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Kodiak Island Road System Chinook Salmon Enhancement Project

by

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



Symbols and Abbreviations

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

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ABSTRACT

This report presents the results of recent efforts (2000-2005) to develop the Kodiak Island Road System Chinook Salmon Enhancement Project. The first phase of the project was to develop a brood source on the Kodiak Island road system from the Karluk River Chinook salmon stock. Once a road system brood source was developed in Monashka Creek, the project entered a production phase. Figures are presented from egg takes, which occurred annually on the Karluk River from 2000 to 2004, and resultant smolt releases in Monashka Creek from 2002 to 2005. In 2005, the egg take was conducted at Monashka Creek utilizing returning adult Chinook salmon from a 2002 smolt release. Forty-four females were spawned providing approximately 208,700 eggs. On-site fertilization was used, producing a record survival of 91% to the eyed egg stage.

Returns from smolt releases are also described. In 2005 an estimated 325 adult Chinook salmon returned to Monashka Bay.

Results of broodstock pathology sampling and resident species disease histories for Karluk River, Monashka Creek, American River, and the Olds River are also presented.

Facilities development is discussed, including the installation of five raceways at the Pillar Creek Hatchery. In 2005 a raceway to expand hatchery production of Chinook salmon smolt was installed at the base of the Monashka Reservoir. This raceway will also be used to ripen broodstock and imprint smolt prior to release.

A project cost accounting is provided detailing \$390,000 in direct expenditures, indirect contributions (such as the estimated value of in-kind services and donated labor), the value of surplus equipment and monetary donations since 2000. A cooperative agreement between Kodiak Regional Aquaculture Association and the Alaska Department of Fish and Game, which compensated the regional aquaculture association for Chinook salmon smolt production, is also discussed.

Future project objectives and direction, including a calendar of events, are also presented.

Key words: Kodiak Island, Chinook salmon, *Oncorhynchus tshawytscha*, broodstock, enhancement.

INTRODUCTION

This report provides a comprehensive record of how the Chinook salmon *Oncorhynchus tshawytscha* enhancement project for the Kodiak Island road system (Figure 1) has developed, from its beginning in 2000 through the 2005 season. An initial unpublished report entitled *Kodiak Road System Chinook Salmon Enhancement Project Report* was authored by Len Schwarz in May 2001. Copies of the 2001 unpublished report are housed in the Anchorage and Kodiak Alaska Department of Fish and Game (ADF&G) offices, as well as the office of the Kodiak Regional Aquaculture Association (KRAA). Less detailed unpublished annual reports have also been completed (2001-2004) and are available in the same locations. This report will emphasize what occurred during the 2005 season, but will also summarize past events so that the report can serve as comprehensive documentation of the entire project.

The current need for a Kodiak Island road system Chinook salmon enhancement project was identified in 1983 by the Kodiak Regional Planning Team (KRPT). The KRPT is a team appointed by the Commissioner of Fish and Game to develop an overall enhancement plan for an area. The KRPT's goals, objectives, and strategies for area enhancement efforts are defined in *The Kodiak Regional Comprehensive Salmon Plan 1982-2002*. The plan states, "Results from the 1983 KRPT questionnaire sent to sport fishermen showed the preferred enhancement species were: (1) Chinook, (2) coho, and (3) sockeye salmon." The plan presents desired salmon production and identifies a difference between the target catch and the catch from natural runs of 3,000 Chinook salmon. Finally, in the Chinook salmon section, the plan also states "Although

sport and subsistence harvest have been low, Chinook salmon are a very desirable species to the fishermen.”

The Comprehensive Salmon Plan mentions several past attempts at establishing Chinook salmon sport fisheries on the Kodiak Island road system. The 2001 unpublished report by Schwarz, describes four past Chinook enhancement projects including: the Frazer Lake project (1966-1969), the Pasagshak River Project (1976-1985), the Island Lake/Mill Bay project (1989-1994), and the Buskin River project (1995-1996). Each project had varying degrees of success but none were successful enough to produce sustainable Chinook salmon sport fisheries.

Development of the current enhancement project is described at length in Schwarz 2001¹ (*unpublished report*), appendices; *Kodiak Road System Chinook Salmon Enhancement Project Development (1998)*, a planning document and *Sequence of Events and Permits needed for Kodiak Road System Chinook Stocking*. Fish Transport Permits (FTP) and Permit Alteration Request (PAR) are also presented as appendices in the 2001 report. These appendices state, “If a new project is to be successful, careful planning must be done. The project must be above reproach from violating any concerns related to genetics, pathology, fisheries management, wild stock escapement, or environmental degradation. In addition to not creating problems in these areas, the project must accomplish the objectives of increasing Chinook salmon sport fishing opportunity along the Kodiak Island road system in a cost effective way.”

In order to accomplish the above objectives the current project has the following elements:

1. A **local broodstock** was chosen (i.e., Karluk River Chinook salmon) in order to address genetic concerns.
2. **Pathology requirements** were established, and are listed in FTP #00A-0010. Several of the major requirements include testing of broodstock for infectious hematopoietic necrosis virus (IHNV) and bacterial kidney disease (BKD) and establishing resident species disease histories for any smolt² release locations.
3. The Alaska Board of Fisheries adopted **regulations to allow for the collection of broodstock and promote an orderly sport fishery** when returns began. These regulations included restrictions on sport and subsistence fishing in Monashka Bay and continuation of an existing commercial fishery closure through July 5. A subsistence closure and saltwater snagging prohibition were established from May 1 through July 5. Sport fishery restrictions also included an inriver sport fishing closure upriver of the Monashka Highway Bridge from May 1 through September 15 and a prohibition on sport fishing from a stream bank section immediately downstream of the bridge to prevent erosion.
4. In order to keep the project cost effective and successful, it was determined that Chinook salmon **smolt would be released** and a local facility (Pillar Creek Hatchery) would be used to rear the fish. Smolt releases would ensure more abundant returns than fry³ releases and a local facility would help offset the cost and potential mortality associated with transporting fish from Anchorage.

¹ Schwarz, L. *Unpublished*. Kodiak road system Chinook salmon enhancement project report. Located at: Alaska Department of Fish and Game, Kodiak. 211 Mission Road, Kodiak, AK.

² *Smolt* – intermediate stage of young salmon between the parr and the grilse, distinguished by their bright silvery color with scales that are easily rubbed off; life stage when these fish first migrate from fresh water to the sea.

³ *Fry* – recently hatched salmon that are less than two months old and usually weigh less than one gram. (D. Loopstra, ADF&G Sport Fish Biologist, Anchorage, *personal communication*).

5. In order to **minimize environmental degradation**, public access and facilities at release locations (such as parking, trash disposal, septic) would be considered beneficial.

On July 1, 2004, a cooperative agreement became effective between the Alaska Department of Fish and Game Division of Sport Fish (SFD) and the Kodiak Regional Aquaculture Association (KRAA; Appendix A1). KRAA operates the Pillar Creek Hatchery, a nonprofit hatchery located near the City of Kodiak. The cooperative agreement compensates KRAA for producing coho salmon fingerlings⁴ and Chinook salmon smolt, which are stocked along the road system to provide a sport fishery. Under the terms of this agreement, KRAA is responsible for spawning ripe Chinook salmon provided by ADF&G, raising them to 15-20 grams, and delivering the smolt to release locations. The department is responsible for all other aspects of the project, including providing ripe fish for spawning and taking pathology samples from all broodstock spawned. ADF&G is also responsible for developing release locations, establishing disease histories, and applying for fish transport permits. Finally the department is also responsible for imprinting the smolt to be released.

ADMINISTRATION/FUNDING

During the initial planning stage, three groups worked cooperatively; ADF&G, KRAA, and the Kodiak Sport Fishing Association. The project also received financial support from the Kodiak Association of Charter Boat Operators (KACO) and several local citizens. Letters of support for the project were received from the Kodiak Island Borough, the City of Kodiak, the Kodiak Island Convention and Visitors Bureau, and the Kodiak Sport Fishing Association (presented in attachment 4 of the *2004 Annual Kodiak Road System Sport Fish Chinook Salmon Enhancement Report*).

Since the inception of this project, five raceways have been installed at Pillar Creek Hatchery and one at the base of Monashka Reservoir. These structures, egg takes, and the purchase of supplies (such as fish food) represent the majority of the project expenditures. Table 1 provides an estimated yearly accounting of the expenditures made to develop the project. Figure 2 gives a graphic representation of the estimated expenditures by source and purpose between fiscal year (FY) 00 and FY06⁵. The estimated total value of expenditures for the project through June 30, 2006 was \$391,100, which included direct expenditures, indirect contributions (such as in-kind services and donated labor and services), surplus equipment donations, and monetary donations. ADF&G was responsible for 76% of the total expenditures. These expenditures were for egg takes, raceway construction, payments to KRAA for rearing and incubation of eggs at the Pillar Creek Hatchery (based on the coop agreement expenses), and the estimated value of surplus raceways. The surplus raceways were valued at \$88,000, although no actual funds were expended, since the raceways were paid for by Elmendorf and Fort Rich hatcheries and were received without cost as surplus inventory. KRAA contributed 17% of the estimated expenditures through donated labor and costs for raceway construction material. Public donation accounted for 7% of the estimated expenditures.

⁴ *Fingerling* – freshwater stage of young salmon between two and 13 months old that weigh between 1-9 grams, intermediate between the fry and the smolt, also known as the parr stage.

⁵ Each fiscal year for the state of Alaska starts July 1 of one year and ends June 30 of the following year. FY00 = fiscal year 2000. FY06 = fiscal year 2006.

Prior to July 1, 2004, ADF&G funding was provided through an annual project budget (Kodiak Chinook salmon egg take). This budget allowed for collecting broodstock from Karluk River as well as other miscellaneous project expenses. Beginning July 1, 2004, ADF&G entered into a formal cooperative agreement with KRAA for production of Chinook and coho salmon smolt. The Kodiak agreement was modeled after a cooperative agreement between ADF&G and Douglas Island Pink & Chum, Inc., which is also for the production of Chinook and coho salmon smolt. The prominent terms of the \$36,200 Kodiak cooperative agreement are to annually compensate KRAA \$27,600 for producing 75,000 20-gram Chinook salmon smolt and \$8,600 for producing 64,100 3-gram coho salmon. A contingency provision stipulates that whenever a shortfall in Chinook salmon production occurs, increased coho salmon smolt production would make up the difference. The cooperative agreement (Appendix A1) was renewed on July 1, 2005.

Under the cooperative agreement, ADF&G maintained responsibility for obtaining ripe Chinook salmon so that egg takes can occur and has retained an annual budget for this purpose. In addition to the cooperative agreement and the annual egg-take budget, in FY05 additional funds were provided by ADF&G to install weirs at Pillar and Monashka creeks and purchase parts and labor to make the Monashka Creek raceway operational.

State funds for projects like the road system Chinook salmon enhancement are generated through the sales of sport fishing license and Chinook salmon stamps. Federal funding (Dingle Johnson) also contributes and is generated through excise taxes on the sale of sport fishing equipment.

FY06 funds dedicated for Chinook salmon enhancement totaled \$43,000. The operating budget contained \$15,400 for egg-take expenses and \$27,600 for the cooperative agreement with KRAA to produce Chinook salmon smolt. An additional \$8,700 was also paid under the terms of the cooperative agreement for coho salmon production.

The FY07 budget request for the cooperative agreement increased from \$36,200 to \$49,000. The \$12,800 increase was due to increase in Chinook smolt production from 75,000 to 110,000 fish, made possible by the installation of an additional raceway at the base of Monashka Reservoir. Of the FY07 proposed cooperative agreement, \$40,300 was dedicated to Chinook salmon production and \$8,700 was used for coho salmon production.

Sport fishing licenses and Chinook salmon stamps sold in the Kodiak Management Area between 2000 and 2004 are presented below. This information was compiled by the licensing section of the ADF&G for the 2005 state legislature.

<u>Year</u>	<u>Fishing Licenses</u>	<u>Chinook Salmon Stamps</u>	<u>Total Revenue</u>
2000	\$335,226	\$66,580	\$401,806
2001	\$331,183	\$66,485	\$397,668
2002	\$336,574	\$71,605	\$408,179
2003	\$332,642	\$76,310	\$408,952
2004	\$339,156	\$86,290	\$425,446

In 2006, a license fee increase was implemented primarily to fund hatchery construction and improvements in Fairbanks, Anchorage and Southeast Alaska. If license sales in 2006 remain the same as occurred in 2003, it is expected that the Kodiak Area would generate an additional \$218,000 in license fees per year beginning in 2007.

It is not possible to estimate how much tax revenue is generated from the Kodiak Management Area to support Federal funding of Dingle Johnson dollars. In FY05 the Sport Fish Division Budget included \$17.1 million dollars from the state fund (license sales) and \$16.7 million matching Federal funds (Dingle Johnson tax funds).

FACILITIES AND OPERATIONS

During the first phase of the project (2000-2004), egg takes were conducted using broodstock from Karluk River. The first phase of the project was to generate a return of adult Chinook salmon to Monashka Creek, which could be used as broodstock for future release locations. Establishment of a local broodstock was desirable because it would eliminate the need to take eggs from wild returns. Separated eggs and sperm were flown to Pillar Creek Hatchery, which generally resulted in delays of 4-12 hours between egg collection and fertilization. Fertilized eggs were incubated inside the hatchery facility and the resulting fry were moved into three outside raceways when they emerged in late winter to early spring. Dimensions of the raceways are approximately: 28 ft x 4 ft x 3 ft, 28 ft x 4 ft x 3 ft, and 24 ft x 4ft x 3 ft. The raceways were surplus from the ADF&G Elmendorf Hatchery. The raceways were installed in 2000 and first used in the spring of 2001 (Figure 3). Table 2 gives a history of the number of eggs collected, resulting ponded fry, and released smolt from 2000 through 2005. Broodstocks in 2000 and 2003 produced over 76,000 ponded fry, which were moved to the three outside raceways. These fry survived to produce 60,000 30-gram smolt, which were released in May 2002 and 73,000 15-gram smolt released in May 2005. Based on this experience, we believe that these raceways can produce approximately 75,000 20-gram smolt.

In the spring of 2003, two additional surplus raceways from the ADF&G Fort Richardson Hatchery were installed next to the three existing Chinook salmon raceways at the Pillar Creek Hatchery (Figure 4). These raceways have approximate dimensions of 20 ft x 4 ft x 4 ft. The purpose of the additional raceways was to accommodate increased production as well as to help fill the gaps during space shortages, such as when fry needed to be ponded but raceways still held smolt awaiting release.

The 2005 egg take in Monashka Creek marked a major step forward and the beginning of the second phase of the road system Chinook salmon enhancement project. Conducting a remote egg take on the Karluk River was no longer needed. Three-ocean female Chinook salmon from smolt released into Monashka Creek in May 2002 returned during summer of 2005. This was the first time that female Chinook salmon returned to Monashka Creek, making a road system egg take possible. This development achieved several desirable objectives. Monashka Creek does not have a sockeye salmon population like Karluk River, so the possibility of broodstock contamination with IHNV is considerably less in Monashka Creek. Secondly, conducting the egg take on the road system saved air charter expense and some personnel time. Finally, a road system egg take allowed for onsite fertilization to occur. Table 2 shows that the survival from the fertilized egg stage to the eyed stage increased to 91% in 2005. This was the highest survival achieved thus far and compares to a range of survival from 22%-75% in 2000-2004 remote egg takes on Karluk River.

In order to facilitate moving into the second stage of project development, a sixth raceway was installed at the base of Monashka Reservoir (Figure 5). This raceway serves as a ripening pen for Monashka Creek broodstock and for rearing fingerlings to smolt size. Benefits from rearing fingerlings to smolt size at Monashka Reservoir raceway include an increase of smolt production capacity by approximately 35,000 fish and additional imprinting time for juvenile salmon before being released (approximately 9 months). The increased imprinting time will probably reduce the straying of returning adult fish. Before the Monashka Reservoir raceway was operational, smolt were moved from the Pillar Creek Hatchery raceway and held in Monashka Creek for an average of 1 week before being released.

MONASHKA CREEK RIPENING PENS

One of the challenges of conducting an egg take in Monashka Creek is how to hold fish until they ripen. Monashka Creek is very shallow and there are not many areas where fish can hold for extended periods of time. Stream surveys conducted in Monashka Creek in 2005 show that fish began entering fresh water on June 16, but the peak survey count did not occur until July 13 (Table 3). The first female was not spawned until August 15; 2 months after fish were first documented in the stream (Figure 6). During this 2-month ripening period, fish were susceptible to otter and bear predation, extreme water level (floods and low water) as well as poaching. In order to capture fish and place them in protected areas to ripen, a weir was placed on Monashka Creek, directly below a large pool (Figure 7). The weir gate was continually open, but had a funnel on the upstream end, so that once a fish went through the weir, they could not go back downstream. This trapped fish in the upper part of Monashka Creek. Fish were then captured above the weir by a small beach seine or dip nets and moved to one of three locations: the fish pipe pen, the creek pen, or the raceway (Figure 8).

Fish Pipe Pen

Monashka Reservoir stores the water supply for the City of Kodiak. At the base of the reservoir, a pump station operated by the public works department pumps water from the reservoir to town. An outflow pipe from the pump station allows water to continually flow from the reservoir into Monashka Creek, even when water is not flowing over the reservoir dam. The city is required to release a minimum of 10 to 13 cubic feet per second (cfs) through the fish pipe valve during July, August, and September for salmon spawning and 8 cfs during other months of the year. The outflow pipe from the pump station to Monashka Creek is referred to as the “fish pipe,” because the water it discharges maintains fish life in the creek below the dam. At the fish pipe outflow a large pool (approximately 40 ft x 20 ft x 5 ft deep) provides an excellent location to hold both adult Chinook salmon for ripening and smolt for imprinting. During the 2005 egg take, a heavy mesh net was suspended above the pool to keep eagles from preying on the broodstock and an electric fence was strung around the pool to keep other predators out (Figure 9).

Creek Pen

The creek pen is located in a pool approximately 0.5 mile upstream of the highway bridge (Figure 8), in one of the largest and deepest holding pools in Monashka Creek (Figure 10). The pool, approximately 30 ft x 12 ft x 3 ft deep, is adjacent to a rock wall. A weir was placed below the pool so fish passing through could not turn around and escape downstream. An electric fence placed around the pool kept bears out; however, it did not repel river otters. A holding pen

(dimensions 12 ft x 6 ft x 4 ft) in the deepest part of the pool was used for ripening broodstock in a protected/confined area. The pen had a secure cover and was also electrified, so that fish placed in the holding pen were safe from predators.

Reservoir Raceway

As mentioned above, a new raceway was installed at the base of the reservoir (Figure 5). The raceway was operational in May 2005. It was used to imprint coho salmon smolt and then as a ripening pen for broodstock. City of Kodiak public works personnel plumbed the raceway into the main discharge pipeline that delivers water into Monashka Creek to satisfy permit requirements. Broodstock placed in the raceway were protected from predators by an electric fence around the perimeter and a wooden cover over the top. In 2006 a chain link fence around the raceway and overhead bird netting were added to protect rearing and adult fish.

EGG-TAKE RESULTS

Fish Pipe Pen

Numbers of Chinook salmon placed in the Monashka Creek fish pipe pen by date are shown in Table 4. The original plan was to hold fish in artificial enclosures for as short a time as possible, since previous experience with holding pens on Karluk River (Figure 11) indicated that holding fish for extended periods might inhibit ripening. However, by early July we decided to transfer Chinook salmon broodstock from the creek to secure pens as soon as possible to reduce losses from predators and poaching. The first fish were transported to the fish pipe pen on July 5 and 6. The fish pipe pen was chosen as the first holding pen because it more closely resembled natural conditions, increasing survival and promoting ripening of the broodstock.

Moving Chinook salmon on July 5 and 6 also necessitated the handling of ocean-bright fish, which tend to be less hardy than Chinook salmon that have been in fresh water longer. Bright fish lose scales more easily and are more stressed by handling. Consequently, prior to the move on July 5 the potential handling mortality associated with moving bright fish was weighed against the probability of continued instream predation.

Special transport tubes were made from 12 in PVC culvert pipe to move Chinook salmon broodstock while minimizing damage associated with handling (Figure 12). Holes were drilled into the plastic tubes to allow water to enter and exit freely. Fish were captured with a dip net or beach seine and put into a tube. The tube was then dragged downstream, frequently through water depths of only 4 inches, and, whenever possible the tube was completely submerged. It took approximately 5 minutes, from the time the fish was put into the tube, until the transporter reached the road. Upon arriving, the tube was placed into a fish transport tank mounted on a truck, which was then driven to the fish pipe pen, where the tube was lifted from the truck and placed in the pool. The time spent in the transport tank was about 5 minutes. A minimum of two people was needed to load, move, and release fish using the brood transportation tubes.

Twenty female and 10 male Chinook salmon were transported between July 5 and 6. These fish survived well for over a month; however, one female died shortly thereafter. This mortality apparently resulted from abrasions on the fish's side that occurred during transport. Additionally, the noses of nearly all of the Chinook salmon transported on July 5 and 6 turned white, but these apparent blunt force trauma injuries did not result in any mortality. The brood

transportation tubes were subsequently modified to prevent further injuries by gluing closed cell foam padding to the inside and both ends of the tube.

No predation from animals occurred at the fish pipe pen during the broodstock phase of the project. However, on the night of July 28 the solar panel battery that charges the electric fence was stolen and five female Chinook salmon were apparently removed from the pen by poachers. These losses were unexpected because the land around the fish pipe pen and raceway is a restricted area (i.e., has a locked gate and numerous signs posted warning against trespassing), which is off limits to the public to protect the drinking water supply for the town of Kodiak. Following these thefts, state troopers agreed to install surveillance cameras to increase security for this area.

On August 15 Chinook salmon in the fish pipe pen were beach seined to check for ripeness (Figure 7). One female and one male fish were subsequently spawned for the egg take.

During the first year of the Monashka Creek egg takes we tried to handle the broodstock, especially females, as little as possible, to reduce mortality. With this in mind, on August 15 eight green females caught incidentally along with the ripe fish to be used during the egg take, were transported from the fish pipe pen into the raceway so they would not have to undergo repeated handling. In the raceway, a crowding gate used to capture fish greatly reduces handling. Fish that were transferred from the fish pipe pen into the raceway (Table 4) were marked with an adipose fin clip, so that ripening and egg survival could be evaluated. Males were not transferred from the fish pipe pen, because males seemed to survive handling better and we also did not want to put too many fish in the raceway.

Of the 25 fish left in the fish pipe pen, after poachers removed five females on July 28, two died before being spawned. Another female mortality on August 5 resulted from abrasions received in an unpadded brood transportation tube. All others ripened except one female that had been transferred to the raceway and was released back into the creek after the last egg take on August 29.

The 15 females that were spawned from the fish pipe pen produced 77,568 eggs, of which 74,240 survived resulting in a survival rate of 95.7% (Tables 5 and 6). One of the fertilized clutches⁶ had to be destroyed (5,120 live eggs) because the male tested positive for bacterial kidney disease (BKD). Two females were found to have hard sections in a portion of their skeins, accompanied by dark black blood clots. It is possible that this condition was caused by transport in an unpadded transportation tube, as the fish sometimes thrashed inside the tube when they dewatered while being dragged over shallow areas.

Creek Pen

Numbers of Chinook salmon placed in the creek pen at Monashka Creek by date are presented in Table 4. During the planning stage it was believed the creek pen would be better than the raceway but not as good as the fish pipe hole to ripen fish. This thinking was based on how closely the pens approximated natural conditions and how secure the facility was from predators and fluctuating water levels. Consequently, the second pen selected to hold broodstock was the creek pen. The first Chinook salmon were placed in the creek pen on July 15, after the fish pipe

⁶ A *clutch* is the complete set of eggs produced or incubated at one time (*Source* – The American Heritage Dictionary of the English Language, fourth edition).

pen was full. This later date probably contributed to the fish being in hardier condition than the fish moved to the fish pipe in early July. Also, most fish placed in the creek pen did not have to be moved in the brood transportation tubes and then driven to a pen. On July 15, the majority of the inriver Chinook salmon escapement was concentrated in the deep pool where the creek pen was located. A beach seine was used to capture fish, which were subsequently moved via hand, or dip nets from the beach seine to the pen, a distance of approximately 20 feet. Six males and 15 females were loaded into the creek pen on July 15.

During a 45-hour period, 3:00 a.m. Tuesday August 2 to midnight Wednesday August 3, an exceptionally heavy rainfall totaling 3.45 inches caused substantial flooding in Kodiak Island road system streams. At 5:30 a.m. the electric fences from the Monashka Creek pen were removed, just as they began to go underwater. Several large drift logs were also pushed off the pen. A series of 1 in x 4 in boards were placed in front of the upstream end of the pen to break the flow of water through the pen and shelter the Chinook salmon in the pen from the increasing water velocities. Our fear was that prolonged exposure to high flows in a holding pen could exhaust fish and cause mortalities. At the height of the flood, the top of the pen was approximately 1.5 feet underwater. When the water receded, we were pleased to discover that all the broodstock had survived. Rainfall similar to what was experienced on August 3 is very rare. A piece of plywood was stored next to the pen thereafter, to be placed in front of the pen during flood events.

Fish were added to the creek pen again on August 8 and 12. These fish were dipnetted further upstream and hauled back to the creek pen using padded brood transportation tubes. A maximum of 40 fish were placed in the pen to avoid overcrowding. Four more fish were added to the pen on August 19 after 4 fish had been used in an egg take and 2 fish had died. Two additional fish were placed in the pen on August 25.

Of the total 46 fish that were placed in the creek pen, six died before being spawned. All of the remaining fish ripened, with the exception of two green females which were released after the last egg take. Fish in poor condition were usually placed in the creek pen to avoid the handling associated with moving the fish to either the fish pipe or raceway. Due to this practice, greater mortality in the creek pen was expected. Egg takes conducted on August 15, 19, 22, 25, and 29 resulted in 18 spawned females, producing 81,159 eggs, of which 69,517 survived (Table 5). This was a survival rate of 85.7%, slightly less than the 95.7% survival, which occurred in the fish pipe pen. Unfortunately 3 clutches, which produced a total of 7,139 eyed eggs, had to be destroyed because one parent for each clutch tested positive for BKD.

Reservoir Raceway

Numbers of Chinook salmon placed in the Monashka Reservoir raceway pen by date are given in Table 4. The raceway is the most artificial of the three holding pens, and due the associated uncertainty how fish would survive and ripen, the transport of fish into this facility was delayed as long as possible. On August 2 a total of 20 Chinook salmon captured in a beach seine from the hole where the creek pen was placed were moved from the creek to the raceway in padded brood transportation tubes. The same transport methods (described in the fish pipe section) were used to transport fish from the creek to the raceway. Twenty-four more fish were transported from the creek to the raceway on August 8-9. By this date, many Chinook salmon had moved upstream in response to the flood on August 3. These fish were captured with dip nets, put in brood transportation tubes, and hauled downstream to the road where they were transported to

the raceway via hatchery truck. As mentioned previously, on August 15 eight females were moved from the fish pipe pen into the raceway. This brought the total number of fish in the raceway to 51. In addition to the artificial nature of the holding pen, there was concern that a high density of fish would also inhibit ripening. Although the raceway was the most secure of the holding pens, no more than 51 fish were placed in this facility to avoid overcrowding. Egg takes using fish taken from the raceway occurred on August 19, 22, 25, and 29. Fish that were finclipped, indicating that they spent a month ripening in the fish pipe pen before being moved to the raceway, were recorded in the spawning results of the fish pipe pen (Table 5). The results under "Raceway" in Tables 5 and 6, only include fish that spent their entire holding time ripening in the raceway. Of the 43 fish that were originally placed in the raceway between August 2-9, 13 died before being spawned. Eleven of 13 mortalities were males. Male fish appeared overly active in the raceway, which may have contributed to their high mortality rates. All but one of the fish that survived ripened. A single, unripe, finclipped female was released back into the creek from the raceway on August 29. Eleven females, which spent their entire ripening period in the raceway, produced 49,946 eggs, of which 46,701 survived (Table 6). This was a survival rate of 93.5%, very similar to the 95.7% survival rate for fish pipe females.

All three Monashka Creek pens had egg survival rates within 10% of each other (Table 6). The lowest survival rate, 85.7% in the creek pen was above the highest rate (75%) ever achieved in Karluk River egg takes during previous years. All Monashka holding pens did relatively well in ripening fish to spawn. The Monashka Reservoir raceway did experience a relatively large number of mortalities, especially for males. No obvious factors lead to this mortality except that the males were unusually active after being put in the raceway. In future years we advise loading the raceway mostly with females and the fish pipe pen mostly with males. Fish densities in each of the three holding pens in 2005 did not hamper fish from ripening (30 fish in the fish pipe, 51 fish in the raceway and 40 fish in the fish pipe pen). These numbers could be repeated in future years and probably increased slightly.

Rearing and Releases

From 2000 to 2004, eggs and sperm were collected from Karluk River Chinook salmon in mid to late August, flown back to Pillar Creek Hatchery and fertilized, using delayed fertilization techniques. Fertilized eggs were incubated at the facility throughout the winter and emerged as fry in the spring. Fry produced from 2000-2004 egg takes were ponded⁷ on 2/14/01, 4/16/02, 2/18-2/28/03, 4/26-5/30/04, and 4/13/05 in three raceways located immediately outside the incubation building (Figure 3). The fry were subsequently held in these raceways for approximately 13 months (i.e., April-May of the following year). In May the smolt were transported by truck to Monashka Creek, a distance of approximately 3 road miles. At Monashka Creek the fish were imprinted and released.

The first smolt release in May 2002 totaled 60,400 fish with an average weight of approximately 30 grams. Releases have occurred during May each year, with total numbers of fish ranging from 11,250 (30 gram avg. wt.) in 2004 to 72,558 (15 gram avg. wt.) in 2005 (Table 2). All releases have occurred from the fish pipe pool at the base of Monashka Reservoir. Prior to release, smolt are held and fed in the fish pipe pool to allow imprinting so that adults will return to Monashka Creek. The dates that smolt were held for imprinting are listed in Table 2.

⁷ *Ponded* is a hatchery term for when fry are transferred from the incubators to a rearing unit (D. Loopstra, ADF&G, Sport Fish Biologist, Anchorage *personal communication*).

The first smolt release, of 60,000 in 2002, was split into three groups. Imprinting occurred May 6-10, May 13-17, and May 20-24. Smolt were released in three separate groups (i.e., 20,000 smolt each) to increase the chances that some fish would enter the marine environment during a favorable time window.

Smolt were released in one group in 2003 and 2004. Imprinting occurred from May 19-30 in 2003 and May 17-28 in 2004. At the last day of imprinting, the barrier was removed from the fish pipe pool and smolt were allowed to leave. It is not know how long smolt stay in Monashka Creek after leaving the fish pipe pen, but because the stream is shallow and less than $\frac{3}{4}$ of a mile long, it is thought that the fish only stay in the creek for a day or two before entering salt water. Whenever possible, releases were timed to occur a day or two before a full/new moon phase, as a full/new moon is thought to promote smolting (Groot, Margolis, and Clark 1995). Because the new raceway at the base of Monashka Reservoir was untested in 2005, it was used only to imprint and release coho salmon smolt into Monashka Creek. Results indicated the new raceway worked extremely well as a holding/imprinting facility prior to release. The coho salmon smolt were held and fed for approximately 1 month, after which they were allowed to egress the raceway at their own volition.

The two pens used for imprinting Chinook salmon smolt in 2005 were located in fish pipe ripening pool and immediately downstream, where egress was blocked by placing a seine across the creek. Smolt were placed in the downriver pen first (4/27/05) and then in the fish pipe pool. It was hoped that the smolt in the downriver pen could be imprinted and released first; however, there was a small hole underneath the perforated plate that was used to separate the two pens, and some fish from the lower pen moved upstream into the fish pipe pen. Several days after the fish were in the pens a large rainfall occurred (5/6/05) which caused back flow from the reservoir spillway into the upstream holding areas, raising the water level by more than a foot. The increased water level created a gap in the seine barrier where fish could escape the pens and enter Monashka Creek. An estimated 36,000 smolt (roughly one half of the 72,560 smolt initially placed in the pens) were missing immediately after the storm.

In order to prevent otter predation an electric fence was installed around the fish pipe pen on May 8. A depredation permit was obtained from the Division of Wildlife Conservation and one otter was trapped as it attempted to enter the fish pipe pen via a small gap beneath the electric fence. Later in the summer the electric fence was more efficient in keeping otters out after installation of fence posts and 2x12 planks to remove gaps between the bottom of the fence and the bank. It was not possible to put an electric fence around the lower pen because of its large size. ADF&G staff camped within 50 feet of the pen for three nights and put out motion detectors as well as traps, but otters were not observed in the lower pen.

RETURNS

Determining the amount of returning Chinook salmon from releases in Monashka Creek is difficult because there is not an accurate method to determine exactly how many returning Chinook salmon are harvested in commercial, subsistence, and sport fisheries. In addition, foot surveys conducted in Monashka Bay stream are not complete counts of Chinook salmon that have entered streams. Although Monashka streams are fairly shallow and it is relatively easy to count Chinook salmon, it is extremely difficult to count 100% of the fish. A larger source of error associated with stream counts is that predation occurs between surveys and the actual peak survey may not occur until after considerable predation has occurred. Because of these and other

factors, the estimates of Chinook salmon abundance given in this report provide a general idea of abundance and are not as accurate as return estimates based on weir counts for escapement and fish tickets, subsistence permits, and creel census data to provide accurate harvest information.

Karluk River Chinook salmon typically stay in fresh water for 1 year, returning as adults to spawn, after spending 1 to 5 years at seas. Returns vary by year; however, over the 11-year period from 1993-2003 returns to Karluk River have averaged the following percentages: 1 year at sea =1.8%, 2 years at seas =9.8%, 3 years at seas =29.8%, 4 years at sea =51.9%, and 5 years at sea = 3.8%. The increase in abundance from 2- to 3-ocean fish the following year has ranged from 1.4 to 2.9 times, with an average of 2.5.

Based on this information, some 1-ocean fish (jacks), comprised only of male fish, were expected to return to Monashka Creek during 2003. In addition, biologists have noted that large smolt can result in an increased abundance of returning jacks. (Appendix B1). Project biologists noted an unusually high abundance of jacks in the Crooked Creek weir count, 1,100 jacks and 4,100 large fish, the year following a release of 20 gram smolt. The 2002 smolt released in Monashka Creek weighed 30 grams, which are relatively large. However, foot surveys of both Pillar and Monashka creeks in 2003 did not document any fish, although several anglers reported catching jacks in Pillar Creek.

In 2004 a larger return of 2-ocean fish was expected. Samples from Karluk River show that an average of 95% of Chinook salmon which spend 2 years at sea are males. An estimated 200 2-ocean fish returned to Monashka Bay in 2004, based on foot surveys conducted in both Pillar and Monashka creeks as well as reports of some angling success. It was estimated that the fish were split equally between Pillar and Monashka creeks.

The Pathology section of ADF&G stated that it is not desirable for Chinook salmon to spawn in Pillar Creek because of IHNV concerns associated with the effluent from the sockeye salmon hatchery upstream. Consequently, department and hatchery staff removed approximately 75 fish from Pillar Creek in 2004. Age and sex determinations made for roughly half of these fish indicated that 36 consisted of 2-ocean males. A single 2-ocean female was also identified. The significant straying in 2004 identified the need to install a weir to keep future Chinook salmon returns out of Pillar Creek, as well as the need to improve imprinting techniques for Monashka Creek smolt releases, which would hopefully reduce straying into Pillar Creek.

Based on the estimated return of 200 2-ocean Chinook salmon in 2004, approximately 500 3-ocean fish were expected to return in 2005, based on Karluk River parent stock's average increase between 2-ocean fish and 3-ocean fish the following year. In addition to 3-ocean fish, there would be an unknown 2-ocean component from the 2003 release of 32,550 smolt.

The first paragraph of this section listed several reasons why it is difficult to accurately estimate returns of Chinook salmon. The actual return of adult Chinook salmon to Monashka Bay in 2005 was difficult to estimate because it included both estimates of fish that entered the streams as well as estimates of fish caught by sport fishermen. Estimates were not made for commercial and subsistence fisheries because there were not fisheries in the immediate vicinity of Monashka Bay during the return. Table 3 presents the foot surveys that were conducted in Monashka Creek during 2005. The peak survey occurred on July 13 when 112 fish were counted in the creek as well as 30 fish that were ripening in the fish pipe pen. Prior to the peak survey, at least two Chinook salmon carcasses were observed in the creek. On August 10, 13 Chinook salmon were also counted in Virginia Creek, a small tributary to Monashka Creek. Additionally, on

August 12, 16 Chinook salmon were observed behind Pillar Creek weir. These instream observations total 173 fish.

Entries made into the 2005 project logbook documented a sport fish harvest of 30 Chinook salmon. Two anglers who frequently fished waters in front of Monashka Creek during June reported their own harvests as well as harvests they observed from others. Additionally, project staff made numerous observations while visiting Pillar and Monashka creeks during the sport fishery. The observed sport harvest and instream counts produced a minimum return estimate of 203 Chinook salmon. The actual number of fish that entered streams and were harvested on rod and reel was almost certainly higher than the observed counts. Predation in Monashka and Virginia creeks by bears and otters was likely significant, although impossible to quantify. Based on almost daily visits to Monashka Bay, to check weirs and ripening pens, it is estimated that sport harvest observations represented about 1/3 of the actual sport fish harvest. It is also estimated that the foot surveys represent about 2/3 of the actual escapement into Monashka and Virginia creeks. Consequently, the total estimated 2005 return was around 325 fish, which was lower than the preseason projection of 500. Again, the estimate of a 325 fish return in 2005 is designed to provide a ballpark estimate, based on the best available information, which unfortunately is not complete.

Management of Returns

In anticipation of the Chinook salmon return to Monashka Bay, the Alaska Board of Fisheries established regulations in 2002 to ensure that sufficient broodstock entered Monashka Creek and also to provide for an orderly fishery. In order to protect broodstock collection, the subsistence fishery was closed in Monashka Bay from May 1 through July 5 and the historic commercial fishery opening date of July 6 was reaffirmed. There had been virtually no subsistence fishing in Monashka Bay in June and early July prior to this project, but a rapid expansion could occur if the Chinook salmon project was a success. The sport fishery was addressed through a snagging closure by regulation in the salt waters of Monashka Bay during the same time period as the subsistence restriction (May 1 through July 5), a sport fishing closure above the Monashka Creek highway bridge from May 1 through September 15, and also prohibiting fishing from the cutbank immediately downstream of the bridge. When these regulations were established it was anticipated that the Monashka Creek returns would mirror Karluk River return timing, where historically 85% of the return has been counted into the river by July 5. However, it appears that the Monashka Creek return may be significantly later, since only 40% of the peak stream count (129 fish on July 29) was observed by July 3.

PATHOLOGY

The Chinook salmon enhancement project must comply with all ADF&G pathology requirements, so that the project will not introduce any diseases to wild stocks and will stay within the guidelines of the ADF&G fish health policy. The first pathology requirement is to test all broodstock for IHNV and BKD. If IHNV is found in any broodstock, the project is to be terminated. IHNV does not commonly occur in Chinook salmon in Alaska; however, Chinook salmon are susceptible to the disease. IHNV is a common occurrence in Chinook salmon stocks in other States in the Pacific Northwest. IHNV is ubiquitous in Alaskan sockeye salmon populations, however. Since Karluk River sockeye escapements averaged 761,000 fish during the years when egg takes were conducted, and live sockeye were captured in the same seine hauls with Chinook salmon broodstock, care was taken to ensure that Chinook salmon samples

were not cross-contaminated with any virus that may be in the water. For these reasons, broodstock are disinfected with Betadine solution and thoroughly dried before being sampled. Ovarian fluid samples are subsequently collected from females and kidney/spleen samples taken from males in order to test for the IHN virus. Of the 309 fish tested from the Karluk River between 1999 and 2004, none were found to be positive for IHN (Table 7). One of the benefits of collecting broodstock in Monashka Creek is that the absence of a sockeye population greatly reduces the possibility of finding IHN in the water and the possible of cross-contamination to the Chinook salmon. Nevertheless, the sampling protocol of disinfecting all broodstock taken in Monashka Creek was adhered to in 2005. None of the 92 Chinook salmon tested from Monashka Creek broodstock in 2005 were positive for IHN.

Karluk River and Monashka Creek broodstocks were also sampled and tested for BKD. The ELISA testing method was used which is a highly sensitive test which detects antigens of *Renibacterium salmoninarum*, the causative agent of BKD. Any eggs from couplings of parents that tested positive for BKD were subsequently destroyed. Of the 349 fish tested from the Karluk River between 1999 and 2004, 12 tested positive for BKD. Of the 92 fish tested from Monashka Creek in 2005, 4 were found to be positive for BKD.

In addition to disease testing of broodstock, disease histories were also developed for resident species in all release locations. The disease history for Monashka Creek is presented in Table 8. A total of 62 pink salmon and 27 coho salmon were tested for IHN and all test results were negative. Fish were also tested for BKD. Of the 64 pink salmon tested, none was positive for BKD. Four of the 79 coho salmon tested positive and 32 of 45 Dolly Varden tested were positive for BKD.

A long-term goal of the enhancement project is to release fish in American and Olds rivers, after a Chinook salmon return has been established in Monashka Creek. These two streams are believed to be the best candidates for a Chinook salmon sport fishery on the road system. Monashka Creek is too small to support a large freshwater fishery and the shallowness of the bay does not lend itself to developing a large shoreline saltwater fishery. In anticipation of submitting a Fish Transport Permit (FTP) to allow for this release, resident species disease histories are currently being developed for both the American and Olds rivers (Tables 9 and 10).

Another pathology concern is the potential straying of returning adult Chinook salmon into Pillar Creek. Straying into Pillar Creek, whose mouth is only 2 miles from the mouth of Monashka Creek (Figure 13), did occur in 2004. All the strays, almost exclusively 2-ocean males, were removed by department and hatchery personnel. The primary pathology concern is that if Chinook salmon stray into Pillar Creek and spawn, the resulting progeny could contract IHN from sockeye salmon present in Pillar Creek Hatchery. To reduce this possibility, a weir was placed near the mouth of Pillar Creek in 2005, which prevented Chinook salmon from immigrating but allowed free passage of other anadromous species. (Figure 14) Sport fishing was also allowed for Chinook salmon in the approximately 300 yards of fresh water between the ocean and the weir. The weir was operated from late May through August 23 and no Chinook salmon spawned in Pillar Creek. The weir will be operated annually during future Chinook salmon returns until straying problems are eliminated. Planned use of Monashka Reservoir raceway to rear fish from September through May and then release them should vastly improve imprinting.

DISCUSSION AND FUTURE DIRECTION OF THE PROJECT

Factors which may influence the abundance of Chinook salmon returns from released smolt (imprinting time to reduce straying, size of smolt and release timing to promote survival) were not precisely known by local staff at the beginning of the project. Based on practices employed in other Division of Sport Fish hatcheries (Appendix B1), a minimum of 1 week was considered sufficient for adequate imprinting. A target smolt size of 20 grams was selected with releases scheduled from late May to early June. Many of these factors are influenced by logistical constraints. For example, fish may not always be imprinted for as long as project leaders would like because of predator problems, water conditions, or personnel shortages. Another logistical challenge is achieving the target smolt size. Water temperature strongly influences growth rates and the target smolt size may be exceeded or not achieved due to factors which are out of hatchery control.

The section on rearing and releases describes imprinting techniques that have been used for Monashka Creek Chinook salmon smolt releases thus far. The first adult Chinook salmon from the initial smolt releases returned in 2004 and 2005. Many of these fish returned to Monashka Creek as planned, but significant straying was also observed into nearby Pillar Creek both years. Although a weir was installed in Pillar Creek to prevent strays from spawning in Pillar Creek, it would be more desirable to develop a large return to Monashka Creek that would not stray. Discussion on how to improve imprinting at Monashka Creek is moot, since the problem has already been solved. Smolt released in May 2006 were imprinted in Monashka Reservoir raceway for a minimum of 1.3 months. Smolt released after 2006 will receive approximately 9 months of imprinting before being released. Installation of Monashka Reservoir raceway has allowed us to increase imprinting time; fish will be reared in the raceway from fingerlings to smolt prior to release.

If Fish Transport Permits are approved, selecting an imprinting time for American and Olds river smolt releases will require careful consideration to provide optimal returns and reduce straying. Building predator proof imprinting pens and placing them in areas where flood or low water conditions will not be a problem, will improve the chances that fish will be imprinted appropriately. An examination of whether 1 week of imprinting would provide the best results was made by reviewing the existing literature on the subject. Studies which compared straying rates of fish that received different imprinting periods were not found. Hayes and Carmichael (2002) reviewed imprinting as a way to reduce straying in Umatilla River in Oregon. The need to reduce straying was a very high priority in order to prevent genetic contamination of the nearby Snake River. During one year 26% of the Snake River escapement, which is listed under the Endangered Species Act, was found to be composed of Umatilla River Chinook salmon releases. If this rate was not lowered to less than 5%, the Umatilla Chinook salmon restoration project would be terminated. In order to achieve a reduction of straying project managers took the following steps: 2 million fish were coded wire tagged/finclipped each year (at a cost of \$268,000/year), returning fish were trapped and tagged fish (strays) were removed at Snake River collection facilities, water flows were regulated to attract fish into the Umatilla River, and the construction and use of three imprinting facilities (costing more than \$6 million). The author's comments were insightful as to what has been scientifically proven regarding different imprinting periods. "Managers agreed that acclimation or holding fish in the river water prior to releases *might* reduce straying. Although the relationship between acclimation and homing was *not conclusive*, use of acclimation to allow fish to recover from transportation (Sharpe et al.

1998) and to improve imprinting and survival (Johnson et al. 1990; McDonald et al. 1993; Whitesel et al. 1994) were recognized and were part of the Umatilla River plan. Three facilities costing more than \$6 million were constructed, and since 1995 fish have been acclimated for a minimum of 2 weeks. *The use of this strategy to reduce straying needs testing because the effect of acclimation on imprinting smolt development, and the length of acclimation required to improve homing are poorly understood.* In the absence of hard scientific conclusions, common sense and judgment based on experience with other projects must be applied. Smolt imprinting for releases in the American and Olds rivers will initially be for a minimum of 1 week and up to 2 weeks if conditions allow. It is very likely that imprinting pens will not be able to hold all the anticipated smolt (37,500) at one time, so releases will have to be split into two groups. Nearby streams will be walked to detect the presence of strays. If significant straying is noted, imprinting time can be increased.

The original target smolt size of 20 grams will be maintained. Again, it is unclear what the trade off is between the number of smolt and their size is with the resulting return (will a more abundant return occur if a larger number of smaller fish are released or a smaller number of larger fish are released). Appendix B1 shows that a 20-gram smolt is well within the range of smolt that are being released in department Chinook salmon enhancement efforts. As mentioned before, smolt size is dependent on water temperatures which are out of the control of existing hatchery facilities on Kodiak Island. During years of warmer water temperatures smolt may develop more quickly and exceed the targeted goal. When 30-gram smolt were released, large numbers of jacks were not observed, therefore, this fear was not realized; however, the hatchery may not have the capacity to hold as many large fish. During years of cold temperatures smolt can be held longer before release in order to come closer to the targeted goal.

Release time may also have an influence on survival. Smolt reaching the salt water at a favorable time will have a higher survival rate than those that do not. Release timing may be the most important factor to imitate in nature; unfortunately, Karluk Chinook salmon smolt emigration timing is unknown. Attempts to capture Chinook salmon smolt in Karluk River have had limited success. Unless more information on the emigration of Karluk River Chinook salmon smolt is obtained, the current release dates in late May to early June will be continued. Appendix B1 shows these release dates are within the range of dates when smolt are currently released statewide. As with the size of smolt and imprinting time, logistical constraints (space availability at the hatchery or Monashka raceway) may also play a determining role on when smolt are released.

Conducting an egg take using Monashka Creek broodstock in 2005 was an important step in achieving the project goal of developing a Chinook salmon sport fishery at American and Olds rivers. Pathology concerns have been greatly reduced by discontinuing the egg take at Karluk River. In addition, conducting the egg take on the road system allowed for direct fertilization; this appeared to greatly improve survival and production. Installing a raceway at the base of Monashka Reservoir provides a ripening pen as well as additional capacity for increased production and better imprinting. Figure 15 presents a time line of objectives that need to be accomplished so that all the data collection and procedures can be completed so that an FTP to release smolt in the American and Olds rivers can be processed. If all the objectives are achieved on time and the necessary permits are received, approximately 75,000 Chinook salmon smolt will be split evenly and released into the American and Olds rivers in 2007. After several years of stocking, with an estimated 2% survival, it is anticipated that an annual combined return

of 1,400 adult Chinook salmon will occur in the American and Olds rivers. These fish are intended solely for harvest and will not be required to spawn to produce future returns.

Approximately 35,000 Chinook salmon smolt will be reared at Monashka Reservoir raceway annually and subsequently released into Monashka Creek to produce broodstock for future egg takes. Using the same estimate survival of 2%, it is anticipated that 700 adults will return annually to Monashka Creek. The number of Chinook salmon smolt reared and released at different locations may be adjusted somewhat to account for actual raceway capacities as well as broodstock needs.

Beginning in 2006, the Monashka Reservoir raceway will be used to imprint smolt for release into Monashka Creek. Beginning in 2007 the raceway will not only be used to ripen broodstock, but will be used to rear fingerlings to smolt size from September through May. These smolt will be held in the Monashka Raceway for approximately 9 months, greatly increasing their imprinting time. Remote releases will be applied for in 2007 in the American and Olds rivers.

Recommendations for 2006

Smolt Releases

Chinook salmon smolt should be moved to the Monashka Reservoir raceway in mid April 2006. They should be fed and imprinted there until shortly before the high tide series on May 26. We anticipate 30,000 smolt will be available. The target smolt size is 20 grams with a target release date of June 1.

Egg Take

The Monashka Creek weir should be installed in the same place as it was in 2005 (Figure 8). It will have a funnel installed in the weir that will prevent fish from swimming downstream once they pass through the weir. A second weir should be installed approximately 75 feet upstream of the first weir, effectively trapping fish between the two weirs. An electric fence should be installed around the perimeter of the two weirs to reduce predation. Because of the terrain around the weir's perimeter, the electric fence will deter bears but not otters. In order to reduce otter predation, as fish become trapped between the two weirs, they should be captured with a beach seine and placed in the creek pen, where they will be safe from predation. Based on our experience in 2005, we should transport fish to the fish pipe pen around July 5-7. A reasonable goal or limit for the fish pipe pen is 25 male and 20 females. After the fish pipe pen is full, the creek pen should be filled with approximately 20 males and 20 females. On about July 31, fish between the two weirs should be transported to Monashka Reservoir raceway. The target goal for the raceway is 20 females and 15 males.

The first egg take should be conducted on approximately August 14. Any females seined from the fish pipe pen will be transferred to the raceway to ease subsequent handling mortality on unripe females. When the raceway is checked for ripe fish, an equal number of males and females should be transferred into the fish pipe pen. The transfer of males from the raceway to the fish pipe may help reduce male mortality in addition to equalizing the number of fish ripening in each pen. It is likely that after this transfer occurs between the raceway and fish pipe pens, the raceway may have 30 females and 5 males while the fish pipe pen may have 10 females and 35 males. Table 11 shows how the overall transport of fish would occur.

ACKNOWLEDGMENTS

ADF&G would like to acknowledge the letters of support for this program that were submitted by the City of Kodiak, Kodiak Island Borough, Kodiak Island Convention and Visitors Bureau, Kodiak Sport Fishing Association, Kodiak Association of Charter Boat Operators, and Mack's Sport Shop. We would also like to thank the City of Kodiak for passing a resolution (number 03-16) which encouraged ADF&G to fully develop the enhancement project. The City Public Works Department, under the direction of Mark Kozak, facilitated our efforts to establish a raceway at the base of the Monashka Reservoir. The Borough permitted ADF&G to place the Monashka raceway on its property. Kodiak Sport Fish Association, President Allan Thielen, raised funds to purchase fish food in 2000. Kodiak Association of Charter Boat Operators, President Tony Chatto, also raised funds to purchase fish food in 2000 and 2001. Mack Sport Shop, owner Tom Merriman, has shared news of project developments with his clients, as well as sold many licenses, which helped to fund this project.

Special thanks also go to Kodiak Regional Aquaculture Association director Larry Malloy who supported and facilitated developing cooperative efforts for this project between KRAA and ADF&G. Pillar Creek Hatchery managers, Chris Clevenger and Gary Byrne, deserve special thanks for producing the fish that will make this project a success. Both Chris and Gary were instrumental in designing and hooking up all raceways that are now in place for the Chinook salmon enhancement project. Both of these managers also worked many long hours processing eggs from Karluk River.

We would like to especially thank and recognize the contribution made by Mike Anderson and Anderson Construction who have done much to make this project a success. Mike arranged for free shipping for the surplus raceways from Anchorage to Kodiak. He also donated excavation services to prepare pads for the first three raceways and a storage shed at Pillar Creek Hatchery. Mike also provide technical expertise regarding the placement of the Monashka Reservoir raceway and donated time, labor, and machinery in hooking up the raceway to the water supply. Mike was also involved with capturing broodstock on almost every Karluk River egg take, able to use both beach seine and rod and reel with equal expertise. Most appreciated from Mike was his "can do" attitude and encouraging words, especially when it looked like we might not capture all the broodstock we needed.

We would like to recognize the Koniag Native Corporation, who allowed us to use their Portage cabins at reduced rates during egg takes. Lastly we would like to recognize Patrick Saltonstall, Jon Carlson, Allan Theilen, Tony Chatto, Mike Anderson, Dan Busch, Adam Schwarz, Denby Lloyd, Matt Foster, and Drew Aro for participating in beach seining broodstock at Karluk River.

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TABLES

Table 1.–Expenditures and donations for the Kodiak Island road system Chinook salmon enhancement project by year and agency, July 1, 2000 through June 30, 2006.

Egg take year	ADF&G			KRAA		Other		
					Labor	Donated by:		
2000	3 Surplus raceways	estimated value	\$45,000	Raceway hook up	252 hrs.	Raceway shipping	PAC AK forwarding	\$1,162
	Raceway hook up parts		\$9,374	Incubation/rearing	365 hrs.	Excavation	Mike Anderson	\$8,000
	Egg-take budget (FY01) ^a		\$16,000			Fish food		
						Kodiak Sport Fishing Association and Kodiak Association of Charter boat Operators (KACO)		\$7,000
2001	Egg-take budget (FY02)		\$20,500	Incubation/rearing	365 hrs.	Fish food	KACO	\$2,000
2002	Egg-take budget (FY03)		\$17,500	Raceway hook up	100 hrs.			
	<i>Includes</i>			Raceway isolation	40 hrs.			
	<i>Aquatic ECO-System chiller</i>	\$2,058		Incubation/rearing	365 hrs.			
	<i>Pipes for raceway isolation</i>	\$1,336						
	<i>Fish food</i>	\$6,622						
	2 Surplus raceways (green)	estimated value	\$13,000					
	Raceway hook up parts		\$13,157					
	Freight		\$387					
2003	Egg-take budget (FY04)		\$17,200	Incubation/rearing	365 hrs.	Raceway Freight (40x10)	Mike Anderson	\$2,000
	<i>Includes</i>					Raceway modification	Tripp/Emerson	\$2,400
	<i>Airsep Oxygen generator</i>	\$3,500	\$2,400			welding		
	Surplus raceway (40x10)	estimated value	\$30,000					
	Raceway modification parts		\$3,171					
2004	Egg-take budget (FY05)		\$39,500	Monashka Raceway (FY05)	\$23,554	Tap into water supply	Mike Anderson	\$3,000
	<i>Includes</i>			<i>Includes</i>				
	<i>Raceway installation</i>	\$14,400		<i>Boardwalks</i>				
	<i>Parts</i>	\$2,040		<i>Outflow structure</i>				
	<i>Raceway fence enclosure</i>	\$2,923		<i>Fencing</i>				
	<i>Weir construction (Pillar and Monashka)</i>	\$11,000						
	Chinook Coop. Agreement		\$27,637					
2005	Egg-take budget (FY06)		\$15,500	Monashka Raceway (FY06)	\$2,365			
	Chinook Coop. Agreement		\$27,637	Green Raceway	\$871			
Total all years			Expenditures:	\$209,963	Direct Expenditures:	\$26,790		
			Surplus equipment value:	\$88,000	Donated Labor ^b :	\$40,744	Estimated value of donations:	\$25,562
Total all years for all sources				\$391,059				

^a Egg-take budgets FY01-05 dollar figures were primarily used to conduct egg takes: included airfare, associated expenses, and partial personnel costs.

^b Estimated value of donated labor = 1,825 hour @ \$22.00 per hour.

Table 2.–Kodiak Island road system Chinook enhancement project, egg take to smolt results, 2000 to 2005.

Project Phase	Brood Year	Females Spawned	Average Fecundity	Green Egg Inventory	Eyed Egg Inventory	Survival to Eyed Stage	Ponded Fry	Smolt Released	Size at Release (grams)	Imprinting Dates
Broodstock Development ^a	2000	24	5,201	124,818	81,772	66%	76,500	60,400	30	May 6-24/02 ^e
	2001	17	5,066	86,120	42,181	49%	42,181	32,554	25	May 19-30/03
	2002	25	5,884	147,098	47,611	32%	42,551	11,252 ^c	30	May 17-28/04
	2003	35	4,923	172,295	129,675	75%	77,815	72,558	15	April 27-May 12/05 ^f
	2004	39	4,656	181,600	39,504	22%	37,800	28,000 ^d		
Project Expansion ^b	2005	44	4,742	208,673	190,461	91%	150,465	111,344 ^d		

^a This phase of the project included initial planning and project start up operations. Egg takes were made at the Karluk River and the eggs were fertilized at the incubation facility (delayed fertilization). Project procedures were being developed and equipment was added or improved each year.

^b Project expansion includes use of the newly installed Monashka Reservoir Raceway, which should increase production potential from 75,000 smolt to 110,000 smolt. Since a broodstock has been developed in Monashka Creek, project expansion will also include applying for additional release sites (American and Olds rivers) which will increase freshwater fishing opportunities.

^c Caused by compromised water flow.

^d Projected figures based on 2000-2004 averages.

^e Smolt were imprinted in three groups: May 6-10, May 13-17 and May 20-24.

^f Approximately half the smolt escaped imprinting pen on May 6 (imprinted April 27-May 6) remaining smolt released May 12.

Table 3.–Chinook salmon foot survey counts of Monashka Creek and pen totals, 2005.

Date	Monashka Creek	Fish Pipe Pen	Creek Pen	Total Number Chinook in Monashka Creek and Pens
16-Jun	5			5
30-Jun	34			34
3-Jul	58			58
13-Jul	112	30		142
15-Jul	110	30		140
29-Jul	78	30	21	129

Note: Virginia Creek, a small tributary to Monashka Creek was surveyed on August 10, 2005. Total count in Virginia Creek was 13 Chinook salmon.

Table 4.–Chinook salmon broodstock placement into fish pipe and creek pens and raceway by day, 2005.

Date	Fish Pipe				Pen total	Event
	Female		Male			
	Addition	Removal	Addition	Removal		
5-Jul & 6-Jul	20		10		30	Moved 30 from creek into pen
29-Jul		5			25	Poachers took 5 female and fence
5-Aug		1			24	Mort
15-Aug		9		1	14	1 pair for egg take, moved 8 females to raceway
19-Aug		4		2	8	2 pairs in egg take, moved 2 females to raceway
22-Aug		1			7	1 female used in egg take
25-Aug				1	6	Mort
29-Aug				4	2	Used 4 males with raceway female
					2	Released 2 males into creek

Date	Creek Pen ^a				Pen total	Event
	Female		Male			
	Addition	Removal	Addition	Removal		
15-Jul	15		6		21	Beach seined fish from creek
8-Aug	1		5		27	Dipnetted from creek
12-Aug	5		8		40	Dipnetted from creek
15-Aug		2		2	36	Egg take 1 pair; 1 spawnout; 1 mort
19-Aug	2	7	2	7	26	2 morts; 2 pair added from creek; 6 pairs used in egg take
22-Aug		4		7	15	3 morts; 4 pair used in egg take
25-Aug	1	4	1	1	10	1 pair added from creek; 3 pair used in egg take; 1 mort.
29-Aug		3		4	3	Egg take; 1 female double fert. Released 2 green females

Date	Raceway ^b				Pen total	Event
	Female		Male			
	Addition	Removal	Addition	Removal		
2-Aug	10		10		20	Moved 20 from creek to raceway
8-Aug	4		10		34	Moved 14 from creek to raceway
9-Aug	1		9		44	Moved 10 from creek to raceway
15-Aug	8				52	Added 8 from fish pipe to raceway
18-Aug				4	48	Morts
19-Aug	2	6		6	38	6 pair used in egg take (3 from fish pipe); added 2 from fish pipe
20-Aug				1	37	Mort
21-Aug		1		2	34	Morts
22-Aug		8		12	14	8 pairs used in egg take (5 were clipped); 4 morts
24-Aug		1			13	Mort
25-Aug		6		6	1	Used in egg take (2 were clipped from fish pipe)
29-Aug		2			-1	Used in egg take (1 was clipped from fish pipe)
					1	Released 1 female back into creek

^a Discrepancy in creek pen count. 24 females added: 22 were used or released. 22 males added: 23 used. Discrepancy may be due to error in sexing fish or recording.

^b Discrepancy in raceway count. 29 males were recorded as added: 31 counted as removed. Discrepancy probably due to not accurately recording number of males added to raceway.

Table 5.–Spawning results from Monashka Creek Chinook salmon broodstock by pen, 2005.

Date Taken	Fish Pen ^a					
	Female #	Male #	Revised Estimate	Eyed Eggs	Dead Eggs	Percent Survival
15-Aug	3 ^b	3	5,263	5,120	143	97.3%
19-Aug	4*	4	6,200	5,587	613	90.1%
	5*	5	5,807	5,588	219	96.2%
	8*	8	5,087	5,043	44	99.1%
	10	10	5,077	4,898	179	96.5%
	11	11	5,498	5,437	61	98.9%
22-Aug	22	22	6,071	6,034	37	99.4%
	23*	23	5,537	5,496	41	99.3%
	24*	24	6,321	6,208	113	98.2%
	25*	25	3,630	3,258	372	89.8%
	27*	27	7,019	6,775	244	96.5%
25-Aug	30*	30	2,686	2,260	426	84.1%
	35*	35	4,221	3,622	599	85.8%
	36*	36	4,180	4,091	89	97.9%
29-Aug	41*	41&49	4,972	4,824	148	97.0%
Total	15	16	77,568	74,240	3,328	95.7%

Date Taken	Creek Pen					
	Female #	Male #	Revised Estimate	Eyed Eggs	Dead Eggs	Percent Survival
15-Aug	1	1	5,940	5,539	401	93.2%
19-Aug	2 ^b	2	1,891	1,779	112	94.1%
	12	12	5,158	5,075	83	98.4%
	13	13	5,316	3,710	1,606	69.8%
	14 ^b	14	4,140	2,492	1,647	60.2%
	15	15	5,272	5,191	81	98.5%
22-Aug	16	16	4,126	4,086	40	99.0%
	17	17	1,459	910	549	62.4%
	18	18	5,090	4,681	409	92.0%
	19 ^b	19	3,140	2,868	272	91.3%
	20	20	6,455	6,247	208	96.8%
25-Aug	21	21	5,163	4,966	197	96.2%
	37	37	5,806	4,703	1,103	81.0%
	38	38	5,849	4,531	1,318	77.5%
29-Aug	39	39	3,553	1,500	2,053	42.2%
	42	42&48	4,278	3,792	486	88.6%
	43	43	6,101	5,349	752	87.7%
44	44&47	2,421	2,098	323	86.7%	
Total	18	20	81,159	69,519	11,640	85.7%

Date Taken	Raceway					
	Female #	Male #	Revised Estimate	Eyed Eggs	Dead Eggs	Percent Survival
19-Aug	6	6	6,717	5,106	1,611	76.0%
	7	7	4,744	4,372	372	92.2%
	9	9	5,242	5,168	74	98.6%
22-Aug	26	26&27	6,092	5,845	247	95.9%
	28	28	4,672	4,649	23	99.5%
	29	29	5,627	5,587	40	99.3%
25-Aug	31	31	6,145	6,015	130	97.9%
	32	32	3,001	2,916	85	97.2%
	33	33	1,307	1,252	55	95.8%
	34	34	4,082	3,866	216	94.7%
29-Aug	40	40&50	2,317	1,926	391	83.1%
Total	11	13	49,946	46,701	3,244	93.5%

^a Fish marked by * were held in the fish pipe 6 July-15 August (41 days) then moved to raceway to complete ripening between 4 to 14 days.

^b Clutches destroyed due to positive bacterial kidney disease test.

Table 6.–Monashka Creek spawning summary by ripening pen, 2005.

Location	Females spawned	Green egg inventory	Eyed egg inventory	% survival egg to eyed	Number eyed eggs destroyed (BKD)	Number of mortalities before spawning
Fish Pipe	15	77,568	74,240	95.7%	1	2
Creek Pen	18	81,158	69,517	85.7%	3	6
Raceway ^a	11	49,946	46,701	93.5%	0	13
Total	44	208,672	190,458	91.3%	4	21

Note: BKD = bacterial kidney disease.

^a Includes only fish that spent the entire ripening time in the raceway.

Table 7.–Chinook salmon broodstock pathology testing at Karluk River and Monashka Creek, 1999-2005.

Year	Karluk River			
	IHNV		BKD	
	Number of Chinook salmon Tested	Positive	Number of Chinook salmon Tested	Positive
1999 ^a	20	0	60	4
2000	51	0	51	1
2001	35	0	35	1
2002	56	0	56	3
2003	71	0	71	2
2004	76	0	76	1

Year	Monashka Creek			
	IHNV		BKD	
	Number of Chinook salmon Tested	Positive	Number of Chinook salmon Tested	Positive
2005	92	0	92	4

Note: IHNV = infectious hematopoietic necrosis virus; BKD = bacterial kidney disease.

^a No eggs were taken. Samples used to establish a disease history for Karluk River Chinook salmon broodstock.

Table 8.—Monashka Creek release location disease history.

Pink salmon				
Date tested	IHNV		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
8/28/2000	62	0	64	0

Coho salmon				
Date tested	IHNV		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
10/7/1991	18	0	36	2
9/30/1994	na	-	24	0
11/1/1999	9	0	19	2

Dolly Varden				
Date tested	IHNV		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
11/1/1999	na	-	1	1
7/12/2000	na	-	45	32

Note: IHNV = infectious hematopoietic necrosis virus;
 BKD = bacterial kidney disease.

Table 9.—American River release location disease history.

Pink salmon				
Date tested	IHN		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
8/30/2004	60	0	120	0

Coho salmon				
Date tested	IHN		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
11/16/2005	38	0	57	0

Chum salmon				
Date tested	IHN		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
8/30/2004	33	0	93	11
8/26/2005	27	0	sample goal completed	

Dolly Varden				
Date tested	IHN		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
10/27/2005	60	0	62	2

Note: IHN = infectious hematopoietic necrosis virus;
 BKD = bacterial kidney disease.

Table 10.–Olds River release location disease history.

Pink salmon				
Date tested	IHNV		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
8/30/2005	30	0	60	0

Coho salmon				
Date tested	IHNV		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
10/17/2005	62	0	60	0

Chum salmon				
Date tested	IHNV		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
8/27/2004	17	0	samples spoiled	
8/30/2005	15	0	45	1

Dolly Varden				
Date tested	IHNV		BKD	
	Number of fish		Number of fish	
	Tested	Positive	Tested	Positive
10/17/2005	70	0	54	3

Note: IHNV = infectious hematopoietic necrosis virus;
 BKD = bacterial kidney disease.

Table 11.–Transport schedule of Monashka Creek Chinook salmon into fish pipe and creek pens and raceway, 2005.

Dates	Activity	Number of fish required	
		Female	Male
1 June - 7 July	Seine fish between weirs and place in creek pen.	25	20
5 - 7 July	Transport fish in creek pen to fish pipe pen	25	20
8 - 15 July	Seine fish between weirs and place in creek pen for ripening	20	20
16 July - 1 August	Seine fish between weirs and transport to raceway ^a	20	15
14-Aug	First egg take. Unripe fish pipe pen females will be transferred to raceway.	NA	NA
	Raceway males not used in egg take will be transferred to fish pipe pen.	NA	NA

Note: NA = not applicable

^a Whenever water conditions allow and six or more fish are available.

FIGURES

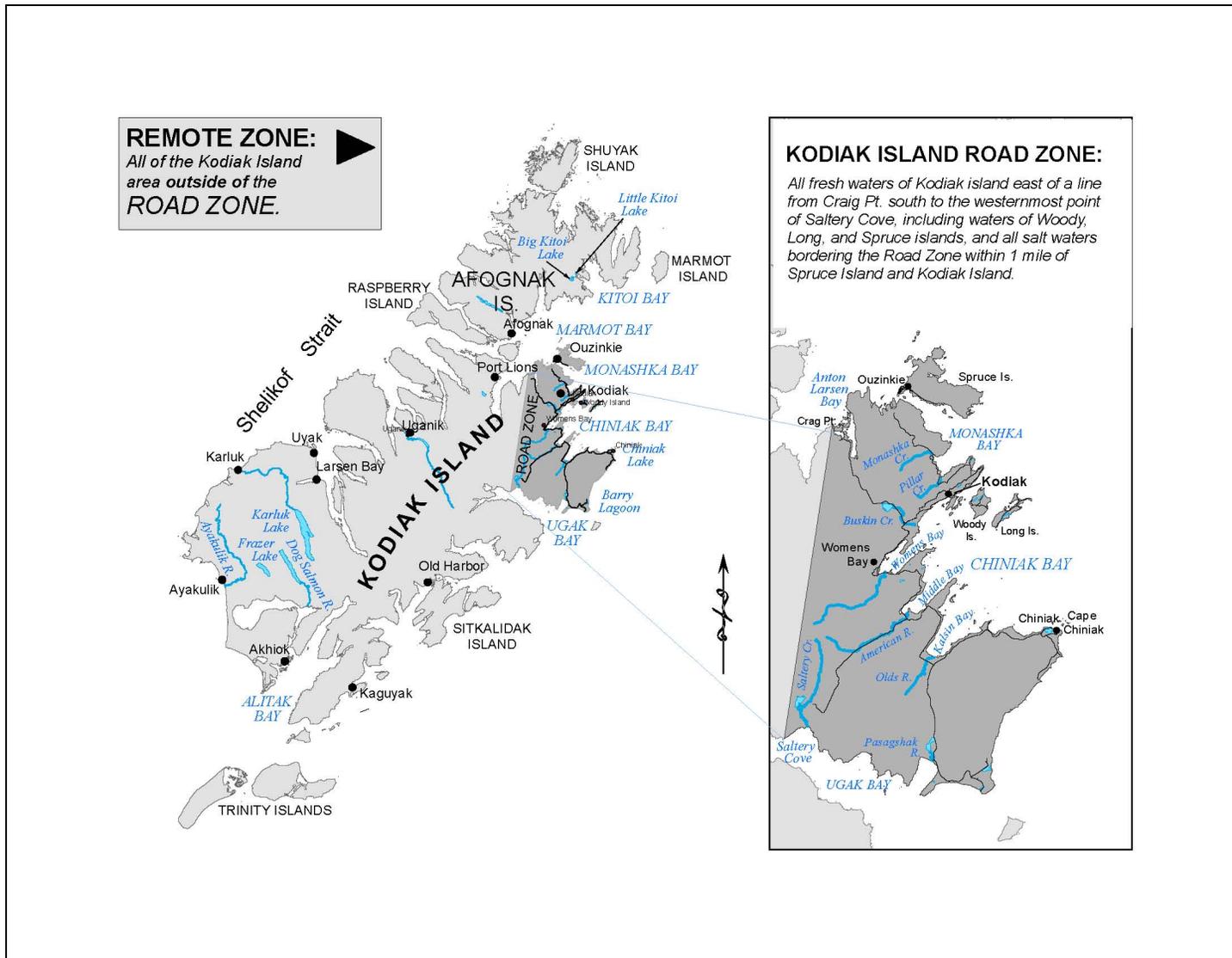


Figure 1.-Kodiak Island with an inset of the road zone.

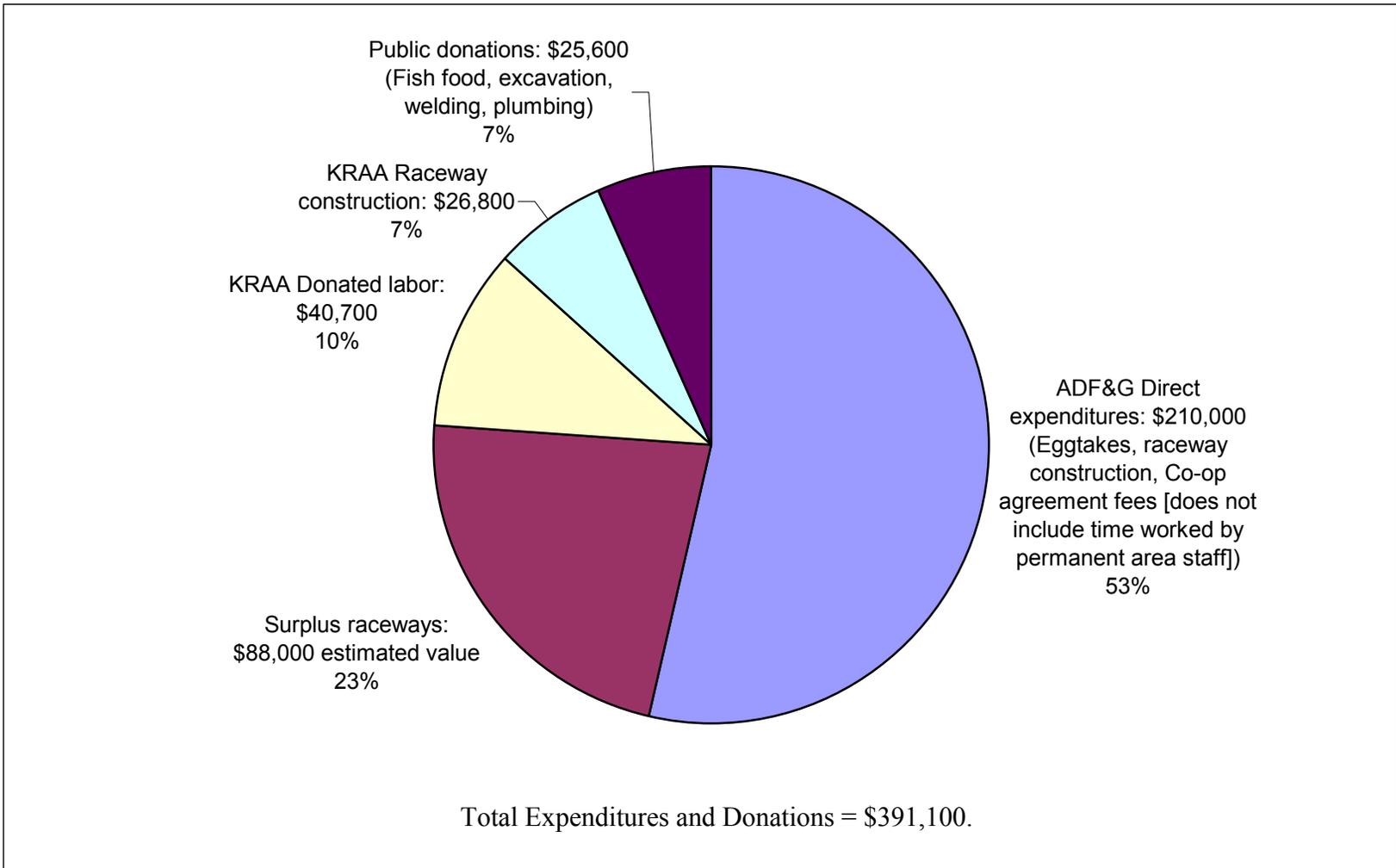


Figure 2.—Kodiak Island road system Chinook salmon enhancement project funding sources, July 1, 2000 through June 30, 2006.



Figure 3.—Fertilized Chinook salmon eggs were incubated inside at Pillar Creek Hatchery and when the resulting fry emerged (late winter to early spring) they were transferred to three outside raceways (above) to be reared for approximately 13 months.



Figure 4.–Two smaller raceways were installed next to the three larger outside raceways at Pillar Creek Hatchery to accommodate increased production and provide alternate areas to pond fry when the other raceways hold smolt awaiting release.



Figure 5.—A sixth raceway at the base of Monashka Reservoir serves as a ripening pen for Chinook salmon broodstock or for rearing fingerlings to smolt.

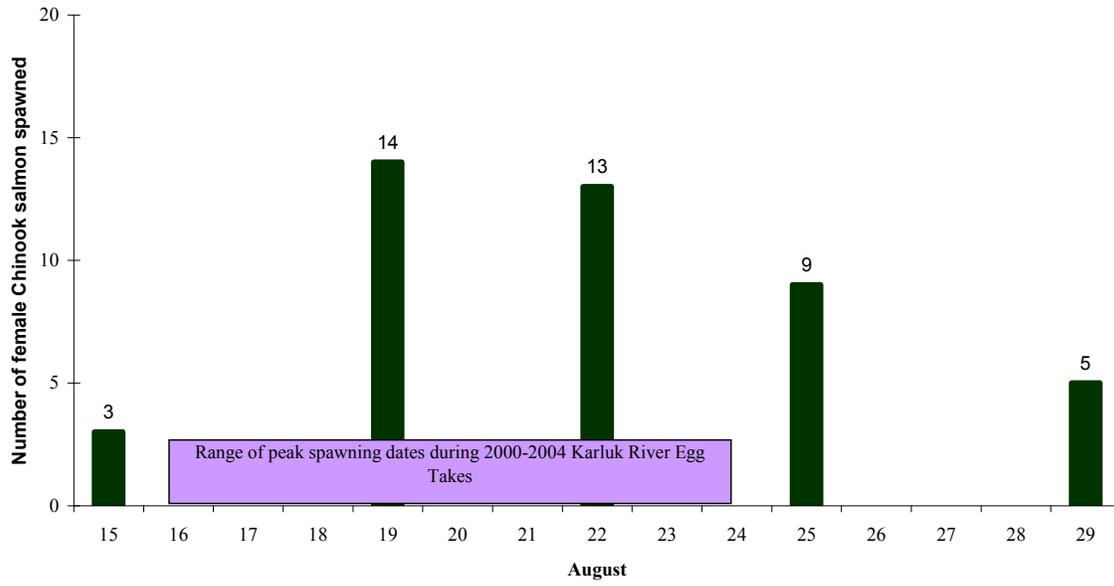


Figure 6.—Number of female Chinook salmon spawned from Monashka Creek pens by day, 2005.



Figure 7.—Monashka Creek weir (left) and holding pen (center).

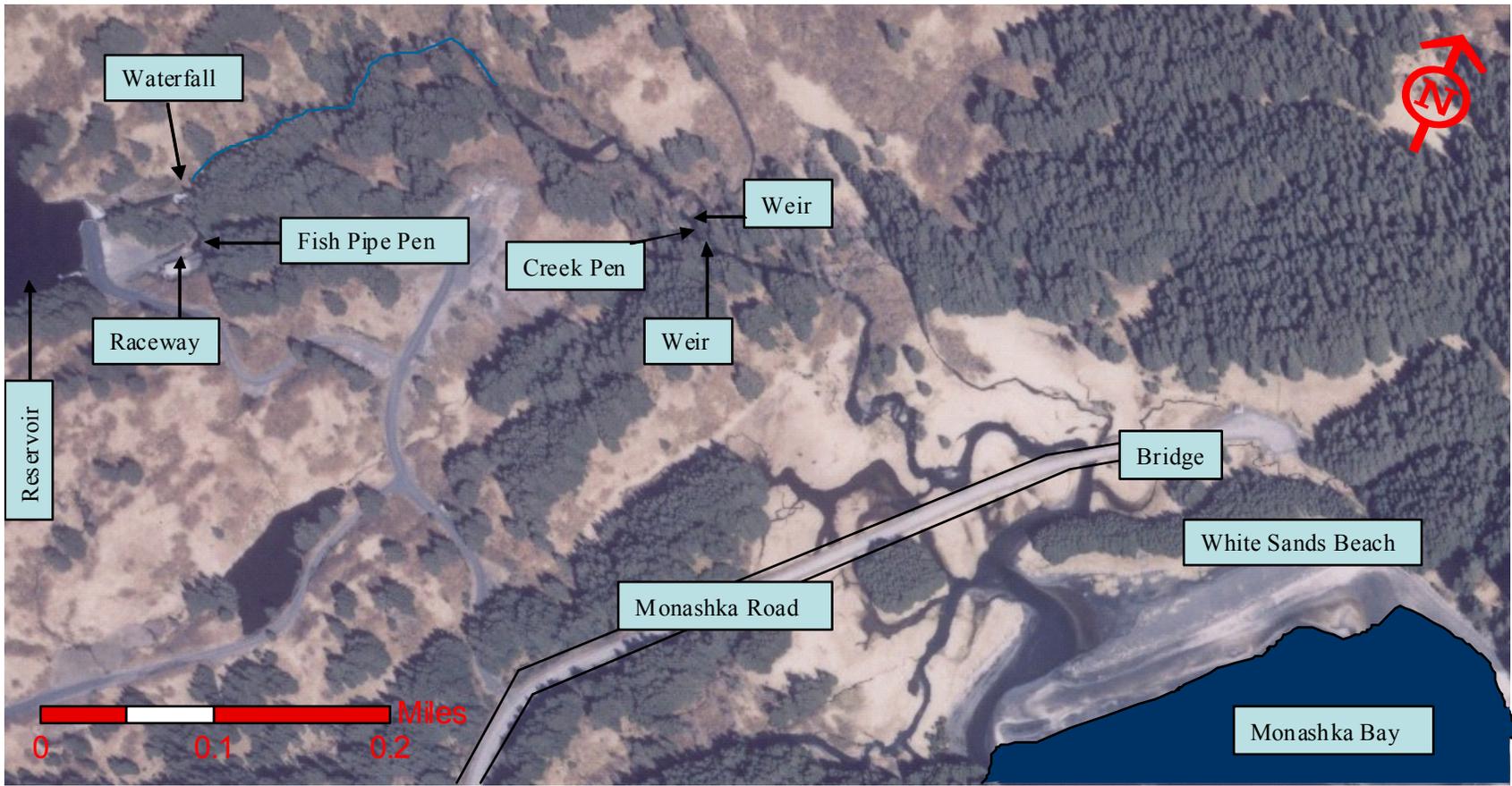


Figure 8.—Aerial photograph of Monashka Creek drainage with Chinook salmon enhancement project facilities and other key features identified, 2005.



Note: Heavy mesh netting suspended above and electric fence surround the pool to protect against predators.

Figure 9.—ADF&G personnel beach seine Chinook salmon broodstock at Fish Pipe holding pen on Monashka Creek for an egg take, July 2005.



Figure 10.—ADF&G personnel capture Chinook salmon broodstock at Monashka Creek holding pen for transport to an upstream holding facility for ripening, July 2005.



Figure 11.—ADF&G personnel capture Chinook salmon broodstock at Karluk River holding pen to check their ripeness for an egg take, August 2005.



Figure 12.—Fishery Biologist Suzanne Schmidt shows a perforated plastic tube that was used to transport adult Chinook salmon broodstock from Monashka Creek to the raceway/fish pipe holding pen, July 2005.



Figure 13.—Freshwater drainages on Kodiak Island road system.



Figure 14.—Weir constructed near the mouth of Pillar Creek to prevent returning Chinook salmon adults from straying into this stream, 2005.

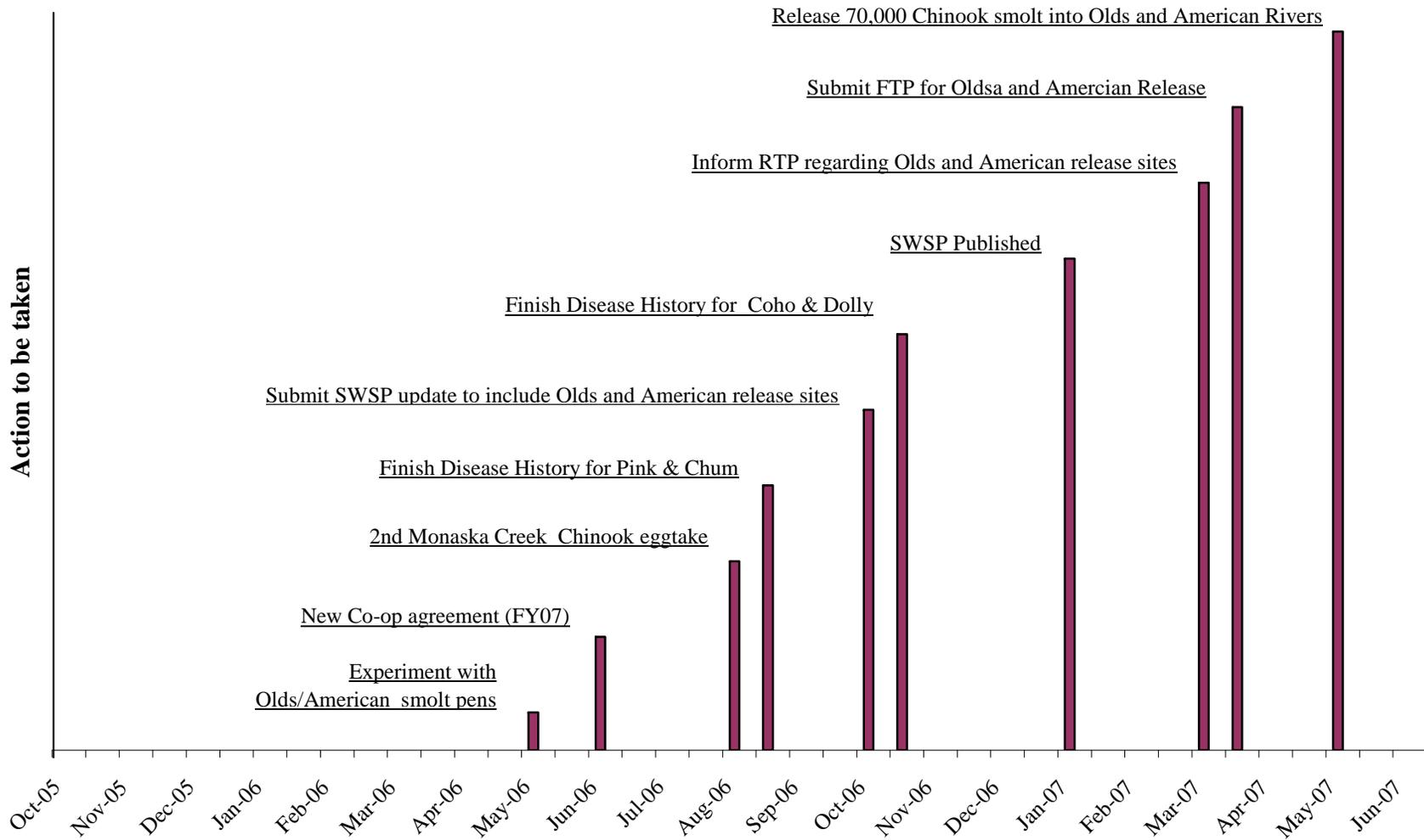


Figure 15.—Timeline of Kodiak Island road system Chinook salmon enhancement project action points.

**APPENDIX A. COOPERATIVE AGREEMENT
COOP-04-103**

COOPERATIVE AGREEMENT

COOP-04-103

Between

Kodiak Regional Aquaculture Association
Kodiak, Alaska

and

Alaska Department of Fish and Game
Sport Fish Division
Kodiak, Alaska

COOPERATIVE AGREEMENT

COOP-04-103

Kodiak Recreational Fisheries Enhancement

This cooperative agreement is made and entered into between Kodiak Regional Aquaculture Association, hereinafter referred to as KRAA (104 Center Ave. Suite 200, Kodiak, Alaska 99615) and the Alaska Department of Fish and Game (ADF&G), Sport Fish Division (211 Mission Road Kodiak Alaska 99615). ADF&G enters into this agreement under the authority of AS16.06.050(13) and AS36.30.300.

I. Purpose of Agreement

Between 1989 and 1996, ADF&G produced Chinook salmon to enhance the Kodiak area recreational fisheries. These fish were raised at the state's Elmendorf Hatchery and released at selected sites on the Kodiak Island road system. In 1996, the Elmendorf Hatchery Chinook salmon releases were terminated because the adult returns were not abundant enough to generate a recreational fishery.

In the 1998 the Kodiak Regional Planning Team (KRPT) began developing a Chinook salmon enhancement project which would accomplish the objectives laid out in its Comprehensive Salmon Plan. The 1983 Comprehensive Plan identified a road system return of 3,000 Chinook salmon as a high priority enhancement opportunity for recreational fishermen. The KRPT plan has the advantage over previous enhancement attempts, because it utilizes a local broodstock (Karluk River). This component is preferred by the State geneticist for wild stock protection. The use of a local broodstock may also improve survival of the released fish. Finally the use of a local hatchery reduces that cost of transportation from ADF&G hatcheries in Anchorage to Kodiak. Transportation is costly and has also resulted in mortality and stress to Chinook smolt.

Fish Transport Permits for this project were applied for and received in March of 2000. The history of the project development is documented in an unpublished report entitled *KODIAK ROAD SYSTEM KING SALMON ENHANCEMENT PROJECT REPORT MAY 2001*. The project was initially a cooperative effort between KRAA, ADF&G and the Kodiak Sport Fishing and Charter Boat Associations. The community and associations donated money to pay for the shipment and installation of surplus raceways at the Pillar Creek Hatchery. Funds to pay for the fish food used to rear smolt during the first two years were also donated by the community and associations. The first egg take occurred on August 2001 and the first release occurred in May 2002, when approximately 63,000 30 gram smolt were released into Monashka Creek.

The current FTP expires on June 30, 2006 and allows the release of the surviving smolt from an egg take of up to 300,000 fertilized king salmon eggs. The KRAA Pillar Creek Hatchery is currently limited to the production of approximately 75,000 20-gram king salmon smolt due to water and raceway limitations. Pillar Creek Hatchery capacity may change in the immediate future as the capacity of the water reservoir is increased and additional hatchery raceways may become available.

In addition to Chinook salmon, KRAA is cooperatively working with ADF&G to produce 64,100 coho salmon fingerlings to provide for additional recreational fishing opportunities on the Kodiak Island Road System.

This agreement will formalize a cooperative project between KRAA and the ADF&G (Division of Sport Fish). ADF&G will directly compensate KRAA \$36,226 to produce 75,000 20 gram Chinook salmon smolt and 64,100 coho salmon fingerlings.

II. Covenants of KRAA

Kodiak Regional Aquaculture Association, does hereby agree to:

- A. Provide Kodiak ADF&G office with quarterly progress reports that include a record of project fish inventories, releases, and average sizes. Quarterly reports are due on the 1st day of October, January, and April. The annual report will complete the last quarter's reporting requirement and is due by July 15. The annual report will include a record of the smolt/fingerlings released (species, number, dates, locations, average size), the species number and size of fish being presently being reared.
- B. Inform ADF&G promptly of any significant event affecting project goals. Contacts for this information are the Kodiak Area Biologist (Len Schwarz) and the South-central Regional Biologist (Dan Sharp).
- C. Return funds to ADF&G on a prorated basis if KRAA chooses to terminate its participation mid-year, (e.g., if KRAA were to terminate participation on December 31, they would return any funds in excess of 50% of that year's funding.)
- D. Abide by good fish culture practices as described in the ADF&G *Fish Culture Manual*. General culture methods shall be discussed annually during the drafting of the Pillar Creek Annual Management Plan.
- E. Federal Compliance Requirements
 1. Political Activity-Federal funds cannot be used for partisan political purposes of any kind by any person or organization involved in the administration of federally assisted programs.
 2. Civil Rights - No person shall, in the grounds of race, color, national origin, age, or handicap, be excluded from participation in or be subjected to discrimination in any program or activity funded in whole or in part by federal funds.
 3. Allowable Costs/Cost Principles - OMB Circular No. A-87, Cost Principles of State and Local Governments establishes principles and standards for determining costs applicable to grants, contracts, and other agreements with state and local governments. A cost is allowable for federal reimbursement only to the extent of benefits received by federal programs, and costs must meet the basic guidelines for allowability, reasonableness, and allocability.
 4. Drug-free Workplace Act - KRAA, by signing this agreement, certifies that they will provide a drug-free workplace.

5. Debarment/Suspension - KRAA, by signing this agreement, certifies that neither it nor its principals is presently disbarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from federal financial assistance programs or activities. Where KRAA is unable to certify to any of the statements in this certification, KRAA shall attach an explanation to this agreement.
6. Audits - KRAA acknowledges that a portion of the funding for this agreement is from the Federal Aid office of the U.S. Fish and Wildlife Service under CFDA 15.605. KRAA acknowledges that receipt of federal funds may create audit requirements under OMB Circular A-128 and/or A-133. KRAA acknowledges that the State of Alaska single audit provisions of 2AAC 45.010 may apply to the remaining portion of the funds.

F. Indemnity and Insurance

Article 1. Indemnification

KRAA, hereafter the Contractor, shall indemnify, hold harmless, and defend the ADF&G, hereafter the Contracting Agency, from and against any claim of, or liability for error, omission or negligent act of the Contractor under this agreement. The Contractor shall not be required to indemnify the Contracting Agency for a claim of, or liability for, the independent negligence of the Contracting Agency. If there is a claim of, or liability for, the joint negligent error or omission of the Contractor and the independent negligence to the Contracting Agency, the indemnification and hold harmless obligation shall be apportioned on a comparative fault basis. Contractor and Contracting Agency, as used within this and the following article, include the employees, agents and other contractors who are directly responsible, respectively, to each. The term independent negligence is negligence other than in the Contracting Agency's selection, administration, monitoring, or controlling of the Contractor and in approving or accepting the Contractor's work.

Article 2. Insurance

Without limiting Contractor's indemnification, it is agreed that Contractor shall purchase at its own expense and maintain in force at all times during the performance of services under this agreement the following policies of insurance. Where specific limits are shown, it is understood that they shall be the minimum acceptable limits. If the Contractor's policy contains higher limits, the state shall be entitled to coverage to the extent of such higher limits. Certificates of Insurance must be furnished to the Contracting Officer prior to beginning work and must provide for a 30-day prior notice of cancellation, nonrenewal or material change of conditions. Failure to furnish satisfactory evidence of insurance or lapse of the policy is a material breach of this contract and shall be grounds for termination of the Contractor's services. All insurance policies shall comply with, and be issued by insurers licensed to transact the business of insurance under AS 21.

2.1 Workers' Compensation Insurance: The Contractor shall provide and maintain, for all employees engaged in work under this contract, coverage as required by AS 23.30.045, and; where applicable, any other statutory obligations including but not limited to Federal U.S.L. & H. and Jones Act requirements. The policy must waive subrogation against the State.

2.2 Commercial General Liability Insurance: covering all business premises and operations used by the Contractor in the performance of services under this agreement with minimum coverage limits of \$300,000 combined single limit per occurrence.

2.3 Commercial Automobile Liability Insurance: covering all vehicles used by the Contractor in the performance of services under this agreement with minimum coverage limits of \$300,000 combined single limit per occurrence.

III. Covenants of ADF&G

Alaska Department of Fish and Game does hereby agree to:

- A. ADF&G will directly compensate KRAA \$36,226 for producing 64,100 coho salmon fingerling (approximately 3 grams) and 75,000 king salmon smolt (approximately 20 grams).
- B. Provide project oversight by annually evaluating the progress of this project and assisting KRAA with the completion of the project reporting requirements.
- C. Obtain and maintain the necessary FTPs for this project.
- D. Designate the following individuals as ADF&G contacts for this project:

Dan Sharp	Len Schwarz
Regional Management Biologist	Kodiak Area Management Biologist
Division of Sport Fish	Division of Sport Fish
267-2186	486-1878

- E. Subject to authorized appropriations, for FY06 make payments to KRAA in the amount not to exceed \$27,637 for the production of 75,000 20 gram smolt and \$8,584 for the production of 64,100 3 gram fingerlings. The final payment may be adjusted if a catastrophic act results in the loss of production and expendable costs are less e.g. fish food. Funding sources for this project are as follows: 75% federal and 25% state fish and game fund. Payments will be made as follows:

July 1- September 30, 2005	\$9,056
October 1 – December 31, 2005	\$9,056
January 1 – March 31, 2006	\$9,057
April 1 – June 30, 2006	\$9,057
Total	\$36,226

- F. Not seek any “refund” of funds if ADF&G chooses to terminate participation mid-year.

IV. It is mutually agreed that:

- A. Sport Fish Division will select the release sites and numbers per site. Initially these sites will be Monashka Creek for Chinook salmon. Coho salmon will be stocked in Island, Dark, Mission, Potato, Mayflower, Monashka Creek, Boy Scout Lake, Sawmill and Southern Lakes and Monashka Creek.

- B. The Sport Fish Division and KRAA will work cooperatively on egg takes conducted on the road system which include the Buskin Lake coho salmon egg take and will include the king salmon egg take in Monashka Creek, once a brood source is established there. In the interim, the Sport Fish Division will conduct and fund the remote egg take on the Karluk River for Chinook salmon stocking.
- C. The goal of this project is to improve recreational angling opportunity for sport fishers. Harvest by other user groups in traditional fisheries will occur, but this project is designed primarily to benefit marine recreational anglers and local shore-based terminal sport fisheries.
- D. An annual production report will be produced by KRAA in cooperation with ADF&G.
- E. The production goals for this project are as follows:
 - 1. 75,000 age-1.0 Chinook salmon smolts, 20 grams at release;
 - 2. 61,400 coho salmon fingerlings, 3 grams at release;
 - 3. Smolts will be released at 20 grams within the period from May 7 to June 15 of each year;
 - 4. Coho salmon production, after review and mutual agreement by all parties concerned, may be substituted for Chinook salmon production if a catastrophic event destroys the Chinook salmon the hatchery is holding,
- F. The particulars of this agreement will be reviewed by both parties during the Pillar Creek Hatchery Annual Management Plan drafting and review, and during the drafting of the next fiscal year's project synopsis in May. Additional terms and conditions to the agreement may be proposed at that (or any other) time and incorporated into amendments that shall be signed by both parties before taking effect.
- G. Nothing in this Cooperative Agreement obligates either party in the expenditure of funds, or for future payments of money, in excess of appropriations authorized by law or specifically agreed within this agreement.
- H. Each party agrees that it will be responsible for its own acts and omissions including those of its officers, agents and employees, and each party shall indemnify, defend and hold harmless the other, to the maximum extent allowed by law, from any claim or liability, of whatever kind, including attorney fees, for damages to property or injury to persons occasioned by each party's own acts or omissions in connection with the terms of this agreement.
- I. No representative of ADF&G or KRAA shall be admitted to any share or part of the agreement or to any direct benefit that may arise there from.
- J. Both parties will act in good faith to continue the project. Either signatory party may prematurely terminate its participation in this Cooperative Agreement by providing to the other party notice in writing at least six months in advance of the date on which its termination becomes effective. Neither party may terminate its participation in this agreement while incubating or rearing Chinook salmon; once a brood cycle is initiated, the agreement may not be terminated until the smolt are released.

- K. The effective date of this cooperative agreement shall be July 1, 2004 and end on June 30, 2013, however either signatory agency may terminate its participation in the Cooperative Agreement by providing notice in writing to the other party a minimum of three months in advance of the date on which their termination becomes effective. Either signatory reserves the option to renegotiate the cost per juvenile by life stage after 5 years, to address inflationary and unforeseen costs related to fish culture expenses.
- L. The parties agree to comply with all applicable federal or state laws regulating ethical conduct of public officers and employees.
- M. Nothing herein is intended to conflict with federal, state, or local laws or regulations. If there are conflicts, this agreement will be amended at the first opportunity to bring it into conformity with conflicting laws or regulations.
- N. Policy and position announcements relating specifically to this cooperative project may be made only by mutual consent of the agencies.
- O. A free exchange of research and assessment of data between KRAA and ADF&G is necessary to ensure the success of this operation.
- P. Appropriate credit will be given to each signatory party in any material published or released to the news media as a result of this cooperative project.
- Q. This agreement may be revised with mutual consent. Any amendment must be in writing and signed by each party. It is expected that amendments will occur in regards to future hatchery modifications which could allow for increased production of Chinook salmon smolt and the possibility of producing additional species (rainbow trout/steelhead)
- R. The parties consent to the jurisdiction of the superior court of the State of Alaska and shall be bound by the laws of Alaska with respect to any dispute under this agreement.
- S. KRAA and any agents and employees of KRAA act in an independent capacity and are not officers or employees or agents of the State in the performance of this agreement.

COOP-04-103

Approving Signatures:

KODIAK REGIONAL AQUACULTURE ASSOCIATION

Date: _____

By: _____

Larry Malloy

Title: Executive Director

ALASKA DEPARTMENT OF FISH AND GAME

Date: _____

By: _____

Kelly Hepler

Title: Director, Division of Sport Fish

Date: _____

By: _____

Tom Lawson

Title: Director, Division of Administration

APPENDIX B.

**ALASKA DEPARTMENT OF FISH AND GAME, DIVISION
OF SPORT FISH CHINOOK SALMON ENHANCEMENT
PROJECTS, INFORMATION, AND STATISTICS, 2006**

Appendix B1.—Alaska Department of Fish and Game, Division of Sport Fish, Chinook salmon enhancement project, information and statistics, 2006.

Area	Wild Stock		Hatchery Release			Imprinting		
	Stream	Average size (g)	Hatchery	Site	Size (g) ^a	Number in thousands	Holding time	Method
Ketchikan	Chickamin	3.5 (2.7 to 4.1)	Crystal Lake	Neets Bay		400	6-8 weeks	Saltwater pens, 22-30 g when released
			Whitman Lake	Neets Bay	15-20	250		
			Whitman Lake	Herring Cove		760		
Petersburg	Andrew Ck	5.12	Crystal Lake	Blind Slough	15-20	600	1 year	Freshwater raceway
Juneau	Andrew Ck	(4.4 to 6.3)	Douglas Island Pink & Chum Inc	Fish Creek		180	4 weeks	Feed in saltwater pens, released June 15 at 25 g. Net pens are used to achieve imprinting, growth, and to make room at the hatchery.
				Auke Bay	17	90		
				Macaulay		225		
				Sheep Creek				
Skagway	Tahini R	3.9 (3.3-5.1)	Douglas Island Pink & Chum Inc	Pullen Creek	17	200	2 weeks	Held in freshwater net pen, 21 g when released
N. Cook Inlet	Ship Ck	Unknown	Elmendorf	Eklutna Trailrace			4 days	Held and fed in raceway, released May 15-20, 5-miles to saltwater.
	Deception Ck			Deception/Willow Ck	12	100-150	0	Released into creek, smolt on own volition.
Anchorage	Ship Ck	Unknown	Elmendorf	Ship Creek	12	315	1 week	Hold in raceway, release into creek.
Kenai Peninsula	Crooked Ck	12	Fort Richardson	Crooked Creek	12 ^b	105	1 week	Crooked Creek Hatchery raceway, June 5 release date.
				Seward Lagoon	12		0	Released directly into Seward Lagoon, smolt on own volition.
				Lowell Creek	12			
Kachemak Bay	Ninilchik R	Unknown	Fort Richardson	Homer Spit		210	1 week	Saltwater pen, June 5 target release date
				Halibut Cove	12		1 week	Saltwater pen, June 5 target release date
				Seldovia		52 ^c	0	Release in ck behind dam, smolt on own volition
Kodiak	Karluk R	Unknown	Pillar Creek	Monashka Creek	15-30 ^d	75	4-11 days ^e	Held and fed in Monashka Ck fish pipe pen. ^f

^a Size of smolt when released from hatchery. Released fish may be larger after imprinting if held and fed for an extended period.

^b When smolt were released at 15-20 g size; the 2003 ADF&G weir crew notice a larger number of jack salmon in the adult return (e.g., 1,111 out of 5,200 returning adult Chinook salmon counted at the weir in 2003 were jack salmon). When smolt were released at 12-20 g size; imprinting time was increased, but there were fewer jack salmon in the adult return.

^c Historically, 105,000 Chinook salmon smolt were stocked annually, but due to hatchery limitations, only half of this number of smolt will be stocked annually until new hatcheries are completed.

^d Very few jack salmon were observed in the adult returns from 2 years of smolt releases with a 30 g smolt size at the time of release and 1 year with a 25 g smolt size at the time of release.

^e Seven groups were released after being held 4-11 days; the average holding time was 7 days.

^f In 2006, smolt were held for one month in Monashka raceway and then released into Monashka Ck. Beginning in 2007, we plan to rear smolt in Monashka raceway for nine months and then release them into Monashka Ck.