

**Genetic Stock Composition of Sockeye Salmon  
Harvested in Commercial Salmon Fisheries of Kodiak  
Management Area, 2015–2016**

by

**M. Birch Foster**

and

**Tyler H. Dann**

April 2015

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



## Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the *Système International d'Unités* (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

| <b>Weights and measures (metric)</b>    |                    | <b>General</b>                                   |   | <b>Mathematics, statistics</b>                                    |                         |
|---|--------------------|--|---|---|-------------------------|
| centimeter                              | cm                 | Alaska Administrative Code                       | AAC   | <i>all standard mathematical signs, symbols and abbreviations</i> |                         |
| deciliter                               | dL                 | all commonly accepted abbreviations              | e.g., Mr., Mrs., AM, PM, etc.               | alternate hypothesis  | H <sub>A</sub>          |
| gram                                    | g                  | all commonly accepted professional titles        | e.g., Dr., Ph.D., R.N., etc.                | base of natural logarithm   | <i>e</i>                |
| hectare                                 | ha                 | at   | @   | catch per unit effort   | CPUE                    |
| kilogram                                | kg                 | compass directions:                              |   | coefficient of variation  | CV                      |
| kilometer                               | km                 | east   | E   | common test statistics  | (F, t, $\chi^2$ , etc.) |
| liter                                   | L                  | north  | N   | confidence interval   | CI                      |
| meter                                   | m                  | south  | S   | correlation coefficient   |                         |
| milliliter                              | mL                 | west   | W   | (multiple)  | R                       |
| millimeter                              | mm                 | copyright  | ©   | correlation coefficient   |                         |
|   |                    | corporate suffixes:                              |   | (simple)  | r                       |
|   |                    | Company  | Co.   | covariance  | cov                     |
| <b>Weights and measures (English)</b>   |                    | Corporation                                      | Corp.                                       | degree (angular)  | °                       |
| cubic feet per second                   | ft <sup>3</sup> /s | Incorporated                                     | Inc.  | degrees of freedom  | df                      |
| foot                                    | ft                 | Limited  | Ltd.  | expected value  | <i>E</i>                |
| gallon                                  | gal                | District of Columbia                             | D.C.  | greater than  | >                       |
| inch                                    | in                 | et alii (and others)                             | et al.                                      | greater than or equal to  | ≥                       |
| mile                                    | mi                 | et cetera (and so forth)                         | etc.  | harvest per unit effort   | HPUE                    |
| nautical mile                           | nmi                | exempli gratia                                   |   | less than   | <                       |
| ounce                                   | oz                 | (for example)                                    | e.g.  | less than or equal to   | ≤                       |
| pound                                   | lb                 | Federal Information Code                         | FIC   | logarithm (natural)   | ln                      |
| quart                                   | qt                 | id est (that is)                                 | i.e.  | logarithm (base 10)   | log                     |
| yard                                    | yd                 | latitude or longitude                            | lat. or long.                               | logarithm (specify base)  | log <sub>2</sub> , etc. |
|   |                    | monetary symbols                                 |   | minute (angular)  | '                       |
|   |                    | (U.S.)   | \$, ¢                                       | not significant   | NS                      |
| <b>Time and temperature</b>             |                    | months (tables and figures): first three letters | Jan, ..., Dec                               | null hypothesis   | H <sub>0</sub>          |
| day                                     | d                  | registered trademark                             | ®   | percent   | %                       |
| degrees Celsius                         | °C                 | trademark  | ™   | probability   | P                       |
| degrees Fahrenheit                      | °F                 | United States (adjective)                        | U.S.  | probability of a type I error                                     |                         |
| degrees kelvin                          | K                  | United States of America (noun)                  | USA   | (rejection of the null hypothesis when true)                      | $\alpha$                |
| hour                                    | h                  | U.S.C.   | United States Code                          | probability of a type II error                                    |                         |
| minute                                  | min                | U.S. state                                       | use two-letter abbreviations (e.g., AK, WA) | (acceptance of the null hypothesis when false)                    | $\beta$                 |
| second                                  | s                  |  |   | second (angular)  | "                       |
|   |                    |  |   | standard deviation  | SD                      |
| <b>Physics and chemistry</b>            |                    |  |   | standard error  | SE                      |
| all atomic symbols                      |                    |  |   | variance  |                         |
| alternating current                     | AC                 |  |   | population  | Var                     |
| ampere                                  | A                  |  |   | sample  | var                     |
| 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                  |  |   |   |                         |

***REGIONAL OPERATIONAL PLAN CF.4K.2015.15***

**GENETIC STOCK COMPOSITION OF SOCKEYE SALMON  
HARVESTED IN COMMERCIAL SALMON FISHERIES OF KODIAK  
MANAGEMENT AREA, 2015–2016**

by

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Division of Commercial Fisheries

April 2015

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**SIGNATURE PAGE**

Project Title: Genetic Stock Composition of Sockeye Salmon Harvested in Commercial Salmon Fisheries of Kodiak Management Area, 2015–2016

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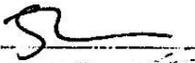
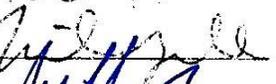
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# TABLE OF CONTENTS

|   | <b>Pages</b> |
|---|--------------|
| LIST OF TABLES.....                               | iv           |
| LIST OF FIGURES.....                              | iv           |
| LIST OF APPENDICES.....                           | iv           |
| PURPOSE.....                                      | 1            |
| BACKGROUND.....                                   | 1            |
| OBJECTIVES.....                                   | 2            |
| Primary Objectives.....                           | 2            |
| Overview.....                                     | 2            |
| Fishery Description.....                          | 2            |
| Northwest (NW) Kodiak District.....               | 2            |
| Afognak District.....                             | 3            |
| Eastside and Northeast (NE) Kodiak districts..... | 3            |
| Alitak District.....                              | 3            |
| Southwest (SW) Kodiak District.....               | 3            |
| Mainland District.....                            | 3            |
| Study Design.....                                 | 4            |
| Tissue and Data Collection.....                   | 4            |
| Data Analysis.....                                | 4            |
| Genetic Analysis.....                             | 4            |
| Mixed Stock Analysis.....                         | 5            |
| SCHEDULE AND DELIVERABLES.....                    | 7            |
| RESPONSIBILITIES.....                             | 7            |
| REFERENCES CITED.....                             | 9            |
| TABLES.....                                       | 11           |
| FIGURES.....                                      | 15           |
| APPENDIX A. SOCKEYE SALMON GENETICS SAMPLING..... | 21           |

## LIST OF TABLES

| <b>Table</b> |  | <b>Page</b> |
|--------------|--|-------------|
| 1.           | Kodiak Management Area commercial salmon harvest by species and year, 1970 through 2014. ....  | 12          |
| 2.           | Kodiak Management Area sockeye salmon genetic stock composition number to be analyzed by strata, 2015–2016. All harvest areas are included with 10-year average annual harvest for comparison of catch magnitude between sampled and non-sampled areas. .... | 13          |
| 3.           | Kodiak Management Area sockeye salmon genetic stock composition samples collected by strata, 2014. ....  | 14          |

## LIST OF FIGURES

| <b>Figure</b> |   | <b>Page</b> |
|---------------|---|-------------|
| 1.            | Map depicting the commercial salmon fishery districts of Kodiak Management Area (Area K) and major processing facility locations (blue stars). .... | 16          |
| 2.            | Map depicting the Kodiak Management Area Northwest and Northeast Kodiak districts. ....   | 17          |
| 3.            | Map depicting the Kodiak Management Area Afognak District. ....   | 18          |
| 4.            | Map depicting the Kodiak Management Area Alitak District and a portion of the Eastside Kodiak District. ....  | 19          |
| 5.            | Map depicting the Kodiak Management Area Southwest Kodiak District and Cape Igvak Section. ....   | 20          |

## LIST OF APPENDICES

| <b>Appendix</b> |   | <b>Page</b> |
|-----------------|---|-------------|
| A1.             | Instructions for bulk sampling finfish tissues for DNA analysis. .... | 22          |
| A2.             | Procedure for clipping axillary process from sockeye salmon. ....     | 23          |
| A3.             | Sockeye Genetics Sampling Form example. ....                          | 24          |
| A4.             | Marine-phase salmon identification. ....                              | 25          |

## PURPOSE

The primary goal of this study is to use Genetic Stock Identification (GSI) to estimate temporal stock contribution of sockeye salmon *Oncorhynchus nerka* harvested in selected Kodiak Management Area (KMA) commercial salmon fisheries during the 2014 to 2016 seasons. Within the Alaska Department of Fish and Game's (ADF&G) KMA there are 61 streams supporting sockeye salmon populations. There has been an increasing realization within the region of the lack of modern stock-specific commercial harvest estimates in KMA. Such information could be invaluable for run reconstructions, brood tables, and refining management. This operational plan provides ADF&G with a sampling plan to achieve that overall goal.

Key words: GSI, sockeye salmon, Kodiak, genetic stock composition, KMA.

## BACKGROUND

KMA comprises the state waters of the western Gulf of Alaska surrounding the Kodiak Archipelago and that portion of the Alaska Peninsula bordering the Shelikof Strait between Cape Douglas and Kilokak Rocks (Figure 1). To the south is the Chignik Management Area and to the north is the Cook Inlet Management Area.

Directed sockeye salmon *O. nerka* fisheries occur in the KMA but sockeye salmon are also incidentally harvested in directed pink *O. gorbuscha*, coho *O. kisutch*, and chum salmon *O. keta* commercial fisheries within the area. In KMA, sockeye salmon spawn in 61 known streams (Jackson and Keyse 2013) but only 9 systems are currently monitored via salmon counting weirs. The 10-year average commercial sockeye salmon harvest is roughly 2.3 million fish from 2004 to 2013 (Table 1). Estimated average KMA sockeye salmon escapement during that same time frame is approximately 1.2 million fish (Jackson and Keyse 2013).

Beginning in the late 1970s the Alaska Board of Fisheries (BOF) adopted into regulation numerous management plans explicitly outlining how different portions of KMA will be managed (e.g., Cape Igvak, Alitak Bay, North Shelikof, and Westside). Essential to these plans was maintaining traditional fishing opportunities and allocations but also promoting sustainable fisheries. Inherent was the recognition that many of the fisheries in this area consisted of mixed sockeye salmon stocks originating not only within KMA ("local") but also from neighboring management areas ("non-local").

Scientific knowledge of the temporal and spatial presence of both local and non-local sockeye salmon in these catches is of regional importance. Historically, stock-specific estimates of sockeye salmon harvest for major commercial fishing areas were achieved utilizing scale pattern analysis (SPA), age marker analysis, historical averages of the latter (Foster 2011), and information garnered from tagging studies (Rich and Morton 1929; Bower 1941; Bevan 1959; Nicholson 1978; Tyler et al. 1981a,b).

The Western Alaska Salmon Stock Identification Program (WASSIP) sampled catches from 2006 to 2009 as an objective measure of the stock of origin of chum and sockeye salmon caught by inshore commercial salmon fisheries of western Alaska utilizing GSI (Eggers et al. 2011). Stock compositions and stock-specific harvests and harvest rates were reported in 2012 (Dann et al. 2012a; Habicht et al. 2012a; Munro et al. 2012; Templin et al. 2012). However, the scope of the WASSIP project ended at the border of Chignik and Kodiak management areas. To the north, Cook Inlet Management Area has conducted genetic analysis of sockeye salmon harvest since

2005, but due to the terminal nature of the fishery does not analyze and report stock of origin for non-local salmon (Barclay et al. 2013). Genetic analysis of the sockeye salmon catch in the KMA commercial salmon fisheries has never been conducted. While the temporal presence of local and non-local sockeye salmon in all fishing areas of KMA has long been debated and scrutinized, feasible solutions to estimate such contributions with scientific merit have been absent until recently. In this modern era of Alaska salmon fisheries, where sustainability is the key, fishery managers and stakeholders understand the benefits of gaining this information. Such information could be invaluable for improving run reconstructions, brood tables, and refining management of KMA as well as the neighboring management areas of Chignik and Cook Inlet.

The following operational plan details implementation, sampling, and reporting of a project to collect genetic tissues from sockeye salmon of the commercial salmon fisheries of KMA in 2015 and 2016. Exact dates of these fisheries and proposed sampling of them vary depending on geographic area (Table 2). Results from the 2014 sampling season are presented in Table 3.

## **OBJECTIVES**

### **PRIMARY OBJECTIVES**

1. Collect genetic tissue (axillary process) from sockeye salmon caught in the major KMA fisheries over the 2015 and 2016 fishing seasons from June through August.
2. Select subsamples of genetic tissues in proportion to catch within designated areas and temporal strata.
3. Using GSI techniques, estimate stock proportions of sockeye salmon in the KMA strata using reporting groups defined herein.

### **OVERVIEW**

The principal objective of this effort is to sample the major sockeye salmon commercial fisheries in marine waters of KMA (Table 2, Figure 1) where significant catches of salmon occur. Overall, there will be three general temporal strata for GSI (early, middle, and late). The early stratum coincides with the commercial fisheries targeting early-run sockeye salmon. The middle stratum coincides with the commercial fisheries targeting early-run sockeye and/or pink and chum salmon. The late stratum coincides with the commercial fisheries targeting late-run sockeye and/or pink and chum salmon (Table 2). Designated sampling areas encompass districts or partial districts as outlined in the fishery description below and are based on geographic location, harvest magnitude, and management discreteness, with consideration given to port delivery location.

Collection of all sockeye salmon samples will follow the bulk sampling procedures outlined in Appendix A. The axillary process will be removed from each fish sampled during a sampling event and placed in a common container with ethanol for each sampling stratum.

### **FISHERY DESCRIPTION**

#### **Northwest (NW) Kodiak District**

Two sampling areas were designated in the NW Kodiak District (Table 2, Figure 2). Both purse seine and set gillnet gear can be used in the majority of this district and it historically represents the largest sockeye salmon harvests in KMA. Uganik-Kupreanof is represented by commercial

harvest from Kupreanof Strait and Uganik, Viekoda, and Terror bays and is dominated by gillnet effort. Uyak Bay is small geographically but is the area with the largest sockeye salmon harvests in KMA, comprising large purse seine and gillnet harvests. For purposes of GSI, a representative sample of 400 tissues subsampled proportional to catch is targeted for the early, middle, and late strata (Table 2). Due to relatively low harvest magnitude, North Cape will not be sampled. Samples for Uganik-Kupreanof will be collected in Kodiak. Samples for Uyak Bay will be collected in Larsen Bay.

### **Afognak District**

No sampling areas were designated in the Afognak District due to lower harvest magnitudes spread out over a large geographic area in addition to little active sockeye salmon management (Table 2; Figure 3).

### **Eastside and Northeast (NE) Kodiak districts**

No sampling areas were designated in the Eastside and NE Kodiak districts due to lower harvest magnitudes spread out over a large geographic area in addition to little active sockeye salmon management (Table 2; Figures 2 and 4).

### **Alitak District**

One sampling area was designated in the Alitak District (Table 2; Figure 4). Both purse seine and set gillnet gear can be used in this district but are segregated by sections within the district. Cape Alitak/Humpy-Deadman is represented by harvest in the outside Cape Alitak and inside Humpy-Deadman purse seine sections. No sampling was designated in Moser/Olga (gillnet areas) due to the terminal nature of this fishery (Table 2; Figure 4). For purposes of GSI, a representative sample of 400 tissues subsampled proportional to catch is targeted for the early, middle, and late strata (Table 2). Samples from Alitak District will be collected in Alitak.

### **Southwest (SW) Kodiak District**

Two sampling areas were designated in the SW Kodiak District (Figure 5). Only purse seine gear can be used in this district that contains fishing sections terminal to Karluk and Ayakulik, the two largest sockeye salmon systems in KMA. For purposes of GSI, a representative sample of 400 tissues subsampled proportional to catch is targeted for the early, middle, and late strata (Table 2). Samples for Karluk/Sturgeon area will be collected in Larsen Bay. Rocky Point, which lies on the border of Outer Karluk Section and is a popular fishing location, will be treated as Karluk/Sturgeon even when given the 254-10 statistical area designation on a fish ticket. Samples for the Ayakulik/Halibut area will be collected in Alitak.

### **Mainland District**

One sampling area was designated in the Mainland District (Figure 5). Cape Igvak Section is a purse seine-only area that is tied by regulation to an allocation based on harvest of Chignik River sockeye salmon. For purposes of GSI, a representative sample of 400 tissues subsampled proportional to catch is targeted for the early and middle strata (Table 2). The late stratum will not be sampled because the vast majority of sockeye salmon harvest in this area occurs in June and July. Due to low harvest magnitude, the remainder of the Mainland District will not be targeted. Samples for Cape Igvak Section will be collected in Larsen Bay.

## **STUDY DESIGN**

Tissues to determine stock of origin will be collected through temporally stratified sampling of the commercial harvest of sockeye salmon throughout KMA from 2014 to 2016. Due to the protracted nature of the fishery (June–September) temporal strata will be broad and fishing areas will be grouped into units typically tendered to the same processing plants. Catch samplers will sample commercial harvests at processing facilities located at the major Kodiak fish processing ports: Kodiak, Larsen Bay, and Alitak (Figure 1). Sampling will, at times, be conducted in conjunction with other regional salmon sampling programs (sockeye scale and Chinook salmon genetics). Daily catch reports will be monitored by project biologists as daily sampling objectives will be tied directly to harvest magnitude. The catch from each area stratum will be sampled at a level sufficient to construct the GSI sample for the time and area strata which will likely be double that of the analysis sample sizes listed in Table 2. Since the potential exists for only having mixed loads from multiple catch areas available, the directive will be to sample these loads when discrete samples from targeted areas are not likely to be obtained. The areas that fish were caught and an estimate of other relative proportions will be documented.

The GSI tissue samples for laboratory analysis will be selected from the available harvest samples post-season by subsampling within strata proportional to the daily catches of the respective strata. A random sample proportional to the catch from fishing periods within a GSI stratum will be constructed for each area and time stratum (Table 2). This ensures that the stock compositions estimated from the GSI analysis are representative of the catch in the strata. Sampling proportional to catch does come with caveats since it entails not only tracking daily harvest but projecting harvest throughout the stratum and oversampling to facilitate post-season subsampling. In post-season sample selection, some samples will be excluded from analysis to most closely approximate the daily catch proportions of a stratum's harvest.

## **TISSUE AND DATA COLLECTION**

The samplers will obtain fish ticket information before collecting samples to determine if the fish were exclusively harvested from the area and timeframe designated to be sampled. If fish ticket data are not available, the processing facility dock foreman or tender operator will be interviewed. Once fish ticket information becomes available, the origin of the catch will be confirmed. It is important to sample without regard to size, so fish will be randomly selected.

Tissue samples will be collected from all fish selected for sampling (Appendix A). The axillary process will be collected from the left side of the fish and placed in 125 ml or 250 ml polyethylene bottle containing ethanol following the procedures outlined in Appendices A1 and A2. All sample information will be recorded on the sockeye Genetics Sampling Form (Appendix A3). Each container will hold samples from a single sampling event.

## **DATA ANALYSIS**

### **Genetic Analysis**

GSI will be accomplished using mixed stock analysis (MSA) by the ADF&G Gene Conservation Laboratory following standardized procedures similar to those described by Dann et al. (2012a). Genomic DNA will be extracted from tissue samples using a DNeasy® 96 Tissue Kit by QIAGEN® (Valencia, CA). DNA will be screened for 96 SNP (single nucleotide polymorphism) markers using a Fluidigm® platform. If necessary, SNPs may be rescreened on an Applied

Biosystems® platform as a backup method for assaying genotypes. Approximately 8% of individuals analyzed for this project will be re-extracted and genotyped as a quality control measure to identify laboratory errors and to measure the background discrepancy rate of the genotyping process. Genotypes will be imported and archived in the Gene Conservation Laboratory Oracle database, LOKI.

## **Mixed Stock Analysis**

Estimates of stock composition will be based on the most current genetic baseline representing spawning sockeye salmon from known origins throughout the Pacific Rim. Baseline development will follow procedures similar to Dann et al. (2012b). Collections that do not conform to Hardy-Weinberg Equilibrium (HWE) will be removed from the baseline and will not be used for MSA. Collections will be pooled when appropriate to obtain better estimates of allele frequencies. Each pair of nuclear SNPs in each population in the baseline will be tested for linkage disequilibrium and adjusted to ensure that analyses will be based on independent markers. If significant linkage disequilibrium is identified, either one of the linked SNPs will be removed or the pair will be combined into a composite, haploid marker, depending on the relative value of information the single or combined marker provide for MSA (e.g.,  $f_{ORCA}$ ; Rosenberg 2005).

### ***Defining reporting groups***

Stocks, in the context of MSA, are referred to as “reporting groups”. Reporting groups are made up of one or more populations that are geographically and/or temporally grouped. Management needs are used to establish initial reporting groups. These initial reporting groups are then subjected to guidelines that incorporate genetic distinctiveness, representation in the baseline, and expectations for the fishery mixture to come up with reporting groups appropriate for specific fishery mixtures (Habicht et al. 2012b). These guidelines include:

- *Adequate MSA performance.* Performance of the proposed reporting groups will be tested using proof tests as outlined in Dann et al. (2012b). ADF&G generally seeks to achieve minimum metrics for MSA performance of 90% correct allocation to reporting group.
- *Adequate numerical representation in the baseline.* Numbers of individuals available within reporting groups will be set at a minimum of 400 fish.
- *Adequate representation of within-reporting group genetic variation in the baseline.* Variation within reporting groups will be visualized using trees or multidimensional scaling (MDS) as outlined in Dann et al. (2012b). Verification that adequate representation is present in the baseline will be obtained from (1) people who have local knowledge that the abundant spawning aggregates are represented in the baseline, (2) the clustering of spawning aggregates on trees and MDS, and (3) the provision of acceptable results from proof tests as a surrogate for escapement tests.
- *Adequate expected number of fish from reporting groups in the mixture.* The minimum number of fish from a reporting group expected to occur within the mixture is 5%, or 20 fish.

Adequate MSA performance will be determined by assessing the identifiability of reporting groups using baseline evaluation tests. From previous genetic differentiation studies (Dann et al. 2012b) the following general area stock groupings outside KMA can be identified and will serve as the basis for that level of reporting in the study.

1. West of Chignik
2. Chignik Early
3. Chignik Late
4. Cook Inlet
5. Prince William Sound/Copper River
6. Southeast Alaska, British Columbia, Washington

The genetic baseline for KMA has recently been improved with the addition of many samples from the Karluk, Ayakulik, and adjacent areas and is still in development. Following a complete analysis we will attempt to identify the following local KMA stock groupings.

1. Karluk
2. Ayakulik
3. Upper Station/Akalura
4. Frazer
5. Saltery
6. Uganik
7. Afognak (Afognak, Portage, Thorsheim, Buskin, Louise)
8. Eastside Minor (Pasagshak, Ocean Beach, Little Kitoi, Miam)
9. Westside Minor ( Little River, Malina, Kafliia, Swikshak)

Recognizing the error caused by miss-assignment among genetically similar reporting groups and the potentially small sample sizes available, these reporting groups may be combined. Alternatively, while the sockeye salmon baseline for the Westward Region is currently in the process of being developed, every attempt will be made to genetically differentiate individual Westward Region stocks including Frazer Lake which is genetically similar to one of its historical brood sources, Ayakulik River (Red Lake). Another caveat is the migration of Spiridon Lake sockeye salmon whose brood stock and hence genetic structure are that of Saltery Lake sockeye salmon.

Only individuals with high-quality data will be included in MSA. Data quality control will include identifying and removing individuals missing >20% genotypic data, duplicate individuals, and non-sockeye salmon. Stock composition of the KMA commercial sockeye salmon fishery harvest for each stratum will be estimated using the software package BAYES (Pella and Masuda 2001). A series of independent Markov Chain Monte Carlo (MCMC) chains with different starting values for each population will be combined to form the posterior distribution. The analysis will tabulate summary statistics from these distributions to describe stock compositions, and apply stock proportions to the harvest each area-time stratum represents to provide estimates of stock-specific harvests.

***Estimating stock-specific harvest of sockeye salmon in the Kodiak Management Area***

Estimates of the stock-specific harvest of sockeye salmon will be estimated following Habicht et al. (2012a) by applying the stock specific composition proportions ( $p_{f,y}$ ) to the stratum harvest  $C_f$ .

$$C_{f,y} = p_{f,y}C_f \tag{1}$$

The estimate ( $\hat{C}_{f,y}$ ) and distribution of stock specific harvest for each reporting group ( $y$ ) and component fishery ( $f$ ) will be obtained by Monte Carlo simulation. Here,  $K = 100,000$

independent realizations of the reporting group-specific harvest ( $C_{f,y}^{(i)}$ ) drawn randomly from the joint distribution of the harvest ( $C_f^{(i)}$ ) and stock composition ( $p_{f,y}^{(i)}$ ) for each stratum

$$C_{f,y}^{(i)} = p_{f,y}^{(i)} C_f^{(i)} \quad (2)$$

$$\hat{C}_{f,y} = \text{median of the } K \text{ observations of } C_{f,y}^{(i)}. \quad (3)$$

Note that the 90% credibility interval (CI) will be determined by 5<sup>th</sup> and 95<sup>th</sup> quantiles of the K observations of  $C_{f,y}^{(i)}$ . The median, 90% CI, mean, SD and CV (coefficient of variation) of the stock specific harvests will be estimated directly from K observations of  $C_{f,y}^{(i)}$ .

Generation of stock-specific catch distributions requires an estimate of the distribution of each component. The distributions of the stock compositions ( $p_{f,y}^{(i)}$ ) will be the Bayesian posterior distributions of stock proportions from the mixed stock analysis described above. The lognormal probability distribution for the harvest ( $C_f^{(i)}$ ) from each stratum will be based upon fish ticket data.

## **SCHEDULE AND DELIVERABLES**

Sampling efforts will begin approximately June 1 and end approximately August 29 for the field seasons. Raw field data will be entered and final error checked by November 1 following sampling season. Sampling results will be reported on an annual basis in the KMA catch and escapement sampling results published in Fisheries Data Series reports the winter following seasonal sampling.

It is anticipated that samples collected from the 2014 and 2015 seasons will be analyzed in the laboratory during the winter of 2015–2016. This allows time for the baseline to be updated and reduces the number of samples to be analyzed the winter prior to final reporting. Samples collected from the 2016 season will be analyzed in the laboratory during the winter of 2016–2017. No results will be reported until a complete three years of sampling have been achieved. The schedule for laboratory analysis will be entirely dependent on identifying a funding source.

## **RESPONSIBILITIES**

M. Birch Foster, Fisheries Biologist III (sampling project leader)

Duties: This position is responsible for supervising all aspects of the overall project, including planning, budget, sample design, permits, and final reporting.

Tyler Dann, Fisheries Geneticist II (genetics project leader)

Duties: This position is responsible for supervising all aspects of the genetic analysis, including planning, budget, personnel, training, and final reporting.

David Barnard, Biometrician III

Duties: Provides input to and approves the sampling design. Reviews and provides biometric support for operational plan, data analysis, and final report.

Kevin Schaberg, Salmon Research Coordinator

Duties: This position is the Salmon Research Coordinator for Westward Region and provides program and budget planning oversight. Also reviews the operational plan, data analysis, and final report.

Bill Templin, Principal Geneticist

Duties: This position is the Principal Geneticist and provides program and budget planning oversight. Also reviews the operational plan, data analysis, and final report.

Michelle Wattum, Fisheries Biologist II (supervise sampling)

Duties: This position supervises field activities from June 1 through the end of the project. Responsible for training and deploying staff. Responsible for arranging logistics with field crew, adjusting personnel hours and schedules as appropriate to achieve objectives.

Molly McFarland, Fisheries Biologist I: Kodiak.

Duties: This position will act as crew leader of samplers in Kodiak, Alitak, and Larsen Bay. This position will conduct sampling at the ports of Kodiak and Larsen Bay when needed.

Laura Griffing and Chloe Ivanoff, Fish and Wildlife Technician IIIs: Kodiak.

Duties: These positions will conduct sampling at the ports of Kodiak and Larsen Bay when needed.

Rose Wallin and Michelle Canete, Fish and Wildlife Technician IIIs: Alitak and Larsen Bay.

Duties: These positions will conduct sampling at the ports of Alitak and Larsen Bay when needed.

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## **TABLES**

Table 1.–Kodiak Management Area commercial salmon harvest by species and year, 1970 through 2014.

| Year              | Species <sup>a</sup> |           |         |            |           | Total      |
|-------------------|----------------------|-----------|---------|------------|-----------|------------|
|                   | Chinook              | Sockeye   | Coho    | Pink       | Chum      |            |
| 1970              | 1,089                | 917,047   | 66,424  | 12,036,598 | 919,972   | 13,941,130 |
| 1971              | 920                  | 478,479   | 22,844  | 4,334,492  | 1,541,444 | 6,378,183  |
| 1972              | 1,300                | 222,408   | 16,587  | 2,478,064  | 1,163,426 | 3,881,785  |
| 1973              | 800                  | 167,341   | 3,573   | 511,708    | 317,921   | 1,001,343  |
| 1974              | 545                  | 418,761   | 13,631  | 2,647,244  | 249,294   | 3,329,475  |
| 1975              | 101                  | 136,418   | 23,659  | 2,942,801  | 84,431    | 3,187,410  |
| 1976              | 766                  | 641,484   | 23,714  | 11,077,992 | 740,495   | 12,484,451 |
| 1977              | 585                  | 623,468   | 27,920  | 6,252,405  | 1,072,313 | 7,976,691  |
| 1978              | 3,228                | 1,071,782 | 48,795  | 15,004,065 | 814,345   | 16,942,215 |
| 1979              | 1,907                | 630,756   | 140,629 | 11,285,809 | 358,336   | 12,417,437 |
| 1980              | 529                  | 651,394   | 139,154 | 17,290,615 | 1,075,557 | 19,157,249 |
| 1981              | 1,418                | 1,288,980 | 121,544 | 10,336,829 | 1,345,328 | 13,094,099 |
| 1982              | 1,214                | 1,203,787 | 344,823 | 8,089,780  | 1,262,587 | 10,902,191 |
| 1983              | 3,839                | 1,231,989 | 157,612 | 4,603,371  | 1,085,165 | 7,081,976  |
| 1984              | 4,657                | 1,950,639 | 229,524 | 10,844,293 | 649,092   | 13,678,205 |
| 1985              | 4,970                | 1,842,731 | 284,166 | 7,334,825  | 430,757   | 9,897,449  |
| 1986              | 4,381                | 3,188,046 | 168,690 | 11,807,727 | 1,134,372 | 16,303,216 |
| 1987              | 4,613                | 1,794,773 | 192,540 | 5,075,101  | 682,023   | 7,749,050  |
| 1988              | 22,374               | 2,699,014 | 303,298 | 14,559,038 | 1,426,410 | 19,010,134 |
| 1989 <sup>b</sup> | 106                  | 1,289,511 | 2,599   | 183,235    | 19,972    | 1,495,423  |
| 1990              | 18,808               | 5,248,400 | 293,819 | 5,983,812  | 577,750   | 12,122,589 |
| 1991              | 22,234               | 5,704,100 | 324,860 | 16,642,841 | 1,029,071 | 23,723,106 |
| 1992              | 24,299               | 4,167,871 | 280,085 | 3,310,644  | 679,559   | 8,462,458  |
| 1993              | 41,029               | 4,378,886 | 313,467 | 34,019,420 | 588,331   | 39,341,133 |
| 1994              | 22,576               | 2,877,999 | 296,311 | 8,162,564  | 738,856   | 12,098,306 |
| 1995              | 18,704               | 4,488,502 | 307,795 | 42,849,309 | 1,522,810 | 49,187,120 |
| 1996              | 13,071               | 4,970,362 | 201,836 | 3,486,930  | 543,751   | 9,215,950  |
| 1997              | 18,735               | 2,506,427 | 381,099 | 11,035,134 | 520,331   | 14,461,726 |
| 1998              | 17,349               | 3,623,712 | 425,152 | 22,062,465 | 316,115   | 26,444,793 |
| 1999              | 18,299               | 4,653,057 | 296,979 | 11,898,382 | 913,867   | 17,780,584 |
| 2000              | 12,293               | 2,906,441 | 333,052 | 9,927,397  | 1,194,448 | 14,373,631 |
| 2001              | 23,843               | 2,659,637 | 409,193 | 19,567,163 | 1,053,763 | 23,713,599 |
| 2002              | 19,320               | 1,831,014 | 503,615 | 18,328,638 | 650,178   | 21,332,765 |
| 2003              | 18,603               | 4,053,847 | 351,767 | 14,067,235 | 1,151,885 | 19,643,337 |
| 2004              | 28,907               | 4,169,565 | 490,161 | 21,440,905 | 1,121,873 | 27,251,411 |
| 2005              | 14,465               | 3,052,048 | 396,841 | 30,143,647 | 477,435   | 34,084,436 |
| 2006              | 20,383               | 1,585,630 | 556,310 | 31,694,492 | 1,082,132 | 34,938,947 |
| 2007              | 17,248               | 2,014,141 | 356,583 | 24,811,459 | 728,920   | 27,928,351 |
| 2008              | 17,252               | 1,821,629 | 301,460 | 8,788,476  | 908,030   | 11,836,847 |
| 2009              | 7,268                | 1,727,776 | 291,470 | 27,649,826 | 955,814   | 30,632,154 |
| 2010              | 14,710               | 1,439,535 | 269,407 | 8,871,063  | 734,901   | 11,329,616 |
| 2011              | 18,615               | 2,269,302 | 190,483 | 16,648,792 | 824,562   | 19,951,754 |
| 2012              | 14,980               | 2,237,903 | 210,350 | 16,874,583 | 866,376   | 20,204,192 |
| 2013              | 34,620               | 2,577,209 | 269,921 | 28,197,885 | 795,123   | 31,874,758 |
| 2014              | 8,571                | 3,266,317 | 474,265 | 10,677,933 | 336,590   | 14,763,676 |
| Average           |                      |           |         |            |           |            |
| 2009–2013         | 18,039               | 2,050,345 | 246,326 | 19,648,430 | 835,355   | 22,798,495 |
| 2004–2013         | 18,845               | 2,289,474 | 333,299 | 21,512,113 | 849,517   | 25,003,247 |

<sup>a</sup> Harvest numbers include personal use with commercial gear and department test fisheries.

<sup>b</sup> Exxon Valdez oil spill.

Table 2.–Kodiak Management Area sockeye salmon genetic stock composition number to be analyzed by strata, 2015–2016. All harvest areas are included with 10-year average annual harvest for comparison of catch magnitude between sampled and non-sampled areas.

| District<br>Geographic Area        | District or Sections             | Primary<br>Sampling Site | Strata                |                         |                       | 2004 to 2013<br>Average Annual<br>Sockeye Salmon<br>Harvest |
|------------------------------------|----------------------------------|--------------------------|-----------------------|-------------------------|-----------------------|---|
|                                    |                                  |                          | (1) early<br>6/1-6/27 | (2) middle<br>6/28-7/25 | (3) late<br>7/26-8/29 |   |
| NW Kodiak District                 |                                  |                          |                       |                         |                       |   |
| Uganik-Kupreanof                   | 253                              | Kodiak                   | 400                   | 400                     | 400                   | 366,221   |
| Uyak Bay                           | 254                              | Larsen Bay               | 400                   | 400                     | 400                   | 416,768   |
| North Cape                         | 259-30 - 259-39                  | Kodiak                   |                       |                         |                       | 49,397  |
| Afognak District                   |                                  |                          |                       |                         |                       |   |
| SW and NW Afognak and Shuyak       | 251-10 - 251-90                  | Kodiak                   |                       |                         |                       | 112,359   |
| NE and SE Afognak and Duck Bay     | 252-10 - 252-39                  | Kodiak                   |                       |                         |                       | 94,540  |
| Eastside and NE Kodiak districts   |                                  |                          |                       |                         |                       |   |
| Sitkalidak/Two Headed/Seven Rivers | 258                              | Alitak                   |                       |                         |                       | 137,307   |
| NE Kodiak/Ugak                     | 259-10 - 259-27; 259-40 - 259-46 | Kodiak                   |                       |                         |                       | 26,532  |
| Alitak District                    |                                  |                          |                       |                         |                       |   |
| Cape Alitak/Humpy Deadman          | 257-10,20,50,60,70               | Alitak                   | 400                   | 400                     | 400                   | 172,015   |
| Moser/Olga                         | 257-40 - 257-43                  | Alitak                   |                       |                         |                       | 277,695   |
| SW Kodiak District                 |                                  |                          |                       |                         |                       |   |
| Karluk/Sturgeon                    | 255-10 - 255-20; 256-40          | Larsen Bay               | 400                   | 400                     | 400                   | 152,163   |
| Ayakulik/Halibut Bay               | 256-10 - 256-30                  | Larsen Bay/Alitak        | 400                   | 400                     | 400                   | 171,427   |
| Mainland District                  |                                  |                          |                       |                         |                       |   |
| North Shelikof                     | 262-10 - 262-55                  | Kodiak                   |                       |                         |                       | 51,034  |
| Katmai/Alinchak                    | 262-60 - 262-70                  | Kodiak                   |                       |                         |                       | 16,778  |
| Cape Igvak Section                 | 262-75 - 262-95                  | Larsen Bay               | 400                   | 400                     |                       | 227,257   |
| Total                              |                                  |                          | 2,400                 | 2,400                   | 2,000                 |   |

Notes: Numbers are for genetic analysis, actual number of samples collected will likely double the above to account for post season subsampling. Primary sampling site is the expected port that a geographic area will tend to be available for sampling.

Table 3.–Kodiak Management Area sockeye salmon genetic stock composition samples collected by strata, 2014.

| District<br>Geographic Area        | Primary<br>Sampling<br>Site | strata                |         |                         |         |                       |         |                            |         |
|------------------------------------|-----------------------------|-----------------------|---------|-------------------------|---------|-----------------------|---------|----------------------------|---------|
|                                    |                             | (1) early<br>6/1-6/27 |         | (2) middle<br>6/28-7/25 |         | (3) late<br>7/26-8/29 |         | post sampling<br>8/30-9/30 |         |
|                                    |                             | Harvest               | Samples | Harvest                 | Samples | Harvest               | Samples | Harvest                    | Samples |
| NW Kodiak District                 |                             |                       |         |                         |         |                       |         |                            |         |
| Uganik-Kupreanof                   | Kodiak                      | 79,494                | 1,400   | 128,836                 | 1,400   | 163,843               | 1,420   | 111,718                    | *       |
| Uyak Bay <sup>a</sup>              | Larsen Bay                  | 102,346               | 1,500   | 126,840                 | 1,400   | 155,658               | 1,400   | 139,213                    | *       |
| North Cape                         |                             | 15,591                | *       | 24,245                  | *       | 4,729                 | *       | 506                        | *       |
| Afognak District                   |                             |                       |         |                         |         |                       |         |                            |         |
| SW and NW Afognak and Shuyak       |                             | 30,446                | *       | 123,610                 | *       | 57,204                | *       | 35,984                     | *       |
| NE and SE Afognak and Duck Bay     |                             | 39,021                | *       | 28,108                  | *       | 44,098                | *       | 1,139                      | *       |
| Eastside and NE Kodiak districts   |                             |                       |         |                         |         |                       |         |                            |         |
| Sitkalidak/Two Headed/Seven Rivers |                             | 20,896                | *       | 77,880                  | *       | 2,026                 | *       | 2                          | *       |
| NE Kodiak/Ugak                     |                             | 3,105                 | *       | 12,280                  | *       | 615                   | *       | 2                          | *       |
| Alitak District                    |                             |                       |         |                         |         |                       |         |                            |         |
| Cape Alitak/Humpy Deadman          | Alitak                      | 0                     | 0       | 115,998                 | 1,100   | 5,437                 | 742     | 0                          | *       |
| Moser/Olga                         |                             | 18,509                | *       | 94,460                  | *       | 15,855                | *       | 4,258                      | *       |
| SW Kodiak District                 |                             |                       |         |                         |         |                       |         |                            |         |
| Karluk/Sturgeon <sup>b</sup>       | Larsen Bay                  | 56,018                | 1,092   | 68,438                  | 960     | 124,879               | 2,000   | 467,253                    | *       |
| Ayakulik/Halibut Bay <sup>b</sup>  | Alitak                      | 162,984               | 1,273   | 175,205                 | 600     | 57,066                | 1,050   | 15,672                     | *       |
| Mainland District                  |                             |                       |         |                         |         |                       |         |                            |         |
| North Shelikof                     |                             | 249                   | *       | 88,416                  | *       | 100,422               | *       | 0                          | *       |
| Katmai/Alinchak                    |                             | 0                     | *       | 54,463                  | *       | 288                   | *       | 0                          | *       |
| Cape Igvak Section                 | Alitak                      | 0                     | 0       | 0                       | 0       | 2,477                 | *       | 0                          | *       |
| Total                              |                             | 528,659               | 5,265   | 1,118,779               | 5,460   | 734,597               | 6,612   | 775,747                    |         |

Note: \* – Not included in sampling.

<sup>a</sup> Does not include Spiridon Bay Terminal Harvest Area

<sup>b</sup> Some samples contain mixes within SW Kodiak District.

## **FIGURES**

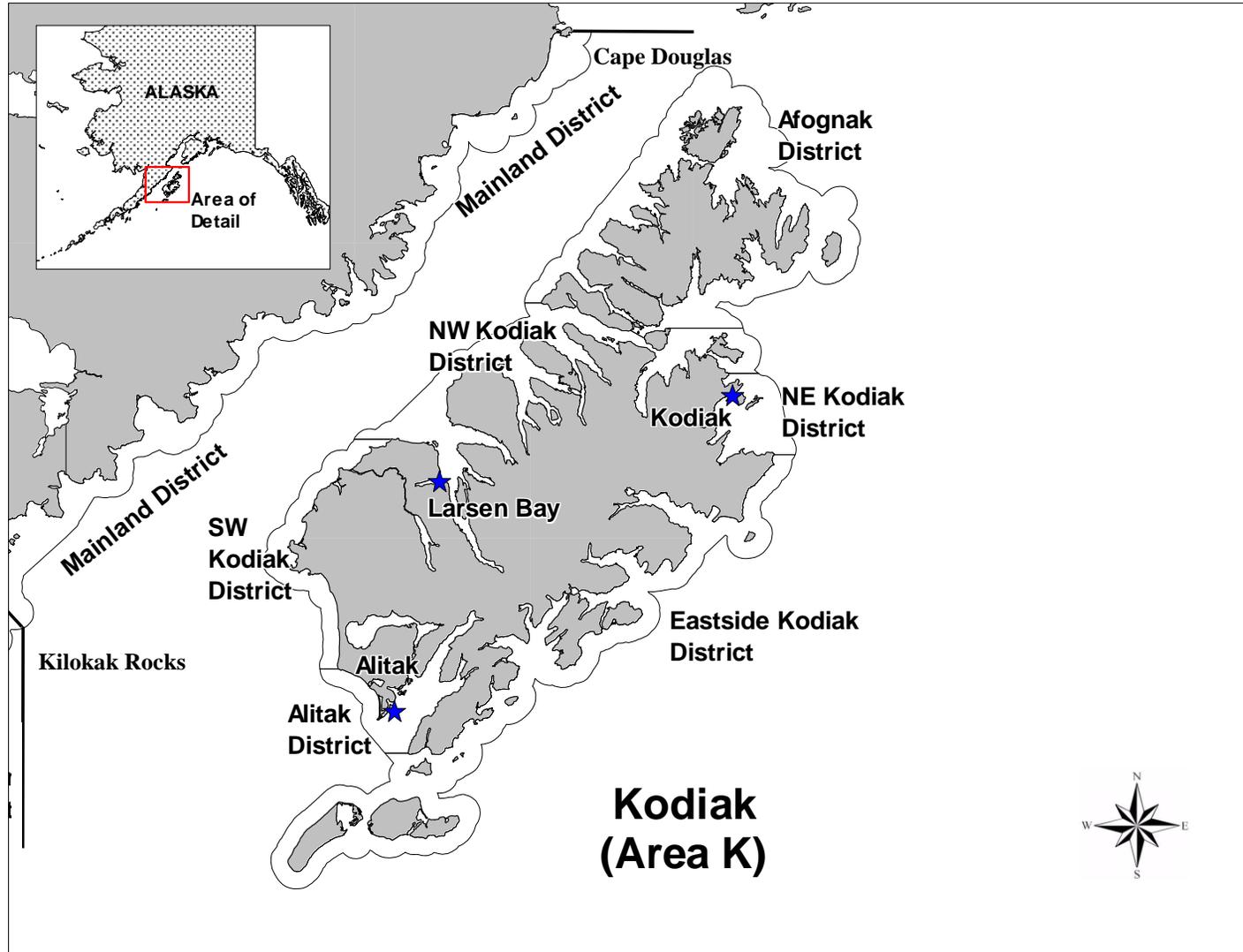


Figure 1.—Map depicting the commercial salmon fishery districts of Kodiak Management Area (Area K) and major processing facility locations (blue stars).

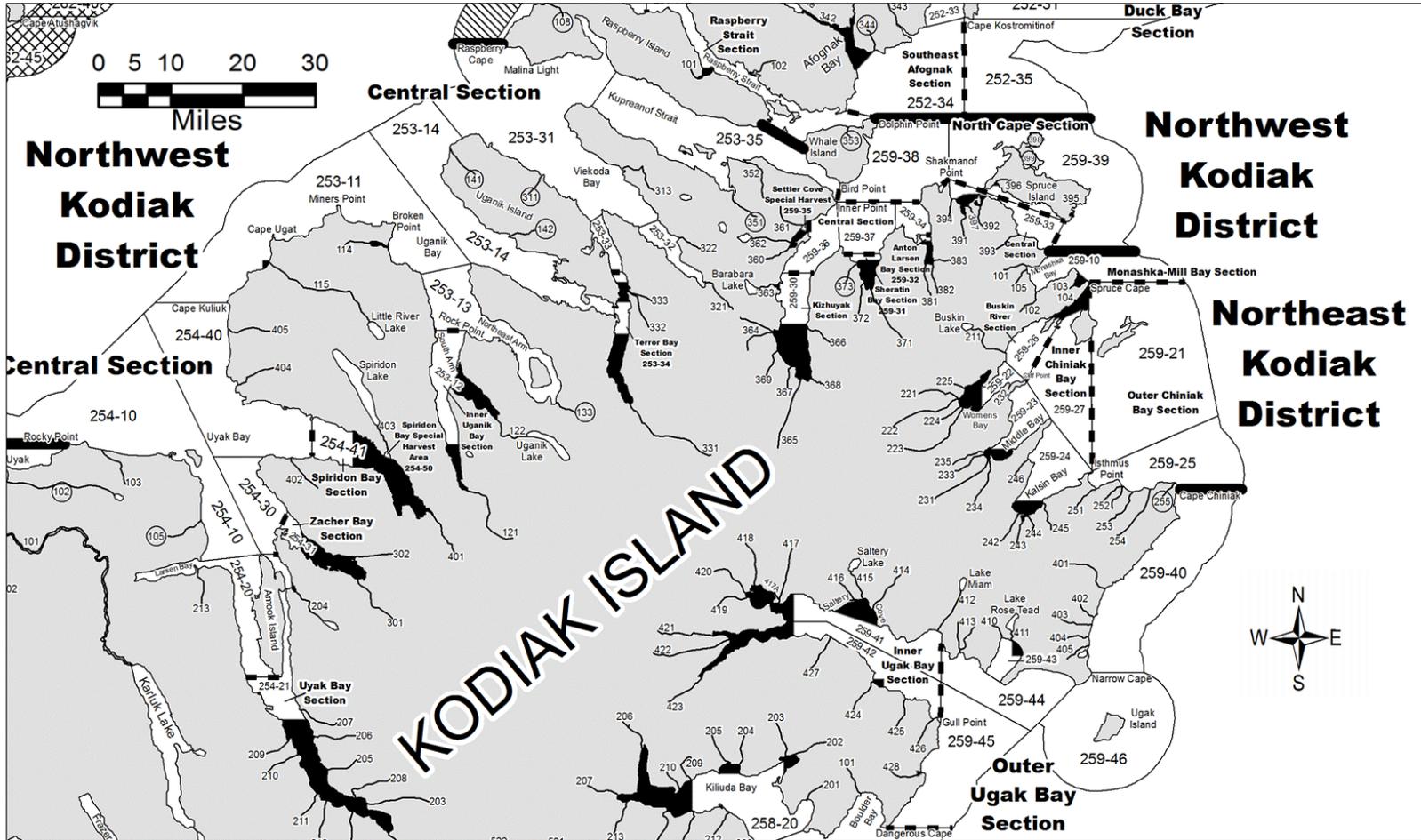


Figure 2.—Map depicting the Kodiak Management Area Northwest and Northeast Kodiak districts.

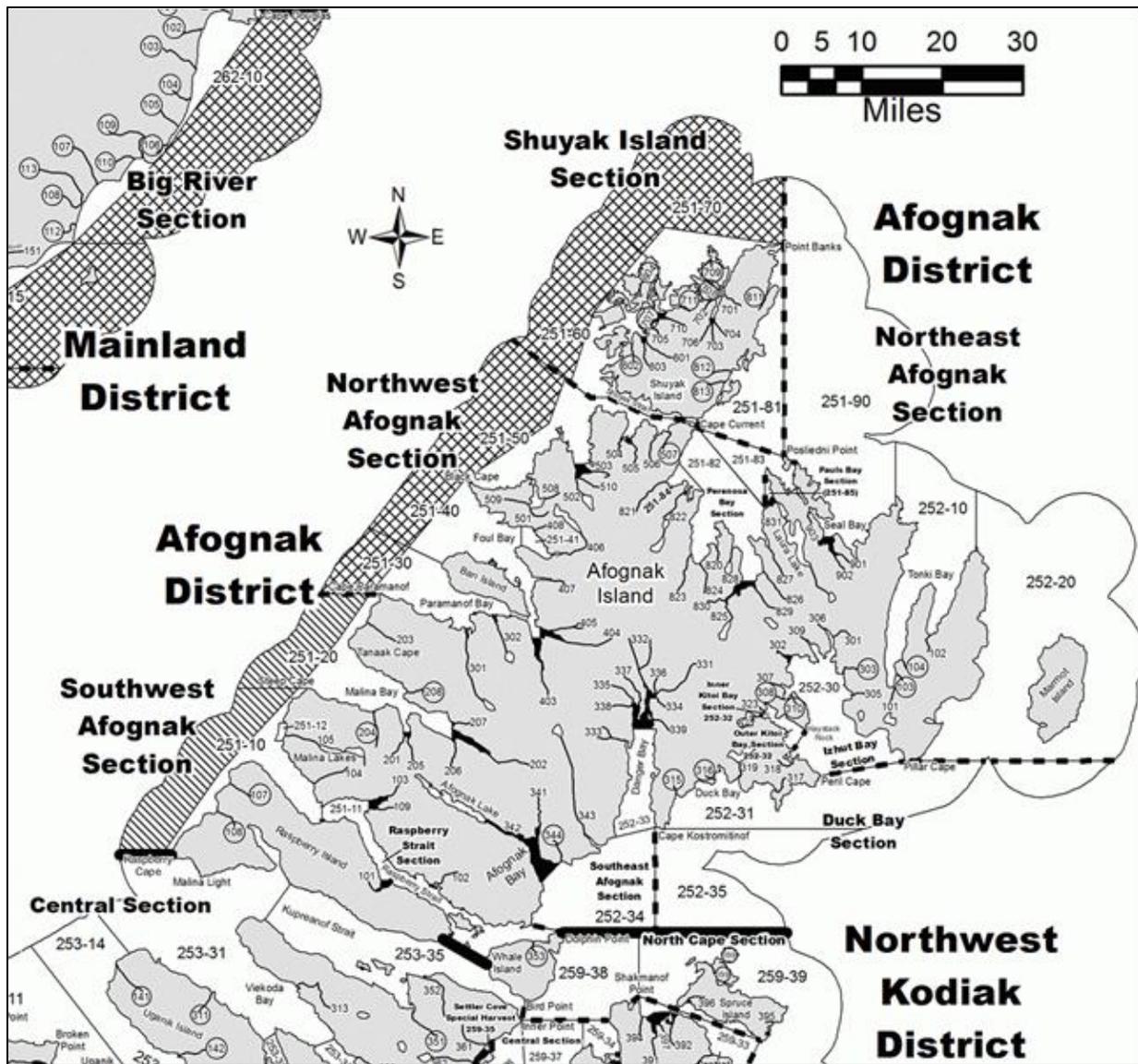


Figure 3.—Map depicting the Kodiak Management Area Afognak District.

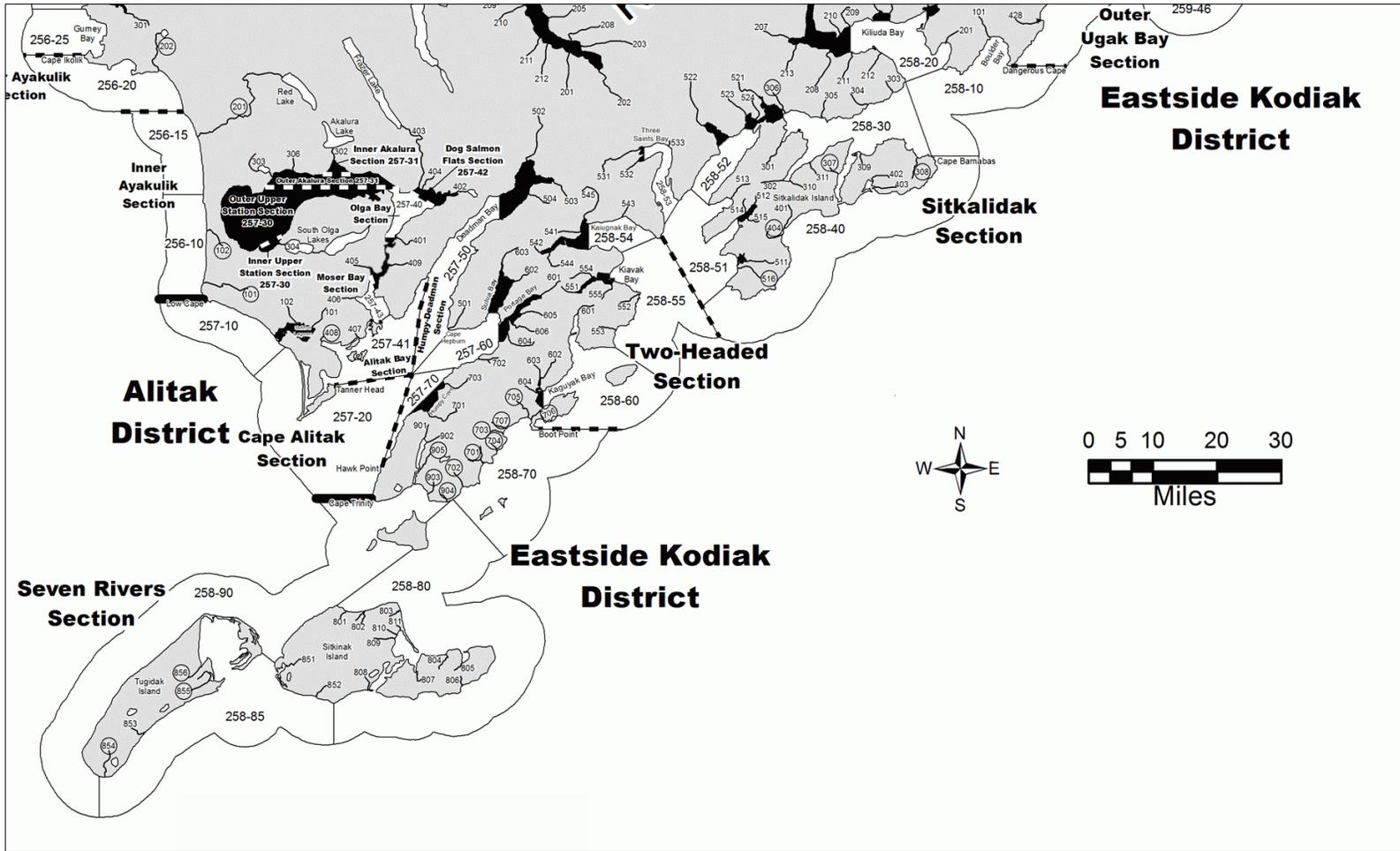


Figure 4.—Map depicting the Kodiak Management Area Alitak District and a portion of the Eastside Kodiak District.

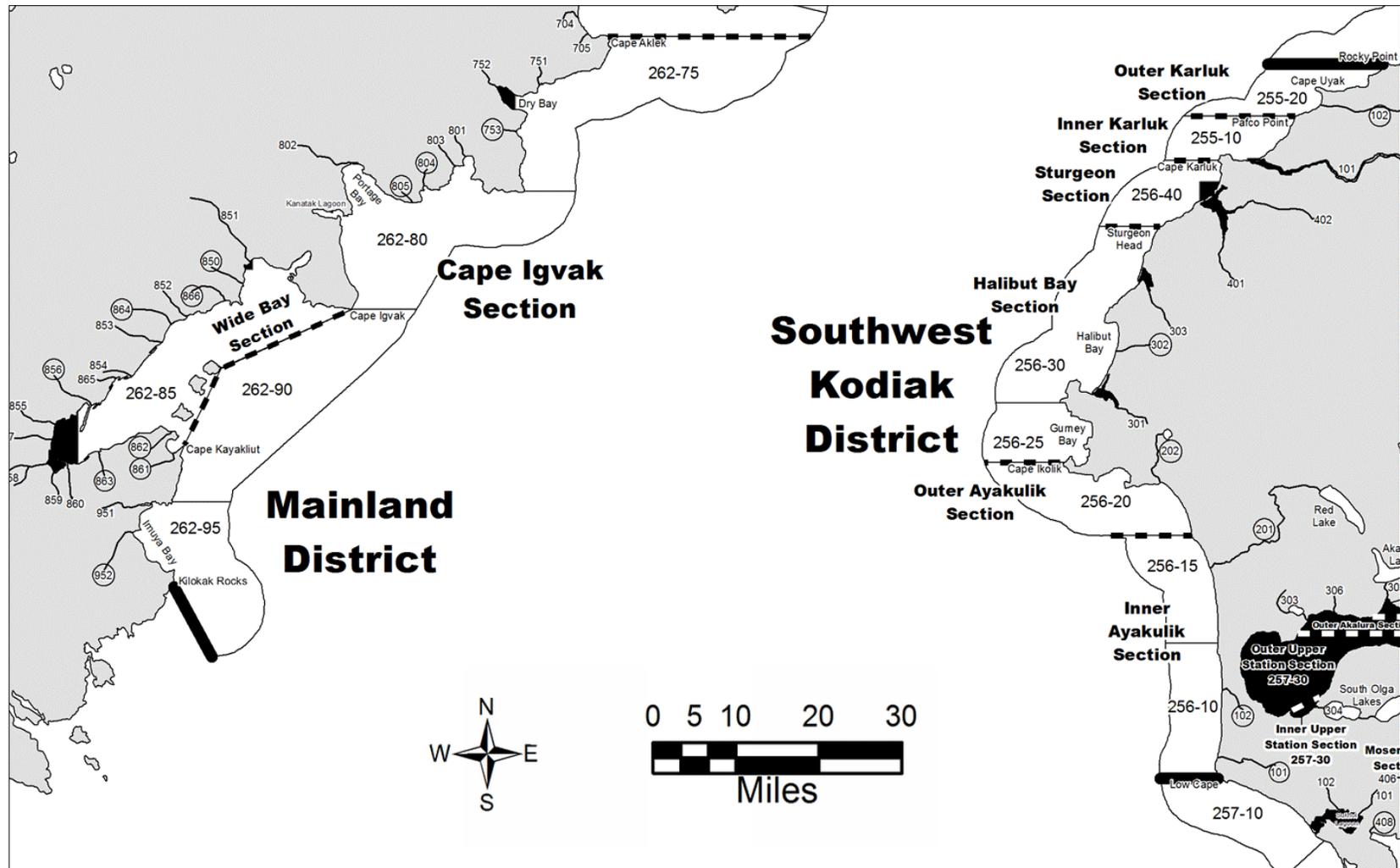


Figure 5.—Map depicting the Kodiak Management Area Southwest Kodiak District and Cape Igvak Section.

## **APPENDIX A. SOCKEYE SALMON GENETICS SAMPLING**

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Appendix A1.–Instructions for bulk sampling finfish tissues for DNA analysis.

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I. General Information

Axillary process tissue samples are collected from individual fish to determine the genetic characteristics and profile of a particular run, stock, or harvest of fish. When sampling the commercial harvest, tissues need to be as “fresh” and as cold as possible and recently moribund. The sample preservative is ethanol (ETOH) which preserves tissues for later DNA extraction without having to store frozen tissues. Avoid extended contact with skin. Each bottle will contain samples from a single stratum.

II. Sample procedure:

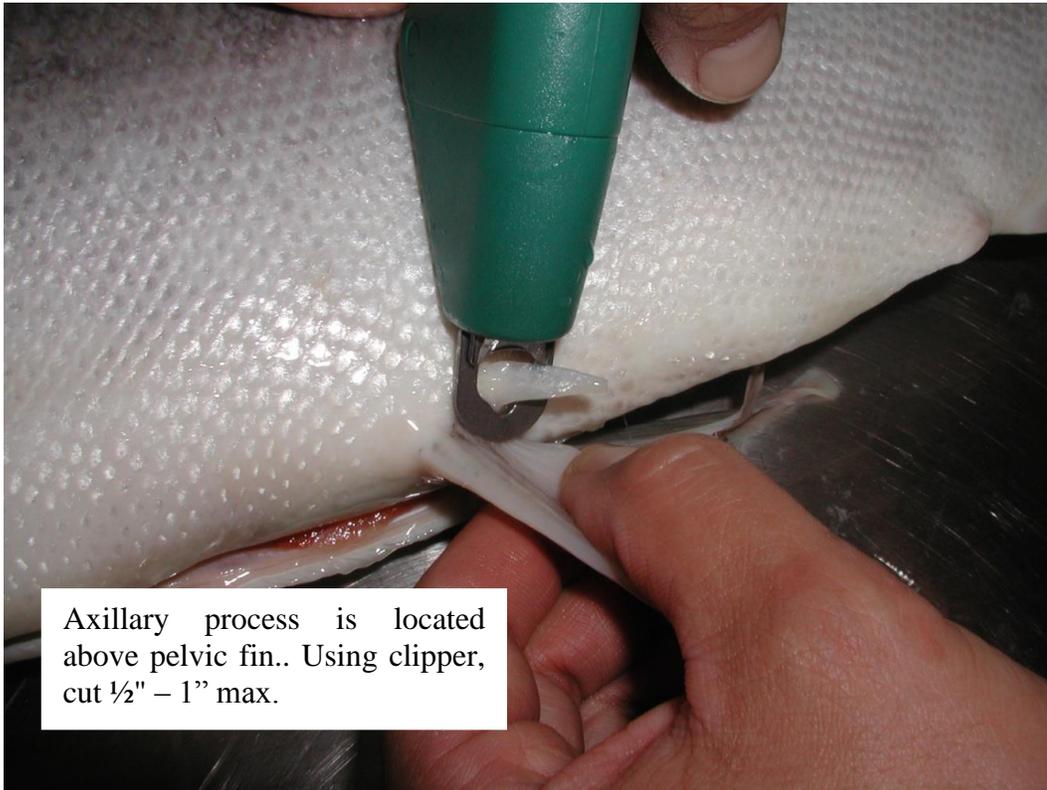
1. Wipe dry the axillary process “spine” prior to sampling to avoid getting excess water or fish slime into the 125 or 250 ml bottle (see diagram).
2. Clip off the whole axillary spine using dog nail clippers.
3. Place each tissue piece into bulk bottle (place only 1 piece of axillary from each fish).
4. Repeat: up to preferred sample size from individual sampling event (maximum storage capacity of 125 or 250 ml bottle is 100 or 200 fish respectively).
5. Record on each label: Location, sampling date (mm/dd/yyyy), sampler’s name(s), total number of fish sampled, latitude/longitude, and field notes (if any). Use pencil. This insures correct data with each collection bottle.

III. What to do after sampling:

1. Double check the sample forms with gum cards, cryovials and with the log book to ensure accuracy.
2. After the collection is complete and 24 hours have passed, “refresh” the axillary tissues as follows: carefully pour off  $\frac{3}{4}$  EtOH and then pour fresh EtOH into sample bottle containing axillary clips. Cap and invert bottle twice mixing EtOH and tissue. Freezing not required, store sample bottle in upright cool location for good tissue quality.
3. Return to ADF&G Anchorage lab following designated hazmat shipping protocol: ADF&G Genetics, 333 Raspberry Road, Anchorage AK 99518.

Appendix A2.–Procedure for clipping axillary process from sockeye salmon.

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Appendix A4.–Marine-phase salmon identification.

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**Chinook (king)**

- Mouth is dark with a black gum line
- Large, sharp teeth
- Spots on both lobes of tail
- Large spots on back



**Coho (silver)**

- Mouth is light with a white gum line
- Medium size, sharp teeth
- Spots only on upper lobe of tail
- Spots on back
- Wide caudal peduncle



**Pink (humpy)**

- Mouth is white with a black gum line.
- In marine areas, almost no teeth
- Large oval spots on both lobes of tail
- Large black spots on back
- Pointed lower jaw
- No silver on tail
- Very small scales



**Chum (dog)**

- Mouth is white with a white gum line
- Well developed teeth
- No spots on tail or back
- Calico markings (vertical bars) – faint on bright fish
- Narrow caudal peduncle
- White tip on anal fin



**Sockeye (red)**

- Mouth is white with a white gum line
- Almost toothless
- No spots on tail or back
- Large, bright gold, glassy eye



January 18, 2006

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-continued-

**Chinook**

**Jaw** – The chinook has a dark mouth and black gums at the base of its teeth. Immature chinook are known as a “blackmouth”

**Tail** – Both the upper and lower lobes of the tail are covered with spots and silver is prominent.



**Coho**

**Jaw** – The mouth is white and the gum line is almost white, but the tongue may be black. The teeth are sharp and strong.

**Tail** – The coho tail has just a few scattered spots, usually on the upper lobe, with silver streaks. It has a wide caudal peduncle.



**Pink**

**Jaw** – The mouth of a pink is white, but the gums and tongue are black, as they are in a chinook. It does not have “teeth” on its tongue.

**Tail** – The pink salmon tail is covered with large oval spots. It does not have silver on the tail. The scales are very small compared to other salmon of the same size.



**Chum**

**Jaw** – The mouth is white and the gum line is white, but the tongue may be black. The lips are fleshy with well developed teeth in both jaws, but there are no teeth on the base of the tongue.

**Tail** – The tail has no spots, but does have silver streaks covering about half of the fin. The caudal peduncle is narrow.



**Sockeye**

**Jaw** – The mouth is white and the gum line is white. The lips are fleshy. The teeth are small and well developed in both jaws. There are no teeth on the base of the tongue.

**Tail** – There are no spots on the tail.



*January 18, 2006*

Source: Washington State Department of Fish and Wildlife.

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