

**Tustumena Lake
Sockeye Salmon Enhancement
Progress Report
2004**

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This year's operation of the Tustumena Lake Sockeye Salmon Enhancement Project was made possible through enhancement taxes paid by the commercial fishermen in Area H, Cook Inlet and associated waters and through the Southeast Sustainable Salmon Fund received from the National Oceanic and Atmospheric Administration

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DISCLAIMER

The Cook Inlet Aquaculture Association conducts salmon enhancement and restoration projects in Area H, Cook Inlet and associated waters. As an integral part of these projects a variety of monitoring and evaluation studies are conducted.

The purpose of these progress reports is to provide a vehicle to distribute the information produced by the monitoring and evaluation activities. Data collected each year are presented with a summary of the information previously collected for comparative purposes. These reports are intended to provide a general description of project activity and are not an exhaustive evaluation of any fisheries project. The information presented in each report has not undergone an extensive review. As reviews are completed, the information may be updated and presented in later progress reports.

The following progress report is a synopsis of the monitoring and evaluation activities conducted for the Tustumena Lake sockeye salmon project.

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ACKNOWLEDGEMENTS

The 2004 Tustumena Lake smolt migration and Bear Creek sockeye fry release were conducted by the Cook Inlet Aquaculture Association (CIAA). Smolt migration equipment was provided courtesy of the Alaska Department of Fish and Game, (ADF&G). CIAA seasonal employees Darin Dodson and Mike Yates spent many hours in the field assisting with the 2003 field activities. Their efforts are greatly appreciated. Ronald Carlson, CIAA Project Technician, Mark Thomas, Assistant Manager at Trail Lakes Hatchery, and Lab Assistants, Cathy Cline and Bridget Dodson are also recognized for their assistance and hard work.

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ABSTRACT

The Alaska Department of Fish and Game (ADF&G) began the Tustumena Lake sockeye enhancement program in 1974. In 1976, the first fry resulting from egg collections were released to Tustumena Lake. During the project, eggs were collected from Bear Creek, Glacier Flats Creek, and Seepage Creek in varying combinations. As the project progressed, as many as 23.6 million eggs were collected and as many as 17.1 million fry were released into Tustumena Lake; and up to eight other lakes were stocked with fry of Tustumena origin. Currently 12 million eggs are collected from Bear Creek and 6 million are released to Tustumena Lake and 3.4 million to three lower Cook Inlet lakes.

In 1993, CIAA assumed operation of the Tustumena Lake sockeye enhancement program from ADF&G. Initially, ADF&G maintained the responsibility of conducting the Tustumena Lake limnological sampling, smolt migration and adult escapement and CIAA accepted the responsibility of enumerating the spawning population at the Bear Creek gamete collection site, collecting gametes for the enhancement program, incubating, rearing and releasing the resulting fish. In 1998, CIAA assumed the responsibility of enumerating the smolt migration and conducting the limnological sampling.

In January 2004, a ruling by the 9th Circuit Court of Appeals found that the enhancement project occurring on Tustumena Lake was a commercial enterprise and thus, violated the Wilderness Act. As a result, the United States Fish and Wildlife Service were no longer able to provide CIAA with a permit to continue operations on Tustumena Lake. The resultant fry from the 2003 egg collection were allowed to be released; however, all other activities were suspended.

This report summarizes the 2004 Bear Creek fry release and the Tustumena Lake smolt migration. The Bear Creek adult enumeration and gamete collection activities, otolith collection activities, and the limnological sampling were not conducted in 2004 and will not take place in the future.

Brood year 2003 sockeye salmon fry from Bear Creek broodstock were released to Bear Creek between 30 May and 1 June 2004. The 6.006 million fry were transported by fixed-wing float-equipped aircraft to the mouth of Bear Creek, held for four hours in Bear Creek water, and then released to Bear Creek 150 to 200 meters upstream. All fry were thermally marked prior to release. In addition to the fish released to Bear Creek, fry of the same brood year and stock were released to Leisure Lake (2.002 million), Hazel Lake (.351 million), and Kirschner Lake (.251 million).

The enumeration of sockeye salmon smolts migrating from Tustumena Lake was conducted at mile 6.3 of the Kasilof River from 20 May to 24 June using a mark/recapture technique developed by ADF&G. The smolt migration totaled 6.28 million ($\pm 994,000$) fish and was composed of 64.7% ($\pm 13.3\%$) age 1 smolts and 24.8% ($\pm 8.1\%$) age 2 smolts (age 3 smolts made up less than 1%). The age 1 smolts averaged 79.3 mm (± 0.42 mm) in length and 4.30 g (± 0.07 g) in weight; the age 2 smolts averaged 91.7 mm (± 0.57 mm) in length and 6.60 g (± 0.12 g) in weight.

g) in weight. Smolts resulting from fry released by CIAA made up 49.9% (\pm 12.9%) of the migration.

An adult counting weir was not placed in Bear Creek in 2004

Gamete collection at Bear Creek did not occur in 2004

Otoliths were not collected from adult sockeye returning to Bear, Moose, Nicolai, and Glacier Creek, tributaries of Tustumena Lake in 2004. However ADF&G collected otoliths from sockeye salmon at the fish wheel on the Kasilof River. Less than 1% of the samples were hatchery released fish.

CIAA also sampled the hatchery outfall for hatchery-reared Tustumena stock adults returning to the hatchery. There were no adult sockeye observed at the Trail Lakes Hatchery outfall in 2004.

INTRODUCTION AND PURPOSE

In July 1993, the Alaska Department of Fish and Game (ADF&G) transferred operation of its Crooked Creek Salmon Hatchery to the Cook Inlet Aquaculture Association (CIAA). Prior to the transfer of hatchery operations to CIAA, Crooked Creek Hatchery incubated and reared sockeye (*Onchorynchus nerka*), coho (*O. kisutch*) and Chinook (*O. tshawytscha*) salmon and steelhead trout (*O. mykiss*) for release into various water bodies throughout the central and lower Cook Inlet drainage. While under CIAA management, the hatchery's stocking programs focused on sockeye salmon releases to Tustumena Lake, several lower Cook Inlet Lakes and Resurrection Bay.

In 1993, when CIAA began operating Crooked Creek Hatchery, ADF&G maintained the responsibility of monitoring the Tustumena Lake sockeye salmon smolt migration and adult escapement. CIAA accepted the responsibility of collecting the gametes (eggs and milt), incubating the eggs, rearing the fry and releasing the resulting fish to the designated water bodies.

In November 1996, CIAA terminated operations at Crooked Creek Hatchery, suspended stocking activities at five lower Cook Inlet Lakes, and transferred the remaining stocking programs to its Trail Lakes and Eklutna hatcheries.

In 1997, the Bear Creek gamete collection procedure and the Tustumena Lake fry stocking program were reviewed by the U.S. Fish and Wildlife Service. The U.S. Fish and Wildlife Service recommended several changes to these activities, which have been incorporated into the program.

In 1998, operations at Eklutna Hatchery were suspended, and the hatchery's Tustumena Lake egg incubation and fry rearing activities were transferred to Trail Lakes Hatchery. During 1998, CIAA also assumed the responsibility of conducting the limnological sampling; and, thus became responsible for conducting all project activities, except the adult escapement monitoring,

which is conducted by ADF&G. Under the current program, approximately twelve million eggs are collected to provide six million fry for rearing in Tustumena Lake and approximately 3.5 million for rearing in three Lower Cook Inlet lakes.

Wilderness Society and the Alaska Center for the Environment (ACE) brought suit against the U.S. Fish and Wildlife service challenging the issuance of a permit for the Tustumena enhancement project. After years of litigation, the 9th Circuit Court of Appeals ruled, in January 2004, that the enhancement project occurring on Tustumena Lake was a commercial enterprise and thus, violated the Wilderness Act. As a result, the United States Fish and Wildlife Service were no longer able to provide CIAA with a permit to continue operations on Tustumena Lake. The resultant fry from the 2003 egg collection were allowed to be released; however, all other activities were suspended.

This report summarizes the 2004 project activities conducted by CIAA. It includes the Bear Creek fry release, the Kasilof River smolt enumeration, and the release of Tustumena Lake origin fish to three lower Cook Inlet lakes.

The Tustumena Lake adult sockeye migration was completed by ADF&G and is reported by ADF&G.

PROJECT AREA

Tustumena Lake is located on the Kenai Peninsula in South-central Alaska (Figure 1). It is the largest lake on the Kenai Peninsula and the fifth largest lake in the State of Alaska. It is a glacial lake with a surface area of 294.5 km². The mean depth is 24 m, and the maximum depth is 320 m. The lake is fed by several clear-water streams and two glacial streams, which originate in the Harding Icefield (Kyle, 1992).

Tustumena Lake is oligotrophic with mean open-water season total phosphorus, total Kjeldahl nitrogen and chlorophyll *a* concentrations of 3.7 µ/L, 155 µ/L, and 0.45 µ/L, respectively. The lake is turbid with glacial silt and light penetration is limited to the upper two meters (Kyle, 1992).

The zooplankton community consists of two copepods, *Diaptomus pribilofensis* and *Cyclops columbianus*. All five species of Pacific salmon, *O. nerka*, *O. keta*, *O. gorbuscha*, *O. tshawytscha*, and *O. kisutch*, are found in the Tustumena Lake system; however, it is mainly sockeye that utilize the limnetic area of the lake. Resident fish species include rainbow trout (*O. mykiss*), lake trout (*Salvelinus namaycush*), Dolly Varden char (*S. malma*), threespine stickleback (*Gasterosteus aculeatus*), coastrange and slimy sculpin (*Cottus aleuticus* and *C. cognatus*) and round whitefish (*Prosopium cylindraceum*) (Kyle, 1992)

The Kasilof River, which flows 17.4 miles to Cook Inlet, forms the outlet. The smolt migration and the enumeration of the adult escapement occur in the Kasilof River.

Bear Creek, a tributary of Tustumena Lake (Figure 1), is the site of the fry release and gamete collection. It is a moderately sized stream approximately 16 miles long with an average gradient of 185 feet/mile. The stream lies northeast of the lake and begins in the Kenai Mountains above tree line at an elevation of approximately 3,100 feet. The upper section of the creek flows with an average gradient of 260 feet/mile for 4.25 miles. At the tree line it enters a narrow canyon. The canyon dominates the middle section of the stream as it flows for the next 8.25 miles with an

average gradient of 180 feet/mile. As the stream leaves the canyon, the gradient over the lower 3.75 miles decreases to approximately 105 feet/mile. The fry release and gamete collection site is located in the lower section of Bear Creek approximately 150 meters upstream of its confluence with Tustumena Lake.

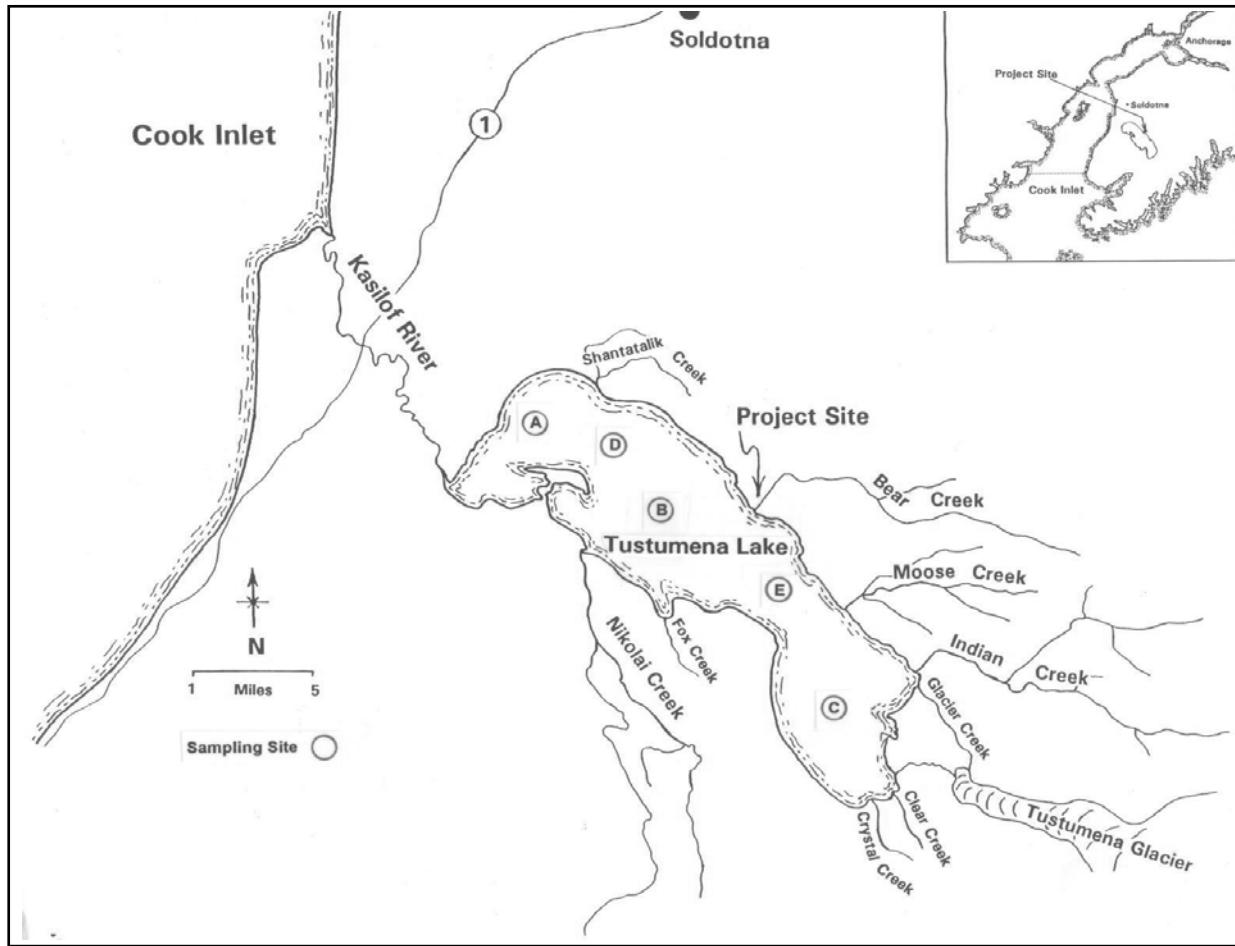


Figure 1. Area Map of Bear Creek, a tributary to Tustumena Lake, near Soldotna, Alaska.

METHODS

CIAA's 2004 Tustumena Lake fishery enhancement activities involved the enumeration of the smolt migration and the release of fry at Bear Creek and to three Lower Cook Inlet lakes. The procedures used to release the fry and enumerate the smolt migration are described below. In general, all procedures follow ADF&G recommendations.

Limnological Sampling and Environmental Conditions

During 2004, there were no limnological samples collected.

Smolt Enumeration

This was the seventh year CIAA was responsible for enumerating the smolt migration from Tustumena Lake. The smolt migration was estimated by enumerating a known proportion of the migration following procedures developed by ADF&G. The following is a general description of the procedures.

One inclined-plane smolt trap (Todd 1994) was placed in the Kasilof River near river mile 6.3 to capture a portion of the migrating smolts. The trap was operated from 20 May through 24 June 2004. It consisted of an inclined plane lead, a live box, and a floating support structure; and measured 1.5 m in width, 1 m in height, and 3.8 m in length.

Each day, the number of smolts captured by the trap was determined by individually counting and releasing each fish; or, when the daily smolt numbers exceeded 15,000 fish, the number of smolts captured was estimated using a biomass technique. To estimate the number of smolts captured by the biomass technique, the average weight of a sample of at least 50 smolts caught that day was divided into the total weight of all smolts captured (Todd and Kyle, 1996). Debris accumulating in the trap was also removed when the trap was checked for fish.

The total number of sockeye smolts migrating from Tustumena Lake was estimated using weekly trap capture efficiencies determined by the recapture of marked fish. For the mark-and-recapture procedure, each week approximately 1,000 sockeye smolts were dyed¹ and released upstream near river mile 7.1. The number of smolts recaptured was then used to estimate the proportion of migrating smolts captured (the trap capture efficiency) and the total smolt migration.

Statistical procedures for estimating the population of migrating smolts (N) followed the *simple stratified M-R design* for One-Site sampling experiments described by Carlson et al. (1998) where:

U = total unmarked population size;
 N = total population size;
 N_h = total population size in stratum h ;
 u_h = total number of unmarked smolts captured in stratum h ;
 M_h = number of marked smolts released in stratum h ;
 m_h = number of marked smolts recaptured in stratum h ;
 L = number of strata or periods; and

$$\hat{U} = \sum_{h=1}^L \hat{N}_h - M_h = \sum_{h=1}^L \frac{u_h (M_h + 1)}{m_h + 1}$$

The variance of the population estimate $v(N)$ and the 95% confidence interval (CI) were estimated as:

$$v(\hat{N}) = \sum_{h=1}^L v(\hat{N}_h) = \sum_{h=1}^L \frac{(M_h + 1)(n_h + 1)(M_h - m_h)(n_h - m_h)}{(m_h + 1)^2 (m_h + 2)}; \text{ and}$$

$$(CI) = \hat{N} \pm 1.96\sqrt{v(\hat{N})}.$$

This method assumes:

- All marked fish released upstream pass the trap before the next release of marked fish;
- The probability that a dyed or unmarked fish enters the trap equals the trap efficiency for all dyed or marked fish;

¹ Fish were marked by placing them in a Bismark Brown Y dye bath (1.0g dye dissolved in 30 liters water) for 30 minutes before being reintroduced into the river.

- Fish are captured or not captured in the trap independently of the fate of other fish;
- All fish entering the trap are counted, and;
- Trap efficiencies do not change significantly during the smolt migration.

The daily migration of sockeye smolts is presented in Appendix 2.

The proportions of age 1, age 2, and age 3 smolts were calculated using the data computed from the aforementioned notations and formulas with the following notations and formulas:

U_i = total unmarked population size for age class = i ;
 U_h = total unmarked population size for stratum = h ;
 U_{hi} = total unmarked population size for age class i , in stratum = h ;
 P_i = proportion of unmarked smolt for age class = i ;
 P_h = proportion of unmarked smolt for stratum = h ;
 P_{hi} = proportion of unmarked smolt for age class = i , in stratum = h ;
 a_i = total number of samples of age class = i ;

The estimated number of migrating age = i smolts was calculated as:

$$U_i = \sum U_h P_{hi}$$

Proportion of age = i smolts was calculated as:

$$P_i = \frac{1}{U} \sum U_h P_{hi}$$

The variance of the proportion of age = i smolts in stratum = h was calculated as:

$$v(P_{hi}) = \frac{P_{hi}(1 - P_{hi})}{a_h - 1}$$

The variance of the number of age = i smolts in stratum = h was calculated as:

$$v(U_{hi}) = U_h^2 v(P_{hi}) + P_{hi}^2 v(U_h) - v(U_h) P_{hi}$$

Therefore, the variance of the estimated number of age = i smolts was calculated as:

$$v(U_i) = \sum v(U_{hi})$$

Confidence intervals (95%) estimates for number of age = i smolts are:

$$U_i \pm 1.96\sqrt{v(U_i)}$$

Since 1976, ADF&G or CIAA has released sockeye salmon fry directly to Tustumena Lake or to Bear Creek, a tributary of Tustumena Lake, for rearing in Tustumena Lake. Since 1996, CIAA has marked the otoliths of all sockeye fry rearing in Tustumena Lake with a thermal band². The purpose of the thermal band was to identify released fish in the population of smolt migrating from Tustumena Lake or adults migrating back to the lake.

In 2004, to assess the enhancement program, CIAA collected a sample of sockeye smolts migrating from the lake to determine age, weight, and length characteristics of the migrating population and to estimate the proportion of enhanced fish in the smolt migration. Smolts collected for evaluation, were collected daily in proportion to the number of smolts captured by the inclined-plane trap. This was accomplished by collecting a sample of migrating smolts approximately equal to 0.3% of the fish captured. Each sockeye smolt collected for evaluation was first measured to the nearest millimeter for fork length³ and then weighed to the nearest 0.1 gram. Several scales were removed from the primary growth area⁴ and mounted on a glass slide for subsequent age determination.

The otoliths of the collected smolts were removed and placed in a labeled 1dram vial. Ethanol was added to the vial to cover the otoliths; and, after the smolt migration was complete, the otoliths were shipped to CIAA headquarters. Lab staff at processed the otoliths and checked each for a hatchery thermal mark following procedures described by Glick and Shields (1993).

In 2004, 730 otoliths were processed and 593 were readable. The enhancement contribution of the migrating smolts was calculated using the same notations and formulas as reported above, but with following exception: i = hatchery or wild.

²The otolith mark is a series of hatchery induced bands produced by controlled temperature changes during incubation.

³Standard fork length was measured from the tip of the snout to the fork of the tail.

⁴Located above the lateral line on a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin.

Sockeye smolt characteristics (average weight and length) for captured smolts were estimated with the following notations and formulas.

If:

y = weight or length of fish

c_i = number of age = i smolts sample

Mean weight or length was calculated as:

$$\bar{y}_i = \frac{\sum y_i}{c_i}$$

The standard deviation for weight and length of each age class was calculated as:

$$\sigma_{y_i} = \sqrt{\frac{c_i \sum y_i - (\sum y_i)^2}{c_i(c_i - 1)}}$$

Confidence intervals (95%) for the mean weight and length are, therefore:

$$\bar{y}_i = \pm 1.96 \left(\frac{\sigma_{y_i}}{\sqrt{c_i}} \right)$$

Adult Escapement

Monitoring of the 2004 Tustumena Lake adult sockeye escapement was completed by ADF&G. Based on preliminary information developed by ADF&G, the total estimated 2004 Tustumena Lake sockeye return was 1,677,059 fish; with a commercial harvest of 1,021,228, personal use harvest of 70,000, a sport fish harvest of 11,000, and a lake escapement of 574,831 (twice the escapement of 2003). The 2004 adult return data will be finalized and reported by ADF&G.

Adult escapement monitoring at Bear Creek did not occur in 2004.

Gamete Collection, Incubation and Rearing

In 2004, the gamete collection at Bear Creek did not occur.

Fish Transport and Stocking

In 2004, all fry were transported by truck in oxygenated transport tanks from Trail Lake Hatchery to Trail Lakes, transferred to a fixed-wing float-equipped aircraft, and flown to the mouth of Bear Creek. Upon arrival, the fry were transferred to seven small holding tanks fitted with an oxygen delivery system and a continuous fresh water exchange. The fresh water was obtained from Bear Creek and gravity fed via a temporary pipe system to the holding tanks. The fry were held in the holding tanks between 3.75 and 6.3 hours for imprinting to Bear Creek. After imprinting, the fry were carried in buckets 150 to 200 meters upstream and released to the creek at the gamete collection site. Many fish immediately drifted downstream to the lake; however, some remained in the creek and were observed holding in small pools and eddies.

Fry of the same brood year and stock were also transported via fixed-wing float-equipped aircraft to Leisure Lake, Hazel Lake, and Kirschner Lake. The fry were gravity fed from the aircraft's holding tank directly to the lake.

All fry from brood year 2003 and of Bear Creek broodstock were not externally marked or tagged upon release; however, the otoliths of these fry were marked with thermal bands [Rbr 1:1.3]. Otolith samples were processed to document the marks and are on file at Trail Lakes Hatchery.

Adult Otolith Collection

Beginning in 1996, CIAA thermally marked all fry released directly into Tustumena Lake or released into Bear Creek for rearing in Tustumena Lake. During the 2004 season, CIAA did not collect otoliths.

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RESULTS AND DISCUSSION

Limnology and Environmental Conditions

During 2004, there were no limnological samples collected.

Environmental conditions during the Kasilof River smolt migration were monitored from 20 May to 24 June 2004. Stream Stage measurements averaged 1.71 feet and ranged from 1.04 to 2.71 feet. During the period of the smolt migration, river temperatures averaged 9.6°C and ranged from 7 to 12°C. Air temperatures averaged 13.2°C and ranged from 5 to 21°C. Nineteen percent of the days were clear, 64% were partly cloudy, and 17% were completely overcast. A total of 33 mm of rain fell during this period (Appendix 1).

Smolt Enumeration

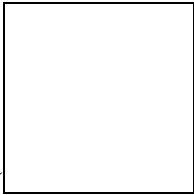
Based on the statistical analysis a total of 6.38 million ( 994,000) sockeye smolts migrated from Tustumena Lake (Table 1) in 2004. Smolts resulting in fry released by CIAA made up 49.9% (+12.9%) of the migration.

Table 1. Tustumena Lake smolt migrations – 1998 to 2004.

Smolt Year	Total (million)	95% C.I.	Wild	Hatchery	% Hatchery	95% C.I.
1998	4.6	(±395,000)	3,872,000	727,000	15.8	(±2.2)
1999	4.5	(±461,000)	3,555,000	945,000	21.0	(±2.5)
2000	4.3	(±526,000)	3,986,000	316,000	7.4	(±1.8)
2001	5.3	(±612,000)	5,155,000	105,000	1.9	(±1.0)
2002	3.5	(±618,000)	3,474,000	0	0	0
2003	12.9	(±2,437,000)	10,619,000	2,329,000	18.0	(±4.6)
2004	6.4	(±997,000)	3,155,332	3,140,255	49.9	(±12.6)
Average	5.9		4,830,905	1,080,322	16.3	

The smolt migration was composed of 64.7% ($\pm 13.3\%$) age 1 smolts and 24.8% ($\pm 8.1\%$) age 2 smolts (age 3 smolts made up less than 1%). The age 1 smolts averaged 79.3 mm (± 0.42 mm) in length and 4.30 g (± 0.07 g) in weight; the age 2 smolts averaged 91.7 mm (± 0.57 mm) in length and 6.60 g (± 0.12 g) in weight. Though both age classes of smolts were smaller than those in the 2003 smolt migration, they were still larger than average (Table 2).

Table 2. Tustumena Lake smolt characteristics – 1997 to 2004.

Smolt Year	Age Class (%)				Mean length (mm)				Mean weight (g)			
	Age 1.0	95% C.I.	Age 2.0	95% C.I.	Age 1.0	95% C.I.	Age 2.0	95% C.I.	Age 1.0	95% C.I.	Age 2.0	95% C.I.
1997	64.7		35.3		76.9		86.6		3.90		5.20	
1998	79.5		20.5		74.5 (± 0.36)		84.9 (± 1.03)		3.75 (± 0.05)		5.43 (± 0.16)	
1999	77.7	($\pm 9.6\%$)	22.3	($\pm 3.8\%$)	76.8 (± 0.34)		88.6 (± 0.66)		3.85 (± 0.05)		5.77 (± 0.13)	
2000	81.3	($\pm 11.5\%$)	18.7	($\pm 4.2\%$)	73.4 (± 0.32)		86.0 (± 0.73)		3.20 (± 0.05)		5.01 (± 0.12)	
2001	60.7	($\pm 9.5\%$)	38.2	($\pm 6.3\%$)	72.3 (± 0.39)		83.7 (± 0.53)		3.26 (± 0.05)		5.07 (± 0.08)	
2002	39.4	($\pm 24.1\%$)	60.9	($\pm 24.8\%$)	74.4 (± 0.42)		81.9 (± 0.64)		3.66 (± 0.06)		5.16 (± 0.11)	
2003	74.2	($\pm 16.2\%$)	24.8	($\pm 6.4\%$)	77.8 (± 0.42)		90.5 (± 0.15)		4.80 (± 0.07)		7.20 (± 0.15)	
2004	64.7	($\pm 13.3\%$)	35.2	($\pm 8.1\%$)	79.3 (± 0.42)		91.7 (± 0.57)		4.30 (± 0.07)		6.60 (± 0.12)	
Ave	67.8		32.0		75.7		86.7		3.84		5.68	

Note: 2001 smolt migration included 1.1% ($\pm 0.07\%$) age class 3 smolt

Note: 2003 smolt migration included 1% ($\pm 0.8\%$) age class 3 smolt

Adult Escapement

Escapement at Bear Creek was not conducted in 2004

Fish Transport and Stocking

Prior to 1996, all releases of sockeye fry by CIAA to Tustumena Lake were made by aerial drop. Fry were transported and released from fixed-wing aircraft from an altitude of approximately 300 feet near the lake's shoreline. In 1996, fry transport and release methods were modified. Fry were transported by skiff to the mouth of Bear Creek and released directly into the creek as it entered the lake.

In 1997, the fry transport and release methods were again modified. The fry were flown to the mouth of Bear Creek by fixed-wing float-equipped aircraft, transferred to several small holding tanks fitted with an oxygen delivery system and a continuous exchange of fresh water and then

carried 150 to 200 meters upstream for release. Although, this transport and release procedure was developed to improve the ability of adult fish to migrate back to Bear Creek, it also provided CIAA with a better opportunity to estimate fry transport mortality and to evaluate the condition of the fry at the time of release. The release method has been consistent since 1997.

In 2004, 6.006 million fry were released between 30 May and 1 June (Table 3).

Table 3. 2004 summary of fry transport, imprinting and release activities at Bear Creek.

Date	Load No.	Transport			Holding		Start Imprint	Release Time	Hours Imprinted	No. of Fry Released Daily
		Air Craft	Weight (kg)	Fry/kg	No. of Fry	D.O (mg/l)				
30-May-04	1	206	80.9	2,993	242,134	ND	10:20	14:30	4:10	1,932,122
	2	Beaver	105	2,993	314,265	ND	11:45	15:45	4:00	
	3	206	78.2	2,677	209,341	ND	11:55	15:55	4:00	
	4	Beaver	106.6	2,677	285,368	ND	13:30	17:30	4:00	
	5	206	83.1	2,270	188,637	ND	13:45	17:45	4:00	
	6	206	81.7	2,604	212,747	ND	15:40	19:40	4:00	
	7	Beaver	105.7	2,831	299,237	ND	17:55	21:55	4:00	
	8	206	87.4	2,064	180,394	ND	18:40	22:40	4:00	
31-May-04	1	Beaver	105.8	3,158	334,116	ND	10:20	15:00	4:40	2,054,622
	2	206	85.6	2,197	188,063	ND	10:50	15:25	4:35	
	3	Beaver	116.0	2,662	308,792	ND	12:15	16:15	4:00	
	4	Beaver	106.0	3,175	336,550	ND	17:15	21:15	4:00	
	5	206	92	3,155	290,260	ND	17:35	21:35	4:00	
	6	Beaver	121.6	2,834	344,614	ND	18:50	22:50	4:00	
	7	206	89.0	2,834	252,226	ND	19:30	23:30	4:00	
1-Jun-04	1	Beaver	117.7	3,095	364,282	ND	10:15	14:00	3:45	2,018,818
	2	206	92.9	3,151	292,728	ND	10:40	14:40	4:00	
	3	Beaver	120.2	3,151	378,750	ND	11:55	18:10	6:15	
	4	206	94.9	3,095	293,716	ND	12:10	18:30	6:20	
	5	Beaver	124.7	3,072	383,078	ND	14:10	19:10	5:00	
	6	Beaver	84	3,646	306,264	ND	ND	ND	ND	
Total			2,079	60,334	6,006,000					
Ave:			99.0	2,873.0	285,979			4:20		

Note: Although Dissolved Oxygen (DO) was not recorded, it was monitored and kept between 7 to 12 mg/l; during the last 0.5 hours of holding the DO was increased to 20 mg/l

Fry from brood year 2003 that were also stocked into lower Cook Inlet lakes are presented in Table 4.

Table 4. A summary of sockeye and smolt releases of Bear Creek broodstock – 1994 to 2004

Release Year	BY	Release to Tustumena L.	Fry Releases							Age 1 Smolt Releases			
			Leisure L.	*Chenik L.	*Paint River L.	Kirschner L.	Hazel L.	*Bruin L.	*Ursus L.	BY	*Coal Ck.	*Grouse L.	
1994	1993	0	0	0	0	208,000	0	0	0	0	1992	0	0
1995	1994	6,000,000	1,632,000	1,129,000	588,000	251,000	1,061,000	251,000	252,000	1993	146,000	83,000	
1996	1995	6,136,000	1,490,000	951,000	500,000	250,000	1,030,000	250,000	250,000	1994	0	218,000	
1997	1996	5,981,000	2,000,000	0	0	250,000	1,000,000	0	0	1995	0	761,000	
1998	1997	4,558,000	1,877,000	0	0	234,000	1,218,000	0	0	1996	0	1,186,000	
1999	1998	5,945,000	26,500	0	0	172,700	453,100	0	0	1997	0	0	
2000	1999	5,431,600	1,707,500	0	0	248,500	1,248,000	0	0	1998	0	0	
2001	2000	0	88,700	0	0	0	0	0	0	1999	0	0	
2002	2001	6,052,000	2,246,000	0	509,000	302,000	1,200,000	0	0	2000	0	0	
2003	2002	6,020,000	2,240,000	0	0	298,400	1,547,100	0	0	2001	0	0	
2004	2003	6,006,000	2,001,800	0	0	250,800	350,500	0	0	2002	0	0	
Average		4,739,055	1,391,773			224,127	827,973						

*Project Not Active

Adult Otolith Collection

CIAA did not collect adult otoliths in 2004.

Gamete Collection

CIAA did not collect gametes from Bear Creek sockeye salmon in 2004.

RECOMMENDATIONS

There are no recommendations.

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APPENDICES

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Appendix 1. Kasilof River 2004 - Environmental Conditions

Smolts					Water	Air
Date	Sky	Precip. (mm)	Stage (ft)	Flow	Temp. (oC)	Temp. (oC)
20-May	1	0	1.04	ND	8.0	16.0
21-May	3	0	1.06	ND	10.0	10.0
22-May	5	5	1.10	ND	10.0	9.0
23-May	5	7	1.08	ND	9.0	9.0
24-May	5	8	1.24	ND	9.0	12.0
25-May	4	1	1.28	ND	ND	13.0
26-May	3	0	1.34	ND	9.0	18.0
27-May	3	2	1.34	ND	8.0	7.0
28-May	2	0	1.36	ND	9.0	19.0
29-May	2	0	1.38	ND	10.0	6.0
30-May	3	0	1.40	ND	10.0	12.0
31-May	2	0	1.41	ND	9.0	13.0
1-Jun	2	0	1.42	ND	10.0	10.0
2-Jun	3	0	1.44	ND	10.0	9.0
3-Jun	2	0	1.48	ND	10.0	5.0
4-Jun	3	0	1.48	ND	11.0	9.0
5-Jun	2	0	1.52	ND	11.0	19.0
6-Jun	2	0	1.54	ND	10.0	6.0
7-Jun	2	0	1.56	ND	7.0	7.0
8-Jun	3	0	1.6	ND	7.0	12.0
9-Jun	3	0	1.61	ND	7.0	12.0
10-Jun	3	0	1.63	ND	9.0	15.0
11-Jun	3	0	1.66	ND	10.0	12.0
12-Jun	2	0	1.72	ND	12.0	14.0
13-Jun	3	0	1.76	ND	9.0	13.0
14-Jun	3	0	1.85	ND	9.0	11.0
15-Jun	4	0	2.00	ND	10.0	11.0
16-Jun	4	8	2.20	ND	10.0	13.0
17-Jun	2	1	2.30	ND	10.0	18.0
18-Jun	1	0	2.38	ND	9.0	20.0
19-Jun	1	0	2.44	ND	12.0	19.0
20-Jun	1	0	2.52	ND	12.0	21.0
21-Jun	1	0	2.56	ND	9.0	17.0
22-Jun	2	0	2.62	ND	10.0	17.0
23-Jun	1	0	2.67	ND	11.0	20.0
24-Jun	1	0	2.71	ND	10.0	20.0
Total		33				

ND = No Data

- 1 = Clear
- 2 = Cloud Cover <50%
- 3 = Cloud Cover >50%
- 4 = Overcast
- 5 = Rain

Appendix 2. Kasilof River 2004 - Smolt Migration

Date	Number of Migrants
20-May-04	7,885
21-May-04	2,731
22-May-04	3,769
23-May-04	4,423
24-May-04	14,154
25-May-04	30,846
26-May-04	17,423
27-May-04	9,692
28-May-04	51,346
29-May-04	257,269
30-May-04	38,769
31-May-04	250,231
1-Jun-04	822,731
2-Jun-04	1,197,423
3-Jun-04	315,913
4-Jun-04	267,848
5-Jun-04	401,978
6-Jun-04	187,739
7-Jun-04	96,652
8-Jun-04	77,978
9-Jun-04	101,587
10-Jun-04	226,304
11-Jun-04	493,250
12-Jun-04	248,714
13-Jun-04	66,214
14-Jun-04	182,929
15-Jun-04	58,321
16-Jun-04	106,964
17-Jun-04	72,893
18-Jun-04	264,188
19-Jun-04	90,313
20-Jun-04	83,750
21-Jun-04	67,125
22-Jun-04	76,375
23-Jun-04	151,750
24-Jun-04	84,125
	* 6,431,603

*This number represents raw data and has not been statistically evaluated.

Appendix 3. Tustumena Lake 2004 - Project Update

Stocking & Misc. Activities			
Crew on-site for fry release:	26-May to 31-May		
Crew on site for adult count:	NA to NA		
Fry release:	30-May to 1-Jun	6,006,000	
Zooplankton sampling:	NA to NA		

Smolt Migration			
Dates:	20-May to 24-Jun		
Sockeye total migration:		6,378,000	(±994,000)
Age 1:	64.7%	(±13.3%)	4,128,000 (±849,000)
Age 2:	35.2%	(±8.1%)	2,244,000 (±516,000)
Hatchery:	49.9%	(±12.9%)	3,140,255 (±810,000)

Adult Migration			
Dates:	ND to ND		
Sockeye return to Cook Inlet:		1,677,059	
Tustumena Escapement:		574,831	34%
Commercial Harvest:		1,021,228	61%
Personal Use Harvest:		70,000	4%
Sport Harvest:		11,000	1%

Bear Creek Escapement	
Dates:	
Sockeye total return:	
Upstream before weir installed:	
Upstream before egtake:	
Remaining after weir removed:	
Used for egtake:	
Creek mortalities	
Total upstream spawners:	

No Data collected in 2004

Egg Take	
Dates:	
Total no. fish used:	
No. of females used:	
No. of males used:	
No. of mortalities	
Green eggs:	
Eyed eggs:	
percent eyed survival	
Fecundity:	

No Gametes collected in 2004

