Regional Operational Plan CF.2A.2014.02

Operational Plan: Salmon Age, Sex, Size and Stock of Origin Sampling from Prince William Sound Area Fisheries and Escapements

by

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March 2014

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)

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

REGIONAL OPERATIONAL PLAN CF.2A.14.02

OPERATIONAL PLAN: SALMON AGE, SEX, SIZE AND STOCK OF ORIGIN SAMPLING FROM PRINCE WILLIAM SOUND AREA FISHERIES AND ESCAPEMENTS

by

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Alaska Department of Fish and Game
Division of Commercial Fisheries

March 2014

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Signature Page

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PURPOSE

This operational plan outlines the objectives, methods, and timeline of projects for which age, sex, size, stock of origin, and associated biological samples are collected from salmon in Prince William Sound Area fisheries and escapements. Salmon age, sex, size, and stock of origin data are used for building brood tables to establish and evaluate spawning escapement goals, forecast future salmon returns, assess inseason run strength, examine river productivity, analyze salmon growth and address other important fisheries management objectives described herein. In saltwater, salmon are sampled from commercial, hatchery cost recovery, hatchery broodstock, and ADF&G test fisheries. Sampling also occurs from spawning escapements, personal use, sport, and subsistence fisheries in freshwater systems that drain into the Prince William Sound Area. This operational plan does not include the sampling of salmon otoliths at fish processing facilities and fishing tenders—used to determine the origin of fish (hatchery vs. wild) harvested in commercial fisheries—which are covered in a separate operational plan.

BACKGROUND

DESCRIPTION OF THE AREA

The Prince William Sound (PWS) Area encompasses coastal waters and associated inland watersheds on the Gulf of Alaska between Cape Suckling on the east and Cape Fairfield on the west (5 AAC 24.100; Figures 1–3). This area includes the Bering River, Copper River, and Prince William Sound salmon management districts, and the freshwater systems that drain into these districts.

The Bering (200) and Copper River (212) districts are located between Hook Point on Hinchinbrook Island and Cape Suckling (Figure 2). These districts have historically been treated as a discrete management unit termed the Copper–Bering River (CBR) area and support a large commercial salmon fishery. Five species of Pacific salmon are present in the CBR area; however, the fishery primarily targets sockeye *Oncorhynchus nerka* and coho *O. kisutch* salmon. Chinook salmon *O. tshawytscha* are numerically less abundant, but because of their large size and generally high price, their monetary value to the fishery is high. Pink *O. gorbuscha* and chum *O. keta* salmon catches are less numerous and considered incidental in both districts. Although commercial catches constitute the majority of the salmon harvested in the CBR fishing districts, there is also a SOA-managed subsistence fishery in the Copper River District. Large personal use and subsistence fisheries also occur in the upper Copper River (UCR), which are managed by SOA (personal use and subsistence) and the federal government (subsistence) (Figure 3). Sport fisheries occur throughout the area.

The PWS Area also includes 9 salmon management districts located between Hook Point and Cape Fairfield that support large commercial salmon fisheries. For salmon management, the PWS districts are divided into the Eastern (221), Northern (222), Unakwik (229), Coghill (223), Northwestern (224), Eshamy (225), Southwestern (226), Montague (227), and Southeastern (228) districts (Figure 1). Targeted species in PWS commercial fisheries (in order of abundance) are pink, chum, sockeye, and coho salmon, with catches of Chinook salmon in the PWS considered incidental. Substantial increases in hatchery production since the late 1980s have increased commercial salmon catches in most districts and altered traditional fishing patterns and management strategies. Although commercial catches account for most of the salmon harvested in

PWS, sport fisheries in the area are growing. Harvests of salmon by subsistence fishermen are small relative to other areas of the state.

HISTORY OF SALMON SAMPLING IN PWS

Salmon age, sex, size, and stock of origin data alone or combined with abundance data are utilized in a variety of applications that are important for salmon management in the PWS area, including: setting spawning escapement goals, forecasting the number of salmon returning in future years, evaluating the inseason progress and magnitude of salmon runs and harvests and determining the destination of salmon harvested in fisheries.

Salmon scales and associated age, sex, and size data have been collected within PWS Area fisheries and escapements since prior to Alaska's statehood in 1959. ADF&G's scale archive and salmon databases in Cordova dates to the early 1960s and contains scales, acetate impressions of scales; and associated age, sex, and size data from 5 species of Pacific Salmon. Pink salmon are poorly represented in the archive due to their fixed life history; however, they are frequently sampled for sex ratio data, which is indicative of run timing. Sex ratio data from pink salmon commercial catches are used to make inseason estimates of the percent of total-return-to-date in PWS. Sex composition is estimated for PWS commercial catches on a weekly basis for common property commercial fisheries and approximately semiweekly for hatchery cost recovery fisheries. Sex ratio data are also frequently collected for coho salmon in the CBR area.

Scales and otoliths are the primary means for determining age in salmon, while various tissues are collected for stock of origin determination using genetic (fin clips or heart tissue) and visual (otolith and scales) techniques. For example, most hatchery fish released within the PWS Area are marked with thermal techniques or strontium chloride that can be detected by examining otoliths (Schroder et al. 2001; Volk et al. 2005). Scales patterns analysis has also been used to distinguish among upper Copper River, Copper River Delta, and Bering River stocks. In addition, scale patterns have been used to separate hatchery and wild sockeye salmon based on differences in growth as juveniles (Sharr 1983; Sharr and Goshert 1985); particularly to differentiate between Coghill Lake wild and Main Bay hatchery sockeye salmon. Finally, since the mid-2000s genetic samples have increasingly been collected from Chinook, sockeye, chum, and pink salmon during sampling for age, sex, and size data (Templin et al. 2008; Ackerman 2010; Templin et al. 2011; Jasper et al. 2013). In the future, genetic analyses may become a standard tool for determining the destination of salmon harvested within these mixed-stock fisheries.

In addition to being used inseason to actively manage fisheries, age, sex, size and stock of origin data are disseminated in publications utilized by managers, the public and the Alaska Board of Fisheries. Documents published from these data include annual management reports (Botz et al. 2013; Sheridan et al. 2013), pre-season forecasts (Moffitt and Brenner 2014), Board of Fisheries reports (Fair et al. 2011) and peer-reviewed manuscripts (Powers et al. 2007; Jasper et al. 2013).

OBJECTIVES

The following are objectives for sampling salmon in Area E fisheries and escapements during 2014:

1. Estimate CBR and PWS catches by age, length, and sex for each species, district, gear type, and temporal stratum. Sample sizes for individual strata will be sufficient to estimate age within 5 percentage points of the actual value 90% of the time;

2. Estimate the CBR and PWS sockeye and chum salmon escapements by age, length, and sex for each available temporal stratum. Sample sizes for individual strata will be sufficient to estimate age within 5 percentage points of the actual value 90% of the time;

3. Estimate Upper Copper River (UCR) personal use, subsistence, and sport-caught sockeye and Chinook salmon by age, length, and sex for each available temporal stratum. Sample sizes for individual strata will be sufficient to estimate age within 5 percentage points of the actual value 90% of the time. Data and biological tissues (scales or otoliths) are collected by ADF&G and National Park Service personnel;

4. Collect sex ratio data from pink and coho salmon commercial catches within commercial processing facilities to make inseason estimates of the percent of total-return-to-date. Sex composition will be estimated for CBR (coho salmon) and PWS (pink salmon) commercial catches on a weekly basis for common property commercial fisheries and approximately semiweekly for hatchery cost recovery fisheries (pink salmon only);

5. Collect genetic samples and scales from salmon as necessary to facilitate the determination of stock of origin.

METHODS

COLLECTION OF SCALES, SEX, SIZE, AND STOCK OF ORIGIN INFORMATION

Sampling to estimate age, sex, and size composition of PWS and CBR salmon catches and escapements will be based on stratified systematic sampling (Cochran 1977). Scales for determination of age will be collected and analyzed according to methods described by INPFC (1963), Clutter and Whitesel (1956) and as shown in Appendix A1. The preferred scale collection area on the fish develops scales first and thus represents the most complete record of growth. Scarred areas are avoided because scales in these areas are typically regenerated and unsuitable for aging. If scales are not present in the preferred area on the left side of the fish, scales from the right side will be used. Scales will be mounted on gum cards, which will be covered with wax paper after drying and placed in a press to keep from curling. Sex will be determined for individual fish either from examination of gonads, where possible, or from examination of external characteristics as in the case of live fish or commercially caught fish not available for internal inspection. Length will be measured in millimeters from the middle of the eye to the fork of the tail (MEF).

Current sample goals and stratification levels for sampling of age, sex, and size data from salmon catches and escapements in the CBR and PWS areas are the result of an ongoing process of review and revision. Sample sizes and sampling strata have increased dramatically since 1980. Initially, these increases provided improved detail for stock contribution studies of sockeye salmon in the Copper River area catch using scale pattern analysis. Sampling has since expanded to include Chinook, chum, and coho salmon. Development of suitable sample designs for these programs has required identification of temporal and spatial differences in age, sex, or stock composition;

construction of stratification schemes adequate to quantify those differences; and estimation of sample sizes needed to achieve desired levels of precision and accuracy.

Temporal changes in the age, sex, or stock composition of a population are area specific. In the absence of detailed historical data, intense sampling is needed to establish the presence of temporal or spatial entry patterns. As entry patterns are identified, the number of sampling strata within samples can be adjusted based on the following criteria:

1) The escapements of discrete spawning populations should be sampled separately and, unless there are no demonstrable differences in the age or stock composition among catches in management units within an area, those units should also be sampled separately.

2) The duration of the sampling effort should cover the time period when approximately 85% of the catch or escapement occurs.

3) The more rapidly the age or stock composition changes, the more strata that are necessary.

4) The duration of each temporal stratum should be such that the catch made or escapement passed is roughly the same for each stratum.

Adherence to these criteria should ensure representation of time and area specific trends in manageable portions of a population within an area. Additionally, it will minimize variance around estimates of age, sex, and stock composition.

Guidelines for sample sizes of stratified samples for CBR and PWS salmon populations with multiple age groups were previously established based on the number of possible groups to be represented in the sample (Table 1). Sample goals were selected so that sufficient numbers of age-able scales would be collected for each stratum to simultaneously estimate the proportion of each major age class in the catch within $\pm$ 5 percentage points of the true proportion 90% of the time based on the normal approximation of a binomial proportion (Goodman 1965; Cochran 1977). However, Thompson's (1987) work on the "worst case" parameter value for the multinomial distribution suggests that these goals may actually result in simultaneously estimating the true percentage of each age group within $\pm$ 5 percentage points over 95% of the time.

Whenever possible, historical data are used to help determine the optimum number of temporal and spatial strata. In the absence of prior knowledge of the typical age structure, the maximum possible number of age groups is assumed and sample sizes larger than necessary are accepted during the initial years of sampling. In succeeding years, as temporal and spatial trends become known, stratification and sample sizes may be revised using the criteria described above. In most cases, this review process has resulted in reductions to the number of strata sampled, and to a reduction of sample sizes in some cases.

Current sample size goals are based on: 1) the observed average proportion of usable scales collected for each species; 2) previously established goals designed to achieve minimum acceptable levels of precision and accuracy based on a normal approximation of binomial proportions; 3) accumulated information about spatial and temporal patterns in age, sex, and stock composition; and 4) estimates of precision and accuracy based on the multinomial proportion work of Thompson (1987). Basic sample size goals for sockeye (one scale/fish) and Chinook salmon (3–4 scales/fish) were set at 600 fish per stratum. A sample size of 450 fish/stratum is suggested for coho salmon (3 scales/fish) and 400 fish/stratum for chum salmon (one scale/fish). These sample goals represent a compromise designed to exceed stated minimum accuracy and precision levels

within the constraints of available personnel and financial resources. Inseason, sample goals may be reduced using the finite population correction factor (Table 1).

Genetic sampling of salmon will be directed by the ADF&G Gene Conservation Laboratory (GCL) in Anchorage. In recent years, most genetic tissue samples taken from Chinook, sockeye and chum salmon have consisted of the axillary process 'spine' of the pelvic fin collected either in bulk containers or individual vials and submerged in ethanol for preservation (e.g., Templin et al. 2011). Individual vials may be matched with corresponding ASL or other data (e.g., otolith thermal marks) and sampling may occur within processing facilities, weirs or spawning locations depending upon the project directives and protocols provided by the GCL.

SAMPLING COMMERCIAL SALMON CATCHES

Commercial fisheries of the CBR and PWS areas occur simultaneously and share a common tender fleet, making it difficult to obtain spatially discrete samples from shore-based facilities. During the first year of intensive sampling in the CBR area, spatially discrete samples were obtained by stationing samplers aboard tenders to ensure that samples were from discrete areas. This data collection technique solved the mixed catch problem but was labor intensive and prohibitively expensive. The following year, an ambitious shore-based radio-monitoring program was instituted to track movements of tender boats. Tender location assignments were collected from radio dispatchers at each fish processor in Cordova prior to every fishing period. Radio conversations between processors and their tender fleet were monitored during fishery openings and all tender activities were recorded in a log. During sampling, skippers of tenders selected for sampling were interviewed to validate their logged movements. This technique was used successfully from 1983 through 1987. Since 1987, fish tickets, processor listed tender locations, electronic vessel tracking, and interviews with tender captains have been used to determine sample locations. The shift to a mostly shore-based sampling program and the gradual refinement of sampling design enabled expansion of the catch sampling program to include other fisheries and species.

Due to budgetary considerations, the number of salmon measured for length and weight was reduced in 1987 to a 200 fish sub-sample per stratum (Tables 2–4). This sub-sampling of lengths and weights will be continued in 2014.

Copper and Bering River Area

Fisheries in the adjacent Copper River and Bering River districts often occur simultaneously and are directed at sockeye, Chinook, and coho salmon returning to drainages in the immediate area. Temporally stratified samples are collected for commercial catches of all 3 species in the Copper River District and from sockeye and coho salmon catches in the Bering River District.

The salmon catch sampling programs in the Copper River and Bering River districts are the oldest and most established in the area. Historical information for the area includes data from years when sampling was very highly stratified, resulting in a well refined sampling program with very few changes in the future. Sample size goals and stratification regimes for scales, sex, and size samples from Copper and Bering River district salmon catches are presented in Table 2.

In addition to the regular catch sampling for scales, sex, and size, we will continue a district and subdistrict-specific program to monitor changes in the sex composition of coho salmon catches through time. This study was initiated to examine the utility of using changes in sex composition inseason to estimate total percentage of harvest complete. The information gathered indicates a close relationship and may be useful as an inseason management tool to evaluate run timing.

Prince William Sound Area

Of 9 fishing districts in PWS, gillnetting is permitted in 4 districts and seining is permitted in 8 districts. Gillnet fisheries primarily target sockeye and chum salmon, but significant numbers of pink salmon are also harvested. Additionally, many Wally Noerenberg Hatchery (WNH) coho salmon are caught some years. Similarly, although purse seine fisheries target primarily pink and chum salmon, incidental interceptions of sockeye salmon are substantial in some years and may strongly affect Eshamy Lake runs. Stratified sampling is conducted for sockeye salmon catches in all PWS gillnet fisheries and in the purse seine fishery at large, as well as for chum salmon from all fisheries and districts (Tables 2–4). Fishing patterns in PWS have undergone substantial changes in the past 25 years as hatchery production has increased, hatchery release locations have been altered and management strategies have evolved in response. Thus, planned sampling efforts often require inseason and postseason adjustments.

Sockeye salmon catch sampling is temporally stratified for the Coghill and Unakwik districts drift gillnet fisheries, the Eshamy District drift and set gillnet fishery, and purse seine fisheries in all districts of PWS. The drift gillnet catch collections from the Coghill District were historically one of the more established and well-refined samples. Three temporal strata have been established to characterize the shift from older to younger age fish typically observed for this fishery throughout the season. In the 1990s, this catch sample was difficult to obtain due to fishery closures, low abundance, and substantial mixing with large catches of pink and chum salmon returning to WNH on Esther Island.

The Unakwik District fishery is directed at 2 small sockeye salmon stocks (Miners and Cowpen lakes) that have different migratory timing. The minimally stratified sample for this fishery is designed to reflect the contributions of these 2 stocks. Good samples have been collected from this fishery in past years in spite of small catches and mixing of tender loads with catches from other districts. The sample is of low priority due to the relatively small size of the fishery and the difficulty of obtaining discrete samples.

Sockeye salmon runs to the Eshamy District have been highly variable. Typically, wild runs have only supported terminal fisheries approximately one out of every 4 years in this district. Substantial runs to Main Bay Hatchery in 1991 through 1994 resulted in increased interceptions of local wild stocks, particularly the Coghill Lake stock. The Department conducted a 2-year (1992–1993) study to investigate the utility of using scale patterns to identify component stocks in Eshamy and Coghill districts catches during the early portion of the season when Coghill Lake stock interceptions are likely to occur. Scale samples were collected from temporally and spatially stratified test fishing and commercial catches in Eshamy District and the Esther Subdistrict of the Coghill District. Results of the 1992 and 1993 work indicated that interceptions of wild stocks occurred in all subdistricts of the Eshamy District, but were lowest in the Main Bay Subdistrict. In 1994 the study was stopped after 2 weeks due to low catches and poor escapement at the Coghill River weir. Scale patterns analysis continues to be used to distinguish between the Coghill Lake wild and Main Bay Hatchery sockeye salmon.

Scale sampling of Eshamy District catches will be temporally stratified into 8 strata: 4 early strata to characterize age composition changes in production from the Main Bay Hatchery and 4 later strata to characterize the natural production from Eshamy Lake (Table 3). In recent years this catch sample has been difficult to obtain due to fishery closures, low abundance, mixing of tender loads from several districts, and few deliveries to Cordova area processors.

District-specific temporally stratified chum salmon catch sampling was initiated in 1983 and was refined through experience with the fisheries. These samples now contribute valuable information to the refinement of run forecasts and may eventually lead to construction of brood tables by district. Samples collected for the Eastern, Northern, and Northwestern districts are designed to characterize the age structure of wild stocks in each area. Returns of hatchery produced chum salmon to WNH and the Port Chalmers subdistrict will be sampled weekly until we are confident that stratification can be reduced. Two time strata are intended for the Eshamy District, primarily to characterize age composition of local wild stocks. It is likely that these samples may include fish from WNH intercepted in this district. Sampling schemes for the Eshamy District will undergo revision as catches and hatchery production change.

The coho salmon catches in PWS are presently still considered incidental. However, hatchery production of coho salmon has increased substantially in the past 20 years. Harvests in the Eastern/Northern and Southwestern districts will be sampled at least once during the season. These samples are of low priority because they are primarily composed of hatchery fish of the same age, and they have to be sorted out of catches composed predominately of pink salmon.

In addition to the regular catch sampling for scales, sex, and size, we will also continue a district-specific program to monitor changes in the sex composition of pink salmon catches through time. A highly stratified sampling program for sex composition was conducted for PWS fisheries during the 1985 season. This study was initiated to examine the utility of using changes in sex composition inseason to estimate total-return-to-date. The information gathered indicated a close relationship and may be useful as an inseason management tool to evaluate run timing (Appendix A2).

These studies will be continued in 2014–2016, with particular emphasis on collecting data from returns to the 4 pink salmon-producing hatcheries of PWS. Sex ratio sample sizes for strata will be 3 repetitions of 300 fish each from any tender load sampled (900 total). These should be collected preferably in the early, middle, and late portions of processing the tender load. In general, stratification of samples will be weekly for all commercial harvests sampled, and semiweekly for all hatchery cost recovery harvests sampled.

It was apparent from the results of 1985 that some districts may need to be stratified by subdistrict, particularly the Eastern District where the wild stocks from large discrete areas such as Port Gravina and Port Fidalgo appear to have different migratory timing. We will continue to track subdistrict capture information whenever possible.

In conjunction with sex ratio sampling, we will gather information about the average size of pink salmon in PWS catches. Sample goals and stratification will be 200 fish biweekly for length and weight from Eastern District, Northern District (Unakwik Inlet), Esther Subdistrict, and Southwestern District catches. These samples will target primarily hatchery returns in each of these areas.

SAMPLING SUBSISTENCE AND PERSONAL USE CATCHES

The largest subsistence fishery in the CBR and PWS areas is located on the upper Copper River (Figure 3). Chinook and sockeye salmon samples from this fishery are used to represent age composition of the subsistence catches as well as the upper Copper River mixed stock escapement. Age, sex, and size samples are collected by ADF&G Sport Fish personnel stationed in Glennallen. The sampling schedule for the subsistence catches from the upper Copper River is summarized in

Table 2 and in the operational plan sampling Gulkana Hatchery salmon in the upper Copper River (Maclean 2013).

SAMPLING ESCAPEMENTS

Escapement sampling in the CBR and PWS areas is generally limited to sockeye salmon, with chum salmon also sampled from Olsen Bay Creek in the Eastern District (221) as part of a long-term monitoring project. Because of extensive resorption along the margins of scales collected from sockeye salmon in escapements, fish length will be used to determine marine age using methods described by Tesch (1970). Thus, length will be recorded for all fish sampled. In addition, otoliths are often collected from a few sockeye salmon at each escapement location to provide some known ages to match with lengths.

Copper & Bering River Area

Sampling plans for this area include the collection of samples from fifteen coastal sockeye salmon spawning areas of the Copper River delta and Bering River drainages. In addition to providing standard age composition data, these samples also provide scales and genetic tissues of known origin for possible stock composition estimates from the commercial catch in adjacent districts. Escapement sample collection was initiated in 1980 and expanded considerably by 1982. This sampling program has become generally well refined during the past 3 decades of sampling due to increased information about escapement timing and improved techniques to capture and sample live sockeye salmon.

Escapement samples will generally be a single stratum for each location due to the remoteness and relatively brief availability of each run (Table 5). Aerial survey counts at road accessible sampling sites, such as Eyak and McKinley lakes, will be monitored closely during the season and additional strata will be sampled if warranted.

Samples collected from subsistence fisheries near Chitina will be used to characterize age and sex composition of upper Copper River escapements. However, it is recognized that these samples do not represent minor stocks that spawn below the fishery nor do they adequately represent stocks from the Chitina River drainage, most notably the escapement to Long Lake. In recent years, local residents have voluntarily maintained a weir on this system; and some age, sex, size data has been collected.

Prince William Sound Area

Escapement sampling in PWS has traditionally been limited to samples collected from weirs at Eshamy and Coghill lakes, the 2 largest sockeye salmon systems in PWS. Samples were also collected at a weir installed on the outlet stream of Jackpot Lake from 1989 through 1991, and Sport Fish Division collected samples at Billy's Hole weir in 2003 and 2004. Other sockeye salmon escapement systems in PWS have been sampled only sporadically. Personnel will collect temporally stratified samples at the Coghill River weir (Table 5). Dates for sampling strata are approximations, with the first stratum beginning when counts at the weir exceed approximately 1500 sockeye salmon. Succeeding strata will be adjusted according to estimated run strength, tides and harvest intensity in the commercial fishery. Escapements to other systems such as Miners Lake, Shrode Lake, Billy's Hole, or Cowpen Lake will be sampled if funding and personnel are available.

DATA ANALYSIS

Data analyses for 2014 will include inseason estimation of age composition of Copper River Chinook and sockeye salmon catches; post season analysis of the age, sex, and size composition of all salmon catches and escapements sampled. Postseason stock composition estimates for Copper River sockeye salmon catches will be completed when the data become available from upriver harvests in the first few months of the year.

Age will be determined by examining scale growth patterns (Mosher 1968). European notation (Koo 1962) will be used to record ages: numerals preceding the decimal refer to the number of freshwater annuli and numerals following the decimal refer to the number of marine annuli. Total age from time of egg deposition, or brood year, is the sum of these two numbers plus one to account for incubation time.

Age and sex composition will be estimated as a series of proportions p_{ijt} defining a multinomial distribution for sockeye salmon. The marginal proportion will be estimated for each combination of age and sex along with estimates of the proportions' variance (Snedecor and Cochran 1967):

$$\hat{p}_{itj} = n_{ij}t / n_t \qquad (1)$$

$$Var(\hat{p}_{itj}) = \frac{p_{ij}t(1-\hat{p}_{itj})}{n_t - 1} \qquad (2)$$

where, n_t is the number in the t-th period sample and $n_{ij}t$ the number in the t-th period sample of age i sex j.

Standard error of length by age, sex, and period of fish sampled in the escapement will be calculated as

$$se(\bar{l}_{itj}) = \frac{1}{n_{ijt}} \sqrt{\frac{\sum_{k=1}^{n_{ijt}} (l_{ijtk} - \bar{l}_{ijt})^2}{n_{ijt} - 1}} \qquad (3)$$

where, $\bar{l}_{itj}$ = mean length for age i, sex j, and period t, l_{ijtk} = length of fish k of age i, sex j, and period t, n_{ijt} = number of fish of age i, sex j, and period t (e.g., Appendix A3).

SCHEDULE AND DELIVERABLES

With expansion of the database in recent years, we have begun to reduce duplication in reporting results and to pool similar types of data under fewer report covers. Beginning in 2014, 3 years of data will be compiled into one report (e.g. 2012–2014, 2015–2017, and 2018–2020).

Task	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec
Preseason planning and supply purchases	XXXX	XXXX				
Sample fisheries and escapements			XXXX	XXXX	XXXX	
Complete catch and escapement tables (except those involving UCR harvest)					XXXX	XXXX
Publish age, sex, size, catch and escapement data within Annual Management Report	XXXX					
Receive UCR harvest data and complete ADF&G Fishery Data Report		XXXX				

RESPONSIBILITIES

Personnel requirements for the CBR and PWS sampling and scale aging programs include one Research Project Leader (FB III), one Assistant Project Leader (FB II), one crew leader (FWT III), and 3 fish and wildlife technician II (FWT II). Additional personnel from ADF&G and NPS are required for sampling sockeye and Chinook salmon in UCR fisheries and escapements and are not included in this operational plan. The salmon stock composition reports will be authored jointly by the Research Project Leader and the Assistant Project Leader. The Assistant Project Leader will be responsible for producing tables and figures that go into annual management reports (Sheridan et al. 2013) and writing the salmon age, sex, and size data report.

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TABLES

Table 1.–ASL sample sizes for desired levels of accuracy and precision.

Sample size, n, from population, N, to simultaneously estimate age proportions, pi, of age categories, k, within a specified distance, d, of the true population age proportion, π_i, (1 - α)x100% of the time. The categories, k, at which the largest sample size is required is m. Assumptions:

1.) Random sampling

2.) Sample size large enough for normal approximation (>30). Thompson (1987; 1992)

α=0.10 (1- α)x100=90%(Specified accuracy) **d=0.05** (±5%) (Specified precision) The "worst case" **(n = 403)** occurs when m=3 and p_i=1/m (three age groups in equal proportions) without finite population correction.					**α=0.05** (1- α)x100=95%(Specified accuracy) **d=0.05** (±5%) (Specified precision) The "worst case" **(n = 510)** occurs when m=3 and p_i=1/m (three age groups in equal proportions) without finite population correction.				
Finite Population Size N	Finite Population Correction Sample Size n	Sample size with correction for regenerated scales			Finite Population Size N	Finite Population Correction Sample Size n	Sample size with correction for regenerated scales		
		10%	15%	20%			10%	15%	20%
1,000	287	316	330	345	1,000	338	372	388	405
2,000	335	369	386	402	2,000	406	447	467	488
3,000	355	391	409	426	3,000	436	479	501	523
4,000	366	403	421	439	4,000	452	498	520	543
5,000	373	410	429	448	5,000	463	509	532	555
6,000	378	415	434	453	6,000	470	517	541	564
7,000	381	419	438	457	7,000	475	523	547	570
8,000	384	422	441	460	8,000	479	527	551	575
9,000	386	424	444	463	9,000	483	531	555	579
10,000	387	426	445	465	10,000	485	534	558	582
11,000	389	428	447	467	11,000	487	536	561	585
12,000	390	429	448	468	12,000	489	538	563	587
13,000	391	430	450	469	13,000	491	540	564	589
14,000	392	431	450	470	14,000	492	541	566	590
15,000	392	432	451	471	15,000	493	543	567	592
16,000	393	432	452	472	16,000	494	544	568	593
17,000	394	433	453	472	17,000	495	545	569	594
18,000	394	434	453	473	18,000	496	546	570	595
19,000	395	434	454	474	19,000	497	546	571	596
20,000	395	435	454	474	20,000	497	547	572	597
40,000	399	439	459	479	40,000	504	554	579	604
60,000	400	440	460	480	60,000	506	556	582	607
80,000	401	441	461	481	80,000	507	557	583	608
100,000	401	442	462	482	100,000	507	558	584	609
120,000	402	442	462	482	120,000	508	559	584	609
140,000	402	442	462	482	140,000	508	559	584	610
160,000	402	442	462	482	160,000	508	559	585	610
180,000	402	442	462	483	180,000	509	559	585	610
200,000	402	442	463	483	200,000	509	560	585	610
220,000	402	442	463	483	220,000	509	560	585	611
240,000	402	443	463	483	240,000	509	560	585	611
260,000	402	443	463	483	260,000	509	560	585	611
400,000	403	443	463	483	400,000	509	560	586	611

Table 2.–Proposed sampling schedule for salmon harvested during subsistence, personal use, commercial and sport fisheries of the Copper and Bering River Districts and the Upper Copper River.

					Suggested Stratification				Sample Goal			
					Stat Week		Dates		Scale/Otoliths[a]			
Species	Dist.	Location	Gear[b]	Fishery	Begin	End	Begin	End	Stratum	Total	Lgth	Wt
Chinook	212	Copper River	DGN	Commercial	20		05/12	– 05/18	600	600	200	NA
Chinook	212	Copper River	DGN	Commercial	20		05/12	– 05/18	600	1,200	200	NA
Chinook	212	Copper River	DGN	Commercial	21		05/19	– 05/25	600	1,800	200	NA
Chinook	212	Copper River	DGN	Commercial	22	– 26	05/26	– 06/29	600	2,400	200	NA
Chinook	212	Upper Copper River [c]	HL,DN, FW	Sport/Sub/PU	24	– 30	06/09	07/27	600	600	200	NA
Sockeye	212	Copper River	DGN	Commercial	20		05/12	– 05/18	600	600	200	200
Sockeye	212	Copper River	DGN	Commercial	21		05/19	– 05/25	600	1,200	200	200
Sockeye	212	Copper River	DGN	Commercial	22		05/26	– 06/01	600	1,800	200	200
Sockeye	212	Copper River	DGN	Commercial	23		06/02	– 06/08	600	2,400	200	200
Sockeye	212	Copper River	DGN	Commercial	24		06/09	– 06/15	600	3,000	200	200
Sockeye	212	Copper River	DGN	Commercial	25		06/16	– 06/22	600	3,600	200	200
Sockeye	212	Copper River	DGN	Commercial	27		06/30	– 07/06	600	4,200	200	200
Sockeye	212	Copper River	DGN	Commercial	29		07/14	– 07/20	600	4,800	200	200
Sockeye	212	Copper River	DGN	Commercial	30	– 33	07/21	– 07/27	600	5,400	200	200
Sockeye	200	Bering River	DGN	Commercial	25	– 30	06/16	– 07/27	600	600	600	200
Sockeye	212	Upper Copper River [c]	DN, FW	Sub/PU	24	– 26	06/09	– 06/29	600	1,200	600	NA
Sockeye	212	Upper Copper River [c]	DN, FW	Sub/PU	26	– 28	06/23	– 07/13	600	1,800	600	NA
Sockeye	212	Upper Copper River [c]	DN, FW	Sub/PU	28	– 30	07/07	– 07/27	600	2,400	600	NA
Sockeye	212	Upper Copper River [c]	DN, FW	Sub/PU	30	– 33	07/21	– 08/17	600	3,000	600	NA
Coho	212	Copper River	DGN	Commercial	33	– 34	08/11	– 08/24	450	450	200	200
Coho	212	Copper River	DGN	Commercial	35	– 36	08/25	– 09/07	450	900	200	200
Coho	212	Copper River	DGN	Commercial	37	– 39	09/08	– 09/28	450	1,350	200	200
Coho	200	Bering River	DGN	Commercial	33	– 34	08/11	– 08/24	450	450	200	200
Coho	200	Bering River	DGN	Commercial	35	– 39	08/25	– 09/28	450	900	200	200

[a] Three or four scales per fish are collected from Chinook and coho salmon and one scale per fish from sockeye and chum salmon.

[b] DGN = Drift Gillnet; HL = Hook & Line; DN = Dipnet; FW = Fish Wheel

[c] Samples to be collected by ADF&G personnel from the Glennallen office: otoliths from sockeye and scales from Chinook.

Table 3.–Proposed sample schedule for scales, sex, length and weight from Prince William Sound sockeye salmon harvested in commercial common property fisheries, 2014.

					Suggested Stratification				Sample Goal			
					Stat Week		Dates		Ages			
Species	Dist.	Location	Gear[a]	Fishery	Begin	End	Begin	End	Stratum	Total	Lgth	Wt
Sockeye	229	Unakwik	DGN	Commercial	26	27	06/23	07/06	610		200	200
Sockeye	229	Unakwik	DGN	Commercial	28	28	07/07	07/13	610	1,220	200	200
Sockeye	223	Coghill	DGN / PS	Commercial	25	27	06/16	07/06	450		200	200
Sockeye	223	Coghill	DGN / PS	Commercial	26		06/23	06/29	450		200	200
Sockeye	223	Coghill	DGN / PS	Commercial	27		06/30	07/06	450		200	200
Sockeye	223	Coghill	DGN / PS	Commercial	28		07/07	07/13	450		200	200
Sockeye	223	Coghill	DGN / PS	Commercial	29	36	07/14	09/07	610	2,410	200	200
Sockeye	225	Eshamy	DGN & SGN	Commercial	26		06/23	06/29	450		200	200
Sockeye	225	Eshamy	DGN & SGN	Commercial	27		06/30	07/06	450		200	200
Sockeye	225	Eshamy	DGN & SGN	Commercial	28		07/07	07/13	450		200	200
Sockeye	225	Eshamy	DGN & SGN	Commercial	29		07/14	07/20	450		200	200
Sockeye	225	Eshamy	DGN & SGN	Commercial	30		07/21	07/27	610		200	200
Sockeye	225	Eshamy	DGN & SGN	Commercial	31	32	07/28	08/10	610		200	200
Sockeye	225	Eshamy	DGN & SGN	Commercial	33	34	08/11	08/24	610		200	200
Sockeye	225	Eshamy	DGN & SGN	Commercial	35	37	08/25	09/14	610	4,240	200	200
Sockeye	226	Southwestern	PS	Commercial	28	29	07/07	07/20	610		200	200
Sockeye	226	Southwestern	PS	Commercial	30	31	07/21	08/03	610		200	200
Sockeye	226	Southwestern	PS	Commercial	32	33	08/04	08/17	610	1,830	200	200

[a] DGN = Drift Gillnet, PS = Purse Seine, SGN = Set Gillnet

Table 4.–Proposed sample schedule of scales, sex, length and weight from Prince William Sound chum salmon harvested in commercial common property (Commercial) and hatchery cost recovery (HCR) fisheries, 2014.

					Suggested Stratification				Sample Goal			
					Stat Week		Dates		Ages			
Species	Dist.	Location	Gear[a]	Fishery	Begin	End	Begin	End	Stratum	Total	Lgth	Wt
Chum	221	Eastern	PS	Commercial	26	27	06/23	07/06	400		200	200
Chum	221	Eastern	PS	Commercial	28	29	07/07	07/20	400		200	200
Chum	221	Eastern	PS	Commercial	30	31	07/21	08/03	400		200	200
Chum	221	Eastern	PS	Commercial	32	34	08/04	08/24	400	1,600		
Chum	222	Northern	PS	Commercial	27		06/30	07/06	400		200	200
Chum	222	Northern	PS	Commercial	28	29	07/07	07/20	400		200	200
Chum	222	Northern	PS	Commercial	30	32	07/21	08/10	400	1,200	200	200
Chum	223	Coghill	DGN & PS	Commercial	23		06/02	06/08	400		200	200
Chum	223	Coghill	DGN & PS	Commercial	24		06/09	06/15	400		200	200
Chum	223	Coghill	DGN & PS	Commercial	25		06/16	06/22	400		200	200
Chum	223	Coghill	DGN & PS	Commercial	26		06/23	06/29	400		200	200
Chum	223	Coghill	DGN & PS	Commercial	27		06/30	07/06	400		200	200
Chum	223	Coghill	DGN & PS	Commercial	28	30	07/07	07/27	400	2,400	200	200
Chum	223-40	Esther (WNH)	PS	HCR	25		06/16	06/22	400		200	200
Chum	223-40	Esther (WNH)	PS	HCR	26		06/23	06/29	400		200	200
Chum	223-40	Esther (WNH)	PS	HCR	27		06/30	07/06	400		200	200
Chum	223-40	Esther (WNH)	PS	HCR	28		07/07	07/13	400		200	200
Chum	223-40	Esther (WNH)	PS	HCR	29		07/14	07/20	400		200	200
Chum	223-40	Esther (WNH)	PS	HCR	30		07/21	07/27	400		200	200
Chum	223-40	Esther (WNH)	PS	HCR	31		07/28	08/03	400		200	200
Chum	223-40	Esther (WNH)	PS	HCR	32		08/04	08/10	400	3,200	200	200

[a] PS = Purse Seine, DGN = Drift Gillnet

Table 4 continued.–Proposed sample schedule of scales, sex, length and weight from Prince William Sound chum salmon harvested in commercial common property (Commercial) and hatchery cost recovery (HCR) fisheries, 2014.

					Suggested Stratification				Sample Goal			
					Stat Week		Dates		Ages			
Species	Dist.	Location	Gear[a]	Fishery	Begin	End	Begin	End	Stratum	Total	Lgth	Wt
Chum	225	Eshamy	DGN & SGN	Commercial	28		07/07	– 07/13	400		200	200
Chum	225	Eshamy	DGN & SGN	Commercial	29		07/14	– 07/20	400	800	200	200
Chum	226	Southwestern	PS	Commercial	29	– 30	07/14	– 07/27	400		200	200
Chum	226	Southwestern	PS	Commercial	31	– 32	07/28	– 08/10	400		200	200
Chum	226	Southwestern	PS	Commercial	33	– 34	08/11	– 08/24	400	1,200	200	200
Chum	227	Montague (P.Chalmers)	PS	Commercial	25		06/16	– 06/22	400		200	200
Chum	227	Montague (P.Chalmers)	PS	Commercial	26		06/23	– 06/29	400		200	200
Chum	227	Montague (P.Chalmers)	PS	Commercial	27		06/30	– 07/06	400		200	200
Chum	227	Montague (P.Chalmers)	PS	Commercial	28		07/07	– 07/13	400		200	200
Chum	227	Montague (P.Chalmers)	PS	Commercial	29		07/14	– 07/20	400	2,000	200	200
Chum	228	Southeastern	PS	Commercial	29		07/14	– 07/20	400		200	200
Chum	228	Southeastern	PS	Commercial	30	– 31	07/21	– 08/03	400		200	200
Chum	228	Southeastern	PS	Commercial	32	– 34	08/04	– 08/24	400	1,200	200	200

[a] DGN = Drift Gillnet, SGN = Set Gillnet, PS = Purse Seine

Table 5.–Proposed sample schedule of scales, sex and length from Prince William Sound Area sockeye salmon escapements, 2014.

Species	Location	Gear	Stratification/ Approximate Run Timing	Suggested Sample Size
	COPPER RIVER			
Sockeye	Eyak Lake - South Beaches	Beach Seine	06/15 – 07/30	600 – 800
Sockeye	Eyak Lake - Middle Arm	Beach Seine	06/01 – 06/30	600 – 800
Sockeye	Eyak Lake - Middle Arm	Beach Seine	07/01 – 07/31	600 – 800
Sockeye	Eyak Lake - Middle Arm	Beach Seine	08/15 – 08/31	600 – 800
Sockeye	Eyak Lake - Hatchery Ck	Beach Seine	06/15 – 07/31	600 – 800
Sockeye	Eyak Lake - Hatchery Ck	Beach Seine	08/01 – 09/30	600 – 800
Sockeye	Salmon Creek	Beach Seine	07/01 – 08/15	600 – 800
Sockeye	27-Mile Slough	Beach Seine	06/15 – 07/31	600 – 800
Sockeye	Martin Lake	Beach Seine	06/15 – 07/31	600 – 800
Sockeye	Tokun Lake	Beach Seine	06/15 – 07/15	600 – 800
Sockeye	Martin River Slough	Beach Seine	06/15 – 07/15	600 – 800
Sockeye	39-Mile Creek	Beach Seine	07/15 – 08/15	600 – 800
Sockeye	Long Lake	Weir [a]	08/01 – 03/01	600 – 800
Sockeye	Tanada Weir	Weir [a]	08/01 – 12/31	600 – 800
	BERING RIVER			
Sockeye	Bering Lake / Dick Creek	Beach Seine	07/01 – 08/15	600 – 800
Sockeye	Kushtaka Lake	Beach Seine	07/15 – 08/31	600 – 800
	PRINCE WILLIAM SOUND			
Sockeye	Eshamy	Weir [b]	07/01 – 07/15	540
Sockeye	Eshamy	Weir [b]	07/15 – 07/31	540
Sockeye	Eshamy	Weir [b]	08/01 – 08/15	540
Sockeye	Coghill	Weir [b]	06/15 – 07/31	540
Sockeye	Coghill	Weir [b]	07/01 – 07/15	540
Sockeye	Coghill	Weir [b]	07/15 – 07/31	540

[a] Samples collected by NPS weir personnel.

[b] Samples collected by ADF&G weir personnel.

FIGURES

Figure 1.–Map of the Prince William Sound Area with arrows indicating escapement sampling locations for PWS. Districts numbers are shown in red.

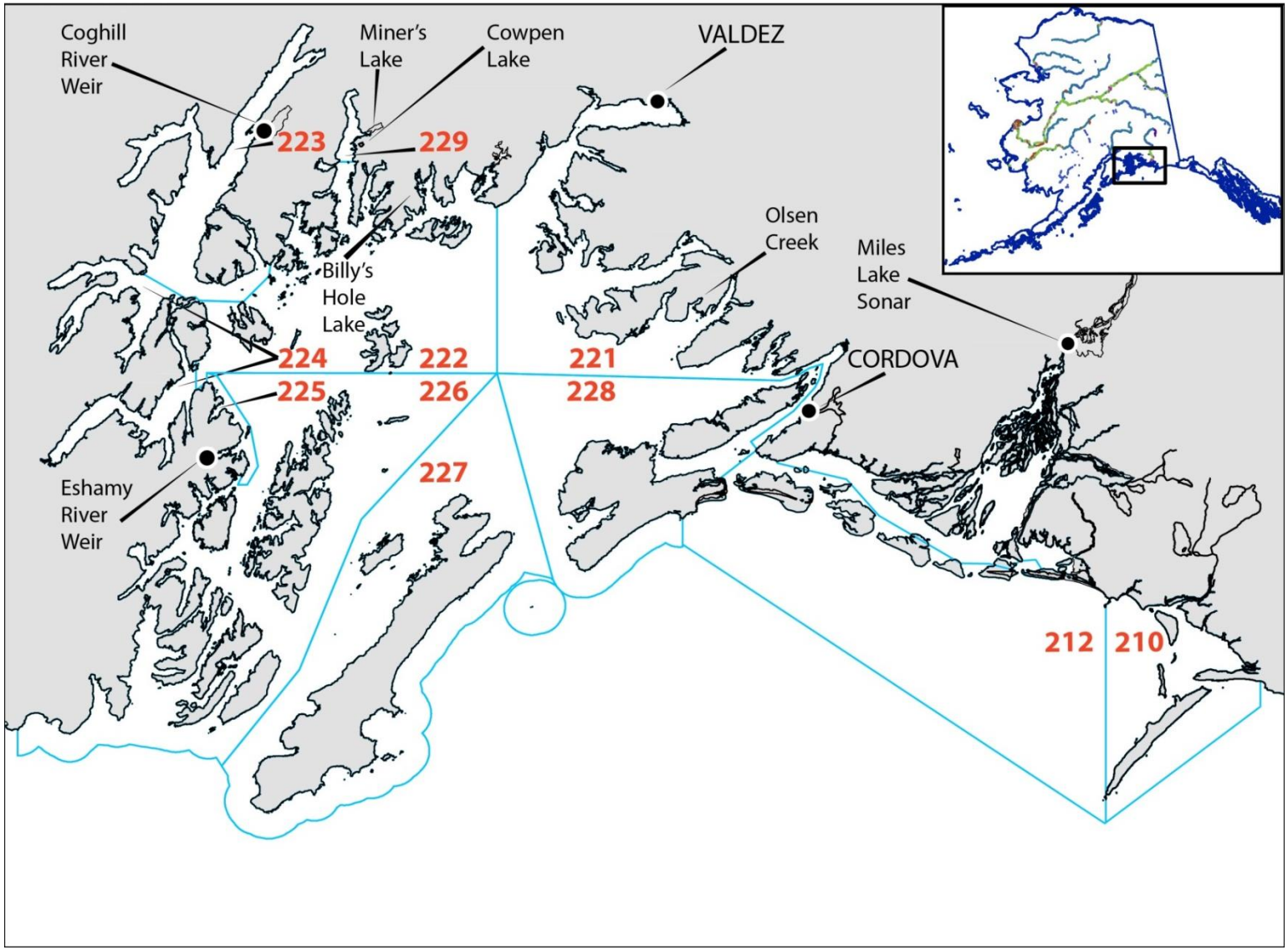


Figure 2.–Map of the Copper River and Bering River districts with arrows indicating escapement sampling locations.

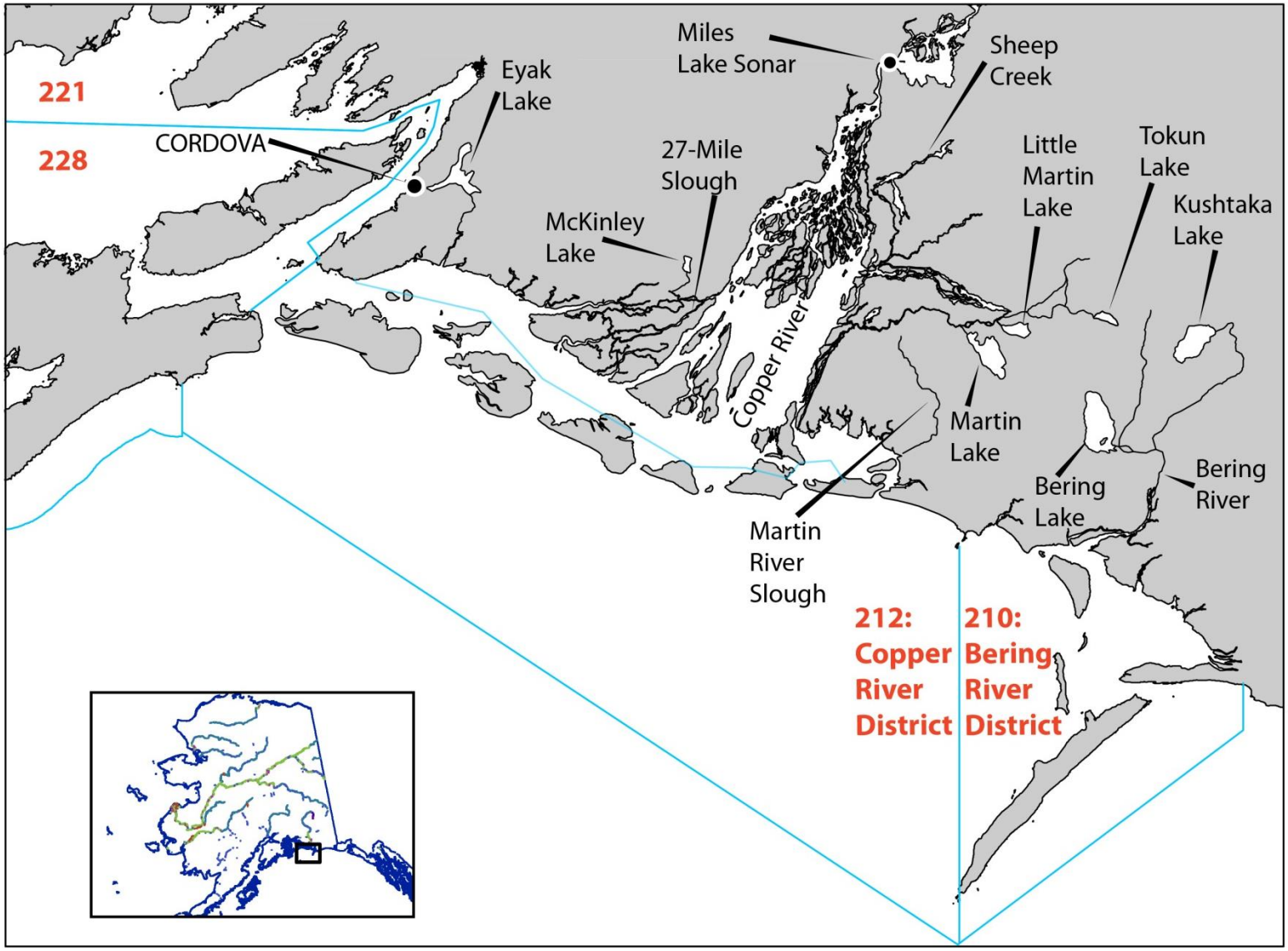
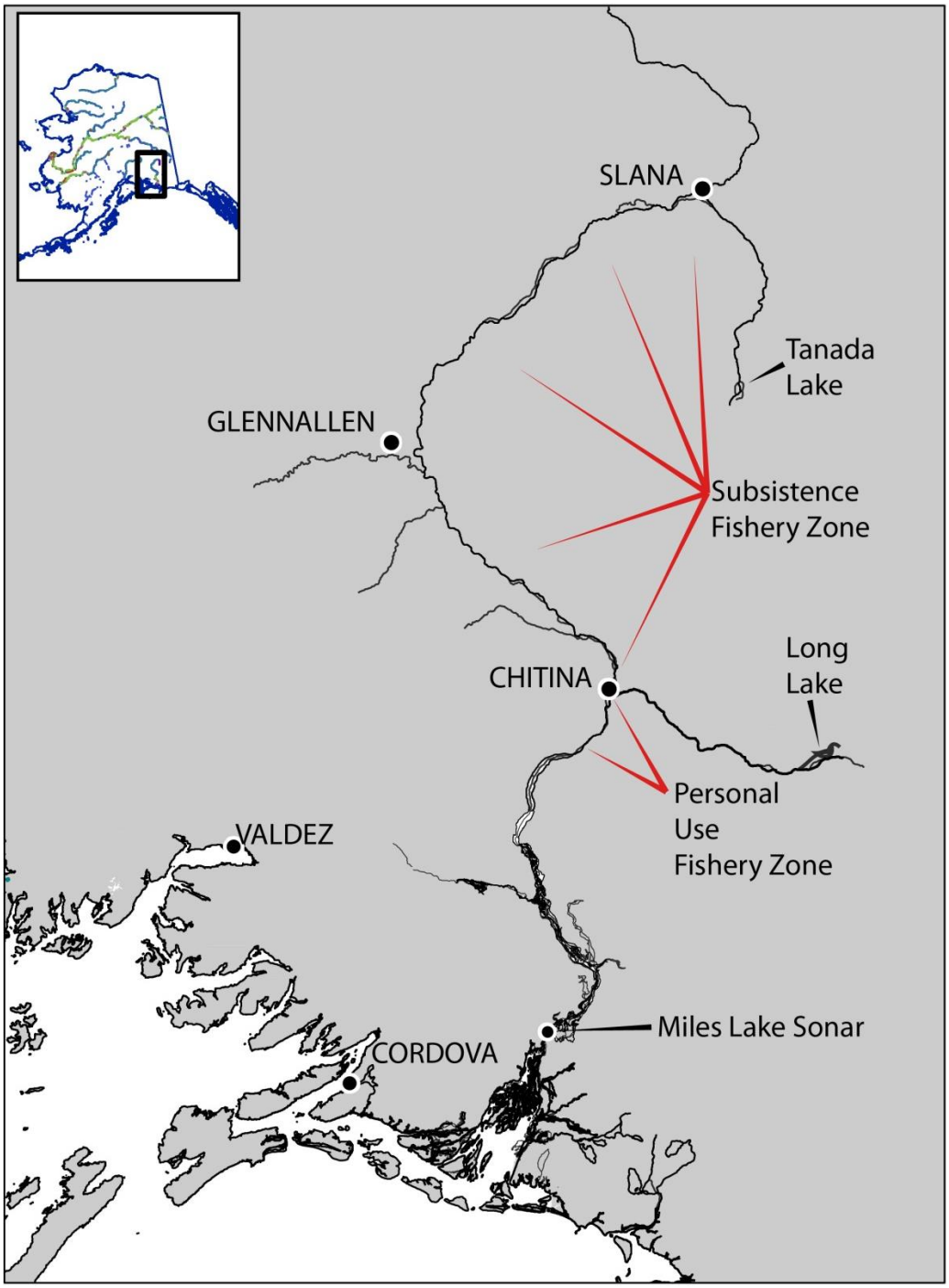
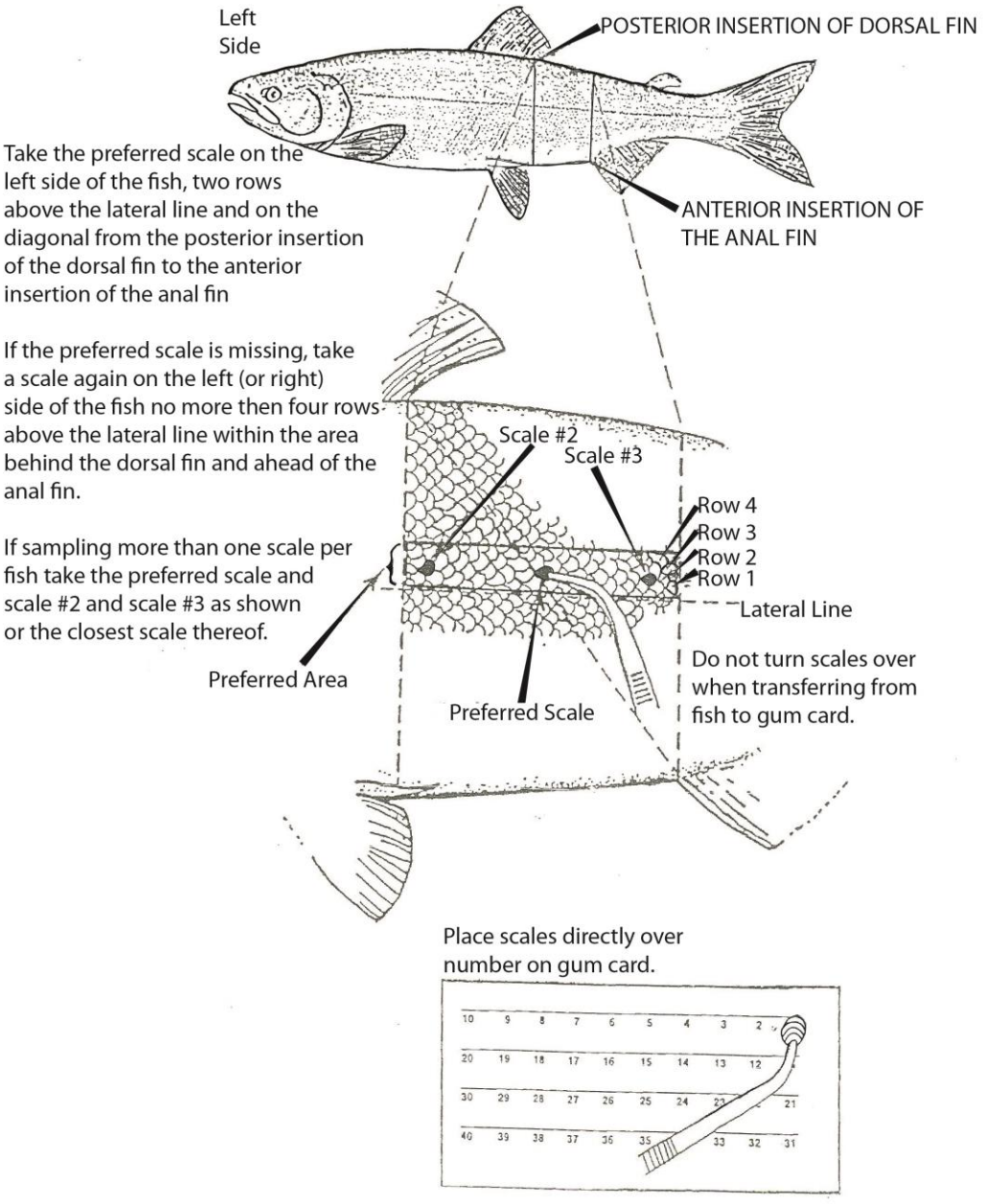


Figure 3.–Map of the Upper Copper River drainage including escapement sampling locations and personal use and subsistence fishery zones.

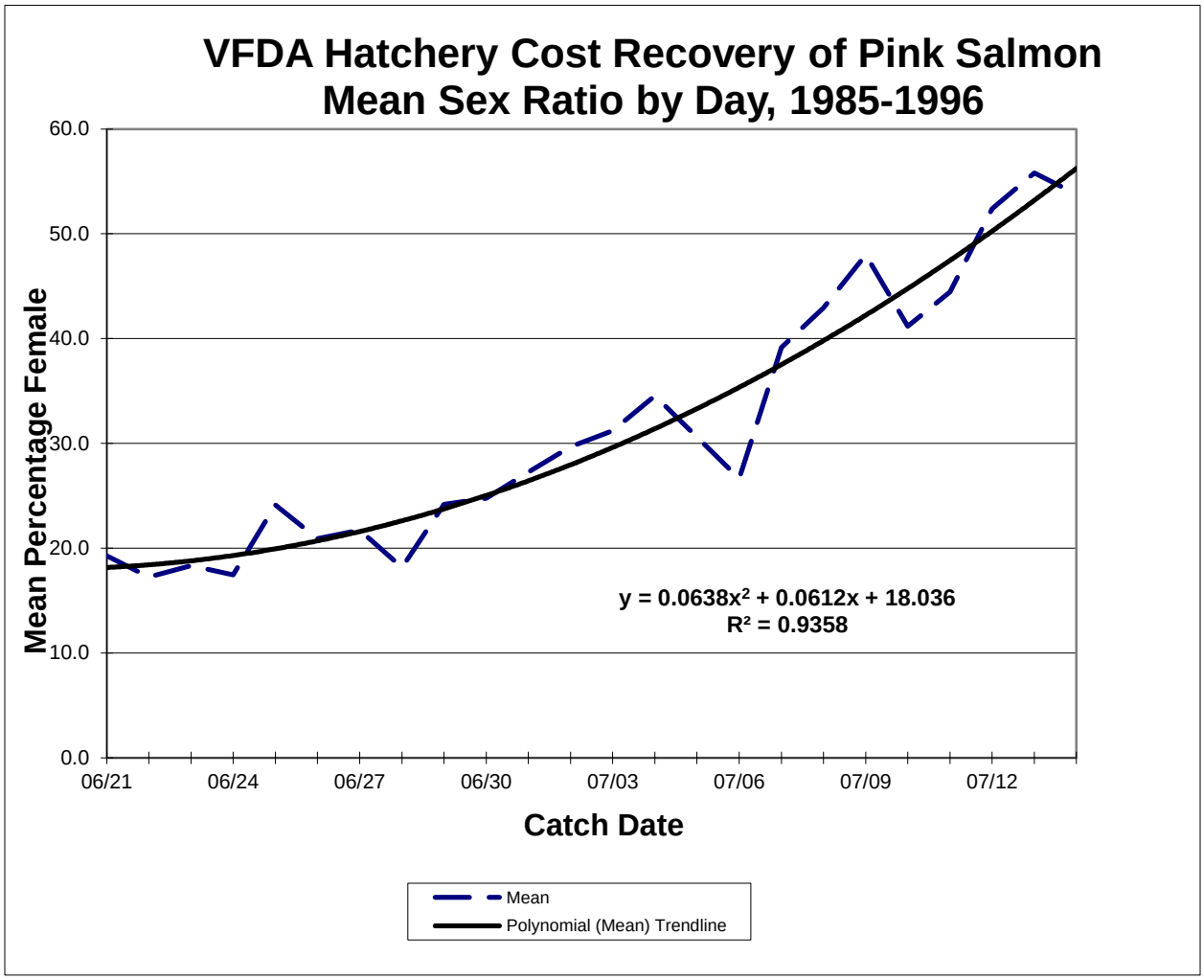


APPENDICES

Appendix A1.–Preferred area for obtaining scales from salmon.



Appendix A2.–Percentage of female pink salmon harvested during VFDA hatchery cost recovery as a function of catch date, 1985-1996.



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Appendix A3.–The age composition of sockeye salmon sampled at the Coghill River weir, 2013.

		Brood Year and Age Class [a,b]							
		2010		2009	2008		2007		
		0.2	1.1	1.2	1.3	2.2	1.4	2.3	Total
Stratum dates:	06/17 - 07/04								
Sampling dates:	06/27 - 06/30								
Sample size:	462								
Female	Percentage of sample	0.0	0.0	4.5	20.8	0.0	2.2	0.4	27.9
	Number in escapement	0	0	343	1,566	0	163	33	2,104
Male	Percentage of sample	0.2	0.4	45.9	18.4	0.9	5.0	1.1	71.9
	Number in escapement	16	33	3,458	1,386	65	375	82	5,415
Total	Percentage of sample	0.2	0.4	50.6	39.2	0.9	7.1	1.5	100.0
	Number in escapement	16	33	3,816	2,952	65	538	114	7,535
	Standard error	16	23	175	171	33	90	43	
Stratum dates:	07/05 - 07/14								
Sampling dates:	07/05 - 07/07								
Sample size:	479								
Female	Percentage of sample	0.0	0.0	5.6	32.2	0.4	2.3	2.3	42.8
	Number in escapement	0	0	433	2,469	32	176	176	3,287
Male	Percentage of sample	0.0	0.2	25.5	24.4	0.8	5.0	1.3	57.2
	Number in escapement	0	16	1,956	1,876	64	385	96	4,393
Total	Percentage of sample	0.0	0.2	31.1	56.6	1.3	7.3	3.5	100.0
	Number in escapement	0	16	2,389	4,345	96	561	273	7,680
	Standard error	0	16	163	174	39	91	65	
Stratum dates:	07/15 - 07/27								
Sampling date:	07/19 - 07/19								
Sample size:	20								
Female	Percentage of sample	0.0	0.0	25.0	10.0	0.0	15.0	10.0	60.0
	Number in escapement	0	0	504	202	0	302	202	1,210
Male	Percentage of sample	0.0	0.0	5.0	15.0	0.0	20.0	0.0	40.0
	Number in escapement	0	0	101	302	0	403	0	806
Total	Percentage of sample	0.0	0.0	30.0	25.0	0.0	35.0	10.0	100.0
	Number in escapement	0	0	605	504	0	706	202	2,016
	Standard error	0	0	212	200	0	221	139	
Strata Combined:	06/17 - 07/27								
Sampling dates:	06/27 - 07/19								
Sample size:	961								
Female	Percentage of sample	0.0	0.0	7.4	24.6	0.2	3.7	2.4	38.3
	Number in escapement	0	0	1,279	4,236	32	642	411	6,600
Male	Percentage of sample	0.1	0.3	32.0	20.7	0.8	6.8	1.0	61.6
	Number in escapement	16	49	5,514	3,565	129	1,163	178	10,614
Total	Percentage of sample	0.1	0.3	39.5	45.3	0.9	10.5	3.4	100.0
	Number in escapement	16	49	6,810	7,801	161	1,805	588	17,231
	Standard error	16	28	320	316	51	255	159	

[a] Fish with resorbed scales have been removed; Strata #1 had 26, #2 - 16.
[b] 274 ages determined using otoliths; Strata #1 had 128, #2 - 128, #3 - 18.