

**Bear Lake  
Salmon Enhancement  
Progress Report  
2010**

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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 and through the harvest and sale of surplus fish. The BKD Research Trial was funded by a grant to the Alaska SeaLife Center from the Alaska Sustainable Salmon Fund.**

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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**

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## 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 2010, 2.2 million sockeye fry (BY09) and 435,000 coho fry (BY09) were released into Bear Lake. At the time of release, the sockeye fry averaged 0.65 grams and the coho fry averaged 1.2 grams. All released fry were of Bear Lake origin. Approximately 1.650 million sockeye smolts (BY08) were released into Resurrection Bay at an average of 13.6 grams. No coho smolts were released.

Smolt migration monitoring began on 19 May and continued daily until 30 June. During this time a total of 598,900 ( $\pm 47,500$ ) sockeye and 48,900 ( $\pm 2,700$ ) coho smolts migrated from the lake.

Based on otolith marks, 93.9% ( $\pm 1.8\%$ ) of the emigrating sockeye smolts were enhanced. An estimated 91.0% smolts were age 1 and 8.9% were age 2. The average length and weight of the age 1 sockeye smolts was 88 mm ( $\pm 0.5$  mm) and 5.9 g ( $\pm 0.2$  g) respectively. The age 2 sockeye smolts were 124 mm ( $\pm 1.4$  mm) and 16.7 g ( $\pm 0.8$  g).

Based on otolith marks, 98.3% ( $\pm 1.4\%$ ) of the emigrating coho smolts were enhanced. An estimated 43.5% of coho smolt were age 1 and 55.9% were age 2. The average length and weight of the age 1 coho smolts was 101 mm ( $\pm 2.5$  mm) and 10.9 g ( $\pm 2.4$  g) and the age 2 coho smolts were 124 mm ( $\pm 0.6$  mm) and 20.1 g ( $\pm 1.03$  g).

A total of 15,864 adult sockeye returned to Bear Creek in 2010. The returning sockeye salmon were age 1.2 (77.7%) or age 1.3 (13.2%). A total of 12,884 were passed into the lake, while the remaining 2,943 were harvested at the weir for cost recovery. An additional 18,408 were harvested in Resurrection Bay in cost recovery. In the common property, 0 were harvested in the commercial fishery and an estimated 8,600 fish were caught in the sport fishery. Total return of sockeye to Resurrection Bay was 43,365.

A total of 1,230 adult coho returned to Bear Creek weir in 2010. The returning fish were age 1.1 (65.4%), age 2.1 (32.1%) or 3.1 (2.5%). Of the adult coho returning, 248 were harvested and sold for cost recovery or donated, 490 were held and used as hatchery broodstock, and 492 were passed into Bear Lake.

From 28 July to 31 August 2010, 5,400,000 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 2,000 females were fertilized with milt from 2,004 males.

From 07 October to 11 October 2010, 647,000 coho eggs were collected from 144 females and fertilized with milt from 96 males. In addition, the Alaska Department of Fish and Game (ADF&G) collected 488,100 coho salmon eggs.

Adult sockeye salmon were either injected with an antibiotic (erythromycin) or sterile saline solution (placebo) or not injected at all. Kidney and ovarian samples were collected from all three groups. Results indicated that those fish injected with erythromycin had a reduced incidence of BKD at the spawning ground (7.9% *Renibacterium salmoninarum* (Rs) positive for erythromycin group versus 64.8% for the placebo group and 63.6% for non-injected group).

A total of 600 gallons of fertilizer was applied to Bear Lake in 2010. 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.

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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.

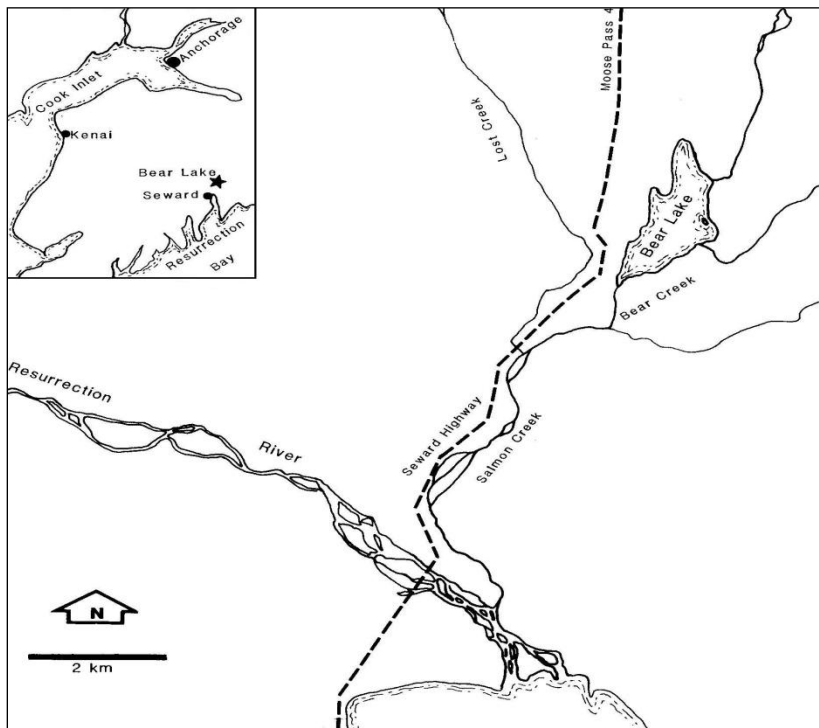


Figure 1. Map showing location of Bear Lake near Seward, Alaska.

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.

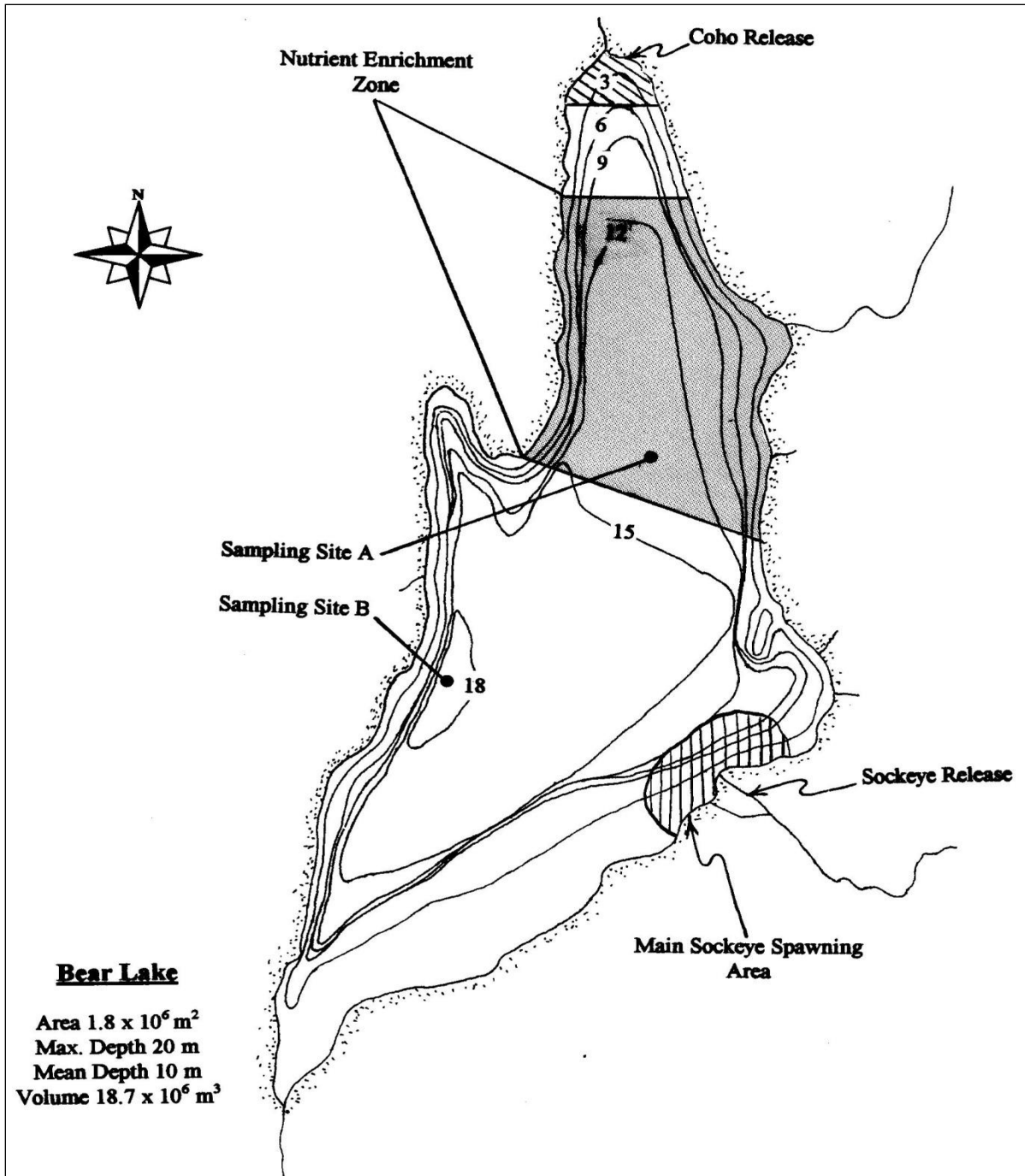


Figure 2. Bear Lake near Seward, Alaska

## 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 2010 were consistent with previous limnological sampling activities with the exception of water sampler used (Kemmerer versus Van Dorn). These procedures are described by Koenings, et al. (1986).

During 2010, assessments of water quality were conducted 4 times (June, July (2x), 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 Van Dorn water sampler (horizontal configuration) 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. However, due to errors in the field, Site B was the primary site for June and the first sampling in July. Site A was mistakenly sampled as the primary site for the second sampling in July and August. All water samples were collected by CIAA and analyses completed by ADF&G. Due to equipment failure, total nitrogen levels could not be analyzed.

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 from 13 June to 22 August. Fertilizer is mixed with lake water and sprayed onto the lake surface from the back of a boat.

## **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 2010 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.

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.

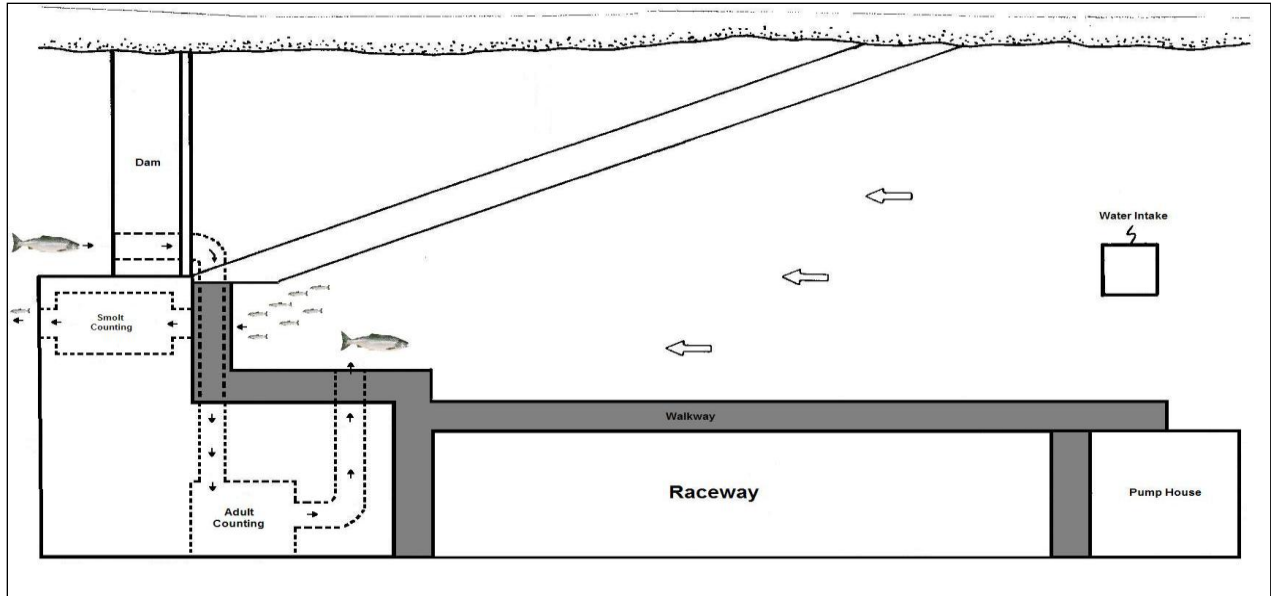


Figure 3. The Bear Creek weir, smolt trap and adult counting complex (Top View).

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:

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:

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

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

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.

### **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 2010, smolts collected for measurement, age determination, and otolith removal were sampled in proportion to the daily smolt migration. This was accomplished by collecting every 835<sup>th</sup> sockeye smolt and every 150<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 716 sockeye smolts (0.12%) and 329 coho smolts (0.67%).

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

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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.

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 filled with a 10% ethanol solution. At CIAA office, 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,

$N_h$  = 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:

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

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<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.

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:



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

## **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 weight 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 (harvest; hatchery broodstock).

Due to the BKD Erythromycin Trial that was taking place during the adult migration of the sockeye, every 5th sockeye was sampled to assess sex, age and weight. For the coho adult migration, every 11th coho was sampled. In 2010, measurements were collected from 3,065 sockeye (19.32%) and 107 coho (8.7%).

## **BKD (Bacterial Kidney Disease) Erythromycin Trial**

As the adult sockeye salmon migrated to Bear Lake, a portion of the fish were temporarily placed into the raceway until they could be anesthetized and injected with either erythromycin or a sterile saline solution (placebo group). A different colored Floy tag was used to distinguish the two groups later on the spawning grounds. Dosage rates for the antibiotic was 0.17 mg/kg fish weight.

On the spawning ground, notation was made to the tag color at the time of stripping the gametes. A small section of kidney was removed for the screening of *Renibacterium salmoninarum* (Rs), the causative agent for BKD. For a selected number of fish, ovarian samples were also sent in.

Samples were sent to ADFG Pathology Lab for testing. Two different screening methodologies were used (ELISA (kidney samples) and Taqman assay (*msa* gene) (ovarian samples).

### **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. The disease screening protocol is described in the above section (BKD Erythromycin Trial). Eggs were fertilized and mating crosses were recorded. The sockeye eggs were incubated at ambient Trail Lakes Hatchery water temperature in 2 different lots. Incubation followed standard hatchery procedures and water temperature was regulated to thermally mark the 2 different lots (Fry – 4H; Smolt – 3,2,3H).

### **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. At the weir both males and females had a small section of kidney removed for screening of *R. salmoninarum*, the causative pathogen for BKD. Eggs were fertilized and mating crosses were recorded. Each mating cross was placed into a vertical heath stack incubator. Once the eggs reached the eyed stage and the BKD pathology results were received any crosses which had a high prevalence of BKD were culled. The coho eggs were incubated at ambient Trail Lakes Hatchery water temperature in 1 distinct lot for fry stocking only. Incubation followed standard hatchery procedures and water temperature was regulated to thermally mark the 1 lot (Fry – 2,2H). 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 2010, 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. Sockeye smolts were transferred to 2 net pens located in Resurrection Bay where they were reared for an additional 2-3 weeks before being released.

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).

## RESULTS AND DISCUSSION

### Limnology, Environmental Conditions and Lake Fertilization

Bear Lake's limnological characteristics have been monitored for several years. The 2010 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 2010.

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/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
2004*	72	6.8	27	1.0	7.3	176	26.5	38 :1	1.5	9.2	3.8	NA
2005*	81	6.7	27	0.4	8.6	137	22.7	41 :1	0.9	9.2	5.4	NA
2006*	82	6.6	28	1.2	12.3	158	8.5	30 :1	2.5	8.3	3.2	NA
2007*	81	6.7	30	1.2	8.1	121	9.3	37 :1	1.6	11.9	4.3	NA
2008*	79	7.1	28	1.5	12.7	106	4.1	16 :1	2.6	8.9	4.0	NA
2009*	81	7.2	30	1.0	7.6	151	4.1	35 :1	1.2	8.4	4.5	NA
2010*	82	7.0	27	1.3	5.5	NA	4.1	NA :1	2.0	9.2	4.2	NA

Averages prior to 1992 compiled by ADF&G.

EZD, Secchi and atomic ratio provided by CIAA.

Open water season only.

\*2004 - 2010 - zooplankton data analysis is incomplete.

2010 data is a combination of both Site A & B

2010 TKN analysis is not complete due to equipment failure

Table 2. Water quality characteristics of Bear Lake in the hypolimnion, 1979 to 2010.

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
2005	79	6.7	27	0.2	8.9	135	16.3	38 :1	0.9
2006	83	6.7	28	2.1	12.5	149	6.8	28 :1	2.4
2007	82	6.5	29	1.8	15.0	169	21.5	29 :1	3.2
2008	81	6.7	28	3.0	13.0	148	23.4	31 :1	2.2
2009	84	6.8	29	4.0	17.2	222	5.2	29 :1	4.8
2010	86	6.7	28	4.1	23	NA	8.0	NA :1	8.9

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)

2010 data is combination of both Site A and B.

2010 TKN analysis is not complete due to equipment failure.

The environmental conditions recorded in 2010 are presented in Appendix 2. Between 16 May and 30 June, the average air temperature was 11.9°C (± 3.7°C) while water temperature averaged 10.7°C (± 3.0°C). Average stage height below the weir was 0.94 ft (± 0.04 ft) and above the weir it was 1.68 ft (± 0.08 ft) for the same time period. Between 01 July and 31 October, the average air temperature was 10.9°C (± 3.6°C) while water temperature averaged 12.6°C (± 2.2°C).

Average stage height below the weir was 0.76 ft ( $\pm$  0.3 ft) and above the weir it was 1.57 ft ( $\pm$  0.14 ft). The environmental conditions observed in 2010 are compared to other years in Table 3.

Table 3. Environmental conditions observed at Bear Lake, 1990 to 2010.

Year	May thru June 30							Precip (mm)	Temperature (C)			
	Total Days	Clear	No. of Days			Days Meas. Precip	Air Avg		Air		Water	
			<50% Cloud Cover	>50% Cloud Cover	100% Overcast				Range	Avg	Range	
1990	44	ND	ND	ND	ND	ND	ND	ND	ND	10	(3-15)	
1991	47	ND	ND	ND	ND	ND	ND	ND	ND	7	(2-15)	
1992	44	13	11	7	13	11	11	48	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)
2005	53	5	13	16	10	9	19	133	15	(10-23)	13	(7-17)
2006	61	12	3	10	28	8	26	105	13	(3-26)	9	(4-14)
2007	61	9	12	10	13	17	28	157	11	(5-22)	7	(1-15)
2008	61	7	8	11	11	9	19	64	12	(4-18)	8	(3-13)
2009	61	21	6	8	19	7	14	102	12	(2-18)	9	(2-14)
2010	46	8	11	8	11	8	14	70	12	(7-20)	11	(4-14)

Year	July thru Sept/Oct/Nov							Precip (mm)	Temperature (C)			
	Total Days	Clear	No. of Days			Days Meas. Precip	Air Avg		Air		Water	
			<50% Cloud Cover	>50% Cloud Cover	100% Overcast				Range	Avg	Range	
1990	119	ND	ND	ND	ND	ND	ND	ND	ND	10	(3-15)	
1991	100	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)
2005	123	25	16	19	36	27	65	416	13	(-1-25)	14	(4-19)
2006	122	7	18	20	38	39	75	864	11	(2-30)	12	(5-17)
2007	131	17	11	25	39	39	77	601	12	(-4-28)	12	(3-17)
2008	123	22	4	12	53	32	57	813	9	(0-22)	11	(3-15)
2009	110	23	5	16	42	24	55	761	12	(6-27)	13	(7-18)
2010	111	25	5	14	46	21	39	678	11	(2-18)	13	(7-16)

\*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 23 of the last 30 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 2010

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
2005			1,050	990	107	6/16 - 8/6	3 times/ week
2006			1,200	1,132	122	7/1 - 8/21	2 to 3 times/ week
2007			330	311	34	7/7 - 8/29	1 time/ week
2008			810	764	83	7/3 - 8/13	Varied
2009			300	283	31	8/12 - 8/28	Almost daily
2010			600	566	61	6/13 - 8/22	Varied

### Smolt Enumeration - Sockeye

Enumeration of Bear Lake sockeye smolts occurred between 19 May and 30 June. A total of 598,900 ( $\pm$  47,500) sockeye smolts migrated from Bear Lake in 2010 (Appendix 3). The 10% sub-sampling procedure was used to count 81.3% of the migrating sockeye salmon.



The age 1.0 smolts averaged 88 mm ( $\pm 0.5$  mm) in length and 5.9 g ( $\pm 0.1$  g) in weight. The age 2.0 smolts averaged 124 mm ( $\pm 1.4$  mm) in length and 16.7 g ( $\pm 0.8$  g) in weight (Table 5). Based on the presence of hatchery induced thermal marks in the otoliths of 716 smolts, it was estimated that 93.9% ( $\pm 1.8\%$ ) of the sockeye smolts were of hatchery origin.

### **Smolt Enumeration - Coho**

A total of 48,900 ( $\pm 2,700$ ) coho salmon smolts migrated from Bear Lake in 2010 (Appendix 3) between 19 May and 30 June. The 10% sub-sampling procedure was used to count 27.2% of the migrating coho smolts.

The average size (Table 6) of the age 1.0 coho smolts was 101 mm ( $\pm 2.5$  mm) and 10.9 g ( $\pm 2.4$  g). Age 2.0 smolts were 124 mm ( $\pm 0.6$  mm) and 20.1 g ( $\pm 1.03$  g). Based on the presence of hatchery induced thermal marks in the otoliths of 329 coho smolt, it was estimated that 98.3% ( $\pm 1.4\%$ ) of the coho smolts were of hatchery origin.

### **Adult Escapement - Sockeye**

Adult sockeye salmon began arriving at the weir on 26 May 2010 and continued to migrate until 31 July 2010 (Appendix 4). During this time, 15,864 adults were captured and counted at the weir (Table 7). The returning major age groups for adult sockeye included ages 1.2 (77.7%), 1.3 (13.2%), 2.2 (8.6%) and 2.3 (0.4%). Of the 15,864 adult sockeye that migrated to Bear Creek in 2010, 2,973 were harvested for cost recovery and 12,884 were passed to the lake. Mortalities at the weir were 0 fish. An additional 0 fish were harvested in the seine fishery and an additional 18,908 fish in the saltwater cost recovery harvest. It was estimated that 8,600 fish were harvested in the sport fishery for a total return to Resurrection Bay of 43,365 sockeye salmon.

A summary of mean age and weight, by age class, for adult sockeye salmon escapement to the Bear Creek weir site for 2010 is presented in Appendix 6.

## **Adult Escapement - Coho**

Adult coho salmon began arriving at the weir on 01 September 2010 and continued to migrate until 18 October (Appendix 5). During this time, 1,230 adults were captured and counted at the weir (Table 7). The returning major age groups for adult coho included ages 1.1 (65.4%), 2.1 (32.1%), and 3.1 (2.5%).

Of the 1,230 adult coho that were counted at the Bear Creek weir site, 248 were harvested, 490 were held for broodstock purposes and 492 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 2010 is presented in Appendix 7.

Table 5. Sockeye smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2010.

Year	Number	%		No.	Age Composition								Average Length (mm) <sup>6</sup>				Average Weight (g) <sup>6</sup>						
		95%CI	Hatch.		95%CI	Wild	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						3,400		20		20			119		187				NA		NA	
1981	3,500						2,800		700		0			117		158				16.2		41.6	
1982	46,300						46,100		100		0			110		144				14.0		29.7	
1983	13,000						11,000		2,000		40			112		149				13.5		32.9	
1984	10,500						7,700		2,500		300			116		153				15.4		35.8	
1985	1,600						1,300		300		30			126		176				20.2		51.4	
1986	1,000						800		100		0			123		167				18.3		47.2	
1987	18,200						17,800		300		100			112		172				12.8		46.5	
1988	9,100						7,200		1,900		30			120		155				16.0		34.9	
1989	5,100						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						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				115	123		152		18.1		18.7		35.3	
1994	253,900					700	228,600		21,200				102	121		154		11.0		17.4		37.0	
1995	73,500	1,900	70.2	8.0	21,900		6,800	1,600	4,800	1,000			122		156				17.9		37.2		
1996	156,000	9,600	64.2	3.5	55,400		149,400	9,400	6,400	2,100			117	0.6	120	2.1			11.8		16.2		
1997	276,000	64,000	74.6	3.6	70,100		270,500	64,000	5,500	3,500			104	0.5	143	7.6			10.1	0.2	26.7	4.4	
1998	107,800	15,500	72.2	5.8	30,000		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	19,300		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	138,600	18,000	20,700	7,500	4,300	3,400	119	114	1.6	172	11.1	16.8		14.0	0.7	59.0	9.8
2001	387,500	15,700	88.2	2.2	45,700		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	76,800		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	100,800		1,306,200	22,000	23,000	10,000			92	0.8	140	7.7			7.5	0.2	30.4	4.9	
2004	123,200		96.2	2.4	4,700		76,500	7,800	46,700	7,800			115	1.3	139	0.8			14.2	1.4	26.1	1.2	
2005	1,420,400	412,100	97.4	0.9	36,900		1,388,400	12,500	29,900	12,000			88	0.5	88				6.4	0.0	6.1		
2006	1,962,400	147,000	94.3	1.0	111,900		1,692,900	34,500	183,000	28,900			85	0.5	105	1.2			5.7	0.2	11.1	0.6	
2007	1,347,900	88,300	96.4	1.0	48,500		1,262,900	20,000	84,900	20,000			89	0.6	92	2.3			6.6	0.1	7.0	0.5	
2008	308,500	19,000	94.5	2.4	17,000		281,900	94,000	26,600	9,400			88	0.4	96	1.1			6.2	0.2	8.3	0.5	
2009	241,100	29,500	97.1	1.6	7,000		235,400	3,900	5,700	9,400			91	0.6	126	NA			6.7	0.1	17.6	NA	
2010	598,900	47,500	93.9	1.8	36,500		544,800	14,000	53,300	14,100			88	0.5	124	1.4			5.9	0.2	16.7	0.8	
Avg. <sup>4</sup>	539,300	61,500	81.2	3.1	45,800	11,400	492,187	21,700	35,200	8,900	3,800	2,300	119	105	0.8	131	3.8	17		11.0	0.9	25.1	3.6
Total <sup>5</sup>	9,708,300					157,600	8,742,200		633,550		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 2009.

<sup>5</sup>Total values calculated from 1980 to 2010.

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

Table 6. Coho smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2010.

Year	Number		%	Age Composition								Average Length (mm) <sup>4</sup>						Average Weight (g) <sup>4</sup>										
	95% CI	Hatch.		95% CI	1.0	95% CI	2.0	95% CI	3.0	95% CI	4.0	95% CI	1.0	95% CI	2.0	95% CI	3.0	95% CI	4.0	95% CI	1.0	95% CI	2.0	95% CI	3.0	95% CI	4.0	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				
2005	65,400	3,700	96.6	1.5	56,500	2,000	8,900	2,000					97	1.0	121	2.3					9.5	0.5	18.2	1.5				
2006	50,000	4,300	88.3	3.7	36,200	2,900	11,900	2,600					93	2.2	128	2.6					8.4	0.9	21.7	1.4				
2007	79,000	2,500	92.8	3.0	42,100	5,200	36,900	5,200					86	1.8	112	0.8					6.0	2.2	14.7	1.1				
2008	63,900	3,800	97.3	1.5	34,900	3,400	28,700	3,400					95	1.1	117	0.4					8.6	1.3	16.9	0.8				
2009	54,800	4,100	98.1	1.2	33,000	2,500	21,900	2,500					98	1.4	115	0.7					9.6	1.2	15.8	0.7				
2010	48,900	2,700	98.3	1.4	21,200	3,000	27,300	3,000					101	2.5	124	0.6					10.9	2.4	20.1	1.03				
Avg <sup>2</sup>	89,832	8,600	92.7	2.3	59,300	4,700	29,000	5,900	3,200	2,900	500	600	110		128		135		157		13.5		20.8		25.3		35.6	
Total <sup>3</sup>	2,784,800				1,800,600		897,400		76,750		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 2009.

<sup>3</sup>Total values calculated from 1980 to 2010.

<sup>4</sup>1980 thru 1992 averages are arithmetic, 1993 and later are weighted averages.

Table 7. Historic returns of Coho and Sockeye Salmon to Bear Lake weir, 1980 to 2010.

Year	Coho Salmon				Sockeye Salmon												
	Weir Retun Total	Age Composition			Weir Retun Total	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	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	
2005	2,947	795	2,095	58	45,312	0	0	0	37,729	0	5,898	0	1,026	659	0	0	
2006	2,089	1,058	952	79	43,069	0	0	0	5,153	0	35,000	0	2,236	681	0	0	
2007	1,113	596	517	0	20,090	0	0	0	10,472	0	8,121	0	321	1,175	0	0	
2008	1,467	489	960	18	17,142	0	61	0	5,896	0	10,030	0	912	243	0	0	
2009	1,245	392	819	34	45,859	0	0	0	1,663	0	43,017	0	151	1,028	0	0	
2010	1,230	805	395	30	15,864	0	18	0	12,323	0	2,095	0	1,369	59	0	0	
Avg <sup>1</sup>	3,461	1,199	2,164	98	22,785	262	153	377	9,224	9	11,217	4	1,069	462	3	2	
% of Avg	100%	34.6%	62.5%	2.8%	100%	1.2%	0.7%	1.7%	40.5%	0.0%	49.2%	0.02%	4.7%	2.0%	0.01%	0.1%	

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

## BKD Erythromycin Trial

A total of 12,884 fish were passed into Bear Lake. One group of fish (n = 1,501) were injected with the erythromycin (red floy tag) and another group (n = 1,504) were injected with the sterile saline solution (palcebo; green floy tag) while the remaining fish (n = 9,879) were not injected at all (some were weighed, sexed and aged).

At the spawning ground, a total of 4,004 broodstock were used to meet the egg target goal (2,000 females; 2,004 males). Of the 4,004 broodstock collected, 571 (14.3%) were from the

erythromycin group, 484 (12.1%) from the placebo group and the remainder (n = 2,949; 73.6%) were untagged (either not injected with either the placebo or erythromycin or had lost the floy tag and could not be identified). Based on the number of fish in each treatment group, 38% and 32% of the fish in the erythromycin and placebo group respectively were recovered on the spawning grounds.

BKD samples were collected from 2,000 females and 400 males. Of these 2,400 samples, 126 samples were identified as the erythromycin group and 108 for the placebo group for screening and analysis at the Pathology Lab (only females samples were used). Of the 2,000 females, 63.6% of the samples (n = 1,272) were positive for Rs (OD (optical density)  $\geq$  0.068). Of the 400 males sampled, 30.3% (n = 121) were positive for Rs (OD  $\geq$  0.068). Of the samples identified as erythromycin (n = 126) and placebo (n = 108), the percentage of fish identified as Rs-positive were 7.9% (n = 10) and 64.8% (n=70) respectively. These results indicate that the use of erythromycin significantly (P < 0.01; Fisher's exact test) reduces the incidence of BKD in the population.

Ovarian samples were collected from 125 fish in total (62 fish - erythromycin group; 63 fish - placebo group). Screening for Rs using Taqman assay specific for the Rs sequences of the *msa* gene indicated that 42.9% of the placebo group tested positive for Rs, while in contrast only 16.1% of the erythromycin were positive for the same pathogen. These results further indicate that the use of the erythromycin significantly (P < 0.01; Fisher;'s exact test) reduces the incidence of BKD in the population.

## **Hatchery Activities**

### Stocking

In 2010, 2.2 million sockeye fry (BY09; 5,2H) and 435,000 coho fry (BY09; 4,H3) were released into Bear Lake. These fish will migrate in 2011/2012 as smolts. At the time of release, the sockeye fry averaged 0.65 gm and the coho fry averaged 1.2 gm.

Approximately, 1.650 million sockeye smolts (BY08; 2,1H) averaging 13.6 gm were released into Resurrection Bay. No coho smolts were released in 2010. A summary of releases are provide in Table 8.

### Eggtake

Between 28 July and 31 August 2010, a total of 5,400,000 sockeye salmon eggs were collected. A total of 4,004 broodfish were used (2,000 females; 2,004 males) providing an average fecundity of 2,700 eggs/female. A total of 316 fish were either inviable or mortalities. Details of the pathology results are given below in the BKD Erythromycin Trial section. Approximately 230,000 eggs were culled due to the incidence of BKD.

From 07 October to 11 October 2010, a total of 545,000 coho eggs were collected from 144 females and fertilized with milt from 96 males. Average fecundity was 4,493 eggs/female. An additional 488,100 coho eggs were collected by ADF&G Fort Richardson Hatchery. Approximately 55,000 eggs were culled due to the incidence of BKD.

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

### Fry-to-Smolt Survival

Migrating smolts in 2010 were stocked either as fry in 2008 (BY07 - Age 2) and 2009 (BY08 - Age 1). Based on age classification from otoliths/scales, the fry-to-smolt survival for each brood year of fry stocking can be determined. This information is summarized in Table 10.

### 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 8. Coho and sockeye salmon releases at Bear Lake, 1986 to 2010.

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		
2005	405,000	1.30	488,000	12.40	2,416,000	0.74	604,000	2.87	402,000	11.6
2006	447,000	0.84	115,000	10.8	2,414,000	0.52			979,000	10.0
2007	521,000	1.0	237,000	8.86	2,437,000	0.65			619,000	9.9
2008 <sup>6</sup>	360,000	1.4	142,000	12.5	2,400,000	0.6			1,600,000	10.4
2009 <sup>6</sup>	270,000	1.3	68,000	13.5	2,543,000	0.5			1,675,000	13.2
2010 <sup>6</sup>	435,000	1.2			2,200,000	0.65			1,650,000	13.6
Total	9,696,800		2,675,330		33,750,000		2,009,000		8,058,200	
Ave	372,954	0.96	157,372	11.4	1,534,091	0.49	669,667	3.96	805,820	9.59

<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.

<sup>6</sup>Sockeye smolt stocking was into net pens at Resurrection Bay not Bear Lake



Table 9. Eggs collected for Bear Lake enhancement, 1989 to 2010.

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
2005	Bear L	1,414,791	1,252,814	88.6	Bear L	4,002,000	3,618,000	90.4
2006	Bear L	1,084,000	990,000	91.3	Bear L	6,087,000	5,444,000	89.44
2007	Bear L	748,000	581,000	77.7	Bear L	6,071,000	5,398,000	88.91
2008	Bear L	574,000	283,000	49.3	Bear L	6,033,000	5,531,000	91.68
2009	Bear L	545,000	462,000	84.8	Bear L	5,009,000	4,531,000	90.5
2010	Bear L	647,000	501,000	77.4	Bear L	5,400,000	4,810,000	89.1
Total		20,202,963	17,092,806			83,652,600	71,488,400	
Ave				83.4				82.2

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	42,923	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	62,900	58,400	14.4	2002	12,504	1,467,000	0.42	106,450	102,800	7.0
2003	395	406,000	1.07	86,100	80,716	19.9	2003	13,233	3,012,000	0.63	1,571,350	1,122,823	37.3
2004	572	405,000	1.30	99,715	89,710	22.2	2004	8,061	3,020,000	1.17	1,777,836	699,283	23.2
2005	546	447,000	0.84	70,760	66,957	15.0	2005	10,285	2,414,000	0.52	1,289,819	623,875	25.8
2006	500	521,000	1.0	56,818	55,469	10.6	2006	8,338	2,437,000	0.65	287,609	271,940	11.2
2007	386	360,000	1.4	60,262	59,172	16.4	2007 *	8,420	2,400,000	0.6	288,658	278,582	11.6
2008 *	368	270,000	1.3	21,247	20,886	7.7	2008 *	8,992	2,543,000	0.5	544,772	511,541	20.1
2009 *	535	435,000	1.2				2009 *	9,977	2,200,000	0.65			
2010 *	492						2010 *	8,564					
Ave <sup>1</sup>	469	390,500	0.95	92,432	84,647	22.1	Ave <sup>1</sup>	9,278	1,668,100	0.52	553,840	338,482	22.3

\* Incomplete broodyear

<sup>1</sup>Average data is for 1993 onward. For # Smolt, Hatchery Smolt and % Survival only includes completed years only.

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 onward. For # Smolts, Hatchery Smolt and % Survival only includes completed years only

Smolt numbers are rounded to the nearest 100 fish.

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

BY2001, 2003,2004 fry stocked includes those stocked as fry and as presmolts

BY2001, BY2003 ,BY2004, B 2005 hatchery smolt do not include the number that were stocked as smolts into Beak Lake

BY2006 - BY2008 hatchery smolt is from fry stocking only. Smolt stocking went to Resurrection Bay

Table 11. Marine survival for sockeye at Bear Lake (BY1989 to BY2008)

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
1999	8.1
2000	17.6
2001	9.8
2002	26.6
2003	6.1
2004	11.0
<i>2005</i>	<i>0.8</i>
<i>2006</i>	<i>4.3</i>
<i>2007</i>	<i>0.0</i>
<i>2008</i>	<i>0.0</i>
AVE	15.6

Red/italics indicates incomplete brood year.

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## **RECOMMENDATIONS**

Results from erythromycin trial indicate that the injection of the adult sockeye at the weir significantly reduces the incidence of BKD in the spawning population. Erythromycin injections should continue but can be reduced to female fish only. The cooperative agreement between ADFG and CIAA for the operation of Bear Lake weir needs to be updated to reflect current operations.

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## **APPENDICES**

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## Appendix 1. Bear Lake 2010 - 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)
6/15/2010	B	1	10.1	3.5	1.1	NA	1.8	4.8	NA :1	2824	506	3.89	0.05	7.6
		10	18.1	3.6	1.3	NA	1.1	13.3	NA :1	3312	584	8.00	NA	
7/9/2010	B	1	6.2	3.4	1.2	NA	4.5	4.1	NA :1	2627	325	1.16	0.19	10.9
		13	26.6	3.9	1.6	NA	5.5	4.1	NA :1	2987	517	11.99	0.02	
7/30/2010	A	1	5.5	2.6	0.6	NA	2.9	3.5	NA :1	2454	278	0.91	0.15	9.2
		12	24.2	3.8	1.1	NA	4.1	6.6	NA :1	3142	557	6.69	NA	
8/20/2010	A	1	6.2	3.4	1.1	NA	5.2	4.4	NA :1	2415	226	0.84	0.18	10.6
		12	27.2	4.6	1.8	NA	3.9	9.2	NA :1	3046	545	8.83	0.56	
Mean			15.5	3.6	1.2	NA	3.6	6.3	NA :1	2851	442	5.3	0.2	9.2
Min			5.5	2.6	0.6	0.0	1.1	3.5	NA :1	2415	226	0.8	0.0	7.6
Max			27.2	4.6	1.8	0.0	5.5	13.3	NA :1	3312	584	12.0	0.6	10.9
1m Ave			5.5	3.2	1.0	NA	3.1	4.1	NA :1	2635	369.7	2.0	0.1	9.2
Hypo Ave			23.0	3.8	1.3	NA	3.6	8.0	NA :1	3147	552.7	8.9	0.0	

\* 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)
6/15/2010	B	1	83	7.0	26.9	2.2	6	12.6	0.7	17	3.0
		13	90	6.9	28.9	5.4	6	12.6	0.8	20	
7/9/2010	B	1	81	7.0	28.2	1.0	5	12.6	0.7	7	4.5
		13	84	6.7	27.4	4.4	5	12.6	0.8	62	
7/30/2010	A	1	81	7.0	27.0	0.8	6	13.1	0.9	12	5.0
		12	85	6.5	28.0	2.5	8	13.2	1.0	106	
8/20/2010	A	1	83	7.0	27.3	0.8	5	12.8	0.8	4	5.0
		12	89	6.6	28.3	1.5	8	13.3	0.8	102	
Mean			85	6.8	27.8	2.3	6.1	12.9	0.8	41.3	4.2
Min			81	6.5	26.9	0.8	5.0	12.6	0.7	4.0	3.0
Max			90	7.0	28.9	5.4	8.0	13.3	1.0	106	5.0
1m Ave			81.7	7.0	27.4	1.3	5.7	12.8	0.8	12.0	4.2
Hypo Ave			86.3	6.7	28.1	4.1	6.3	12.8	0.9	62.7	

Appendix 1. (continued) Bear Lake 2010 - Zooplankton Analysis

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

## Appendix 2. Bear Lake 2010 - 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							1-Jun	4	7.4	0.94	1.7	9	12
2-May							2-Jun	5	0	0.96	1.7	13	14
3-May							3-Jun	4	3.5	0.96	1.72	11	14
4-May							4-Jun	2	0	0.92	1.72	12	19
5-May							5-Jun	5	0.99	0.86	1.82	11	10
6-May							6-Jun	2	1	0.86	1.78	13	15
7-May							7-Jun	3	0	0.89	1.78	13	12
8-May							8-Jun	3	0	0.92	1.77	13	8
9-May							9-Jun	2	0	0.94	1.76	12	9
10-May							10-Jun	3	0	0.95	1.76	12	8
11-May							11-Jun	4	2	0.96	1.76	12	11
12-May							12-Jun	3	0	0.96	1.76	13	15
13-May							13-Jun	1	0	0.92	1.76	13	15
14-May							14-Jun	5	0	0.9	1.76	13	7
15-May	2	0		1.7	4	9	15-Jun	5	15	0.96	1.76	13	7
16-May	4	0		1.69	4	8	16-Jun	4	3	0.96	1.76	12	7
17-May	1	0	0.88	1.69	4	8	17-Jun	5	15.2	0.96	1.74	12	7
18-May	4	0	0.92	1.66	7	13	18-Jun	5	4.8	0.94	1.74	12	7
19-May	4	0	0.96	1.66	6	12	19-Jun	5	7.2	0.94	1.74	12	7
20-May	3	0	0.94	1.66	6	12	20-Jun	2	2.8	0.92	1.68	12	14
21-May	2	1	0.96	1.68	6	12	21-Jun	1	0	0.92	1.68	13	15
22-May	2	0.02	0.96	1.68	6.5	11	22-Jun	2	0	0.92	1.68	13	
23-May	2	0	0.98	1.69		12	23-Jun	3	0	0.92	1.66	12	16
24-May	1	0	0.98	1.68	7	12	24-Jun	2	0	0.91	1.52	14	15
25-May	1	0	0.98	1.68	9	20	25-Jun	4	0	0.9	1.51	13	12
26-May	1	0	1	1.68	9	18	26-Jun	4	0	0.9	1.51	12	10
27-May	1	0	1.02	1.7	10	18	27-Jun	5	6.5	0.9	1.51	12	8
28-May	2	0	1	1.7	10	18	28-Jun	4	0	0.9	1.51	14	9
29-May	3	0	0.96	1.7	9	16	29-Jun	4	0	0.98	1.5	14	8
30-May	3	0	0.92	1.7	9	16	30-Jun	1	0	0.98	1.5	14	8
31-May													

### 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 2010 - 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	4	0.98	1.52	14	9	1-Aug	4	0	0.92	1.64	14	14
2-Jul	4	4.6	0.98	1.52	14	8	2-Aug	4	0	0.94	1.67	14	14
3-Jul	4	0	0.98	1.52	14	9	3-Aug	4	0	1.6	1.69	14	14
4-Jul	4	7.7	0.82	1.49	14	8	4-Aug	5	50	1.6	1.67	14	13
5-Jul	5	17.2	0.82	1.49	14	8	5-Aug	4	0	1.6	1.64	14	14
6-Jul	4	7	0.82	1.49	15	9	6-Aug	4	4.2	0.96	1.64	13	11
7-Jul	5	4.2	0.82	1.49	15	10	7-Aug	5	11.8	0.96	1.63	13	10
8-Jul	4	92	0.83	1.49	15	8	8-Aug	5	1.2	0.96	1.62	13	12
9-Jul	4	4.6	0.84	1.49	15	9	9-Aug	5	5	0.96	1.62	13	11
10-Jul	4	13.2	0.88	1.49	15	10	10-Aug	4	0	0.96	1.62	13	11
11-Jul	1	0	0.88	1.48	16	12	11-Aug	4	0	0.95	1.62	13	11
12-Jul	4	3.1	0.86	1.48	16	12	12-Aug	4	0	0.94	1.59	13	12
13-Jul	4	1.6	0.86	1.48	16	12	13-Aug	5	4.6	0.93	1.59	13	11
14-Jul	3	2.6	0.86	1.47	16	16	14-Aug	4	0	0.91	1.59	13	12
15-Jul	4	0.5	0.83	1.46	15	10	15-Aug	5	20	0.86	1.58	13	12
16-Jul	4	0	0.82	1.46	15	16	16-Aug	4	8.8	0.86	1.58	13	10
17-Jul	4	0	0.82	1.46	15	12	17-Aug	1	0	0.85	1.59	13	16
18-Jul	5	10.8	0.84	1.49	13	10	18-Aug	1	0	0.85	1.59	13	18
19-Jul	4	7	0.84	1.5	13	11	19-Aug	1	0	0.85	1.59	13	18
20-Jul	4	3.2	0.82	1.5	13	10	20-Aug	4	0	0.84	1.58	13	12
21-Jul	4	3.8	0.9	1.5	13	11	21-Aug	4	0	0.83	1.58	13	13
22-Jul	4	1.6	0.86	1.49	13	12	22-Aug	1	0	0.83	1.58	13	14
23-Jul	4	0	0.86	1.49	14	14	23-Aug	2	0	0.83	1.59	13	14
24-Jul	5	0	0.86	1.48	14	8	24-Aug	3	0	0.82	1.66	14	16
25-Jul	5	7.2	0.88	1.49	14	10	25-Aug	2	0	0.82	1.66	14	16
26-Jul	4	40	0.94	1.49	14	13	26-Aug	1	0	0.82	1.66	14	17
27-Jul	4	0	0.94	1.49	14	12	27-Aug	4	2.6	0.82	1.66	14	17
28-Jul	4	0	0.93	1.49	14	12	28-Aug	3	0	0.82	1.66	14	16
29-Jul	4	0	0.92	1.48	14	12	29-Aug	3	0	0.82	1.66	14	16
30-Jul	5	0.8	0.92	1.48	14	12	30-Aug	3	2.6	0.81	1.65	14	15
31-Jul	4	0	0.91	1.47	14	14	31-Aug	3	3.4	0.81	1.65	14	14

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 2010 - 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	3	6.2	0.87	1.64	14	13	1-Oct	5	74	0.72		10	6
2-Sep	5	4.2	0.66	1.6	14	14	2-Oct	5	62	0.58	1.92	10	6
3-Sep	1	0	0.66	1.6	14	14	3-Oct	5	68	0.4	1.94	10	6
4-Sep	5	5.2	0.66	1.6	14	10	4-Oct	4	0	0.4	1.94	10	6
5-Sep	3	5.6	0.66	1.59	14	15	5-Oct	3	0	0.38	1.94	10	5
6-Sep	1	0	0.65	1.58	13	15	6-Oct	4	0	0.32	1.9	10	5
7-Sep	3	0	0.64	1.58	13	12	7-Oct	4	5	0.2	1.89	10	6
8-Sep	4	0	0.63	1.58	13	12	8-Oct	4	2.5		1.89	9	6
9-Sep	4	8.4	0.62	1.58	13	12	9-Oct	3	0		1.86	9	7
10-Sep	1	0	0.6	1.56	13	14	10-Oct	2	0		1.86	9	7
11-Sep	1	0	0.6	1.54	13	14	11-Oct	3	0		1.78	8	5
12-Sep	1	0	0.58	1.52	13	14	12-Oct	1	0		1.74	8	4
13-Sep	1	0	0.53	1.5	13	15	13-Oct	1	0		1.62	8	2
14-Sep	1	0	0.5	1.49	13	15	14-Oct	1	0		1.62	7	2
15-Sep	1	0	0.49	1.49	13	15	15-Oct	2	0		1.58	7	4
16-Sep	1	0	0.49	1.49	13	13	16-Oct	4	0		1.56	7	8
17-Sep	1	0	0.49	1.49	12	13	17-Oct	5	8.2		1.54	7	10
18-Sep	1	0	0.49	1.49	12	12	18-Oct	5	7.5		1.54	7	5
19-Sep	1	0	0.49	1.46	12	12	19-Oct	5	2.8		1.54	7	5
20-Sep	1	0	0.48	1.46	12	11	20-Oct						
21-Sep	3	0	0.48	1.44	12	10	21-Oct						
22-Sep	4	0	0.48	1.38	12	9	22-Oct						
23-Sep	1	0	0.47	1.38	11	9	23-Oct						
24-Sep	1	0	0.25	1.34	11	8	24-Oct						
25-Sep	2	0	0.24	1.34	11	7	25-Oct						
26-Sep	3	0	0.23	1.32	11	7	26-Oct						
27-Sep	1	0	0.4	1.3	11	6	27-Oct						
28-Sep	4	0	0.4	1.3	11	6	28-Oct						
29-Sep	5	5.8	0.56	1.32	11	7	29-Oct						
30-Sep	4	62	0.62	1.32	11	7	20-Oct						
							31-Oct						

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 2010 - 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	0	0	0	0
17-May	0	0	0	0	0	0	0	0
18-May	0	0	0	0	0	0	0	0
19-May	1	1	3	3	1	1	0	0
20-May	0	1	5	8	0	1	0	0
21-May	0	1	0	8	0	1	0	0
22-May	16,132	16,133	31	39	0	1	0	0
23-May	38,839	54,972	238	277	3	4	0	0
24-May	58,542	113,514	407	684	63	67	1	1
25-May	90,704	204,218	401	1,085	15	82	0	1
26-May	57,675	261,893	488	1,573	33	115	0	1
27-May	51,053	312,946	795	2,368	27	142	0	1
28-May	54,298	367,244	1,648	4,016	50	192	0	1
29-May	44,711	411,955	1,214	5,230	13	205	0	1
30-May	61,065	473,020	2,903	8,133	33	238	0	1
31-May	34,451	507,471	3,579	11,712	32	270	1	2
01-Jun	15,374	522,845	3,393	15,105	21	291	0	2
02-Jun	22,889	545,734	4,863	19,968	15	306	0	2
03-Jun	11,067	556,801	4,230	24,198	10	316	0	2
04-Jun	11,222	568,023	4,319	28,517	0	316	0	2
05-Jun	6,341	574,364	2,028	30,545	4	320	0	2
06-Jun	6,824	581,188	2,935	33,480	6	326	0	2
07-Jun	3,210	584,398	2,407	35,887	4	330	2	4
08-Jun	3,869	588,267	1,988	37,875	6	336	0	4
09-Jun	2,762	591,029	2,015	39,890	4	340	0	4
10-Jun	1,854	592,883	573	40,463	0	340	0	4
11-Jun	322	593,205	288	40,751	0	340	0	4
12-Jun	85	593,290	6	40,757	0	340	0	4
13-Jun	473	593,763	369	41,126	0	340	0	4
14-Jun	129	593,892	138	41,264	0	340	0	4
15-Jun	75	593,967	68	41,332	0	340	0	4
16-Jun	50	594,017	231	41,563	0	340	0	4
17-Jun	94	594,111	242	41,805	0	340	0	4
18-Jun	7	594,118	148	41,953	0	340	0	4
19-Jun	44	594,162	339	42,292	0	340	0	4
20-Jun	449	594,611	614	42,906	0	340	0	4
21-Jun	852	595,463	780	43,686	1	341	0	4
22-Jun	485	595,948	579	44,265	7	348	0	4
23-Jun	972	596,920	1,329	45,594	1	349	1	5
24-Jun	753	597,673	773	46,367	0	349	0	5
25-Jun	475	598,148	556	46,923	0	349	0	5
26-Jun	134	598,282	637	47,560	0	349	0	5
27-Jun	43	598,325	162	47,722	0	349	0	5
28-Jun	332	598,657	809	48,531	0	349	0	5
29-Jun	135	598,792	134	48,665	0	349	0	5
30-Jun	119	598,911	202	48,867	0	349	0	5
01-Jul		598,911		48,867		349		5
02-Jul		598,911		48,867		349		5
03-Jul		598,911		48,867		349		5
04-Jul		598,911		48,867		349		5
05-Jul		598,911		48,867		349		5
06-Jul		598,911		48,867		349		5
07-Jul		598,911		48,867		349		5
08-Jul		598,911		48,867		349		5
09-Jul		598,911		48,867		349		5
10-Jul		598,911		48,867		349		5
11-Jul		598,911		48,867		349		5
Totals		598,911		48,867		349		5



Appendix 4. Bear Lake 2010 - Adult Sockeye Salmon Migration.

Date	Lake Escapement			Donate & Harvest	Morts	Daily Total	Cummm. Total
	Males	Females	Combined				
20-May			0			0	0
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	3	0	3	0	0	3	3
27-May	3	0	3	0	0	3	6
28-May	34	22	56	0	0	56	62
29-May	44	11	55	0	0	55	117
30-May	136	7	143	0	0	143	260
31-May	63	16	79	0	0	79	339
01-Jun	83	16	99	0	0	99	438
02-Jun	66	7	73	0	0	73	511
03-Jun	76	17	93	0	0	93	604
04-Jun	91	21	112	0	0	112	716
05-Jun	231	31	262	0	0	262	978
06-Jun	320	69	389	0	1	390	1,368
07-Jun	144	96	240	0	0	240	1,608
08-Jun	524	161	685	0	1	686	2,294
09-Jun	524	211	735	0	0	735	3,029
10-Jun	512	302	814	0	0	814	3,843
11-Jun	900	288	1,188	0	0	1,188	5,031
12-Jun	478	138	616	0	0	616	5,647
13-Jun	473	369	842	0	0	842	6,489
14-Jun	449	276	725	0	5	730	7,219
15-Jun	136	157	293	0	0	293	7,512
16-Jun	140	130	270	0	0	270	7,782
17-Jun	120	111	231	0	0	231	8,013
18-Jun	116	148	264	0	0	264	8,277
19-Jun	120	175	295	0	0	295	8,572
20-Jun	0	76	76	0	0	76	8,648
21-Jun	0	182	182	0	0	182	8,830
22-Jun	0	237	237	418	0	655	9,485
23-Jun	39	287	326	597	0	923	10,408
24-Jun	20	374	394	378	0	772	11,180
25-Jun	77	441	518	365	0	883	12,063
26-Jun	40	155	195	126	0	321	12,384
27-Jun	43	162	205	113	0	318	12,702
28-Jun	20	122	142	207	0	349	13,051
29-Jun	27	120	147	129	0	276	13,327
30-Jun	35	118	153	27	0	180	13,507
01-Jul	30	105	135	112	0	247	13,754
02-Jul	26	74	100	25	0	125	13,879
03-Jul	35	78	113	111	0	224	14,103
04-Jul	25	47	72	7	0	79	14,182
05-Jul	62	79	141	20	0	161	14,343
06-Jul	33	79	112	22	0	134	14,477
07-Jul	44	74	118	112	0	230	14,707
08-Jul	61	59	120	25	0	145	14,852
09-Jul	37	57	94	8	0	102	14,954
10-Jul	46	50	96	0	0	96	15,050
11-Jul	23	39	62	11	0	73	15,123
12-Jul	0	0	0	0	0	0	15,123
13-Jul	71	65	136	0	0	136	15,259
14-Jul	54	49	103	38	0	141	15,400
15-Jul	1	43	44	84	0	128	15,528
16-Jul	1	24	25	11	0	36	15,564
17-Jul	2	25	27	0	0	27	15,591
18-Jul	3	20	23	21	0	44	15,635
19-Jul	3	17	20	6	0	26	15,661
20-Jul	5	14	19	0	0	19	15,680
21-Jul	6	11	17	0	0	17	15,697
22-Jul	4	8	12	0	0	12	15,709
23-Jul	5	9	14	0	0	14	15,723
24-Jul	7	18	25	0	0	25	15,748
25-Jul	6	8	14	0	0	14	15,762
26-Jul	3	4	7	0	0	7	15,769
27-Jul	15	11	26	0	0	26	15,795
28-Jul	6	9	15	0	0	15	15,810
29-Jul	0	0	0	0	0	0	15,810
30-Jul	15	21	36	0	0	36	15,846
31-Jul	6	12	18	0	0	18	15,864
01-Aug			0			0	15,864
02-Aug			0			0	15,864
03-Aug			0			0	15,864
04-Aug			0			0	15,864
05-Aug			0			0	15,864
06-Aug			0			0	15,864
07-Aug			0			0	15,864
08-Aug			0			0	15,864
Total	6,722	6,162	12,884	2,973	7	15,864	

### Appendix 5. Bear Lake 2010 - 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	Females			
01-Sep	0	1	1	0	0	0	0	0	0	0	1	0	1	1
02-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	1
03-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	1
04-Sep	8	0	8	0	0	0	0	0	0	8	0	0	8	9
05-Sep	0	1	1	0	0	0	0	0	0	0	1	0	1	10
06-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	10
07-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	10
08-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	10
09-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	10
10-Sep	2	0	2	0	0	0	0	0	0	2	0	0	2	12
11-Sep	2	1	3	0	0	0	0	0	0	2	1	0	3	15
12-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	15
13-Sep	1	0	1	0	0	0	0	0	0	1	0	0	1	16
14-Sep	7	0	7	0	0	0	0	0	0	7	0	0	7	23
15-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	23
16-Sep	3	0	3	0	0	0	0	0	0	3	0	0	3	26
17-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	26
18-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	26
19-Sep	2	0	2	0	0	0	0	0	0	2	0	0	2	28
20-Sep	0	1	1	0	0	0	0	0	0	0	1	0	1	29
21-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	29
22-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	29
23-Sep	6	1	7	0	0	0	0	0	0	6	1	0	7	36
24-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	36
25-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	36
26-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	36
27-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	36
28-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	36
29-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	36
30-Sep	52	1	53	0	0	0	0	0	0	52	1	0	53	89
01-Oct	76	17	93	91	41	132	0	0	0	167	58	0	225	314
02-Oct	41	19	60	143	59	202	0	0	0	184	78	0	262	576
03-Oct	0	18	18	9	71	80	0	0	0	9	89	0	98	674
04-Oct	6	27	33	25	5	30	84	0	84	115	32	0	147	821
05-Oct	0	20	20	0	68	68	85	0	85	85	88	0	173	994
06-Oct	0	21	21	0	21	21	28	0	28	28	42	0	70	1,064
07-Oct	0	22	22	0	32	32	0	0	0	0	54	0	54	1,118
08-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,118
09-Oct	0	0	0	0	0	0	27	7	34	27	7	0	34	1,152
10-Oct	10	6	16	9	8	17	17	0	17	36	14	0	50	1,202
11-Oct	5	2	7	0	0	0	0	0	0	5	2	0	7	1,209
12-Oct	0	1	1	4	0	4	0	0	0	4	1	0	5	1,214
13-Oct	2	1	3	0	0	0	0	0	0	2	1	0	3	1,217
14-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,217
15-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,217
16-Oct	4	9	13	0	0	0	0	0	0	4	9	0	13	1,230
17-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,230
18-Oct	57	39	96	(57)	(39)	(96)	0	0	0	0	0	0	0	1,230
19-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,230
Total	284	208	492	224	266	490	241	7	248	749	481	0	1,230	

Appendix 6. Bear Lake 2010 – Adult Sockeye Age and Sex Characteristics

	Age						Total
	1.1	1.2	1.3	2.1	2.2	2.3	
Sample Period:	26 May through 31 July						
Males (No.)	0	4,769	685	0	572	18	6,043
Percent	0.0%	78.9%	11.3%	0.0%	9.5%	0.3%	38.1%
Sample Size	0	808	116	0	97	3	1024
Total Sample Size							1171
Mean Length (mm)							477
Std. Deviation							40.6
Std. Error							1.2
Mean Weight (kg)		2.02	2.75		1.94	2.60	2.09
Std. Deviation		0.43	0.49		0.43	0.36	0.51
Std. Error		0.02	0.05		0.04	0.21	0.01
Females (No.)	18	7,542	1,411	0	797	41	9,809
Percent	0.2%	76.9%	14.4%	0.0%	8.1%	0.4%	61.8%
Sample Size	3	1278	239	0	135	7	1662
Total Sample Size							1894
Mean Length (mm)							486
Std. Deviation							26.4
Std. Error							0.6
Mean Weight (kg)	0.90	1.88	2.31		1.85	2.09	1.94
Std. Deviation	0.21	0.34	0.30		0.26	0.57	0.36
Std. Error	0.12	0.01	0.02		0.02	0.21	0.01
Both Sexes (No.)	18	12,323	2,095	0	1,369	59	15,864
Percent	0.1%	77.7%	13.2%	0.0%	8.6%	0.4%	99.9%
Sample Size	3	2088	355	0	232	10	2688
Total Sample Size							3065
Mean Length (mm)							478
Std. Deviation							38.1
Std. Error							0.7
Mean Weight (kg)	0.90	1.93	2.46		1.89	2.24	1.99
Std. Deviation	0.30	0.38	0.43		0.39	0.42	0.43
Std. Error	0.17	0.01	0.02		0.03	0.13	0.01

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

Appendix 7. Bear Lake 2010 – Adult Coho Age and Sex Characteristics

	Age			Total
	1.1	2.1	3.1	
Sample Period:	01 September through 17 October			
Males (No.)	683	304	30	1,017
Percent	67.2%	29.9%	3.0%	82.7%
Sample Size	45	20	2	67
Total Sample Size				88
Mean Length (mm)	571	591	687	577
Std. Deviation	52.3	40.4	4.2	53.4
Std. Error	7.8	9.0	3.0	5.7
Mean Weight (kg)	2.91	3.46	5.45	3.16
Std. Deviation	0.90	0.87	0.10	1.00
Std. Error	0.13	0.20	0.07	0.11
Females (No.)	8	6	0	14
Percent	57.1%	42.9%	0.0%	1.1%
Sample Size	8	6	0	14
Total Sample Size				19
Mean Length (mm)	620	617		612
Std. Deviation	16.9	38.2		27.4
Std. Error	6.0	15.6		6.3
Mean Weight (kg)	3.96	3.91		3.81
Std. Deviation	0.28	0.92		0.57
Std. Error	0.10	0.38		0.13
Both Sexes (No.)	805	395	30	1,230
Percent	65.4%	32.1%	2.5%	100.0%
Sample Size	53	26	2	81
Total Sample Size				107
Mean Length (mm)	578	597	687	583
Std. Deviation	51.7	40.7	4.2	51.5
Std. Error	7.1	8.0	3.0	5.0
Mean Weight (kg)	3.07	3.56	5.45	3.28
Std. Deviation	0.92	0.89	0.10	0.97
Std. Error	0.13	0.17	0.07	0.09

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

## Appendix 8. Bear Lake 2010 – Project Updates

### Sockeye Salmon Project

#### Stocking & Misc. Activities

Crew on-site:	16-May		
Ice-out:	NA		
Crew off-site:	20-Oct		
Fry stocking:	10-Jun	2,200,000	0.65 g
PreSmolt stocking:			
Smolt stocking:(Res Bay)	11-Jun	1,650,000	14
Fertilizer application:	13-Jun to 22-Aug	600 gallon	

#### Egg Take

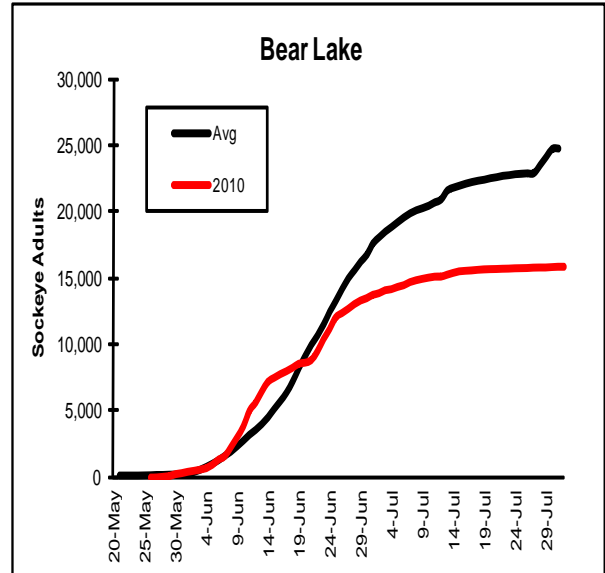
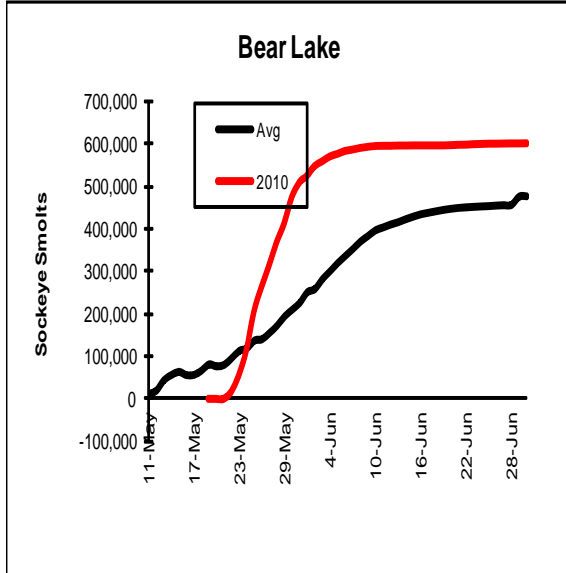
Dates:	28-Jul to 31-Aug	
No. of broodstock used:	4,004	
Green eggs:	5,400,000	
Fecundity:	2,700	
Eyed eggs:	4,810,000	
% Survival	89.1%	

#### Smolt Migration

Dates:	19-May to 30-Jun	
Sockeyes:	598,911	
Percent age 1:	91.0%	
Percent age 2:	8.9%	
Percent age 3:	0.0%	
Percent hatchery:	93.9%	
Dolly Varden:	349	

#### Adult Migration

Dates:	26-May to 31-Jul	
Total return:	43,365	
Commercial & Sport Fish harvest:	8,600	20%
C.R. harvest(FW & SW):	21,881	50%
Lake:	12,884	30%
Mortalities	0	
Hatchery broodstock:	4,320	
Lake broodstock:	8,564	



## Appendix 8 (continued). Bear Lake 2010 – Project Updates

### Coho Salmon Project

#### Stocking & Misc. Activities

Crew on-site:	16-May	
Ice-out:	NA	
Crew off-site:	20-Oct	
Fry stocking:	29-Jun	435,000 1.2 g
Smolt stocking Bear Lake		
Fertilizer application:	13-Jun to 22-Aug	600 gallon

#### Egg Take

Dates:	7-Oct to 11-Oct	
No. of females used:	144	
Green eggs:	647,000	
Fecundity:	4,493	
Eyed eggs:	501,000	
% Survival	77.4%	

#### Smolt Migration

Dates:	19-May to 30-Jun	
Cohos:	48,867	
Percent age 1:	43.5%	
Percent age 2:	55.9%	
Percent age 3:	0.0%	
Percent hatchery:	98.3%	
Dolly Varden:	349	

#### Adult Migration

Dates:	1-Sep to 18-Oct	
Coho total creek return:	1,230	
Weir return:	1,230	100%
C.R. harvest:	248	20%
Lake:	492	40%
Hatchery broodstock:	490	40%
Est. Remaining in Bear Ck:	0	0%
Est. Remaining in Salmon Ck:	0	0%

