeye salmon from each stock harvested within Egegik District within Bristol Bay, Alaska, in 2006, 2007, and 2008.

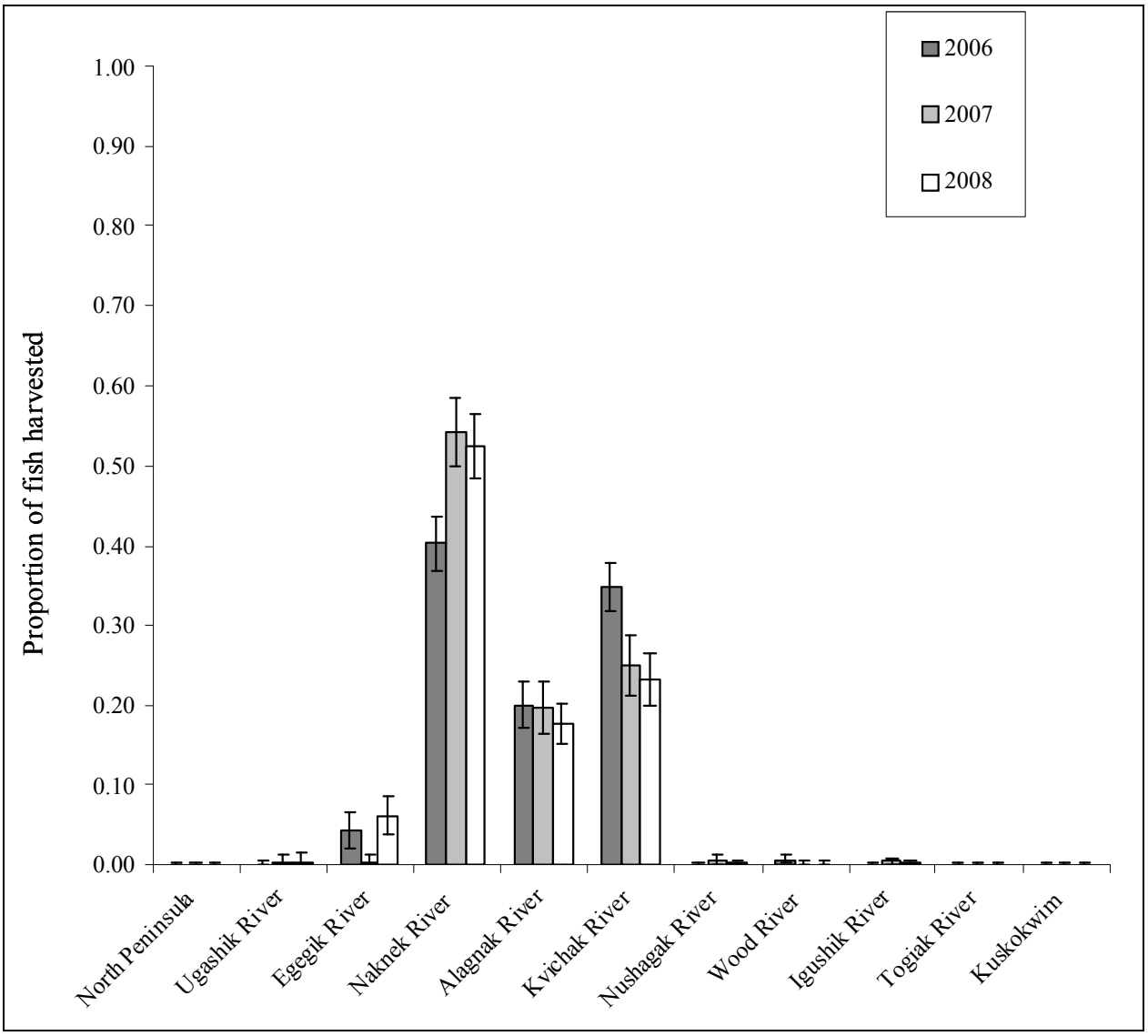


Figure 9.–Estimated proportion (and 90% credibility intervals) of sockeye salmon from each stock harvested within Naknek-Kvichak District within Bristol Bay, Alaska, in 2006, 2007, and 2008.

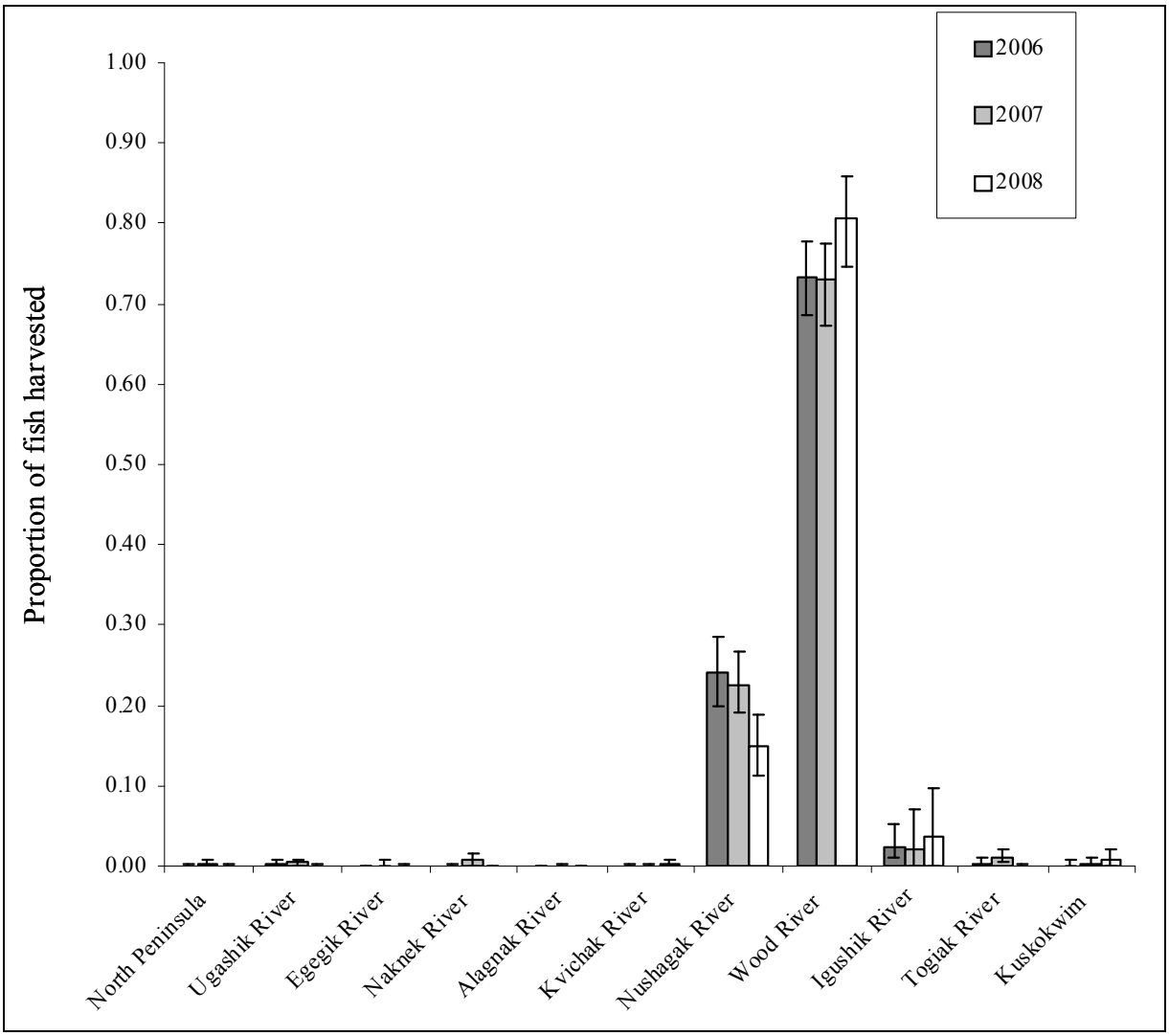


Figure 10.–Estimated proportion (and 90% credibility intervals) of sockeye salmon from each stock harvested within Nushagak District within Bristol Bay, Alaska, in 2006, 2007, and 2008.

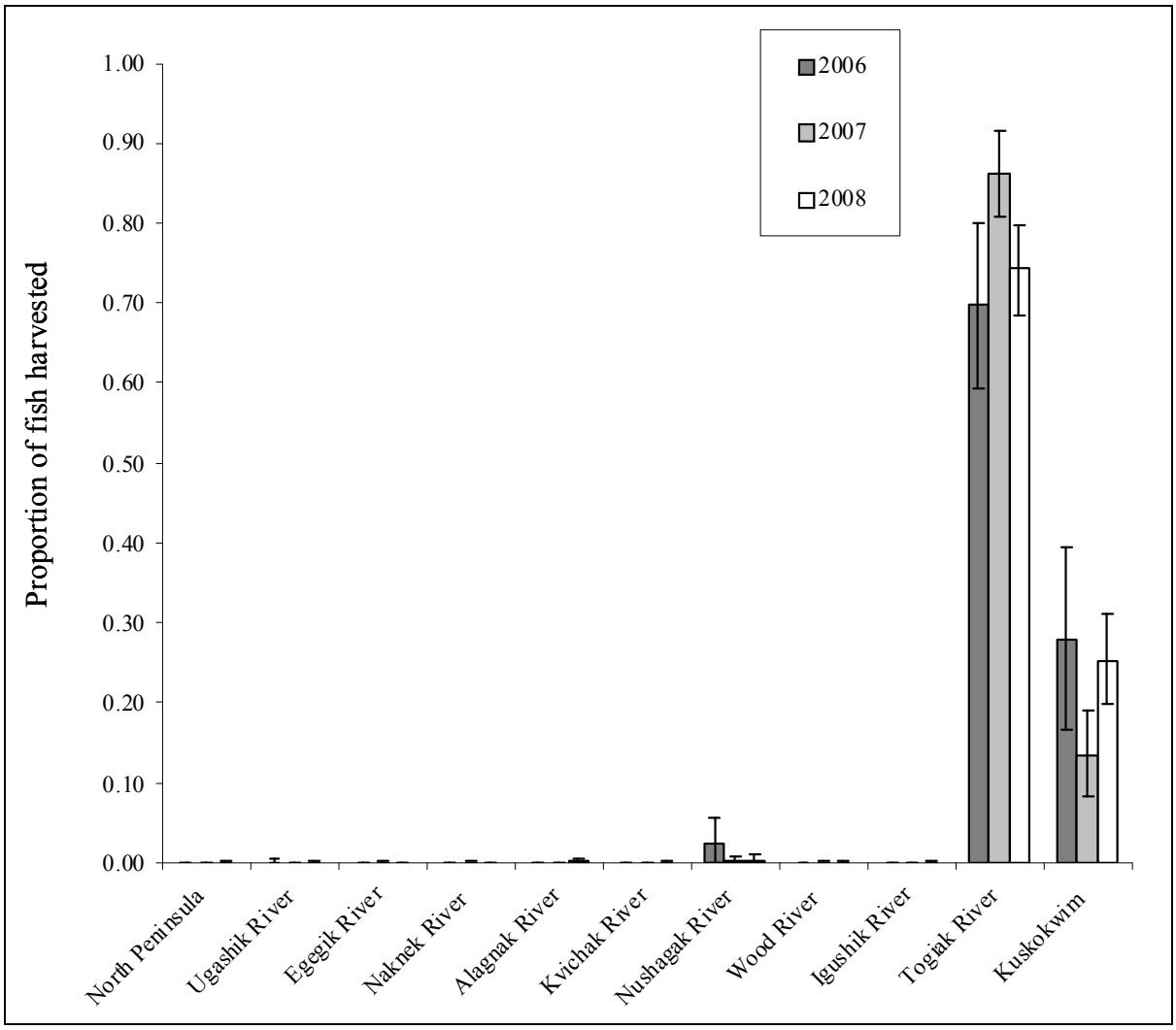


Figure 11.–Estimated proportion (and 90% credibility intervals) of sockeye salmon from each stock harvested within Togiak District within Bristol Bay, Alaska, in 2006, 2007, and 2008.

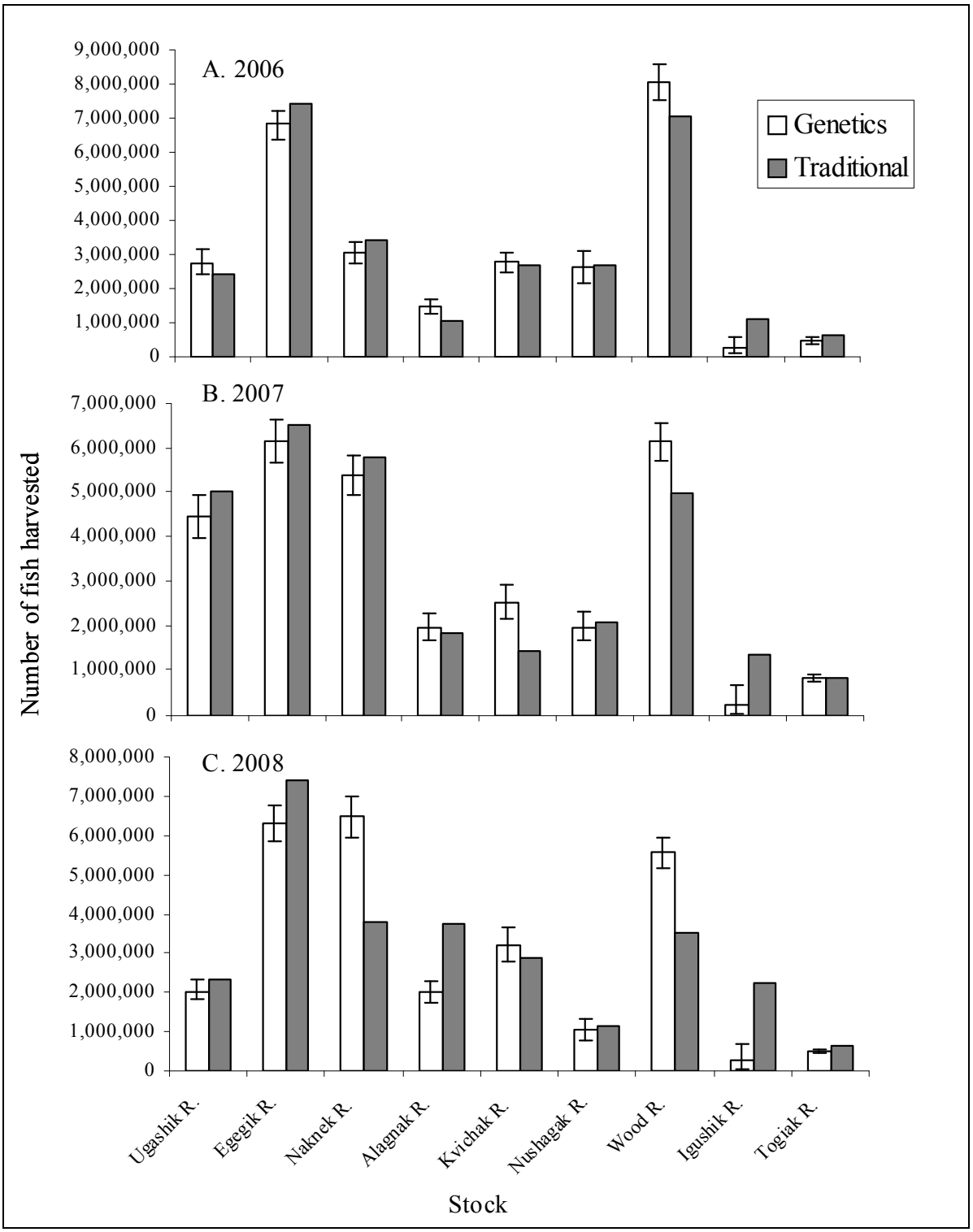


Figure 12.–Estimated number (and 90% credibility intervals) of sockeye salmon from each stock harvested using the genetic and traditional stock allocation methods within Bristol Bay, Alaska, in A. 2006, B. 2007, and C. 2008.

APPENDIX A

Appendix A1.–Baseline collection information organized geographically by reporting group and subdivided by population.

Reporting Group	Pop #	Population	H-W	Collection	Date	N
North Alaska Peninsula	1	Summer Bay Lake		Summer Bay Lake	8/25/1999	96
	2	McLees Lake		McLees Lake	6/4/2004	95
	3	Whaleback Mountain Creek		Whaleback Mountain Creek	7/30/2002	96
	4	Peterson Lagoon		Peterson Lagoon	8/2/2005	95
	5	Swansons Lagoon		Swansons Lagoon	8/25/2008	95
	6	Outer Marker Lake		Outer Marker Lake	9/9/2004	95
	7	Paul Hansen tributary		Paul Hansen tributary	7/30/2002	96
	8	North Creek		North Creek	7/25/2007	95
	9	Hoodoo Lake Shoals		Hoodoo Lake Shoals	7/31/2005	95
	10	Davids River		Davids River	7/31/2005	95
	11	Nelson River		Nelson River	7/5/2000	96
	12	Bear River Early		Bear River Early	6/30/2000	96
	13	Bear River Late	3	Bear River Late	8/18/2000	96
	14	Sandy Lake		Sandy Lake	6/30/2000	96
	15	Wildman Lake		Wildman Lake	7/30/2005	95
	16	Ilnik/Ocean Rivers		Ocean River	2001	96
				Ilnik River	7/29/2002	95
	17	Willie Creek		Willie Creek	8/27/2001	81
	18	Meshik Lake		Meshik Lake Shoals	7/30/2005	95
				Meshik Lake Outlet	7/30/2005	95

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Reporting Group	Pop #	Population	H-W	Collection	Date	N
	19	Meshik River		L Creek	7/30/2005	95
				Blue Violet Creek	7/29/2002	97
				Landlock Creek	7/29/2002	96
	20	Red Bluff Creek		Red Bluff Creek	7/30/2005	95
	21	Lava Creek		Mud Creek A	7/30/2005	95
				Lava Creek	7/23/2004	95
	22	Cinder River		Mainstem Cinder River	7/29/2005	95
				Wiggly Creek	7/29/2005	90
						2,652
Ugashik	23	Old Ham Creek		Old Ham Creek	8/22/2005	95
	24	Figure Eight Creek	3	Figure Eight Creek	8/22/2005	95
	25	Ugashik Creek		Ugashik Creek	7/21/2001	96
	26	Ugashik Lake		Deer Creek	7/20/2001	96
				Ugashik Narrows	8/24/2000	97
				Black Creek	8/24/2005	95
				East Creek Mouth	8/8/2005	95
	27	Outlet Stream	3	Outlet Stream	8/26/2000	96
						765
Egegik	28	Kejulik River		Kejulik River	8/17/2001	96
	29	East Becharof Lake		Cabin Creek	8/15/2000	96
				Ruth Lake Outlet	8/12/2000	96
				Salmon Creek	8/16/2006	186
				Burls Creek	8/16/2006	95
				Cleo Creek	8/16/2001	95
				Becharof Creek	8/11/2000	98

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Reporting Group	Pop #	Population	H-W	Collection	Date	N
				Featherly Creek	8/16/2001	95
	30	Becharof Lake North		Becharof Lake North Tributary	8/11/2008	95
	31	Becharof Lake South		Becharof Lake South Beach	8/11/2008	95
						1,047
Naknek	32	American River		American River	8/17/2001	96
				American River	8/22/2000	96
	33	Grosvenor Lake		Grosvenor Lake	8/12/2003	96
	34	Hardscrabble Creek		Hardscrabble Creek	8/12/2003	96
	35	Margot Creek		Margot Creek	8/15/2001	96
	36	Headwater Creek		Headwater Creek	7/22/2001	132
	37	Brooks Lake		Brooks Lake	8/22/2000	100
	38	Idavain Creek		Idavain Creek	8/23/2000	96
	39	Dumpling Creek #3		Dumpling Creek #3	9/17/2006	83
						891
Alagnak	40	Moraine Creek	3	Funnel Creek Early	8/8/2004	171
				Moraine Creek	9/4/2001	96
				Moraine Creek Early	8/8/2004	192
				Moraine Creek	9/9/2004	96
	41	Battle Lake		Battle Creek	9/4/2001	96
				Battle Creek	9/8/2004	96
				Battle Lake Tributary	9/11/2004	192
				Battle Lake Beach	9/11/2004	192
	42	Nanuktuk Creek		Nanuktuk Creek Early	8/9/2004	192
				Nanuktuk Creek	9/9/2004	192

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Reporting Group	Pop #	Population	H-W	Collection	Date	N
	43	Kulik River		Kulik River	9/5/2001	96
				Kulik River	9/8/2004	96
						1,707
Kvichak	44	Tlikakila River Upper		Tlikakila River Upper	9/24/2001	96
	45	Kijik River Lower		Kijik River Lower	9/18/2001	96
	46	Kijik River		Kijik River	9/19/2001	96
	47	Chulitna Lodge Beach		Chulitna Lodge Beach	10/5/1999	100
	48	Newhalen River		Tazimina River	8/29/2001	96
				Newhalen River	9/3/2002	96
	49	East Iliamna Lake		Chinkelyes Creek	8/28/2000	98
				Finger Beach 1	8/24/2000	84
				Knutson Bay	8/27/2000	96
	50	Iliamna River Late		Iliamna River Late	10/17/1999	96
	51	Iliamna Lake Islands		Fuel Dump Island	8/28/2000	99
				Woody Island West Beach	8/19/2001	100
				Triangle Island	8/16/2000	96
	52	Tommy Creek		Tommy Creek	8/24/2000	96
	53	Copper River		Copper River	8/28/2000	96
	54	South Iliamna Lake	3	Nick N Creek	8/25/2000	96
				Gibralter River	8/25/2000	100
				Dennis Creek	8/23/2000	96
	55	Gibraltar Lake		Dream Creek	8/22/2001	97
				Southeast Creek	8/26/2000	96
	56	Upper Talarik Creek		Upper Talarik Creek	8/15/2004	95
				Upper Talarik Creek	8/10/2006	95

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Reporting Group	Pop #	Population	H-W	Collection	Date	N
	57	Lower Talarik Creek	3	Lower Talarik Creek	8/26/2000	96
				Lower Talarik Creek	8/23/2001	70
						2,282
Nushagak	58	Mulchatna River Upper		Mulchatna River	8/27/2001	97
	59	Mulchatna River Lower		Koktuli River	8/13/2000	96
				Stuyahok River	8/14/2000	96
	60	Nushagak River Upper		Klutapuk Creek	8/18/2001	95
				King Salmon River	8/18/2001	96
				Upper Nushagak Sloughs	8/19/2001	96
	61	Chauekuktuli Lake beach		Chauekuktuli Lake beach	8/22/2001	96
	62	Allen River Beach		Allen River Beach	8/17/2000	96
	63	Allen River		Allen River	8/22/2001	95
	64	Nuyakuk Lake		Nuyakuk Lake	8/16/2000	99
	65	Tikchik River		Tikchik River	8/18/2001	96
						1,058
Wood	66	East Lake Kulik		Lake Kulik beaches	9/10/2007	95
				Grant River	8/22/2007	95
	67	Lake Kulik		Lake Kulik	8/1/2001	96
	68	Lake Beverly Beaches		Silver Horn Beaches	9/10/2007	95
				Hardluck Bay Beaches	9/10/2007	95
	69	Agulukpak River		Agulukpak River	8/21/2001	96
	70	Anvil Bay Beach		Anvil Bay Beach	8/20/2006	95
				N4 Beach	8/11/2006	96
	71	Little Togiak Lake		A Beach	8/8/2004	65
				A Beach	8/10/2005	30

-continued-

Reporting Group	Pop #	Population	H-W	Collection	Date	N
	72	Pick Creek		Pick Creek	8/3/2001	95
				Pick Creek	7/22/2008	93
	73	Agulowok River		Agulowok River	8/22/2001	95
	74	Lynx Beach		Lynx Beach	8/11/2006	96
	75	Lynx Creek		Lynx Creek	8/22/2001	96
	76	Ice Creek Upper		Ice Creek Upper	8/10/2007	68
	77	Aleknagik Lake Creeks	3	Ice Creek Lower	8/9/2007	95
				Bear Creek	8/2/2001	96
				Happy Creek	7/30/2001	95
				Hansen Creek	8/4/2004	95
	78	Yako Beach		Yako Beach	8/19/2006	95
	79	Eagle Creek		Eagle Creek	8/12/2007	93
	80	Mission Creek		Mission Creek	1998	94
						2,064
Igushik	81	Ualik Lake		Ualik Lake	8/14/2003	96
	82	Ongoke Lake Upper		Ongoke Lake Upper	8/27/2007	95
	83	Ongoke Lake Lower		Ongoke Lake Lower	8/28/2007	95
	84	Amanka Lake		Amanka Lake	8/14/2003	96
						382
Togiak	85	Kulukak Lake		Kulukak Lake	8/24/2006	95
	86	Togiak River		Togiak Lake, Sunday Creek	8/21/2000	95
				Togiak Lake, Outlet	7/27/2006	95
	87	Ongivinuk Lake		Ongivinuk Lake	8/24/2006	95
	88	Nenevok Lake		Nenevok Lake	8/24/2006	95

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	Reporting Group	Pop #	Population	H-W	Collection	Date	N
		89	Gechiak Lake	3	Gechiak Lake	8/21/2000	96
							571
	Kuskokwim	90	Goodnews River	5	Goodnews River Middle Fork	7/15/2001	96
					Goodnews River North Fork	7/23/2002	95
		91	Kanektok River		Kanektok River	7/16/2002	95
		92	Necons River		Necons River	8/1/2006	55
					Necons River	7/28/2007	95
		93	Telaquana Lake		Telaquana Lake	8/14/2003	96
		94	Kogrukluk River		Kogrukluk River	7/6/2001	95
		95	Salmon River	3	Salmon River	8/2/2006	95
		96	Kwethluk River		Kwethluk River	2007	95
							817
Total	11		96		144		14,236

Note: Each line contains an individual collection with associated collection name, collection date (only year is provided for collections where calendar day was not known), and sample size. Some collections were pooled based on geographic proximity and tests of homogeneity (see text for methods). Collections that were pooled fall under the same number under the "Pop. #" column. Populations that were out of H-W at more than the number of loci than expected by chance (2 loci @ $P = 0.05$) are noted with the number of loci out of H-W equilibrium under the H-W column.

APPENDIX B

Appendix B1.–Forty-five SNP markers assayed for this project:

Marker	Reference[a]	H-W
One_ACBP-79	A	
One_ALDOB-135	A	
One_ctgf-301	A	
One_CO1 [b]	A	
One_Cytb_17 [b]	A	
One_Cytb_26 [b]	A	
One_E2-65	B	
One_GHII-2165	A	
One_GPDH-201	B	
One_GPDH2-187	B	
One_GPH-414	A	
One_hsc71-220	A	
One_HGFA-49	B	
One_HpaI-71	A	
One_HpaI-99	A	
One_IL8r-362 [c]		
F: TTGCTAGAAGCGTTGGTTATGATGA		
R: CAGCAAAATTGAGAAGTCACTAGGAAAA		
VIC- CAGCCAAAGAAGAGTC		
FAM- AGCCAAAAAAGAGTC		
One_KPNA-422	A	6
One_LEI-87	A	
One_MARCKS-241		
F: CCTATCACAGCTTGGTTGAGTTCAA		
R: TCCACCCGCTCATTTTTGTAAGAT		
VIC-TTGCTTAAAAGGTCTTCC		
FAM-TTGCTTAAAAGGTCATCC		
One_MHC2_190 [d]	A	
One_MHC2_251 [d]	A	
One_Ots213-181	A	
One_p53-534	A	
One_ins-107	B	
One_Prl2	A	6
One_RAG1-103	A	

-continued-

Marker	Reference[a]	H-W
One_RAG3-93	A	
One_RFC2-102	B	
One_RFC2-285	B	
One_RH2op-395	A	
One_serpin-75	B	
One_STC-410	A	
One_STR07	A	
One_Tf_ex11-750	A	6
One_Tf_in3-182	A	
One_U301_92	A	
One_U401-224		
F: GGGTGGAGACGAACGGATTC		
R: GTACGATTTTTTTGTAGCCCCAAGT		
VIC-CACCTGGAAAGGACTGA		
FAM-ACACCTGGAAATGACTGA		
One_U404-229 [c]		
F: GTTTGTGTGTTGGTGTTTGTCCTT		
R: CATTTATCTTGGTGGACGTGTGAGT		
VIC-CATGTTCTTCAGTGAACC		
FAM-ATGTTCTTCAATGAACC		
One_U502-167 [c]		
F: GCTTTTGTGCAATAGCTATGTTGCT		
R: GCAAAGGTAGGCAGCAGATTG		
VIC-CTTCTTGATCAATAACG		
FAM-CTTCTTGATCGATAACG		
One_U503-170 [c]		
F: GATTCAGAATTGCCACGACAAAGAA		
R: GTGATTGGTACATGTCTGTCGAGTT		
VIC-AAGTACTAAAATCAGTTTTACATTG		
FAM-TACTAAAATCAGTTGTACATTG		
One_U504-141 [c]		
F: GCTATAGCTCACAGAGGATCCCA		
R: TATTGGCGGGTGAGGGATG		
VIC-TCAAGGACACAAACAA		
FAM-TCAAGGACAAAAACAA		

-continued-

Marker	Reference[a]	H-W
One_U508-533 [c]		
F: AGGCACAACCTCACATTTGGAA		
R: CTCAAAGGGTCTGAATACTTATGTAAATAAGGT		
VIC-ACACTACAGCCTTATTC		
FAM-ACACTACAGCTTTATTC		
One_VIM-569	A	
One_ZNF-61 [c]		
F: CCATTCATGTTCTATTCAGATATATTTTGTGCA		
R: CCTAGCTAGAGCTCAACAATATGCA		
VIC-CTATGGACATGATCTTT		
FAM-TTCTATGGACATTATCTTT		
One_Zp3b-49	B	

[a] A) Elfstrom et al. (2006); B) Smith et al. (2005).

[b] mtDNA markers; composite haplotype loci were assembled for MSA analyses.

[c] Markers that were not screened for the commercial catch samples collected in 2006.

[d] MHC markers were significantly linked in more than 50% of collections. Composite phenotypes were assembled for MSA analyses.

APPENDIX C

Appendix C1.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Ugashik District, Bristol Bay, Alaska, in 2006.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Ugashik District	6/12-19/2006	3,124			
		6/20/2006	7,556	55		
		6/21/2006	6,964			
		6/22/2006	13,299	160		
		6/23-29/2006	0			
		6/30/2006	11,729			
		7/1/2006	63,167	240	47	
		7/2/2006	70,555			
		7/3/2006	0			
		7/4/2006	31,150	239	24	
		7/5/2006	127,719	202	23	
		7/6/2006	103,427			
		7/7/2006	120,500	240	23	
		7/8/2006	165,929	240	23	
		7/9/2006	149,761			
		7/10/2006	82,152			
		7/11/2006	115,007	240	48	
		Period Subtotal	1,072,039	1,616	188	(182)
2	Ugashik District	7/12/2006	106,433			
		7/13/2006	221,234	200	48	
		7/14/2006	120,209			
		7/15/2006	89,135	240	47	
		7/16/2006	136			
		7/17/2006	65,969			
		7/18/2006	91,487	240	39	
		7/19/2006	112,214	240	39	
		7/20/2006	148,095			
		7/21/2006	59,176	120	19	
		7/22-31/2006	304,048			
		8/1-31/2006	39,422			
		Period Subtotal	1,357,558	1,040	192	(190)
Total			2,429,597	2,656	380	(372)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift gillnet fishery and used to estimate stock composition and stock-specific harvest during each period (Appendix D1).

Appendix C2.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Ugashik District, Bristol Bay, Alaska, in 2007.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Ugashik District	6/12-17/2007	649			
		6/18/2007	2,418	120	3	
		6/19/2007	4,526			
		6/20/2007	7,968			
		6/21/2007	3,239			
		6/22/2007	6,543	225	4	
		6/23/2007	0			
		6/24/2007	20,991	61	13	
		6/25/2007	9,094			
		6/26-28/2007	0			
		6/29/2007	123,890	80	63	
		6/30/2007	17,907			
		7/1/2007	146,834	303	107	
		Period Subtotal	344,059	789	190	(182)
3	Ugashik District	7/2/2007	3,227			
		7/3/2007	195,937	240	28	
		7/4/2007	386,497	121	58	
		7/5/2007	312			
		7/6/2007	240,511	219	37	
		7/7/2007	448,280	120	67	
		Period Subtotal	1,274,764	700	190	(184)
3	Ugashik District	7/8/2007	409,617	120		
		7/9/2007	175,209			
		7/10/2007	325,163	120	107	
		7/11/2007	252,120	199	83	
		Period Subtotal	1,162,109	439	190	(186)
4	Ugashik District	7/12/2007	364,921	479	56	
		7/13/2007	128,459			
		7/14/2007	259,258	50	40	
		7/15/2007	406,077			
		7/16/2007	476,106	177	73	
		7/17/2007	135,388	80	21	
		7/18-24/2007	444,796			
		7/25-31/2007	26,391			
		8/1-17/2008	4,287			
		Period Subtotal	2,245,683	786	190	(185)
Total			5,026,615	2,714	760	(737)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift gillnet fishery and used to estimate stock composition and stock-specific harvest during each period (Appendix D2).

Appendix C3.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Ugashik District, Bristol Bay, Alaska, in 2008

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Ugashik District	6/16-20/2008	13,531	169	5	
		6/21/2008	0			
		6/22/2008	0			
		6/23/2008	25,720	288	33	
		6/24/2008	0			
		6/25/2008	0			
		6/26/2008	50,501	288	66	
		6/27/2008	0			
		6/28/2008	3,388			
		6/29/2008	67,282	275	86	
		Period Subtotal	160,422	1,020	190	(186)
2	Ugashik District	6/30/2008	0			
		7/1/2008	0			
		7/2/2008	162,871	288	190	
		7/3/2008	201,679			
		Period Subtotal	364,550	288	190	(188)
3	Ugashik District	7/4/2008	155,945	140	34	
		7/5/2008	154,103	144	31	
		7/6/2008	191,196	144	42	
		7/7/2008	219,987			
		7/8/2008	214,920	288	41	
		7/9/2008	175,060	144	42	
		7/10/2008	154,338			
		Period Subtotal	1,265,549	860	190	(188)
4	Ugashik District	7/11/2008	130,201	251	124	
		7/12/2008	94,186			
		7/13/2008	52,756	144	66	
		Period Subtotal	277,143	395	190	(185)
5	Ugashik District	7/14/2008	43,107	144	60	
		7/15/2008	5,698			
		7/16/2008	57,542	144	80	
		7/17/2008	50,100			
		7/18/2008	33,268	144	51	
		7/19/2008	26,464			
		7/20/2008	25,170			
		7/21-31/2008	24,996			
		8/1-31/2008	13			
		Period Subtotal	266,358	432	190	(187)
Total			2,334,022	2,995	950	(934)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift gillnet fishery and used to estimate stock composition and stock-specific harvest during each period (Appendix D3).

Appendix C4.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Egegik District, Bristol Bay, Alaska in 2006.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Egegik River Special	6/12-20/2006	3,396			
	Harvest Area (ERSHA)	6/21/2006	23,718	94		
		6/22/2006	1,936			
		6/23/2006	12,995			
		6/24-25/2006	0			
		6/26/2006	219,995	240	48	
		6/27/2006	130,893	240	47	
		6/28/2006	111,291	240	48	
		6/29/2006	268,754	225	47	
		6/30/2006	227,093	360	47	
		7/1/2006	419,130			
		Period Subtotal	1,419,201	1,399	237	(235)
2	Egegik River Special	7/2/2006	55,493			
	Harvest Area (ERSHA)	7/3/2006	220,656	480	96	
		7/4/2006	299,926			
		7/5/2006	676,362	240	47	
		7/6/2006	528,931	240	47	
		Period Subtotal	1,781,368	960	190	(189)
3	Egegik River Special	7/7/2006	266,811			
	Harvest Area (ERSHA)	7/8/2006	424,620	200	95	
	until 7/9/2006	7/9/2006	490,557			
	Egegik District	7/10/2006	403,019			
	7/10-12/2006	7/11/2006	302,583			
		7/12/2006	258,670	232	95	
		Period Subtotal	2,146,260	432	190	(188)
4	Egegik District	7/13/2006	280,069			
		7/14/2006	385,515	180	95	
		7/15/2006	377,452	300	96	
		Period Subtotal	1,043,036	480	191	(191)
5	Egegik District	7/16/2006	154,671	240	190	
		Period Subtotal	154,671	240	190	(186)
6	Egegik District	7/17/2006	153,416	240	95	
		7/18/2006	170,460			
		7/19/2006	180,593			
		7/20/2006	132,412			
		7/21/2006	22,220	240	95	
		7/22-23/2006	0			
		7/24-31/2006	196,074			
		8/1-31/2006	8,522			
		Period Subtotal	863,697	480	190	(187)
Total			7,408,233	3,991	1,188	(1176)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift gillnet fishery and used to estimate stock composition and stock-specific harvest during each period (Appendix D4).

Appendix C5.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Egegik District, Bristol Bay, Alaska, in 2007.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Egegik District	6/12-19/2007	30,869			
		6/20/2007	45,279	226	106	
		6/21/2007	30,027			
		6/22/2007	70,467			
		6/23/2007	45,858	100	84	
		6/24/2007	0			
		6/25/2007	55,943			
		6/26/2007	41,955			
		6/27/2007	155,549			
		Period Subtotal	475,947	326	190	(186)
2	Egegik River Special	6/28/2007	80,359			
	Harvest Area (ERSHA)	6/29/2007	53,588			
		6/30/2007	59,997			
		7/1/2007	314,703			
		7/2/2007	215,854			
		7/3/2007	513,200	480	190	
		Period Subtotal	1,237,701	480	190	(186)
3	Egegik River Special	7/4/2007	398,590			
	Harvest Area (ERSHA)	7/5/2007	522,716	241	120	
		7/6/2007	434,043			
		7/7/2007	314,433	239	70	
		7/8/2007	445,539			
		Period Subtotal	2,115,321	480	190	(183)
4	Egegik District	7/9/2007	469,107			
		7/10/2007	402,560	240	73	
		7/11/2007	386,533	210	65	
		7/12/2007	410,032			
		7/13/2007	167,949	120	29	
		7/14/2007	129,287	239	23	
		Period Subtotal	1,965,468	809	190	(185)
5	Egegik District	7/15/2007	126,187			
		7/16/2007	165,595	120	84	
		7/17/2007	146,757	120	74	
		7/18/2007	62,996	119	32	
		7/19/2007	45,812			
		7/20/2007	42,438			
		7/21-31/2007	101,949			
		8/1-31/2007	9,737			
		Period Subtotal	701,471	359	190	(184)
Total			6,495,908	2,454	950	(924)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift gillnet fishery and used to estimate stock composition and stock-specific harvest during each period (Appendix D5).

Appendix C6.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Egegik District, Bristol Bay, Alaska, in 2008.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Egegik District	6/9-19/2008	41,110			
		6/20/2008	75,440	250	45	
		6/21/2008	0			
		6/22/2008	102,275	144	59	
		6/23/2008	111			
		6/24/2008	139			
		6/25/2008	145,528	258	86	
		6/26/2008	235,930			
		Period Subtotal	600,533	652	190	(188)
2	Egegik District	6/27/2008	336,585			
		6/28/2008	358,170	265	97	
		6/29/2008	397,840	144	93	
		Period Subtotal	1,092,595	409	190	(188)
3	Egegik District	6/30/2008	476,773			
		7/1/2008	403,485	288	38	
		7/2/2008	645,684	144	61	
		7/3/2008	675,660			
		7/4/2008	477,748	144	45	
		7/5/2008	499,597	130	46	
		Period Subtotal	3,178,947	706	190	(187)
4	Egegik District	7/6/2008	504,691	143	109	
		7/7/2008	356,038			
		7/8/2008	373,063	288	81	
		Period Subtotal	1,233,792	431	190	(189)
5	Egegik District	7/9/2008	281,250	138	97	
		7/10/2008	263,770	144	93	
		7/11/2008	113,798			
		Period Subtotal	658,818	282	190	(188)
6	Egegik District	7/12/2008	63,649			
		7/13/2008	163,163			
		7/14/2008	121,035	144	95	
		7/15/2008	69,191	125	53	
		7/16/2008	79,153			
		7/17/2008	48,554			
		7/18/2008	37,912	144	30	
		7/19/2008	24,039			
		7/20/2008	16,496	144	12	
		7/21-31/2008	14,916			
		8/1-31/2008	1,092			
		Period Subtotal	639,200	557	190	(188)
Total			7,403,885	3,037	1,140	(1128)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift gillnet fishery and used to estimate stock composition and stock-specific harvest during each period (Appendix D6).

Appendix C7.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Naknek-Kvichak District, Bristol Bay, Alaska, in 2006.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Naknek River Special	6/19-24/2006	3,107	215		
	Harvest Area	6/25/2006	70,684	461		
		6/26/2006	0			
		6/27/2006	45,201	240		
		6/28/2006	86,808	188		
		6/29/2006	108,389			
		6/30/2006	199,286	80	24	
		7/1/2006	117,125	240	24	
		7/2/2006	108,503			
		7/3/2006	127,853	240	24	
		7/4/2006	301,101	240	23	
		7/5/2006	165,736			
		7/6/2006	197,715			
		7/7/2006	229,299	200	24	
		7/8/2006	303,005	240	24	
		7/9/2006	145,286	240	24	
		Period Subtotal	2,209,098	2,584	167	(162)
2	Naknek-Section	7/10/2006	235,526	240	190	
		Period Subtotal	235,526	240	190	(188)
3	Naknek-Kvichak	7/11/2006	592,863	471	95	
	District	7/12/2006	684,347	240	47	
		7/13/2006	758,524	229	48	
		Period Subtotal	2,035,734	940	190	(189)
4	Naknek-Kvichak	7/14/2006	565,776	240	47	
	District	7/15/2006	269,411	120	48	
		7/16/2006	49,871	239	47	
		7/17/2006	450,620	120	50	
		Period Subtotal	1,335,678	719	192	(191)
5	Naknek-Kvichak	7/18/2006	191,032	200	60	
	District	7/19/2006	85,477	240	60	
		7/20/2006	143,558			
		7/21/2006	125,884			
		7/22/2006	218,229			
		7/23/2006	130,123	84	84	
		7/24-31/2006	188,052			
		8/1-25/2006	7,576			
		Period Subtotal	1,089,931	524	204	(202)
6	Alagnak River Special	7/7-12/2006	45,975	164	164	
	Harvest Area	Period Subtotal	45,975	164	164	(163)
7	Kvichak Section	7/10-8/4/2006	198,598	200	190	
	Set Gillnet Only	Period Subtotal	198,598	200	190	(188)
Total			7,150,540	5,371	1,297	(1283)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries, except harvest was only from the set gillnet fishery in Kvichak Section (Period 7). Samples were collected from the drift gillnet fishery in Naknek-Section and Naknek-Kvichak District; from the drift and set gillnet fisheries in Naknek and Alagnak river special harvest areas; and from set gillnet fishery only in Kvichak Section. Samples were used to estimate stock composition and stock-specific harvest during each period (Appendix D7).

Appendix C8.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Naknek-Kvichak District, Bristol Bay, Alaska, in 2007.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Naknek-Kvichak District	6/12-20/2007	30,652			
		6/21/2007	30,523	240	136	
		6/22/2007	26,459			
		6/23/2007	0			
		6/24/2007	0			
		6/25/2007	81,107	60	54	
		6/26/2007	57,183			
		6/27/2007	125,585			
		Period Subtotal	351,509	300	190	(188)
2	Naknek River Special Harvest Area	6/28/2007	203,261			
		6/29/2007	236,014			
		6/30/2007	247,406			
		7/1/2007	140,382	120	25	
		7/2/2007	351,480	480	61	
		7/3/2007	661,344			
		7/4/2007	519,108	120	104	
		7/5/2007	596,808			
		7/6/2007	299,621			
		7/7/2007	300,075			
		7/8/2007	366,916			
		Period Subtotal	3,922,415	720	190	(185)
3	Naknek-Kvichak District	7/9/2007	448,372	100	46	
		7/10/2007	557,912	320	57	
		7/11/2007	815,873	389	87	
		7/12/2007	606,137			
		Period Subtotal	2,428,294	809	190	(187)
4	Naknek-Kvichak District	7/13/2007	650,013	240	90	
		7/14/2007	322,979	360	49	
		7/15/2007	405,097			
		7/16/2007	353,914	120	51	
		Period Subtotal	1,732,003	720	190	(187)
5	Naknek-Kvichak District	7/17/2007	139,073	145	105	
		7/18/2007	107,619			
		7/19/2007	112,787	120	85	
		7/20/2007	74,257			
		7/21/2007	52,630			
		7/22/2007	33,509			
		7/23-31/2007	65,677			
		8/1-21/2007	2,738			
		Period Subtotal	588,290	265	190	(188)
Total			9,022,511	2,814	950	(935)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift gillnet fishery in Naknek-Section and Naknek-Kvichak District and from the drift and set gillnet fisheries in Naknek River Special Harvest Area. Samples were used to estimate stock composition and stock-specific harvest during each period (Appendix D8).

Appendix C9.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Naknek-Kvichak District, Bristol Bay, Alaska, in 2008.

Period	Description	Date(s)	Harvest	Samples Collected	Samples Selected	
1	Naknek-Kvichak	6/1-25/2008	13,758			
	District	6/26/2008	152,479	288	73	
		6/27/2008	77,320	96	35	
		6/28/2008	182,825	144	83	
		Period Subtotal	426,382	528	191	(178)
2	Naknek-Kvichak	6/29/2008	280,163	252	67	
	District	6/30/2008	329,060			
		7/1/2008	540,584	144	123	
		Period Subtotal	1,149,807	396	190	(184)
3	Naknek-Kvichak	7/2/2008	997,932	144	90	
	District	7/3/2008	585,263			
		7/4/2008	599,559	240	55	
		7/5/2008	467,147	144	44	
		Period Subtotal	2,649,901	528	189	(181)
4	Naknek-Kvichak	7/6/2008	736,617	144	50	
	District	7/7/2008	580,851	96	48	
		7/8/2008	556,958	144	42	
		7/9/2008	671,562	124	50	
		Period Subtotal	2,545,988	508	190	(188)
5	Naknek-Kvichak	7/10/2008	614,585	131	72	
	District	7/11/2008	285,942	288	38	
		7/12/2008	406,329			
		7/13/2008	488,349	288	66	
		7/14/2008	86,186	288	14	
		Period Subtotal	1,881,391	995	190	(186)
6	Naknek-Kvichak	7/15/2008	393,887	144	79	
	District	7/16/2008	200,647	144	42	
		7/17/2008	141,478	105	30	
		7/18/2008	117,213	253	24	
		7/19/2008	45,720	67	10	
		7/20/2008	38,259			
		7/21/2008	27,131	96	5	
		7/22/2008	18,706			
		7/23-31/2008	24,897			
		8/1-31/2008	1,671			
		Period Subtotal	1,009,609	809	190	(172)
7	Kvichak Section	6/19-7/29/2008	718,766	500	190	
	Set Gillnet Only	Period Subtotal	718,766	500	190	(188)
Total			10,381,844	4,264	1,330	(1277)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries, except harvest was only from the set gillnet fishery in Kvichak Section (Period 7). Samples were collected from the drift gillnet fishery in Naknek-Section and Naknek-Kvichak District and from set gillnet fishery only in Kvichak Section. Samples were used to estimate stock composition and stock-specific harvest during each period (Appendix D9).

Appendix C10.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Nushagak District, Bristol Bay, Alaska, in 2006.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Nushagak District	611-24/2006	26,841			
		6/25/2006	383,684	220	95	
		6/26/2006	487,947	235	64	
		6/27/2006	564,982			
		6/28/2006	617,147	241	31	
		6/29/2006	497,370			
		Period Subtotal	2,577,971	696	190	(186)
2	Nushagak District	6/30/2006	529,979			
		7/1/2006	402,104	228	95	
		7/2/2006	766,275	89	48	
		7/3/2006	549,072	110	47	
		7/4/2006	727,434	40	40	
		7/5/2006	660,908	80	48	
		Period Subtotal	3,635,772	547	278	(270)
3	Nushagak District	7/6/2006	584,757			
		7/7/2006	708,245	240	95	
		7/8/2006	623,337			
		7/9/2006	387,620	240	97	
		7/10/2006	385,457	240	95	
		Period Subtotal	2,689,416	720	287	(277)
4	Nushagak Section	7/11/2006	309,434			
		7/12/2006	194,433	240	95	
		7/13/2006	343,848			
		7/14/2006	299,034	240	95	
		7/15/2006	175,921			
		Period Subtotal	1,322,670	480	190	(184)
5	Nushagak District	7/16/2006	121,012	120	24	
		7/17/2006	107,918	120	24	
		7/18/2006	54,931	240	47	
		7/19/2006	48,497			
		7/20/2006	32,691	238	48	
		7/21-31/2006	106,575			
		8/1-20/2006	642			
		Period Subtotal	472,266	718	143	(143)
6	Igushik Section	6/22-7/25/2006	178,262	200	190	
	Set Gillnet Only	Period Subtotal	178,262	200	190	(189)
Total			10,876,357	3,361	1,278	(1249)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift and set gillnet fisheries in Nushagak District and from set gillnet fishery in Igushik Section. Samples were used to estimate stock composition and stock-specific harvest during each period (Appendix D10).

Appendix C11.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Nushagak District, Bristol Bay, Alaska, in 2007.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Nushagak District	6/9-24/2007	53,002	234	10	
		6/25/2007	221,866			
		6/26/2007	312,431	140	70	
		6/27/2007	502,966	260	110	
		6/28/2007	407,900			
		Period Subtotal	1,498,165	634	190	(180)
2	Nushagak District	6/29/2007	341,336	267	65	
		6/30/2007	589,225			
		7/1/2007	691,870	274	125	
		7/2/2007	252,785			
		Period Subtotal	1,875,216	541	190	(183)
3	Nushagak District	7/3/2007	689,061	239	94	
		7/4/2007	703,939			
		7/5/2007	279,253	257	36	
		7/6/2007	456,948			
		7/7/2007	441,550	258	60	
		Period Subtotal	2,570,751	754	190	(187)
4	Nushagak District	7/8/2007	450,911	300	80	
		7/9/2007	391,190			
		7/10/2007	402,080			
		7/11/2007	331,279	260	63	
		7/12/2007	254,806	60	47	
		Period Subtotal	1,830,266	620	190	(190)
5	Nushagak District	7/13/2007	125,421	280	77	
		7/14/2007	115,588			
		7/15/2007	108,841	240	60	
		7/16/2007	112,534			
		7/17/2007	55,574	230	30	
		7/18/2007	38,829			
		7/19/2007	20,683	238	12	
		7/20/2007	19,302	100	11	
		7/21/2007	12,175			
		7/22/2007	6,653			
		7/23/2007	6,281			
		7/24/2007	2,773			
		7/25-31/2007	3,555			
		8/1-31/2007	1,504			
		Period Subtotal	629,713	1,088	190	(187)
Total			8,404,111	3,637	950	(927)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift and set gillnet fisheries in Nushagak District and used to estimate stock composition and stock-specific harvest during each period (Appendix D11).

Appendix C12.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Nushagak District, Bristol Bay, Alaska, in 2008.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Nushagak District	6/9-25/2008	25,480			
		6/26/2008	172,712	192	38	
		6/27/2008	224,976	96	34	
		6/28/2008	269,840	288	70	
		6/29/2008	332,378			
		6/30/2008	365,755	192	48	
		7/1/2008	517,027			
		Period Subtotal	1,908,168	768	190	(186)
2	Nushagak District	7/2/2008	742,678			
		7/3/2008	509,688	288	190	
		Period Subtotal	1,252,366	288	190	(178)
3	Nushagak District	7/4/2008	304,050	288	190	
		7/5/2008	443,028			
		7/6/2008	350,628			
		Period Subtotal	1,097,706	288	190	(181)
4	Nushagak District	7/7/2008	346,831			
		7/8/2008	425,533	412	80	
		7/9/2008	594,294	144	110	
		Period Subtotal	1,366,658	556	190	(186)
5	Nushagak District	7/10/2008	288,691			
		7/11/2008	196,190	288	81	
		7/12/2008	297,330			
		7/13/2008	147,852			
		7/14/2008	83,859	288	61	
		7/15/2008	107,847	144	48	
		Period Subtotal	1,121,769	720	190	(174)
6	Nushagak District	7/16/2008	50,823			
		7/17/2008	26,133	144	84	
		7/18/2008	24,984	144	106	
		7/19/2008	23,086			
		7/20/2008	12,866			
		7/21/2008	5,157			
		7/22/2008	6,580			
		7/23/2008	2,848			
		7/24/2008	1,477			
		7/25/2008	714			
		8/1-31/2008	1,821			
		Period Subtotal	156,489	288	190	(183)
Total			6,903,156	2,908	1,140	(1088)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift and set gillnet fisheries in Nushagak District and used to estimate stock composition and stock-specific harvest during each period (Appendix D12).

Appendix C13.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and period in Togiak District, Bristol Bay, Alaska, in 2006.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Togiak District	6/19-26/2006	9,949			
		6/27/2006	11,103	164	95	
		6/28-7/3/2006	41,446			
		7/4/2006	25,842	125	48	
		7/5/2006	19,954	125	47	
		7/6-26/2006	408,586			
		7/26/2006	18,727	266	95	
		7/27-31/2006	54,496			
		8/1-9/2006	36,338			
		Period Subtotal	626,441	680	285	(278)
Total			626,441	680	285	(278)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift gillnet fishery and used to estimate stock composition and stock-specific harvest during each period (Appendix D13).

Appendix C14.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Togiak District, Bristol Bay, Alaska, in 2007. .

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Togiak District	6/18-30/2007	19,252			
		7/1/2007	0			
		7/2/2007	17,159	139	52	
		7/3/2007	23,158	32	20	
		7/4/2007	17,976			
		7/5/2007	23,577	455	64	
		7/6/2007	25,004			
		7/7/2007	16,543			
		7/8/2007	0			
		7/9/2007	27,295	945	54	
		7/10/2007	29,859			
		Period Subtotal	199,823	1,571	190	(189)
2	Togiak District	7/11/2007	0			
		7/12/2007	0			
		7/13/2007	51,700			
		7/14/2007	43,860			
		7/15/2007	26,713	300	55	
		7/16/2007	39,802			
		7/17/2007	34,978	440	79	
		7/18/2007	36,805	80	56	
		7/19/2007	41,939			
		7/20/2007	28,895			
		7/21/2007	1,413			
		Period Subtotal	306,105	820	190	(187)
3	Togiak District	7/22/2007	0			
		7/23/2007	29,706	120	72	
		7/24/2007	48,534	279	118	
		7/25/2007	49,312			
		7/26/2007	30,707			
		7/27/2007	31,460			
		7/28/2007	27,932			
		7/29/2007	14,433			
		7/30/2007	23,891			
		7/31/2007	22,015			
		8/1-6/2007	32,663			
		Period Subtotal	310,653	399	190	(185)
Total			816,581	2,790	570	(561)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift gillnet fishery and used to estimate stock composition and stock-specific harvest during each period (Appendix D14).

Appendix C15.–Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods in Togiak District, Bristol Bay, Alaska, in 2008.

				Samples		
Period	Description	Date(s)	Harvest	Collected	Selected	
1	Togiak District	6/18-30/2008	12,054	149	4	
		7/1/2008	10,376	83	42	
		7/2/2008	5,232			
		7/3/2008	10,225			
		7/4/2008	14,438			
		7/5/2008	12,006			
		7/6/2008	0			
		7/7/2008	15,928	387	64	
		7/8/2008	19,812	155	80	
		7/9/2008	21,480			
		7/10/2008	27,584			
		7/11/2008	31,753			
		7/12/2008	16,849			
		Period Subtotal	197,737	774	190	(188)
2	Togiak District	7/13/2008	8,949	253	40	
		7/14/2008	46,325	37	37	
		7/15/2008	37,964	114	54	
		7/16/2008	25,874	148	36	
		7/17/2008	16,133	325	23	
		7/18/2008	28,720			
		7/19/2008	30,197			
		Period Subtotal	194,162	877	190	(188)
3	Togiak District	7/20/2008	13,898			
		7/21/2008	41,177	98	87	
		7/22/2008	36,190			
		7/23/2008	29,431	243	63	
		7/24/2008	29,376			
		7/25/2008	17,251			
		7/26/2008	14,093			
		7/27/2008	5,509			
		7/28/2008	19,394	357	40	
		7/29/2008	13,815			
		7/30/2008	9,346			
		7/31/2008	5,843			
		8/1-6/2008	24,093			
		Period Subtotal	259,416	698	190	(189)
Total			651,315	2,349	570	(565)

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Samples were collected from the drift gillnet fishery and used to estimate stock composition and stock-specific harvest during each period (Appendix D15).

APPENDIX D

Appendix D1.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Ugashik District, Bristol Bay, Alaska, 2006.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Ugashik District		Proportion	0.2%	83.8%	9.9%	0.4%	0.3%	2.9%	0.2%	1.8%	0.3%	0.2%	0.1%
	Year	2006	Lower 90% CI	0.0%	72.4%	0.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	1.8%	93.6%	17.4%	2.4%	2.3%	11.4%	0.8%	5.0%	2.5%	2.0%	0.1%
	End Date	07/11	Harvest	2,525	897,967	105,786	3,829	3,294	30,874	1,765	18,968	3,133	2,676	1,221
	Harvest	1,072,039	Lower 90% CI	0	776,297	7,931	0	0	1,577	0	0	0	0	0
	n	182	Upper 90% CI	19,450	1,003,709	186,446	26,104	25,155	122,461	8,711	53,975	26,703	21,313	1,221
2	Ugashik District		Proportion	0.0%	94.2%	3.9%	0.1%	0.0%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	86.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/12	Upper 90% CI	0.0%	99.3%	11.7%	0.1%	0.0%	3.8%	0.0%	0.1%	0.0%	0.1%	0.0%
	End Date	08/31	Harvest	434	1,278,998	52,973	1,194	170	21,742	510	415	136	640	345
	Harvest	1,357,558	Lower 90% CI	0	1,167,482	0	0	0	3,289	0	0	0	0	0
	n	190	Upper 90% CI	434	1,348,507	158,705	1,194	170	52,180	588	973	136	1,371	345
Total			Proportion	0.1%	89.6%	6.5%	0.2%	0.1%	2.2%	0.1%	0.8%	0.1%	0.1%	0.1%
	Year	2006	Lower 90% CI	0.0%	83.1%	2.1%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.9%	95.0%	12.0%	1.6%	1.0%	6.1%	0.7%	2.3%	1.1%	1.0%	0.2%
	End Date	08/31	Harvest	2,959	2,176,965	158,759	5,023	3,465	52,616	2,275	19,383	3,269	3,316	1,566
	Harvest	2,429,597	Lower 90% CI	0	2,018,165	49,978	0	0	12,088	0	0	0	0	0
	n	372	Upper 90% CI	22,032	2,308,807	291,105	37,938	25,302	147,650	16,272	54,834	27,001	24,813	4,957

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift gillnet fishery. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C1).

Appendix D2.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Ugashik District, Bristol Bay, Alaska, 2007.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Ugashik District		Proportion	0.0%	89.3%	8.1%	0.1%	0.0%	0.1%	0.5%	1.2%	0.4%	0.0%	0.2%
	Year	2007	Lower 90% CI	0.0%	78.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.0%	98.7%	17.7%	0.1%	0.0%	0.4%	3.7%	4.7%	2.9%	0.0%	1.2%
	End Date	07/01	Harvest	107	307,316	27,805	433	66	437	1,847	4,147	1,285	33	583
	Harvest	344,059	Lower 90% CI	0	271,422	0	0	0	0	0	0	0	0	0
	n	182	Upper 90% CI	107	339,440	60,873	433	66	1,367	12,764	16,229	9,974	33	4,086
2	Ugashik District		Proportion	0.0%	87.7%	10.9%	0.0%	0.0%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	79.3%	3.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/02	Upper 90% CI	0.0%	95.7%	19.2%	0.1%	0.0%	2.9%	0.0%	0.0%	0.0%	0.0%	0.0%
	End Date	07/07	Harvest	266	1,118,333	138,834	465	105	15,202	179	187	323	423	446
	Harvest	1,274,764	Lower 90% CI	0	1,010,895	39,176	0	0	2,566	0	0	0	0	0
	n	184	Upper 90% CI	266	1,219,352	245,335	816	105	36,813	179	187	399	423	446
3	Ugashik District		Proportion	0.0%	88.4%	10.6%	0.0%	0.0%	0.5%	0.1%	0.0%	0.1%	0.1%	0.2%
	Year	2007	Lower 90% CI	0.0%	74.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/08	Upper 90% CI	0.0%	99.6%	24.1%	0.0%	0.0%	1.7%	0.2%	0.0%	0.1%	0.3%	0.5%
	End Date	07/11	Harvest	458	1,027,743	122,789	230	116	6,006	973	351	613	925	1,907
	Harvest	1,162,109	Lower 90% CI	0	869,482	0	0	0	0	0	0	0	0	0
	n	186	Upper 90% CI	458	1,156,895	280,551	230	116	19,239	2,548	351	1,252	3,184	5,809
4	Ugashik District		Proportion	0.0%	63.0%	36.5%	0.1%	0.0%	0.0%	0.1%	0.2%	0.1%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	49.8%	23.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/12	Upper 90% CI	0.0%	75.9%	49.6%	0.1%	0.0%	0.0%	0.2%	1.4%	0.9%	0.0%	0.0%
	End Date	08/17	Harvest	893	1,414,427	818,730	1,167	245	360	1,723	4,768	2,752	188	431
	Harvest	2,245,683	Lower 90% CI	0	1,118,104	528,073	0	0	0	0	0	0	0	0
	n	185	Upper 90% CI	893	1,705,218	1,114,144	1,167	245	360	5,447	30,756	20,975	188	431
Total			Proportion	0.0%	76.9%	22.0%	0.0%	0.0%	0.4%	0.1%	0.2%	0.1%	0.0%	0.1%
	Year	2007	Lower 90% CI	0.0%	70.0%	15.3%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.2%	83.7%	29.0%	0.2%	0.1%	1.0%	0.5%	0.7%	0.5%	0.2%	0.4%
	End Date	08/17	Harvest	1,724	3,867,819	1,108,158	2,294	531	22,005	4,722	9,452	4,974	1,569	3,366
	Harvest	5,026,615	Lower 90% CI	0	3,518,650	769,054	0	0	5,309	0	0	0	0	0
	n	737	Upper 90% CI	8,514	4,209,037	1,457,248	12,548	2,531	48,440	23,620	36,932	27,442	10,024	20,645

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift gillnet fishery. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C2).

Appendix D3.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Ugashik District, Bristol Bay, Alaska, 2008.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Ugashik District		Proportion	0.1%	60.6%	33.6%	0.1%	0.0%	1.9%	1.1%	0.3%	2.2%	0.0%	0.1%
	Year	2008	Lower 90% CI	0.0%	46.5%	21.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/16	Upper 90% CI	0.2%	74.2%	46.8%	0.4%	0.1%	9.6%	4.8%	2.4%	5.8%	0.0%	0.1%
	End Date	06/29	Harvest	200	97,223	53,840	173	79	3,018	1,750	470	3,490	78	101
	Harvest	160,422	Lower 90% CI	0	74,553	33,977	0	0	0	0	0	0	0	0
	n	186	Upper 90% CI	263	119,025	75,073	653	207	15,403	7,751	3,876	9,337	78	101
2	Ugashik District		Proportion	0.4%	84.0%	14.6%	0.0%	0.0%	0.2%	0.0%	0.4%	0.0%	0.2%	0.1%
	Year	2008	Lower 90% CI	0.0%	73.9%	7.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/30	Upper 90% CI	3.1%	92.1%	24.3%	0.0%	0.0%	0.9%	0.0%	1.9%	0.2%	1.6%	0.2%
	End Date	07/03	Harvest	1,366	306,299	53,193	134	101	765	109	1,307	145	839	292
	Harvest	364,550	Lower 90% CI	0	269,338	25,534	0	0	0	0	0	0	0	0
	n	188	Upper 90% CI	11,418	335,828	88,416	134	101	3,220	112	6,877	574	5,854	852
3	Ugashik District		Proportion	0.1%	83.5%	9.3%	0.2%	5.3%	0.9%	0.0%	0.0%	0.0%	0.6%	0.0%
	Year	2008	Lower 90% CI	0.0%	73.9%	2.7%	0.0%	2.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/04	Upper 90% CI	0.1%	91.2%	17.9%	1.0%	9.2%	3.8%	0.0%	0.0%	0.0%	3.8%	0.0%
	End Date	07/10	Harvest	951	1,057,175	117,233	2,278	67,552	11,671	277	158	241	7,766	248
	Harvest	1,265,549	Lower 90% CI	0	935,268	33,889	0	28,718	321	0	0	0	0	0
	n	188	Upper 90% CI	951	1,154,424	226,758	12,994	115,893	48,078	277	158	241	47,538	248
4	Ugashik District		Proportion	0.0%	81.6%	14.8%	0.8%	0.4%	0.2%	1.8%	0.0%	0.1%	0.0%	0.2%
	Year	2008	Lower 90% CI	0.0%	67.4%	5.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/11	Upper 90% CI	0.0%	91.5%	28.7%	3.5%	2.5%	0.5%	5.8%	0.1%	0.7%	0.0%	1.3%
	End Date	07/13	Harvest	45	226,285	40,885	2,080	1,221	482	5,126	137	342	47	494
	Harvest	277,143	Lower 90% CI	0	186,843	15,838	0	0	0	0	0	0	0	0
	n	185	Upper 90% CI	45	253,618	79,648	9,779	6,834	1,416	16,035	286	1,826	47	3,734
5	Ugashik District		Proportion	0.0%	80.2%	18.1%	0.0%	0.0%	0.3%	0.4%	0.3%	0.5%	0.1%	0.0%
	Year	2008	Lower 90% CI	0.0%	64.7%	3.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/14	Upper 90% CI	0.0%	95.3%	33.2%	0.0%	0.0%	1.3%	2.8%	2.2%	2.8%	0.1%	0.0%
	End Date	08/31	Harvest	47	213,563	48,223	93	106	746	1,089	837	1,460	137	57
	Harvest	266,358	Lower 90% CI	0	172,287	8,060	0	0	0	0	0	0	0	0
	n	187	Upper 90% CI	47	253,917	88,488	93	115	3,520	7,400	5,957	7,491	137	57
Total			Proportion	0.1%	81.4%	13.4%	0.2%	3.0%	0.7%	0.4%	0.1%	0.2%	0.4%	0.1%
	Year	2008	Lower 90% CI	0.0%	75.5%	8.9%	0.0%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/16	Upper 90% CI	0.7%	86.5%	18.8%	0.8%	5.0%	2.4%	0.9%	0.5%	0.6%	2.1%	0.3%
	End Date	08/31	Harvest	2,609	1,900,544	313,374	4,757	69,058	16,682	8,351	2,909	5,678	8,867	1,192
	Harvest	2,334,022	Lower 90% CI	0	1,763,075	208,279	0	29,848	1,132	0	0	0	0	0
	n	934	Upper 90% CI	17,440	2,017,767	439,421	18,114	117,158	57,063	21,865	11,208	14,786	48,912	7,835

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift gillnet fishery. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C3).

Appendix D4.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Egegik District, Bristol Bay, Alaska, 2006.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Egegik River Special Harvest Area		Proportion	0.0%	1.5%	97.1%	0.4%	0.0%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	86.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.0%	12.5%	99.8%	3.1%	0.0%	2.3%	0.0%	0.0%	0.0%	0.0%	0.0%
	End Date	07/01	Harvest	279	20,808	1,377,894	5,451	117	13,297	251	254	138	434	277
	Harvest	1,419,201	Lower 90% CI	0	0	1,222,014	0	0	2,336	0	0	0	0	0
	n	235	Upper 90% CI	279	177,327	1,415,948	43,331	117	32,544	251	260	138	434	277
2	Egegik River Special Harvest Area		Proportion	0.0%	3.1%	89.8%	0.1%	0.3%	3.1%	0.1%	2.2%	0.2%	0.0%	1.1%
	Year	2006	Lower 90% CI	0.0%	0.0%	76.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/02	Upper 90% CI	0.0%	18.6%	97.9%	0.1%	1.8%	11.3%	0.7%	5.0%	1.2%	0.0%	4.4%
	End Date	07/06	Harvest	395	54,793	1,599,856	1,114	5,119	55,974	1,888	39,722	2,990	711	18,806
	Harvest	1,781,368	Lower 90% CI	0	0	1,368,896	0	0	0	0	0	0	0	0
	n	189	Upper 90% CI	395	331,929	1,743,493	1,256	31,954	200,616	11,668	88,782	21,272	711	78,626
3	Egegik River Special Harvest Area		Proportion	0.0%	2.3%	93.1%	3.0%	0.1%	1.2%	0.0%	0.0%	0.0%	0.0%	0.2%
	Year	2006	Lower 90% CI	0.0%	0.0%	81.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/07	Upper 90% CI	0.0%	12.0%	100.0%	12.3%	0.1%	6.3%	0.0%	0.1%	0.0%	0.0%	1.3%
	End Date	07/12	Harvest	715	48,501	1,998,915	65,351	1,122	26,216	256	484	309	594	3,797
	Harvest	2,146,260	Lower 90% CI	0	0	1,746,821	0	0	0	0	0	0	0	0
	n	188	Upper 90% CI	715	256,771	2,146,230	264,889	1,829	135,852	256	1,318	309	594	28,014
4	Egegik District		Proportion	0.1%	12.3%	77.7%	2.8%	0.1%	7.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	64.0%	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/13	Upper 90% CI	0.1%	25.0%	91.6%	13.0%	0.3%	15.0%	0.1%	0.0%	0.0%	0.0%	0.0%
	End Date	07/15	Harvest	598	128,663	810,873	28,756	576	72,544	516	75	71	210	154
	Harvest	1,043,036	Lower 90% CI	0	0	667,140	0	0	6,473	0	0	0	0	0
	n	191	Upper 90% CI	1,074	260,559	954,966	135,683	3,017	156,136	859	75	71	210	154
5	Egegik District		Proportion	0.1%	28.4%	50.2%	9.6%	4.6%	6.9%	0.1%	0.0%	0.1%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	13.6%	36.3%	0.0%	0.0%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/16	Upper 90% CI	0.1%	42.6%	66.1%	20.2%	10.2%	16.1%	0.1%	0.0%	0.1%	0.0%	0.0%
	End Date	07/16	Harvest	104	43,983	77,722	14,904	7,082	10,613	78	27	108	34	16
	Harvest	154,671	Lower 90% CI	0	21,109	56,184	0	0	1,092	0	0	0	0	0
	n	186	Upper 90% CI	124	65,927	102,240	31,293	15,766	24,850	78	27	390	34	16
6	Egegik District		Proportion	0.0%	30.6%	57.4%	5.3%	1.3%	5.1%	0.0%	0.0%	0.0%	0.1%	0.0%
	Year	2006	Lower 90% CI	0.0%	17.4%	42.7%	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/17	Upper 90% CI	0.0%	43.4%	71.7%	15.7%	5.3%	11.8%	0.0%	0.0%	0.0%	0.6%	0.0%
	End Date	08/31	Harvest	179	263,968	495,519	46,081	11,443	44,474	117	390	164	1,023	339
	Harvest	863,697	Lower 90% CI	0	150,042	368,680	0	0	6,741	0	0	0	0	0
	n	187	Upper 90% CI	179	375,104	619,277	135,870	45,520	101,865	117	390	164	5,243	339
Total			Proportion	0.0%	7.6%	85.9%	2.2%	0.3%	3.0%	0.0%	0.6%	0.1%	0.0%	0.3%
	Year	2006	Lower 90% CI	0.0%	4.0%	80.5%	0.2%	0.0%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.2%	12.7%	90.4%	5.3%	0.9%	5.6%	0.3%	1.2%	0.3%	0.3%	1.2%
	End Date	08/31	Harvest	2,270	560,716	6,360,780	161,657	25,459	223,118	3,106	40,952	3,780	3,006	23,389
	Harvest	7,408,233	Lower 90% CI	0	294,451	5,962,040	14,578	245	74,682	0	67	0	0	0
	n	1,176	Upper 90% CI	12,362	944,413	6,694,189	392,824	68,992	416,603	19,711	90,591	24,330	20,142	87,898

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift gillnet fishery. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C4).

Appendix D5.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Egegik District, Bristol Bay, Alaska, 2007.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Egegik District		Proportion	0.0%	7.3%	69.3%	5.5%	2.4%	7.6%	0.1%	1.4%	6.2%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	0.0%	57.5%	1.6%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.0%	18.0%	81.1%	10.6%	6.6%	15.6%	0.1%	7.6%	11.7%	0.0%	0.0%
	End Date	06/27	Harvest	174	34,753	330,008	26,408	11,630	36,218	575	6,532	29,417	87	145
	Harvest	475,947	Lower 90% CI	0	0	273,729	7,536	0	579	0	0	0	0	0
	n	186	Upper 90% CI	174	85,890	386,163	50,633	31,544	74,255	613	36,314	55,747	87	145
2	Egegik River Special Harvest Area		Proportion	0.0%	1.6%	91.1%	2.5%	1.6%	3.0%	0.0%	0.0%	0.1%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	0.0%	81.9%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/28	Upper 90% CI	0.0%	8.7%	97.7%	8.2%	4.6%	8.9%	0.0%	0.0%	0.3%	0.0%	0.0%
	End Date	07/03	Harvest	202	19,900	1,127,834	31,463	19,757	36,884	116	267	672	349	258
	Harvest	1,237,701	Lower 90% CI	0	0	1,013,973	0	0	3,944	0	0	0	0	0
	n	186	Upper 90% CI	202	107,950	1,209,327	101,785	56,649	109,708	116	353	3,864	378	258
3	Egegik River Special Harvest Area		Proportion	0.0%	1.5%	87.5%	8.1%	0.1%	1.6%	1.0%	0.0%	0.0%	0.0%	0.2%
	Year	2007	Lower 90% CI	0.0%	0.0%	77.1%	2.5%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/04	Upper 90% CI	0.0%	10.3%	94.5%	15.0%	1.0%	5.3%	3.6%	0.0%	0.0%	0.0%	1.3%
	End Date	07/08	Harvest	344	31,371	1,850,125	172,185	2,976	33,512	20,418	179	166	341	3,705
	Harvest	2,115,321	Lower 90% CI	0	0	1,631,210	52,570	0	4,017	0	0	0	0	0
	n	183	Upper 90% CI	344	218,763	1,999,436	317,294	21,219	112,507	76,016	179	166	341	28,530
4	Egegik District		Proportion	0.0%	18.3%	57.6%	8.8%	7.5%	6.1%	0.1%	0.9%	0.1%	0.3%	0.5%
	Year	2007	Lower 90% CI	0.0%	0.0%	45.4%	2.5%	2.1%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/09	Upper 90% CI	0.0%	30.9%	72.7%	16.8%	13.1%	15.0%	0.3%	4.0%	0.3%	2.2%	3.2%
	End Date	07/14	Harvest	277	358,827	1,131,667	173,127	146,888	119,905	1,412	17,520	1,581	5,143	9,120
	Harvest	1,965,468	Lower 90% CI	0	0	891,445	49,084	42,041	33,873	0	0	0	0	0
	n	185	Upper 90% CI	277	607,067	1,428,051	330,226	257,807	294,715	5,600	78,624	5,595	43,384	63,358
5	Egegik District		Proportion	0.0%	12.4%	80.0%	4.7%	1.0%	1.7%	0.1%	0.0%	0.0%	0.1%	0.0%
	Year	2007	Lower 90% CI	0.0%	1.3%	69.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/15	Upper 90% CI	0.0%	23.2%	90.2%	12.4%	3.2%	5.5%	0.2%	0.0%	0.0%	0.1%	0.0%
	End Date	08/31	Harvest	173	87,058	561,280	32,954	6,993	11,650	532	209	68	407	148
	Harvest	701,471	Lower 90% CI	0	9,195	484,939	0	0	12	0	0	0	0	0
	n	184	Upper 90% CI	173	162,747	632,383	87,302	22,343	38,409	1,482	215	68	541	148
Total			Proportion	0.0%	8.2%	77.0%	6.7%	2.9%	3.7%	0.4%	0.4%	0.5%	0.1%	0.2%
	Year	2007	Lower 90% CI	0.0%	2.2%	71.6%	3.7%	1.2%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.1%	13.0%	82.5%	10.2%	4.7%	6.7%	1.2%	1.4%	0.9%	0.7%	1.2%
	End Date	08/31	Harvest	1,170	531,909	5,000,914	436,138	188,243	238,169	23,053	24,707	31,903	6,327	13,375
	Harvest	6,495,908	Lower 90% CI	0	145,687	4,652,342	240,962	75,826	110,049	0	0	0	0	0
	n	924	Upper 90% CI	6,202	844,330	5,356,565	663,465	307,360	436,672	80,313	89,401	61,563	46,027	77,061

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift gillnet fishery. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C5).

Appendix D6.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Egegik District, Bristol Bay, Alaska, 2008.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Egegik District		Proportion	0.1%	0.9%	84.7%	3.7%	0.1%	10.1%	0.1%	0.1%	0.1%	0.1%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	75.2%	0.0%	0.0%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/01	Upper 90% CI	0.8%	5.3%	93.2%	8.4%	0.3%	18.5%	0.4%	0.5%	0.9%	0.2%	0.0%
	End Date	06/26	Harvest	891	5,200	508,840	22,199	361	60,694	464	401	781	545	156
	Harvest	600,533	Lower 90% CI	0	0	451,341	0	0	12,957	0	0	0	0	0
	n	188	Upper 90% CI	4,508	31,613	559,487	50,185	2,007	110,947	2,668	2,772	5,134	1,047	156
2	Egegik District		Proportion	0.0%	1.7%	50.5%	24.6%	1.7%	20.9%	0.2%	0.1%	0.2%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	39.3%	10.0%	0.0%	9.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/27	Upper 90% CI	0.0%	11.8%	62.2%	41.3%	6.1%	35.4%	1.4%	0.2%	1.5%	0.0%	0.0%
	End Date	06/29	Harvest	209	18,303	552,149	269,134	18,793	228,598	2,175	591	2,323	146	174
	Harvest	1,092,595	Lower 90% CI	0	0	429,873	109,222	0	99,944	0	0	0	0	0
	n	188	Upper 90% CI	209	128,515	680,126	450,949	67,042	386,435	15,842	1,657	16,905	146	174
3	Egegik District		Proportion	0.1%	0.8%	72.7%	16.0%	1.7%	8.5%	0.0%	0.1%	0.1%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	62.7%	9.6%	0.0%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/30	Upper 90% CI	0.4%	6.6%	81.2%	23.0%	5.0%	14.9%	0.0%	0.5%	0.4%	0.0%	0.0%
	End Date	07/05	Harvest	3,175	26,201	2,309,646	508,105	53,762	270,937	596	2,460	2,429	966	670
	Harvest	3,178,947	Lower 90% CI	0	0	1,991,649	306,014	0	102,627	0	0	0	0	0
	n	187	Upper 90% CI	11,640	209,960	2,579,956	729,707	157,850	472,424	596	14,379	13,670	966	670
4	Egegik District		Proportion	0.2%	3.2%	78.9%	4.0%	0.3%	13.3%	0.0%	0.0%	0.0%	0.0%	0.1%
	Year	2008	Lower 90% CI	0.0%	0.0%	66.8%	0.0%	0.0%	6.3%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/06	Upper 90% CI	0.8%	16.4%	88.8%	12.2%	1.9%	21.2%	0.0%	0.0%	0.0%	0.0%	0.2%
	End Date	07/08	Harvest	2,463	39,004	972,846	49,198	3,734	164,652	412	302	226	211	744
	Harvest	1,233,792	Lower 90% CI	0	0	824,340	0	0	77,771	0	0	0	0	0
	n	189	Upper 90% CI	9,932	202,684	1,095,294	150,521	23,385	261,095	412	302	226	211	1,892
5	Egegik District		Proportion	0.0%	0.5%	71.4%	18.9%	2.3%	6.4%	0.0%	0.2%	0.2%	0.0%	0.1%
	Year	2008	Lower 90% CI	0.0%	0.0%	62.5%	11.4%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/09	Upper 90% CI	0.0%	3.8%	79.8%	27.1%	6.6%	12.5%	0.0%	1.4%	1.6%	0.0%	0.1%
	End Date	07/11	Harvest	121	3,410	470,222	124,624	15,081	42,133	206	1,198	1,270	196	356
	Harvest	658,818	Lower 90% CI	0	0	411,575	75,070	0	557	0	0	0	0	0
	n	188	Upper 90% CI	121	25,176	525,803	178,383	43,223	82,471	206	9,331	10,603	196	356
6	Egegik District		Proportion	0.2%	0.2%	87.6%	7.3%	3.2%	0.6%	0.1%	0.2%	0.5%	0.1%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	80.0%	1.5%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/12	Upper 90% CI	0.4%	0.4%	94.3%	13.5%	6.2%	3.3%	0.2%	1.5%	3.4%	0.2%	0.0%
	End Date	08/31	Harvest	994	1,242	560,254	46,819	20,410	4,036	440	1,167	3,034	584	221
	Harvest	639,200	Lower 90% CI	0	0	511,634	9,347	5,884	0	0	0	0	0	0
	n	188	Upper 90% CI	2,285	2,738	602,823	86,315	39,634	21,054	1,041	9,383	21,982	1,349	221
Total			Proportion	0.1%	1.3%	72.6%	13.8%	1.5%	10.4%	0.1%	0.1%	0.1%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	67.5%	9.9%	0.4%	7.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/01	Upper 90% CI	0.7%	4.6%	77.2%	17.9%	3.1%	14.1%	0.4%	0.4%	0.6%	0.2%	0.2%
	End Date	08/31	Harvest	7,854	93,361	5,373,957	1,020,078	112,141	771,051	4,292	6,118	10,063	2,648	2,321
	Harvest	7,403,885	Lower 90% CI	0	0	4,995,739	735,656	28,025	521,771	0	0	0	0	0
	n	1,128	Upper 90% CI	50,519	339,045	5,717,823	1,325,010	228,333	1,044,924	26,905	29,399	42,458	16,784	13,397

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift gillnet fishery. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C6).

Appendix D7.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Naknek-Kvichak District, Bristol Bay, Alaska, 2006.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Naknek River Special Harvest Area		Proportion	0.0%	0.1%	0.1%	91.7%	5.2%	2.7%	0.0%	0.0%	0.0%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	86.0%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/19	Upper 90% CI	0.0%	0.1%	0.4%	96.7%	10.0%	5.6%	0.0%	0.1%	0.0%	0.0%	0.0%
	End Date	07/09	Harvest	457	1,495	3,292	2,026,103	114,188	60,103	391	1,052	452	981	583
	Harvest	2,209,098	Lower 90% CI	0	0	0	1,899,911	170	17,220	0	0	0	0	0
	n	162	Upper 90% CI	457	1,624	7,960	2,135,811	221,832	124,311	391	2,649	452	981	583
2	Naknek Section		Proportion	0.1%	0.2%	8.4%	39.8%	15.2%	36.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	27.4%	9.7%	28.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/10	Upper 90% CI	0.7%	1.0%	18.8%	53.8%	21.3%	44.5%	0.0%	0.0%	0.0%	0.0%	0.0%
	End Date	07/10	Harvest	290	406	19,898	93,766	35,872	85,142	26	21	18	22	66
	Harvest	235,526	Lower 90% CI	0	0	0	64,611	22,883	65,898	0	0	0	0	0
	n	188	Upper 90% CI	1,761	2,395	44,300	126,716	50,163	104,829	26	21	18	22	66
3	Naknek-Kvichak District		Proportion	0.0%	0.1%	9.5%	10.3%	42.4%	58.6%	0.1%	0.0%	0.0%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	3.1%	3.5%	15.2%	50.3%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/11	Upper 90% CI	0.0%	0.0%	15.9%	18.5%	28.1%	66.5%	0.1%	0.0%	0.0%	0.0%	0.0%
	End Date	07/11	Harvest	757	1,137	193,255	210,566	434,585	1,192,426	1,056	273	450	703	527
	Harvest	2,035,734	Lower 90% CI	0	0	63,890	71,036	308,759	1,024,738	0	0	0	0	0
	n	189	Upper 90% CI	757	1,137	323,736	376,040	571,727	1,354,362	2,810	273	450	703	527
4	Naknek-Kvichak District		Proportion	0.0%	0.1%	3.6%	27.0%	24.0%	43.3%	0.0%	1.9%	0.0%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	16.8%	17.2%	35.6%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/14	Upper 90% CI	0.0%	0.2%	11.4%	36.7%	31.2%	50.9%	0.0%	4.8%	0.0%	0.0%	0.0%
	End Date	07/17	Harvest	414	1,485	48,038	360,627	320,698	577,770	323	25,342	215	308	458
	Harvest	1,335,678	Lower 90% CI	0	0	0	223,748	229,617	475,206	0	0	0	0	0
	n	191	Upper 90% CI	414	3,123	152,422	490,243	416,423	680,070	323	63,927	215	308	458
5	Naknek-Kvichak District		Proportion	0.0%	0.0%	0.2%	15.8%	39.5%	44.3%	0.0%	0.0%	0.0%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	10.5%	32.6%	37.4%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/18	Upper 90% CI	0.0%	0.0%	1.7%	21.6%	46.5%	51.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	End Date	08/25	Harvest	412	399	2,658	172,139	430,283	483,158	135	170	83	325	168
	Harvest	1,089,931	Lower 90% CI	0	0	0	114,102	355,468	407,587	0	0	0	0	0
	n	202	Upper 90% CI	412	399	18,438	235,083	506,766	558,319	135	320	83	325	168

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Period	Description			Reporting Groups										
				North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
6	Alagnak River Special Harvest Area		Proportion	0.1%	0.8%	10.4%	0.5%	56.6%	12.4%	1.7%	16.9%	0.3%	0.1%	0.2%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.4%	0.0%	48.6%	5.9%	0.0%	10.5%	0.0%	0.0%	0.0%
	Start Date	07/07	Upper 90% CI	0.1%	5.9%	17.6%	4.6%	64.5%	19.9%	6.0%	24.0%	1.5%	0.1%	1.2%
	End Date	07/12	Harvest	34	372	4,760	246	26,024	5,699	792	7,792	144	26	85
	Harvest	45,975	Lower 90% CI	0	0	166	0	22,344	2,691	0	4,836	0	0	0
	n	163	Upper 90% CI	36	2,698	8,107	2,126	29,640	9,172	2,765	11,039	709	26	550
7	Kvichak Section Set Gillnet Only		Proportion	0.0%	0.1%	12.4%	9.1%	35.5%	42.4%	0.1%	0.1%	0.3%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	6.6%	2.6%	28.6%	34.8%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/10	Upper 90% CI	0.0%	0.0%	18.6%	17.1%	42.5%	49.9%	0.8%	0.8%	1.9%	0.0%	0.0%
	End Date	08/04	Harvest	51	162	24,689	17,993	70,440	84,207	251	232	501	28	45
	Harvest	198,598	Lower 90% CI	0	0	13,011	5,090	56,735	69,189	0	0	0	0	0
	n	188	Upper 90% CI	51	162	36,949	33,910	84,448	99,134	1,643	1,548	3,767	28	45
Total			Proportion	0.0%	0.1%	4.1%	40.3%	20.0%	34.8%	0.0%	0.5%	0.0%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	2.0%	36.9%	17.2%	31.7%	0.0%	0.1%	0.0%	0.0%	0.0%
	Start Date	06/19	Upper 90% CI	0.2%	0.4%	6.5%	43.7%	23.0%	37.8%	0.2%	1.1%	0.1%	0.2%	0.1%
	End Date	08/04	Harvest	2,415	5,455	296,591	2,881,441	1,432,091	2,488,505	2,974	34,882	1,864	2,392	1,931
	Harvest	7,150,540	Lower 90% CI	0	0	142,203	2,641,433	1,230,491	2,269,987	0	6,953	0	0	0
	n	1,283	Upper 90% CI	13,049	29,673	467,792	3,127,690	1,641,309	2,705,597	13,147	75,643	8,360	11,973	9,516

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries, except harvest was only from the set gillnet fishery in Kvichak Section (Period 7). Genetic samples were collected from the drift gillnet fishery in Naknek-Section and Naknek-Kvichak District; from the drift and set gillnet fisheries in Naknek and Alagnak river special harvest areas; and from set gillnet fishery only in Kvichak Section. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C7).

Appendix D8.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Naknek-Kvichak District, Bristol Bay, Alaska, 2007.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Naknek-Kvichak District		Proportion	0.0%	0.2%	1.0%	60.4%	7.1%	22.1%	0.4%	0.5%	8.3%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	50.2%	2.8%	14.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.1%	0.9%	6.5%	70.1%	12.3%	31.1%	2.9%	3.7%	13.3%	0.0%	0.0%
	End Date	06/28	Harvest	169	667	3,404	212,410	24,998	77,627	1,353	1,619	29,079	54	129
	Harvest	351,509	Lower 90% CI	0	0	0	176,323	9,931	49,942	0	0	0	0	0
	n	188	Upper 90% CI	198	3,101	22,927	246,252	43,333	109,218	10,320	13,112	46,915	54	129
2	Naknek River Special Harvest Area		Proportion	0.0%	0.1%	0.1%	80.2%	9.6%	9.9%	0.0%	0.0%	0.1%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	72.8%	5.0%	5.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/28	Upper 90% CI	0.0%	0.1%	0.4%	86.8%	15.1%	15.4%	0.0%	0.0%	0.4%	0.0%	0.0%
	End Date	07/09	Harvest	578	4,587	4,935	3,144,176	375,906	387,878	495	398	2,469	521	471
	Harvest	3,922,415	Lower 90% CI	0	0	0	2,853,697	194,613	199,881	0	0	0	0	0
	n	185	Upper 90% CI	578	4,587	15,196	3,403,090	591,105	603,996	495	398	14,341	521	471
3	Naknek-Kvichak District		Proportion	0.1%	0.2%	0.5%	30.7%	25.6%	42.7%	0.0%	0.1%	0.0%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	22.6%	18.6%	34.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/09	Upper 90% CI	0.1%	1.0%	3.8%	39.5%	32.9%	51.1%	0.0%	0.2%	0.1%	0.0%	0.0%
	End Date	07/12	Harvest	2,198	4,393	12,731	745,776	621,227	1,036,585	892	1,246	1,206	862	1,178
	Harvest	2,428,294	Lower 90% CI	0	0	0	548,807	452,240	825,134	0	0	0	0	0
	n	187	Upper 90% CI	3,548	24,122	93,462	959,850	799,447	1,239,871	925	5,539	2,990	862	1,178
4	Naknek-Kvichak District		Proportion	0.1%	0.3%	0.1%	34.8%	30.8%	31.8%	1.7%	0.2%	0.2%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	25.6%	23.7%	22.6%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/13	Upper 90% CI	0.1%	1.5%	0.1%	44.6%	38.3%	41.1%	6.1%	1.8%	1.7%	0.0%	0.0%
	End Date	07/16	Harvest	1,027	4,520	2,022	602,210	533,877	551,545	28,740	3,943	3,473	291	355
	Harvest	1,732,003	Lower 90% CI	0	0	0	442,827	409,911	390,833	0	0	0	0	0
	n	187	Upper 90% CI	1,027	25,891	2,042	773,104	663,727	712,295	105,441	31,564	29,185	291	355
5	Naknek-Kvichak District		Proportion	0.0%	0.1%	0.3%	30.9%	35.5%	33.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	23.4%	28.0%	25.8%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/17	Upper 90% CI	0.0%	0.1%	2.2%	38.9%	43.1%	40.8%	0.1%	0.0%	0.1%	0.0%	0.0%
	End Date	08/21	Harvest	87	315	1,727	181,530	208,821	195,072	288	63	179	98	108
	Harvest	588,290	Lower 90% CI	0	0	0	137,389	164,663	151,516	0	0	0	0	0
	n	188	Upper 90% CI	87	315	13,087	228,627	253,695	240,041	675	63	419	98	108
Total			Proportion	0.0%	0.2%	0.3%	54.2%	19.6%	24.9%	0.4%	0.1%	0.4%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	49.8%	16.4%	21.2%	0.0%	0.0%	0.1%	0.0%	0.0%
	Start Date	06/12	Upper 90% CI	0.2%	1.1%	1.4%	58.4%	23.0%	28.7%	1.2%	0.5%	0.8%	0.1%	0.1%
	End Date	08/21	Harvest	4,058	14,482	24,819	4,886,102	1,764,829	2,248,707	31,768	7,269	36,405	1,828	2,242
	Harvest	9,022,511	Lower 90% CI	0	0	0	4,496,009	1,477,483	1,914,532	0	0	6,716	0	0
	n	935	Upper 90% CI	21,314	94,777	125,652	5,270,849	2,070,954	2,592,001	110,462	42,006	75,395	9,165	11,297

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift gillnet fishery in Naknek-Section and Naknek-Kvichak District; and from the drift and set gillnet fisheries in Naknek River Special Harvest Area. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C8).

Appendix D9.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Naknek-Kvichak District, Bristol Bay, Alaska, 2008.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Naknek-Kvichak District		Proportion	0.1%	0.5%	19.3%	36.8%	4.5%	37.0%	0.1%	0.2%	1.5%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	10.0%	27.5%	0.4%	27.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/01	Upper 90% CI	0.1%	3.3%	29.5%	46.6%	9.4%	47.0%	0.3%	1.6%	5.1%	0.0%	0.0%
	End Date	06/28	Harvest	220	1,943	82,107	156,987	19,381	157,741	460	869	6,433	90	152
	Harvest	426,382	Lower 90% CI	0	0	42,570	117,361	1,703	115,379	0	0	0	0	0
	n	178	Upper 90% CI	345	13,895	125,764	198,720	40,271	200,395	1,188	6,790	21,853	90	152
2	Naknek-Kvichak District		Proportion	0.0%	0.0%	9.7%	45.3%	7.7%	35.9%	0.8%	0.3%	0.1%	0.0%	0.1%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.6%	35.6%	3.8%	27.3%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/29	Upper 90% CI	0.0%	0.0%	17.6%	55.7%	12.5%	44.6%	4.4%	2.4%	0.2%	0.0%	0.6%
	End Date	07/01	Harvest	105	287	111,966	520,419	88,093	413,005	9,616	3,999	614	464	1,239
	Harvest	1,149,807	Lower 90% CI	0	0	7,271	409,707	44,180	314,320	0	0	0	0	0
	n	184	Upper 90% CI	105	287	202,020	640,243	143,709	513,265	50,358	27,724	2,223	464	7,339
3	Naknek-Kvichak District		Proportion	0.0%	0.0%	1.0%	59.5%	14.9%	24.4%	0.0%	0.0%	0.0%	0.1%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	50.1%	9.3%	16.4%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/02	Upper 90% CI	0.0%	0.0%	5.7%	68.9%	21.2%	32.6%	0.0%	0.0%	0.0%	0.2%	0.0%
	End Date	07/05	Harvest	275	486	25,781	1,576,695	395,821	647,423	801	375	343	1,616	284
	Harvest	2,649,901	Lower 90% CI	0	0	0	1,327,837	247,135	434,167	0	0	0	0	0
	n	181	Upper 90% CI	275	486	151,889	1,825,755	560,835	865,136	801	375	343	5,178	284
4	Naknek-Kvichak District		Proportion	0.1%	0.7%	15.0%	57.6%	14.3%	12.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	7.2%	47.7%	8.8%	5.6%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/06	Upper 90% CI	0.3%	5.5%	23.5%	67.5%	20.4%	19.7%	0.0%	0.0%	0.0%	0.0%	0.0%
	End Date	07/09	Harvest	3,478	16,753	381,652	1,467,391	363,493	310,663	555	462	824	362	352
	Harvest	2,545,988	Lower 90% CI	0	0	182,215	1,213,542	224,676	141,638	0	0	0	0	0
	n	188	Upper 90% CI	6,457	140,312	597,790	1,718,104	519,000	502,591	555	462	824	362	352
5	Naknek-Kvichak District		Proportion	0.0%	0.0%	1.1%	74.9%	11.2%	12.6%	0.1%	0.0%	0.0%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	64.5%	6.4%	6.4%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/10	Upper 90% CI	0.0%	0.0%	5.4%	83.3%	16.7%	21.3%	0.2%	0.1%	0.0%	0.0%	0.0%
	End Date	07/14	Harvest	211	469	21,380	1,408,607	211,281	236,410	1,052	790	302	670	219
	Harvest	1,881,391	Lower 90% CI	0	0	0	1,213,858	119,901	120,026	0	0	0	0	0
	n	186	Upper 90% CI	211	469	101,803	1,567,744	313,667	400,924	3,579	1,948	302	670	219

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Period	Description			Reporting Groups										
				North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
6	Naknek-Kvichak District		Proportion	0.0%	0.9%	0.8%	28.9%	41.1%	27.9%	0.0%	0.2%	0.1%	0.0%	0.1%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	20.6%	33.4%	19.7%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	07/15	Upper 90% CI	0.0%	6.8%	6.7%	37.3%	49.0%	36.0%	0.0%	1.3%	0.1%	0.0%	0.1%
	End Date	08/31	Harvest	196	8,951	8,293	291,723	415,279	281,673	293	1,767	580	320	534
	Harvest	1,009,609	Lower 90% CI	0	0	0	208,441	336,854	198,768	0	0	0	0	0
	n	172	Upper 90% CI	196	68,224	68,140	376,245	494,480	362,966	293	13,401	580	320	534
7	Kvichak Section Set Gillnet Only		Proportion	0.0%	0.0%	0.2%	4.2%	45.3%	49.7%	0.2%	0.1%	0.1%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.7%	38.2%	42.8%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/19	Upper 90% CI	0.0%	0.0%	1.0%	8.7%	52.5%	56.7%	1.6%	1.0%	0.1%	0.0%	0.0%
	End Date	07/29	Harvest	65	222	1,225	30,306	325,623	357,463	1,549	1,017	930	89	277
	Harvest	718,766	Lower 90% CI	0	0	0	4,862	274,801	307,459	0	0	0	0	0
	n	188	Upper 90% CI	65	222	7,351	62,578	377,194	407,850	11,245	7,473	6,755	89	277
Total			Proportion	0.0%	0.3%	6.1%	52.5%	17.5%	23.2%	0.1%	0.1%	0.1%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	3.7%	48.4%	15.1%	19.9%	0.0%	0.0%	0.0%	0.0%	0.0%
	Start Date	06/01	Upper 90% CI	0.2%	1.5%	8.7%	56.6%	20.1%	26.6%	0.6%	0.4%	0.3%	0.2%	0.2%
	End Date	08/31	Harvest	4,551	29,111	632,403	5,452,131	1,818,972	2,404,378	14,326	9,278	10,026	3,611	3,057
	Harvest	10,381,844	Lower 90% CI	0	0	384,464	5,026,414	1,565,941	2,065,885	0	0	0	0	0
	n	1,277	Upper 90% CI	18,644	158,862	903,584	5,872,001	2,084,214	2,763,131	60,781	41,648	32,245	23,316	19,478

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries, except harvest was only from the set gillnet fishery in Kvichak Section (Period 7). Genetic samples were collected from the drift gillnet fishery in Naknek-Section and Naknek-Kvichak District; and from set gillnet fishery only in Kvichak Section. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C9).

Appendix D10.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Nushagak District, Bristol Bay, Alaska, 2006.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Nushagak District		Proportion	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	17.6%	79.9%	2.0%	0.3%	0.1%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.7%	68.0%	0.0%	0.0%	0.0%
	Start Date	06/11	Upper 90% CI	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	27.3%	89.8%	10.7%	1.5%	0.3%
	End Date	06/29	Harvest	987	1,253	281	1,960	639	831	452,475	2,058,570	50,685	6,617	3,673
	Harvest	2,577,971	Lower 90% CI	0	0	0	0	0	0	223,641	1,753,499	0	0	0
	n	186	Upper 90% CI	987	1,253	281	4,120	639	831	703,909	2,315,764	274,877	37,566	7,463
2	Nushagak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	29.7%	69.4%	0.7%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	22.3%	60.7%	0.0%	0.0%	0.0%
	Start Date	06/30	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	37.6%	77.2%	6.4%	0.0%	0.0%
	End Date	07/05	Harvest	1,249	415	277	401	468	211	1,080,750	2,523,131	27,166	933	771
	Harvest	3,635,772	Lower 90% CI	0	0	0	0	0	0	809,609	2,205,418	0	0	0
	n	270	Upper 90% CI	1,276	415	277	401	468	211	1,368,241	2,806,709	231,163	933	771
3	Nushagak District		Proportion	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	27.1%	72.0%	0.2%	0.3%	0.1%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	61.3%	0.0%	0.0%	0.0%
	Start Date	07/06	Upper 90% CI	0.0%	2.2%	0.0%	0.0%	0.0%	0.0%	37.6%	81.4%	0.2%	2.0%	0.1%
	End Date	07/10	Harvest	786	8,849	318	261	182	834	729,034	1,935,477	4,933	7,064	1,677
	Harvest	2,689,416	Lower 90% CI	0	0	0	0	0	0	477,406	1,647,592	0	0	0
	n	277	Upper 90% CI	786	58,908	318	261	182	834	1,012,515	2,189,989	4,933	54,648	1,677
4	Nushagak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.1%	80.4%	0.2%	0.1%	0.1%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.9%	69.9%	0.0%	0.0%	0.0%
	Start Date	07/11	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	29.5%	90.6%	0.2%	0.6%	0.1%
	End Date	07/15	Harvest	133	93	84	281	121	187	252,364	1,063,863	2,253	1,555	1,737
	Harvest	1,322,670	Lower 90% CI	0	0	0	0	0	0	117,775	925,015	0	0	0
	n	184	Upper 90% CI	133	93	84	281	121	187	389,731	1,198,270	2,828	7,976	1,975
5	Nushagak District		Proportion	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	21.9%	72.1%	5.6%	0.1%	0.1%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11.8%	57.8%	0.0%	0.0%	0.0%
	Start Date	07/16	Upper 90% CI	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	31.6%	84.5%	21.7%	0.2%	0.1%
	End Date	08/20	Harvest	97	735	111	69	60	127	103,249	340,558	26,370	634	256
	Harvest	472,266	Lower 90% CI	0	0	0	0	0	0	55,721	272,845	0	0	0
	n	143	Upper 90% CI	97	5,428	111	69	60	127	149,352	399,140	102,704	811	276
6	Igushik Section Set Gillnet Only		Proportion	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	1.1%	26.8%	71.9%	0.0%	0.0%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	9.6%	53.7%	0.0%	0.0%
	Start Date	06/22	Upper 90% CI	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	5.7%	45.4%	88.7%	0.0%	0.0%
	End Date	07/25	Harvest	38	101	23	37	20	27	1,908	47,820	128,243	20	26
	Harvest	178,262	Lower 90% CI	0	0	0	0	0	0	0	17,162	95,665	0	0
	n	189	Upper 90% CI	38	195	23	27	20	27	10,103	80,902	158,127	20	26
Total			Proportion	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	24.1%	73.3%	2.2%	0.2%	0.1%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.8%	68.3%	1.0%	0.0%	0.0%
	Start Date	06/11	Upper 90% CI	0.2%	0.6%	0.1%	0.2%	0.1%	0.1%	28.6%	77.9%	5.1%	0.9%	0.5%
	End Date	08/20	Harvest	3,289	11,447	1,093	3,008	1,489	2,218	2,619,780	7,969,419	239,651	16,823	8,140
	Harvest	10,876,357	Lower 90% CI	0	0	0	0	0	0	2,150,099	7,432,023	110,681	0	0
	n	1,249	Upper 90% CI	20,154	65,820	5,486	16,851	6,215	10,237	3,110,242	8,470,446	556,493	94,464	55,237

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift and set gillnet fisheries in Nushagak District and from set gillnet fishery in Igushik Section. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C10).

Appendix D11.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Nushagak District, Bristol Bay, Alaska, 2007.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Nushagak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	21.8%	77.5%	0.4%	0.0%	0.1%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	14.1%	68.2%	0.0%	0.0%	0.0%
	Start Date	06/11	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	30.4%	85.5%	1.7%	0.0%	0.8%
	End Date	06/28	Harvest	166	154	106	306	171	132	327,283	1,161,518	6,206	442	1,681
	Harvest	1,498,165	Lower 90% CI	0	0	0	0	0	0	211,134	1,022,461	0	0	0
	n	180	Upper 90% CI	166	154	106	306	171	132	455,847	1,280,912	24,770	442	11,334
2	Nushagak District		Proportion	0.6%	0.0%	0.2%	2.3%	0.0%	0.1%	11.2%	84.1%	1.2%	0.2%	0.2%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.6%	74.8%	0.0%	0.0%	0.0%
	Start Date	06/29	Upper 90% CI	3.5%	0.0%	1.3%	6.3%	0.0%	0.3%	16.5%	90.2%	9.1%	1.2%	0.5%
	End Date	07/02	Harvest	11,255	280	3,049	43,582	139	1,143	209,996	1,576,560	22,249	3,221	3,743
	Harvest	1,875,216	Lower 90% CI	0	0	0	0	0	0	123,676	1,402,511	0	0	0
	n	183	Upper 90% CI	66,493	280	24,941	117,696	139	4,818	309,392	1,691,766	171,117	21,799	8,854
3	Nushagak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	27.0%	71.3%	1.6%	0.0%	0.0%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	18.7%	57.7%	0.0%	0.0%	0.0%
	Start Date	07/03	Upper 90% CI	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	36.6%	80.8%	14.4%	0.0%	0.0%
	End Date	07/07	Harvest	183	241	193	697	257	406	694,210	1,832,486	40,685	497	895
	Harvest	2,570,751	Lower 90% CI	0	0	0	0	0	0	481,177	1,482,512	0	0	0
	n	187	Upper 90% CI	183	241	193	1,816	257	406	941,821	2,077,219	369,460	497	895
4	Nushagak District		Proportion	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	27.0%	71.9%	0.1%	0.6%	0.2%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.5%	64.0%	0.0%	0.0%	0.0%
	Start Date	07/08	Upper 90% CI	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	35.0%	79.3%	0.2%	3.6%	0.8%
	End Date	07/12	Harvest	476	1,899	570	558	354	752	494,583	1,315,689	1,955	10,504	2,925
	Harvest	1,830,266	Lower 90% CI	0	0	0	0	0	0	356,277	1,171,772	0	0	0
	n	190	Upper 90% CI	476	7,786	570	558	354	752	640,857	1,452,038	3,161	66,125	14,335
5	Nushagak District		Proportion	0.0%	5.5%	0.3%	0.0%	0.1%	0.0%	27.8%	38.3%	17.0%	10.2%	0.7%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.5%	20.1%	0.0%	3.5%	0.0%
	Start Date	07/13	Upper 90% CI	0.0%	10.1%	3.2%	0.0%	0.1%	0.0%	36.4%	58.7%	37.1%	16.4%	5.3%
	End Date	08/10	Harvest	198	34,737	2,130	195	338	311	175,070	241,009	107,167	64,395	4,162
	Harvest	629,713	Lower 90% CI	0	0	0	0	0	0	122,749	126,290	0	22,151	0
	n	187	Upper 90% CI	198	63,512	20,154	195	629	311	229,218	369,771	233,923	103,104	33,370
Total			Proportion	0.1%	0.4%	0.1%	0.5%	0.0%	0.0%	22.6%	72.9%	2.1%	0.9%	0.2%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.0%	67.4%	0.0%	0.3%	0.0%
	Start Date	06/11	Upper 90% CI	0.8%	0.8%	0.5%	1.4%	0.1%	0.2%	26.5%	77.4%	7.0%	1.8%	1.0%
	End Date	08/10	Harvest	12,278	37,312	6,047	45,339	1,259	2,745	1,901,142	6,127,262	178,262	79,060	13,405
	Harvest	8,404,111	Lower 90% CI	0	426	0	0	0	0	1,595,995	5,662,607	0	28,532	0
	n	927	Upper 90% CI	67,812	70,250	39,719	120,175	7,959	18,314	2,229,017	6,504,035	587,547	150,180	80,025

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift and set gillnet fisheries in Nushagak District. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C11).

Appendix D12.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Nushagak District, Bristol Bay, Alaska, 2008.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Nushagak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	21.9%	77.8%	0.1%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	12.5%	67.0%	0.0%	0.0%	0.0%
	Start Date	06/09	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	32.6%	87.2%	0.1%	0.0%	0.0%
	End Date	07/01	Harvest	191	271	340	326	198	2,499	417,885	1,483,840	1,473	312	834
	Harvest	1,908,168	Lower 90% CI	0	0	0	0	0	0	238,529	1,278,663	0	0	0
	n	186	Upper 90% CI	191	271	340	326	198	17,886	622,369	1,663,798	1,473	312	834
2	Nushagak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.5%	89.1%	0.1%	0.0%	0.2%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.9%	80.8%	0.0%	0.0%	0.0%
	Start Date	07/02	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	18.9%	95.3%	0.1%	0.0%	0.8%
	End Date	07/03	Harvest	127	121	105	117	95	395	131,196	1,115,941	1,065	399	2,805
	Harvest	1,252,366	Lower 90% CI	0	0	0	0	0	0	49,049	1,011,694	0	0	0
	n	178	Upper 90% CI	127	121	105	117	95	395	236,146	1,193,884	1,065	399	9,455
3	Nushagak District		Proportion	0.1%	0.1%	0.1%	0.0%	0.0%	0.2%	23.6%	75.5%	0.2%	0.0%	0.1%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	15.8%	67.4%	0.0%	0.0%	0.0%
	Start Date	07/04	Upper 90% CI	0.4%	0.5%	1.1%	0.0%	0.0%	1.4%	31.6%	83.2%	0.2%	0.0%	0.1%
	End Date	07/06	Harvest	909	1,164	1,561	414	147	2,430	258,730	829,038	2,267	493	554
	Harvest	1,097,706	Lower 90% CI	0	0	0	0	0	0	173,528	739,443	0	0	0
	n	181	Upper 90% CI	4,622	5,597	12,228	414	147	14,869	347,042	913,764	2,267	493	554
4	Nushagak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.0%	82.9%	7.0%	0.0%	0.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.6%	59.0%	0.0%	0.0%	0.0%
	Start Date	07/07	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.8%	94.5%	34.4%	0.0%	0.0%
	End Date	07/09	Harvest	176	102	86	96	243	135	136,481	1,132,331	96,134	337	538
	Harvest	1,366,658	Lower 90% CI	0	0	0	0	0	0	36,152	806,534	0	0	0
	n	186	Upper 90% CI	176	102	86	96	243	135	242,690	1,290,975	469,777	337	538
5	Nushagak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	5.2%	78.0%	12.4%	0.1%	4.1%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	60.3%	0.0%	0.0%	0.0%
	Start Date	07/10	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	10.9%	92.5%	30.1%	0.2%	10.6%
	End Date	07/15	Harvest	134	211	207	175	310	1,459	58,756	874,743	138,941	1,134	45,700
	Harvest	1,121,769	Lower 90% CI	0	0	0	0	0	0	8,890	676,162	0	0	0
	n	174	Upper 90% CI	134	211	207	175	310	10,218	121,888	1,037,757	337,244	1,971	118,760
6	Nushagak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.3%	79.5%	7.4%	0.7%	2.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	61.0%	0.0%	0.0%	0.0%
	Start Date	07/16	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	20.8%	95.3%	24.2%	5.2%	7.4%
	End Date	08/31	Harvest	30	21	19	24	18	23	16,179	124,363	11,567	1,129	3,118
	Harvest	156,489	Lower 90% CI	0	0	0	0	0	0	0	95,469	0	0	0
	n	183	Upper 90% CI	30	21	19	24	18	23	32,521	149,167	37,932	8,191	11,566
Total			Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	14.8%	80.5%	3.6%	0.1%	0.8%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11.1%	74.4%	0.1%	0.0%	0.0%
	Start Date	06/09	Upper 90% CI	0.2%	0.2%	0.2%	0.1%	0.1%	0.5%	18.7%	85.7%	9.5%	0.3%	1.9%
	End Date	08/31	Harvest	1,566	1,890	2,318	1,152	1,010	6,941	1,019,226	5,560,256	251,446	3,803	53,548
	Harvest	6,903,156	Lower 90% CI	0	0	0	0	0	0	767,191	5,138,323	3,549	0	1
	n	1,088	Upper 90% CI	10,468	12,555	16,073	5,628	5,766	34,548	1,291,382	5,916,087	656,119	19,256	133,527

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift and set gillnet fisheries in Nushagak District. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C12).

Appendix D13.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Togiak District, Bristol Bay, Alaska, 2006.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1			Proportion	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%	69.8%	27.8%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	59.4%	16.8%
	Start Date	06/19	Upper 90% CI	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	5.7%	0.0%	0.0%	79.8%	39.3%
	End Date	08/09	Harvest	86	547	183	177	43	46	13,707	91	96	437,259	174,206
	Harvest	626,441	Lower 90% CI	0	0	0	0	0	0	0	0	0	371,844	105,372
	n	278	Upper 90% CI	86	3,709	183	177	43	46	35,625	91	96	499,788	246,084
Total			Proportion	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%	69.8%	27.8%
	Year	2006	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	59.3%	16.8%
	Start Date	06/19	Upper 90% CI	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	5.7%	0.0%	0.0%	79.8%	39.4%
	End Date	08/09	Harvest	86	547	183	177	43	46	13,707	91	96	437,259	174,206
	Harvest	626,441	Lower 90% CI	0	0	0	0	0	0	0	0	0	371,614	104,930
	n	278	Upper 90% CI	86	3,983	183	177	43	46	35,733	91	96	500,130	246,659

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift gillnet fishery. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C13).

Appendix D14.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Togiak District, Bristol Bay, Alaska, 2007.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Togiak District		Proportion	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.4%	0.0%	0.0%	70.0%	29.3%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	54.9%	14.6%
	Start Date	06/18	Upper 90% CI	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	2.7%	0.1%	0.0%	84.5%	44.6%
	End Date	07/10	Harvest	80	53	54	135	30	34	781	78	54	139,919	58,606
	Harvest	199,823	Lower 90% CI	0	0	0	0	0	0	0	0	0	109,776	29,259
	n	189	Upper 90% CI	80	53	54	135	30	34	5,477	173	54	168,940	89,026
2	Togiak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	83.2%	16.6%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	73.3%	6.3%
	Start Date	07/11	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	93.5%	26.5%
	End Date	07/21	Harvest	83	57	138	38	23	20	165	80	51	254,695	50,755
	Harvest	306,105	Lower 90% CI	0	0	0	0	0	0	0	0	0	224,526	19,220
	n	187	Upper 90% CI	83	57	178	38	23	20	412	80	51	286,240	81,047
3	Togiak District		Proportion	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	99.5%	0.3%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	97.2%	0.0%
	Start Date	07/22	Upper 90% CI	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	1.9%
	End Date	08/06	Harvest	29	41	48	177	30	26	148	45	37	308,991	1,081
	Harvest	310,653	Lower 90% CI	0	0	0	0	0	0	0	0	0	302,072	0
	n	185	Upper 90% CI	29	41	48	185	30	26	148	45	37	310,653	5,764
Total			Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	86.2%	13.5%
	Year	2007	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	80.8%	8.2%
	Start Date	06/18	Upper 90% CI	0.1%	0.1%	0.2%	0.3%	0.0%	0.0%	0.8%	0.1%	0.1%	91.5%	18.9%
	End Date	08/06	Harvest	192	150	240	350	84	80	1,094	203	142	703,604	110,442
	Harvest	816,581	Lower 90% CI	0	0	0	0	0	0	0	0	0	660,136	66,904
	n	561	Upper 90% CI	604	739	1,286	2,107	328	317	6,607	1,147	703	746,984	154,026

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift gillnet fishery. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C14).

Appendix D15.–Proportion and harvest estimates (including 90% credibility intervals) by reporting group from mixtures of sockeye salmon harvested in Togiak District, Bristol Bay, Alaska, 2008.

				Reporting Groups										
Period	Description			North Peninsula	Ugashik	Egegik	Naknek	Alagnak	Kvichak	Nushagak	Wood	Igushik	Togiak	Kuskokwim
1	Togiak District		Proportion	0.1%	0.0%	0.0%	0.0%	0.3%	0.1%	0.4%	0.0%	0.0%	58.6%	40.4%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	47.6%	29.5%
	Start Date	06/18	Upper 90% CI	0.1%	0.0%	0.0%	0.0%	1.9%	0.2%	3.0%	0.0%	0.0%	69.3%	51.5%
	End Date	07/12	Harvest	117	55	36	83	621	129	817	55	56	115,954	79,814
	Harvest	197,737	Lower 90% CI	0	0	0	0	0	0	0	0	0	94,201	58,347
	n	188	Upper 90% CI	217	55	36	83	3,786	489	5,860	55	56	137,045	101,917
2	Togiak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	79.9%	20.0%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	69.5%	10.7%
	Start Date	07/13	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	89.2%	30.3%
	End Date	07/19	Harvest	18	17	17	19	56	12	68	58	42	155,106	38,748
	Harvest	194,162	Lower 90% CI	0	0	0	0	0	0	0	0	0	134,936	20,805
	n	188	Upper 90% CI	18	17	17	19	56	12	68	58	42	173,117	58,897
3	Togiak District		Proportion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	81.9%	17.9%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	72.7%	9.5%
	Start Date	07/20	Upper 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	90.4%	27.1%
	End Date	08/06	Harvest	56	85	34	20	26	21	117	113	54	212,437	46,452
	Harvest	259,416	Lower 90% CI	0	0	0	0	0	0	0	0	0	188,530	24,543
	n	189	Upper 90% CI	56	85	34	20	26	21	117	113	54	234,413	70,328
Total			Proportion	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%	74.2%	25.3%
	Year	2008	Lower 90% CI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	68.5%	19.7%
	Start Date	06/18	Upper 90% CI	0.1%	0.1%	0.1%	0.1%	0.6%	0.1%	1.0%	0.2%	0.1%	79.8%	31.1%
	End Date	08/06	Harvest	191	157	88	122	702	162	1,003	227	152	483,497	165,015
	Harvest	651,315	Lower 90% CI	0	0	0	0	0	0	0	0	0	445,932	128,573
	n	565	Upper 90% CI	972	709	326	464	4,051	909	6,581	1,146	755	519,576	202,847

Note: Harvest was the number of sockeye salmon commercially harvested in drift and set gillnet fisheries. Genetic samples were collected from the drift gillnet fishery. Sockeye salmon commercial harvest and numbers of samples collected and selected (successfully screened) for genetic analysis by date(s) and periods (Appendix C15).