Regional Operational Plan CF.2A.2019.03

Estimating Wild and Hatchery Contributions of Pacific Salmon Stocks in Prince William Sound Management Area Fisheries

by

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September 2019

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.

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.2019.03

ESTIMATING WILD AND HATCHERY CONTRIBUTIONS OF PACIFIC SALMON STOCKS IN PRINCE WILLIAM SOUND MANAGEMENT AREA FISHERIES

by
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Alaska Department of Fish and Game
Division of Commercial Fisheries

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PURPOSE

Alaska Department of Fish and Game (ADF&G) employees in the Prince William Sound Management Area (PWSMA), also known as Area E, recover otoliths from Pacific salmon *Oncorhynchus* spp. harvested in commercial fisheries and examine the samples for hatchery marked otoliths to estimate contributions of wild and hatchery fish by facility of origin. These contribution estimates are used by ADF&G fisheries managers to assist in managing mixed stock commercial harvests to be consistent with sustained yield of wild and hatchery stocks (AS 16.05.730 and 5 AAC 39.220), follow appropriate principles and criteria in the Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222), and achieve spawning escapement goals (5 AAC 39.223). In addition to inseason management uses, harvest contributions are necessary to evaluate gear group allocations specified in the Prince William Sound Management and Salmon Enhancement Allocation Plan (5 AAC 24.370), evaluate wild stock escapements goals, and create preseason and inseason harvest and run projections. Hatchery operators use contribution estimates to assess hatchery runs inseason and evaluate total run, marine survival, and release strategies. This regional operational plan summarizes mark–recapture applications of thermal and strontium chloride (SrCl) otolith marking techniques, laboratory quality assurance measures, otolith collection and sample processing procedures, and methods employed to calculate commercial fishery harvest contributions for fishing districts in the PWSMA.

BACKGROUND

Prior to hatchery development in Prince William Sound (PWS), the annual commercial purse seine harvest of wild pink salmon *Oncorhynchus gorbuscha* averaged approximately 3.4 million fish (Randall et al. 1983). Run failures in the early 1970s stimulated the development of an enhancement program and the construction of several hatcheries. By 1986, five hatcheries were operating in PWS by the State of Alaska, Prince William Sound Aquaculture Corporation (PWSAC), and Valdez Fisheries Development Association (VFDA). The PWS hatcheries include the Solomon Gulch Hatchery (SGH), operated by VFDA, and the Armin F. Koernig (AFK), Wally Noerenberg (WNH), Cannery Creek (CCH), and Main Bay hatcheries (MBH), operated by PWSAC. The CCH and MBH hatcheries are owned, and were originally developed, by the State of Alaska, but have been operated by PWSAC since 1993.

Since 1986, these hatchery facilities have contributed an average of 33 million hatchery-origin pacific salmon per year (1986-2017) to PWS commercial fisheries (including commercial common property (CCP), and hatchery cost recovery (HCR) fisheries), with annual harvests of over 70 million hatchery-origin fish in 2010, 2013, and 2015. Pink salmon dominate hatchery production in PWS and composed, on average, over 90% of the hatchery-origin fish harvested each year during this time period (Stopha 2018). Salmon species produced by these facilities have changed through time, but in 2019 SGH produced pink salmon and coho salmon *O. kisutch*, CCH produced pink salmon, WNH produced pink salmon, chum *O. keta* salmon, Chinook *O. tschawytscha* salmon, and coho salmon, MBH produced sockeye salmon *O. nerka*, and AFK produced pink salmon and chum salmon. From 2008 through 2017, these facilities produced an average of 92% of all chum salmon, 82% of all pink salmon, and 86% of all sockeye salmon harvested in PWSMA CCP fisheries each year, excluding Copper River and Bering River Districts (ADF&G unpublished data)

In addition to PWS hatcheries, Gulkana Hatchery (GH) in the Copper River Basin began producing sockeye salmon in brood year 1973. Gulkana Hatchery currently has two rearing facilities, Gulkana I and Gulkana II, and releases sockeye salmon fry into Paxson, Summit, and Crosswind lakes. This facility is owned and was operated by the State of Alaska until 1993 when operation of the facility was turned over to PWSAC. Since 1978, GH has contributed an average of approximately 165,000 sockeye salmon per year to Copper River District commercial harvests. More recently (2008-2017), GH contributed an average of approximately 205,000 sockeye salmon per year to Copper River District commercial harvests, composing about 15% of the total commercial sockeye salmon harvest each year in this district (Vega et al. 2019). Additionally, sockeye salmon produced at GH contributed an average of 36,000 sockeye salmon per year (2008-2017) to inriver subsistence and personal use fisheries, composing an average of 16% of total sockeye salmon harvest each year in these fisheries (Vega et al. 2019).

In PWSMA, Pacific salmon are exploited in mixed-stock commercial, subsistence, personal use, and sport fisheries that are predominately comprised of hatchery populations in most fishing districts. Migratory timing and abundance of wild and hatchery runs in marine fishing areas varies among populations. To sustain wild stocks, managers must ensure that adequate numbers of wild fish from all temporal components of wild runs escape fisheries to spawn. To achieve escapement goals for wild stocks, mixed stock fisheries must be managed to achieve exploitation rates appropriate for less productive wild populations (Geiger et al. 1992). Therefore, managers need to distinguish the origin of the exploited species (i.e., hatchery or wild origin), and estimate their relative spatial and temporal abundance in fishing areas. Several tools and techniques are available to estimate the proportions of hatchery and wild fish in a given area and time period.

Prior to development of thermal marking otoliths (Volk et al. 1990), coded wire tags combined with adipose fin clips (visual tag cue) were the tool of choice for applying unique marks to hatchery populations of salmon in PWS and the Copper River (e.g., Riffe et al. 1996, Joyce and Riffe 1999). However, high cost and the many assumptions associated with coded wire tag programs caused biologists to evaluate alternatives for marking larger proportions of hatchery populations with relatively inexpensive, non-intrusive methods. Marking the entire population allows sample sizes for processing to be much smaller without compromising the accuracy and precision of contribution estimates. Non-intrusive marks that are not lost and do not affect survival or behavior eliminate important sources of error in mark-recapture population and straying rate estimates. Otolith marking techniques (e.g., thermal or SrCl marks) have many advantages over coded wire tags. The cost of applying marks is comparatively low, precision and accuracy of contribution estimates are greatly increased if appropriate sampling is completed, tag loss and differential mortality are non-existent, and the required adult sampling and processing effort is decreased. Unlike contribution estimates derived from coded wire tags, estimates calculated from otolith mark proportions are available sooner for management staff to use during the commercial fishing season.

As a result, PWS shifted from using coded wire tags to otolith thermal marking beginning in 1996, when all pink salmon released from PWS hatcheries contained otolith thermal marks. Other salmon species were released in PWS with otolith thermal marks beginning in brood year 1997 (PWSAC chum salmon), brood year 1999 (PWSAC coho and sockeye salmon), brood year 2000 (SGH coho salmon), and brood year 2010 (WNH Chinook salmon). The otolith thermal marking program had support from a number of projects started in response to the Exxon Valdez Oil Spill (EVOS), and has been used for inseason management of pink salmon since 1997 (Joyce and Evans

1999). Chum salmon in PWS have been sampled for thermal marks since 2003 and sockeye salmon since 2004.

Prior to 2000, GH released sockeye salmon emergent fry into Crosswind and Summit lakes, and the resulting smolts were coded-wire-tagged when migrating out of the lakes. However, sockeye salmon fry released into Paxson Lake were not tagged as smolt due to mixing with large numbers of wild sockeye salmon stocks, conflicts with the Gulkana Wild and Scenic River land use regulations, and difficult sampling conditions at the outlet of Paxson Lake. Therefore, in addition to the other issues with coded wire tag process mentioned earlier, almost one third of the sockeye salmon released from GH were unmarked. This required additional untested assumptions to generate contributions of GH sockeye salmon to commercial, subsistence, personal use, and sport fisheries in the Copper River District and upper Copper River. Like PWS, other options were examined to mark GH sockeye salmon releases, and in the spring of 2000, SrCl marks were applied to all GH sockeye salmon fry, which continues to be the marking method used today.

This operational plan outlines the activities of the Commercial Fisheries Division (CFD) in collecting and analyzing stock composition data. The Division of Sport Fish (DSF) operational plan for the contribution of Gulkana Hatchery sockeye salmon releases in the Chitina Subdistrict personal use fishery provides additional information about the upper Copper River sampling effort (Maclean 2013).

OBJECTIVES

1. Ensure Cordova otolith laboratory staff identify hatchery thermal marks and distinguish between marked and unmarked pink salmon *O. gorbuscha*, chum salmon *O. keta*, and sockeye salmon *O. nerka* otoliths to within 5% of the true accuracy, 90% of the time.
2. Ensure staff at UAF Advanced Instrumentation Laboratory are able to distinguish unmarked and Sr marked sockeye salmon otoliths that were prepared by Cordova otolith laboratory staff to within 5% of the true accuracy, 90% of the time.
3. Estimate the stock composition of CCP harvests of pink salmon, chum salmon, and sockeye salmon by fishing period and district by using thermal mark recoveries, such that the estimate is within 10% of the true proportion 95% of the time.
4. Estimate the stock composition of selected hatchery cost recovery (HCR) harvests of pink salmon, chum salmon, and sockeye salmon by statistical week and district by examining otolith recoveries for thermal marks, such that the estimate is within 10% of the true proportion 95% of the time.
5. Estimate the stock composition of the Copper River CCP harvests of sockeye salmon by fishing period using SrCl mark recoveries such that the estimate is within 10% of the true proportion 95% of the time.
6. Estimate the stock composition of the Copper River personal use and subsistence fishery harvests of sockeye salmon by sampling week using SrCl mark recoveries such that the estimate is within 10% of the true proportion 95% of the time.

METHODS

STUDY AREA

Sampling of pink, chum, and sockeye salmon from commercial harvests will occur in most of the 11 commercial fishing districts between Cape Suckling and Cape Fairfield (Figure 1). Most sampling will occur at shore-based processing facilities in Cordova and Valdez. If necessary, additional sampling may occur on floating processors in PWS.

Sampling of sockeye salmon in the Chitina Subdistrict fishery will occur along the Copper River from the McCarthy Bridge at Chitina, downstream approximately four miles to below the confluence of O'Brien Creek with the Copper River (Figure 2). The lower portion of the subdistrict may be restricted to boat traffic only because of landslides that occurred in 2002. Sampling of sockeye salmon will also occur in the Glennallen Subdistrict above the Chitina-McCarthy Bridge. All sampling in the Chitina and Glennallen subdistricts will be completed by DSF staff from the Glennallen office.

PRESEASON READER EVALUATION (OBJECTIVES 1 & 2)

Single-Blind Tests of Thermal Mark Readers (Objective 1)

Reader ability to accurately determine the origin of otoliths extracted from brood years of salmon fry returning as adults will be examined with blind tests conducted at the ADF&G otolith laboratory in Cordova before the fishing season. The extent to which readers agree with known-mark assignments will be measured and an identification matrix constructed to highlight misclassification tendencies for each reader and test.

Each spring, pink, chum, and sockeye salmon fry will be collected from incubators at the SGH, CCH, MBH, WNH, and AFK hatcheries, and delivered to the Cordova office by PWSAC and VDFA. Cordova Division of Commercial Fisheries (DCF) will collect wild chum, pink, and sockeye salmon smolts for unmarked otolith samples from area streams as needed. Cordova otolith laboratory personnel will catalog and extract otoliths from a subset of know-origin fish for use in blind testing. Extracted otoliths will be mounted, sulcus side up, on a petrographic glass slide with thermoplastic glue. Remaining samples will be delivered to ADF&G MTA laboratory in Juneau for verification of thermal marks and photographic documentation. All of this information will be posted to the ADF&G voucher summary website (https://mtalab.adfg.alaska.gov/OTO/reports/VoucherSummary.aspx). Mounted otoliths will be placed and stored for ten years or until degraded in slide boxes labeled by facility of origin and thermal mark assignment. Thermal marks will be classified according to a "Region, Band, and ring" (RBr) code in addition to the hatch code assigned to the species, brood year, and facility (Table 1).

Slides will be coded and randomly selected by Cordova ADF&G employees not working in the otolith laboratory. Single-blind tests will be administered to all personnel whose duties include reading otoliths. Prior to testing, readers will train with known-origin otoliths from previous years and review pictures of known-origin marked otoliths. Then, readers will be tested by reading and identifying discrete sets of 100 coded and randomized otoliths by species for marks that will potentially be seen that season. During testing, otoliths will be ground to the mid-sagittal plane manually with 1200-grit or 4000-grit silicon carbide (SiC) paper and viewed under a compound light microscope at 200X or 400X magnification. The Fishery Biologist I (FB I, Cordova

laboratory supervisor) and the Fish and Wildlife Technician III (FWT III) principal inseason reader will grind all otoliths for these tests. While taking the blind test, readers will have access to notes from previous seasons as well as internet resources; however, consulting other readers is prohibited. Correct hatch code information will not be made available to any laboratory personnel until results of the tests have been analyzed by the FB III project leader.

The overall ability of readers to correctly identify otoliths will be determined by comparing readers' interpretations of marks to the known origins. The priority order of identifications for readers is as follows: 1) thermal-marked fish versus an unmarked fish, 2) hatchery of origin versus all other origins, and 3) the specific mark versus all other thermally marked or unmarked fish. Agreement between or among readers and trends in misclassifications will also be examined. If readers are misidentifying specific marks, they will have further training and practice and the test will be repeated with additional coded and randomized samples of 100 otoliths. The minimum score for each reader to pass the blind test is >90% correct identification of the otoliths to mark (priority 3 listed above). However, blind test score minimums may be adjusted in the case of a poor marks. For example, a poor mark with multiple variants that is misidentified consistently by all readers might only need a >80% correct identification to proceed with inseason reading. However, in the case of poor marks, readers still must correctly identify >90% of otoliths at the thermal-marked versus unmarked level in order to proceed. Scores required to advance to inseason reading in the case of poor marks will be determined in consultation with the project leader and the most experienced otolith reader.

Single-Blind Test of Scanning Electron Microscope (SEM) Laboratory (Objective 2)

The extent to which Cordova otolith laboratory personnel can prepare known-origin otoliths for the UAF Advanced Instrumentation Laboratory and the ability of the SEM laboratory to detect Sr marks will also be assessed prior to the start of the season. This test will be repeated if otolith laboratory personnel are not properly preparing otoliths or if the SEM laboratory does not correctly identify the mark status in >95% of known-origin adult salmon otoliths. Otoliths considered to be of known origin will be from samples documented as marked by the SEM laboratory in previous commercial harvest sampling.

Otoliths for these tests are from analyzed samples of the Copper River commercial drift gillnet fishery from the previous year. The unused otolith of a previously sampled pair will be mounted, sulcus side up, on a cover slip with thermoplastic cement. The cover slip will be mounted on a petrographic glass slide with low melting temperature glue. Otoliths are then ground to the mid-sagittal plane using a LaboPol grinder with 500-grit SiC paper and viewed under a compound microscope and transmitted light at 200X. Otoliths will be polished with lapping paper (4000-grit) and rinsed with distilled water until they appear clean and smooth. To reduce SEM processing time, eight cover slips with associated otoliths will be mounted on each glass microscope slide.

Ninety-six randomly selected otoliths of known origin will be placed in slide boxes and sent to the SEM laboratory for analysis. Results from the SEM laboratory will be analyzed by the project leader or Cordova otolith laboratory supervisor using methods outlined in the thermal mark analysis section.

RECOVERY OF THERMAL AND SR MARKED OTOLITHS FROM PROCESSORS (OBJECTIVES 3, 4, & 5)

After a CCP period and select HCR fisheries, otoliths will be recovered by sampling all available tender or purse seine vessel loads delivered to major processors based on vessel availability and management sample priority. There may be as many as 16 different fishery-district-species deliveries to sample per period during the season. Ideally, all tenders from all major processors participating in the district-period stratum will be sampled. Sampling efforts have to occur frequently because there may be small differences in overall estimated hatchery proportions among processors between two fishing periods. There can also be significant differences in the overall estimates of individual hatchery proportions for the same two fishing periods (Joyce and Evans 1999). However, because of budget and personnel limitations, sampling priorities are developed by the project leader and the Cordova otolith laboratory supervisor to satisfy the data needs of the management and research staff. These sampling priorities are evaluated daily and adjusted as necessary based on run entry patterns, survey observations, stock timing, district openers, fleet distribution, and fishery effort.

Prior to sampling, otolith recovery technicians will interview vessel captains to obtain descriptive and quantitative data for the fish aboard that vessel. Information of interest includes poundage, date harvested, fishing period, and fishing district for each species that will be collected. Using this information as well as the sample priorities for that day, the otolith recovery technician will decide which sampling method to use for that particular vessel.

Two approaches are employed to collect PWS otolith samples: systematic sampling and grab sampling. Systematic samples are collected by removing otolith pairs from salmon sampled from processor belts at set time intervals. Time intervals used by technicians at each processor depend on the poundage and speed at which Pacific salmon are processed. Each technician will use a timing device with a count-down feature that sets off an audible alarm after a pre-set time has elapsed. The entire tender will be sampled in this manner so that an unbiased sample is collected throughout the load. Vessel off-loading systems at each processing plant vary, but efforts will be made to ensure samples are collected systematically throughout the vessel load.

In the case of a non-priority species aboard a vessel, a grab sample, or opportunistic sample, may also be employed to collect specimens. At various points in the commercial fishing season, some vessel deliveries contain significant numbers of multiple target species. As a result, a single sampler will collect a systematic sample from a priority species and a grab sample from the other species. The collection method (systematic vs. grab) will be documented during sample cataloging because insufficient mixing of fish occurs in most tender deliveries, potentially resulting in significantly different contribution estimates between the beginning and end of the fishing period (Joyce and Evans 1999). Therefore, contribution and variance estimates calculated from grab samples can be biased, and the resulting management decisions based on contribution estimates derived only from grab samples will be conservative.

Otoliths collected using both systematic and grab sampling methods from each vessel are placed in order of selection into plastic 96-well plate trays. Individual trays are labeled with vessel name, species, fishing district and period, and other descriptive information for data entry, cataloging, and storage purposes. Otoliths will be collected so that each vessel, species, fishing period, and district will be stored in their own tray with its own data sheet containing the descriptive and quantitative data for data entry and cataloging purposes (Appendix B1). All data forms and otolith

trays from Cordova samplers will be delivered to the crew leader's office at the end of each shift. Samplers in locations outside of Cordova (i.e., Valdez and Whittier) will fax sampling information from the previous day and a list of tenders they anticipate sampling that day by 9 AM each morning. Completed sample data forms and otolith collections will be delivered to Cordova approximately twice weekly, depending on the location and delivery services available.

When sample data are entered into the Microsoft Access™ database using a front-end application, harvest estimates from interviews are compared with processor reporting summarized in the ADF&G Mariner system. If large differences (>10,000 pounds) between the two estimates are noted, fish tickets will be examined before the proportional allocation will be completed. Because tender poundage will be used to select a representative subset of otoliths (96 or fewer) from among many tenders, correct tender delivery weights can have a large effect on the contribution estimates. Large, inexplicable differences will require consultation with processor fish ticket personnel and will delay the calculation and dissemination of contribution estimates.

Second Reads of Inseason Mark Interpretation (Objectives 3 & 4)

After all otoliths are read for the season, readers will reexamine (i.e., second read) ≥30% of previously examined (i.e., first read) otolith samples from CCP and HCR harvests. Subsamples from each district-species combination will be randomly selected and examined by a different reader in the Cordova otolith laboratory. Differences between first and second reads will be arbitrated by the laboratory supervisor or the most experienced reader. Errors found in the quality control process will be corrected in the database and the contribution estimates will be recalculated as necessary. If >10% of second reads are discrepancies for a particular reader or species, a minimum of 50% of otoliths from that reader/species will be second read accordingly to remedy potential errors in the final data set.

RECOVERY OF SR MARKED OTOLITHS FROM UPPER COPPER RIVER HARVESTS (OBJECTIVE 6)

Otoliths will be collected from three subareas of the Glennallen Subdistrict subsistence fishery (Gakona to Slana (GS), Tonsina to Gakona (TG), and Bridge to Tonsina (BT)) and the Chitina Subdistrict personal use fishery in the upper Copper River by the DSF for estimating the age composition of and the GH contribution to upriver harvests (see Maclean 2013 for objectives and methods). DSF personnel, in Glennallen, will collect 200 otoliths per week; 100 from the Chitina Subdistrict and 100 from the Glennallen Subdistrict composed of 10 from GS, 35 from TG, and 55 from BT subareas. Associated data will be collected on forms provided by the Cordova ADF&G office (Appendix B3). The FB II project leader in Glennallen will mail samples and copies of data forms and will forward electronic data spreadsheets to Cordova every two weeks from June through August. After otoliths are received, the FB I age, sex, and size (ASL) crew leader will check all data forms, assign a unique sample number, and enter sample data into the Microsoft Excel™ spreadsheet. Sample data forms will be stored with corresponding otolith trays until selected for processing.

These otoliths will be interpreted for age by Cordova ADF&G staff. After aging the otoliths, the ASL crew leader will enter individual specimen data in a Microsoft Excel™ spreadsheet and systematically select a subsample of 45 otoliths from the Glennallen Subdistrict, representative of the three subareas (GS n=4, TG n=16, BT n=25) and 45 otoliths from the Chitina Subdistrict each sampling week. Selected otoliths will be sent first to GH staff for sample preparation, and from

there will go to UAF's Advanced Instrumentation Laboratory for SEM analysis. After processing, data forms will be entered and stored in a Microsoft Excel™ spreadsheet.

Contribution estimates will be calculated in a manner similar to CCP, HCR, and Test Fishery reports. Harvests will be summarized in the contribution estimates for the State subsistence (Glennallen Subdistrict and individual subareas), State personal use (Chitina Subdistrict), and Federal subsistence (Chitina and Glennallen subdistricts) fisheries by sampling week. These contribution estimates will be completed and sent via email to PWSAC, ADF&G staff, and other interested stakeholders as soon as harvest data are available.

THERMAL AND SR SAMPLE PROCESSING FOR MARK IDENTIFICATION

Data Entry and Sample Development

The Cordova recovery crew leader or Cordova laboratory supervisor will review all data forms for correctness and completeness, assign a unique sample identification number, and enter sample data into the database daily or as needed. Sample data forms will be stored with the corresponding otolith trays until the sample is selected for processing. After processing, data forms will be stored by fishery type, district, and species. Data forms will be saved and scanned at the end of the season.

Individual specimen results and any matched data (e.g., sex, genetic samples, age, etc.) will be entered directly into a Microsoft Access™ database by Cordova otolith laboratory personnel during sample processing. Sample data will be entered with a front-end application into the database. Support for the application and database will be provided by programming staff at the Juneau Mark, Tag, and Age (MTA) Laboratory.

For each district-period opening, a weighted sample of 96 otoliths will be selected from all otoliths collected after the fishing period. To build a representative sample, otoliths will be selected systematically from within a tender's otolith tray(s). A proportional allocation scheme will be used where the tender's delivered poundage and the processor's overall percentage of harvest received determines the number of otoliths used for the entire representative sample. If sufficient otoliths are available (≥20 otoliths), another sample of otoliths formed in a similar manner will be selected and stored for possible postseason analysis.

Thermal Mark Processing of CCP and HCR Harvested Samples

Extracted otoliths (left otolith from each pair) from the weighted subsample will be mounted, sulcus side up, on a petrographic glass slide with thermoplastic glue. Each glass slide will be marked with a bar-coded label. Otoliths will be ground to the mid-sagittal plane manually using 500-grit SiC paper and viewed under a compound light microscope at 200X magnification. After determining the origin of an otolith, a bar-code scanner will record the slide identity to a Microsoft Access™ database, and a front-end application will be used to enter additional relevant data about the otolith. Contribution estimates will be determined after all otoliths from a sample are read for thermal marks.

Sr Mark Processing from CCP Harvests

After a sample for Sr mark analysis is selected, ground, and polished for reading with the SEM (up to 96 otoliths for each district-period stratum), samples are shipped to UAF along with an email describing shipping details and other important sample notes. Laboratory personnel at UAF enter the results (marked or unmarked and comments) directly into a Microsoft Excel™ spreadsheet and emailed to the Cordova otolith laboratory. After receiving the inseason identification data from the

SEM laboratory, hatchery contributions will be estimated and distributed to PWSAC, ADF&G management personnel, and other interested stakeholders via email. Preliminary hatchery contribution estimates in a district-period stratum will be generated from otolith samples collected at Cordova processors. Another inseason hatchery contribution estimate will be calculated when otoliths from Valdez and Whittier are received and analyzed.

Since 2004, sampling for otoliths in the Copper River District CCP fishery has begun in the period closest to 10 June and continued until about 20 July. The department will sample the Copper River District commercial harvest from early June through late July (14 periods) but may move the sampling start date forward or backward up to a week depending on run timing indicators such as harvest and Miles Lake sonar passage. The goal will be to maintain a maximum of 7–10 days between when a period ends and the availability of preliminary results.

DATA ANALYSIS

IDENTIFICATION MATRICES (OBJECTIVE 1)

An identification matrix will be produced to identify trends in errors in blind tests results. A matrix for each blind test set for each reader and species will be constructed with true and observed origin describing rows (*i*) and columns (*j*), respectively. Additional matrices will be constructed to identify trends in 2nd read results.

SUCCESS RATES IN VOUCHER MARK IDENTIFICATION (OBJECTIVES 1 & 2)

This test will estimate the expected identification success rate for a group of 100 otoliths selected from the population of otoliths consisting of those marked salmon returning in a given year and their wild counterparts for any reader at any time. Success rates will be estimated in two ways.

The first, $\hat{p}'_i$, is defined:

$$\hat{p}'_i = \frac{\sum_{j=1}^{b}\sum_{k=1}^{r}\sum_{l=1}^{t} p'_{ijkl}}{brt} \qquad (1)$$

where,

$$p'_{ijkl} = \frac{\sum_{m=1}^{n} x_{ijklm}}{n} \qquad (2)$$

where x_{ijklm} =1 if the identification of the m^{th} otolith in box *j* identified by reader *k* for time *l* is correct according to the decision rule: 'Of origin *i*' versus 'Not of origin *i*', and 0 otherwise. The index *i* denotes hatchery of origin with values specific to hatcheries or release sites for each species. For example for pink salmon index *i* values would include: SGH, WNH, AFK, CCH and 'Hatcheries Combined'. For example, for $p'_{SGH\ 123}$ = 0.90, the otoliths in box 1 assessed by reader 2 at time 3 were identified correctly 90% of the time based on the criteria that a successful identification occurs if the otolith in question is assigned a "SGH' or 'Not SGH' identity correctly.

The second definition, $\hat{p}_i^{"}$, is defined similarly, except that the success criteria are restricted only to the otoliths of origin *i*. Thus, for $p_{SGH123}^{"}$ = 0.90, the SGH otoliths in box 1 assessed by reader 2 at time 3, were identified correctly 90% of the time.

ESTIMATED HATCHERY CONTRIBUTIONS WITH THERMALLY AND SR-MARKED OTOLITHS (OBJECTIVES 3-6)

The otolith-derived estimate of the contribution of hatchery *h* to district-period stratum *i*, C_{hi} is

$$\hat{C}_{hi} = \frac{o_{hi}}{n_i} N_i \tag{3}$$

where,

o_{hi} = Number of otoliths from hatchery *h* in sample n_i,

n_i = Number of otoliths sampled from stratum *i* (usually 96), and

N_i = Number of fish caught in stratum *i*.

The variance estimate of $\hat{C}_{hi}$ is

$$var(\hat{C}_{hi}) = N_i{}^2 \frac{1}{n_i - 1} \frac{o_{hi}}{n_i} \left(1 - \frac{o_{hi}}{n_i}\right) \tag{4}$$

Otolith-derived estimates of the contribution of hatchery *h*, C_{Sh}, to all sampled CCP (or other collections: HCR, special harvests, or broodstocks), will be calculated as

$$\hat{C}_{Sh} = \sum_{i=1}^{Q} C_{hi} \tag{5}$$

where,

Q = Number of recovery strata associated with CCP or other collection in which otoliths from hatchery *h* are found.

The variance estimate of $\hat{C}_{Sh}$ is

$$var(\hat{C}_{Sh}) = \sum_{i=1}^{Q} var(C_{h_i}) \tag{6}$$

The contribution of hatchery *h* to unsampled strata, C_{Uh}, will be estimated from contribution rates associated with strata sampled from the same district-period openings as the unsampled strata using methods similar to those used for coded wire tags (Riffe et al. 1996):

$$\hat{C}u_h = \sum_{i=1}^{U} \left[N_i * \left(\frac{\sum_{j=1}^{S} \hat{C}_{hj}}{\sum_{j=1}^{S} N_j} \right) \right] \tag{7}$$

where,

U = Number of unsampled strata,

N_i = Number of fish in *i*th unsampled stratum,

S = Number of strata sampled in the period in which the unsampled stratum resides,

C_{tj} = Contribution of thermal mark *h* to the sampled stratum *j*, and

N_j = Number of fish in *j*th sampled stratum.

The variance estimate of $\hat{C}_{Uh}$ is

$$var(\hat{C}_{Uh}) = \sum_{i=1}^{U}\left[{N_i}^2 * \left(\frac{1}{\sum_{j=1}^{S} N_j - 1}\right)\left(\frac{\sum_{j=1}^{S}\hat{C}_{hj}}{\sum_{j=1}^{S} N_j}\right)\left(1 - \frac{\sum_{j=1}^{S}\hat{C}_{hj}}{\sum_{j=1}^{S} N_j}\right)\right] \quad (8)$$

If a fishing periods was not sampled (an infrequent occurrence), the harvest from that opening will be treated as unsampled harvest of the subsequent or previous opening in the same district.

An estimate of the contribution by hatchery *h* to all strata, sampled and unsampled, will be calculated by

$$\hat{C}_h = \hat{C}_{Sh} + \hat{C}_{Uh} \quad (9)$$

The variance estimate of $\hat{C}_h$ is

$$var(\hat{C}_h) = var(\hat{C}_{Sh}) + var(\hat{C}_{Uh}) \quad (10)$$

If there are few unsampled strata, the variance associated with $\hat{C}_{Uh}$ will be assumed to be negligible.

For any sampled stratum, the sample size goal of 96 otoliths will provide a hatchery proportion estimate with at least a 95% chance that it is within 10% of the true proportion.

SCHEDULE AND DELIVERABLES

INSEASON DATA DISSEMINATION

Inseason contribution estimates will be generated with a Microsoft Excel™ spreadsheet application using mark result data queried from the Cordova otolith laboratory Microsoft Access™ database and harvest by processor queried from the ADF&G Mariner application database. Preliminary hatchery contribution estimates in a district-period-fishery-species stratum will be generated from the first reading of the otolith samples collected at Cordova processors. The Cordova otolith laboratory supervisor or the project leader will generate contribution estimates and distribute them as .pdf files via email to PWSAC, VFDA, ADF&G staff, and other interested stakeholders as soon as preliminary data are available. As soon as all remaining samples are processed from otoliths collected in Valdez, Whittier, and any other sites outside of Cordova, a final contribution estimate will be generated and distributed accordingly.

ANNUAL REPORT SCHEDULE

This outlines the main annual reports and tasks for the program; others are outlined in the basic management plans, annual management plans, and cooperative agreements for the PWSMA. Deadlines for other projects not related to the commercial salmon fishing seasons may be added at a later date.

Date	Responsible Party	Report / Task
By 10 April 2020–2021	ADF&G, PWSAC	Cooperative Agreement finalized
By 30 June 2020–2021	PWSAC, VFDA	Vouchers arrive at ADF&G offices for processing
1 November 2019–2021	S. Haught, C. Moenaert	Preliminary contribution tables to PWSAC and VFDA
1 December 2019–2021	S. Haught, C. Moenaert	Final contribution tables to PWSAC and VFDA
1 April 2020–2021	S. Haught, C. Moenaert	Individual mark report due to PWSAC and VFDA for CCP and HCR samples.

DISPOSITION OF OTOLITH SAMPLES

Samples are stored in a secure bin in the ADF&G Cordova Field Office's warehouse. Because of space limitations, certain samples can be disposed of after a certain period of time. However, because of the potentially sensitive nature of some projects completed by the laboratory, other sample categories need to be retained indefinitely. The final disposition of all otolith samples will be as follows:

1) Disposed of after one additional year (e.g., 2019 samples disposed of in spring 2020):
    a. CCP and HCR otoliths that were mounted and read,
    b. Unmounted right otoliths from CCP and HCR samples.
2) Placed into long-term storage:
    a. CCP and HCR post season otolith samples,
    b. Southwestern District test fishery otoliths and slides.
    c. All CCP otolith samples from the Copper River District
    d. All upper Copper River personal use and subsistence otoliths and slides examined for Sr marks.
    e. Any other otoliths from special projects (e.g., straying studies, Alaska Hatchery Research Program, etc.).

STUDY PERSONNEL AND RESPONSIBILITIES

The project will use permanent personnel of ADF&G, Division of Commercial Fisheries and permanent personnel funded by cooperative agreement with PWSAC (Table 2). Additionally, otoliths will be collected from sockeye salmon in the upper Copper River personal use and subsistence fisheries by ADF&G Division of Sport Fish personnel, from the escapements of sockeye salmon to Crosswind and Summit lakes by PWSAC personnel, and from commercial harvests of pink salmon delivered to Valdez processors by VFDA personnel. If additional floating processors are used, additional personnel may be required. Responsibilities for each job class are outlined in Table 3.

REFERENCES CITED

Geiger, H. J., J. Brady, W. Donaldson, and S. Sharr. 1992. The importance of stock identification for management of the Prince William Sound pink salmon fishery. Regional Information Report 5J92-12, Juneau.

Joyce, T. L., and D. G. Evans. 1999. Otolith marking of pink salmon in Prince William Sound hatcheries. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 99188). Alaska Department of Fish and Game, Cordova and Anchorage, Alaska.

Joyce, T., and R. Riffe. 1999. Summary of Pacific salmon coded wire tag and thermal mark application and recovery, Prince William Sound, 1998. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A99–07, Anchorage.

Maclean, S. H. 2013. Operational Plan: Gulkana River Hatchery contribution to Glennallen and Chitina Subdistrict sockeye salmon harvests. Alaska Department of Fish and Game, Division of Sport Fish, Regional Operational Plan ROP.SF.3F.2013.09, Anchorage.

Randall, R., P. Fridgen, M. McCurdy, and K. Roberson. 1983. Prince William Sound Area Annual Finfish Management Report. Alaska Department of Fish and Game, Division of Commercial Fisheries, Cordova.

Riffe, R., S. Gehlbach, D. Evans, and B. Bue. 1996. Coded wire tag recoveries from Prince William Sound salmon fisheries, 1995. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project R95320B), Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Cordova, Alaska.

Russell, C., J. Botz, S. Haught, S. Moffitt. 2016. 2016 Prince William Sound area finfish management report. Alaska Department of Fish and Game, Fishery Management Report No. 17-37, Anchorage.

Vega, S. L., C. W. Russell, J. Botz, and S. Haught. 2018. 2017 Prince William Sound area finfish management report. Alaska Department of Fish and Game, Fishery Management Report No. 19-07, Anchorage.

Volk, E. C., S. L. Schroder, and K. L. Fresh. 1990. Inducement of unique otolith banding patterns as a practical means to mass-mark juvenile Pacific salmon. American Fisheries Society Symposium 7:203-21.

TABLES

Table 1. Thermal mark codes at Prince William Sound and Copper River hatcheries for the predominant brood years of pink, chum, and sockeye salmon returning in 2019.

TMID	RBr	HATCH CODE	SPECIES	AGE
WNH13A	1:1.1,2.3, 3.1	1,3,1H	CHUM	6
WNH13B-AFK	1:1.1,2.2,3.1,4.2	1,2,1,2H	CHUM	6
WNH13C-PC	1:1.1,2.2n,3.3	1,2n,3H	CHUM	6
WNH14A	1:1.3,2.4n	3,4nH	CHUM	5
WNH14B-AFK	1:1.1,2.2,3.3	1,2,3H	CHUM	5
WNH14C	1:1.1,2.3,3.3	1,3,3H	CHUM	5
WNH15A	1:1.6	6H	CHUM	4
WNH15B-AFK	1:1.1,2.2,3.1	1,2,1H	CHUM	4
WNH15C-PC	1:1.3,2.2n,3.1	3,2n,1H	CHUM	4
WNH16A	1:1.5n,2.2	5n,2H	CHUM	3
WNH16B-AFK	1:1.1,2.4	1,4H	CHUM	3
WNH16C- PC	1:1.1,2.3n,3.2	1,3n,2H	CHUM	3
AFK17B	1:1.4	4H	PINK	2
CCH17	1:1.3,2.3	3,3H	PINK	2
SGH17	1:1.6	6H	PINK	2
WNH17PINKB	1:1.8	8H	PINK	2
MBH13A	1:1.3+2.3	3H3	SOCK	6
MBH13B	1:1.3+2.2,3.2	3H2,2	SOCK	6
MBH13C	1:1.3+2.5	3H5	SOCK	6
MBH13D	1:1.3+2.3,3.3	3H3,3	SOCK	6
MBH13E	1:1.3+2.5	3H	SOCK	6
MBH14A	1:1.5+2.3	5H3	SOCK	5
MBH14B	1:1.5+2.2+3.2	5H2,2	SOCK	5
MBH14C	1:1.5+2.5	5H5	SOCK	5
MBH14D	1:1.5+2.3+3.3	5H3,3	SOCK	5
MBH14E	1:1.5	5H	SOCK	5
MBH15A	1:1.2,2.2+3.3	2,2H3	SOCK	4
MBH15B	1:1.2,2.2	2,2H	SOCK	4
MBH15C	1:1.2,2.2+3.5	2,2H5	SOCK	4

-continued-

Table 1. Page 2 of 2.

TMID	RBr	HATCH CODE	SPECIES	AGE
MBH15D	1:1.2,2.2+3.3,4.3	2,2H3,3	SOCK	4
MBH15E	1:1.2,2.2+3.4	2,2H4	SOCK	4
MBH16A	1:1.3+2.3	3H3	SOCK	3
MBH16B	1:1.3+2.2,3.2	3H2,2	SOCK	3
MBH16C	1:1.3+2.5	3H5	SOCK	3
MBH16D	1:1.3+2.3,3.3	3H3,3	SOCK	3
MBH16E	1:1.3+2.5	3H	SOCK	3

Table 2. Division of Commercial Fisheries personnel working on otolith recovery and analysis in 2019.

Name	Job Type	Job Status	Job Description	Location	Season
Stormy Haught	FB III	Permanent	Project Leader	Cordova	Full time
Crystal Moenaert	FB I	Permanent	Otolith Laboratory Supervisor	Cordova	11-month Seasonal
Tim Frawley	AP V	Permanent	Analyst Programmer	Juneau	Full time
Xinxian Zhang	Biometrician III	Permanent	Consulting Statistician	Anchorage	Full time
Melanie O'Rourke	FWT III	Permanent	Otolith Recovery Crew Leader	Cordova	mid-May – Nov.
Al Cox	FWT III	Permanent	Otolith Recovery Crew Leader	Valdez	June – Sept.
Jane Allen-Schmid	FWT II	Permanent	Otolith Laboratory Technician	Cordova	May – Nov.
Chloe Bee	FWT II	Permanent	Otolith Laboratory Technician	Cordova	June – Sept.
Tara Anderson	FWT II	Permanent	Otolith Lab. Tech. - Sr Marks	Cordova	mid-May – Sept.
Florencio Espejo	FWT II	Permanent	Otolith Recovery Technician	Cordova	June – Sept.
David Warren	FWT II	Permanent	Otolith Recovery Technician	Cordova	June – early Sept.
Casey Somerville	FWT II	Permanent	Otolith Recovery Technician	Cordova	June – July
Riley Somerville	FWT II	Permanent	Otolith Recovery Technician	Cordova	June – early Sept.
Vacant	FWT II	Permanent	Otolith Recovery Technician	Whittier	June–July
Kathleen Weibl	OA I	Permanent	Commercial Fisheries Fish Ticket staff	Cordova	May-October
Tara Craig	OA I	Permanent	Commercial Fisheries Fish Ticket staff	Cordova	May–October

Table 3. General position descriptions as they relate to otolith mark recovery and sample processing.

Job Description	Duties
Project Leader	Supervise project, complete data analysis and reporting.
Otolith Laboratory Supervisor	Supervise daily laboratory activities, assist with otolith reading, distribute inseason contribution reporting, assist with data analysis and reporting.
Analyst Programmer	Provide technical support for database and write/support front-end application for access to database.
Consulting Biometricians	Review data collection methodology and provide technical support for data analysis.
Otolith Recovery Crew Leader	Supervise daily activities and training of new personnel in sampling procedures. Edit and enter sampling data into database, assist with sampling.
Otolith Laboratory Technician	Prepare otolith samples and interpret thermal marks. Prepare otoliths for Sr mark interpretation. Enter mark interpretation data into database. Assist in collection of field data.
Otolith Recovery Technician	Assist in collection of field data. Routine data entry.
Commercial Fisheries Fish Ticket staff	Collect, edit, enter, and summarize processor reports and fish tickets.

FIGURES

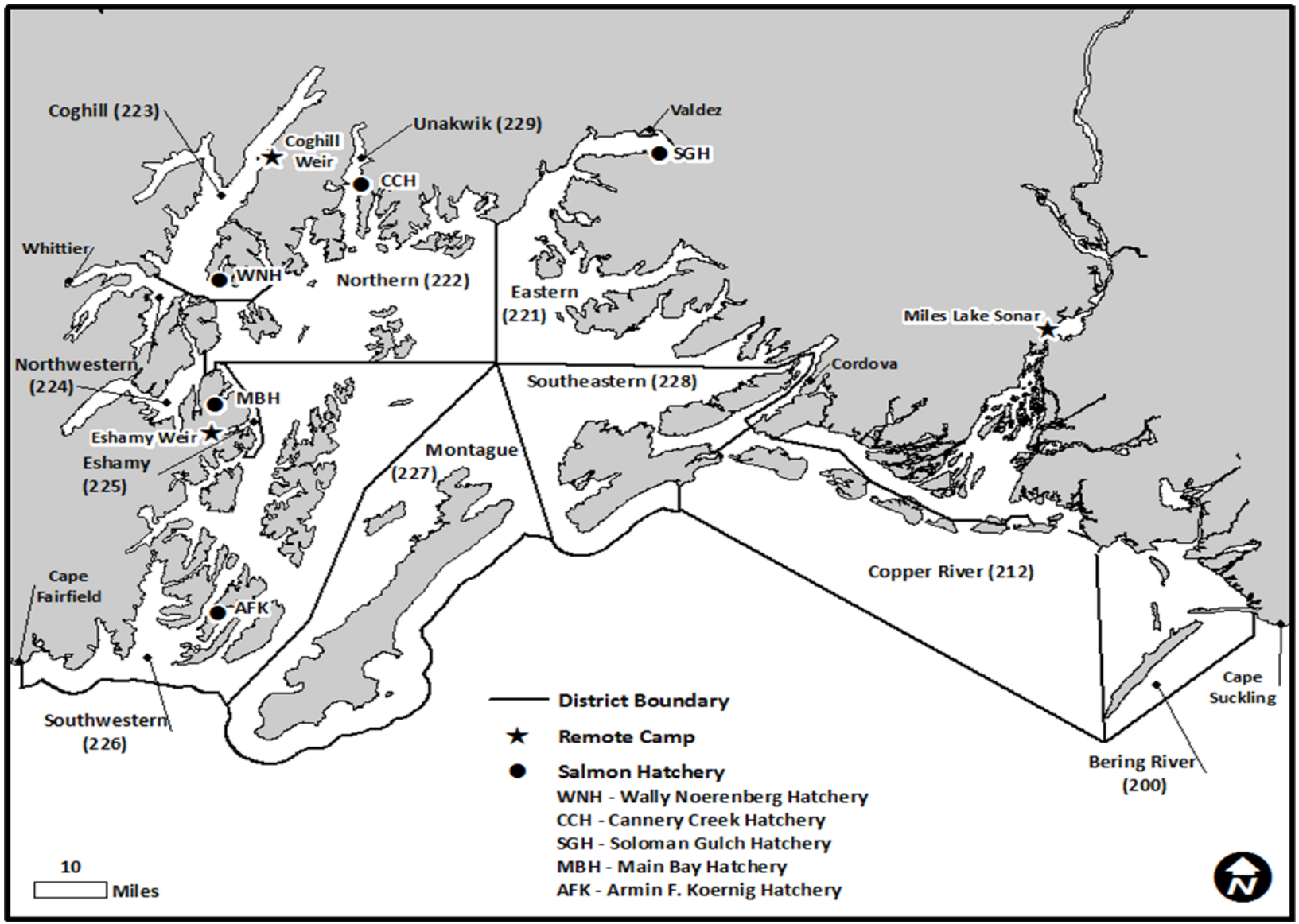

Figure 1. Prince William Sound Management Area showing commercial fishing districts and salmon hatcheries (Russell 2017).

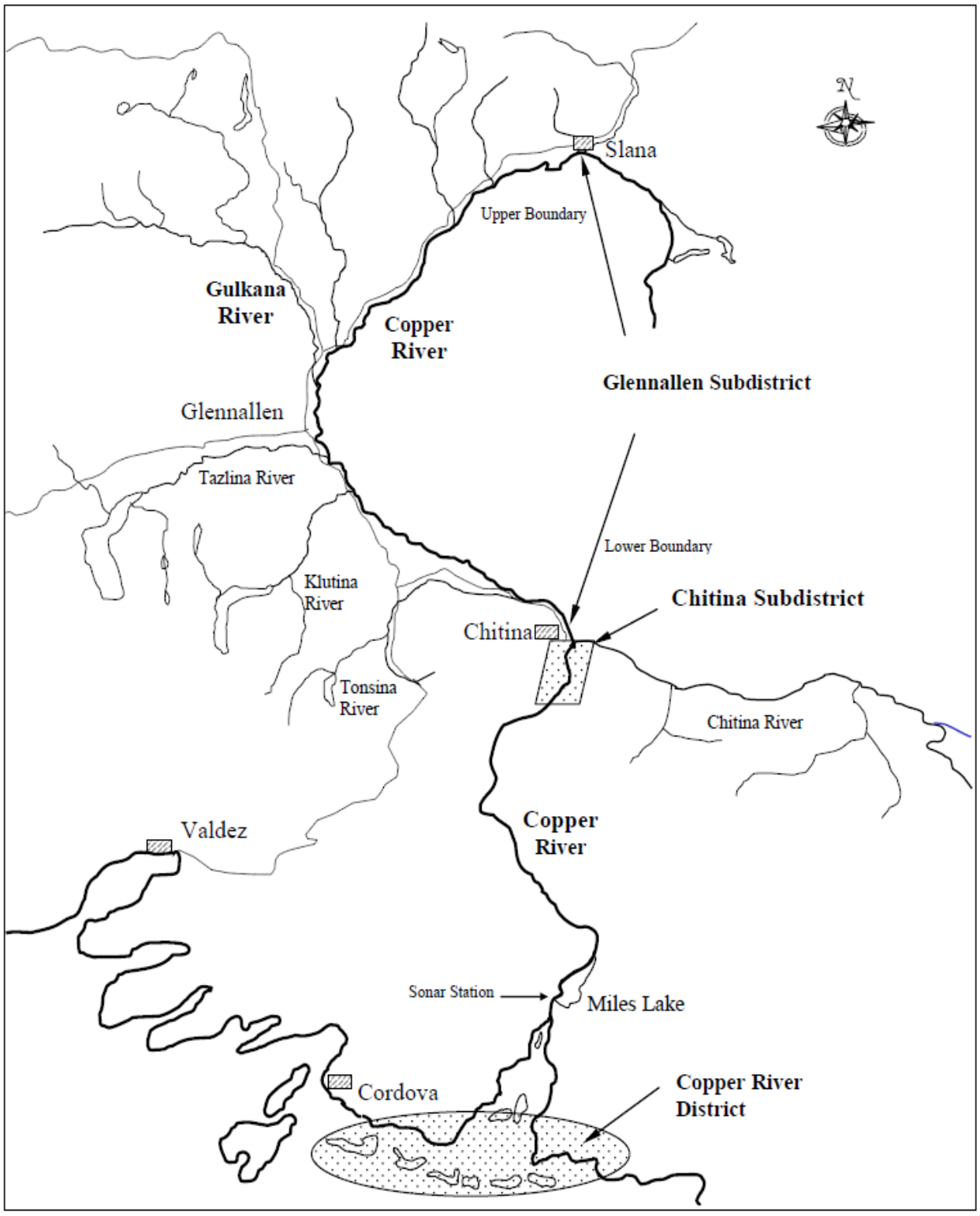

Figure 2. Map of Upper Copper River drainage state and Federal personal use and subsistence fishing districts. Adapted from Maclean 2013.

APPENDIX A

Appendix A1. A list of abbreviations used in this document.

Complete term	Abbreviation
Prince William Sound	PWS
Prince William Sound Aquaculture Association	PWSAC
Valdez Fisheries Development Association	VFDA
Solomon Gulch Hatchery	SGH
Cannery Creek Hatchery	CCH
Wally Noerenberg Hatchery	WNH
Main Bay Hatchery	MBH
Armin F. Koernig Hatchery	AFK
Gulkana Hatchery	GH
Strontium chloride (for otolith marking)	SrCl
Exxon Valdez Oil Spill	EVOS
Juneau Mark, Tag, and Age Laboratory	MTA
Alaska Department of Fish and Game	ADF&G
Division of Commercial Fisheries	CFD
Division of Sport Fisheries	DSF
Commercial common property	CCP
Hatchery cost recovery	HCR
Catch per unit effort	CPUE
Region, band, ring (otolith mark description)	RBr
Thermal mark identification (short descriptive name of thermal mark)	TMID
Fishery Biologist (specified by level)	FB I, FB II, etc.
Fish and Wildlife Technician (specified by level)	FWT II, FWT III, etc.
University of Alaska Fairbanks	UAF

APPENDIX B

Appendix B1. Sampling form for otoliths collected from Pacific salmon harvested in the commercial common property (CCP) and hatchery cost recovery (HCR) fisheries, 2019. All fields on the data sheet should be on one page.

Alaska Department of Fish and Game

Otolith Sampling Form

Commercial Fisheries - Prince William Sound

Sample Number | 1 | 9 | | | | | |

Page ____ of ____

Harvest Type: commercial hatchery

Sample Type: systematic grab **Sample Rate: _____**

Species: sockeye pink chum **Sample Time:**

begin _____ end_____

Survey Site: _____ **Date Sampled: _____**

Sampler: _____ **Date Caught: _____**

Catcher/Area Information

Processor:_____	**Gear type: Gillnet**		**Seine**	
Tender:_____	200-	222-	225-	228-
Poundage:_____	212-	223-	226-	229-
Period Number:_____	221-	224-	227-	

Name of Place Fished:_____

-continued-

Otolith Recovery Information

Total # sampled: ____ Shade the boxes of each sample taken

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												
E												
F												
G												
H												

Comments

Appendix B2. Sampling form for otoliths collected from Pacific salmon harvested as part of the state and Federal personal use and subsistence fisheries, 2019. All fields on the data sheet should be on one page.

Alaska Department of Fish and Game

Otolith Sampling Form

Upper Copper River Personal Use/Subsistence

Sample Number | 1 | 9 | D | O | | | |

ONLY 1 DATE & DATA SHEET PER SAMPLE NUMBER

Harvest Type: Personal Use Subsistence Species: sockeye

Sample Type: grab Sample Time: Begin Time: _____ End Time: _____

SURVEY SITE (INCLUDING SUB AREA): _____

SAMPLER(S): _____

Date Sampled: _____ Date Caught: _____ Stat Week:_____

-continued-

Otolith Recovery Information

Total # sampled: ____ Please indicate single otoliths or no otoliths where necessary

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												
E												
F												
G												
H												

Comments