Big Lake
Sockeye Salmon Enhancement
Progress Report
2003

Prepared by:
Trenten T. Dodson, Biologist
March 2004

This year's operation of the Big Lake Sockeye Salmon Enhancement Project was made possible through enhancement taxes paid by the commercial fishermen in Area H, Cook Inlet and associated waters, through the harvest and sale of surplus fish and by a grant from the U.S. Fish and Wildlife Service.

This page intentionally left blank

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 following progress report is a synopsis of the monitoring and evaluation studies conducted for the Big Lake sockeye salmon enhancement project.

The purpose of the progress report is to provide a vehicle to distribute the information produced by the monitoring and evaluation studies. 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 restoration or enhancement project. The information presented in this report has not undergone an extensive review. As reviews are completed, the information may be updated and presented in later progress reports.

This page intentionally left blank

ACKNOWLEDGEMENTS

Many individuals and agencies contributed to the successful 2003 field season at the Big Lake Salmon Enhancement Project. Appreciation is extended to Cook Inlet Aquaculture Association seasonal employees, Alger Aleck, Eric Gallant, Jeff Pike, Christine Starkweather, and Jeriel Hillman; and full time staff who endured many long hours in the field. The Cook Inlet Aquaculture Association Board of Directors and the Alaska Department of Fish and Game for the support they have provided to the Big Lake Sockeye Salmon Enhancement Project. Finally, thank you to the U.S. Fish and Wildlife Service and Senator Ted Stevens for providing the funding that CIAA to increase the evaluation of this important salmon resource.

This page intentionally left blank

TABLE OF CONTENTS

This page intentionally left blank

LIST OF FIGURES

This page intentionally left blank

LIST OF TABLES

This page intentionally left blank

ABSTRACT

Big Lake, located in the Matanuska-Susitna Valley 24 kilometers west of Wasilla, Alaska, has been managed by the Alaska Department of Fish and Game (ADF&G) for sockeye salmon (*Oncorhynchus nerka*) enhancement since 1976. Initial salmon enhancement activities were conducted by ADF&G. The Cook Inlet Aquaculture Association (CIAA) began assisting ADF&G in the enhancement project in 1991; and, since 1993, has completed all the field activities.

On 12 May and 13 May 2003, an estimated 3.590 million sockeye fry (0.49 g) were released into Big Lake. All 3.590 million fry were released to Meadow Creek northeast of the lake and all the released fish were otolith marked.

In 2003, smolt migration monitoring began on 27 May and continued daily until 25 June. During this time, a total of 116,994 sockeye salmon (*O. nerka*) and 23,524 coho salmon (*O. kisutch*) smolts migrated from the lake.

Based on otolith marks, 1.0% (±2.0%) of the emigrating sockeye smolts were enhanced. An estimated 97.8% (±2.2%) were age 1 and 1.9% (±2.9%) were age 2. The average length and weight of the age 1 sockeye smolts was 128.4 mm (±1.0 mm) and 21.7 g (±0.6 g). The age 2 sockeye smolts were 162.5 mm (±5.9 mm) and 43.7 g (±2.9 g).

Of the migrating coho smolts, an estimate, 7.9% (±1.2%) were age 1, 90.2% (±1.3%) were age 2 and 1.8% (±0.6%) were age 3. The average length and weight of the age 1 coho smolts was 177.1 mm (±0.04 mm) and 17.6 g (±0.01g). the age 2 coho smolts were 135.2 mm (±1.03 mm) and 23.4g (±0.01 g), and the age 3 coho smolts were 165.5 mm (±0.08 mm) and 41.4g (±0.08 g).

Adult sockeye salmon escapement was monitored in 2003 by ADF&G.

Between 9 August and 20 August 2003, 7.046 million eggs were collected and shipped to Trail Lakes Hatchery for fertilization and incubation. An estimated 82.8% (5.837million) have survived to the eyed stage.

This page intentionally left blank

INTRODUCTION AND PURPOSE

The Alaska Department of Fish and Game began sockeye salmon (*Oncorhychus nerka*) enhancement activities at Big Lake in 1975. In 1993, the Cook Inlet Aquaculture Association (CIAA) became involved in the Big Lake Enhancement Project and conducted the gamete collection, incubation, and fry release activities; ADF&G remained responsible for limnological data gathering at Big Lake.

Though ADF&G conducted smolt enumeration activities during its involvement in the Big Lake Project, this is the second year CIAA has conducted smolt migration enumeration activities since taking over the project.

Historical information on ADF&G activities can be found in Enhancement of Big Lake Sockeye Salmon (*Oncorhychus nerka*): Summary of Fisheries Production (1976 – 1989) by R. S. Chlupach and G.B. Kyle, or by contacting ADF&G directly.

The CIAA Big Lake Project is the enhancement of the Big Lake sockeye return for the common property fishery. Production from this project contributes to the commercial fishery in Cook Inlet and a significant personal use fishery on Fish Creek.

This page intentionally left blank

PROJECT AREA

Big Lake is located in the Matanuska-Susitna Valley of South Central Alaska 24 kilometers west of Wasilla, Alaska (Figure 1). The main tributary of Big Lake is Meadow Creek; the outlet is Fish Creek, which flows approximately 23 km into Knick Arm of Cook Inlet (Chlupach and Kyle 1990).

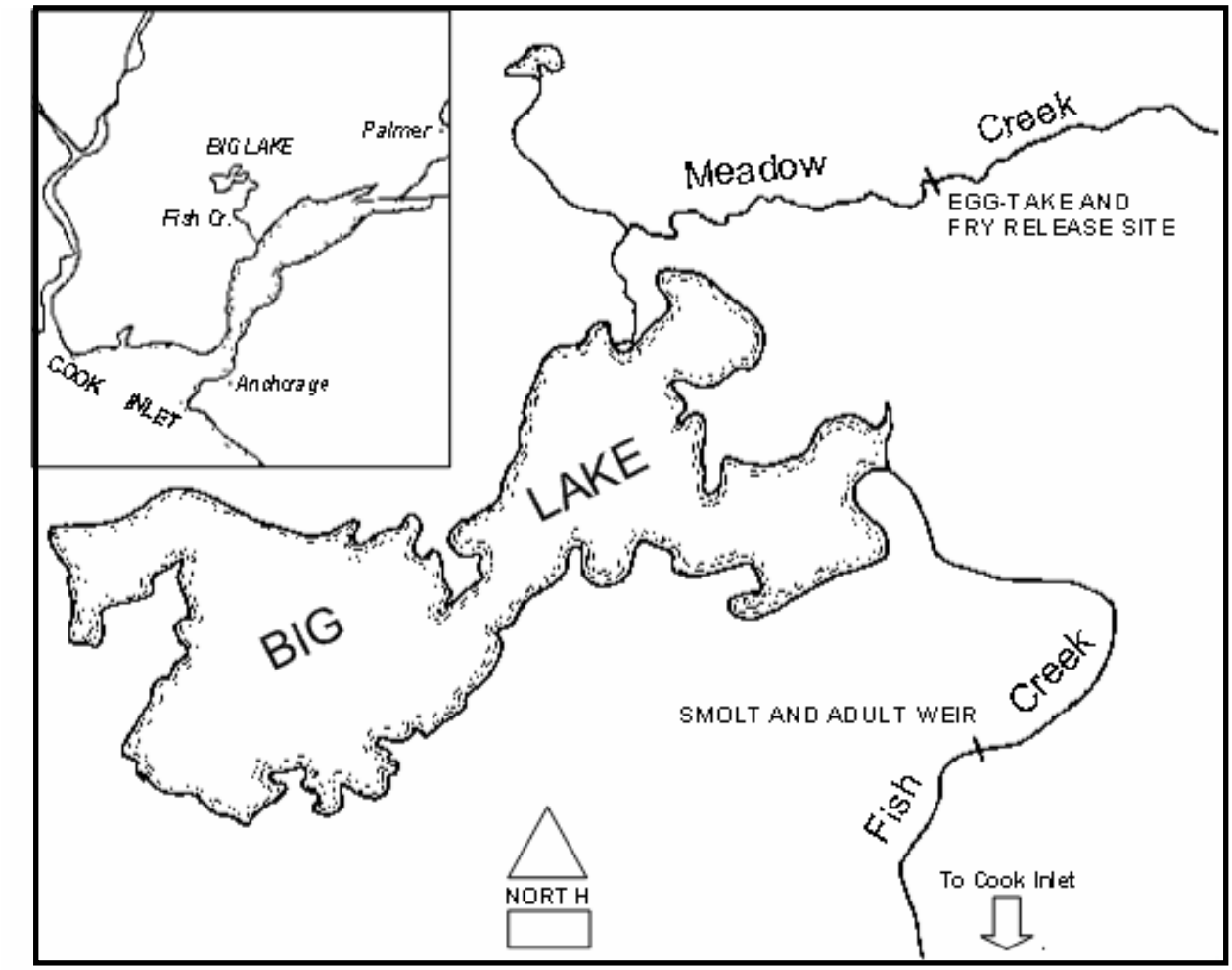


Figure 1. Area Map of Big Lake, Mat-Su Borough, South Central Alaska.

Fish present in the Big Lake watershed include all five species of Pacific salmon (*O. nerka, O. kisutch, O. tshawytscha, O. gorbuscha,* and *O. keta*); however, sockeye salmon and coho salmon are the dominate species of the lake. Other salmonids present are rainbow trout (*O. mykiss*) and Arctic char (*Salvelinus alpinus*). Several other species that comprise the fish fauna of Big Lake include: round whitefish (*Prosopium cylindraceum*), burbot (*Lota lota*), longnose sucker (*Catostomus catostomus*), slimy sculpin (*Cottus cognatus*), prickly sculpin (*C. asper*), Threespine stickleback (*Gasterosteus aculeatus*), ninespine stickleback (*Pungitius pungitius*), and Arctic lamprey (*Lampetra japonica*) (Chlupach and Kyle 1990).

METHODS

In general, Big Lake salmon egg takes, hatchery incubation, fry rearing, and smolt enumeration monitoring follow procedures recommended by ADF&G.

Limnological Sampling and Environmental Conditions

During 2003, assessments of water quality were conducted by ADF&G. For the results of the water quality assessment and a description of the methods used contact ADF&G

Percent cloud cover was estimated, precipitation measured to the nearest millimeter and Fish Creek water and air temperatures were recorded at 5:00 PM each day during by CIAA as part of the smolt enumeration activities. Standard CIAA procedures were followed for collecting these measurements.

Smolt Enumeration

To enumerate the smolt migration, a smolt trap was temporarily placed in Fish Creek. The smolt trap consisted of a modified fyke net with nylon mesh leads extended with Vexar® netting and a double compartment live-box. The leads and fyke net funneled migrating smolts into the live-box. A swing gate remotely controlled by the trap operators directed smolts into one of two live-box compartments where they were counted and released downstream, momentarily held for a sub-sample count, or passed through the trap system uncounted.

Total counts of smolts migrating from Big Lake were made until the migration of fish exceeded 1,000 to 2,000 fish per hour. At migrations rates greater than 2,000 fish per hour, fish densities in the trap become too great and the fish become stressed. To avoid stressing the fish during periods of peak migration, a 10% sub-sampling procedure was used to enumerate the fish.

To enumerate migrating smolts with the 10% sub-sampling procedure, the counting period was divided into 20-minute intervals. During each 20-minute interval, migrating fish were directed into the live-box for two minutes and then counted. During the remaining 18 minutes, migrating smolts passed through the trap uncounted. To estimate the number of smolts migrating during the 20-minute interval, the two-minute smolt count was multiplied by 10.

Assuming the two-minute sub-sampling intervals were randomly distributed throughout sub-sampling[1] and smolts moved through the weir randomly, the total smolt migration was estimated as follows:

If:

T_c = number of fish counted with the total count procedure,

$\hat{T}_s$ = number of fish counted with the 10% sub-sampling procedure,

$\hat{T}$ = the total smolt migration,

y = the number of fish counted in each two minute sub-sampling interval,

n = the number of two minute sub-sampling intervals sampled, and

N = the number of possible two minute sub-sampling intervals,

Then, the total smolt migration ($\hat{T}$) is:

$$\hat{T} = T_c + \hat{T}_s;$$

with a variance of:

$$v\left(\hat{T}_s\right) = N^2\left((N-n)/N\right)\sum\left(y_i - \bar{y}\right)^2 / \left(n(n-1)\right);$$

and 95% confidence limits of:

$$\hat{T}_s \pm 2\sqrt{v\left(\hat{T}_s\right)}.$$

The variance about the estimated smolt migration, $\hat{T}$, is equal to the variance about $\hat{T}_s$, because T_c is a total count with 0 variance.

1 Predetermined randomly selected 2-minute sub-sampling intervals assured random distribution within each 20-minute period.

In 2003, migrating smolts were enumerated from 27 May through 25 June. The 10% sub-sampling procedure was not used in 2003. A detailed description of smolt enumeration procedures is available in CIAA's Big Lake Enhancement Project procedure manual (CIAA, 2002).

Smolt Characteristics and Enhanced Contribution

CIAA has released sockeye salmon fry to Big Lake since 1993. This is the second year the smolt migration was enumerated by CIAA. The smolt characteristics and enhanced contribution were assessed by collecting a sample of the migrating sockeye and coho smolts to collect an otolith and determine the smolts' age, weight, and length characteristics.

Since 1993, CIAA has marked the otolith of all salmon fry released to Big Lake with a thermal mark[2]. The purpose of this mark is to determine the contribution of released fish to the smolt population. In 2003, the otoliths of sockeye smolts collected for age, weight and length measurements were removed and checked for a thermal mark. Otoliths were not collected from migrating coho smolts.

In 2003, smolts collected for measurement and otolith removal were sampled in proportion to the daily smolt migration. This was accomplished by collecting every 1,135th sockeye smolt and every 50th coho smolt that was counted and passed through the smolt trap. The numbering sequence began when the first fish passed through the trap and continued consecutively until the smolt migration was complete. The number of migrating smolts was lower than predicted; therefore, age, weight and length measurements were made on and otoliths removed from 103 sockeye smolts. Age, weight and length measurements were made on 543 coho smolts.

2 The otolith mark is a hatchery induced thermal band produced by controlled temperature changes during incubation.

Each smolt collected for evaluation was first measured to the nearest millimeter for fork length[3] and then weighed to the nearest 0.1 gram. Several scales were also removed from the primary growth area[4] and mounted on a glass slide for subsequent age determination. The otoliths were then removed and placed in a labeled one-dram vial. Ethanol was added to the vial to cover the otoliths.

After the smolt migration was complete, the otoliths were shipped to Trail Lakes Hatchery. Staff at Trail Lakes Hatchery processed the otoliths and checked each for a hatchery mark following procedures described by Glick and Shields (1993). Of the 103 pairs of sockeye otoliths collected, 100 were readable.

Sockeye smolt characteristics, the proportion of enhanced sockeye smolt and the proportion of age 1 and 2 sockeye smolt in the migrating population, were estimated with the following notations and formulas provided by ADF&G.

If:

N = total number of migrating smolts,

N_h = number of smolts in stratum h, $\left(N = \sum N_h\right)$,

n = total number of smolts sampled,

n_h = number of smolts sampled in stratum h, $\left(n = \sum n_h\right)$,

a = total number of enhanced smolts sampled,

a_h = number of enhanced smolts sampled in stratum h, $\left(a = \sum a_h\right)$,

$p_h = a_h / n_h$, the proportion of enhanced smolts in stratum h,

$q_h = 1 - p_h$, the proportion of wild smolts in stratum h,

c_i = number of age $= i$ smolts sampled,

c_{hi} = number of age $= i$ smolts sampled in stratum h, $\left(c_i = \sum c_{hi}\right)$,

$l_{hi} = c_{hi} / n_{hi}$, the proportion of age $= i$ smolts in stratum h,

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

4 The primary growth area is located above the lateral line on a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin.

$m_{hi} = 1 - l_{hi}$, the proportion of other than age = i smolts in stratum h,

$f = n / N$, the sampling fraction (assumed equal in all strata),

$W_h = N_h / N$, the stratum weight, and

$y =$ the weight or length of the smolt.

Then, the proportion of enhanced smolts, $\hat{P}$, is:

$$\hat{P} = a / n;$$

with a variance of:

$$v(\hat{P}) = (1 - f)(1/n)\sum W_h p_h q_h;$$

which, under proportional allocation, is like the usual simple random sample estimate. And, the total number of enhanced smolts, $\hat{A}$, is:

$$\hat{A} = N(a/n) = N\hat{P};$$

with a variance of:

$$v(\hat{A}) = N^2(1 - f)(1/n)\sum W_h p_h q_h = N^2 v(\hat{P}).$$

Since samples sizes are large and $\hat{P}$ is not extreme, the normal approximation without a correction for continuity, can be used to develop the relative error. Thus, the 95% confidence interval estimates for $\hat{P}$ and $\hat{A}$ are:

$$\hat{P} \pm 1.96\sqrt{v(\hat{P})} \quad \text{and} \quad \hat{A} \pm 1.96\sqrt{v(\hat{A})};$$

with relative errors of:

$$\left(1.96\sqrt{v(\hat{P})}/(\hat{P})\right)100 \quad \text{and} \quad \left(1.96\sqrt{v(\hat{A})}/(\hat{A})\right)100.$$

The proportion of age = i smolts in the migration was also estimated as:

$$\hat{L}_i = c_i / n;$$

with a variance of:

$$v(\hat{L}_i) = (1 - f)\frac{1}{n}\sum_h W_h l_{hi} m_{hi};$$

and, the total number of age = i smolts was estimated as:

$$\hat{C}_i = N(\hat{L}_i);$$

with a variance of:

$$v(\hat{C}_i) = N^2 v(\hat{L}_i).$$

Confidence intervals (95%) estimates for age-class proportion and abundance, assuming 2 age-classes, are:

$$\hat{L}_i \pm 2.24\left(\sqrt{v(\hat{L}_i)}\right) \quad \text{and} \quad \hat{C}_i \pm 2.24\left(\sqrt{v(\hat{C}_i)}\right).$$

Mean weight or length of age = *i* smolt was also estimated as:

$$\bar{y}_i = \frac{\sum_h \sum_j y_{hij}}{c_i};$$

with an approximate variance estimate of:

$$v(\bar{y}_i) \cong \frac{1}{\hat{C}_i^2} \sum_h \frac{N_h^2(1-f)}{n_h(n_h-1)} \left[\sum_j (y_{hij} - \bar{y}_{hi})^2 + c_{hi}(1 - {}^{c_{hi}}\!/_{n_h})(\bar{y}_{hi} - \bar{y}_i)^2 \right];$$

and 95% confidence interval estimates of:

$$\bar{y}_i \pm 1.96\left(\sqrt{v(\bar{y}_i)}\right).$$

Adult Escapement

Each year ADF&G enumerates the escapement of adult fish to Big Lake. For the results of the adult enumeration and a description of the methods used contact ADF&G

Gamete Collection, Incubation and Rearing

Since 1993, CIAA has been involved in the collection of sockeye gametes and the release of hatchery incubated fry to enhance the sockeye population in Big Lake. To date, a total of 70,636,000 eggs have been collected for incubation at Eklutna Salmon Hatchery and Trail Lakes Hatchery by CIAA. The annual gamete collections conducted since 1993 are summarized in Table 1.

In 2003, male and female adult sockeye salmon in spawning areas were collected by weir and dipnet and artificially spawned. Gametes were collected, transported and fertilized using a delayed fertilization technique. Gamete collection procedures are described in CIAA's "Egg-Take Procedures" manual (CIAA, 1993).

Table 1. Summary of sockeye salmon gamete collection and fry releases at Big Lake, 1993 - 2003.

Brood Year	No. eggs taken	No. females used	Fecundity	Receiving hatchery	No. fry released to Meadow Creek	No. fry released to Blodgett Lake	No. Smolt released to Eklutna Tail Race	No. Smolt released to Grouse Lake	Egg-to-fry survival (%)
1991	Fry Transfer from Big Lake Hatchery to Eklutna						869,000		
1992	Fry Transfer from Big Lake Hatchery to Elklutna; IHNV detected all fish destroyed						0		
1993	9,000,000	3,600	2,500	Eklutna	3,000,000	2,000,000	1,000,000	200,000	68.9
1994	7,755,000	2,674	2,900	Eklutna	3,000,000	2,000,000	0	0	64.5
1995	8,000,000	3,200	2,500	Eklutna	3,000,000	2,000,000	1,000,000	500,000	75.0
1996	8,000,000	3,200	2,500	Eklutna	2,900,000	1,118,000	1,009,000	226,000	62.8
1997	8,000,000	3,200	2,500	Eklutna	3,000,000	2,000,000	PNLA	0	62.5
1998	5,132,000	1,955	2,625	Trial Lakes	197,000	0	PNLA	0	20.3 *
1999	1,149,000	574	2,002	Trial Lakes	846,000	0	PNLA	PNLA	73.6
2000	3,638,000	1,408	2,584	Trial Lakes	0	0	PNLA	PNLA	0.0
2001	6,574,000	2,206	2,980	Trail Lakes	4,316,000	0	PNLA	PNLA	65.7
2002	6,342,000	2,305	2,751	Trail Lakes	3,589,000	0	PNLA	PNLA	56.6
2003	7,046,000	2,685	2,624	Trail Lakes					
Total	70,636,000	27,007			23,848,000	9,118,000	3,878,000	926,000	
Mean	6,421,455	2,455	2,588		2,384,800	911,800	646,333	154,333	54.8

PNLA = Project No Longer Active

*Reflects the survival of 1.042 million fry. 197,000 were released to Meadow creek, while the remaining 845,000 of these fry were held over to be released to Grouse Lake as smolt, but were later destoryed due to IHN virus.

Between 9 August and 20 August 2003, 7.046 million eggs were collected from 2,685 female sockeye salmon and shipped to Trail Lakes Hatchery for fertilization. Mixing the eggs from each female with a portion of the milt from eight to ten males and then activating the sperm with a 0.7% saline solution completed fertilization. An estimated 5.837 million eggs (82.8%) have survived to the eyed stage.

The sockeye eggs collected in 2003 are currently being incubated at Trail Lakes Hatchery and are beginning to emerge. Incubation will follow standard hatchery procedures (Wilson and Hetrick, 1992) and water temperature will be regulated to thermally mark the otoliths of fish scheduled for release in 2004.

Fish Transport and Stocking

All the sockeye salmon fry produced from gametes collected from Big Lake in 2002 were released to Meadow Creek (at the old Big Lake Hatchery site) on 12 May and 13 May 2003. The 3.589 million fry were transported by truck in oxygenated tanks from Trail Lakes Hatchery to Big Lake and gravity fed via tubing into Meadow Creek. None of the released fry were externally marked or tagged; however, the otoliths of all the released fry were marked with thermal bands [Rbr 1:1.3]. Otoliths samples were processed to document the marks and are on file at Trail Lakes Hatchery. Since 1993, over 23.8 million sockeye salmon fry have been released to Big Lake by CIAA (Table 1).

RESULTS AND DISCUSSION

Limnology and Environmental Conditions

Big Lake limnological characteristics are monitored by ADF&G. Results are available from ADF&G.

Environmental conditions during the Big Lake (Fish Creek) smolt migration were monitored from 27 May to 25 June 2003. Stream stage measurements averaged 0.59 feet and ranged from 0.50 to 0.78 feet. During the period of smolt migration, stream temperatures averaged 15.9°C and ranged from 14.0 to 18.0°C. Air temperatures averaged 14.8°C and ranged from 10.0 to 18.0°C. Thirty percent of the days were clear, 60% partly cloudy, and 10% were completely overcast. A total of 1 mm of rain fell during this period (Appendix 1).

Environmental conditions during the Big Lake (Meadow Creek) egg collection were monitored from 30 June to16 August 2003. Stream stage measurements averaged 0.58 feet and ranged from 0.36 to 1.10 feet. During the period of egg collection, stream temperatures averaged 15.4°C and ranged from 13.0 to 19.0°C. Air temperatures averaged 19.2°C and ranged from 120 to 32.0°C. Six percent of the days were clear, 39% partly cloudy, 39% were completely overcast, and 11% of the days had no recorded cloud cover data. A total of 2 mm of rain was recorded during this period (Appendix 1).

Smolt Enumeration

In 2003, a total of 116,994 sockeye smolts migrated from the lake. Other fish counted included 23,524 coho smolts, 2 Arctic char and 25 rainbow trout (Appendix 2). The peak of the 2003 smolt migration occurred about 4 June.

Smolt Characteristics and Enhanced Contribution

In 2003, characteristics of the smolt migration were evaluated from scale samples collected throughout the migration and from measurements of length and weight. Based on these samples and measurements, an estimated 97.8% (±2.2%) of the sockeye smolts were age 1 and 1.9% (±2.9%) were age 2. The average length and weight of the age 1 sockeye smolts were 128.4 mm (±1.0 mm) and 21.7 g (±0.56g). The age 2 sockeye smolts were 162.5 mm (±5.9 mm) and 43.7 g (±2.89 g). There were no age 3 smolts (Table 2).

Of the migrating coho smolts, an estimated 7.9% (±1.2%) were age 1, 90.2% (±1.3%) were age 2 and 1.8% (±0.6%) were age 3. The average length and weight of the age 1 coho smolts was 117.1 mm (±0.4 mm) and 17.2 g (±0.10g), the age 2 coho smolts were 135.2 mm (±0.3 mm) and 23.36 g (±0.10 g) and the age 3 coho smolts were 165.5 mm (±0.8 mm) and 41.29 g (±0.80 g).

Table 2. Age structure, length, and weight characteristics of Big Lake sockeye smolt, 2002 - 2003

	Age Class (%)				Mean length (mm)				Mean weight (g)			
Smolt Year	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.
2002	91	(±2.2)	9	(±2.2)	123	(±2.2)	160	(±7.6)	22.3	(±0.4)	38.6	(±4.7)
2003	98	(±2.2)	2	(±2.9)	128	(±1.0)	163	(±5.9)	21.7	(±0.6)	43.7	(±2.9)
Mean[1]	95		5		126		161		22.0		41.2	
Hist. Mean[2]	91		9		129		162		22.1		44.0	

[1]Mean dirived from data collected by CIAA 2002 and on

[2]This is a historical mean comprised of data from 1976 to 1989 (Clupach and Kyle 1990)

In 2003, the proportion of hatchery-incubated fry in the sockeye smolt migration was 1.0% (±2.0%) (Table 3). This proportion is low because it is believed that the majority of smolt migrated prior to the installation of the smolt trap (see Recommendations).

Table 3. The contribution of enhanced sockeye to the Big Lake smolt migration, 2002 - 2003

Smolt Year	Number	Wild	Hatchery	Hatchery %	95% C.I.
2002	48,865	48,547	318	0.7	(+1.4)
2003	116,994	115,824	1,170	1.0	(+2.0)
Mean[1]	82,930	82,186	744		
Hist. Mean[2]	573,860	132,885	566,966	70.0	

[1]From CIAA smolt counts 2002 and on

[2]These are historical means dirived from Clupach and Kyle 1990

Adult Escapement

Adult sockeye salmon escapement was monitored by ADF&G in 2003. For information on Big Lake escapement contact ADF&G

This page intentionally left blank.

RECOMMENDATIONS

Warmer than normal winter and spring conditions could have attributed to an early smolt emigration, and it is possible that the majority of the emigration took place before the enumeration activities commenced. In addition, because smolt evaluations haven't taken place since 1989, it is unknown when the majority of the smolts will generally migrate. 2002, revealed a late emigration time; however, less that 50,000 sockeye salmon were enumerated during the migration. It is recommended that the smolt trap be placed in Fish Creek a week earlier to insure that the emigrating sockeye smolts are accurately enumerated. All other activities should continue as normal.

This page intentionally left blank

LITERATURE CITED

Chlupach, R. S. and G. B Kyle. 1990. Enhancement of Big Lake Sockeye Salmon (*Oncorhynchus nerka*): Summary of Fisheries Production (1976-1989). Alaska Department of Fish and Game, Division of Fisheries Rehabilitation, Enhancement, and Development. Report No. 106. Juneau, AK. 28 Pages.

Cook Inlet Aquaculture Association. 2002. Big Lake Procedures Manual. CIAA. Kenai, Alaska.

Cook Inlet Aquaculture Association. 1993b. Egg-take Procedures Manual. CIAA. Kenai, Alaska.

Glick, W.J. and P.A. Shields. 1993. Juvenile Salmonid Otolith Extraction and Preparation Techniques for Microscopic Examination. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development. Report No. 132. Soldotna, AK.

Wilson, D. and J. Hetrick. 1992. The Trail Lakes Hatchery Manual. March 1992. CIAA, Moose Pass, Alaska. 47 pages.

This page is intentionally left blank

APPENDICES

This page is intentionally left blank

Appendix 1. Big Lake 2003 – Environmental Conditions.

Smolts Date	Sky	Precip. (mm)	Stage (ft)	Flow	Water Temp. (°C)	Air Temp. (°C)
27-May	2	0	0.78	ND	ND	ND
28-May	1	0	0.75	ND	15.0	16.0
29-May	2	0	0.70	ND	15.0	17.0
30-May	2	0	0.70	ND	15.0	18.0
31-May	3	0	0.64	ND	14.0	15.0
1-Jun	2	0	0.65	ND	14.0	15.0
2-Jun	1	0	0.65	ND	14.0	10.0
3-Jun	2	0	0.64	ND	15.0	16.0
4-Jun	1	0	0.62	ND	15.0	15.0
5-Jun	2	0	0.59	ND	15.0	13.0
6-Jun	2	0	0.58	ND	14.0	10.0
7-Jun	2	0	0.56	ND	15.0	11.0
8-Jun	2	0	0.54	ND	16.0	14.0
9-Jun	2	0	0.54	ND	16.0	17.0
10-Jun	3	0	0.54	ND	15.0	17.0
11-Jun	1	0	0.55	ND	17.0	14.0
12-Jun	2	0	0.55	ND	16.0	15.0
13-Jun	1	0	0.58	ND	16.0	18.0
14-Jun	4	0	0.60	ND	16.0	18.0
15-Jun	1	0	0.61	ND	16.0	15.0
16-Jun	2	0	0.58	ND	17.0	13.0
17-Jun	4	0	0.58	ND	18.0	14.0
18-Jun	2	0	0.54	ND	17.0	15.0
19-Jun	1	0	0.52	ND	17.0	15.0
20-Jun	2	0	0.50	ND	17.0	16.0
21-Jun	2	0	0.51	ND	17.0	14.0
22-Jun	1	0	0.59	ND	18.0	15.0
23-Jun	1	0	0.50	ND	17.0	13.0
24-Jun	3	0	0.51	ND	17.0	16.0
25-Jun	5	1	0.51	ND	17.0	14.0
Total	30	1				

ND = No Data Ice out = ND

		Meas. Precip	Stage	Flow	Water Temp	Air Temp
Smolts	Avg.	0.03	0.59	ND	15.9	14.8
	Min.	0	0.50	ND	14.0	10.0
	Max.	1	0.78	ND	18.0	18.0

Egg Take Date	Sky	Precip. (mm)	Stage (ft)	Flow	Water Temp. (°C)	Air Temp. (°C)
30-Jul	4	0	0.47	ND	15.0	15
31-Jul	2	0	0.46	ND	15.0	20
1-Aug	2	0	0.40	ND	15.0	17
2-Aug	3	0	0.40	ND	15.0	17
3-Aug	4	0	0.39	ND	14.0	16
4-Aug	2	0	0.40	ND	15.0	17
5-Aug	3	0	0.36	ND	16.0	20
6-Aug	2	0	0.38	ND	17.0	23
7-Aug	2	0	0.39	ND	17.0	25
8-Aug	1	0	0.39	ND	17.0	26
9-Aug	ND	0	ND	ND	18.0	32
10-Aug	ND	0	0.90	ND	19.0	27
11-Aug	5	ND	ND	ND	ND	ND
12-Aug	5	1	1.10	ND	14.0	17
13-Aug	5	1	ND	ND	13.0	14
14-Aug	5	1	1.10	ND	13.0	15
15-Aug	4	0	1.00	ND	13.0	14
16-Aug	4	0	ND	ND	15.0	12
Total	18	2				

ND = No Data

		Meas. Precip	Stage	Flow	Water Temp	Air Temp
Egg Take	Avg.	0.13	0.58	ND	15.4	19.2
	Min.	0	0.36	ND	13.0	12.0
	Max.	1	1.10	ND	19.0	32.0

	Cloud Cover - No. of Days				
	Meas. Rain	100%	<100% >50%	<50% >0%	Clear
Smolts	1	3	3	15	9
Egg-Take	3	7	2	5	1

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

Appendix 2. Big Lake 2003 – Smolt Migration.

	Sockeye			Coho		Rainbow		Arctic Char	
Date	Daily	Mort.	Total	Daily	Total	Daily	Total	Daily	Total
20-May									
21-May									
22-May									
23-May									
24-May									
25-May									
26-May									
27-May	1,809	0	1,809	137	137	2	2	0	0
28-May	3,126	0	4,935	800	937	0	2	0	0
29-May	7,630	0	12,565	1,438	2,375	2	4	0	0
30-May	3,489	0	16,054	701	3,076	1	5	0	0
31-May	12,395	0	28,449	4,119	7,195	3	8	0	0
1-Jun	1,987	0	30,436	719	7,914	0	8	0	0
2-Jun	5,687	0	36,123	1,537	9,451	0	8	0	0
3-Jun	7,704	0	43,827	1,661	11,112	2	10	0	0
4-Jun	27,531	0	71,358	4,511	15,623	1	11	0	0
5-Jun	1,130	0	72,488	107	15,730	0	11	0	0
6-Jun	6,783	0	79,271	1,334	17,064	0	11	0	0
7-Jun	16,005	0	95,276	1,133	18,197	2	13	0	0
8-Jun	1,387	0	96,663	2,005	20,202	1	14	0	0
9-Jun	8,701	0	105,364	1,562	21,764	2	16	0	0
10-Jun	951	0	106,315	141	21,905	0	16	0	0
11-Jun	1,472	0	107,787	210	22,115	0	16	1	1
12-Jun	1,509	0	109,296	216	22,331	1	17	0	1
13-Jun	680	0	109,976	160	22,491	0	17	0	1
14-Jun	954	0	110,930	113	22,604	1	18	0	1
15-Jun	1,692	0	112,622	73	22,677	2	20	0	1
16-Jun	170	0	112,792	228	22,905	2	22	0	1
17-Jun	589	0	113,381	72	22,977	0	22	0	1
18-Jun	237	0	113,618	49	23,026	0	22	0	1
19-Jun	763	0	114,381	189	23,215	2	24	0	1
20-Jun	314	0	114,695	43	23,258	0	24	0	1
21-Jun	861	0	115,556	119	23,377	1	25	0	1
22-Jun	967	0	116,523	81	23,458	0	25	0	1
23-Jun	161	0	116,684	17	23,475	0	25	0	1
24-Jun	166	0	116,850	27	23,502	0	25	1	2
25-Jun	144	0	116,994	22	23,524	0	25	0	2
26-Jun			116,994		23,524		25		2
27-Jun			116,994		23,524		25		2
28-Jun			116,994		23,524		25		2
29-Jun			116,994		23,524		25		2
30-Jun			116,994		23,524		25		2
Total		0	116,994		23,524		25		2

Appendix 3. Big Lake 2003 - Project Update.

Stocking & Misc. Activities

Crew on-site:	18-May		
Ice-out:	24-May		
Crew off-site:	28-Jun		
Fry stocking:	28-May to 29-May	4,317,000	0.54 g

Egg Take

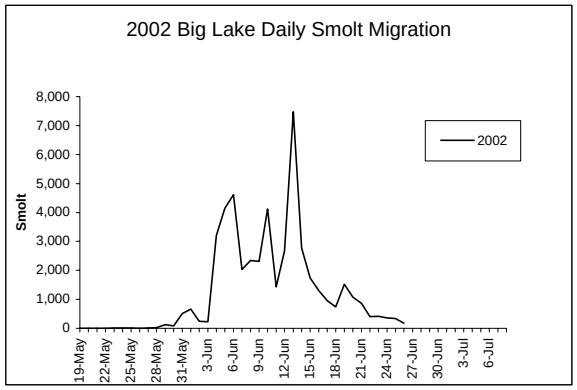
Dates:	12-Aug	to	19-Aug		
No. of broodstock used:				4,155	
Green eggs:				6,342,000	
Fecundity:				2,751	
Eyed eggs:				5,298,000	
Survival				83.5%	

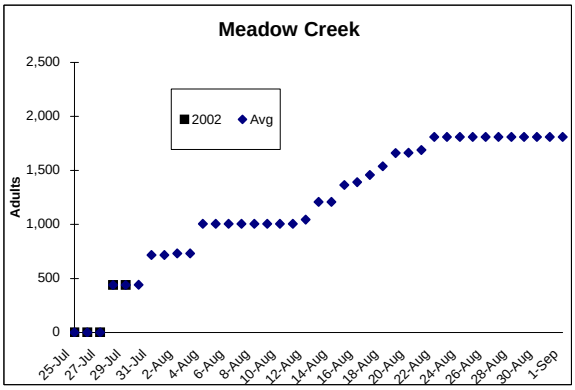
Smolt Migration

Dates:	20-May to 27-Jun			
Sockeyes:			48,865	
Mortalities:			1,445	
Percent age 1:	89.5%	±5.57%	43,755	(±2450)
Percent age 2:	10.5%	±5.57%	5,110	(±286)
Percent hatchery:	0.65%	±1.41%		
Coho:			22,628	
Arctic Char:			2	
Rainbow:			156	

Adult Migration

Dates:					
Sockeye total return:	8-Jul	to	8-Sep	143,244	est.
Fish Creek Return:				89,327	62%
Sport/PU Harvest:				8,000	6%
Commercial Harvest				45,917	32%
Meadow Creek Return:	28-Jul	to	22-Aug	1,811	





This page is intentionally left blank