

**Bear Lake  
Salmon Enhancement  
Progress Report  
2004**

**Prepared by:  
Caroline Cherry, Hatchery Operations Coordinator  
June 2012**

**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, through a grant from the Seward Chamber of Commerce and a grant administered by the United States Fish and Wildlife Services provided by Senator Ted Stevens.**

*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 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.

CIAA maintains a strong policy of equal employment opportunity for all employees and applicants for employment. We hire, train, promote, and compensate employees without regard for race, color, religion, sex, sexual orientation, national origin, age, marital status, disability or citizenship, as well as other classifications protected by applicable federal, state or local laws.

Our equal employment opportunity philosophy applies to all aspects of employment with CIAA including recruiting, hiring, training, transfer, promotion, job benefits, pay, dismissal, and educational assistance.

*This page intentionally left blank*

## **ACKNOWLEDGEMENTS**

The 2004 Bear Lake smolt migration, fry release, adult count, and gamete collection exercise were conducted by the Cook Inlet Aquaculture Association (CIAA). Appreciation is extended to the full-time and seasonal staff at Bear Lake Weir and Trail Lakes Hatchery.

*This page intentionally left blank*

# TABLE OF CONTENTS

DISCLAIMER.....	iii
ACKNOWLEDGEMENTS.....	v
TABLE OF CONTENTS .....	vii
LIST OF FIGURES .....	ix
LIST OF TABLES.....	xi
ABSTRACT .....	xiii
INTRODUCTION AND PURPOSE.....	15
PROJECT AREA .....	17
METHODS.....	19
Limnological Sampling and Environmental Conditions.....	19
Lake Nutrient Enrichment .....	19
Smolt Enumeration .....	20
Smolt Characteristics and Enhanced Contribution .....	21
Adult Escapement.....	23
Gamete Collection, Incubation and Rearing - Sockeye.....	24
Gamete Collection, Incubation, and Rearing - Coho.....	25
Fish Transport and Stocking.....	25
RESULTS AND DISCUSSION.....	27
Limnology, Environmental Conditions and Lake Fertilization .....	27
Smolt Enumeration - Sockeye .....	30
Smolt Enumeration - Coho .....	31
Adult Escapement - Sockeye .....	32
Adult Escapement - Coho.....	33
Hatchery Activities .....	34
RECOMMENDATIONS.....	36
LITERATURE CITED.....	39
APPENDICES .....	41

*This page intentionally left blank*



## LIST OF FIGURES

Figure 1. Map showing location of Bear Lake near Seward, Alaska.....	17
Figure 2. Bear Lake near Seward, Alaska .....	18
Figure 3. The Bear Creek weir, smolt trap and adult counting complex (Top View).....	20

*This page intentionally left blank*

## LIST OF TABLES

Table 1. Water quality characteristics of Bear Lake at 1 meter, 1979 to 2004. ....	27
Table 2. Water quality characteristics of Bear Lake in the hypolimnion, 1979 to 2004. ....	28
Table 3. Environmental conditions observed at Bear Lake, 1990 to 2004. ....	28
Table 4. Fertilizer application at Bear Lake, 1981 to 2004. ....	30
Table 5. Sockeye smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2004. ....	31
Table 6. Coho smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2004. ....	32
Table 7. Historic returns of Coho and Sockeye Salmon to Bear Lake weir, 1980 to 2004. ....	33
Table 8. Coho and sockeye salmon releases at Bear Lake, 1986 to 2004. ....	34
Table 9. Eggs collected for Bear Lake enhancement, 1989 to 2003. ....	35
Table 10. Bear Lake smolt production by brood years. ....	36
Table 11. Marine survival for sockeye at Bear Lake (BY1989 to BY2004). ....	36

*This page intentionally left blank*

## ABSTRACT

The Cook Inlet Aquaculture Association (CIAA) has been conducting sockeye salmon (*Oncorhynchus nerka*) and coho salmon (*Oncorhynchus 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 2004, 2,409 million sockeye fry (BY03), 603,000 presmolts (BY03) and 406,000 coho fry (BY03) were released into Bear Lake. At the time of release, the sockeye fry averaged 0.6 grams, presmolts averaged 4.5 grams and the coho fry averaged 1.1 grams. All released fry were of Bear Lake origin. No sockeye smolts were released to Bear Lake. Approximately 285,000 coho smolts (BY02) were released into Bear Creek (average 10.5 gm) and 192,000 coho smolts were released into Resurrection Bay (average 13.0 gm).

Smolt migration monitoring began on 24 May and continued daily until 30 June. During this time a total of 123,213 sockeye and 73,397 coho smolts migrated from the lake.

Based on otolith marks, 96.2% ( $\pm 2.4\%$ ) of the emigrating sockeye smolts were enhanced. An estimated 62.1% smolts were age 1 and 37.9% were age 2. The average length and weight of the age 1 sockeye smolts was 115 mm ( $\pm 1.3$  mm) and 14.2 g ( $\pm 1.4$  g) respectively. The age 2 sockeye smolts were 139 mm ( $\pm 0.8$  mm) and 26.1 g ( $\pm 1.2$  g).

Based on otolith marks, 92.2% ( $\pm 2.6\%$ ) of the emigrating coho smolts were enhanced. An estimated 73.7% of coho smolt were age 1 and 26.0% were age 2. The average length and weight of the age 1 coho smolts was 103 mm ( $\pm 4.9$  mm) and 11.5g ( $\pm 1.2$  g) and the age 2 coho smolts were 128 mm ( $\pm 1.6$  mm) and 22.1 g ( $\pm 1.2$  g).

A total of 11,923 adult sockeye returned to Bear Creek in 2004. The majority of the returning sockeye salmon was age 1.3 (57.9%) or age 1.2 (22.1%). All adult sockeye salmon were passed into the lake. No freshwater harvest occurred. Of the 11,923 fish passed into the lake, 3,725 were used for hatchery broodstock.

A total of 2,672 adult coho returned to Bear Creek weir in 2004. The returning fish were age 1.1 (47.0%), age 2.1 (51.2%) or 3.1(1.8%). Of the adult coho returning, 1,224 were harvested and sold for cost recovery or donated, 876 were held and used as hatchery broodstock, and 572 were passed into Bear Lake.

From 26 July to 14 September 2004, 5,661,000 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 1,866 females were fertilized with milt from 1,859 males.

From 15 to 25 October 2004, 1,673,000 coho eggs were collected from 400 females and fertilized with milt from 279 males. In addition, the Alaska Department of Fish and Game

(ADF&G) collected 348,000 coho salmon eggs.

A total of 1,260 gallons of fertilizer was applied to Bear Lake in 2004. 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 (*Oncorhynchus 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.

---

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

*This page intentionally left blank*



## 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.

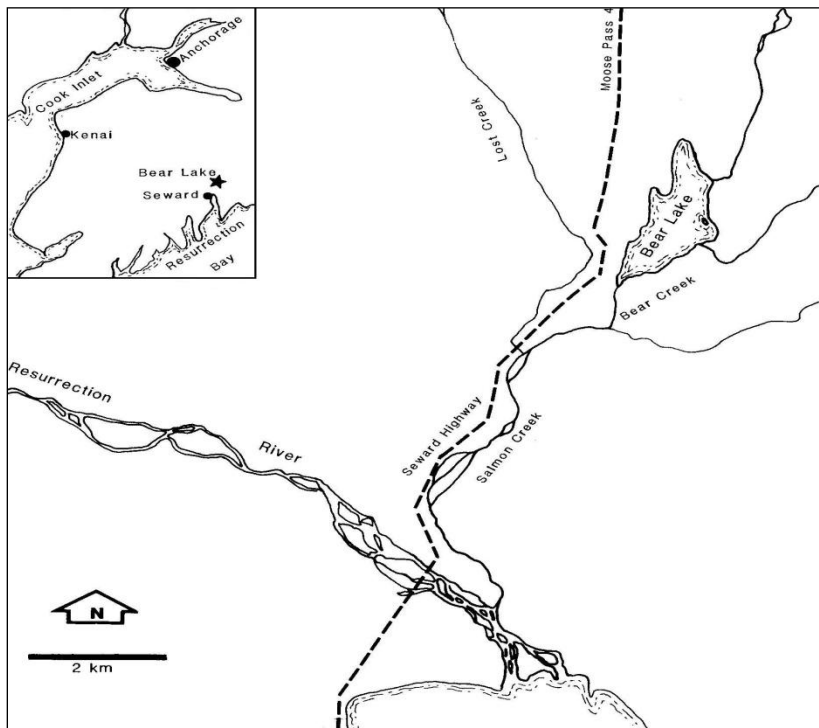


Figure 1. Map showing location of Bear Lake near Seward, Alaska.

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.

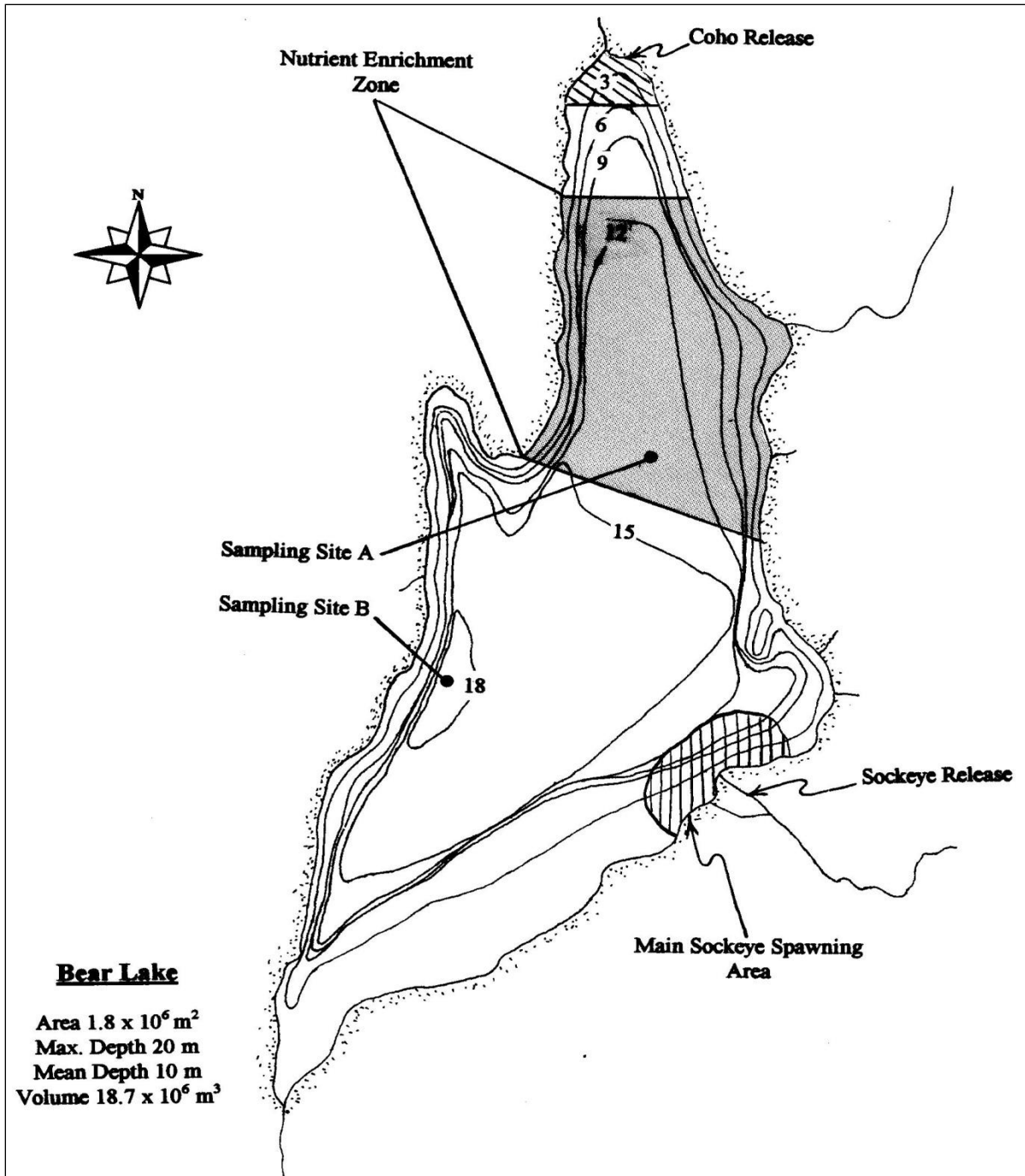


Figure 2. Bear Lake near Seward, Alaska

## **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 2004 were consistent with previous limnological sampling activities. These procedures are described by Koenings, et al. (1986).

During 2004, assessments of water quality were conducted 3 times (June, July, August) 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**

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. Fertilizer was

applied at a rate of 1 barrel every other day from June 22 to the end of July. In August, 2 barrels were applied every other day.

### 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 2004 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. In 2004, due to the low number of fish emigrating from the lake, the 10% sub-sampling procedure was not required.

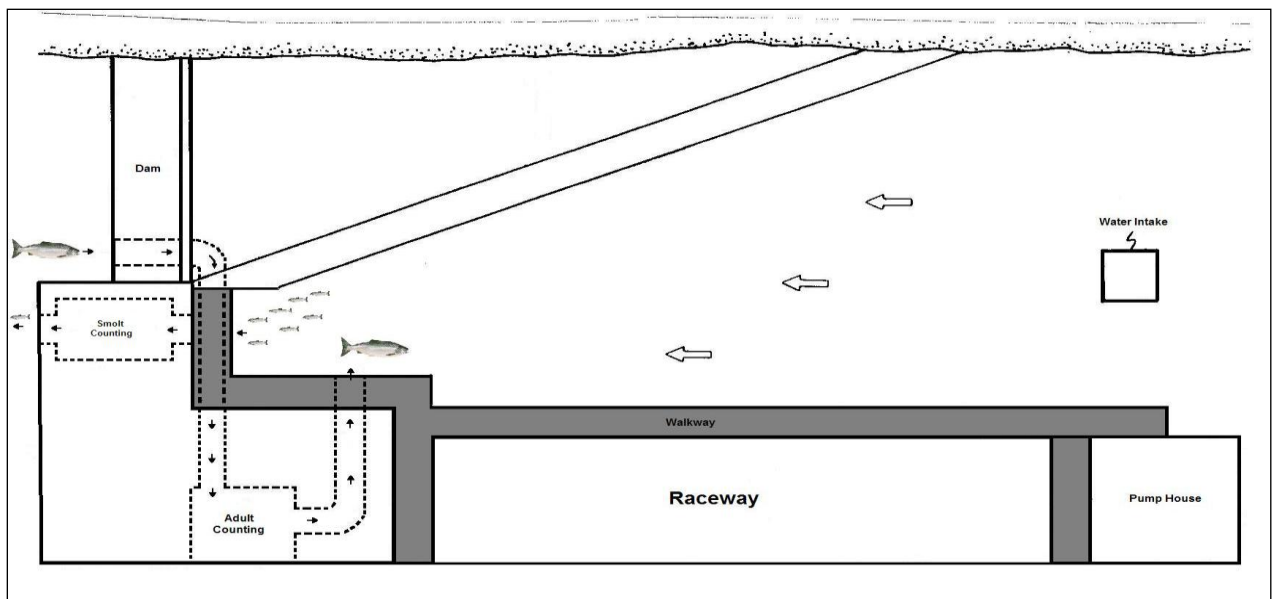


Figure 3. The Bear Creek weir, smolt trap and adult counting complex (Top View).

## 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>2</sup>. The purpose of this mark is to determine the contribution of released hatchery fish to the Bear Lake smolt population.

In 2004, smolts collected for measurement, age determination, and otolith removal were sampled in proportion to the daily smolt migration. This was accomplished by collecting every 500<sup>th</sup> sockeye smolt and every 180<sup>th</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 253 sockeye smolts and 405 coho smolts.

Each smolt collected for evaluation was first measured to the nearest millimeter for fork length<sup>3</sup> and weighed to the nearest 0.1 gram. Several scales were then removed from the primary growth area<sup>4</sup> and mounted on a glass slide for subsequent age determination. Finally, otoliths were removed and placed in a labeled one dram vial filled with a 10% ethanol solution. At CIAA HQ, each otolith was checked for a hatchery mark following procedures described by Glick and Shields (1993).

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,

---

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

<sup>3</sup> Standard fork length was measured from the tip of the snout to the fork of the tail.

<sup>4</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.

$N_h$  = 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:

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

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

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

## 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. The escapement enumeration included the assessment of the sex, age, and standard fork length<sup>5</sup> of the returning population of fish.

To enumerate the adult migration, fish attempting to migrate upstream were directed by the weir

---

<sup>5</sup> Standard fork length was defined as the measurement from mid-eye to the fork of the tail.

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 (harvest; hatchery broodstock).

To assess the sex, age and length of the returning populations, 10% of the daily migration was sampled for the returning sockeye adults from May 28 to June 20. This was reduced to 5% for the June 21 to July 9 time period. For the returning coho adults, 10% for the daily migration was sampled. In 2004, measurements were collected from 706 sockeye (5.9%) and 243 coho (9.09%).

### **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. 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.

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, 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 in 3 different lots. Incubation followed standard hatchery procedures and water temperature was regulated to thermally mark the 3 different lots (Fry - H4; Presmolt - 6H; Smolt - 3,3H3).

### **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. Gametes were collected and transported to Trail lakes Hatchery. Eggs were pooled in groups of approximately 10 females for fertilization. The coho eggs were incubated at ambient Trail Lakes Hatchery water temperature in 2 distinct lots for fry and smolt stocking. Incubation followed standard hatchery procedures and water temperature was regulated to thermally mark the 2 different lots (Fry - 3,3H; Smolt - 3,3H2). Coho salmon eggs were also collected by ADF&G Ft. Richardson Hatchery staff.

### **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. In 2004, 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.

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 contrast, all coho smolts were transported by truck in oxygenated tanks and placed into raceways at the weir for imprinting. Due to the number of fish on site at the hatchery, approximately 1/2 of the smolts were delivered to the weir in late February and released in late May, while the remainder were stocked into Resurrection Bay in late May.

## RESULTS AND DISCUSSION

### Limnology, Environmental Conditions and Lake Fertilization

Bear Lake's limnological characteristics have been monitored for several years. The 2004 limnological data are presented in Appendix 1. This information has been summarized and is presented as open water seasonal average concentrations in Table 1 (1 meter) and Table 2 (hypolimnion).

Table 1. Water quality characteristics of Bear Lake at 1 meter, 1979 to 2004.

Year	1 meter depth											
	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)	EZD (m)	Secchi (m)	Zooplankton (mg/m2 )
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
2004*	72	6.8	27	1.0	7.3	176	26.5	38 :1	1.5	9.2	3.8	NA

Averages prior to 1992 compiled by ADF&G.

EZD, Secchi and atomic ratio provided by CIAA.

Open water season only.

\*2004 - zooplankton data analysis is incomplete.

Table 2. Water quality characteristics of Bear Lake in the hypolimnion, 1979 to 2004.

Year	Hypolimnion								
	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)
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
2004*	74	6.7	27	0.9	28.1	275	78.9	32 :1	1.7

Averages prior to 1992 compiled by ADF&G.

EZD, Secchi and atomic ratio provided by CIAA

Open water season only

\*2004 - possible contamination of hypolimnion sample (7/14/2004)

The environmental conditions recorded in 2004 are presented in Appendix 2. Between 01 May and 30 June, the average air temperature was 14.6°C (±3.9°C) while water temperature averaged 8.7°C (±4.9°C). Average stage height below the weir was 1.0 ft (±0.2 ft) and above the weir it was 1.8 ft (±0.1 ft) for the same time period. Between 01 July and 29 October, the average air temperature was 14.5°C (±6.8°C) while water temperature averaged 13.5°C (±4.8°C). Average stage height below the weir was 0.7 ft (±0.2 ft) and above the weir it was 1.4 ft (±0.2 ft). The environmental conditions observed in 2004 are compared to other years in Table 3.

Table 3. Environmental conditions observed at Bear Lake, 1990 to 2004.

Year	May thru June 30											
	Total Days	Clear	No. of Days			Rain	Days Meas. Precip	Precip (mm)	Temperature (C)			
			<50% Cloud Cover	>50% Cloud Cover	100% Overcast				Air Avg	Air Range	Water Avg	Water Range
1990	44	ND	ND	ND	ND	ND	ND	ND	ND	ND	10	(3-15)
1991	47	ND	ND	ND	ND	ND	ND	ND	ND	ND	7	(2-15)
1992	44	13	11	7	13	11	11	48	IC	IC	9	(3-14)
1993	42	5	13	11	7	6	16	ND	14	(8-20)	13	(7-17)
1994	47	8	8	11	5	15	18	38	12	(5-22)	11	(5-16)
1995	38	5	5	17	6	5	19	185	12	(6-22)	10	(6-14)
1996	45	9	7	11	6	12	17	102	11	(5-16)	12	(8-15)
1997	42	28	1	5	2	6	11	40	15	(9-22)	12	(5-20)
1998	29	6	11	3	3	6	14	5	15	(8-24)	7	(4-14)
1999	44	12	5	4	18	5	13	35	11	(4-20)	7	(0-14)
2000	46	15	5	6	17	3	8	44	11	(2-16)	7	(2-12)
2001	58	14	9	11	20	4	11	15	10	(1-18)	8	(0-15)
2002	54	18	2	7	9	18	27	58	12	(6-24)	8	(1-16)
2003	61	12	3	9	17	20	27	172	13	(6-23)	11	(1-16)
2004	61	19	2	12	14	14	17	218	15	(8-22)	9	(2-17)

Year	July thru Sept/Oct/Nov											
	Total Days	Clear	No. of Days			Rain	Days Meas. Precip	Precip (mm)	Temperature (C)			
			<50% Cloud Cover	>50% Cloud Cover	100% Overcast				Air Avg	Air Range	Water Avg	Water Range
1990	119	ND	ND	ND	ND	ND	ND	ND	ND	ND	10	(3-15)
1991	100	ND	ND	ND	ND	ND	ND	ND	ND	ND	7	(2-15)
1992	92	17	22	16	48	38	38	345	IC	IC	IC	IC
1993	109	15	25	12	17	30	38	ND	14	(6-24)	15	(8-20)
1994	68	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC
1995	105	24	17	26	12	26	65	728	13	(3-20)	13	(6-16)
1996	101	17	11	31	23	19	50	308	10	(4-16)	14	(6-16)
1997	107	32	13	25	6	31	48	616	14	(5-21)	15	(6-20)
1998	117	24	19	13	39	31	72	627	12	(3-30)	11	(3-21)
1999	113	25	13	10	38	27	44	509	12	(3-25)	10	(2-16)
2000	125	19	25	14	36	31	56	443	9	(0-18)	10	(1-16)
2001	121	8	18	18	34	43	79	718	11	(-3-19)	12	(1-18)
2002	130	12	14	25	34	45	75	1084	12	(3-26)	11	(6-18)
2003	123	19	21	22	30	30	56	661	14	(3-28)	13	(5-19)
2004	122	26	20	18	30	27	40	427	15	(3-32)	14	(6-19)

\*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.

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. Application levels are presented in Table 4.

Table 4. Fertilizer application at Bear Lake, 1981 to 2004

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	5,620	40	6/04 - 8/09	4 to 6 times/week
1993			960	905	98	5/25 - 8/07	3 times/week
1994							No application
1995							No Application
1996	2,280		600	4,234	61	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			1,050	990	107	6/26 - 8/8	Mon, Wed, Fri
2004			1,260	1,188	129	6/22 - 8/20	Every other day

### Smolt Enumeration - Sockeye

Enumeration of Bear Lake sockeye smolts occurred between May 24 - June 30. A total of 123,213 sockeye smolts migrated from Bear Lake in 2004 (Appendix 3). The 10% sub-sampling procedure was not used to count any of the smolt migrating from the lake.

The age 1.0 smolts averaged 115 mm ( $\pm 1.3$  mm) in length and 14.2 g ( $\pm 1.4$  g) in weight. The age 2.0 smolts averaged 139 mm ( $\pm 0.8$  mm) in length and 26 g ( $\pm 1.2$  g) in weight (Table 5). Based on the presence of hatchery induced thermal marks in the otoliths of 235 smolts, it was estimated that 96.2% ( $\pm 2.4\%$ ) of the sockeye smolts were of hatchery origin.

Table 5. Sockeye smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2004.

Year	Number	(±) 95%CI	Hatch. (%)	(±) 95% CI	No. Wild	Age Composition						Average Length (mm) <sup>6</sup>				Average Weight (g) <sup>6</sup>						
						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
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	15.4	16.7		49.4		
1993	345,800					54,600		285,500		4,900		0	115	123		152	18.1	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	21,903	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	55,848	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	70,104	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	29,968	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	19,329	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	40,600	11,400	5,600	138,600	18,000	20,700	7,500	4,300	3,400	119	1.6	172	11.1	16.8	14.0	0.7	59.0	9.8
2001	387,500	15,700	88.2	2.2	45,725	0		346,600	12,900	28,600	7,400	12,200	4,900	103	0.8	131	0.4	10.1	6.5	28.9	11.9	
2002	107,200	7,100	28.4	3.2	76,755	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	100,814	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	
2004	123,200		96.2	2.4	4,682	0		76,500	7,800	46,700	7,800	0		115	1.3	139	0.8	14.2	1.4	26.1	1.2	
Avg. <sup>4</sup>	298,400	18,400	71.3	4.3	51,200	1,300	5,600	271,644	17,000	16,700	5,100	2,100	2,300	119	0.9	147	5.0	17	13.3	1.3	33.3	5.2
Total <sup>5</sup>	3,829,100					157,600		3,335,900		250,150		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 to 2003.

<sup>5</sup>Total values calculated from 1980 to 2004.

<sup>6</sup>1980 thru 1992 averages are arithmetic, 1993 and later are weighted averages.

## Smolt Enumeration - Coho

A total of 73,397 coho salmon smolts migrated from Bear Lake in 2004 (Appendix 3) between May 24 and June 30. The 10% sub-sampling procedure was not used to count any smolt migrating from the lake.

The average size (Table 6) of the age 1.0 coho smolts was 103 mm ( $\pm 1.2$  mm) and 11.5 g ( $\pm 0.8$  g). Age 2.0 smolts were 128 mm ( $\pm 1.6$  mm) and 22.1 g ( $\pm 1.2$  g). Based on the presence of hatchery induced thermal marks in the otoliths of 384 coho smolt, it was estimated that 92.2% ( $\pm 2.6\%$ ) of the coho smolts were of hatchery origin.

Table 6. Coho smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2004.

Year	Number		%		Age Composition								Average Length (mm) <sup>4</sup>						Average Weight (g) <sup>4</sup>					
	(±)	95% CI	Hatch.	95% CI	(±)	95% CI	(±)	95% CI	(±)	95% CI	(±)	95% CI	(±)	95% CI	(±)	95% CI	(±)	95% CI	(±)	95% CI	(±)	95% CI	(±)	95% CI
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		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			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			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			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			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			109		119		137.6		11.9		16.3	26.5		
2004	73,400		92.2	2.6	54,000	3,500	19,100	3,500					103	1.2	128	1.6			11.5	0.8	22.1	1.2		
Avg <sup>2</sup>	97,892	11,300	88	3	63,400	5,700	30,900	7,800	3,200	2,900	500	600	114		130		135		14.6		21.4	25.3		35.6
Total <sup>3</sup>	2,422,800				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>Average values calculated from smolt year 1980 to 2003.  
<sup>3</sup>Total values calculated from 1980 to 2004.  
<sup>4</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 28 May 2004 and continued to migrate until 31 July 2004 (Appendix 4). During this time, 11,923 adults were captured and counted at the weir (Table 7). The returning major age groups for adult sockeye included ages 1.1 (8.3%), 1.2 (22.1%), 1.3 (57.9%), 2.2 (9.5%) and 2.3 (2.0%). Of the 11,923 adult sockeye that migrated to Bear Creek in 2004, 0 were harvested for cost recovery, 11,923 were passed to the lake. An additional 16,645 fish were harvested in the seine fishery for a total return to Resurrection Bay of 28,568 sockeye salmon.



A summary of mean age and weight, by age class, for adult sockeye salmon escapement to the Bear Creek weir site for 2004 is presented in Appendix 6.

Table 7. Historic returns of Coho and Sockeye Salmon to Bear Lake weir, 1980 to 2004.

**Historic Returns to the Bear Creek Weir**

Year	Coho Salmon Age Composition				Sockeye Salmon Age Composition											
	Weir Return Total	1.1	2.1	3.1	Weir Return Total	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	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
2004	2,672	1,255	1,369	49	11,923	0	992	0	2,639	0	6,904	20	1,131	238	0	0
Avg <sup>1</sup>	4,431	1,477	2,823	131	18,182	406	230	582	7,598	15	7,866	7	1,106	365	4	2
% of Avg	100%	33.3%	63.7%	3.0%	100%	2.2%	1.3%	3.2%	41.8%	0.1%	43.3%	0.04%	6.1%	2.0%	0.02%	0.1%

<sup>1</sup> Average calculation is based weir returns from 1994 to 2004

**Adult Escapement - Coho**

Adult coho salmon began arriving at the weir on 22 September 2004 and continued to migrate until 27 October (Appendix 5). During this time, 2,672 adults were captured and counted at the weir (Table 7). The returning major age groups for adult coho included ages 1.1 (47.0%), 2.1 (51.2%), and 3.1 (1.8%).

Of the 2,672 adult coho that were counted at the Bear Creek weir site, 1,224 were harvested, 876 were held for broodstock purposes and 572 were passed into the lake.

A summary of mean age and weight, by age class for adult salmon escapement to the Bear Creek weir site for 2004 is presented in Appendix 7.

## **Hatchery Activities**

### Stocking

In 2004, 2.409 million sockeye fry (BY03; 2H), 603,000 sockeye presmolts (BY03: 2,1H) and 406,000 coho fry (BY03: 3,3H) were released into Bear Lake. These fish will migrate in 2005/2006 as smolts. No sockeye smolts (BY02) were released to Bear Lake. At the time of release, the sockeye fry averaged 0.63 gm, sockeye presmolts averaged 4.5 gm and the coho fry averaged 1.07 gm.

Approximately, 285,000 coho smolts (BY02: 6,2H) were released into Bear Creek (average = 10.5 gm) and 192,000 coho smolts (BY02: 6,2H) were released into Resurrection Bay (average = 13.0 gm). A summary of releases are provide in Table 8.

### Eggtake

Between 26 July and 14 September 2004, a total of 5,661,000 sockeye salmon eggs were collected. A total of 3,725 broodfish were used (1,866 females; 1,859 males) providing an average fecundity of 3,034 eggs/female.

From 15 to 25 October 2004, a total of 1,673,000 coho eggs were collected from 400 females and fertilized with milt from 279 males. Average fecundity was 4,183 eggs/female.

Table 9 provides an overview of egg collection activities for enhancement at Bear Lake since 1989.

Table 8. Coho and sockeye salmon releases at Bear Lake, 1986 to 2004.

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	4.50		
2003 <sup>5</sup>	405,000	1.37	253,000	13.7	1,467,000	0.42			334,000	11.8
2004	406,000	1.07	477,000	11.51	2,409,000	0.63	603,000	4.50		
Total	7,258,800		1,625,330		19,340,000		1,405,000		1,133,200	
Ave	362,940	0.89	135,444	11.4	1,208,750	0.45	702,500	4.50	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.

Table 9. Eggs collected for Bear Lake enhancement, 1989 to 2004.

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
2004	Bear L	1,673,000	1,557,000	93.1	Bear L	5,661,000	4,989,000	88.1
Total		15,190,172	13,022,992			51,050,600	42,156,400	
Ave				85.4				79.8

### Fry-to-Smolt Survival

Migrating smolts in 2004 were stocked as fry in 2002 (BY01 - Age 2) and 2003 (BY02 - Age 1).

Based on age classification from otolith/scales in 2004, Table 10 summarizes the fry-to-smolt survival for each brood year.

### Marine Survival

Based on information collected from migrating sockeye smolts and returning sockeye adults (total return), it is possible to provide an estimate of the survival of hatchery fish in the marine environment. This information is summarized below in Table 11.

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	345,000		
1990	919	390,600	1.42	118,000			1990	1,071	1,530,000	0.35	157,800		
1991	227	203,800	0.49	86,470			1991	741	1,796,000	0.72	910,600		
1992	332	450,000	0.30	91,950			1992	1,925	1,813,000	0.38	288,200		
1993	560	335,000	0.22	62,800			1993	5,045	170,000	0.15	69,100	47,600	28.0
1994	475	509,000	0.75	204,100			1994	8,430	330,000	0.37	155,400	100,400	30.4
1995	444	350,000	0.70	84,600			1995	8,334	781,000	0.37	296,700	220,700	28.3
1996	380	448,700	0.63	64,500			1996	8,012	788,000	0.34	101,400	73,800	9.4
1997	276	409,000	0.66	57,700			1997	7,945	265,000	0.56	92,500	71,100	26.8
1998	350	306,000	0.82	74,827			1998	8,427	1,380,000	0.25	168,500	132,014	9.6
1999	368	316,100	0.94	100,200	90,700	28.7	1999	7,815	1,796,400	0.80	378,900	311,700	17.4
2000	429	311,000	0.99	114,300	97,300	31.3	2000	11,828	144,500	0.30	105,400	42,900	29.7
2001	495	405,000	1.04	186,900	163,400	40.3	2001 *	12,801	3,209,000	0.49	1,352,800	917,788	28.6
2002 *	875	405,000	1.37	54,000	49,800	12.3	2002 *	12,504	1,467,000	0.42	76,549	73,640	5.0
2003 *	395	406,000	1.07				2003 *	13,233	3,012,000	0.63			
2004 *	572						2004	8,061					
Ave <sup>1</sup>	468	381,900	0.84	100,393	100,300	28	Ave <sup>1</sup>	9,370	1,213,000	0.43	279,725	199,164	21.3

\* Incomplete broodyear

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

Smolt numbers are rounded to the nearest 100 fish.

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

\* Incomplete broodyear

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

Smolt numbers are rounded to the nearest 100 fish.

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

BY2001 & 2003 fry stocked includes 2,409 M stocked as fry and 603,000 as presmolts

BY2001 hatchery smolt do not include the number that were stocked as smolts into Beak Lake

Table 11. Marine survival for sockeye at Bear Lake (BY1989 to BY2002)

BY	Marine Survival (%)
1989	5.0
1990	24.9
1991	5.4
1992	15.5
1993	18.6
1994	34.2
1995	16.1
1996	15.4
1997	14.5
1998	20.1
<i>1999</i>	<i>7.9</i>
<i>2000</i>	<i>6.1</i>
<i>2001</i>	<i>0.2</i>
<i>2002</i>	<i>0.0</i>
AVE	16.6

Incomplete broodyears are in red and italicized

## RECOMMENDATIONS

There are no changes recommended for the Bear Lake Enhancement Project.

*This page is intentionally left blank*

## LITERATURE CITED

- Cooperative Agreement, ADF&G, FRED Division and ADF&G, Sport Fish Division and CIAA. Operation of the Weir and Cooperative Use of On-site Housing for the Bear Creek Coho Enhancement Project in Resurrection Bay. Cook Inlet. 2004.
- Koenings, J.P., J.A. Edmundson, J.M. Edmundson, and G.B. Kyle. 1986. Limnology Field and Laboratory Manual: Methods for Assessing Aquatic Production. ADF&G, FRED Division. Soldotna, Ak. 222 pages.
- Koenings, J.P., and R.D. Burkett. 1987. Population Characteristics of Sockeye Salmon, (*Onchorynchus nerka*), Smolts Relative to Temperature Regimes, Euphotic Volume, Fry Density and Forage Base Within Alaskan Lakes. pp 216-234. In H.D. Smith, L. Margolis, and C.C. Wood (ed.) Sockeye Salmon, (*Onchorynchus nerka*), Population Biology and Future Management. Can. Spec. Pub. of Fish. and Aquatic Sci. 96.
- State Pathology Review Committee. 1987. Regulation Changes, Policies and Guidelines for Alaska Fish and Shellfish Health and Disease Control. ADF&G, FRED Division. 69 pages.
- Vincent-Lang, D. 1987. Biological statistics for coho (*Onchorynchus kisutch*) and sockeye (*Onchorynchus nerka*) salmon in Resurrection Bay, Alaska, 1962-1986. Management Options for Bear Lake. A Summary of Past Performance and Evaluations of Future Options. ADF&G, Division of Sport Fish.

*This page is intentionally left blank*



## **APPENDICES**

*This page is intentionally left blank*

## Appendix 1. Bear Lake 2004 - 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)
6/17/2004	B	1	9.0	2.6	2.0	158	7.6	12.4	42 :1	2440	569.00	2.49	1.13	7.7
	B	15	9.2	3.1	2.7	167	7.8	5.0	41 :1	2454	515.00	2.35	0.48	
7/14/2004*	B	1	10.8	3.5	2.7	183	29.6	16.0	41 :1	2334	393.00	0.95	0.31	9.6
	B	12	59.5	34.4	31.7	493	229.5	200.8	26 :1	2411	416.00	1.01	0.30	
8/18/2004	B	1	16.8	6.5	4.5	186	31.9	51.1	31 :1	2197	278.00	1.18	0.34	10.2
	B	13	15.7	4.6	2.5	165	7.9	31.0	28 :1	2304	368.00	1.64	0.35	
Mean			20.2	9.1	7.7	225.3	52.4	52.7	35 :1	2356.7	423.2	1.6	0.5	9.2
Min			9.0	2.6	2.0	157.9	7.6	5.0	26 :1	2197.0	278.0	1.0	0.3	7.7
Max			59.5	34.4	31.7	493.2	229.5	200.8	42 :1	2454.0	569.0	2.5	1.1	10.2
1m Ave			12.2	4.2	3.1	175.5	23.0	26.5	37.9 :1	2323.7	413.3	1.5	0.6	9.2
Hypo Ave			28.1	14.0	12.3	275.0	81.7	78.9	31.6 :1	2389.7	433.0	1.7	0.4	

\* Possible contamination of hypolimnion sample.

### 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)
6/17/2004	B	1	72	6.5	25.6	0.9	9	11.4	0.3	10	2.5
	B	15	72	6.6	25.4	0.9	9	11.6	0.3	10	
7/14/2004	B	1	73	6.8	26.6	1.3	8	11.9	0.3	13	4.0
	B	12	74	6.7	26.6	1.1	9	11.9	0.3	12	
8/18/2004	B	1	71	7.0	27.8	0.8	5	12.2	0.4	11	5.0
	B	13	76	6.8	28.0	0.8	6	11.6	0.5	16	
Mean			73	6.7	26.7	1.0	7.7	11.8	0.4	12.0	3.8
Min			71	6.5	25.4	0.8	5.0	11.4	0.3	10.0	2.5
Max			76	7.0	28.0	1.3	9.0	12.2	0.5	16.0	5.0
1m Ave			72	7	27	1	7	12	0	11	4
Hypo Ave			74	7	27	1	8	12	0	13	

Appendix 1. (continued) Bear Lake 2004 - Zooplankton Analysis

Zooplankton data is incomplete. This section will need to be completed at a later date.

## Appendix 2. Bear Lake 2004 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)	Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water	
												Temp (oC)	Air Temp (oC)
1-May	4	0	1.6	1.8	2	8	1-Jun	3	0	0.86	1.78	9	12
2-May	4	0	1.6	1.8	2	14	2-Jun	5	5	0.82	1.8	8	12
3-May	1	0	1.6	1.8	2	17	3-Jun	3	0	0.88	1.84	9	14
4-May	1	0	1.15	1.9	2	21	4-Jun	2	0	0.86	1.84	12	20
5-May	1	0	1.9	1.9	2	20	5-Jun	3	0	0.86	1.8	12	19
6-May	1	0	1.23	1.9	3	17	6-Jun	3	0	0.84	1.8	10	15
7-May	1	0	1.3	1.9	3	21	7-Jun	4	0	0.84	1.76	9	13
8-May	3	0	1.24	1.82	3	13	8-Jun	4	0	0.84	1.76	10	14
9-May	3	0	1.21	1.87	3	12	9-Jun	5	2	0.92	1.68	8	13
10-May	4	0	1.4	1.87	3	14	10-Jun	5	0	0.92	1.68	11	10
11-May	3	0	1.24	1.87	3	10	11-Jun	5	0	0.92	1.68	11	12
12-May	1	0	1.18	1.87	3	17	12-Jun	4	0	0.92	1.68	11	13
13-May	1	0	1.12	1.87	3	13	13-Jun	4	2	0.88	1.64	12	14
14-May	4	0	1.13	1.88	3	8	14-Jun	4	1	0.92	1.58	13	15
15-May	5	30	1.12	1.88	4	8	15-Jun	5	60	0.88	1.82	12	12
16-May	5	5.6	1.12	1.88	4	8	16-Jun	5	58	0.86	1.96	12	12
17-May	5	3.6	1.12	1.88	4	8	17-Jun	2	20	0.8	1.96	13	16
18-May	3	2.4	1.09	1.87	4	12	18-Jun	3	0	0.8	1.96	13	16
19-May	1	0	1.2	1.88	6	18	19-Jun	1	0	0.82	1.96	13	18
20-May	1	0	1.21	1.88	7	17	20-Jun	1	0	0.8	1.96	14	22
21-May	1	0	1.26	1.89	7	13	21-Jun	1	0	0.85	1.96	14	21
22-May	1	0	1.26	1.89	7	13	22-Jun	1	0	0.92	1.8	16	20
23-May	5	15	1.26	1.89	6	11	23-Jun	1	0	0.82	1.8	15	20
24-May	5	0.48	1.06	1.89	6	10	24-Jun	1	0	0.92	1.78	17	20
25-May	5	0.32	0.9	1.86	7	11	25-Jun	1	0	0.9	1.78	17	20
26-May	4	0	0.86	1.88	7	14	26-Jun	1	0	0.88	1.78	17	20
27-May	5	0.5	0.8	1.88	7	8	27-Jun	4	0	0.86	1.78	17	17
28-May	5	5	0.89	1.88	7	10	28-Jun	4	0	0.86	1.78	17	17
29-May	3	0	0.86	1.82	9	15	29-Jun	4	0	0.85	1.77	17	17
30-May	3	0	0.86	1.78	9	16	30-Jun	4	0	0.84	1.74	17	17
31-May	3	7	0.86	1.78	9	12							

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 2004 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)	Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Jul	4	0	0.84	1.68	17	17	1-Aug	3	0	0.74	1.54	17	19
2-Jul	4	0	0.82	1.66	17	16	2-Aug	1	0	0.74	1.54	17	22
3-Jul	4	0	0.8	1.66	17	16	3-Aug	2	0	0.64	1.44	19	23
4-Jul	4	0	0.78	1.62	17	17	4-Aug	2	0	0.62	1.44	19	22
5-Jul	3	0	0.78	1.6	17	19	5-Aug	2	0	0.6	1.44	19	22
6-Jul	3	0	0.76	1.6	17	25	6-Aug	2	0	0.58	1.4	19	23
7-Jul	1	0	0.74	1.58	17	32	7-Aug	1	0	0.61	1.37	19	22
8-Jul	2	0	0.74	1.58	17	32	8-Aug	3	0	0.66	1.34	19	17
9-Jul	3	0	0.72	1.56	17	28	9-Aug	4	0	0.7	1.32	18	16
10-Jul	1	0	0.77	1.55	17	28	10-Aug	1	0	0.72	1.3	18	24
11-Jul	1	0	0.68	1.52	17	24	11-Aug	5	0	0.72	1.3	18	17
12-Jul	2	0	0.66	1.5	18	20	12-Aug	1	0	0.72	1.3	18	24
13-Jul	2	0	0.66	1.5	19	25	13-Aug	1	0	0.72	1.3	19	25
14-Jul	4	0	0.66	1.5	19	15	14-Aug	1	0	0.72	1.3	19	26
15-Jul	1	0	0.66	1.5	19	18	15-Aug	1	0	0.7	1.3	18	27
16-Jul	1	0	0.73	1.53	19	18	16-Aug	1	0	0.7	1.3	18	28
17-Jul	5	2	0.73	1.53	19	13	17-Aug	2	0	0.72	1.3	18	26
18-Jul	5	10	0.73	1.53	18	14	18-Aug	2	0	0.75	1.31	18	26
19-Jul	3	0	0.71	1.52	18	18	19-Aug	5	7	0.77	1.31	18	17
20-Jul	3	0	0.71	1.52	18	16	20-Aug	2	0	0.78	1.33	17	21
21-Jul	5	7	0.78	1.52	18	15	21-Aug	1	0	0.8	1.33	17	18
22-Jul	5	24	0.82	1.48	14	14	22-Aug	2	0	0.8	1.3	17	22
23-Jul	4	0	0.8	1.5	17	16	23-Aug	2	0	0.8	1.3	17	20
24-Jul	3	0	0.76	1.42	17	17	24-Aug	2	0	0.8	1.28	17	20
25-Jul	5	0	0.76	1.42	17	16	25-Aug	2	0	0.84	1.28	17	19
26-Jul	4	0	0.78	1.42	17	16	26-Aug	4	6	0.88	1.28	17	15
27-Jul	5	42	0.8	1.54	17	14	27-Aug	4	15	0.94	1.34	17	15
28-Jul	5	17	0.92	1.62	16	12	28-Aug	2	2.2	0.94	1.34	16	14
29-Jul	4	0	0.82	1.6	16	16	29-Aug	1	0	0.92	1.3	16	18
30-Jul	5	4	0.78	1.56	16	17	30-Aug	1	0	0.9	1.28	16	17
31-Jul	4	0	0.78	1.56	16	16	31-Aug	1	0	0.84	1.27	16	18

**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 2004 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)	Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Sep	4	0	0.88	1.28	16	16	1-Oct	3	0	0.82	1.4	8	10
2-Sep	4	11	0.86	1.28	16	14	2-Oct	5	12.5	0.84	1.4	8	8
3-Sep	2	0	0.86	1.28	16	15	3-Oct	5	38.5	0.8	1.68	8	8
4-Sep	1	0	0.84	1.28	16	15	4-Oct	5	19	0.45	1.86	8	9
5-Sep	3	0	0.84	1.26	16	15	5-Oct	5	4.2	0.45	1.86	8	11
6-Sep	2	2	0.82	1.26	16	15	6-Oct	4	0	0.45	1.84	8	11
7-Sep	1	0	0.8	1.26	16	14	7-Oct	3	0	0.7	1.84	8	11
8-Sep	1	0	0.78	1.2	16	15	8-Oct	3	4	0.44	1.78	8	11
9-Sep	4	0	0.78	1.2	16	13	9-Oct	5	2	0.58	1.72	8	12
10-Sep	4	0	0.68	1.18	16	11	10-Oct	5	4	0.52	1.72	8	8
11-Sep	1	0	0.62	1.1	13	14	11-Oct	5	3	0.56	1.72	8	8
12-Sep	2	0	0.5	1.1	13	14	12-Oct	5	2	0.5	1.72	8	8
13-Sep	2	0	0.48	1.08	13	13	13-Oct	5	1	0.43	1.72	8	8
14-Sep	2	0	0.44	1.08	13	13	14-Oct	5	33	0.45	1.7	8	9
15-Sep	1	0	0.4	1.08	10	12	15-Oct	5	4	0.45	1.7	8	9
16-Sep	1	0	0.4	1.08	10	9	16-Oct	4	0	0.48	1.66	7	6
17-Sep	1	0	0.4	1.08	10	8	17-Oct	1	7.4	0.4	1.6	6	5
18-Sep	4	0	0.36	1.04	8	12	18-Oct	3	0	0.32	1.58	6	4
19-Sep	4	16.5	0.36	1.04	8	8	19-Oct	3	5	0.34	1.54	6	4
20-Sep	4	0	0.36	1.04	8	8	20-Oct	4	0.5	0.5	1.52	6	3
21-Sep	5	9.5	0.68	1.1	8	7	21-Oct	5	12	0.48	1.46	6	3
22-Sep	4	0	0.68	1.1	8	5	22-Oct	3	0	0.48	1.46	6	3
23-Sep	4	0	0.66	1.18	8	6	23-Oct	3	4	0.46	1.38	6	4
24-Sep	1	4	0.72	1.18	8	7	24-Oct	4	7.5	0.46	1.38	6	4
25-Sep	4	7	0.72	1.22	8	6	25-Oct	4	0	0.44	1.38	6	4
26-Sep	3	42	1.2	1.28	8	11	26-Oct	5	8.5	0.42	1.38	6	6
27-Sep	3	0	1.2	1.36	8	12	27-Oct	5	0.3	0.42	1.38	6	5
28-Sep	4	0	1.2	1.36	8	9	28-Oct	4	0	0.38	1.38	6	4
29-Sep	5	8	0.8	1.34	8	8	29-Oct	4	0 na	na		6	6
30-Sep	5	18	0.9	1.34	8	9							

### 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 2004 - Smolt Migration.

Date	Sockeye		Coho		Dolly Varden		Rainbow Trout	
	Daily	Cumm	Daily	Cumm	Daily	Cumm	Daily	Cumm
01-May		0		0		0		0
02-May		0		0		0		0
03-May		0		0		0		0
04-May		0		0		0		0
05-May		0		0		0		0
06-May		0		0		0		0
07-May		0		0		0		0
08-May		0		0		0		0
09-May		0		0		0		0
10-May		0		0		0		0
11-May		0		0		0		0
12-May		0		0		0		0
13-May		0		0		0		0
14-May		0		0		0		0
15-May		0		0		0		0
16-May		0		0		0		0
17-May		0		0		0		0
18-May		0		0		0		0
19-May		0		0		0		0
20-May		0		0		0		0
21-May		0		0		0		0
22-May		0		0		0		0
23-May		0		0		0		0
24-May	0	0	1	1	0	0	0	0
25-May	0	0	48	49	0	0	0	0
26-May	248	248	256	305	0	0	0	0
27-May	1,116	1,364	411	716	2	2	0	0
28-May	24	1,388	325	1,041	2	4	0	0
29-May	3,062	4,450	653	1,694	4	8	0	0
30-May	4,099	8,549	1,002	2,696	7	15	0	0
31-May	7,173	15,722	2,020	4,716	6	21	0	0
01-Jun	840	16,562	1,665	6,381	4	25	0	0
02-Jun	5,282	21,844	1,661	8,042	8	33	0	0
03-Jun	5,211	27,055	3,044	11,086	3	36	0	0
04-Jun	7,408	34,463	2,301	13,387	9	45	0	0
05-Jun	9,663	44,126	3,065	16,452	11	56	0	0
06-Jun	7,695	51,821	6,690	23,142	30	86	0	0
07-Jun	11,958	63,779	4,007	27,149	13	99	0	0
08-Jun	3,763	67,542	3,634	30,783	8	107	0	0
09-Jun	5,289	72,831	3,484	34,267	5	112	0	0
10-Jun	7,833	80,664	2,230	36,497	9	121	0	0
11-Jun	2,404	83,068	3,291	39,788	3	124	0	0
12-Jun	11,267	94,335	4,190	43,978	6	130	0	0
13-Jun	6,386	100,721	3,473	47,451	12	142	0	0
14-Jun	3,511	104,232	803	48,254	11	153	0	0
15-Jun	3,537	107,769	532	48,786	3	156	0	0
16-Jun	2,622	110,391	249	49,035	0	156	0	0
17-Jun	3,907	114,298	1,890	50,925	2	158	0	0
18-Jun	1,161	115,459	2,502	53,427	0	158	0	0
19-Jun	1,344	116,803	1,950	55,377	0	158	0	0
20-Jun	1,490	118,293	2,126	57,503	0	158	0	0
21-Jun	3,010	121,303	2,315	59,818	0	158	0	0
22-Jun	950	122,253	2,655	62,473	0	158	0	0
23-Jun	138	122,391	1,440	63,913	0	158	0	0
24-Jun	180	122,571	3,120	67,033	0	158	0	0
25-Jun	182	122,753	1,813	68,846	0	158	0	0
26-Jun	166	122,919	2,063	70,909	0	158	0	0
27-Jun	231	123,150	1,863	72,772	0	158	0	0
28-Jun	63	123,213	625	73,397	0	158	0	0
29-Jun	0	123,213	0	73,397	0	158	0	0
30-Jun	0	123,213	0	73,397	0	158	0	0
01-Jul		123,213		73,397		158		0
02-Jul		123,213		73,397		158		0
03-Jul		123,213		73,397		158		0
04-Jul		123,213		73,397		158		0
05-Jul		123,213		73,397		158		0
06-Jul		123,213		73,397		158		0
07-Jul		123,213		73,397		158		0
08-Jul		123,213		73,397		158		0
09-Jul		123,213		73,397		158		0
10-Jul		123,213		73,397		158		0
11-Jul		123,213		73,397		158		0
Totals		123,213		73,397		158		0



### Appendix 4. Bear Lake 2004 - Adult Sockeye Salmon Migration.

Date	Lake Escapement			Donate & Harvest	Morts	Daily Total	Cumm. Total
	Males	Females	Combined				
20-May							
21-May			0			0	0
22-May			0			0	0
23-May			0			0	0
24-May			0			0	0
25-May			0			0	0
26-May			0			0	0
27-May			0			0	0
28-May	0	5	5	0	0	5	5
29-May	3	6	9	0	0	9	14
30-May	0	1	1	0	0	1	15
31-May	15	30	45	0	0	45	60
01-Jun	46	88	134	0	0	134	194
02-Jun	8	10	18	0	0	18	212
03-Jun	34	58	92	0	0	92	304
04-Jun	96	166	262	0	0	262	566
05-Jun	96	55	151	0	0	151	717
06-Jun	118	11	129	0	0	129	846
07-Jun	200	79	279	0	0	279	1,125
08-Jun	110	53	163	0	0	163	1,288
09-Jun	84	51	135	0	0	135	1,423
10-Jun	126	82	208	0	0	208	1,631
11-Jun	129	110	239	0	0	239	1,870
12-Jun	95	75	170	0	0	170	2,040
13-Jun	216	86	302	0	0	302	2,342
14-Jun	90	68	158	0	0	158	2,500
15-Jun	131	91	222	0	0	222	2,722
16-Jun	134	94	228	0	0	228	2,950
17-Jun	186	156	342	0	0	342	3,292
18-Jun	51	74	125	0	0	125	3,417
19-Jun	67	42	109	0	0	109	3,526
20-Jun	66	49	115	0	0	115	3,641
21-Jun	121	128	249	0	0	249	3,890
22-Jun	186	142	328	0	0	328	4,218
23-Jun	547	317	864	0	0	864	5,082
24-Jun	572	433	1,005	0	0	1,005	6,087
25-Jun	409	477	886	0	0	886	6,973
26-Jun	455	733	1,188	0	0	1,188	8,161
27-Jun	349	574	923	0	0	923	9,084
28-Jun	214	332	546	0	0	546	9,630
29-Jun	155	356	511	0	0	511	10,141
30-Jun	67	201	268	0	0	268	10,409
01-Jul	45	130	175	0	0	175	10,584
02-Jul	51	110	161	0	0	161	10,745
03-Jul	49	75	124	0	0	124	10,869
04-Jul	40	43	83	0	0	83	10,952
05-Jul	43	45	88	0	0	88	11,040
06-Jul	15	31	46	0	0	46	11,086
07-Jul	18	46	64	0	0	64	11,150
08-Jul	34	40	74	0	0	74	11,224
09-Jul	36	79	115	0	0	115	11,339
10-Jul	29	43	72	0	0	72	11,411
11-Jul	17	32	49	0	0	49	11,460
12-Jul	33	65	98	0	0	98	11,558
13-Jul	23	46	69	0	0	69	11,627
14-Jul	10	17	27	0	0	27	11,654
15-Jul	11	24	35	0	0	35	11,689
16-Jul	7	15	22	0	0	22	11,711
17-Jul	9	16	25	0	0	25	11,736
18-Jul	20	25	45	0	0	45	11,781
19-Jul	6	18	24	0	0	24	11,805
20-Jul	4	4	8	0	0	8	11,813
21-Jul	1	5	6	0	0	6	11,819
22-Jul	9	11	20	0	0	20	11,839
23-Jul	0	2	2	0	0	2	11,841
24-Jul	4	14	18	0	0	18	11,859
25-Jul	2	6	8	0	0	8	11,867
26-Jul	7	6	13	0	0	13	11,880
27-Jul	4	11	15	0	0	15	11,895
28-Jul	3	7	10	0	0	10	11,905
29-Jul	3	5	8	0	0	8	11,913
30-Jul	1	3	4	0	0	4	11,917
31-Jul	3	3	6	0	0	6	11,923
Total	5,713	6,210	11,923	0	0	11,923	



Appendix 5. Bear Lake 2004 - Adult Coho Salmon Migration.

Date	Lake Escapement		Broodstock			Harvest *			Total		Raceway Morts	Daily Total	Cumm Total
	Males	Females	Combined	Males	Females	Combined	Males	Females	Combined	Males			
15-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Sep	19	3	22	0	0	0	0	0	19	3	0	22	22
23-Sep	24	9	33	0	0	0	0	0	24	9	0	33	55
24-Sep	2	2	4	0	0	0	0	0	2	2	0	4	59
25-Sep	6	2	8	0	0	0	0	0	6	2	0	8	67
26-Sep	57	13	70	0	0	0	0	0	57	13	0	70	137
27-Sep	38	12	50	0	0	0	0	0	38	12	0	50	187
28-Sep	35	3	38	0	0	0	0	0	35	3	0	38	225
29-Sep	22	8	30	0	0	0	0	0	22	8	0	30	255
30-Sep	16	4	20	0	0	0	0	0	16	4	0	20	275
01-Oct	19	4	23	0	0	0	0	0	19	4	0	23	298
02-Oct	33	16	49	0	0	0	0	0	33	16	0	49	347
03-Oct	26	16	42	189	29	218	0	0	215	45	0	260	607
04-Oct	0	21	21	118	37	155	0	0	118	58	0	176	783
05-Oct	0	29	29	0	73	73	0	0	0	102	0	102	885
06-Oct	0	1	1	0	95	95	224	224	224	96	0	320	1,205
07-Oct	0	5	5	0	26	26	47	47	47	31	0	78	1,283
08-Oct	0	0	0	0	132	132	0	0	0	132	0	132	1,415
09-Oct	0	0	0	0	71	71	323	323	323	71	0	394	1,809
10-Oct	0	0	0	0	47	47	208	208	208	47	0	255	2,064
11-Oct	0	0	0	0	29	29	45	45	45	29	0	74	2,138
12-Oct	30	15	45	0	0	0	184	184	214	15	0	229	2,367
13-Oct	0	0	0	0	20	20	0	0	0	20	0	20	2,387
14-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,387
15-Oct	0	0	0	0	0	0	44	44	44	0	0	44	2,431
16-Oct	0	0	0	0	0	0	140	140	140	0	0	140	2,571
17-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,571
18-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,571
19-Oct	3	5	8	0	0	0	0	0	3	5	0	8	2,579
20-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,579
21-Oct	1	9	10	1	9	10	0	0	2	18	0	20	2,599
22-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,599
23-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,599
24-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,599
25-Oct	8	7	15	0	0	0	0	0	8	7	0	15	2,614
26-Oct	6	5	11	0	0	0	9	9	15	5	0	20	2,634
27-Oct	0	38	38	0	0	0	0	0	0	38	0	38	2,672
28-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,672
29-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,672
30-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,672
31-Oct	0	0	0	0	0	0	0	0	0	0	0	0	2,672
Total	345	227	572	308	568	876	1,224	0	1,224	1,877	795	0	2,672

Appendix 6. Bear Lake 2004 – Adult Sockeye Age and Sex Characteristics

	Age						Total
	1.1	1.2	1.3	2.1	2.2	2.3	
Sample Period:	29 May - 9 July 2004						
Males (No.)	694	1,230	3,928	20	555	159	6,586
Percent	10.5%	18.7%	59.6%	0.3%	8.4%	2.4%	55.2%
Sample Size	35	62	198	1	28	8	332
Total Sample Size							389
Mean Length (mm)	342	499	553	390	497	551	512
Std. Deviation	23.0	28.7	25.7		29.5	12.4	72.6
Std. Error	3.9	3.6	1.8		5.6	4.4	3.7
Mean Weight (kg)	0.61	1.97	2.70	1.02	2.04	2.61	2.25
Std. Deviation	0.15	0.39	0.38		0.45	0.35	0.78
Std. Error	0.03	0.05	0.03		0.08	0.12	0.04
Females (No.)	298	1,409	2,956	0	575	79	5,317
Percent	5.6%	26.5%	55.6%	0.0%	10.8%	1.5%	44.6%
Sample Size	15	71	149	0	29	4	268
Total Sample Size							316
Mean Length (mm)	336	487	540		502	537	511
Std. Deviation	28.8	25.9	23.1		26.6	24.3	51.7
Std. Error	7.4	3.1	1.9		4.9	12.2	2.9
Mean Weight (kg)	0.61	1.82	2.38		1.93	2.65	2.10
Std. Deviation	0.13	0.37	0.32		0.33	0.26	0.54
Std. Error	0.03	0.04	0.03		0.06	0.13	0.03
Both Sexes (No.)	992	2,639	6,904	20	1,131	238	11,923
Percent	8.3%	22.1%	57.9%	0.2%	9.5%	2.0%	91.7%
Sample Size	50	133	348	1	57	12	601
Total Sample Size							705
Mean Length (mm)	340	493	547	390	499	547	512
Std. Deviation	24.7	27.7	25.3		27.9	17.5	64.0
Std. Error	3.5	2.4	1.4		3.7	5.1	2.4
Mean Weight (kg)	0.61	1.89	2.56	1.02	1.98	2.62	2.18
Std. Deviation	0.14	0.39	0.38		0.39	0.31	0.69
Std. Error	0.02	0.03	0.02		0.05	0.09	0.03

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

Appendix 7. Bear Lake 2004 – Adult Coho Age and Sex Characteristics

	Age			Total
	1.1	2.1	3.1	
Sample Period:	Sep - 16 Oct			
Males (No.)	847	1,075	16	1,939
Percent	43.7%	55.5%	0.8%	72.6%
Sample Size	52	66	1	119
Total Sample Size				177
Mean Length (mm)	589	603	625	600
Std. Deviation	55.7	44.5		48.8
Std. Error	7.7	5.5		3.7
Mean Weight (kg)	3.37	3.41	3.44	3.44
Std. Deviation	1.05	0.79		0.78
Std. Error	0.15	0.10		0.06
Females (No.)	25	18	2	45
Percent	55.6%	40.0%	4.4%	1.7%
Sample Size	25	18	2	45
Total Sample Size				66
Mean Length (mm)	605	593	632	603
Std. Deviation	35.6	46.8	59.4	40.3
Std. Error	7.1	11.0	42.0	5.0
Mean Weight (kg)	3.44	3.30	4.02	3.46
Std. Deviation	0.66	0.96	1.30	0.81
Std. Error	0.13	0.23	0.92	0.10
Both Sexes (No.)	1,255	1,369	49	2,672
Percent	47.0%	51.2%	1.8%	100.0%
Sample Size	77	84	3	164
Total Sample Size				243
Mean Length (mm)	594	601	630	601
Std. Deviation	50.4	44.9	42.2	46.6
Std. Error	5.7	4.9	24.4	3.0
Mean Weight (kg)	3.39	3.39	3.83	3.44
Std. Deviation	0.94	0.83	0.98	0.89
Std. Error	0.11	0.09	0.57	0.06

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

## Appendix 8. Bear Lake 2004 – Project Updates

### Sockeye Salmon Project

#### Stocking & Misc. Activities

Crew on-site:	1-May		
Ice-out:	NA		
Crew off-site:	29-Oct		
Fry stocking:	14-Jun	2,409,000	0.63 g
PreSmolt stocking:		603,000	4.5 g
Smolt stocking:	None in 2004		
Fertilizer application:	22-Jun to 20-Aug	1,260	gallon

#### Smolt Migration

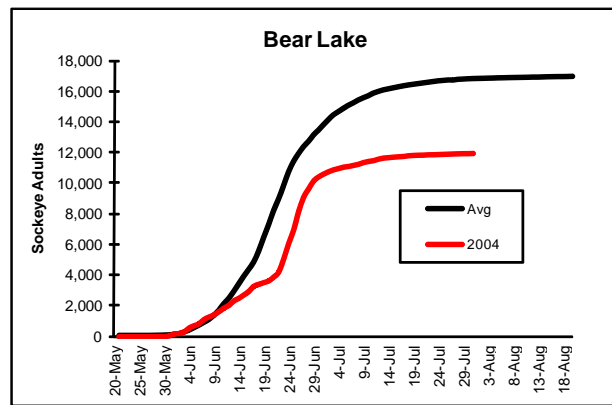
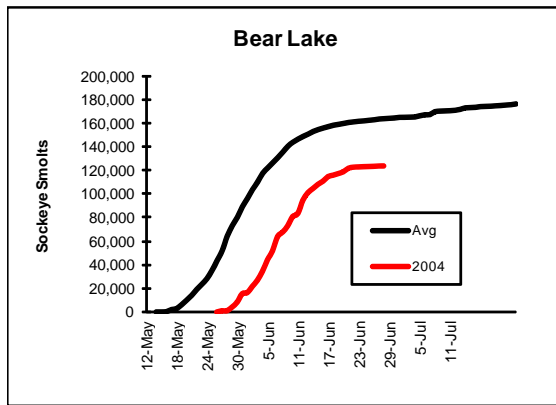
Dates:	24-May to 30-Jun		
Sockeyes:		123,213	
Percent age 1:		62.1%	
Percent age 2:		37.9%	
Percent age 3:		0.0%	
Percent hatchery:		96.2%	
Dolly Varden:		158	

#### Egg Take

Dates:	26-Jul to 14-Sep	
No. of broodstock used:	3,725	
Green eggs:	5,661,000	
Fecundity:	3,034	
Eyed eggs:	4,989,000	
% Survival:	88.1%	

#### Adult Migration

Dates:	28-May to 31-Jul	
Total return:	28,568	
Commercial harvest:	16,645	58%
Creek return:	11,923	42%
C.R. harvest:	0	0%
Mortalities:	0	0%
Lake:	11,923	42%
Hatchery broodstock:	3,862	14%
Lake broodstock:	8,061	28%



## Appendix 8 (continued). Bear Lake 2004 – Project Updates

### Coho Salmon Project

#### Stocking & Misc. Activities

Crew on-site:	1-May		
Ice-out:			
Crew off-site:	29-Oct		
Fry stocking:	23-Jun	406,000	1.07 g
Smolt stocking Bear Cr	23-Feb	253,000	10.0 g
Smolt stocking Res Ba	27-Jun	192,000	13.0 g
Fertilizer application:	22-Jun to 20-Aug	1,260 gallon	

#### Egg Take

Dates:	15-Oct to 25-Oct	
No. of females used:	400	
Green eggs:	1,673,000	
Fecundity:	4,183	
Eyed eggs:	1,557,000	
% Survival	93.1%	

#### Smolt Migration

Dates:	24-May to 30-Jun	
Cohos:	73,397	
Percent age 1:	73.7%	
Percent age 2:	26.0%	
Percent age 3:	0.0%	
Percent hatchery:	92.2%	
Dolly Varden:	158	

#### Adult Migration

Dates:	22-Sep to 27-Oct	
Coho total creek return:	2,672	
Weir return:	2,672	100%
C.R. harvest:	1,224	46%
Lake:	572	21%
Hatchery broodstock:	876	33%
Est. Remaining in Bear Ck:	0	0%
Est. Remaining in Salmon Ck:	0	0%

