Regional Operational Plan No. ROP.SF.2A.2022.25

Operational Plan: Crooked Creek Chinook Salmon Enhancement Project, 2022–2024

by

Jenny L. Gates

May 2022

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

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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 NO. ROP.SF.2A.2022.25

OPERATIONAL PLAN: CROOKED CREEK CHINOOK SALMON ENHANCEMENT PROJECT 2022–2024

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SIGNATURE PAGE

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Period Covered	2022–2024
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Plan Type:	Category II

Approval

Title	Name	Signature	Date
Project leader	Jenny L. Gates		
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ABSTRACT

The Crooked Creek Chinook Salmon Enhancement Project is designed to monitor both naturally- and hatchery-produced Chinook salmon (*Oncorhynchus tshawytscha*) escapement as well as collect broodstock and conduct egg takes to provide additional sport fishing opportunities within the Kasilof River and other terminal fisheries on the Kenai Peninsula. This project will imprint Chinook salmon smolt for 7 to 10 days at the beginning of June. Additionally, age, sex, and length, will be collected from returning naturally- and hatchery-produced Chinook salmon. The sustainable escapement goal for Crooked Creek is 700–1,400 naturally-produced Chinook salmon.

Keywords: Crooked Creek, *Oncorhynchus tshawytscha*, Chinook salmon, weir, ASL composition, broodstock, egg take, smolt, imprinting, escapement, return, inriver run, digital video recorder, coded wire tag, adipose finclip, otolith marking, hatchery, hatchery-produced, naturally produced, enhancement, escapement

INTRODUCTION

PURPOSE

The Crooked Creek Chinook Salmon Enhancement Project provides broodstock used to enhance Crooked Creek (Kasilof River), 1 stocked lake on the Kenai Peninsula, and terminal fisheries in Resurrection Bay and Kachemak Bay, and monitors the returns of naturally- and hatchery-produced escapements of Chinook salmon (*Oncorhynchus tshawytscha*) to Crooked Creek with the overall goal of providing additional sport fishing opportunities within these enhancement areas.

BACKGROUND

Crooked Creek is a tannin-stained stream flowing into the glacial waters of the Kasilof River approximately 11 kilometers (km) upstream of the Kasilof River's mouth in Cook Inlet. The Kasilof River (flowing from its outlet at Tustumena Lake) is approximately 31 km to Cook Inlet (Figure 1). Its origin in the glaciers of the Kenai Mountains makes it turbid throughout the year. Four species of Pacific salmon—Chinook, coho (*O. kisutch*), sockeye (*O. nerka*), and pink (*O. gorbuscha*) salmon—are present in the drainage, as well as anadromous and resident rainbow trout (*O. mykiss*), Dolly Varden (*Salvelinus malma*), resident lake trout (*S. namaycush*), and round whitefish (*Prosopium cylindraceum*; Johnson and Weiss 2006). Sport fisheries exist for all Pacific salmon species present, although most of the sport fishing effort is directed at early-run Chinook salmon destined for Crooked Creek. This operational plan describes Alaska Department of Fish and Game (ADF&G) Chinook salmon enhancement, escapement enumeration, and biological sampling at the Crooked Creek Facility.

Crooked Creek Facility and Operations

Crooked Creek originally had a stock of wild Chinook salmon, which has been supplemented with hatchery-produced Chinook salmon smolt of Crooked Creek origin. The stocking program began in 1974 and since then (except 1997 and 1998), the annual escapement has been monitored through a weir at the Crooked Creek Facility (Todd *Unpublished*[1]). Naturally-produced fish (fish from naturally spawning parents) made up 96% of the escapement in 1978, but these fish declined in proportion as hatchery production increased during the 1980s. Since 2002, the proportion of naturally-produced fish (fish denoted by the presence of an adipose fin) in the escapement has remained consistently higher than 50% and this is likely to continue due to regulation changes affecting harvest in the Kasilof River sport fishery and the reduction of the enhanced component

[1] Todd, G. L. *Unpublished*. Crooked Creek Chinook enhancement project 1990 summary report. Alaska Department of Fish and Game, Division of Commercial Fisheries, Soldotna, Alaska.

(numbers of hatchery-produced smolt released). The Crooked Creek Hatchery Facility was operated by ADF&G until 1995, when Cook Inlet Aquaculture Association (CIAA) assumed operations. Escapement monitoring continued until 1997, when the facility was returned to ADF&G. There was no escapement monitoring at the Crooked Creek Facility during 1997 and 1998. During this time, smolt continued to be stocked (via the ADF&G Elmendorf Hatchery) despite inactivity at the Crooked Creek Facility. ADF&G resumed escapement monitoring in 1999. From 1988 to 1996, the number of naturally-produced Chinook salmon was held to approximately 700 fish in the spawning escapement of Crooked Creek upstream from the hatchery. The former management policy, adopted in 2001, requires ADF&G to achieve a sustainable escapement goal (SEG) at the Crooked Creek weir of 650–1,700 ocean-age-1.2+ naturally-produced adult Chinook salmon during the early run (Bue and Hasbrouck *Unpublished*[2]). Under the current management policy, adopted in 2020, the SEG is 700–1,400 (McKinley et al. 2020).

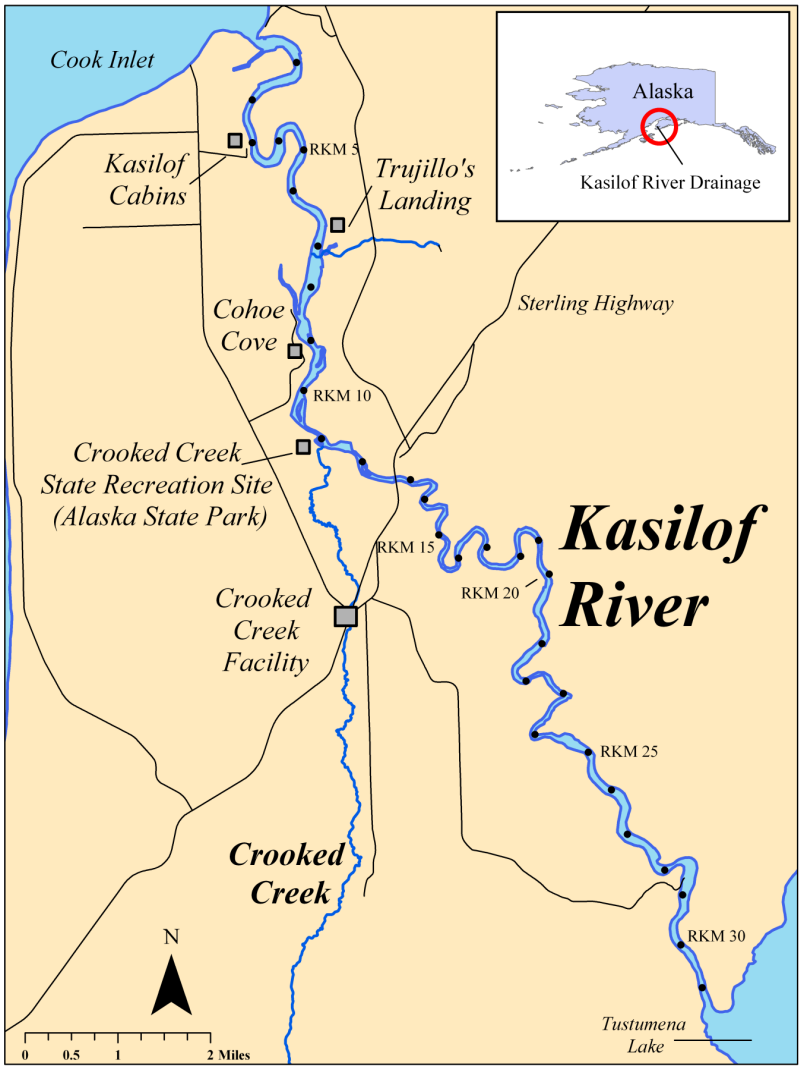

Figure 1.–Map showing the Crooked Creek Facility, Kasilof River, and river access locations.

[2] Bue, B. G., and J. J. Hasbrouck. *Unpublished*. Escapement goal review of salmon stocks of Upper Cook Inlet. Alaska Department of Fish and Game, Report to the Alaska Board of Fisheries, November 2001 (and February 2002), Anchorage.

Beginning in 2021, staff started minimizing the escapement of hatchery-produced fish to ensure that the proportionate natural influence (PNI) is 0.67 or higher (Pearsons et al. 2020). PNI is calculated using the proportion of naturally-produced fish in the broodstock (pNOB) and the proportion of hatchery-produced fish in the escapement (pHOS) as PNI = pNOB/(pNOB + pHOS). Between 2011 and 2020 the PNI for the Crooked Creek hatchery program fell below 0.67 on 2 occasions.

Historically, hatchery-produced smolt from Crooked Creek Chinook salmon stock have been stocked at sites other than Crooked Creek to create or enhance other sport fisheries. Presently, this stock is used to enhance Crooked Creek itself, 1 stocked lake on the Kenai Peninsula, and terminal fisheries in Resurrection Bay and Kachemak Bay. From 1974 through 1994, broodstock collection and egg takes were conducted at the Crooked Creek Hatchery, although broodstock were from both hatchery- and naturally-produced parents. In 1995, broodstock collection moved to the Nick Dudiak Fishing Lagoon (Homer Spit) where progeny from Crooked Creek Chinook salmon were returning. Adult fish were captured at Homer Spit, transported to Elmendorf Hatchery, and held for egg takes. Spawning success was low, varying from 34% in 1995 to 66% in 1996 (D. Keifer, ADF&G, Elmendorf Hatchery, personal communication). Hormone ripening tests were conducted in 1997 and 1998 (at Homer Spit) with generally poor results. Because of these problems and incidences of straying in adult Chinook salmon, egg takes and smolt imprinting were moved back to the Crooked Creek Facility. Starting in 1999, smolt were held at the facility for imprinting to address straying problems, egg takes were conducted to improve spawning success, and fertilized gametes were taken to Fort Richardson Hatchery for incubation. Beginning in 2011, gametes have been transported separately to the William Jack Hernandez Sport Fish Hatchery (WJHSFH) where they are fertilized in a process called delayed fertilization and then the fertilized eggs are incubated. Beginning in 2004, only naturally-produced Chinook salmon were used as broodstock for restocking Crooked Creek.

Concerns about straying have resulted in other changes to the stocking policy. Beginning in 2000, the stocking level was decreased from approximately 210,000 smolt (1999 level) to approximately 105,000 smolt, and all smolt were marked with an adipose finclip (AFC), a coded wire tag (CWT), and a thermal otolith mark. In previous years, the marking rate was highly variable, ranging from 12.5% to 50.0%. Currently, it is estimated that the AFC marking rate is 100%. Coded wire tags were discontinued with the 2011 smolt release year, resumed with the 2015 smolt release year, but then discontinued again in 2018; however, adipose finclips and thermal marks were used for marking hatchery-produced fish during this time and these are still currently implemented. Evidence of straying amongst hatchery-produced fish of Crooked Creek origin has been negligible since hatchery operations were improved in the early 2000s. This, combined with an increase in hatchery capacity in 2014, allowed ADF&G to increase stocking levels to approximately 140,500 smolt beginning in 2015.

OBJECTIVES

PRIMARY OBJECTIVES

The annual primary objectives of this study during 2022–2024 are as follows:

1) Census the escapement of ocean-age-2+ naturally- and hatchery-produced Chinook salmon in Crooked Creek that pass through the weir from late May to the middle of August.

2) Estimate the age composition, sex composition, and age-by-sex composition of ocean-age-2+ naturally- and hatchery-produced Chinook salmon in Crooked Creek, such that the estimated proportions are within 10 percentage points of the true value 90% of the time[3].

SECONDARY OBJECTIVES

Annual secondary objectives of this project are as follows:

1) Hold, imprint, and release approximately 140,500 Chinook salmon smolt at the Crooked Creek Facility in June[4].
2) Collect, hold, and artificially spawn a minimum of 115 male and 115 female naturally- and hatchery-produced Chinook salmon adults returning to Crooked Creek during July 2022–2024 to produce approximately 140,500 smolt to release into Crooked Creek and up to 315,000 smolt for other releases in 2023–2025[5].
3) Monitor upstream migration of returning adult sockeye salmon during the Chinook salmon run from late May to the middle of August.
4) Estimate the mean length-at-age of ocean-age-2+ naturally- and hatchery-produced Chinook salmon in Crooked Creek that pass through the weir from late May to the middle of August.
5) Minimize the number of hatchery-produced Chinook salmon in the spawning escapement.

METHODS

STUDY DESIGN AND DATA COLLECTION

Escapement Sampling

ADF&G personnel will monitor the weir from late May until approximately the middle of August or until the daily count of Chinook salmon through the weir is less than 1% of the cumulative seasonal count for 3 consecutive days. Fish will be allowed unobstructed passage through a chute (connected to a video camera box) located and attached to a gate in Raceway 1 (Figure 2) during periods of low fish passage, but during high fish passage, fish will be manually counted. Manual counting during periods of high fish passage is logistically easier because staff are already handling fish for brood stock collection, and this allows staff to cull hatchery-produced fish to maximize PNI.

A digital video recorder (DVR) located inside a building near the raceway will be used to record fish passage through the Crooked Creek Facility via a digital video system located in Raceway 1 (Figure 2). One underwater video camera will be located inside a sealed video box that will be attached to the fish passage chute. The video box will be constructed of 3.2 mm aluminum sheeting and will be filled with filtered or bottled water to keep it submerged under the water in the raceway. One-half inch thick glass will be installed on the front of the video box to allow for a scratch free, clear surface through which video footage of passing fish will be captured. Two 12 V underwater

[3] Within d% of the true value A% of the time" implies $P\left(p_i - \frac{d}{100} \le \hat{p}_i \le p_i + d/100\right) = A/100$ where p_i denotes the population age proportion for age class i.

[4] Due to low numbers of naturally produced Chinook salmon returning to the Crooked Creek Facility in 2021, approximately 97,000 smolt will be stocked in 2022 only.

[5] These numbers are provided by William Jack Hernandez Sport Fish Hatchery staff and may change in response to stocking demands and production at other broodstock collection sites.

pond lights will be mounted inside the video box to provide a consistent source of light during all hours of the day and night. The underwater pond lights are wired to an inverter located in the small building adjacent to the raceways and operates off AC power.

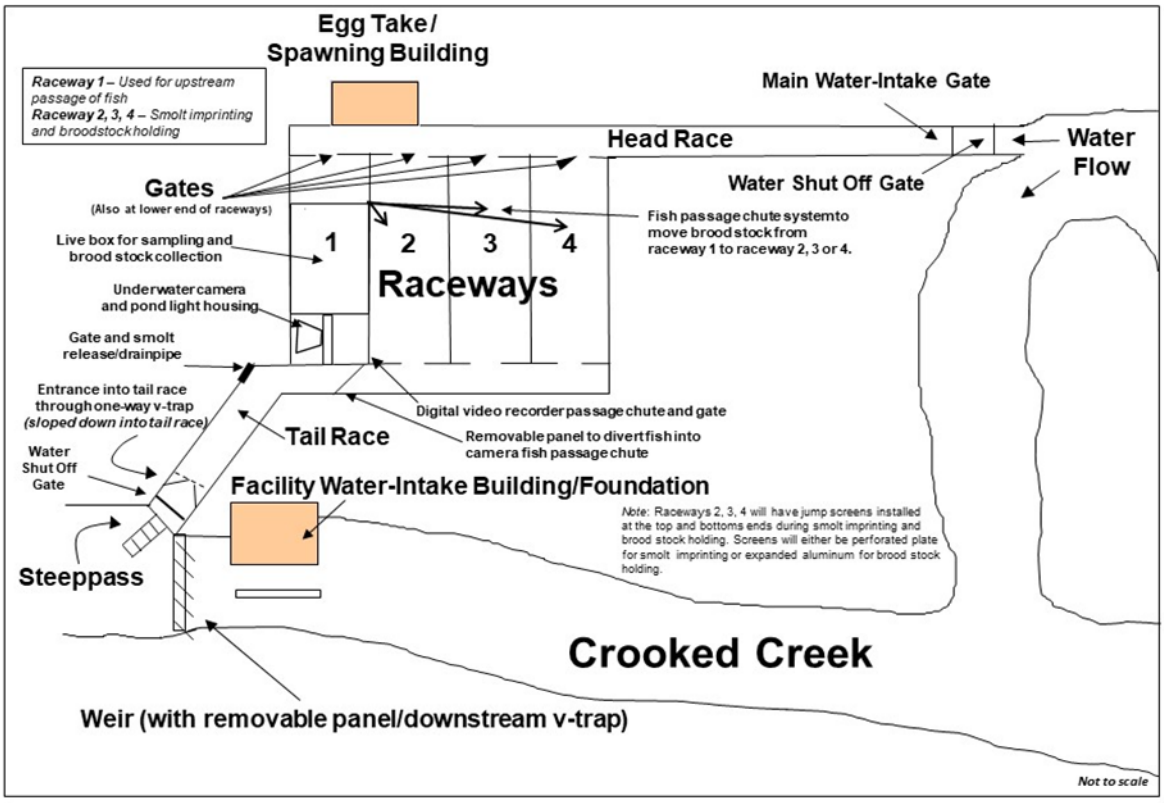

Figure 2.–Diagram of the layout of the Crooked Creek Facility, weir, and passage chute.

Video information will be reviewed on weekdays by ADF&G personnel. All Chinook salmon will be examined for the presence of an AFC from recorded video footage. The hatchery contribution to the adult escapement into Crooked Creek can be obtained directly from the count of adipose finclipped (AFC) Chinook salmon at the weir each year because all returning adults are from stocking release groups that were 100% marked, and all Chinook salmon are inspected for AFC marks by examining recorded video footage. Other species of adult fish such as Dolly Varden, rainbow trout or steelhead, pink salmon, sockeye salmon, and coho salmon will be enumerated. Occasionally, lamprey (Petromyzontidae) also pass through the weir and will be noted. Juvenile salmonids will not be identified or enumerated. All observed data will be recorded on the DVR Passage Data Form (Appendix A1). Chinook salmon longer than a 20-inch reference mark located within the DVR passage chute will be considered ocean-age-2+ fish; those shorter than the mark will be considered jacks (ocean-age-1 Chinook salmon). Limited historical data from 1999 indicate that mid eye to tail fork (METF) lengths of ocean-age-1 fish were within a range of 311–428 mm and ocean-age-2 fish were within a range of 510–720 mm (20 inches = 508 mm). Because the 20-inch reference mark is compared to total length, the 20-inch mark likely excludes all jack Chinook salmon although some ocean-age-2 Chinook salmon may be excluded erroneously. Sport fishing regulations define bag limits for Chinook salmon shorter or longer than 20 inches of length.

All mortalities that occur within the facility before the DVR (i.e., within the V-trap within the tail raceway) will be recorded on the Facility Mortalities Data Form (Appendix A2 and Appendix A3). Any mortalities that occur upstream of the DVR system in Raceway 1 or the head raceway will also be recorded on this data form. Although rare, other situations, such as physically moving fish by net upstream of the facility, will also be recorded on the DVR Passage Data Form (Appendix A1 and Appendix A3).

Manual fish enumeration will be implemented during the peak of the run, which corresponds with broodstock collection. The live box (Figure 2) above the video chute will be crowded and emptied of fish. The door at the upper end of the live box will then be closed for the duration of the project or until few hatchery-produced fish are returning to the facility. Each fish that arrives in the live box will be manually counted and either released above the trap to escape back to the creek or be collected as brood stock. Most hatchery-produced fish will be culled. All fish encountered in the trap will be tallied on a counter and entered on the Daily Weir Reporting Form (Appendix A3). Once daily counts of hatchery-produced fish have diminished, the DVR will be reinstated.

The total number of adults that return to the weir will be the sum of the daily counts (counts derived from reviewing digital video or manually counting) and the mortalities that occurred in the tail raceway before entering the DVR system. Daily escapement counts will be defined as the DVR or manual daily count minus broodstock collection for that day and any mortalities that occur upstream of the DRV system as well as hatchery-produced fish that are culled. Escapement counts will include broodstock that are manually passed upstream and not used for egg takes.

During periods of DVR-based enumeration, staff will not be stationed at the facility after normal working hours or on weekends. In the case of an electrical malfunction, a battery backup and alarm system are in place. This system will ensure a minimal amount of data are lost in the event of a power outage. An alarm system will automatically call ADF&G personnel and notify them of the problem and corrective measures will be taken immediately. The battery backup system will provide power to the DVR system until staff can address the problem.

If there is a DVR malfunction, the gate to the upstream DVR passage chute and the swinging gate at the sampling structure will be closed as soon as possible. All fish will be held in the tail race and diverted to the sampling structure box (Figure 2) for biological sampling, broodstock collection, or culling; fish will be counted and passed upstream manually each day until the DVR is operable. Staff schedules will be adjusted accordingly to allow for counting 7 days a week.

New weir designs were implemented during the 2009 and 2010 field seasons to improve juvenile fish and emigrating steelhead kelt passage. A daily count will be kept of any steelhead or other emigrating fish species mortalities caused by the weir structure as well as for emigrating fish that may be trapped, requiring assistance to pass the weir. The daily count data will be recorded on the Weir Mortalities and Trapped Emigrating Fish Data Form (Appendix A4). The weir will be cleaned to remove debris as necessary to ensure adequate water flow through the weir.

Stream level readings and temperature above and below the weir will be recorded daily (Appendix A5) when the weir is being cleaned.

Due to gravel movement in an upstream braided channel above the Crooked Creek Facility, the water flow into the main water intake gate may be greatly diminished. In 2004, 2005, 2008, and 2011–2020 ADF&G personnel obtained an ADF&G, Division of Habitat, Fish Habitat Permit and dredged this area to a depth of approximately 4 feet using a large track hoe. This dredging increases

the water flow into the main water intake gate, head trough, and subsequently into all raceways (Figure 2). A creek inspection will be completed by late April and if it is needed, dredging will be completed by middle May 2022 if snow depth and spring weather permits and if the Department of Transportation spring road restrictions do not limit heavy equipment transportation. Other measures will be taken to divert water as well. In the event of low water levels, a fence made with specialty fabric will be installed in Crooked Creek at a slight angle such that it parallels the current. It will divert water from the main channel to the channel that feeds water to the facility. An ADF&G, Division of Habitat, Fish Habitat Permit will be obtained for this activity as well.

Substantial renovations of the Crooked Creek Facility occurred during the fall of 2016 to address safety concerns at the failing facility. These renovations changed how the facility was operated beginning in 2017 and have been addressed in this operational plan.

Smolt Imprinting and Release

Depending on spring weather and in preparation of DVR installation and smolt delivery, Raceways 1, 2, 3, and 4 at the Crooked Creek Facility will be cleaned using high-pressure water hoses or by running a small amount of creek water through the raceways and manually sweeping sediment out of the facility in late May. Once debris and sediment are removed, the raceways will be disinfected with a water and Betadyne solution of 200 parts per million (A. Tesch, ADF&G, WJHSFH, personal communication). Preferably, this will be done on a sunny day to increase the effectiveness of the microbiocide treatment. Specialized smolt panels constructed of perforated plate will be installed at the upper and lower ends of the raceways to prevent smolt from out-migrating. The raceways will then be flooded with water such that the water level is maintained within 0.3 m of the top of the raceway walls. One technician and the project biologist will be involved in the preparation. The DVR system will be operational during the smolt imprinting period.

Chinook salmon smolt (approximately 140,500 fish with an expected 100% AFC and thermal otolith mark) will be transported from WJHSFH to the Crooked Creek Facility during the first week of June. A network of ultraviolet stabilized polyethylene fabric panels will be hung over the raceway to protect the imprinting smolt from sunburn and the feeding activities of birds. ADF&G personnel will be on duty to feed the smolt a minimum of twice daily and to monitor operations. Smolt will be held for approximately 7 to 10 days for imprinting. A daily smolt mortality census will be conducted and recorded on a Smolt Imprinting and Release Data Form (Appendix A6). Dead smolt will be examined for an AFC and will be measured (total length in millimeters) and recorded on the Smolt Mortality Data Form (Appendix A7). If mortality levels become a concern, smolt may be released sooner. Other information including water temperature, dissolved oxygen content, and quantity of food fed in each raceway will be recorded on a Smolt Imprinting and Release Data Form (Appendix A6). Water quality recordings will be taken at the inlet and outlet of the raceway. If ADF&G personnel encounter any problems with water flow into Raceways 2, 3, or 4 during the 7 to 10 days of imprinting, staff will consider an earlier smolt release.

Once imprinting period is complete, the specialized smolt panels at the lower end of the raceways and the diversion panel in the tail raceway (Figure 2) will be removed at the time of release. Smolt will exit the facility using the tail raceway and facility drainpipe. The smolt release will occur over an approximately 2-day period in which the facility drainpipe will be fully opened to allow remaining smolt to exit (Figure 2). The remaining smolt panels will be removed and replaced with expanded aluminum jump screens for holding broodstock (Figure 2). After the smolt are released,

Raceways 2, 3 and 4 will be dewatered, cleaned, and disinfected in preparation for holding adult Chinook salmon for broodstock.

Biological Sampling

A sample size of 101 adult Chinook salmon for estimation of the age and sex composition of the escapement of adult (age-1.2+) Chinook salmon was determined by the methods in Thompson (1987). Given that age cannot be determined on approximately 15% of the scale samples, sampling 118 adult Chinook salmon would meet the stated objective criterion. Assuming approximately 1,064 ocean-age-2+ naturally-produced Chinook salmon migrate to the weir during 2022[6], then a sampling rate of 1:9 naturally-produced fish will be required. Assuming approximately 1,606 ocean-age-2+ hatchery-produced Chinook salmon migrate to the weir during 2022[7], then a sampling rate of 1:13 hatchery-produced fish would meet the stated objective criterion.

During broodstock collection periods and periods of manual fish counting, biological samples will be collected twice weekly, which is tentatively scheduled to be on Tuesdays and Fridays. When the DVR system is being used to enumerate fish passage, the live box gate will be closed on Mondays and Thursdays to facilitate sampling the following day. During the middle of the run (when fish passage is high and the DVR system is discontinued), the same procedure will be employed. After a fish is sampled, it will either be placed into Raceway 2, 3, or 4 via fish passage chutes for holding as broodstock, passed into Raceway 1 above the trap for upstream passage or culled depending on marking status.

During use of the DVR system, fish will be given an anal fin hole-punch mark so that duplicate sampling doesn't occur if the fish ends up back in the trap. Because every fish will be sampled on sampling days there is no selective sampling of fish within the trap. All fish are crowded into the upstream end of the trap prior to sampling. The water flow at the main water intake gate will be reduced during sampling (Figure 2).

Adult Chinook salmon collected for sampling will be examined for sex, measured for length (mid eye to tail fork to the nearest 1 mm), and examined for the presence of an AFC. Scales will be removed from each collected fish and all data will be recorded on the Scale Sampling Data Form (Appendix A8). Three scales from the preferred area[8] will be collected from each adult Chinook salmon selected for age sampling (Welander 1940). Scales will be mounted on adhesive coated scale cards; the scales will be pressed such that impressions are made on acetate cards to allow for age determination postseason, following procedures described by Mosher (1969). After each fish is sampled for age, sex, and length, a hole punch will be administered to the anal fin. This anal fin hole punch will mark each fish and help prevent field technicians from sampling fish twice in the event the fish ends up back in the trap while using the DVR system for enumerating. Fish collected for broodstock, mortalities, and culled hatchery-produced fish will be recorded by sex and tallied on the Broodstock Collection Data Form (Appendix A9). Counts of all fish by type and species will also be tracked on counters.

Ocean-age-1 hatchery-produced Chinook salmon, easily identified by their small size (less than 20 inches total length), will be culled as they are encountered. This will be on either biological

[6] The average of 2019–2021 naturally-produced fish to the weir was 1,064.

[7] The average of 2019–2021 hatchery-produced fish to the weir was 1,606.

[8] The preferred area for scale sampling is on the left side of the fish at a point on a diagonal line from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin, 2 rows above the lateral line.

sampling days or on broodstock collection and manual counting days and will be recorded on the Broodstock Collection Data Form (Appendix A9). Naturally-produced jack Chinook salmon will not be sampled and will be passed upstream of the trap for passage out of the facility.

Broodstock Collection and Egg Takes

Broodstock collection will begin in approximately late June or as soon as semi-ripe fish start returning to the weir. During biological sampling days and (or) broodstock collection days, fish of acceptable sexual maturity will be moved via a chute system to Raceways 2, 3, or 4 and held for an egg take. Fish that are not used for broodstock will be placed upstream of the live box in Raceway 1 and allowed passage upstream to Crooked Creek via the head raceway. Raceway 2 will be used to hold naturally-produced Chinook salmon broodstock, and Raceways 3 and 4 will be used to hold hatchery-produced Chinook salmon broodstock. Each raceway will contain mixed sexes, and staff will collect and sort fish so that each raceway holds approximately the same number of males and females.

Any brightly colored naturally-produced Chinook salmon encountered during broodstock collection will be immediately passed upstream because they have higher mortality rates when held. Most hatchery-produced Chinook salmon will be kept as broodstock until a sufficient number has been attained, at which time fish will be culled to limit the number of hatchery-produced fish in the escapement. The minimum request from WJHSFH of 115 males and 115 females (35 pairs naturally-produced and 80 pairs hatchery-produced) will be obtained from egg takes that will occur 2 or 3 times throughout the middle to later part of July. Additional egg takes may occur at Crooked Creek if more eggs are needed to help with broodstock shortages at other egg take locations. While fish are being held, Raceways 2, 3, and 4 will be partially covered by a network of polyethylene, ultraviolet stabilized fabric panels to provide shelter from environmental conditions. Water temperature, mortalities, and dissolved oxygen content of each raceway will be recorded daily on the Broodstock Holding Hydrology Form (Appendix A10), and all mortalities will be recorded on the Brood Stock Mortality Data Form and Daily Weir Reporting Data Form (Appendix A11 and Appendix A3).

Only naturally-produced Chinook salmon will be used as broodstock to support Crooked Creek stocking demands whereas both naturally- and hatchery-produced Chinook salmon will be used as broodstock to support stocking demands in other drainages. If small numbers of naturally-produced Chinook salmon return, collection of naturally-produced broodstock will be reduced to try and meet the lower bound of the SEG (700). Hatchery-produced Chinook salmon progeny will not be used for restocking Crooked Creek in years when naturally-produced Chinook salmon runs are low. Consequently, Crooked Creek may not be stocked with the total requested number of smolt in subsequent years.

Adult Chinook salmon held for broodstock will be examined to determine sexual maturity; this will assist in setting dates for egg takes. If fish are not ripening during sorting and if sufficient numbers of fish are returning, select broodstock will be released upstream. This will be recorded on the Broodstock Collection Data Form (Appendix A9) and noted on the Daily Weir Reporting Data Form (Appendix A3). Egg takes are tentatively scheduled to begin in the middle of July and will be conducted weekly until desired numbers of fish have been artificially spawned. WJHSFH staff and Soldotna sport fish staff will conduct the egg takes. WJHSFH staff will provide necessary equipment for collecting gametes from broodstock. Eggs will be taken on site following a limited Chinook salmon egg-take protocol (ADF&G 1983). Fish used for the egg take will be sacrificed

and recorded on the Egg-Take Data Form (Appendix A12). The abdomen of the fish will be wiped with Betadyne before removing the eggs. Separate (male and female) gametes will be placed in sealed plastic bags. The gametes will be placed on ice in coolers for transport the same day to WJHSFH, where they will be fertilized. Fish used for egg takes will be sampled for Infectious Hematopoietic Necrosis Virus (IHNV) and sampled for Bacterial Kidney Disease (BKD) by collecting ovarian fluid samples from females and liver-kidney samples from males. These samples will be sent to the ADF&G Fish Pathology Laboratory for testing.

After egg takes have been conducted and regional broodstock collection goals have be met, surplus hatchery-produced Chinook salmon being held for broodstock will be culled.

Sockeye Salmon

Small numbers of sockeye salmon arrive at the Crooked Creek weir in July. Some sockeye salmon may pass upstream of the weir while the DVR is operating. Infectious hematopoietic necrosis virus (IHNV) is commonly found in sockeye salmon (Meyers 2003) and high densities of sockeye salmon on Chinook salmon spawning grounds can increase the potential spread of IHNV to Chinook salmon. Should Crooked Creek Chinook salmon stocks become infected with IHNV, the ability to use them for broodstock for Chinook salmon enhancement projects would be compromised. Because run timing of Crooked Creek sockeye salmon and Chinook salmon differ slightly, concerns of disease transmission during broodstock collection periods are reduced (Meyers, Fish Pathology Laboratory, ADF&G, personal communication).

Sockeye salmon will be able to pass through the Crooked Creek Facility freely although their passage will be recorded and enumerated using the DVR and data recorded on the DVR Passage Data Form (Appendix A1) and Daily Weir Reporting Data Form (Appendix A3). On sampling days, broodstock collection days, and during manual fish counting, any sockeye salmon encountered will be enumerated, destroyed, and recorded on the Daily Weir Reporting Data Form (Appendix A3). End of season sockeye salmon escapement summaries will be given to ADF&G Fish Pathology Laboratory and hatchery personnel for evaluation, and programmatic recommendations will be solicited.

DATA REDUCTION

Crooked Creek DVR counts, facility mortalities, weir mortalities, smolt imprinting, smolt mortalities, broodstock collection, broodstock holding hydrology, brood stock mortalities egg take, and ASL information will be recorded on specialized field data forms (Appendices A1–A12). Technicians will return data forms to the Soldotna ADF&G office daily. The Project Biologist will examine all data forms for errors and enter the data electronically. The Project Biologist will convert the data to fixed width, comma separated values (.csv), modified mark sense format for analysis.

Data maps for all information collected in this project are shown in Appendices B1–B2. The project biologist will edit Crooked Creek biological and escapement data to ensure values of counts, age, and length-at-age are within regular bounds. The biologist will also prepare inseason data summaries daily, conduct postseason data analyses, and write the Division of Sport Fish Fishery Data Series report. All Crooked Creek data will be entered into computer files and edited by 1 November. A final edited copy of all data files along with a data map will be sent to the Alaska Department of Fish and Game Research and Technical Services (RTS) for archiving.

DATA ANALYSIS

Separate analyses will be conducted for naturally- and hatchery-produced fish. All (100%) hatchery-produced fish are marked; therefore, the number of marked Chinook salmon counted in the escapement is equal to the contribution of hatchery releases to the escapement.

The number of ocean-age-1 Chinook salmon (jacks) in the escapement will be determined by comparing all passed fish to a 20-inch reference mark. The number of adult Chinook salmon in the escapement (N^{adult}) will be calculated by subtracting the number of jacks (N^{jack}) from the total number of Chinook salmon that passed through the weir (N^{weir})[9]:

$$N^{adult} = N^{weir} - N^{jack} \tag{1}$$

The total number of adults that returned to the weir will be the sum of escapement (N^{adult}), the number of adult Chinook salmon that died during holding or in the facility downstream of the DVR, and the number used for egg takes.

The sampling protocol attempts proportional sampling of the total escapement. If proportional sampling is achieved or age compositions do not differ between temporal strata, then samples will be pooled and unstratified estimates will be calculated. To test if a stratified estimator is required, the run will be split into 4 temporal strata based on the daily escapement counts such that each stratum represents approximately a quarter of the total run, and a likelihood ratio test (G-test, $\alpha = 0.05$) will be applied to age-by-time contingency tables. The likelihood ratio test statistic, the G-statistic, will be calculated as follows:

$$G = 2\sum_i f_i \ln\left(\frac{f_i}{\hat{f}_i}\right) \tag{2}$$

where f_i is the observed number of fish in the ith cell of the age-by-time contingency table, and $\hat{f}_i$ is the expected number of fish in the ith cell calculated under the assumption that age proportions don't change over time (Sokal and Rohlf 1995). The G-statistic has an approximate χ^2 distribution with $(r-1)(c-1)$ degrees of freedom, where r is the number of rows and c the number of columns in the table.

The following describes estimation of the age composition; estimation of the sex or age-by-sex composition is accomplished with appropriate substitutions. The proportion of adult (ocean-age-.2 and older) Chinook salmon that belong to age class z in the escapement by sampling stratum will be estimated as follows:

$$\hat{p}_{tz} = \frac{n_{tz}}{n_t} \tag{3}$$

where $\hat{p}_{tz}$ is the estimated proportion of adult salmon passing the weir during sampling stratum t from age category z, n_{tz} is the number of fish sampled during sampling stratum t that were classified as age category z, and n_t is the number of salmon sampled for age determination during sampling stratum t.

The estimated sampling variance of $\hat{p}_{tz}$ will be calculated by

[9] Minor adjustments will be made if mortalities are observed within the facility upstream of the DVR.

$$\text{var}\left[\hat{p}_{tz}\right] = \left(1 - \frac{n_t}{N_t^{adult}}\right) \frac{\hat{p}_{tz}\left(1 - \hat{p}_{tz}\right)}{n_t - 1} \tag{4}$$

where N_t^{adult} is the number of adult Chinook salmon passing the weir during sampling stratum *t*.

The estimates of escapement by age category in each sampling stratum will be calculated by

$$\hat{N}_{tz}^{adult} = N_t^{adult} \hat{p}_{tz} \tag{5}$$

with variance estimated as

$$\text{var}\left[\hat{N}_{tz}^{adult}\right] = N_t^{adult^2} \text{var}\left[\hat{p}_{tz}\right] \tag{6}$$

The total adult escapement by age category and its variance will then be estimated by summation:

$$\hat{N}_z^{adult} = \sum_{t=1}^{L} \hat{N}_{tz}^{adult} \tag{7}$$

and

$$\text{var}\left[\hat{N}_z^{adult}\right] = \sum_{t=1}^{L} \text{var}\left[\hat{N}_{tz}^{adult}\right] \tag{8}$$

where L equals the number of sampling strata.

Finally, the proportion of the adult escapement by age category and its variance will be estimated by

$$\hat{p}_z = \frac{\hat{N}_z^{adult}}{N^{adult}} \tag{9}$$

and

$$\text{var}\left[\hat{p}_z\right] = \frac{\text{var}\left[\hat{N}_z^{adult}\right]}{N^{adult^2}}. \tag{10}$$

If age composition is independent of time, age proportions for the escapement ($\hat{p}_z$), as well as the number of fish by age ($\hat{N}_z^{adult}$) and their estimated variances, will be calculated using Equations 3–6 with the pooled data and ignoring subscripts for temporal strata.

Mean length-at-age of naturally- and hatchery-produced Chinook salmon will be estimated by standard statistical techniques.

SCHEDULE AND DELIVERABLES

Dates	Activity
May 24, 2022	Install Crooked Creek weir (Gates, Stumpf, Wurst, Kassube)
May 28–31, 2022	Clean and disinfect raceways prior to smolt delivery (Gates, Stumpf, Wurst, Kassube)
June 1–7 through 10, 2022	Hold Chinook salmon smolt for imprinting and release (Gates, Stumpf, Wurst, Kassube)
June 7–August 15, 2022	Census all fish passed upstream of weir and sample adult Chinook salmon (Gates, Stumpf, Wurst, Kassube)
August 1–August 15, 2022	Crooked Creek Facility cleanup, winterization, and monitor weir (Gates, Stumpf, Wurst, Kassube)
August 15, 2022	Weir removal (Gates, Stumpf, Wurst, Kassube)
November 1, 2022	Crooked Creek Chinook salmon escapement project FDS report (Gates, Stumpf)
November 15, 2022	Scale ageing (Stumpf)
December 15, 2022	Data analysis and results (Gates, Stumpf)
April 1, 2025	Review operational plan (Gates, Stumpf)

RESPONSIBILITIES

Jenny Gates, Fishery Biologist II, Project Leader
Duties: The project leader is responsible for overseeing project development and operations, data quality, data analysis, and report preparation. This position is responsible for ensuring accurate inseason data editing and reduction, postseason data analysis, and a summary of the enhancement program to be reported in a Fishery Data Series (FDS) report. This position ensures that inseason Crooked Creek weir data is entered accurately and uploaded into ADF&G's Internet "DocuShare," Region II Inseason Data, entitled: "Crooked Creek Weir Summary." This position will draft the project operational plan, assist in the FDS report writing, review performance reports and synopsis, as well as manage the project budgets, budget requests, and midyear audits. This position is also lead in communications for facility maintenance issues.

Lucas Stumpf, Fishery Biologist I, Field Biologist
Duties: The field crew leader is responsible for overseeing project development, data quality, data analysis, and report preparation. This position is responsible for hiring and training any new personnel, leading 2 technicians, inseason data editing and reduction, postseason data analysis, and a summary of the enhancement program to be reported in an FDS report. This position will ensure that all data are in proper format for SF Research and Technical Services (RTS) and are archived with RTS at the completion of the field season. Inseason duties include entering Crooked Creek weir data into ADF&G's Internet "DocuShare," Region II Inseason Data, entitled: "Crooked Creek Weir Summary." This position is responsible for informing their supervisor of any problems with equipment or personnel affecting the completion of this project. At the end of the season, this position will supervise crew activities involved with winterizing field equipment and the Crooked Creek Facility. This position will assist in writing the project operational plan, FDS report, performance report, and synopsis as well as assist in tracking the budget, assist in preparation of

budget requests and midyear audits, write performance evaluations for technicians, apply for and renew fish transport permits, and apply for fish habitat permits. This position also interacts with Anchorage hatchery staff in evaluation of the Crooked Creek enhancement program and coordinates activities associated with the Chinook salmon smolt release and the adult egg takes at Crooked Creek.

Adam Reimer, Biometrician III
Duties: The Biometrician is responsible for review, consultation, and approval of design and analytical procedures.

Denali Wurst, Fish and Wildlife Technician II, (May 24–August 15)
Duties: Assist with 1) conducting a census of fish passed upstream of the weir at Crooked Creek and 2) biological sampling adult Chinook salmon. This individual will be responsible for conducting inseason Crooked Creek escapement counts either manually or using a DVR, pre- and postseason cleaning and disinfecting of raceways, feeding and imprinting smolt, assisting in egg takes and preparation of the Crooked Creek Facility for winter. As time allows, this individual may be involved in some facility maintenance activities, such as painting buildings and vegetation control.

Sean Kassube, Fish and Wildlife Technician II, (May 24–August 15)
Duties: Assist with 1) conducting a census of fish passed upstream of the weir at Crooked Creek and 2) biological sampling adult Chinook salmon. This individual will be responsible for conducting inseason Crooked Creek escapement counts either manually or using a DVR, pre- and postseason cleaning and disinfecting of raceways, feeding and imprinting smolt, assisting in egg takes, and preparation of the Crooked Creek Facility for winter. As time allows, this individual may be involved in some facility maintenance activities, such as painting buildings and vegetation control.

Vacant, Non- Permanent Fish and Wildlife Technician II, (July 1 –August 15)
Duties: Assist with 1) conducting a census of fish passed upstream of the weir at Crooked Creek and 2) biological sampling adult Chinook salmon. This individual will be responsible for conducting inseason Crooked Creek escapement counts either manually or using a DVR, pre- and postseason cleaning and disinfecting of raceways, assisting in egg takes and preparation of the Crooked Creek Facility for winter.

BUDGET SUMMARY

Crooked Creek stock assessment (11229581)

Line item	Category	FY22 Budget ($K)	FY23 Budget Request ($K)
100	Personal Services	86.9	90.1
200	Travel	0.0	0.0
300	Contractual	4.3	4.3
400	Commodities	2.1	2.1
500	Equipment	0.0	0.0
Total		93.3	96.5

Crooked Creek egg take and stocking (11229591)

Line item	Category	FY22 Budget ($K)	FY23 Budget Request
100	Personal Services	17.6	17.8
200	Travel	0.0	0.0
300	Contractual	.1	0.0
400	Commodities	.3	.4
500	Equipment	0.0	0.0
Total		18.0	18.1

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APPENDIX A: FISH ENUMERATION DATA FORMS

Appendix A1.–Crooked Creek Chinook salmon enhancement project digital video recorder (DVR) passage data form.

DVR Passage

		Video Time	Video Time	Age 2+		Jacks							
Date	Observer	Start	Stop	Non-AFC	AFC	Non-AFC	AFC	DV	STHL/RT	Sockeye	Pink	Coho	Comments

Appendix A2.–Crooked Creek Chinook salmon enhancement project facility mortalities data form.

Facility Mortalities Form

		Below DVR (Tailrace)				Above DVR (Trap, Raceway 1 and Headrace)			
Date	Observer	AFC	Non AFC	Jack AFC	Jack Non AFC	AFC	Non AFC	Jack AFC	Jack Non AFC

Appendix A3.–Crooked Creek Chinook salmon enhancement project daily weir reporting data form.

Daily Weir Reporting Form

DATE: _____ STAFF: _____

DVR Counts

Age 2+		Jacks						
Non-afc	AFC	Non-afc	AFC	DV	STHD/RBT	Sockeye	Pink	Coho

Facility Mortalities (Below DVR)

Age 2+		Jacks						
Non-afc	AFC	Non-afc	AFC	DV	STHD/RBT	Sockeye	Pink	Coho

Facility Mortalities (Above DVR)

Age 2+		Jacks						
Non-afc	AFC	Non-afc	AFC	DV	STHD/RBT	Sockeye	Pink	Coho

Hatchery Fish and Sockeye Culled

Age 2+		Jacks						
Non-afc	AFC	Non-afc	AFC	DV	STHD/RBT	Sockeye	Pink	Coho
-		-		-	-		-	-

Total Broodstock Collected = Sum From Raceway 2, 3, 4

Age 2+		Jacks						
Non-afc	AFC	Non-afc	AFC	DV	STHD/RBT	Sockeye	Pink	Coho
		-	-	-	-	-	-	-

NOTES:

Broodstock Collected Daily Total

	Non-AFC		AFC	
Raceway #	M	F	M	F
2				
3				
4				
Total				

Cumulative Broodstock Count (total from previous day + above count)

	Non-AFC		AFC	
	M	F	M	F
Previous Day Total /				
Mortalities				
Daily Total				
Cum Total Held				

Broodstock Mortalities

Raceway #	M	F
2		
3		
4		
Total		

-continued-

RETURN = DVR + facility mortalities below DVR

Age 2+		Jacks						
Non-afc	AFC	Non-afc	AFC	DV	STHD/RBT	Sockeye	Pink	Coho

ESCAPEMENT = DVR - facility mortalities above DVR - hatchery fish culled - broodstock

Age 2+		Jacks						
Non-afc	AFC	Non-afc	AFC	DV	STHD/RBT	Sockeye	Pink	Coho

TOTAL RETURN = Previous days count + above return

	Age 2+		Jacks						
	Non-afc	AFC	Non-afc	AFC	DV	STHD/RBT	Sockeye	Pink	Coho
Previous Day Total /									
Total = (previous day + total above)									

TOTAL ESCAPEMENT = Previous days count + above

	Age 2+		Jacks						
	Non-afc	AFC	Non-afc	AFC	DV	STHD/RBT	Sockeye	Pink	Coho
Previous Day Total /									
Total = (previous day + total above)									

Appendix A4.–Crooked Creek Chinook salmon enhancement project weir mortalities and trapped emigrating fish data form.

Weir Mortalities and Trapped Emigrating Fish

Date	Time	Observer	Species	Daily Total	Comments

Appendix A5.–Crooked Creek Chinook salmon enhancement project stream level and temperature readings data form.

Stream Guage Readings

Date	Time	Observer	Upstream	Downstream	Water Temp (°C)	Air Temp (°C)	Weather	Comments

Appendix A6.–Crooked Creek Chinook salmon enhancement project smolt imprinting, hydrology, and release data form.

Smolt Imprinting and Release

Raceway #: _____

Smolt arrival date: _____

No. of smolt: _____

Page _____ of _____

Smolt release date: _____

			Water Temp (C)		Water DO (%)			Mortalities in Raceway				
Date	Time	Observer	Inlet	Oulet	Inlet	Outlet	Food (No. Scoops)	Non-AFC	AFC	Daily Total	Cumulative Total	Comments
Total:												

Appendix A7.–Crooked Creek Chinook salmon enhancement project smolt mortality data form.

Smolt Mortality Data Form

Collectors: ______________________ Date: ______________________

Raceway 2		Raceway 3		Raceway 4	
Length	AFC: Y or N	Length	AFC: Y or N	Length	AFC: Y or N

Appendix A8.–Crooked Creek Chinook salmon enhancement project scale sampling data form for recording biological sampling of age, sex, and length.

Scale Sampling

Date: ______________________________

Collectors: ______________________________

Scale Card No.	Fish No.	Sex	AFC	Length	Age	Vial No.
	1	M F	Y N			
	2	M F	Y N			
	3	M F	Y N			
	4	M F	Y N			
	5	M F	Y N			
	6	M F	Y N			
	7	M F	Y N			
	8	M F	Y N			
	9	M F	Y N			
	10	M F	Y N			

Scale Card No.	Fish No.	Sex	AFC	Length	Age	Vial No.
	1	M F	Y N			
	2	M F	Y N			
	3	M F	Y N			
	4	M F	Y N			
	5	M F	Y N			
	6	M F	Y N			
	7	M F	Y N			
	8	M F	Y N			
	9	M F	Y N			
	10	M F	Y N			

Scale Card No.	Fish No.	Sex	AFC	Length	Age	Vial No.
	1	M F	Y N			
	2	M F	Y N			
	3	M F	Y N			
	4	M F	Y N			
	5	M F	Y N			
	6	M F	Y N			
	7	M F	Y N			
	8	M F	Y N			
	9	M F	Y N			
	10	M F	Y N			

Scale Card No.	Fish No.	Sex	AFC	Length	Age	Vial No.
	1	M F	Y N			
	2	M F	Y N			
	3	M F	Y N			
	4	M F	Y N			
	5	M F	Y N			
	6	M F	Y N			
	7	M F	Y N			
	8	M F	Y N			
	9	M F	Y N			
	10	M F	Y N			

Appendix A9.–Crooked Creek Chinook salmon enhancement project broodstock collection and culling data form.

Brood Stock Collection and Culling

Date: _____

Collectors: _____

Non-AFC (Raceway #2)	
M	F
Hatchery Jacks culled	
AFC 2+ Culled	

AFC (Raceway #3)	
M	F
AFC (Raceway #4)	
M	F

Appendix A10.–Crooked Creek Chinook salmon enhancement project broodstock holding, hydrology, and mortality data form.

Brood Stock Holding Hydrology

Page _____ of_____

			Raceway #2				Raceway #3				Raceway #4			
			Water Temp (C)		Water DO (%)		Water Temp (C)		Water DO (%)		Water Temp (C)		Water DO (%)	
Date	Time	Observer	Inlet	Oulet	Inlet	Outlet	Inlet	Oulet	Inlet	Outlet	Inlet	Oulet	Inlet	Outlet

Appendix A11.–Crooked Creek Chinook salmon enhancement project brood stock mortality data form.

Brood Stock Mortality Data Form

		Raceway #2 (Non-AFC)			Raceway #3 (AFC)			Raceway #4 (AFC)	
Date	Collector	M	F		M	F		M	F

Appendix A12.–Crooked Creek Chinook salmon enhancement egg-take data form for recording counts of artificially spawned fish.

Egg Take

Date:

Personnel:

Non-AFC		**AFC**		**COMMENTS**
M	F	M	F	
Mortalities:				

APPENDIX B: CROOKED CREEK CHINOOK SALMON WEIR AND ASL DATA MAPS

Appendix B1.–Crooked Creek Chinook salmon weir and escapement data map.

Data field Name	Width	Start column	End column	Comma column	Codes and Comments
Date code	8	1	8	9	
Year	4	1	4		Four digit year
Month	2	5	6		Two digit month
Day	2	7	8		Two digit day
Var1	3	10	12	13	DVR count: Non-AFC ocean age 2+
Var2	3	14	16	17	DVR count: AFC ocean age 2+
Var3	3	18	20	21	DVR count: Non-AFC jacks
Var4	3	22	24	25	DVR count: AFC jacks
Var5	3	26	28	29	Upstream released or sampled: Non-AFC ocean age 2+
Var6	3	30	32	33	Upstream released or sampled: AFC ocean age 2+
Var7	3	34	36	37	Upstream released or sampled: Non-AFC jacks
Var8	3	38	40	41	Upstream released or sampled: AFC jacks
Var9	3	42	44	45	Downstream of DVR mortalities: Non-AFC ocean age 2+
Var10	3	46	48	49	Downstream of DVR mortalities: AFC ocean age 2+
Var11	3	50	52	53	Downstream of DVR mortalities: Non-AFC jacks
Var12	3	54	56	57	Downstream of DVR mortalities: AFC jacks
Var13	3	58	60	61	Upstream of DVR mortalities: Non-AFC ocean age 2+
Var14	3	62	64	65	Upstream of DVR mortalities: AFC ocean age 2+
Var15	3	66	68	69	Upstream of DVR mortalities: Non-AFC jacks
Var16	3	70	72	73	Upstream of DVR mortalities: AFC jacks
Var17	3	74	76	77	Brood stock collected: Non-AFC ocean age 2+
Var18	3	78	80	81	Brood stock collected: AFC ocean age 2+
Var19	3	82	84	85	Brood stock collected: Non-AFC jacks
Var20	3	86	88	89	Brood stock collected: AFC jacks
Var21	3	90	92	93	Brood stock released: Non-AFC age 2+ ocean
Var22	3	94	96	97	Brood stock released: AFC age 2+ ocean
Var23	3	98	100	101	Brood stock released: Non-AFC jacks
Var24	3	102	104	105	Brood stock released: AFC jacks
Var25	3	106	108	109	Brood stock mortalities: Non-AFC age 2+ ocean
Var26	3	110	112	113	Brood stock mortalities: AFC age 2+ ocean
Var27	3	114	116	117	Brood stock mortalities: Non-AFC jacks
Var28	3	118	120	121	Brood stock mortalities: AFC jacks

-continued-

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Data field Name	Width	Start column	End column	Comma column	Codes and Comments
DV	3	122	124	125	Dolly Varden
STH	3	126	128	129	Steelhead Trout
RT	3	130	132	133	Rainbow Trout
PS	4	134	137	138	Pink Salmon
SS	4	139	142	143	Coho Salmon
RS	4	144	147	148	Sockeye Salmon
Var29	4	149	152	153	Hatchery-produced Chinook salmon jacks culled
Var30	4	154	157	158	Hatchery-produced Chinook salmon (2+) culled

Appendix B2.–Crooked Creek Chinook salmon ASL data map.

Data field Name	Width	Start column	End column	Comma column	Codes and Comments
Date code	8	1	8	9	
Year	4	1	4		Four digit year
Month	2	5	6		Two digit month
Day	2	7	8		Two digit day
(Blank)	2	10	11	12	
(Blank)	1	13	13	14	
Survey area code	2	15	16	17	P0 = Kenai Peninsula fresh water
Site code	3	18	20	21	160 = Crooked Creek
(Blank)	2	22	23	24	
(Blank)	2	25	26	27	
Species	3	28	30	31	410 = Chinook
(Blank)	3	32	34	35	
(Blank)	3	36	38	39	
(Blank)		40	57	43,45,47,49,58	
(Blank)	2	59	60	61	
Sex	1	62	62	63	= M or F
AFC or Non-AFC	1	64	64	65	0 = Non-AFC, 1 = AFC
(Blank)	4	66	69	70	Length (mm)
(Blank)		71	86	76,81,84,87	
(Blank)	2	88	89	90	
(Blank)	5	91	95	96	
Scale card number	3	97	99	100	
Fish number	1	101	102	103	Number on scale card (Values 1–10)
Age	2	104	105	106	Column 104 = freshwater age, column 105 = marine age
Age error	1	107	107	end	R = Regen, M = Missing, I = Inverted, A = Absorbed, U = Unreadable, D = Dirty