

**Bear Lake  
Salmon Enhancement  
Progress Report  
2003**

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**This year's operation of the Bear Lake Sockeye and Coho 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 through a grant from the Seward Chamber of Commerce.**

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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 following progress report is a synopsis of the monitoring and evaluation studies conducted for the Bear Lake 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.

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## **ACKNOWLEDGEMENTS**

The 2003 Bear Lake smolt migration, fry release, adult count, and gamete collection exercise were conducted by the Cook Inlet Aquaculture Association (CIAA). CIAA employees Terry Magee and Cathy Cline spent many hours in the field assisting with the 2003 field activities. Their efforts are appreciated. Sockeye salmon fry and coho salmon smolt stocked into Bear Lake were provided by Trail Lakes Hatchery. Appreciation is extended to the staff at Trail Lakes Hatchery: Robert Blankenship, Tom Prochazka, Mark Thomas, Mitch Johnson, and Carol Smith.

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## ABSTRACT

The Cook Inlet Aquaculture Association (CIAA) has been conducting sockeye salmon (*Oncorhynchus nerka*) and coho salmon (*O. kisutch*) enhancement activities at Bear Lake since 1988. Enhancement efforts have focused on sockeye and coho fry stocking and improvements to the fry rearing environment through nutrient enrichment. Associated assessment activities have involved smolt and adult enumeration and limnological sampling.

In 2003, 1.467 million sockeye fry and 405,000 coho fry were released into Bear Lake. At the time of release, the sockeye fry averaged 0.42 grams and the coho fry averaged 1.37 grams. All released fry were of Bear Lake origin. In addition, 334,000 sockeye smolts averaging 11.8 grams were released to Bear Lake. The smolts were all of Bear Lake origin. Approximately 253,000, coho smolts were released into Bear Creek or Bear Lake. These fish averaged 13.7 grams

Smolt migration monitoring began on 12 May and continued daily until 11 July. During this time a total of 1.326 million ( $\pm 24,100$ ) sockeye and 208,100 ( $\pm 10,800$ ) coho smolts migrated from the lake. Most of the sockeye smolts migrated between 15 May and 15 June 2003. Most of the coho smolts migrated between 2 June and 27 June, 2003.

Based on otolith marks, 92.4% ( $\pm 1.7\%$ ) of the emigrating sockeye smolts were enhanced. An estimated 98.5% smolts were age 1 and 1.5% were age 2. The average length and weight of the age 1 sockeye smolts was 92.3 mm ( $\pm 0.76$  mm) and 7.50 g ( $\pm 0.19$  g) respectively. The age 2 sockeye smolts were 139.5 mm ( $\pm 7.73$  mm) and 30.40 g ( $\pm 4.86$  g).

Based on otolith marks, 86.9% ( $\pm 3.1\%$ ) of the emigrating coho smolts were enhanced. An estimated 80.6% of coho smolt were age 1, 15.3% were age 2, and 4.1% were age 3. The average length and weight of the age 1 coho smolts was 108.7 mm ( $\pm 4.89$  mm) and 11.89g ( $\pm 0.30$  g) and the age 2 coho smolts were 119.4 mm ( $\pm 2.48$  mm) and 16.25g ( $\pm 1.62$  g).

A total of 16,010 adult sockeye returned to Bear Creek in 2003. The majority of the returning sockeye salmon was age 1.2 (45.1%) or age 1.3 (40.0%). Of the adult sockeye returning, 2,776 were sold for cost recovery or donated, one sockeye was found dead in the weir, and 13,233 were passed into Bear Lake. Of the fish passed into the lake, 3,735 were used for hatchery broodstock.

A total of 3,506 adult coho returned to Bear Creek weir in 2003. The returning fish were age 1.1 (77.8%), age 2.1 (21.5%) or 3.1(0.8%). Of the adult coho returning, 2,065 were harvested and sold for cost recovery or donated, 1,021 were held and used as hatchery broodstock, 395 were passed into Bear Lake, and 25 remained in Bear Creek.

From 30 July to 9 September 2003, 5,000,000 sockeye salmon eggs were collected for incubation, rearing, and release to Bear Lake. The eggs were obtained from Bear Lake broodstock, shipped to CIAA's Trail Lakes Hatchery, and fertilized using a delayed fertilization technique. Eggs from 1,854 females were fertilized with milt from 1,881 males.

From 15 to 26 October 2003, 1,250,000 coho eggs were collected from 299 females and fertilized with milt from 106 males. In addition, the Alaska Department of Fish and Game (ADF&G) collected gametes from 355 Bear Lake coho.

One thousand fifty gallons of fertilizer was applied to Bear Lake in 2003. Limnological samples were collected monthly throughout the open-water season.

## INTRODUCTION AND PURPOSE

Bear Lake is located on Alaska's Kenai Peninsula near the community of Seward, Alaska and has been the site of salmon enhancement activities since 1962. Initial enhancement activities, conducted by the Alaska Department of Fish and Game (ADF&G) Sport Fish Division, focused on coho salmon (*Oncorhynchus kisutch*) and the control of predator and competitor species<sup>1</sup>.

In 1988, the Alaska Board of Fisheries revised the management plan for Bear Lake. The revision allowed for the enhancement of sockeye salmon (*O. nerka*).

The revised Bear Lake management plan developed in 1988 was soon followed by a cooperative agreement between ADF&G, Sport fish Division, ADF&G Fisheries Rehabilitation, Enhancement and Development (FRED) Division, and the Cook Inlet Aquaculture Association (CIAA). The cooperative agreement, which became effective in August 1989, allowed CIAA to operate and maintain the Bear Lake coho salmon enhancement project and to begin sockeye enhancement activities in the lake. The agreement also provided CIAA with the responsibility of operating and maintaining the Bear Creek weir site.

Current enhancement activities at Bear Lake now target both sockeye and coho salmon with control of predator and competitor species. The objectives are to create a commercial sockeye fishery and to maintain the coho sport fishery enhancement program. To accomplish the objectives CIAA will:

- 1) Maintain the level of coho salmon production;
- 2) Maintain sockeye and coho lake spawning escapement goals;
- 3) Annually describe the timing, abundance, size, and percent of wild and enhanced sockeye and coho in smolt migrations;
- 4) Annually describe the timing, abundance, and size of sockeye and coho salmon in adult migrations;
- 5) Monitor the number of marked fish resulting from fry, pre-smolt, and smolt releases in sockeye and coho adult migrations and evaluate the success of enhancement through the recovery of marked fish.

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<sup>1</sup> ADF&G enhancement activities conducted prior to 1987 are reported by Vincent-Lang (1987).

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## PROJECT AREA

Bear Lake is located on Alaska's Kenai Peninsula 9 km north of Seward, Alaska. It is the largest clear water lake in the Resurrection Bay drainage.

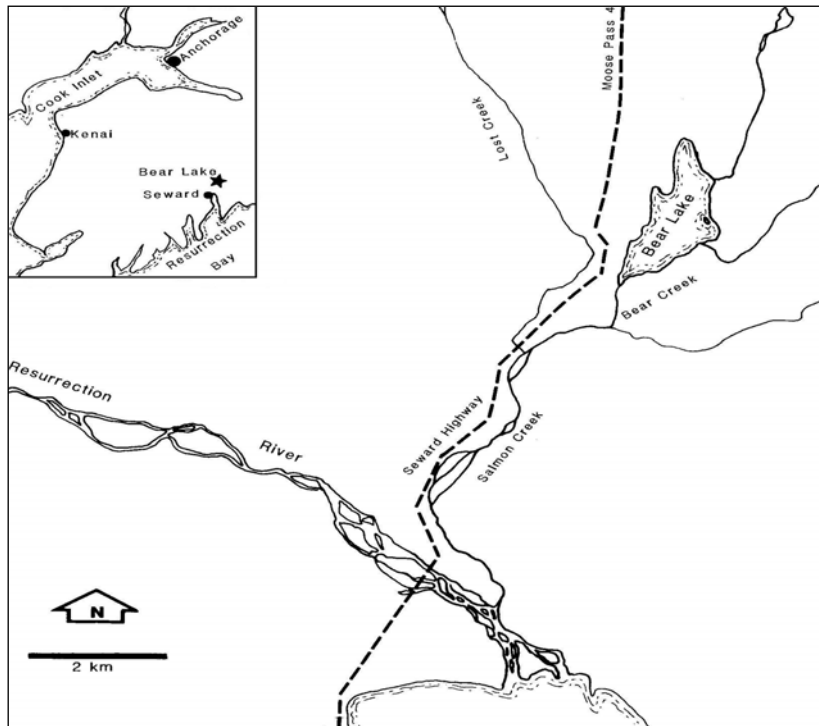


Figure 1. Map showing location of Bear Lake near Seward, Alaska.

Bear Lake has a watershed area of 15 km<sup>2</sup> and one outlet, which drains into Resurrection Bay through Bear Creek, Salmon Creek and the Resurrection River. A weir and fish passage complex, located 0.5 km downstream of the lake, provide a barrier to fish migration and allow for complete control of fish movements into or out of the lake (Figure 1).

Bear Lake (Figure 2) is oligotrophic with a surface area of 180 hectares. It has a mean depth of 10 meters, a maximum depth of 20 meters, a lake volume of  $18.7 \times 10^6 \text{ m}^3$  and a water residence time of 0.75 years. There is one small island located along the east shore. The shoreline is heavily wooded and shoreline substrates vary from exposed bedrock, to large cobble, sand and organic muck.

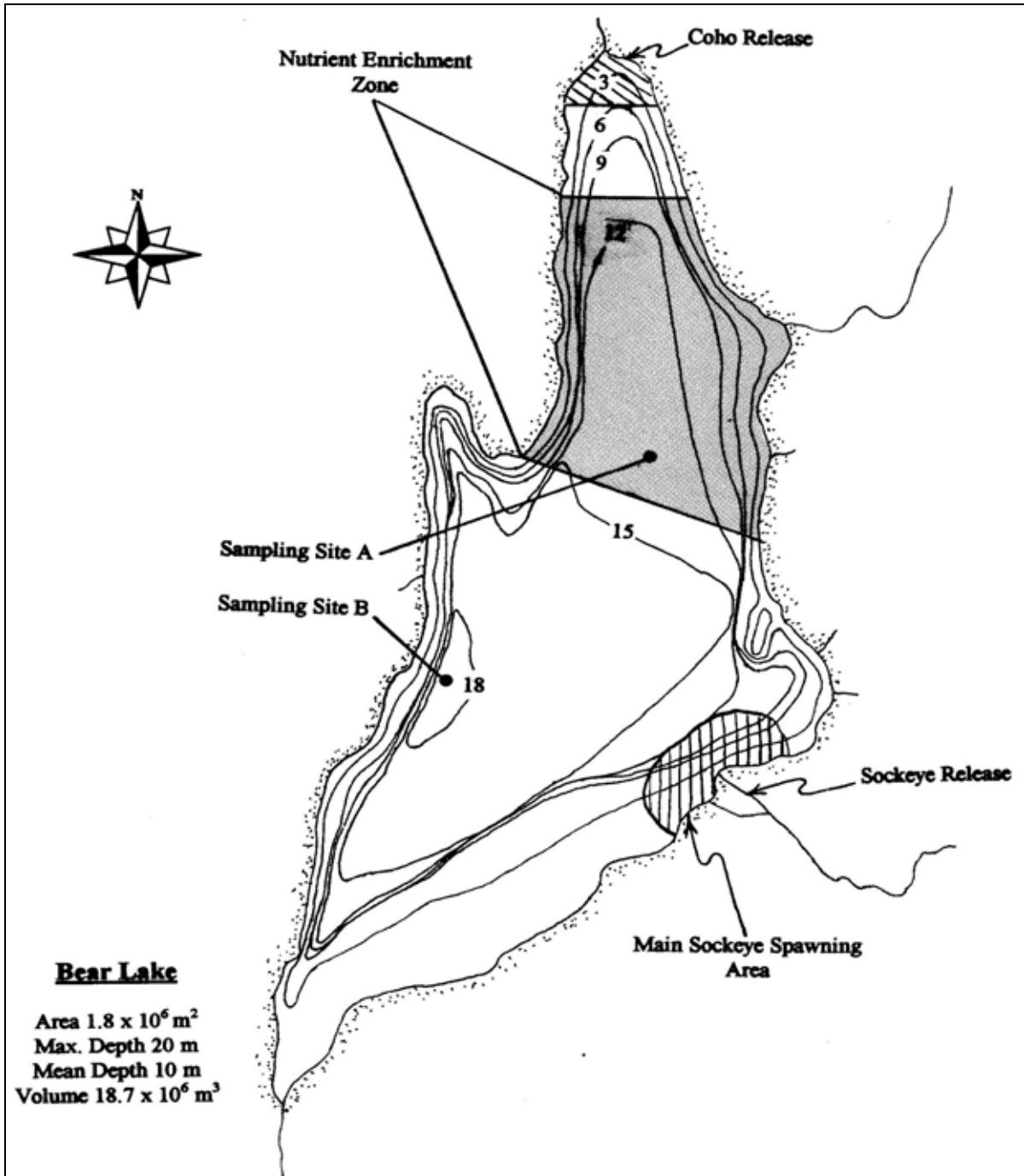


Figure 2. Bear Lake near Seward, Alaska

## **METHODS**

In general, Bear Lake limnological sampling, salmon egg takes, hatchery incubation, fry rearing, smolt enumeration and adult escapement monitoring follow procedures recommended by ADF&G.

### **Limnological Sampling and Environmental Conditions**

The limnological sampling and analysis procedures used in 2003 were consistent with previous limnological sampling activities. These procedures are described by Koenings, et al. (1986).

During 2003, assessments of water quality were conducted 5 times throughout the open water season of May through October. One primary site, site B (Figure 2) was sampled for dissolved oxygen, temperature and light transmission profiles, Secchi disk transparency and zooplankton densities. Samples for analysis of phosphorus, carbon, chlorophyll a, phaeophytin a, nitrogen, calcium, magnesium, iron, conductivity, pH, alkalinity, turbidity and color were also collected with a Kemmerer sampler 1 meter below the surface and from the hypolimnion. One secondary site, site A, (Figure 2) was also sampled for Secchi disk transparency and zooplankton densities. All water samples were collected by CIAA and analyses completed by ADF&G.

In addition to the water chemistry analysis, daily observations of other environmental conditions at Bear Lake were made. These observations, completed at 5:00 P.M. throughout the summer field season, included percent cloud cover, precipitation to the nearest millimeter, air temperature, Bear Creek water temperature and Bear Creek stage.

### **Lake Nutrient Enrichment**

Liquid fertilizer applied to Bear Lake has been an important element of the Bear Lake enhancement project since 1981. The purpose of fertilizer application, applied throughout the

growing season to the pelagic area of the lake, is to stimulate algae growth and increase the zooplankton community.

Liquid fertilizer has been applied to Bear Lake in 17 of the last 23 years. It was not applied in 1987-1989, 1994, 1995, and 2001. Applications levels are presented in Table 1.

Table 1. Fertilizer application at Bear Lake, 1981 to 2003

Year	32-0-0 (gal)	27-7-0 (gal)	20-5-0 (gal)	N (Kg)	P (Kg)	Dates	Comments
1981	2,760	--	--	4,441	--	9/01 - 10/31	Every 10 days
1982	3,240	--	--	5,213	--	7/15 - 10/31	Every 10 days
1983	4,080	--	--	6,565	--	6/01 - 10/04	Every 3 days
1984	1,960	1,120	--	4,760	181	6/01 - 9/15	Every 3 days
1985	2,800	--	--	4,505	--	6/01 - 9/15	Every 3 days
1986	1,680	1,120	--	4,309	181	7/01 - 9/15	Every 3 days
1987	--	--	--	--	--	--	No application
1988	--	--	--	--	--	--	No application
1989	--	--	--	--	--	--	No application
1990	2,640	--	420	4,644	43	6/05 - 8/28	Every 2 days, 20-5-0 first
1991	2,340	--	390	4,133	40	5/30 - 8/14	Daily, 20-5-0 first
1992	3,264	--	390	2,896	40	6/04 - 8/09	4 to 6 times/week
1993	--	--	960	906	99	5/25 - 8/07	3 times/week
1994	--	--	--	--	--	--	No application
1995	--	--	--	--	--	--	No Application
1996	2,280	--	600	4,235	62	6/03 - 9/01	Daily, 20-5-0 mid-summer
1997	1,620	--	540	3,116	55	6/01 - 8/4	2 bbl. a day 4 times a wk.
1998	--	--	990	934	101	6/24 - 8/10	Every day
1999	--	--	1,050	990	107	6/17 - 8/25	Every other day
2000	--	--	840	792	86	6/12 - 8/26	Every other day
2001	--	--	--	--	--	--	No application
2002	--	--	900	849	92	6/27 - 8/18	Every other day
2003	--	--	1050	990	107	6/26 - 8/8	Mon, Wed, Fri

### Smolt Enumeration

A permanently installed weir, located approximately 0.5 km downstream of Bear Lake prevents the uncontrolled migration of fish into or out of Bear Lake. This structure (Figure 3) was used in 2003 to identify, count and control the migration of all fish moving into or out of Bear Lake.

For smolt enumeration, fish migrating downstream were directed by the weir into a live box

where they were captured, temporarily held, identified to species, counted and released downstream. Total counts of smolts migrating from the lake were made until the migration of fish exceeded 2,000 to 3,000 fish per hour. When this occurred, a 10% sub-sampling procedure was used to enumerate the migrating smolts.

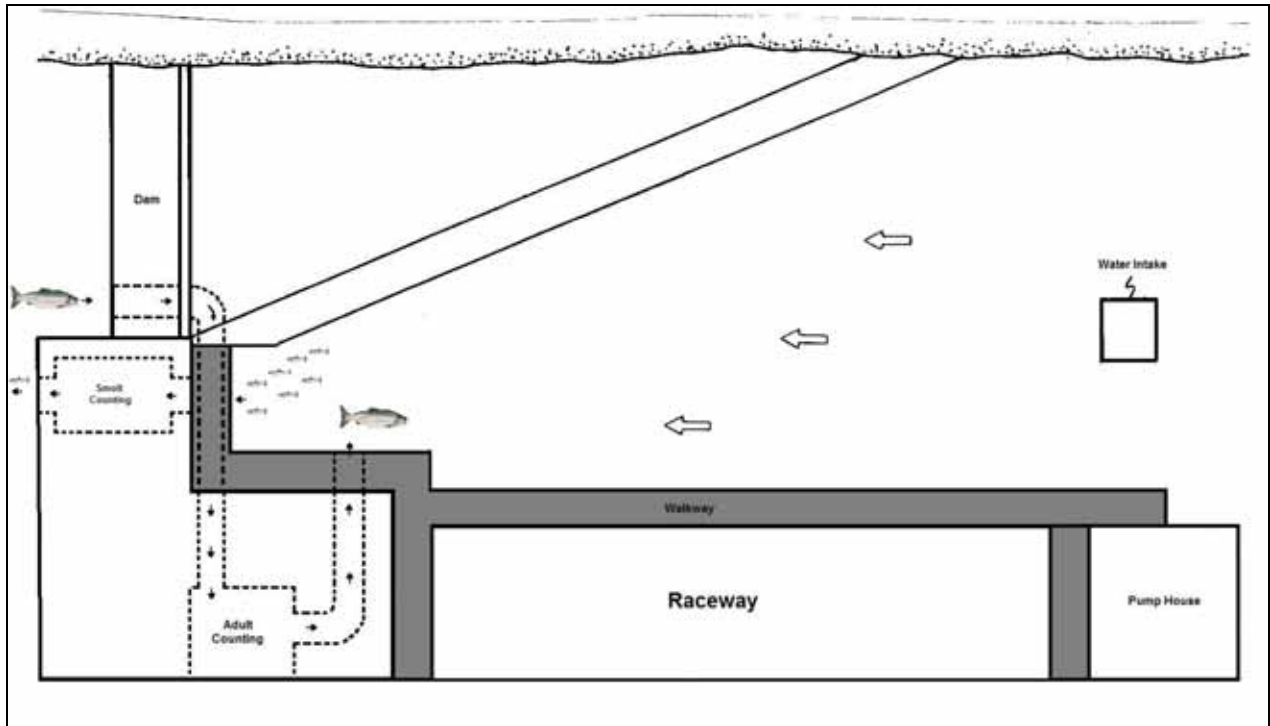


Figure 3. The Bear Creek weir, smolt trap and adult counting complex (Top View).

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 were passed through the weir structure uncounted. The two-minute smolt count was multiplied by 10 to estimate the number of smolts migrating during the twenty minute interval.

Assuming the two minute sub-sampling intervals were randomly distributed throughout sub-sampling<sup>2</sup> and smolt moved through the weir randomly, the total smolt migration was estimated as follows:

<sup>2</sup> Predetermined randomly selected 2 minute subsampling intervals assured random distribution within each 20 minute period.

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:

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

and the variance is,

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

And:

$$C.I._{\alpha=95\%} \text{ for } \hat{T}_s = \pm 2\sqrt{v(\hat{T}_s)}$$

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.

In 2003, migrating smolts were enumerated from 12 May through 11 July. The 10% sub-sampling procedure was used to count 49.0% of the sockeye migration and 6.9% of the coho migration.

### **Smolt Characteristics and Enhanced Contribution**

CIAA has released sockeye and coho salmon fry to Bear Lake since 1990. To evaluate this enhancement procedure, CIAA has collected a sample of sockeye and coho smolts migrating

each year to determine age, weight, and length characteristics of the migrating populations. Since 1993, CIAA has also marked the otolith of all salmon fry released to Bear Lake with a thermal mark<sup>3</sup>. The purpose of this mark is to determine the contribution of released hatchery fish to the Bear Lake smolt population.

In 2003, smolts collected for measurement, age determination, and otolith removal were sampled in proportion to the daily smolt migration. This was accomplished by collecting every 1,263<sup>rd</sup> sockeye smolt and every 422<sup>nd</sup> coho smolt that 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. Age, weight and length measurements were taken on 1,050 sockeye smolts and 493 coho smolts.

Each smolt collected for evaluation was first measured to the nearest millimeter for fork length<sup>4</sup> and weighed to the nearest 0.1 gram. Several scales were then removed from the primary growth area<sup>5</sup> and mounted on a glass slide for subsequent age determination. Finally, otoliths were 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 otolith samples were shipped to Trail Lakes Hatchery; and CIAA staff processed the scales and otoliths.

Each otolith was checked each for a hatchery mark following procedures described by Glick and Shields (1993). Of the 1,050 sockeye otoliths collected, 952 were readable; and of the 493 coho otoliths were collected, 468 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.

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<sup>3</sup> The otolith mark is a hatchery induced thermal band produced by controlled temperature changes during incubation.

<sup>4</sup> Standard fork length was measured from the tip of the snout to the fork of the tail.

<sup>5</sup> 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.

If:

$N$  = total number of migrating smolts,

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

$n$  = total number of smolts sampled,

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

$a$  = total number of enhanced smolts sampled,

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

$p_h = a_h / n_h$ , 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  $h$ , ( $c_i = \sum c_{hi}$ ),

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

$m_{hi} = 1 - l_{hi}$ , 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,  $\hat{P}$ , was estimated as:

$$\hat{P} = a / n; \quad \text{with a variance of} \quad v(\hat{P}) = (1 - f)(1/n) \sum W_h p_h q_h;$$

which, under proportional allocation, is like the usual simple random sample estimate.

The total number of enhanced smolts,  $\hat{A}$ , was also estimated as:

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

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 were fairly large and  $\hat{P}$  was not extreme, the normal approximation, without a correction for continuity, could be used to develop the relative error. Thus, the 95% confidence interval estimate for  $\hat{P}$  and  $\hat{A}$  is:



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

and, the relative error is:

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

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

$$\hat{L}_i = c_i/n; \quad \text{with a variance of} \quad v(\hat{L}_i) = (1-f)\frac{1}{n}\sum_h W_h l_{hi} m_{hi};$$

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

$$\hat{C}_i = N(\hat{L}_i); \quad \text{with a variance of} \quad v(\hat{C}_i) = N^2 v(\hat{L}_i).$$

Confidence interval (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:

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

The confidence interval (95%) estimate for the mean weight and length is:

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

A detailed description of the weir and fish counting complex and the procedures used for enumerating migrating salmon smolts is provided in the Bear Lake Procedures Manual (CIAA, 2001).

## **Adult Escapement**

The weir structure that was used for enumerating the smolt migration was also used to identify, count, and control the migration of adult fish returning to Bear Lake. In 2003, adult escapement monitoring was conducted from 21 May through 30 October. The escapement enumeration included the assessment of the sex, age, and standard fork length<sup>6</sup> of the returning population of fish.

To enumerate the adult migration, fish attempting to migrate upstream were directed by the weir into a live box attached to a mechanical lift. Once in the live box, the fish were lifted above the weir, identified, and counted. Counted fish were either passed into the Bear Lake system or collected for other uses. Fish passed upstream to continue their migration to Bear Lake totaled 13,233 sockeye and 395 coho. Other uses of the weir included harvest and hatchery broodstock collection.

In 2003, it was assumed that 27,600 adult sockeye and 10,700 adult coho would return to the Bear Creek weir. Based on this assumption, it was calculated that a sample of 2.2% of the returning sockeye and 5.6% of returning coho were needed to appropriately assess the sex, age and length characteristics of the returning populations. Each day a representative sample of sockeye and coho equal to 2.2% and 5.6% respectively, of the previous day's escapement were captured for measurement. In 2003, less than the predicted number of salmon returned to the weir and measurements were collected from 324 sockeye (1.2%) and 324 coho (3.0%).

A detailed description of the weir and fish counting complex and the procedures used for enumerating migrating adult salmon is provided in the Bear Lake Procedures Manual (CIAA, 1993).

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<sup>6</sup> Standard fork length was defined as the measurement from mid-eye to the fork of the tail.

## Gamete Collection, Incubation and Rearing - Sockeye

Since 1989, egg collection, incubation and rearing of sockeye salmon have been done to develop a Bear Lake sockeye fishery. To date, a total of 45,389,600 sockeye salmon eggs have been collected for incubation and rearing at Trail Lakes Hatchery. The number of eggs collected since 1989 is summarized in Table 2.

Table 2. Eggs collected for Bear Lake enhancement, 1989 to 2003.

Brood Year	Brood Stock	Coho			Brood Stock	Sockeye		
		Green Eggs	Eyed Eggs	%		Green Eggs	Eyed Eggs	%
1989	Bear L	932,300	711,800	76.3	SF Big R	3,119,300	2,713,700	87.0
					U Russian L	57,400	47,700	83.1
1990	Bear L	798,200	669,300	83.9	SF Big R	134,000	100,700	75.1
					U Russian L	2,602,800	1,721,500	66.1
1991	Bear L	695,600	533,400	76.7	SF Big R	2,534,500	1,794,500	70.8
					U Russian L	1,441,800	974,400	67.6
1992	Bear L	802,700	749,900	93.4	SF Big R	3,428,100	2,976,000	86.8
					Bear L	47,000	45,100	96.0
1993	Bear L	735,500	696,000	94.6	Bear L	276,700	172,800	62.5
1994	Bear L	847,000	739,600	87.3	Bear L	530,000	420,000	79.2
1995	Bear L	867,500	737,600	85.0	Bear L	2,040,000	1,672,000	82.0
1996	Bear L	968,000	829,000	85.6	Bear L	1,481,000	1,039,000	70.2
1997	Bear L	687,000	606,000	88.2	Bear L	502,000	363,000	72.3
1998	Bear L	805,000	727,000	90.3	Bear L	2,645,000	2,377,000	89.9
1999	Bear L	867,000	637,000	73.5	Bear L	2,436,000	1,902,000	78.1
2000	Bear L	972,300	785,800	80.8	Bear L	5,093,000	4,402,000	86.4
2001	Bear L	1,052,000	864,000	82.1	Bear L	6,017,000	5,127,000	85.2
2002	Bear L	1,237,500	1,085,700	87.7	Bear L	6,004,000	4,921,000	82.0
2003	Bear L	1,249,572	1,093,892	87.5	Bear L	5,000,000	4,398,000	88.0
Total		13,517,172	11,465,992			45,389,600	37,167,400	
Ave				84.9				79.4

Prior to 1993 sockeye salmon returning to the Big River Lakes area on the west side of Cook Inlet or to Upper Russian Lake on the Kenai Peninsula served as broodstock for the Bear Lake sockeye stocking program. Fry from eggs collected from one or both of these broodstocks were released into Bear Lake each spring from 1990 through 1993.

In 1993, adults resulting from the Bear Lake stocking program returned to Bear Lake in numbers

large enough (>5,000) to provide broodstock for the hatchery. Since 1993 all sockeye gametes collected for the Bear Lake stocking program were collected from adults returning to Bear Lake.

Originally, it was believed returning adult sockeye would congregate in the spawning area identified on Figure 2 and be susceptible to capture by beach seine. In 1993, fish were captured here; but, most of the returning sockeye were found spawning at a depth of 40 feet or greater and were not susceptible to beach seining. In 1993, the egg collection goal was not met primarily because of the difficulty in capturing broodstock.

Since 1993 several methods have been employed to collect fish for hatchery broodstock. Efforts included capturing fish at the weir and holding them in raceways or deepwater net pens for ripening and purse seining or gill netting the fish from the deepwater spawning areas. Although the number of eggs collected has increased, none of the fish capture methods has worked well. In 1995, fry were released directly to a small tributary stream where it was expected returning adults could be easily captured. Since 1999, adults have returned to this area and broodstock collections have improved.

In 2003, field crews concentrated their broodstock capture efforts by beach seining in the near shore spawning areas and seining fish from deepwater spawning areas. Between 30 July and 4 September, 3,735 adult sockeye were captured and 18 egg collection exercises were completed. These efforts resulted in the collection of 5,000,000 eggs from 1,854 females.

Male and female adult sockeye salmon from the spawning areas were killed and stripped of their gametes. The gametes were shipped to Trail Lakes Hatchery for fertilization<sup>7</sup>, incubation and rearing. Fertilization was completed by mixing the eggs from each female with a portion of the milt from 8 to 10 males and activating the sperm with a 0.7% saline solution. The sockeye eggs were incubated at ambient Trail Lakes Hatchery water temperature. Incubation followed standard hatchery procedures and water temperature was regulated to thermally mark all fry.

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<sup>7</sup> Sockeye salmon eggs collected for stocking follow the delayed fertilization technique outlined in the ADF&G's Sockeye Salmon Policy Manual (State Pathology Review Committee, 1987).

For eggs collected in 2003, survival to the eyed stage was 88.0%.

Procedures for the removal of the gametes from the captured fish have remained the same since 1989 and are described in CIAA's "Egg-Take Procedures" manual (CIAA, 1993).

### **Gamete Collection, Incubation, and Rearing - Coho**

Coho salmon eggs were collected by capturing adult fish as they attempted to migrate past the weir. The fish were held in the raceways at the weir (Figure 3) until the females' eggs matured. Coho were spawned at the Bear Creek weir site between 15 October and 26 October. A total of 1,249,572 eggs were collected from 299 females and shipped to CIAA's Trail Lakes Hatchery for fertilization, incubation and rearing. The eggs were fertilized with the milt from 206 males. Additional gametes from 355 fish were collected and shipped to ADF&G's Fort Richardson Hatchery.

Once at Trail Lakes Hatchery, delayed fertilization was conducted following ADF&G sockeye salmon protocol. Eggs were pooled in groups of approximately 10 females for fertilization. The coho eggs were incubated at ambient Trail Lakes Hatchery water temperature. Incubation followed standard hatchery procedures and water temperature was regulated to thermally mark all resulting fry.

For eggs collected in 2003, survival to the eyed stage was 87.5%.

### **Fish Transport and Stocking**

Sockeye fry have been stocked into Bear Lake since 1990. For stocking, all fry were transported by truck from Trail Lakes Hatchery to Bear Lake in oxygenated transport tanks. Fry were either transferred to a boat in oxygenated transport tanks then motored to the eastside of the lake, or

trucked to a small tributary stream and released less than 0.5 kilometers upstream of the lake (Figure 2).

In 2003, fry were transported by truck in oxygenated tanks to a small tributary stream, 0.5 kilometers from Bear Lake (Figure 2). Fry were held in large containers and supplied with creek water for four hours to imprint them to the stream. After imprinting the fry were released into the tributary.

In 2003, 1,467,000 sockeye fry were released on 26 June thru 27 June (Table 3). All fry were released to the small tributary stream. The fry weighed 0.42 grams at the time of release and all were thermally marked (Rbr 1:1.6 Prehatch, Hatch Code 6H). Fry otolith samples were processed prior to the fry release to document thermal marks and are on file at the Trail Lakes Hatchery.

In 2003, 334,000 sockeye smolts were released between 1 May and 4 May (Table 3). All smolts were released from the raceways at Bear Creek Wier. The smolts weighed 4.06 grams and all were thermally marked (Rbr 1:1.5,2.4 Prehatch, Hatch Code 65, 4H). Smolt otoliths samples were processed prior to release to document thermal marks and are on file at the Trail Lakes Hatchery.

Coho fry have been stocked into Bear Lake since 1986. For stocking, all coho fry were transported by truck in oxygenated transport tanks, transferred to a boat and motored to the north end of the lake where they were released in the littoral zone (Figure 2).

In 2003, 405,000 coho fry were released on 24 June (Table 3). The fry weighed 1.37 grams at the time of release and all were thermally marked (Rbr 1:1.3, 2.3; Hatch Code: 3, 3H).

Since 1990, coho smolts have been released into Bear Creek. In 2003, 253,800 coho smolt weighing 13.6 grams were held in raceways for rearing and imprinting at Bear Creek From 4 March to 15 May days and released on 16 May. These fish were thermally marked (Rbr 1:1.3,

2.4; Hatch Code: 3, 4H). In addition, 103, 000 coho smolts from the same brood year and bearing the same hatchery mark, were transported to Homer and released from the Homer spit.

Table 3. Coho and sockeye salmon releases at Bear Lake, 1986 to 2003.

Release Year	Coho				Sockeye					
	Fry	Size (g)	Smolt	Size (g)	Fry	Size (g)	Pre-Smolt	Size (g)	Smolt	Size (g)
1986	445,700	1.64								
1987	226,300	1.46								
1988	347,200	1.00								
1989	491,300	0.75								
1990	333,200	1.30	93,700	20.0	2,260,200	0.80			158,800	7.1
1991	390,000	1.42			1,533,800	0.35			74,900	3.9
1992	203,800	0.49	51,730	10.1	1,795,500	0.72			565,500	4.4
1993 <sup>1</sup>	450,000	0.30			47,000	0.15				
1993 <sup>2</sup>	170,600	0.30			1,765,900	0.38				
1994	335,000	0.22			170,000	0.35				
1995	509,000	0.75	7,400	6.5	330,000	0.37				
1996 <sup>3</sup>	350,000	0.70	75,000	11.2	780,600	0.37				
1997	448,700	0.63	153,000	8.0	788,000	0.34				
1998	409,000	0.66	117,000	8.3	265,000	0.56				
1999	306,000	0.82	51,000	7.8	1,380,000	0.26				
2000 <sup>4</sup>	316,000	0.94	102,000	12.8	1,796,000	0.69				
2001	311,000	0.99	120,500	12.8	145,000	0.30				
2002	405,000	1.04	124,000	13.6	2,407,000	0.49	802,000	4.5		
3003 <sup>5</sup>	405,000	1.37	253,000	13.7	1,467,000	0.42			334,000	11.8
Total	6,852,800		1,148,330		16,931,000		802,000		1,133,200	
Ave	360,674	0.88	104,394	11.3	1,128,733	0.44	802,000	4.5	283,300	6.80

<sup>1</sup> Released into Bear Lake

<sup>2</sup> Extra Fry Released into Bear Creek

<sup>3</sup> sockeye fry release, 445, 300 @ .36g & 335,300 @ .38g

<sup>4</sup> sockeye fry release, 1,573,000 @ (.35-.45 g) & 223,000 @2.7 g

<sup>5</sup> An additional 103,000 coho smolts @ 12.7g (Bear Lake brood year 2001) were released at the Homer Spit.

## Cost Recovery

Returning adult sockeye and coho salmon in excess of broodstock and escapement needs were harvested by CIAA to recover cost of enhancement activities or donated if a market could not be found. Fish harvested for cost recovery were captured at the weir, killed, and iced.

## RESULTS AND DISCUSSION

### Limnology and Environmental Conditions

Bear Lake's limnological characteristics have been monitored for several years. The 2003 limnological data are presented in Appendix 1. This information has been summarized and is presented as open water seasonal average concentrations in Table 4 (1 meter) and Table 5 (hypolimnion).

Table 4. Water quality characteristics of Bear Lake at 1 meter, 1979 to 2003.

Year	1 meter depth											
	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	NO <sub>2</sub> +NO <sub>3</sub> (ug/l)	TN:TP	Chl a (ug/l)	EZD (m)	Secchi (m)	Zooplankton (mg/m <sup>2</sup> )
1979	76	7.4	30		8.0		8.3					
1980	74	7.3	29		7.7	138	9.8	42 :1	3.4			
1981	68	6.3	28		7.2	101	14.0	35 :1	3.4			734
1982	77	7.6	29		9.9	149	47.0	44 :1	1.9			704
1983	86	7.6	32		8.7	175	41.6	55 :1	2.0			914
1984	88	7.4	32	2.5	10.6	204	24.0	48 :1	3.6			836
1985	87	7.2	36	1.7	11.3	177	89.7	52 :1	2.6			429
1986	82	7.3	32	2.3	12.3	188	12.4	36 :1	2.9			583
1987	81	7.4	29	1.3	9.7	135	2.1	31 :1	1.6			401
1988												
1989												
1990	78	7.4	29	1.6	6.5	170	54.1	76 :1	1.9	11.2	3.6	1,134
1991	84	7.6	28	2.4	8.5	183	52.1	67 :1	2.8	7.4	3.2	467
1992	80	7.2	26	1.7	7.5	166	89.1	85 :1	1.7	9.0	3.8	395
1993	82	7.1	27	1.2	7.3	134	37.4	58 :1	1.9	8.7	4.4	804
1994	88	6.9	27	1.8	7.8	132	14.9	45 :1	2.1	11.4	5.0	743
1995	80	7.2	27	1.9	7.6	116	12.0	37 :1	2.7	10.1	4.4	377
1996	86	7.3	30	2.3	6.3	191	7.5	70 :1	3.1	9.0	3.8	949
1997	89	7.5	33	2.3	7.4	161	17.8	56 :1	3.0	8.2	4.4	556
1998	79	7.2	29	1.2	7.6	176	18.7	66 :1	0.6	8.5	5.3	485
1999	82	7.2	30	1.2	5.6	126	9.0	53 :1	0.9	9.7	5.6	698
2000	80	7.0	28	2.2	6.8	125	3.4	42 :1	3.4	8.9	4.6	711
2001	79	7.1	27	1.2	6.0	124	4.0	35 :1	2.0	9.2	5.0	896
2002	78	7.1	29	0.7	7.0	117	12.4	42 :1	2.4	10.4	5.0	1,271
2003	74	6.7	26	0.6	6.7	124	6.8	44 :1	2.1	11.0	6.4	345

Averages prior to 1992 compiled by ADF&G.  
 EZD, Secchi and atomic ratio provided by CIAA.  
 Open water season only.



Table 5. Water quality characteristics of Bear Lake in the hypolimnion ,1979 to 2003.

Year	Hypolimnion								
	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	NO2+NO3 (ug/l)	TN:TP	Chl a (ug/l)
1979	79	7.3	30		18.3		16.2		
1980	81	7.2	31		13.9	168	14.3	29 :1	8.8
1981	69	6.3	29		11.3	124	19.3	28 :1	5.5
1982	78	7.4	28		16.6	177	37.6	29 :1	5.8
1983	88	7.3	32		14.7	259	43.1	46 :1	6.8
1984	96	7.1	34	6.3	13.9	269	29.9	48 :1	7.7
1985	90	6.9	36	2.8	11.6	253	76.6	63 :1	4.1
1986	89	6.7	32	4.1	14.4	244	34.1	43 :1	3.9
1987	85	7.1	29	2.1	15.2	222	20.8	35 :1	
1988									
1989									
1990	83	7.1	29	2.9	11.2	248	47.4	58 :1	5.4
1991	88	7.1	29	3.3	10.6	203	55.9	55 :1	3.4
1992	84	7.0	26	2.9	8.1	194	82.7	83 :1	3.2
1993	88	7.0	29	1.9	8.8	140	65.6	62 :1	1.1
1994	88	6.9	29	1.9	13.6	185	17.7	34 :1	5.6
1995	83	7.0	28	4.7	12.8	202	8.3	36 :1	8.1
1996	87	7.0	30	4.6	12.4	273	1.9	49 :1	7.6
1997	93	7.3	34	8.3	17.1	332	4.3	44 :1	9.7
1998	89	7.1	32	2.9	8.5	188	34.5	63 :1	1.6
1999	86	6.9	30	4.2	14.7	222	12.2	38 :1	3.8
2000	81	7.2	28	1.9	6.9	127	3.0	41 :1	4.6
2001	80	7.0	27	1.9	5.8	137	3.9	37 :1	3.2
2002	80	7.0	31	0.9	10.1	127	15.2	32 :1	2.4
2003	73	6.8	26	0.7	6.7	116	7.1	41 :1	2.2

Averages prior to 1992 compiled by ADF&G.  
 EZD, Secchi and atomic ratio provided by CIAA  
 Open water season only

The environmental conditions recorded in 2003 are presented in Appendix 2. During the 2003 field season (1 May through 31 October 2003), 5:00 PM air temperature measurements ranged from 3.0°C to 28.0°C with a seasonal average of 13.5°C. Bear Creek water temperatures ranged from 1.0°C to 19.0°C and averaged 12.0°C. Precipitation recorded at the weir totaled 836 mm (33.0 inches). The recorded stage level (lower gauge) ranged from 0.88 to 2.02 feet; and averaged a level of 0.45 feet. The environmental conditions observed in 2003 are compared to other years in Table 6.

Table 6. Environmental conditions observed at Bear Lake, 1990 to 2003.

Year	May thru June 30									
	Total Days	No. of Days			Days Meas. Precip	Precip (mm)	Temperature (C)			
		<50% Cloud Cover	>50% Cloud Cover	100% Overcast			Air		Water	
						Avg	Range	Avg	Range	
1990	44	ND	ND	ND	ND	ND	ND	ND	10	(3-15)
1991	47	ND	ND	ND	ND	ND	ND	ND	7	(2-15)
1992	49	24	20	13	11	48	IC	IC	9	(3-14)
1992	42	18	24	13	6	ND	14	(8-20)	13	(7-17)
1994	47	16	31	20	18	IC	12	(5-22)	11	(5-16)
1995	38	10	28	11	19	185	12	(6-22)	10	(6-14)
1996	45	16	29	18	17	102	11	(5-16)	12	(8-15)
1997	42	29	5	2	13	40	15	(9-22)	12	(5-20)
1998	29	17	3	3	14	5	15	(8-24)	7	(4-14)
1999	44	17	4	18	13	35	11	(4-20)	7	(0-14)
2000	46	20	6	10	13	44	11	(2-16)	7	(2-12)
2001	58	23	11	24	11	15	10	(1-18)	8	(0-15)
2002	54	20	7	27	27	58	12	(6-24)	8	(1-16)
2003	61	15	9	37	27	172	13	(6-23)	11	(1-16)

Year	July thru Sept/Oct/Nov									
	Total Days	No. of Days			Days Meas. Precip	Precip (mm)	Temperature (C)			
		<50% Cloud Cover	>50% Cloud Cover	100% Overcast			Air		Water	
						Avg	Range	Avg	Range	
1990	119	ND	ND	ND	ND	ND	ND	ND	10	(3-15)
1991	100	ND	ND	ND	ND	ND	ND	ND	7	(2-15)
1992	92	28	64	48	38	345	IC	IC	IC	IC
1992	109	40	69	57	38	ND	14	(6-24)	15	(8-20)
1994	103	IC	IC	IC	IC	IC	IC	IC	IC	IC
1995	105	42	63	36	67	728	13	(3-20)	13	(6-16)
1996	101	28	73	42	50	308	10	(4-16)	14	(6-16)
1997	107	45	25	6	48	616	14	(5-21)	15	(6-20)
1998	117	43	13	36	72	627	12	(3-30)	11	(3-21)
1999	113	38	10	38	44	509	12	(3-25)	10	(2-16)
2000	125	44	14	12	68	443	9	(0-18)	10	(1-16)
2001	121	26	18	77	79	718	11	(-3-19)	12	(1-18)
2002	130	26	25	79	67	1084	12	(3-26)	11	(6-18)
2003	123	40	22	60	56	661	14	(3-28)	13	(5-19)

\*Sky condition data is calculated differently from 1997 onward. Rain days are counted as days with measurable precipitation and 100% overcast is measured as those days indicated as 100% overcast with or without measurable precipitation.

## Smolt Enumeration - Sockeye

A total of 1,326,500 ( $\pm 24,100$ ) sockeye smolts migrated from Bear Lake in 2002 (Appendix 3). The 10% sub-sampling procedure was used to count 49.0% of the migration.

The age 1.0 smolts averaged 92.3 mm ( $\pm 0.76$  mm) in length and 7.50 g ( $\pm 0.19$  g) in weight. The age 2.0 smolts averaged 139.5 mm ( $\pm 7.73$  mm) in length and 30.40 g ( $\pm 4.86$  g) in weight (Table 7). Based on the presence of hatchery induced thermal marks in the otoliths of 952 smolts, it was estimated that 92.4% ( $\pm 1.7\%$ ) of the sockeye smolts were of hatchery origin.

Table 7. Sockeye smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2003.

Year	Number		%		Age Composition						Average Length (mm)				Average Weight (g)								
	Number	95%CI	Hatch.	95%CI	0.0	95% CI	1.0	95% CI	2.0	95% CI	3.0	95% CI	0.0	1.0	CI	2.0	CI	0.0	1.0	CI	2.0	CI	
1980	3,400				0		3,400		20		20		119		187		NA		NA				
1981	3,500				0		2,800		700		0		117		158		16.2		41.6				
1982	46,300				0		46,100		100		0		110		144		14.0		29.7				
1983	13,000				0		11,000		2,000		40		112		149		13.5		32.9				
1984	10,500				0		7,700		2,500		300		116		153		15.4		35.8				
1985	1,600				0		1,300		300		30		126		176		20.2		51.4				
1986	1,000				0		800		100		0		123		167		18.3		47.2				
1987	18,200				0		17,800		300		100		112		172		12.8		46.5				
1988	9,100				0		7,200		1,900		30		120		155		16.0		34.9				
1989	5,100				0		3,700		1,300		200		122		152		18.8		35.6				
1990 <sup>1</sup>	53,400				52,500		800		30		3		NA		113		125		NA		15.2		28.4
1991 <sup>2</sup>	122,000				0		119,900		1,600		600		125		164		18.7		40.4				
1992 <sup>3</sup>	133,800				38,400		78,000		15,800		1,600		110		118		170		15		16.7		49.4
1993	345,800				54,600		285,500		4,900		0		115		123		152		18		18.7		35.3
1994	253,900				700		228,600		21,200		0		102		121		154		11.0		17.4		37.0
1995	73,500	1,900	70.2	8	0		6,800	1,600	4,800	1,000	0		122		156		17.9		37.2				
1996	156,000	9,600	64.2	3.5	0		149,400	9,400	6,400	2,100	0		117	0.6	120	2.1	11.8		16.2				
1997	276,000	64,000	74.6	3.6	0		270,500	64,000	5,500	3,500	0		104	0.5	143	7.6	10.1	0.2	26.7	4.4			
1998	107,800	15,500	72.2	5.8	0		81,800	13,600	25,500	7,200	500	1,400	115	1.1	151	3.6	13.1	0.5	35.2	2.5			
1999	75,800	6,800	74.5	5.5	0		59,800	5,400	15,400	4,000	700	900	132	1.2	163	6.3	20.3	0.6	31.4	2.1			
2000	175,000	20,600	76.8	5.2	11,400	5,600	138,600	18,000	20,700	7,500	4,300	3,400	119	1.4	172	11.1	17		14.0	0.7	59.0	9.8	
2001	387,500	15,700	88.2	2.2	0		346,600	12,900	28,600	7,400	12,200	4,900	103	0.8	131	0.4	10.1	0.5	28.9	11.9			
2002	107,200	7,100	28.4	3.2	0		85,100	6,300	20,800	3,300	1,300	800	115	0.6	146	1.5	15.1	0.7	35.1	1.0			
2003	1,326,500	24,100	92.4	1.7	0		1,306,200	22,000	23,000	10,000	0		92	0.8	140	7.7	7.5	0.2	30.4	4.9			
Avg. <sup>4</sup>	298,400	18,400	71.3	4.3	1,300	5,600	271,644	17,000	16,700	5,100	2,100	2,300	119	1.1	147	5.0	17		13.3	1.3	33.3	5.2	
Total	3,705,900				157,600		3,259,400		203,450		21,923												

Average Length rounded to nearest mm, Average Weight rounded to nearest 0.1 g. All other figures have been rounded to nearest 100 fish.

<sup>1</sup>In 1990, the migration of juvenile sockeye salmon consisted of three groups of fish: 870 wild smolts of age 1.0 or older, 227,906 age 0.0 fingerlings and 52, 491 age 0.0 smolts. Age, length and weight data for age 0.0 smolts have been lost. Summary statistics are based on the wild smolt migration.

<sup>2</sup>In 1991 smolt migration monitoring may have terminated before age 0.0 smolt migration.

<sup>3</sup>In 1992, an additional 68,505 sockeye fingerlings migrated from Bear Lake. These small fingerlings were expected to have low survivals and AWL data was not collected

<sup>4</sup>Average values calculated from smolt year 1995 onward.

## Smolt Enumeration - Coho

A total of 208,100 ( $\pm 10,800$ ) coho salmon smolts migrated from Bear Lake in 2003 (Appendix 3). The 10% sub-sampling procedure was used to count 6.5% of the migration.

The average size (Table 8) of the age 1.0 coho smolts was 108.7 mm ( $\pm 4.98$ ) and 11.89 g ( $\pm 0.30$ ). Age 2.0 smolts were 119.4 ( $\pm 2.48$ ) mm and 16.25 ( $\pm 1.62$ ) g. Based on the presence of hatchery induced thermal marks in the otoliths of 468 coho smolt, it was estimated that 86.9% ( $\pm 3.1\%$ ) of the coho smolts were of hatchery origin.

Table 8. Coho smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2003.

Year	Number		% Hatch.		Age Composition								Average Length (mm)				Average Weight (g)			
		95% CI		95% CI	1	95% CI	2	95% CI	3	95% CI	4	95% CI	1	2	3	4	1	2	3	4
1980	75,000				54,600		20,300		100				122	135			19.3	24.0		
1981	72,900				10,900		61,800		200				122	127			18.4	19.8		
1982	143,700				134,000		9,600		100				116	127			15.0	20.4		
1983	108,400				100,400		7,900		100				115	129			14.3	20.2		
1984	93,800				78,300		15,200		300				116	134			15.0	22.4		
1985	105,900				104,300		1,600		0				125	168			18.1	41.5		
1986	72,700				60,900		11,500		300				126	137			19.5	24.9		
1987	80,200				61,200		18,700		250				109	145			11.6	27.9		
1988	63,800				50,500		13,300		0				118	133			16.4	22.3		
1989	99,400				96,200		3,200		0				116	134			18.8	23.0		
1990	83,400				67,500		14,800		1,000				119	139			15.7	24.1		
1991	97,600				86,500		10,600		500				121	138			18.0	25.5		
1992	112,900				107,500		4,700		600				120	137			17.1	25.7		
1993	53,500				42,300		10,400		0				124	137			19.5	25.8		
1994	54,400				6,000		43,700		0				115	128			14.4	20.7		
1995	89,200	4,000			3,500	1,000	85,000	3,800	500	400	100	150	103	121			11.4	18.0		
1996	154,900	15,300			16,100	4,700	137,300	14,400	1,400	1,400	0	0	95	112			8.4	13.5		
1997	114,100	24,100			3,500	1,900	68,800	20,500	40,600	12,600	1,200	1,000	100	109	124	146	9.7	12.9	19.2	30.7
1998	92,200	7,200			8,200	2,500	73,000	6,000	10,900	2,800	600	700	100	114	140	168	8.4	13.6	26.2	40.5
1999	106,800	11,700			44,300	7,400	54,500	8,600	8,000	2,600	0	0	113	123	128		13.5	18.3	19.4	
2000	70,900	4,600			55,600	3,300	13,500	2,900	1,800	1,200	0	0	109	128	144		13.0	20.4	28.9	
2001 <sup>1</sup>	101,400	12,600	91.8	2.2	80,200	11,800	19,900	4,100	1,300	900	0	0	104	117	125		11.6	17.0	20.5	
2002	94,200	11,700	84.5	3.0	82,400	11,300	11,500	3,000	300	500	0	0	109	119	148		11.9	16.2	36.5	
2003	208,100	10,900	86.9	3.1	167,800	7,700	31,900	6,700	8,500	3,700	0	0	109	119	138		11.9	16.3	26.5	
Avg. <sup>2</sup>	97,892	11,300	87.7	2.8	63,400	5,700	30,900	7,800	3,200	2,900	200	600	114	130	135	157	15	22	25	36
Total	2,349,400				1,522,700		710,800		68,250		1,900									

Note: Averages for age 3.0 and 4.0 smolts are based on a small sample size.

Average Length rounded to nearest mm. Average Weight rounded to nearest 0.1 g. All other figures have been rounded to nearest 100 fish.

<sup>1</sup>Percent Hatchery calculated for Age 1.0 smolts only

<sup>2</sup>1980 thru 1992 averages are arithmetic, 1993 and later are weighted averages.

## Adult Escapement - Sockeye

Adult sockeye salmon began arriving at the weir on 21 May 2003 and continued to migrate until 31 July 2003 (Appendix 4). During this time, 16,010 adults were captured and counted at the weir (Table 8). The peak of the migration occurred between 14 June and 24 June. The returning major age groups for adult sockeye included ages 1.2 (45.1%), 1.3 (40.0%), and 2.3 (12.0%). Of the 16,010 adult sockeye that migrated to Bear Creek in 2003, 2,776 were harvested for cost recovery, 13,233 were passed to the lake, and 1 dead sockeye was found in the weir. An

additional 7,341 fish were harvested in the seine fishery for a total return to Resurrection Bay of 23,351 sockeye salmon.

A summary of mean age and weight, by age class, for adult salmon escapement to the Bear Creek weir site for 2003 is presented in Appendix 6.

Table 9. Historic returns of Coho and Sockeye Salmon to Bear Lake weir, 1980 to 2003.

Year	Weir Return Total	Coho Salmon Age Composition			Weir Return Total	Sockeye Salmon Age Composition										
		1.1	2.1	3.1		0.2	1.1	0.3	1.2	0.4	1.3	2.1	2.2	2.3	3.2	3.3
1980	4,520	NA	NA	NA	1,462	0	0	0	1,447	0	0	15	0	0	0	
1981	3,924	2,252	1,627	45	704	0	0	0	5	0	631	0	63	5	0	0
1982	2,122	NA	NA	NA	472	0	0	0	407	0	26	0	6	28	0	0
1983	5,797	5,261	510	25	627	0	0	0	275	0	316	0	25	11	0	0
1984	3,375	3,969	401	5	3,552	0	0	0	3,432	0	74	0	31	10	0	0
1985	4,825	4,222	603	0	1,235	0	0	0	245	0	935	0	52	3	0	0
1986	5,479	5,384	95	0	830	0	0	0	356	0	425	0	44	6	0	0
1987	6,021	5,888	133	0	212	0	0	0	75	0	102	0	26	5	0	0
1988	2,174	1,818	356	0	106	0	0	0	51	0	44	0	3	8	0	0
1989	5,106	4,174	932	0	185	0	0	0	174	0	11	0	0	0	0	0
1990	7,525	7,179	346	0	1,071	0	0	0	390	0	627	0	---	11	0	0
1991	7,331	6,328	1,003	0	741	0	0	0	232	0	409	0	90	5	0	0
1992	3,055	2,444	611	0	1,925	1,398	33	0	246	0	225	0	17	6	0	0
1993	8,671	8,136	535	0	6,708	84	17	4,068	2,336	0	135	0	17	17	0	0
1994	5,995	4,643	1,352	0	16,752	4,399	149	196	4,813	44	6,198	0	802	129	20	0
1995	3,295	883	2,346	66	29,203	29	380	4,877	4,877	117	17,317	29	876	672	0	0
1996	1,711	495	1,216	0	15,957	34	101	1,280	7,002	0	5,555	0	1,919	67	0	0
1997	3,569	618	2,883	68	17,965	0	663	26	4,849	0	10,080	0	1,123	1,174	26	26
1998	11,023	935	9,531	557	29,447	0	49	25	24,613	0	4,245	0	344	172	0	0
1999	3,811	529	2,991	291	17,439	0	0	0	9,004	0	6,802	25	1,534	74	0	0
2000	6,765	1,172	5,465	129	13,716	0	136	0	2,139	0	10,253	0	917	272	0	0
2001	2,913	1,515	1,265	133	16,364	0	0	0	5,187	0	9,705	0	736	736	0	0
2002	3,484	1,475	1,884	124	15,227	0	0	0	11,235	0	3,064	0	859	70	0	0
2003	3,506	2,727	752	27	16,010	0	58	0	7,219	0	6,404	0	1,921	408	0	0
Avg <sup>1</sup>	4,607	1,499	2,968	140	18,808	446	154	640	8,094	16	7,962	5	1,103	377	5	3
% of Avg	100%	32.5%	64.4%	3.0%	100%	2.4%	0.8%	3.4%	43.0%	0.1%	42.3%	0.03%	5.9%	2.0%	0.02%	0.1%

<sup>1</sup> Average calculation is based on 1994 data onward.

### Adult Escapement - Coho

Adult coho salmon began arriving at the weir on 17 August 2003 and continued to migrate until 28 October (Appendix 5). During this time, 3,506 adults were captured and counted at the weir (Table 10). The peak of the adult coho migration occurred between 29 September and 5 October. The returning major age groups for adult coho included ages 1.1 (77.8%), 2.1 (21.5%), and 3.1 (0.8%).

Of the 3,506 adult coho that were counted at the Bear Creek weir site, 2,065 were harvested, 1,021 were captured and held for hatchery broodstock (505 for CIAA, 355 for ADF&G, and 161 mortalities), and 395 were passed into the lake. There were 25 coho observed in Bear Creek below the weir; and no coho were estimated to remain in Salmon Creek when operations were terminated on October 31.

A summary of mean age and weight, by age class for adult salmon escapement to the Bear Creek weir site for 2003 is presented in Appendix 7.

### **Cost Recovery**

In 2003, 2,776 sockeye were harvested and sold or donated; 2,065 coho were harvested and sold or donated. For more detailed information on the Resurrection Bay cost recovery harvest reference the Cook Inlet Aquaculture Association's Cost Recovery Harvest Summary 2003. A copy is available by calling 907-283-5761.

### **Stocking**

Prior to brood year 1993, adult sockeye escapement to Bear Lake was small, wild smolt production was considered negligible and hatchery survival rates were estimated from total smolt production. The hatchery survival rates reported in Table 10 assume no wild smolt production and represent maximum values. After brood year 1993, smolt production was based on the recovery of otolith marks.

ADF&G considers a fry to smolt survival rate of 20% to be a reasonable sockeye stocking program goal. The reported sockeye fry to smolt survival rates for brood years 1989 through 1992 were less than 20%. Since brood year 1992, reported survival rates have average slightly more than 20%.

Coho salmon smolts produced from Bear Lake are the result of the coho fry stocking program and natural production in the lake. Since brood year 1993, attempts have been made to distinguish lake produced coho smolts from smolts resulting from the fry stocking program. This assessment is based on the recovery of otolith marks during the smolt migration and is not complete at this time.

The result of the fry stocking activity, in terms of smolt production and percent survival, is presented in Table 10.

Table 10. Bear Lake smolt production by brood years.

Brood Year	Coho						Brood Year	Sockeye					
	Escap.	No. Fry Stocked	Size (g)	No. Smolt	Hatch Smolt	% Hatch. Survival		Escap.	No. Fry Stocked	Size (g)	No. Smolt	Hatch. Smolt	% Hatch. Survival
1985	4,421	445,700	1.64	74,520			1985	1,235			19,740		
1986	5,115	226,300	1.46	54,700			1986	830			8,450		
1987	5,653	347,200	1.00	111,570			1987	212			4,320		
1988	1,640	491,300	0.75	78,680			1988	106			4,030		
1989	475	333,200	1.30	91,280			1989	185	2,260,000	0.80	188,140		
1990	919	390,600	1.42	118,000			1990	1,071	1,530,000	0.35	82,920		
1991	227	203,800	0.49	86,470			1991	741	1,796,000	0.72	345,080		
1992	332	450,000	0.30	91,950			1992	1,925	1,813,000	0.38	288,680		
1993	560	335,000	0.22	62,800			1993	5,045	170,000	0.15	67,960	47,710	28.1
1994	475	509,000	0.75	204,100			1994	8,430	330,000	0.37	155,700	101,020	30.6
1995	444	350,000	0.70	84,600			1995	8,334	781,000	0.37	296,500	220,541	28.2
1996	380	448,700	0.63	64,500			1996	8,012	788,000	0.34	101,395	70,311	8.9
1997	276	409,000	0.66	57,700			1997	7,945	265,000	0.56	92,532	70,857	26.7
1998	350	306,000	0.82	74,827			1998	8,427	1,380,000	0.25	168,449	134,508	9.7
1999	368	316,100	0.94	95,902	85,528	27.1	1999	7,815	1,796,400	0.80	378,915	320,644	17.8
2000 *	429	311,000	0.99	98,331	98,712	31.7	2000	11,828	144,500	0.30	105,367	44,121	30.5
2001 *	495	405,000	1.04	83,885	74,574	18.4	2001 *	12,801	2,407,000	0.49	368,171	287,357	11.9
2002 *	875	405,000	1.37				2002 *	12,504	1,467,000	0.42			
2003 *	395						2003 *	13,233					
Ave <sup>1</sup>	459	379,500	0.81	92,845	86,271	NA	Ave <sup>1</sup>	9,489	952,900	0.41	170,852	144,119	22.6

\* Incomplete broodyear

<sup>1</sup>Average data is for 1993 onward.

**Note:** Number of Hatchery Smolt is based on otolith mark data..

\* Incomplete broodyear

<sup>1</sup>Average data is for 1993 to 2000

**Note:** Number of Hachery Smolt is based on otolith mark data.

## **RECOMMENDATIONS**

There are no new recommendations regarding the Bear Lake Enhancement Project.



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## **APPENDICES**

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## Appendix 1. Bear Lake 2003 - Water Chemistry Analysis

### Nutrients and Primary Productivity

Date	Sta	Depth (m)	TP (ug/l)	TFP (ug/l)	FRP (ug/l)	TKN (ug/l)	NH3+NH4 (ug/l)	NO2+NO3 (ug/l)	TN:TP	RSi (ug/l)	Carbon (ug/l)	Chla (ug/l)	Phaeo (ug/l)	EZD (m)
5/14/2003	B	1	6.6	3.2	2.5	134	15.9	3.9	46 :1	2370	ND	2.13	3.70	10.6
	B	16	6.8	2.9	2.2	115	7.7	6.5	40 :1	2393	ND	4.26	4.98	
6/23/2003	B	1	5.3	3.5	2.5	114	9.7	5.1	50 :1	2279	ND	0.55	0.20	13.3
	B	13	5.0	3.2	2.5	95	7.0	5.8	45 :1	2278	ND	0.53	0.27	
7/20/2003	B	1	6.8	4.9	3.8	109	3.8	9.0	38 :1	1901	ND	1.41	0.30	13.6
	B	13	6.6	3.1	2.0	111	9.5	8.0	40 :1	1888	ND	0.84	0.33	
8/28/2003	B	1	5.0	3.6	2.1	109	12.5	8.1	52 :1	1403	ND	0.99	0.24	9.4
	B	13	5.3	2.9	1.8	105	11.9	8.1	47 :1	1384	ND	0.47	0.28	
9/24/2003	B	1	10.0	3.2	2.5	154	8.5	8.0	36 :1	1846	ND	5.50	1.11	7.9
	B	16	9.9	3.0	2.0	151	4.8	7.2	35 :1	1812	ND	4.80	0.87	
Mean			6.7	3.4	2.4	119.8	9.1	7.0	43 :1	1955.4	NA	2.1	1.2	11.0
Min			5.0	2.9	1.8	95.0	3.8	3.9	35 :1	1384.0	0.0	0.5	0.2	7.9
Max			10.0	4.9	3.8	154.0	15.9	9.0	52 :1	2393.0	0.0	5.5	5.0	13.6

### General Tests and Metals

Date	Sta	Depth (m)	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb (NTU)	Color (Pt)	Ca (mg/l)	Mg (mg/l)	Fe (ug/l)	Secchi (meters)
5/14/2003	B	1	65	6.7	22.8	0.8	9	ND	ND	15	3.0
	B	16	65	6.7	22.6	0.6	9	ND	ND	22	
6/23/2003	B	1	74	6.8	27.2	0.8	8	ND	ND	13	6.5
	B	13	73	6.8	26.6	0.7	9	ND	ND	15	
7/20/2003	B	1	75	7.1	28.8	0.6	5	ND	ND	10	5.0
	B	13	73	7.0	26.6	0.8	6	ND	ND	9	
8/28/2003	B	1	76	6.3	26.9	0.6	6	ND	ND	11	9.4
	B	13	76	6.9	27.1	0.4	6	ND	ND	9	
9/24/2003	B	1	79	6.8	26.6	0.3	8	ND	ND	8	7.9
	B	16	78	6.8	27.0	0.8	6	ND	ND	20	
Mean			73	6.8	26.2	0.6	7.2	NA	NA	13.2	6.4
Min			65	6.3	22.6	0.3	5.0	0.0	0.0	8.0	3.0
Max			79	7.1	28.8	0.8	9.0	0.0	0.0	22.0	9.4

Appendix 1. (continued) Bear Lake 2003 - Zooplankton Analysis

	Macrozooplankton Density - Site A (No/m <sup>2</sup> )					Mean (No/m <sup>2</sup> )	Seasonal Mean (No/m <sup>2</sup> )
	14-May	23-Jun	20-Jul	26-Aug	24-Sep		
<i>Ergasilus</i>						0	0
<i>Scapholeberis</i>						0	0
<i>Epischura</i>	21	18,684	16,136	6,369		8,242	8,242
<i>Diaptomus</i>		4,246	1,274	0	0	1,104	1,104
Ovig <i>Diaptomus</i>		212				42	42
<i>Cyclops</i>	74	2,972	0	425	2,123	1,119	1,119
Ovig <i>Cyclops</i>		212	425			127	127
<i>Bosmina</i>	74	6,157	152,017	44,586	3,609	41,289	41,289
Ovig <i>Bosmina</i>		2,972	2,548	1,699	637	1,571	1,571
<i>Daphnia l.</i>	159	27,813	81,953	83,227	38,217	46,274	46,274
Ovig <i>Daphnia l.</i>	11	14,225	18,684	14,013	3,185	10,024	10,024
<i>Ceriodaphnia sp.</i>						0	0
<i>Holopedium</i>						0	0
<i>Chydorinae</i>						0	0
<i>Polyphemus</i>						0	0
Total:	339	77,493	273,037	150,319	47,771	109,792	109,792
Ave:	68	8,610	34,130	21,474	7,962	14,449	14,449
Stdev:	59	9,562	54,934	31,429	14,888	15,156	15,156

	Macrozooplankton Density - Site B (No/m <sup>2</sup> )					Mean (No/m <sup>2</sup> )	Seasonal Mean (No/m <sup>2</sup> )
	14-May	23-Jun	20-Jul	26-Aug	24-Sep		
<i>Ergasilus</i>						0	0
<i>Scapholeberis</i>						0	0
<i>Epischura</i>	32	9,130	15,924	10,828	425	7,268	7,268
<i>Diaptomus</i>		1,274	0	0	2,548	764	764
Ovig <i>Diaptomus</i>						0	0
<i>Cyclops</i>	255	5,732	2,548	6,369	1,274	3,236	3,236
Ovig <i>Cyclops</i>		212	3,185			679	679
<i>Bosmina</i>	96	2,760	124,841	42,038	7,219	35,391	35,391
Ovig <i>Bosmina</i>	32	637	1,274	3,185	2,123	1,450	1,450
<i>Daphnia l.</i>	764	26,539	135,669	159,873	68,365	78,242	78,242
Ovig <i>Daphnia l.</i>	287	5,308	21,019	28,662	5,096	12,074	12,074
<i>Ceriodaphnia sp.</i>						0	0
<i>Holopedium</i>						0	0
<i>Chydorinae</i>						0	0
<i>Polyphemus</i>						0	0
Total:	1,466	51,592	304,460	250,955	87,050	139,105	139,105
Ave:	244	6,449	38,058	35,851	12,436	18,607	18,607
Stdev:	277	8,666	57,468	56,744	24,773	21,207	21,207

Appendix 1 (continued). Bear Lake 2003 – Zooplankton Analysis

	Body Size - Site A (mm)					Seasonal Means			
	14-May	23-Jun	20-Jul	26-Aug	24-Sep	Mean	Weighted	Biomass	Weighted
						Length	Length		(mg/m <sup>2</sup> )
<i>Ergasilus</i>									
<i>Scapholeberis</i>									
<i>Epischura</i>	0.61	0.98		1.83		1.14	1.20	54	62
<i>Diaptomus</i>		0.70	1.32	1.31	1.22	1.14	0.84	7	3
Ovig <i>Diaptomus</i>		1.36				1.36	1.36	0.43	0.43
<i>Cyclops</i>	0.79	0.73	0.76	1.29	0.65	0.84	0.74	3	2
Ovig <i>Cyclops</i>		1.24	1.20			1.22	1.21	1	1
<i>Bosmina</i>	0.42	0.36	0.38	0.51	0.52	0.44	0.41	74	64
Ovig <i>Bosmina</i>		0.51	0.40	0.61	0.53	0.51	0.50	4	4
<i>Daphnia l.</i>	0.58	0.57	0.74	0.85	0.69	0.69	0.75	94	114
Ovig <i>Daphnia l.</i>	0.80	0.86	1.03	1.18	0.87	0.95	1.01	41	47
<i>Ceriodaphnia sp.</i>									
<i>Holopedium</i>									
<i>Chydorinae</i>									
<i>Polyphemus</i>									
TOTAL:								277	297

	Body Size - Site B (mm)					Seasonal Means			
	14-May	23-Jun	20-Jul	26-Aug	24-Sep	Mean	Weighted	Biomass	Weighted
						Length	Length		(mg/m <sup>2</sup> )
<i>Ergasilus</i>									
<i>Scapholeberis</i>									
<i>Epischura</i>	0.50	1.13	1.20	1.75	1.54	1.22	1.35	58	77
<i>Diaptomus</i>		1.16	1.28	1.32	1.34	1.28	1.28	7	7
Ovig <i>Diaptomus</i>									
<i>Cyclops</i>	0.91	0.88	1.08	1.05	0.65	0.91	0.96	10	11
Ovig <i>Cyclops</i>		1.25	1.21			1.23	1.21	4	4
<i>Bosmina</i>	0.39	0.41	0.37	0.43	0.46	0.41	0.39	56	49
Ovig <i>Bosmina</i>	0.54	0.50	0.42	0.55	0.52	0.51	0.51	4	4
<i>Daphnia l.</i>	0.63	0.58	0.69	0.80	0.69	0.68	0.73	155	180
Ovig <i>Daphnia l.</i>	0.75	0.84	1.03	1.14	0.90	0.93	1.05	48	62
<i>Ceriodaphnia sp.</i>									
<i>Holopedium</i>									
<i>Chydorinae</i>									
<i>Polyphemus</i>									
TOTAL:								340	393



## Appendix 2. Bear Lake 2003 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gage (ft)	Upper Gage (ft)	Water Temp. (C)	Air Temp. (C)
1-May	1	0	0.76	1.39	5.0	13.0
2-May	1	0	0.72	1.38	5.0	16.0
3-May	1	0	0.68	1.38	5.0	18.0
4-May	5	0	0.96	1.38	7.0	9.0
5-May	5	11	0.79	1.40	7.0	11.0
6-May	3	1	1.06	1.38	7.0	12.0
7-May	1	0	1.20	1.37	7.0	13.0
8-May	4	0	0.96	1.36	7.0	11.0
9-May	5	44	1.20	1.40	7.0	7.0
10-May	4	45	0.80	1.85	7.0	8.0
11-May	5	4	0.82	1.82	7.0	6.0
12-May	5	8	0.96	1.82	7.0	9.0
13-May	4	1	0.92	1.82	8.0	9.0
14-May	3	0	0.88	1.82	8.0	10.0
15-May	3	0	0.92	1.82	8.0	11.0
16-May	3	0	0.92	1.82	8.0	12.0
17-May	4	0	0.90	1.52	8.0	10.0
18-May	5	0	0.92	1.50	8.0	10.0
19-May	1	1	1.00	1.48	8.0	11.0
20-May	1	2	0.90	1.42	9.0	14.0
21-May	1	0	0.90	1.30	1.0	12.0
22-May	4	0	0.92	1.30	1.0	12.0
23-May	4	0	0.94	1.30	1.0	12.0
24-May	5	0	0.96	1.30	1.0	15.0
25-May	2	1	0.96	1.30	12.0	16.0
26-May	4	1	1.00	1.36	12.0	13.0
27-May	3	2	0.97	1.35	13.0	13.0
28-May	1	0	0.93	1.35	13.0	13.0
29-May	4	0	0.92	1.35	13.0	16.0
30-May	4	0	0.92	1.35	13.0	15.0
31-May	5	2	0.85	1.28	13.0	9.0

Date	Sky	Precip. (mm)	Lower Gage (ft)	Upper Gage (ft)	Water Temp. (C)	Air Temp. (C)
1-Jun	5	2	1.20	1.28	13.0	9.0
2-Jun	3	2	1.20	1.28	13.0	12.0
3-Jun	2	0	1.97	1.25	14.0	16.0
4-Jun	5	0	1.97	1.25	14.0	13.0
5-Jun	5	2	1.97	1.28	13.0	11.0
6-Jun	5	10	1.04	1.30	13.0	10.0
7-Jun	5	2	1.04	1.31	13.0	11.0
8-Jun	4	0	1.05	1.32	13.0	16.0
9-Jun	4	0	1.05	1.32	13.0	16.0
10-Jun	5	0	1.05	1.32	13.0	15.0
11-Jun	4	2	0.96	1.22	13.0	13.0
12-Jun	1	2	0.96	1.22	14.0	16.0
13-Jun	5	0	1.06	1.26	14.0	16.0
14-Jun	4	0	1.04	1.30	14.0	15.0
15-Jun	4	1	0.97	1.32	14.0	13.0
16-Jun	3	0	1.01	1.32	15.0	17.0
17-Jun	5	0	1.05	1.32	15.0	16.0
18-Jun	3	0	1.01	1.28	15.0	16.0
19-Jun	3	0	1.01	1.28	15.0	15.0
20-Jun	4	0	1.01	1.28	15.0	16.0
21-Jun	5	3	1.01	1.28	15.0	13.0
22-Jun	1	0	1.08	1.28	15.0	16.0
23-Jun	4	0	1.08	1.28	14.0	13.0
24-Jun	5	3	1.08	1.28	14.0	12.0
25-Jun	5	8	2.02	1.28	13.0	12.0
26-Jun	5	3	2.02	1.28	13.0	12.0
27-Jun	4	4	2.02	1.26	13.0	12.0
28-Jun	1	4	0.98	1.26	15.0	20.0
29-Jun	2	0	0.98	1.30	15.0	17.0
30-Jun	1	0	1.40	1.30	16.0	23.0

Sky conditions

- 1 = Clear
- 2 = less than 50% cloud cover
- 3 = more than 50% cloud cover
- 4 = 100% overcast
- 5 = rain

Appendix 2 (continued). Bear Lake 2003 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gage (ft)	Upper Gage (ft)	Water Temp. (C)	Air Temp. (C)
1-Jul	4	0	1.02	1.3	17.0	18.0
2-Jul	5	0.6	1.03	1.1	17.0	15.0
3-Jul	2	0	1.10	1.38	18.0	23.0
4-Jul	4	0	1.10	1.38	18.0	15.0
5-Jul	2	0	1.10	1.34	18.0	23.0
6-Jul	2	0	1.10	1.34	18.0	22.0
7-Jul	2	0	1.10	1.32	18.0	23.0
8-Jul	3	0	1.08	1.32	18.0	22.0
9-Jul	3	0	1.08	1.32	18.0	19.0
10-Jul	4	0	1.08	1.32	18.0	19.0
11-Jul	4	0	1.08	1.32	18.0	14.0
12-Jul	1	0	1.10	1.32	18.0	20.0
13-Jul	1	0	1.10	1.32	18.0	23.0
14-Jul	2	0	1.11	1.32	18.0	16.0
15-Jul	4	0	1.11	1.32	18.0	15.0
16-Jul	5	0	1.16	1.30	17.0	16.0
17-Jul	3	0	1.16	1.30	17.0	17.0
18-Jul	1	0	1.16	1.22	17.0	19.0
19-Jul	3	0	1.16	1.24	17.0	20.0
20-Jul	4	0	1.16	1.26	17.0	18.0
21-Jul	3	0	1.17	1.28	17.0	18.0
22-Jul	4	0.5	1.16	1.30	17.0	17.0
23-Jul	4	0	1.16	1.30	17.0	14.0
24-Jul	4	1.2	1.16	1.30	16.0	14.0
25-Jul	5	8.2	1.16	1.30	16.0	14.0
26-Jul	5	0	1.16	1.30	16.0	14.0
27-Jul	4	0	1.16	1.30	16.0	12.0
28-Jul	5	18	0.96	1.30	16.0	14.0
29-Jul	5	0	0.96	1.30	16.0	12.0
30-Jul	3	0	0.96	1.32	16.0	16.0
31-Jul	1	1	1.02	1.25	16.0	22.0

Date	Sky	Precip. (mm)	Lower Gage (ft)	Upper Gage (ft)	Water Temp. (C)	Air Temp. (C)
1-Aug	1	0	1.02	1.25	16.0	21.0
2-Aug	2	0	1.02	1.25	16.0	20.0
3-Aug	4	0	0.86	1.22	17.0	17.0
4-Aug	3	0	0.82	1.24	17.0	16.0
5-Aug	1	0	0.82	1.24	17.1	22.0
6-Aug	2	0	0.82	1.23	18.0	22.0
7-Aug	2	0	0.80	1.22	18.0	23.0
8-Aug	2	0	0.78	1.22	18.0	22.0
9-Aug	1	0	0.78	1.22	18.0	19.0
10-Aug	1	0	0.78	1.22	18.0	13.0
11-Aug	5	1	0.78	1.22	19.0	16.0
12-Aug	4	23	1.18	1.37	18.0	13.0
13-Aug	5	21	1.19	1.30	16.0	13.0
14-Aug	5	23	1.90	1.38	15.0	13.0
15-Aug	5	21	1.10	1.40	16.0	13.0
16-Aug	5	20	1.50	1.42	16.0	13.0
17-Aug	3	14	1.01	1.48	16.0	16.0
18-Aug	3	0	0.89	1.44	16.0	15.0
19-Aug	5	1	0.76	1.42	16.0	12.0
20-Aug	3	1	0.86	1.48	15.0	14.0
21-Aug	4	0	0.80	1.46	15.0	16.0
22-Aug	2	0	0.76	1.44	15.0	19.0
23-Aug	2	0	0.62	1.36	14.0	18.0
24-Aug	4	0	0.62	1.36	14.0	15.0
25-Aug	5	1	0.60	1.32	14.0	12.0
26-Aug	5	23	0.67	1.34	14.0	13.0
27-Aug	4	16	0.65	1.34	14.0	13.0
28-Aug	5	25	0.74	1.34	14.0	14.0
29-Aug	4	22	0.82	1.35	14.0	14.0
30-Aug	3	9	0.92	1.37	14.0	15.0
31-Aug	3	0	0.86	1.37	14.0	16.0

Sky conditions

- 1 = Clear
- 2 = less than 50% cloud cover
- 3 = more than 50% cloud cover
- 4 = 100% overcast
- 5 = rain

Appendix 2 (continued). Bear Lake 2003 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gage (ft)	Upper Gage (ft)	Water Temp. (C)	Air Temp. (C)
1-Sep	2	0	0.78	1.28	14.0	15.0
2-Sep	2	0	0.67	1.40	14.0	19.0
3-Sep	3	0	0.60	1.38	14.0	16.0
4-Sep	4	0	0.60	1.38	14.0	15.0
5-Sep	2	0	0.60	1.38	14.0	16.0
6-Sep	2	0	0.60	1.38	14.0	16.0
7-Sep	1	0	0.80	1.36	14.0	16.0
8-Sep	5	0	0.78	1.36	14.0	14.0
9-Sep	5	3	0.80	1.30	14.0	13.0
10-Sep	2	0	0.80	1.30	14.0	28.0
11-Sep	2	0	0.78	1.32	14.0	16.0
12-Sep	4	0	0.70	1.30	14.0	15.0
13-Sep	1	0	0.68	1.26	14.0	13.0
14-Sep	1	0	0.68	1.24	14.0	10.0
15-Sep	1	0	0.68	1.24	13.0	11.0
16-Sep	1	0	0.66	1.22	12.0	12.0
17-Sep	2	0	0.66	1.18	12.0	15.0
18-Sep	1	0	0.66	1.18	12.0	9.0
19-Sep	4	0	0.62	1.16	12.0	11.0
20-Sep	4	22	0.82	1.32	9.0	5.0
21-Sep	3	0	0.78	1.28	9.0	9.0
22-Sep	2	0	0.60	1.20	9.0	11.0
23-Sep	5	0	0.62	1.18	9.0	8.0
24-Sep	4	1	0.46	1.18	9.0	9.0
25-Sep	3	8	0.46	1.18	9.0	10.0
26-Sep	4	1	0.46	1.18	9.0	11.0
27-Sep	3	0	0.48	1.20	9.0	11.0
28-Sep	5	8	0.48	1.18	9.0	12.0
29-Sep	5	10	0.95	1.20	9.0	12.0
30-Sep	5	35	1.42	1.40	9.0	12.0

Date	Sky	Precip. (mm)	Lower Gage (ft)	Upper Gage (ft)	Water Temp. (C)	Air Temp. (C)
1-Oct	3	45	0.62	1.68	10.0	11.0
2-Oct	5	34	0.60	1.68	10.0	11.0
3-Oct	3	44	0.76	1.92	10.0	10.0
4-Oct	5	7	0.22	1.94	10.0	9.0
5-Oct	5	22	ND	1.98	10.0	9.0
6-Oct	5	42	ND	2.16	9.0	10.0
7-Oct	5	28	ND	2.62	9.0	10.0
8-Oct	4	7	ND	1.58	9.0	9.0
9-Oct	5	3	ND	2.38	8.0	7.0
10-Oct	3	7	ND	1.90	8.0	7.0
11-Oct	3	1	ND	1.84	8.0	9.0
12-Oct	4	0	ND	1.76	8.0	7.0
13-Oct	4	1	ND	1.76	8.0	7.0
14-Oct	5	1	ND	1.74	8.0	7.0
15-Oct	1	2	ND	1.68	7.0	6.0
16-Oct	1	0	ND	1.68	7.0	6.0
17-Oct	3	0	ND	1.68	6.0	7.0
18-Oct	4	1	ND	1.68	6.0	7.0
19-Oct	4	13	ND	1.52	6.0	6.0
20-Oct	3	1	ND	1.52	6.0	7.0
21-Oct	2	0	ND	1.50	6.0	8.0
22-Oct	ND	2	ND	1.46	6.0	8.0
23-Oct	4	0	ND	1.42	6.0	9.0
24-Oct	4	13	ND	1.38	6.0	7.0
25-Oct	5	24	ND	1.36	6.0	8.0
26-Oct	5	22	ND	1.36	6.0	5.0
27-Oct	1	10	ND	1.34	6.0	3.0
28-Oct	1	0	ND	1.34	5.0	4.0
29-Oct	1	0	ND	1.34	5.0	4.0
30-Oct	4	0	ND	1.34	5.0	6.0
31-Oct	2	0	ND	1.46	5.0	6.0

Sky conditions

- 1 = Clear
- 2 = less than 50% cloud cover
- 3 = more than 50% cloud cover
- 4 = 100% overcast
- 5 = rain

### Appendix 3. Bear Lake 2003 - Smolt Migration.

Date	Sockeye		Coho		Dolly Varden		Rainbow Trout	
	Daily	Cumm	Daily	Cumm	Daily	Cumm	Daily	Cumm
01-May	0	0	0	0	0	0	0	0
02-May	0	0	0	0	0	0	0	0
03-May	0	0	0	0	0	0	0	0
04-May	0	0	0	0	0	0	0	0
05-May	0	0	0	0	0	0	0	0
06-May	0	0	0	0	0	0	0	0
07-May	0	0	0	0	0	0	0	0
08-May	0	0	0	0	0	0	0	0
09-May	0	0	0	0	0	0	0	0
10-May	0	0	0	0	0	0	0	0
11-May	0	0	0	0	0	0	0	0
12-May	15,766	15,766	106	106	0	0	5	5
13-May	20,350	36,116	126	232	0	0	1	6
14-May	13,944	50,060	255	487	0	0	0	6
15-May	53,329	103,389	514	1,001	2	2	0	6
16-May	43,548	146,937	494	1,495	2	4	0	6
17-May	48,145	195,082	1,182	2,677	36	40	0	6
18-May	14,478	209,560	410	3,087	0	40	0	6
19-May	127,349	336,909	1,689	4,776	10	50	0	6
20-May	53,036	389,945	735	5,511	40	90	0	6
21-May	118,955	508,900	2,229	7,740	50	140	0	6
22-May	78,983	587,883	1,966	9,706	21	161	0	6
23-May	106,140	694,023	3,653	13,359	0	161	0	6
24-May	66,060	760,083	2,417	15,776	20	181	0	6
25-May	74,176	834,259	5,053	20,829	20	201	0	6
26-May	63,276	897,535	3,737	24,566	10	211	0	6
27-May	27,257	924,792	1,282	25,848	0	211	0	6
28-May	50,154	974,946	1,883	27,731	0	211	0	6
29-May	26,247	1,001,193	1,773	29,504	0	211	0	6
30-May	17,383	1,018,576	2,015	31,519	0	211	0	6
31-May	12,921	1,031,497	3,072	34,591	1	212	0	6
01-Jun	21,040	1,052,537	9,499	44,090	2	214	0	6
02-Jun	21,662	1,074,199	8,393	52,483	0	214	0	6
03-Jun	32,772	1,106,971	8,945	61,428	2	216	0	6
04-Jun	30,805	1,137,776	5,199	66,627	3	219	0	6
05-Jun	12,536	1,150,312	9,877	76,504	3	222	0	6
06-Jun	7,233	1,157,545	6,052	82,556	1	223	0	6
07-Jun	15,433	1,172,978	7,922	90,478	0	223	0	6
08-Jun	26,048	1,199,026	6,106	96,584	3	226	0	6
09-Jun	5,271	1,204,297	7,532	104,116	0	226	0	6
10-Jun	720	1,205,017	1,523	105,639	0	226	0	6
11-Jun	7,281	1,212,298	7,175	112,814	3	229	0	6
12-Jun	14,115	1,226,413	11,890	124,704	1	230	0	6
13-Jun	19,354	1,245,767	7,371	132,075	1	231	0	6
14-Jun	6,126	1,251,893	6,095	138,170	0	231	0	6
15-Jun	340	1,252,233	1,862	140,032	0	231	0	6
16-Jun	3,702	1,255,935	9,015	149,047	0	231	0	6
17-Jun	3,062	1,258,997	6,125	155,172	0	231	0	6
18-Jun	1,061	1,260,058	3,231	158,403	0	231	0	6
19-Jun	1,122	1,261,180	3,587	161,990	0	231	0	6
20-Jun	2,421	1,263,601	3,494	165,484	0	231	0	6
21-Jun	4,053	1,267,654	5,325	170,809	0	231	0	6
22-Jun	1,789	1,269,443	4,562	175,371	0	231	0	6
23-Jun	9,641	1,279,084	6,587	181,958	0	231	0	6
24-Jun	3,341	1,282,425	3,069	185,027	0	231	0	6
25-Jun	5,544	1,287,969	3,746	188,773	0	231	0	6
26-Jun	3,191	1,291,160	3,440	192,213	0	231	0	6
27-Jun	3,355	1,294,515	2,713	194,926	0	231	0	6
28-Jun	2,673	1,297,188	2,421	197,347	0	231	0	6
29-Jun	1,209	1,298,397	1,155	198,502	0	231	0	6
30-Jun	3,546	1,301,943	1,827	200,329	0	231	0	6
01-Jul	4,521	1,306,464	2,310	202,639	0	231	0	6
02-Jul	4,440	1,310,904	1,680	204,319	0	231	0	6
03-Jul	5,057	1,315,961	1,231	205,550	0	231	0	6
04-Jul	3,505	1,319,466	189	205,739	0	231	0	6
05-Jul	1,502	1,320,968	22	205,761	0	231	0	6
06-Jul	1,241	1,322,209	853	206,614	0	231	0	6
07-Jul	1,023	1,323,232	168	206,782	0	231	0	6
08-Jul	989	1,324,221	587	207,369	0	231	0	6
09-Jul	1,277	1,325,498	410	207,779	0	231	0	6
10-Jul	697	1,326,195	274	208,053	0	231	0	6
11-Jul	281	1,326,476	67	208,120	0	231	0	6
Totals		1,326,476		208,120		231		6

Appendix 4. Bear Lake 2003 - Adult Sockeye Salmon Migration.

Date	Lake		Donate & Harvest	Morts	Daily Total	Total 2003
	Males	Females				
21-May	2	0	0	0	2	2
22-May	0	1	0	0	1	3
23-May	3	3	0	0	6	9
24-May	1	1	0	0	2	11
25-May	0	0	0	0	0	11
26-May	3	1	0	0	4	15
27-May	17	9	0	0	26	41
28-May	1	1	0	0	2	43
29-May	4	2	0	0	6	49
30-May	3	3	0	0	6	55
31-May	4	3	0	0	7	62
01-Jun	45	27	0	0	72	134
02-Jun	104	33	0	0	137	271
03-Jun	165	46	0	0	211	482
04-Jun	111	40	0	0	151	633
05-Jun	98	34	0	0	132	765
06-Jun	110	36	0	0	146	911
07-Jun	66	20	0	0	86	997
08-Jun	189	63	0	0	252	1,249
09-Jun	104	49	0	0	153	1,402
10-Jun	92	67	0	1	160	1,562
11-Jun	93	47	0	0	140	1,702
12-Jun	41	36	0	0	77	1,779
13-Jun	61	66	0	0	127	1,906
14-Jun	70	54	0	0	124	2,030
15-Jun	119	94	0	0	213	2,243
16-Jun	149	92	0	0	241	2,484
17-Jun	137	83	0	0	220	2,704
18-Jun	310	307	0	0	617	3,321
19-Jun	575	1,015	0	0	1,590	4,911
20-Jun	326	923	0	0	1,249	6,160
21-Jun	449	1,538	0	0	1,987	8,147
22-Jun	303	819	0	0	1,122	9,269
23-Jun	173	419	0	0	592	9,861
24-Jun	204	667	7	0	878	10,739
25-Jun	98	167	0	0	265	11,004
26-Jun	86	14	71	0	171	11,175
27-Jun	85	0	409	0	494	11,669
28-Jun	116	4	0	0	120	11,789
29-Jun	68	5	455	0	528	12,317
30-Jun	15	7	0	0	22	12,339

Appendix 4 (continued) Bear Lake 2003 - Adult Sockeye Salmon Migration.

Date	Lake		Donate & Harvest	Morts	Daily Total	Total 2003
	Males	Females				
01-Jul	114	7	382	0	503	12,842
02-Jul	121	26	20	0	167	13,009
03-Jul	91	13	477	0	581	13,590
04-Jul	110	15	5	0	130	13,720
05-Jul	37	5	53	0	95	13,815
06-Jul	98	42	192	0	332	14,147
07-Jul	51	14	27	0	92	14,239
08-Jul	109	48	120	0	277	14,516
09-Jul	83	41	100	0	224	14,740
10-Jul	83	27	13	0	123	14,863
11-Jul	74	34	140	0	248	15,111
12-Jul	48	46	23	0	117	15,228
13-Jul	54	25	22	0	101	15,329
14-Jul	52	50	15	0	117	15,446
15-Jul	28	16	8	0	52	15,498
16-Jul	43	22	0	0	65	15,563
17-Jul	24	17	9	0	50	15,613
18-Jul	25	28	10	0	63	15,676
19-Jul	27	14	12	0	53	15,729
20-Jul	54	21	9	0	84	15,813
21-Jul	0	0	14	0	14	15,827
22-Jul	0	0	98	0	98	15,925
23-Jul	0	0	13	0	13	15,938
24-Jul	0	0	12	0	12	15,950
25-Jul	0	0	0	0	0	15,950
26-Jul	0	0	36	0	36	15,986
27-Jul	0	0	0	0	0	15,986
28-Jul	0	0	24	0	24	16,010
29-Jul	0	0	0	0	0	16,010
30-Jul	0	0	0	0	0	16,010
31-Jul	0	0	0	0	0	16,010
Total	5,926	7,307	2,776	1	16,010	16,010

Appendix 5. Bear Lake 2003 - Adult Coho Salmon Migration.

Date	Lake		Harvest Not Sexed	Broodstock		Total		Raceway Morts	Daily Total	Cumm Total
	Males	Females		Males	Females	Males	Females			
25-Jul						0	0		0	0
26-Jul						0	0		0	0
27-Jul						0	0		0	0
28-Jul						0	0		0	0
29-Jul						0	0		0	0
30-Jul						0	0		0	0
31-Jul						0	0		0	0
01-Aug	0	0				0	0		0	0
02-Aug	0	0				0	0		0	0
03-Aug	0	0				0	0		0	0
04-Aug	0	0				0	0		0	0
05-Aug	0	0				0	0		0	0
06-Aug	0	0				0	0		0	0
07-Aug	0	0				0	0		0	0
08-Aug	0	0				0	0		0	0
09-Aug	0	0				0	0		0	0
10-Aug	0	0				0	0		0	0
11-Aug	0	0				0	0		0	0
12-Aug	0	0				0	0		0	0
13-Aug	0	0				0	0		0	0
14-Aug	0	0				0	0		0	0
15-Aug	0	0				0	0		0	0
16-Aug	0	0				0	0		0	0
17-Aug	0	1				0	1		1	1
18-Aug	2	0				2	0		2	3
19-Aug	0	0				0	0		0	3
20-Aug	3	4				3	4		7	10
21-Aug	0	0				0	0		0	10
22-Aug	0	0				0	0		0	10
23-Aug	0	0				0	0		0	10
24-Aug	0	0				0	0		0	10
25-Aug	0	0				0	0		0	10
26-Aug	1	0				1	0		1	11
27-Aug	2	0				2	0		2	13
28-Aug	8	5				8	5		13	26
29-Aug	6	2				6	2		8	34
30-Aug	11	8				11	8		19	53
31-Aug	3	1				3	1		4	57

Appendix 5 (continued). Bear Lake 2002 - Adult Coho Salmon Migration.

Date	Lake		Harvest Not Sexed	Broodstock		Total		Raceway Morts	Daily Total	Cumm Total
	Males	Females		Males	Females	Males	Females			
01-Sep	11	4				11	4		15	72
02-Sep	31	16				31	16		47	119
03-Sep	17	4				17	4		21	140
04-Sep	6	3				6	3		9	149
05-Sep	4	3				4	3		7	156
06-Sep	6	3				6	3		9	165
07-Sep	14	11				14	11		25	190
08-Sep	12	14				12	14		26	216
09-Sep	11	8				11	8		19	235
10-Sep	3	7	4			3	11		14	249
11-Sep	0	0	2			0	2		2	251
12-Sep	4	26	0			4	26		30	281
13-Sep	7	9	34			7	43		50	331
14-Sep	3	4	7			3	11		14	345
15-Sep	1	2	8			1	10		11	356
16-Sep	0	0	15			0	15		15	371
17-Sep	1	5	24			1	29		30	401
18-Sep	0	3	0			0	3		3	404
19-Sep	0	0	0			0	0		0	404
20-Sep	0	0	0			0	0		0	404
21-Sep	0	0	24			0	24		24	428
22-Sep	0	0	63			0	63		63	491
23-Sep	0	0	15	35	4	35	19		54	545
24-Sep	0	0	0	31	4	31	4		35	580
25-Sep	0	0	18	48	7	48	25		73	653
26-Sep	0	0	0	80	22	80	22		102	755
27-Sep	0	0	3	55	10	55	13		68	823
28-Sep	0	0	0	32	10	32	10		42	865
29-Sep	0	0	30	44	7	44	37		81	946
30-Sep	0	0	0	30	45	30	45		75	1,021
01-Oct	0	0	84	7	23	7	107		114	1,135
02-Oct	0	0	292	0	45	0	337		337	1,472
03-Oct	0	0	65	0	76	0	141		141	1,613
04-Oct	0	0	638	0	13	0	651		651	2,264
05-Oct	0	0	110	0	39	0	149		149	2,413
06-Oct	0	0	0	4	92	4	92		96	2,509
07-Oct	0	0	0	0	58	0	58		58	2,567
08-Oct	16	20	0	0	0	16	20		36	2,603
09-Oct	0	0	0	10	87	10	87		97	2,700
10-Oct	0	0	178	0	10	0	188		188	2,888
11-Oct	0	0	117	11	25	11	142		153	3,041
12-Oct	0	0	24	0	0	0	24		24	3,065
13-Oct	0	0	0	13	18	13	18		31	3,096
14-Oct	0	0	263	0	0	0	263		263	3,359
15-Oct	0	0	0	0	0	0	0		0	3,359
16-Oct	0	0	0	2	3	2	3		5	3,364
17-Oct	0	0	47	0	0	0	47		47	3,411
18-Oct	0	0	0	0	0	0	0		0	3,411
19-Oct	0	0	0	0	0	0	0		0	3,411
20-Oct	0	0	0	6	6	6	6		12	3,423
21-Oct	0	0	0	4	2	4	2		6	3,429
22-Oct	0	0	0	6	6	6	6		12	3,441
23-Oct	0	0	0	3	4	3	4		7	3,448
24-Oct	0	0	0	10	13	10	13		23	3,471
25-Oct	0	0	0	0	1	0	1		1	3,472
26-Oct	0	0	0	2	2	2	2		4	3,476
27-Oct	2	3	0	0	0	2	3		5	3,481
28-Oct	30	14	0	(30)	(14)	0	0		0	3,481
29-Oct	0	0	0	0	0	0	0		0	3,481
30-Oct	0	0	0	0	0	0	0		0	3,481
31-Oct	0	0	0	0	0	0	0		25	3,506
Total	215	180	0	2,065	403	618	618	2,863	0	3,506



## Appendix 6. Bear Lake 2003 – Sockeye Adult Weir Return Summary

	1.1	1.2	1.3	2.1	2.2	2.3	Total
Sample Period:	38 May - 20 July 2003						
Males (No.)		2,387	2,212		349	116	5,065
Percent		14.9%	13.8%		2.2%	0.7%	32.1%
Aged Sample Size		41	38		6	2	87
Total Sample Size							104
Mean Length (mm)		495.0	557.5		526.5	560.0	525.3
Std. Deviation		33.90	34.94		22.77	14.14	43.4
Std. Error		5.29	5.67		2.00	10.00	4.26
Mean Weight (kg)		1.90	2.70		0.34	2.50	2.20
Std. Deviation		0.42	0.51			0.42	0.59
Std. Error		0.066	0.083		0.000	0.297	0.06
Females (No.)	58	4,832	4,192		1,572	291	10,887
Percent	0.4%	30.2%	26.2%		9.8%	1.8%	67.9%
Aged Sample Size	1	83	72		27	5	188
Total Sample Size							220
Mean Length (mm)	374	501.5	543.3		505.9	533.4	516.0
Std. Deviation	0	24.59	27.22		19.46	10.71	35.1
Std. Error	0.00	2.70	3.21		3.75	4.79	2.37
Mean Weight (kg)	1	1.90	2.40		1.90	2.20	2.10
Std. Deviation	0	0.54	0.34		0.24	1.80	0.59
Std. Error	0.000	0.059	0.040		0.046	0.805	0.043
Both Sexes (No.)	58	7,219	6,404		1,921	408	16,010
Percent	0.4%	45.1%	40.0%		12.0%	2.5%	100%
Total Aged Sample Size	1	124	110		33	7	275
Total Sample Size							324
Mean Length (mm)	374	499.3	548.2		509.4	542	520.7
Std. Deviation	0	28.04	30.71		21.03	16.33	37.4
Std. Error	499.300	2.518	2.928		3.661	6.172	2.258
Mean Weight (kg)	1	1.9	2.5		1.9	2.3	2.10
Std. Deviation	0	0.5	0.43		0.26	0.26	0.52
Std. Error	0.000	0.045	0.041		0.045	0.098	0.031

## Appendix 7. Bear Lake 2003 – Coho Adult Weir Return Summary

	Age			Total
	1.1	2.1	3.1	
Sample Period:	28 August - 21 October 2003			
Males (No.)	1,693	416	13	2,122
Percent	48%	12%	0.4%	61%
Aged Sample Size	126	31	1	158
Total Sample Size				197
Mean Length (mm)	574.0	574.5	599.0	573.3
Std. Error	4.94	9.35		3.75
Mean Weight (kg)	3.1	3.1	3.7	2.9
Std. Error	0.09	0.17		0.12
Females (No.)	954	296	13	1,263
Percent	27%	8%	0.4%	36%
Sample Size	71	22	1	94
Total Sample Size				115
Mean Length (mm)	595.3	597.8	590.0	591.6
Std. Error	5.25	8.25		3.95
Mean Weight (kg)	3.3	3.3	3.4	3.2
Std. Error	0.09	0.16		0.07
Both Sexes (No.)	2,727	752	27	3,506
Percent	77.8%	21.5%	0.8%	100%
Sample Size	203	56	2	261
Total Sample Size				320
Mean Length (mm)	581.6	584.3	594.5	580.1
Std. Error	3.7	4.50	4.50	2.77
Mean Weight (kg)	3.2	3.2	3.6	3.2
Std. Error	0.06	0.11	0.16	0.05

59 scales samples were unreadable (38 from males and 21 from females)

Total means for males, females and both sexes are generated from the total sample size

## Appendix 8. Bear Lake 2003 – Project Updates

### Sockeye Salmon Project

#### Stocking & Misc. Activities

Crew on-site:	1-May		
Ice-out:	26-May		
Crew off-site:	1-Nov		
Fry stocking:	26-May to 27-May	1,467,000	0.42 g
Smolt Stocking	1-May to 4-May	334,000	11.8 g
Fertilizer application:	26-Jun to 8-Aug	1050 gal.	

#### Smolt Migration

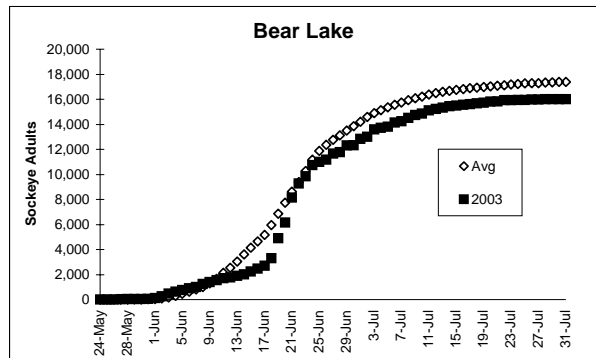
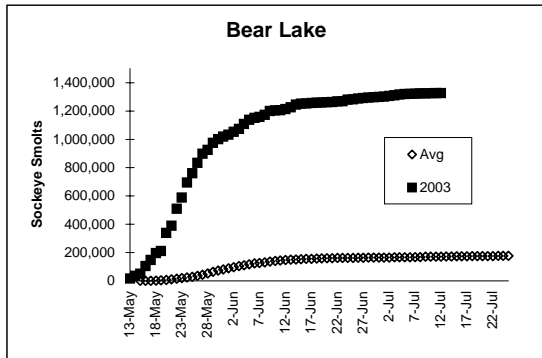
Dates:	12-May to 11-Jul		
Sockeyes:	1,326,476		
Percent age 1:	98.5%		
Percent age 2:	1.5%		
Percent age 3:	0.0%		
Percent hatchery:	92.4%		
Dolly Varden:	231		

#### Egg Take

Dates:	30-Jul to 4-Sep	
No. of broodstock used:	3,735	
Green eggs:	5,000,000	
Fecundity:	2,813	
Eyed eggs:	4,398,000	
% Survival	88.0%	

#### Adult Migration

Dates:	12-May to 31-Jul	
Total return:	23,351	
Commercial harvest:	7,341	31%
Creek return:	16,010	69%
C.R. harvest:	2,776	12%
Mortalities:	1	0%
Lake:	13,233	57%
Hatchery broodstock:	3,735	16%
Lake broodstock:	9,498	41%



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## Appendix 8 (continued). Bear Lake 2003 – Project Updates

### Coho Salmon Project

#### Stocking & Misc. Activities

Crew on-site:	1-May		
Ice-out:	26-May		
Crew off-site:	1-Nov		
Fry stocking:	24-Jun to 24-Jun	405,000	1.37 g
Smolt stocking:	4-Mar to 16-May	253,000	13.7 g
Fertilizer application:	26-Jun to 18-Aug	1050 gal.	

#### Smolt Migration

Dates:	12-May to 11-Jul	
Cohos:	208,120 *	
Percent age 1:	80.4%	
Percent age 2:	15.3%	
Percent age 3:	4.1%	
Percent hatchery:	86.9%	
Dolly Varden:	231	

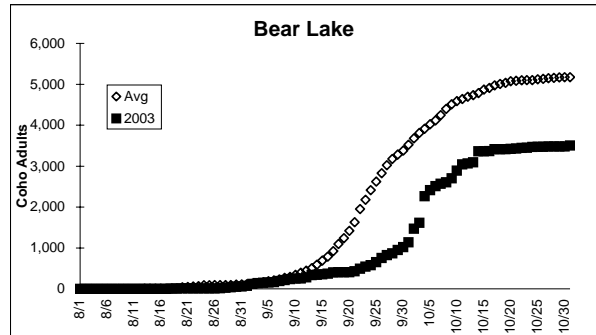
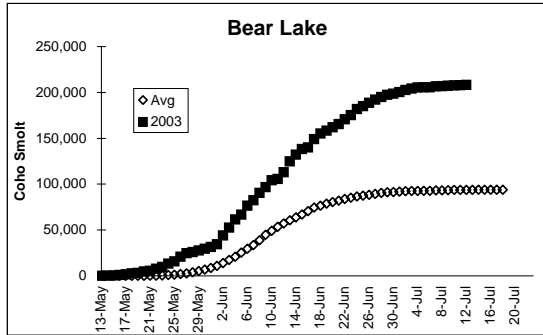
\*39.7% of the smolts were from smolt releases, 49.1% were from fry releases

#### Egg Take

Dates:	to	
No. of females used:	206	
Green eggs:	1,249,572	
Fecundity:	4,179	
Eyed eggs:	1,093,892	
% Survival:	87.5%	

#### Adult Migration

Dates:	1-Aug to 14-Oct	
Coho total creek return:	3,506	
Weir return:	3,481	99%
C.R. harvest:	2,065	59%
Lake:	395	11%
Hatchery broodstock:	1,021	29%
Est. Remaining in Bear Ck:	25	1%
Est. Remaining in Salmon Ck:	0	0%



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