Bear Lake
Salmon Enhancement
Progress Report
2007

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This year's operation of the Bear Lake Sockeye and Coho Enhancement Project was made possible through enhancement taxes paid by the commercial fishermen in Area H, Cook Inlet and associated waters, through the harvest and sale of surplus fish, through a grant from the Seward Chamber of Commerce and a grant administered by the National Oceanic and Atmospheric Administration and the Alaska Department of Fish and Game provided by Senator Ted Stevens.
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DISCLAIMER

The Cook Inlet Aquaculture Association conducts salmon enhancement and restoration projects in area H, Cook Inlet and associated waters. As an integral part of these projects a variety of monitoring and evaluation studies are conducted. The following progress report is a synopsis of the monitoring and evaluation studies conducted for the Bear Lake salmon enhancement project.

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

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ACKNOWLEDGEMENTS

The 2007 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.

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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 2007, 2.437 million sockeye fry (BY06) and 521,000 coho fry (BY06) were released into Bear Lake. At the time of release, the sockeye fry averaged 0.65 grams and the coho fry averaged 1.0 grams. All released fry were of Bear Lake origin. Approximately 619,000 sockeye smolts (BY05) and 237,000 coho smolts (BY05) were released into Bear Lake/Creek (average 9.9 and 18.9 gm respectively).

Smolt migration monitoring began on 16 May and continued daily until 30 June. During this time a total of 1,347,874 (± 88,267) sockeye and 78,891 (± 2,466) coho smolts migrated from the lake.

Based on otolith marks, 96.4% (± 1.0%) of the emigrating sockeye smolts were enhanced. An estimated 93.7% smolts were age 1 and 6.3% were age 2. The average length and weight of the age 1 sockeye smolts was 89 mm (± 0.6 mm) and 6.6 g (± 0.1 g) respectively. The age 2 sockeye smolts were 92 mm (± 2.3 mm) and 7.0 g (± 0.5 g).

Based on otolith marks, 92.8% (± 3.0%) of the emigrating coho smolts were enhanced. An estimated 53.3% of coho smolt were age 1 and 46.7% were age 2. The average length and weight of the age 1 coho smolts was 86 mm (± 1.8 mm) and 6.0 g (± 2.2 g) and the age 2 coho smolts were 112 mm (± 0.8 mm) and 14.7 g (± 1.1 g).

A total of 20,090 adult sockeye returned to Bear Creek in 2007. The returning sockeye salmon were age 1.2 (52.1%) or age 1.3 (40.4%). A total of 12,840 were passed into the lake, while the remaining 7,250 were harvested at the weir for cost recovery. An additional 1,712 were harvested in Resurrection Bay in cost recovery. In the common property, 15,000 were harvested and an estimated 4,125 fish were caught in the sport fishery. Total return of sockeye to Resurrection Bay was 40,927.

A total of 1,113 adult coho returned to Bear Creek weir in 2007. The returning fish were age 1.1 (53.5%), age 2.1 (46.5%) or 3.1 (0.0%). Of the adult coho returning, 0 were harvested and sold for cost recovery or donated, 673 were held and used as hatchery broodstock, and 386 were passed into Bear Lake. There were also 54 mortalities.

From 28 July to 25 August 2007, 6,071,000 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 2,132 females were fertilized with milt from 2,133 males.

From 7 October to 05 November 2007, 748,000 coho eggs were collected from 220 females and fertilized with milt from 146 males. In addition, the Alaska Department of Fish and Game (ADF&G) collected 336,000 coho salmon eggs.

A total of 330 gallons of fertilizer was applied to Bear Lake in 2007. 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[1].

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.

1 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.

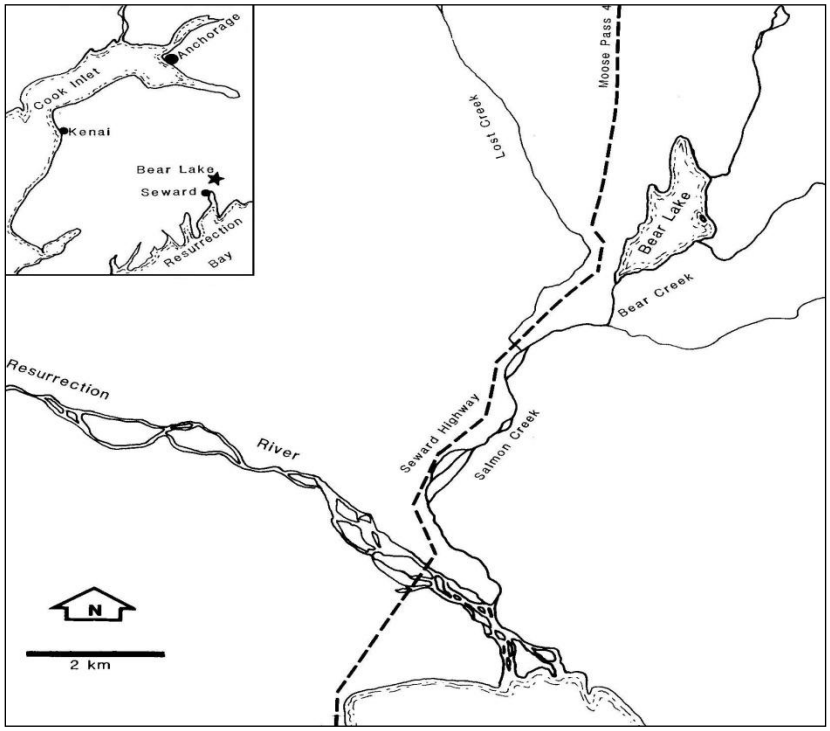

Figure 1. Map showing location of Bear Lake near Seward, Alaska.

Bear Lake has a watershed area of 15 km^2 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 X 10^6 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.

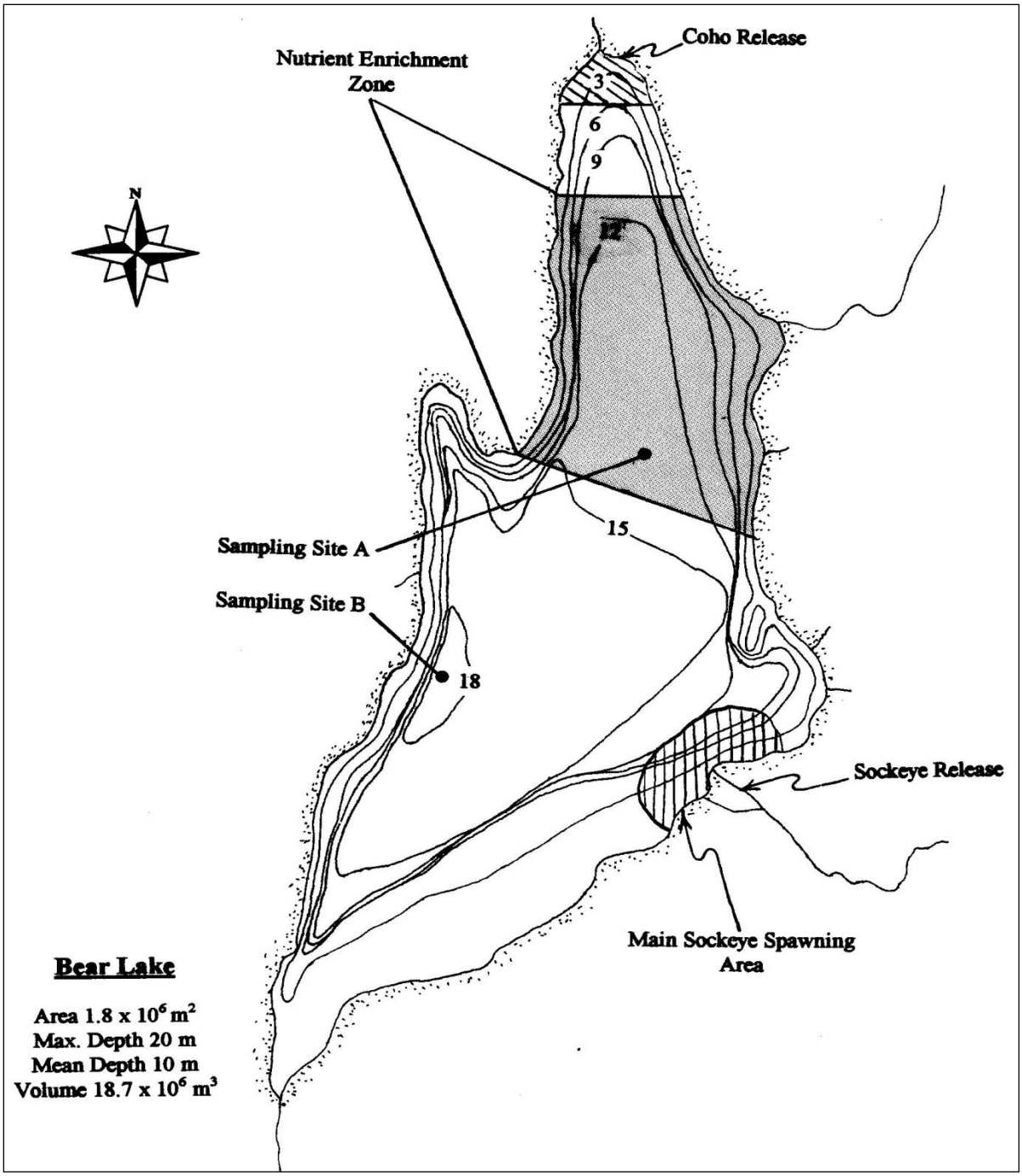

Figure 2. Bear Lake near Seward, Alaska

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 2007 were consistent with previous limnological sampling activities. These procedures are described by Koenings, et al. (1986).

During 2007, assessments of water quality were conducted 4 times (June, July, August, September) 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 from 07 July to 29 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 2007 to identify, count and control the migration of all fish moving into or out of Bear Lake.

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

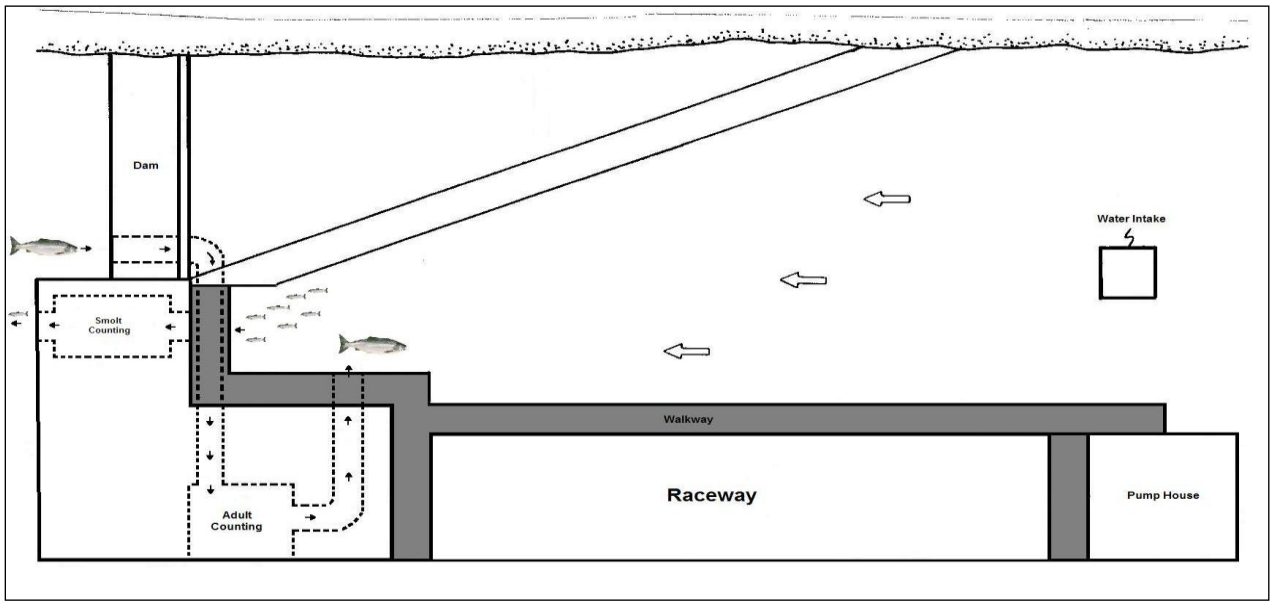

Figure 3. The Bear Creek weir, smolt trap and adult counting complex (Top View).

To enumerate migrating smolts with the 10% sub-sampling procedure, the counting period was divided into 20 minute intervals. During each 20 minute interval, migrating fish were directed

into the live-box for two minutes and then counted. During the remaining 18 minutes, migrating smolts were passed through the weir structure uncounted. The two-minute smolt count was multiplied by 10 to estimate the number of smolts migrating during the twenty minute interval.

Assuming the two minute sub-sampling intervals were randomly distributed throughout sub-sampling[2] 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:

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

and the variance is,

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

And:

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

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

2 Predetermined randomly selected 2 minute subsampling intervals assured random distribution within each 20 minute period.

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[3]. The purpose of this mark is to determine the contribution of released hatchery fish to the Bear Lake smolt population.

In 2007, smolts collected for measurement, age determination, and otolith removal were sampled in proportion to the daily smolt migration. This was accomplished by collecting every 1,300th sockeye smolt and every 300th coho smolt that passed through the smolt trap. The numbering sequence began when the first fish passed through the trap and continued consecutively until the smolt migration was complete. Age, weight and length measurements were taken on 1,317 sockeye smolts and 276 coho smolts.

Each smolt collected for evaluation was first measured to the nearest millimeter for fork length[4] and weighed to the nearest 0.1 gram. Several scales were then removed from the primary growth area[5] 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,

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

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

5 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, $\left(N = \sum N_h\right)$,

n = total number of smolts sampled,

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

a = total number of enhanced smolts sampled,

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

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

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

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

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

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

$m_{hi} = 1 - l_{hi}$, 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:

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

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:

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

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:

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

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:

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

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

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

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 standard fork length[6] of the returning population of fish.

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

6 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, every 40th adult sockeye and 14th adult coho were sampled. In 2007, measurements were collected from 491 sockeye (2.44%) and 79 coho (7.10%).

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 2 different lots. Incubation followed standard hatchery procedures and water temperature was regulated to thermally mark the 2 different lots (Fry – 1,4H; Smolt – 2,4H).

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 *Renibacterium salmoninarum*, the causative pathogen for Bacterial Kidney Disease (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 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 – H1,4; Smolt – H4; Homer-Seldovia Smolt - H4). 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 2007, 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.

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RESULTS AND DISCUSSION

Limnology, Environmental Conditions and Lake Fertilization

Bear Lake's limnological characteristics have been monitored for several years. The 2007 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 2007.

1 meter depth

Year	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
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

Averages prior to 1992 compiled by ADF&G.
EZD, Secchi and atomic ratio provided by CIAA.
Open water season only.
*2004 - 2007 - zooplankton data analysis is incomplete.

Table 2. Water quality characteristics of Bear Lake in the hypolimnion, 1979 to 2007.

	Hypolimnion								
Year	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	NO2+NO3 (ug/l)	TN:TP	Chl a (ug/l)
1979	79	7.3	30		18.3		16.2		
1980	81	7.2	31		13.9	168	14.3	29 :1	8.8
1981	69	6.3	29		11.3	124	19.3	28 :1	5.5
1982	78	7.4	28		16.6	177	37.6	29 :1	5.8
1983	88	7.3	32		14.7	259	43.1	46 :1	6.8
1984	96	7.1	34	6.3	13.9	269	29.9	48 :1	7.7
1985	90	6.9	36	2.8	11.6	253	76.6	63 :1	4.1
1986	89	6.7	32	4.1	14.4	244	34.1	43 :1	3.9
1987	85	7.1	29	2.1	15.2	222	20.8	35 :1	
1988									
1989									
1990	83	7.1	29	2.9	11.2	248	47.4	58 :1	5.4
1991	88	7.1	29	3.3	10.6	203	55.9	55 :1	3.4
1992	84	7.0	26	2.9	8.1	194	82.7	83 :1	3.2
1993	88	7.0	29	1.9	8.8	140	65.6	62 :1	1.1
1994	88	6.9	29	1.9	13.6	185	17.7	34 :1	5.6
1995	83	7.0	28	4.7	12.8	202	8.3	36 :1	8.1
1996	87	7.0	30	4.6	12.4	273	1.9	49 :1	7.6
1997	93	7.3	34	8.3	17.1	332	4.3	44 :1	9.7
1998	89	7.1	32	2.9	8.5	188	34.5	63 :1	1.6
1999	86	6.9	30	4.2	14.7	222	12.2	38 :1	3.8
2000	81	7.2	28	1.9	6.9	127	3.0	41 :1	4.6
2001	80	7.0	27	1.9	5.8	137	3.9	37 :1	3.2
2002	80	7.0	31	0.9	10.1	127	15.2	32 :1	2.4
2003	73	6.8	26	0.7	6.7	116	7.1	41 :1	2.2
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	169	21.5	29 :1	3.2

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 2007 are presented in Appendix 2. Between 01 May and 30 June, the average air temperature was 11.3^{o}C (± 3.7^{o}C) while water temperature averaged 7.4^{o}C (± 5.1^{o}C). Average stage height below the weir was 0.94 ft (±0.1 ft) and above the weir it was 1.64 ft (± 0.1 ft) for the same time period. Between 01 July and 05 November, the average air temperature was 11.5^{o}C (± 6.2^{o}C) while water temperature averaged 12.1^{o}C (± 4.3^{o}C). Average stage height below the weir was 0.78 ft (± 0.2 ft) and above the weir it was 1.47 ft (± 0.3 ft). The environmental conditions observed in 2007 are compared to other years in Table 3.

Table 3. Environmental conditions observed at Bear Lake, 1990 to 2007.

May thru June 30

Year	Total Days	Clear	No. of Days <50% Cloud Cover	No. of Days >50% Cloud Cover	No. of Days 100% Overcast	Rain	Days Meas. Precip	Precip (mm)	Temperature (C) 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)
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)

July thru Sept/Oct/Nov

Year	Total Days	Clear	No. of Days <50% Cloud Cover	No. of Days >50% Cloud Cover	No. of Days 100% Overcast	Rain	Days Meas. Precip	Precip (mm)	Temperature (C) 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)
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)

*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 20 of the last 27 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 2007

FERTILIZER APPLICATION

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

Smolt Enumeration - Sockeye

Enumeration of Bear Lake sockeye smolts occurred between 16 May and 30 June. A total of 1,347,874 (± 88,267) sockeye smolts migrated from Bear Lake in 2007 (Appendix 3). The 10% sub-sampling procedure was used to count 62.5% of the migrating sockeye salmon.

The age 1.0 smolts averaged 89 mm (± 0.6 mm) in length and 6.6 g (± 0.1 g) in weight. The age 2.0 smolts averaged 92 mm (± 2.3 mm) in length and 7.0 g (± 0.5 g) in weight (Table 5). Based on the presence of hatchery induced thermal marks in the otoliths of 1,317 smolts, it was estimated that 96.4% (± 1.0%) 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 2007.

						Age Composition								Average Length (mm)[6]					Average Weight (g)[6]				
Year	Number	95%CI	% Hatch.	95%CI	No. 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	CI
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[1]	53,400					52,500		800		30		3		NA	113		125		NA	15.2		28.4	
1991[2]	122,000							119,900		1,600		600			125		164			18.7		40.4	
1992[3]	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	21,903			6,800	1,600	4,800	1,000				122		156			17.9		37.2	
1996	156,000	9,600	64.2	3.5	55,848			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	70,104			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	29,968			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			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	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	45,725			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			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			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	4,682			76,500	7,800	46,700	7,800				115	1.3	139	0.8		14.2	1.4	26.1	1.2
2005	1,420,428	412,108	97.4	0.9	36,931			1,388,388	12,537	29,904	12,044				88	0.5	88			6.4	0.0	6.1	
2006	1,962,415	147,058	94.3	1.0	111,858			1,692,890	34,472	182,962	28,907				85	0.5	105	1.2		5.7	0.2	11.1	0.6
2007	1,347,874	88,267	96	1.0	48,523			1,262,928	19,974	84,946	19,974				89	0.6	92	2.3		6.6	0.1	7.0	0.5
Avg.[4]	515,900	65,900	77.5	3.6	51,200	11,400	5,600	466,882	17,300	34,200	7,900	3,800	2,300	119	108	0.9	138	4.2	17	12.2	1.1	28.6	4.3
Total[5]	8,559,817					157,600		7,680,106		547,962		21,923											

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

[1]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.

[2]In 1991 smolt migration monitoring may have terminated before age 0.0 smolt migration.

[3]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

[4]Average values calculated from smolt year 1995 to 2006.

[5]Total values calculated from 1980 to 2007.

[6]1980 thru 1992 averages are arithmetic, 1993 and later are weighted averages.

Smolt Enumeration - Coho

A total of 78,891 (± 2,466) coho salmon smolts migrated from Bear Lake in 2007 (Appendix 3) between 20 May and 30 June. The 10% sub-sampling procedure was used to count 16.6% of the migrating coho smolts.

The average size (Table 6) of the age 1.0 coho smolts was 86 mm (± 1.8 mm) and 6.0 g (± 2.2 g). Age 2.0 smolts were 112 mm (± 0.8 mm) and 14.7 g (± 1.1 g). Based on the presence of

hatchery induced thermal marks in the otoliths of 277 coho smolt, it was estimated that 92.8% (± 3.0%) 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 2007.

					Age Composition								Average Length (mm)[4]								Average Weight (g)[4]							
Year	Number	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[1]	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	65,448	3,675	96.6	1.5	56,449	2,005	8,889	2,005					97	1.0	121	2.3					9.5	0.5	18.2	1.5				
2006	49,980	4,263	88.3	3.7	36,249	2,862	11,900	2,636					93	2.2	128	2.6					8.4	0.9	21.7	1.4				
2007	78,981	2,466	92.8	3.0	42,066	5,168	36,915	5,168					86	1.8	112	0.8					6.0	2.2	14.7	1.1				
Avg[2]	94,008	10,000	90.1	2.7	61,800	5,000	29,000	6,500	3,200	2,900	500	600	112		129		135		157		14.1		21.3		25.3		35.6	
Total[3]	2,617,209				1,711,464		819,504		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 rouinded to nearset 0.1 g. All other figures have been rounded to nearest 100 fish.
[1]Percent Hatchery calculated for Age 1.0 smolts only
[2]Average values calculated from smolt year 1980 to 2006.
[3]Total values calculated from 1980 to 2007.
[4]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 2007 and continued to migrate until 31 July 2007 (Appendix 4). During this time, 20,090 adults were captured and counted at the

weir (Table 7). The returning major age groups for adult sockeye included ages 1.2 (52.1%), 1.3 (40.4%), 2.2 (1.6%) and 2.3 (5.9%). Of the 20,090 adult sockeye that migrated to Bear Creek in 2007, 7,250 were harvested for cost recovery and 12,840 were passed to the lake. Mortalities at the weir were 0 fish. An additional 15,000 fish were harvested in the seine fishery and an additional 1,712 fish in the saltwater cost recovery harvest. It was estimated that 4,125 fish were harvested in the sport fishery for a total return to Resurrection Bay of 40,927 sockeye salmon.

A summary of mean age and weight, by age class, for adult sockeye salmon escapement to the Bear Creek weir site for 2007 is presented in Appendix 6.

Table 7. Historic returns of Coho and Sockeye Salmon to Bear Lake weir, 1980 to 2007.

	Weir	Coho Salmon			Weir	Sockeye Salmon										
	Retun	Age Composition			Retun	Age Composition										
Year	Total	1.1	2.1	3.1	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
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
Avg[1]	3,921	1,335	2,473	113	22,034	319	181	457	9,781	12	9,682	5	1,125	466	3	2
% of Avg	100%	34.1%	63.1%	2.9%	100%	1.4%	0.8%	2.1%	44.4%	0.1%	43.9%	0.02%	5.1%	2.1%	0.01%	0.1%

[1] Average calculation is based on 1994 data onward.

Adult Escapement - Coho

Adult coho salmon began arriving at the weir on 18 September 2007 and continued to migrate until 05 November (Appendix 5). During this time, 1,139 adults were captured and counted at the weir (Table 7). The returning major age groups for adult coho included ages 1.1 (53.5%), 2.1 (46.5%), and 3.1 (0.0%).

Of the 1,113 adult coho that were counted at the Bear Creek weir site, 0 were harvested, 673 were held for broodstock purposes and 386 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 2007 is presented in Appendix 7.

Hatchery Activities

Stocking

In 2007, 2.437 million sockeye fry (BY06; 4,2H) and 521,000 coho fry (BY06; H2,2,2) were released into Bear Lake. These fish will migrate in 2008/2009 as smolts. At the time of release, the sockeye fry averaged 0.65 gm and the coho fry averaged 1.0 gm.

Approximately, 619,000 sockeye smolts (BY05; 2,1H) and 237,000 coho smolts (BY05: H2,2) were released into Bear Lake/Bear Creek. Average weight was 9.9 and 8.9 gm respectively. A summary of releases are provide in Table 8. Trail Lakes Hatchery experienced low water supply which made it necessary for the smolts to be transferred to the Eklutna Salmon Hatchery for 3-4 months temporary rearing.

Eggtake

Between 28 July and 25 August 2007, a total of 6,071,000 sockeye salmon eggs were collected.

A total of 4,265 broodfish were used (2,132 females; 2,133 males) providing an average fecundity of 2,848 eggs/female. A total of 155 fish were either inviable or mortalities.

From 7 October to 05 November 2007, a total of 748,000 coho eggs were collected from 220 females and fertilized with milt from 146 males. Average fecundity was 3,290 eggs/female. An additional 336,000 coho eggs were collected by ADF&G Fort Richardson Hatchery.

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 2007.

	Coho				Sockeye					
Release Year	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[1]	450,000	0.30			47,000	0.15				
1993[2]	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[3]	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[4]	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[5]	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
Total	8,631,800		2,465,330		26,607,000		2,009,000		3,133,200	
Ave	375,296	0.91	164,355	11.2	1,400,368	0.48	669,667	3.96	447,600	8.39

[1] Released into Bear Lake
[2] Extra Fry Released into Bear Creek
[3] sockeye fry relase, 445, 300 @ .36g & 335,300 @ .38g
[4] sockeye fry release, 1,573,000 @ (.35-.45 g) & 223,000 @2.7 g
[5] 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 2007.

	Coho				Sockeye			
Brood Year	Brood Stock	Green Eggs	Eyed Eggs	%	Brood Stock	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	91.33	Bear L	6,087,000	5,444,000	89.44
2007	Bear L	748,000	581000	77.67	Bear L	6,071,000	5,398,000	88.91
Total		18,436,963	15,846,806			67,210,600	56,616,400	
Ave				85.5				81.1

Fry-to-Smolt Survival

Migrating smolts in 2007 were stocked either as fry in 2005 (BY04 - Age 2) and 2006 (BY05 - Age 1) or as smolts (2007). Assuming that all smolts migrated out (i.e. no residuals stayed in the lake) and 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 10. Bear Lake smolt production by brood years.

Brood Year		Coho Escap.	No. Fry Stocked	Size (g)	No. Smolt	Hatch Smolt	% Hatch. Survival	Brood Year		Sockeye 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	1,692,890	699,283	23.2
2005	*	546	447,000	0.84	42,066	39,037	8.7	2005	*	10,285	2,414,000	0.52	1,777,850	598,463	24.8
2006	*	500	521,000	1.0				2006	*	8,338	2,437,000	0.65			
2007		386						2007		8,420					
Ave[1]		470	398,100	0.88	95,439	88,466	23.6	Ave[1]		9,299	1,515,300	0.50	605,326	341,646	23.1

* Incomplete broodyear
[1]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
[1]Average data is for 1993 onward
Smolt numbers are rounded to the nearest 100 fish.
Note: Number of Hachery 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

Table 11. Marine survival for sockeye at Bear Lake (BY1989 to BY2005)

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	*25.1*
2003	*1.4*
2004	*0.0*
2005	*0.0*
AVE	15.8

Red/italics indicates incomplete brood year.

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RECOMMENDATIONS

Due to the high incidence of Bacterial Kidney Disease (BKD) in the coho, family tracking should continue during the coho eggtake. To avoid the water supply issues at the hatchery, CIAA will begin releasing the sockeye smolts directly into Resurrection Bay after a short-term rearing in net pens.

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APPENDICES

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Appendix 1. Bear Lake 2007 - 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)
6/21/2007		1	10.2	6.5	4.2	138	17.0	8.0	32 :1	2557	na	na	na	17.4
		15	11.6	7.1	4.4	106	11.0	28.0	26 :1	2749	na	na	na	
7/27/2007		1	7.7	3.5	1.9	102	10.9	9.0	32 :1	2520	408	0.57	0.18	9.5
		17	14.9	4.2	2.9	182	27.0	28.0	31 :1	3271	549	3.49	0.33	
8/16/2007		1	6.1	2.7	2.8	130	2.0	10.0	51 :1	2519	564	0.84	0.27	10.7
		12	16.5	3.8	3.5	252	2.4	11.0	35 :1	3221	631	5.43	0.58	
9/20/2007		1	8.4	5.0	3.3	115	9.7	10.0	33 :1	2772	544	3.42	0.26	10.0
		19	15.2	6.6	3.7	136	33.6	19.0	23 :1	3328	447	0.78	0.63	
Mean			11.3	4.9	3.3	144.9	14.2	15.4	33 :1	2867	524	2.4	0.4	11.9
Min			6.1	2.7	1.9	102.2	2.0	8.0	26 :1	2519	408	0.6	0.2	9.5
Max			16.5	7.1	4.4	251.6	33.6	28.0	51 :1	3328	631	5.4	0.6	17.4
1m Ave			8.1	4.4	3.1	121.2	9.9	9.3	36.8 :1	2592	505.3	1.6	0.2	11.9
Hypo Ave			14.6	5.4	3.6	168.7	18.5	21.5	28.6 :1	3142	542.3	3.2	0.5	

* 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)
6/21/2007		1	78	6.7	28.4	1.6	8	12.4	0.6	22	2.5
		15	79	6.7	29.7	0.9	9	12.4	0.7	21	
7/27/2007		1	80	6.6	29.3	1.1	4	12.3	0.6	12	4.5
		17	82	6.4	28.3	3.0	5	12.5	0.7	37	
8/16/2007		1	83	6.7	30.5	0.5	4	12.1	0.6	10	5.5
		12	83	6.4	28.4	2.0	5	12.5	0.6	19	
9/20/2007		1	82	6.8	30.0	1.7	5	12.7	0.6	12	4.5
		19	83	6.5	31.2	1.3	5	12.3	0.7	16	
Mean			81	6.6	29.5	1.5	5.6	12.4	0.6	18.6	4.3
Min			78	6.4	28.3	0.5	4.0	12.1	0.6	10.0	2.5
Max			83	6.8	31.2	3.0	9.0	12.7	0.7	37.0	5.5
1m Ave			80.8	6.7	29.6	1.2	5.3	12.4	0.6	14.0	4.3
Hypo Ave			81.8	6.5	29.4	1.8	6.0	12.4	0.7	23.3	

Appendix 1. (continued) Bear Lake 2007 - Zooplankton Analysis

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

Appendix 2. Bear Lake 2007 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-May	4	0		1.6	1	5
2-May	2	0	0.79	1.6	1	7
3-May	2	0	0.79	1.6	2	11
4-May	2	0	0.79	1.6	2	9
5-May	4	0	0.79	1.6	2	10
6-May	2	0	0.98	1.6	2	10
7-May	4	1	0.98	1.6	2	8
8-May	2	0	0.96	1.6	2	10
9-May	5	1.4	0.96	1.6	2	8
10-May	2	1.2	1.2	1.6	2	10
11-May	3	0	1.2	1.6	2	9
12-May	4	0	1.1	1.6	2	10
13-May	4	0	1.2	1.61	2	8
14-May	5	7.5	0.94	1.56	3	6
15-May	4	3.6	1.1	1.6	3	9
16-May	4	4.5	1.1	1.6	3	9
17-May	5	0	0.72	1.6	4	9
18-May	3	0	0.8	1.62	4	9
19-May	3	0	0.8	1.62	4	8
20-May	1	0	0.88	1.62	5	14
21-May	2	0	0.88	1.62	5	10
22-May	2	0	0.88	1.62	6	16
23-May	5	15.2	0.98	1.56	6	7
24-May	4	3.8	1.04	1.7	6	14
25-May	5	1	0.98	1.56	6	13
26-May	5	5.2	0.98	1.68	5	8
27-May	4	4.4	0.98	1.68	5	8
28-May	4	0.5	0.98	1.68	5	6
29-May	5	1.6	0.9	1.68	5	7
30-May	5	2	0.88	1.7	6	8
31-May	5	3.8	0.9	1.75	6	10

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Jun	5	0.3	0.95	1.75	6	11
2-Jun	5	2	0.94	1.72	6	10
3-Jun	3	1	1	1.72	7	13
4-Jun	5	23.5	0.98	1.75	8	14
5-Jun	4	0.6	1.1	1.72	7	12
6-Jun	5	0.6	0.92	1.74	8	10
7-Jun	5	12.3	0.94	1.74	8	7
8-Jun	5	12.6	0.96	1.72	8	8
9-Jun	3	3.8	0.94	1.76	10	16
10-Jun	3	0	1.1	1.72	9	12
11-Jun	3	0	0.95	1.78	10	11
12-Jun	3	0	0.94	1.78	10	12
13-Jun	3	0	0.9	1.72	10	12
14-Jun	1	0	0.96	1.68	10	13
15-Jun	1	0	0.92	1.61	10	14
16-Jun	1	0	0.92	1.65	10	14
17-Jun	2	0	0.92	1.65	10	14
18-Jun	3	1.5	0.92	1.6	11	13
19-Jun	1	0	0.9	1.62	13	17
20-Jun	1	0	0.88	1.58	11	14
21-Jun	2	0	0.9	1.65	12	16
22-Jun	4	0	0.9	1.6	13	13
23-Jun	5	1	0.88	1.6	12	11
24-Jun	5	11	0.9	1.6	12	9
25-Jun	4	30	0.9	1.58	12	10
26-Jun	1	0	0.88	1.56	12	22
27-Jun	1	0	0.88	1.56	12	20
28-Jun	1	0	0.88	1.56	12	20
29-Jun	2	0	1	1.55	15	18
30-Jun	2	0	0.98	1.55	14	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 2007 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Jul	5	10.1	1	1.55	14	13
2-Jul	4	0.03	1.11	1.59	14	14
3-Jul	2	0	1.1	1.59	14	13
4-Jul	4	0	1.1	1.59	15	12
5-Jul	4	4.6	1	1.55	15	17
6-Jul	2	0	1	1.48	15	14
7-Jul	3	0	0.98	1.46	16	15
8-Jul	3	0	0.98	1.46	16	16
9-Jul	4	0	0.94	1.42	16	15
10-Jul	4	2.2	0.94	1.42	15	15
11-Jul	4	1.6	0.94	1.42	15	14
12-Jul	4	1.2	0.94	1.42	15	14
13-Jul	3	0	0.94	1.42	15	16
14-Jul	3	2.4	0.94	1.44	17	18
15-Jul	1	0	0.78	1.44	17	21
16-Jul	1	0	0.8	1.44	17	23
17-Jul	4	0	0.8	1.4	17	15
18-Jul	5	1.6	0.8	1.4	17	13
19-Jul	3	1	0.88	1.4	17	18
20-Jul	2	0	0.88	1.4	17	17
21-Jul	2	0	0.88	1.4	17	18
22-Jul	5	10.2	0.85	1.4	17	16
23-Jul	5	2.8	0.88	1.4	16	16
24-Jul	5	9.8	0.92	1.42	16	13
25-Jul	5	2.8	0.92	1.42	16	14
26-Jul	3	1	0.92	1.42	16	16
27-Jul	3	0	0.9	1.92	16	18
28-Jul	3	0	0.9	1.92	16	17
29-Jul	3	0	0.88	1.92	16	17
30-Jul	3	0	0.88	1.9	16	15
31-Jul	3	0	0.88	1.9	16	14

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Aug	4	0	0.88	1.9	16	14
2-Aug	4	3	0.88	1.9	16	12
3-Aug	4	0	0.88	1.9	16	12
4-Aug	5	6	0.88	1.9	15	12
5-Aug	4	3	0.88	1.95	15	12
6-Aug	4	0	0.88	1.95	15	12
7-Aug	3	0	0.84	1.92	15	16
8-Aug	2	0	0.84	1.92	15	17
9-Aug	5	2	0.84	1.92	17	13
10-Aug	2	3.8	0.84	1.92	17	25
11-Aug	2	0	0.82	1.9	17	22
12-Aug	1	0	0.82	1.9	17	28
13-Aug	1	0	0.82	1.9	17	28
14-Aug	5	1.6	0.84	1.9	16	13
15-Aug	5	2.5	0.92	1.9	16	14
16-Aug	5	3	0.92	1.88	16	14
17-Aug	5	2.5	0.94	1.84	16	14
18-Aug	5	1	0.94	1.84	16	14
19-Aug	5	0.4	0.94	1.68	16	14
20-Aug	5	0.2	0.96	1.56	15	13
21-Aug	5	0.1	0.96	1.56	15	13
22-Aug	5	0.2	0.98	1.4	15	13
23-Aug	5	0.7	0.98	1.4	15	13
24-Aug	3	0	0.98	1.4	15	15
25-Aug	3	0.05	0.98	1.4	15	16
26-Aug	5	0	0.98	1.4	15	18
27-Aug	4	0.05	0.94	1.4	15	18
28-Aug	3	0	0.9	1.38	15	16
29-Aug	1	0	0.88	1.38	15	23
30-Aug	1	0	0.84	1.36	15	22
31-Aug	2	0	0.84	1.36	15	23

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 2007 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Sep	4	0	0.82	1.34	16	18
2-Sep	3	0	0.8	1.3	16	17
3-Sep	4	0	0.78	1.3	16	16
4-Sep	5	1.5	0.8	1.32	15	15
5-Sep	3	0	0.8	1.32	15	16
6-Sep	4	3.5	0.8	1.3	15	15
7-Sep	5	0	0.78	1.3	15	13
8-Sep	5	5	0.8	1.3	15	12
9-Sep	5	30	0.92	1.44	14	13
10-Sep	1	6	0.91	1.4	14	15
11-Sep	4	0	0.9	1.4	14	14
12-Sep	5	65	0.8	1.4	13	12
13-Sep	5	6	0.78	1.48	13	13
14-Sep	4	2	0.78	1.48	13	11
15-Sep	1	0	0.78	1.48	13	11
16-Sep	1	0	0.68	1.44	13	11
17-Sep	3	0.5	0.6	1.44	13	15
18-Sep	5	9.6	0.6	1.43	12	9
19-Sep	5	2	0.6	1.43	12	12
20-Sep	4	6	0.6	1.41	12	10
21-Sep	1	0	0.6	1.41	12	12
22-Sep	2	0	0.58	1.39	11	9
23-Sep	4	6.2	0.56	1.39	11	9
24-Sep	4	2.6	0.56	1.37	11	7
25-Sep	3	20	0.53	1.34	11	8
26-Sep	4	4.2	0.53	1.34	11	8
27-Sep	1	0	0.53	1.33	11	9
28-Sep	4	6.2	0.53	1.33	11	8
29-Sep	3	0	0.88	1.3	10	9
30-Sep	4	8.2	0.89	1.31	10	9

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Oct	4	0.62	0.88	1.31	10	9
2-Oct	2	0	0.87	1.29	10	8
3-Oct	1	0	0.82	1.28	9	7
4-Oct	5	1	0.81	1.2	8	7
5-Oct	2	6	0.83	1.2	8	9
6-Oct	3	1.2	0.77	1.18	8	7
7-Oct	1	0	0.74	1.17	8	4
8-Oct	1	0	0.74	1.17	8	6
9-Oct	1	0	0.73	1.18	8	7
10-Oct	1	0	0.71	1.17	7	3
11-Oct	4	0	0.69	1.15	7	4
12-Oct	4	7.2	0.7	1.13	7	7
13-Oct	4	4.2	0.65	1.13	7	5
14-Oct	5	16.7	0.74	1.13	7	5
15-Oct	3	0	0.69	1.13	7	4
16-Oct	4	1.2	0.69	1.15	7	4
17-Oct	4	0.8	0.68	1.15	7	5
18-Oct	3	0.6	0.67	1.14	7	7
19-Oct	4	3.5	0.64	1.18	7	6
20-Oct	4	7.5	0.66	1.18	6	-1
21-Oct	4	0.8	0.69	1.19	6	4
22-Oct	5	2.2	0.66	1.18	6	-1
23-Oct	3	5.6	0.66	1.18	6	-2
24-Oct	4	0.5	0.66	1.18	6	2
25-Oct	5	5.8	0.67	1.18	6	5
26-Oct	4	8.2	0.7	1.2	6	5
27-Oct	4	0.7	0.77	1.22	6	6
28-Oct	4	1.5	0.74	1.19	6	5
29-Oct	5	2	0.78	1.21	6	4
20-Oct	5	63.4	0.5	1.5	5	2
31-Oct	3	22.1	0.1	1.5	5	5

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 2007 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Nov	5	36	0.18	1.16	5	4
2-Nov	5	23.6	0.18	1.66	5	3
3-Nov	1	2.2		1.82	4	1
4-Nov	5	23		1.9	4	-4
5-Nov	4	12.5		1.91	4	-1
6-Nov	5	22.2		1.91	4	1
7-Nov	5	16		1.93	4	1
8-Nov	5	36.2		1.94	3	1
9-Nov						

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 2007 - Smolt Migration.

	Sockeye		Coho		Dolly Varden		Rainbow Trout	
Date	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	78	78	0	0	0	0		0
17-May	0	78	0	0	0	0		0
18-May	27	105	0	0	0	0		0
19-May	186	291	0	0	1	1		0
20-May	1,622	1,913	16	16	0	1		0
21-May	10,957	12,870	6	22	0	1		0
22-May	2,571	15,441	6	28	0	1		0
23-May	25,558	40,999	131	159	0	1		0
24-May	492	41,491	18	177	0	1		0
25-May	4,307	45,798	294	471	0	1		0
26-May	21,972	67,770	557	1,028	1	2		0
27-May	28,552	96,322	1,179	2,207	0	2		0
28-May	47,400	143,722	2,252	4,459	0	2		0
29-May	44,081	187,803	1,240	5,699	0	2		0
30-May	37,379	225,182	1,592	7,291	0	2		0
31-May	74,312	299,494	3,246	10,537	11	13		0
01-Jun	158,117	457,611	3,943	14,480	10	23		0
02-Jun	83,572	541,183	2,903	17,383	0	23		0
03-Jun	119,561	660,744	1,850	19,233	0	23		0
04-Jun	40,931	701,675	980	20,213	0	23		0
05-Jun	112,137	813,812	689	20,902	1	24		0
06-Jun	58,376	872,188	969	21,871	0	24		0
07-Jun	68,964	941,152	942	22,813	0	24		0
08-Jun	9,750	950,902	540	23,353	0	24		0
09-Jun	46,415	997,317	2,209	25,562	20	44		0
10-Jun	73,866	1,071,183	3,445	29,007	0	44		0
11-Jun	21,341	1,092,524	721	29,728	0	44		0
12-Jun	15,020	1,107,544	2,290	32,018	0	44		0
13-Jun	16,565	1,124,109	3,027	35,045	0	44		0
14-Jun	41,320	1,165,429	3,830	38,875	20	64		0
15-Jun	38,900	1,204,329	4,620	43,495	0	64		0
16-Jun	34,673	1,239,002	5,087	48,582	0	64		0
17-Jun	26,037	1,265,039	4,670	53,252	0	64		0
18-Jun	9,760	1,274,799	1,830	55,082	0	64		0
19-Jun	11,915	1,286,714	3,337	58,419	0	64		0
20-Jun	15,960	1,302,674	2,970	61,389	0	64		0
21-Jun	10,053	1,312,727	3,079	64,468	0	64		0
22-Jun	6,548	1,319,275	2,764	67,232	0	64		0
23-Jun	1,064	1,320,339	1,178	68,410	0	64		0
24-Jun	1,230	1,321,569	1,590	70,000	0	64		0
25-Jun	150	1,321,719	160	70,160	0	64		0
26-Jun	7,340	1,329,059	4,290	74,450	0	64		0
27-Jun	2,823	1,331,882	1,374	75,824	0	64		0
28-Jun	2,791	1,334,673	1,522	77,346	0	64		0
29-Jun	12,263	1,346,936	1,068	78,414	0	64	1	1
30-Jun	938	1,347,874	567	78,981	0	64	0	1
01-Jul		1,347,874		78,981		64		1
02-Jul		1,347,874		78,981		64		1
03-Jul		1,347,874		78,981		64		1
04-Jul		1,347,874		78,981		64		1
05-Jul		1,347,874		78,981		64		1
06-Jul		1,347,874		78,981		64		1
07-Jul		1,347,874		78,981		64		1
08-Jul		1,347,874		78,981		64		1
09-Jul		1,347,874		78,981		64		1
10-Jul		1,347,874		78,981		64		1
11-Jul		1,347,874		78,981		64		1
Totals		1,347,874		78,981		64		1

Appendix 4. Bear Lake 2007 - Adult Sockeye Salmon Migration.

Date	Lake Escapement Males	Females	Combined	Donate & Harvest	Morts	Daily Total	Cumm. Total
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	1	1	0	0	1	1
29-May	0	0	0	0	0	0	1
30-May	2	1	3	0	0	3	4
31-May	10	6	16	0	0	16	20
01-Jun	6	5	11	0	0	11	31
02-Jun	11	11	22	0	0	22	53
03-Jun	27	32	59	0	0	59	112
04-Jun	16	5	21	0	0	21	133
05-Jun	12	6	18	0	0	18	151
06-Jun	96	49	145	0	0	145	296
07-Jun	18	8	26	0	0	26	322
08-Jun	22	16	38	0	0	38	360
09-Jun	44	16	60	0	0	60	420
10-Jun	59	31	90	0	0	90	510
11-Jun	69	29	98	0	0	98	608
12-Jun	100	43	143	0	0	143	751
13-Jun	40	13	53	0	0	53	804
14-Jun	159	70	229	0	0	229	1,033
15-Jun	447	229	676	0	0	676	1,709
16-Jun	674	363	1,037	0	0	1,037	2,746
17-Jun	947	564	1,511	0	0	1,511	4,257
18-Jun	1,089	584	1,673	0	0	1,673	5,930
19-Jun	861	507	1,368	0	0	1,368	7,298
20-Jun	975	502	1,477	0	0	1,477	8,775
21-Jun	381	456	837	140	0	977	9,752
22-Jun	75	200	275	0	0	275	10,027
23-Jun	70	363	433	172	0	605	10,632
24-Jun	30	256	286	270	0	556	11,188
25-Jun	55	345	400	229	0	629	11,817
26-Jun	35	338	373	280	0	653	12,470
27-Jun	42	70	112	1,267	0	1,379	13,849
28-Jun	5	29	34	350	0	384	14,233
29-Jun	13	100	113	683	0	796	15,029
30-Jun	30	210	240	558	0	798	15,827
01-Jul	5	10	15	519	0	534	16,361
02-Jul	14	105	119	202	0	321	16,682
03-Jul	0	0	0	526	0	526	17,208
04-Jul	21	200	221	510	0	731	17,939
05-Jul	15	120	135	275	0	410	18,349
06-Jul	0	0	0	378	0	378	18,727
07-Jul	0	0	0	285	0	285	19,012
08-Jul	0	0	0	255	0	255	19,267
09-Jul	31	97	128	0	0	128	19,395
10-Jul	15	20	35	0	0	35	19,430
11-Jul	13	34	47	0	0	47	19,477
12-Jul	0	0	0	47	0	47	19,524
13-Jul	4	5	9	52	0	61	19,585
14-Jul	0	0	0	44	0	44	19,629
15-Jul	0	11	11	31	0	42	19,671
16-Jul	0	0	0	20	0	20	19,691
17-Jul	7	21	28	2	0	30	19,721
18-Jul	15	47	62	18	0	80	19,801
19-Jul	20	22	42	3	0	45	19,846
20-Jul	6	11	17	9	0	26	19,872
21-Jul	0	0	0	72	0	72	19,944
22-Jul	0	0	0	7	0	7	19,951
23-Jul	12	9	21	0	0	21	19,972
24-Jul	10	6	16	11	0	27	19,999
25-Jul	0	0	0	0	0	0	19,999
26-Jul	0	0	0	20	0	20	20,019
27-Jul	2	3	5	15	0	20	20,039
28-Jul	0	0	0	0	0	0	20,039
29-Jul	5	16	21	0	0	21	20,060
30-Jul	3	5	8	0	0	8	20,068
31-Jul	12	10	22	0	0	22	20,090
01-Aug	0	0	0	0	0	0	20,090
02-Aug	0	0	0	0	0	0	20,090
03-Aug	0	0	0	0	0	0	20,090
04-Aug	0	0	0	0	0	0	20,090
05-Aug	0	0	0	0	0	0	20,090
06-Aug	0	0	0	0	0	0	20,090
07-Aug	0	0	0	0	0	0	20,090
08-Aug	0	0	0	0	0	0	20,090
Total	6,630	6,210	12,840	7,250	0	20,090	

Appendix 5. Bear Lake 2007 - Adult Coho Salmon Migration.

	Lake Escapement			Broodstock			Harvest *			Total		Raceway	Daily	Cumm
Date	Males	Females	Combined	Males	Females	Combined	Males	Females	Combined	Males	Females	Morts	Total	Total
18-Sep	8	3	11	0	0	0	0	0	0	8	3	0	11	11
19-Sep	4	1	5	0	0	0	0	0	0	4	1	0	5	16
20-Sep	4	4	8	0	0	0	0	0	0	4	4	0	8	24
21-Sep	3	2	5	0	0	0	0	0	0	3	2	0	5	29
22-Sep	4	1	5	0	0	0	0	0	0	4	1	0	5	34
23-Sep	5	0	5	0	0	0	0	0	0	5	0	0	5	39
24-Sep	5	1	6	0	0	0	0	0	0	5	1	0	6	45
25-Sep	14	5	19	0	0	0	0	0	0	14	5	0	19	64
26-Sep	5	7	12	0	0	0	0	0	0	5	7	0	12	76
27-Sep	27	15	42	0	0	0	0	0	0	27	15	0	42	118
28-Sep	15	4	19	0	0	0	0	0	0	15	4	0	19	137
29-Sep	25	7	32	0	0	0	0	0	0	25	7	0	32	169
30-Sep	33	27	60	28	4	32	0	0	0	61	31	0	92	261
01-Oct	4	13	17	47	10	57	0	0	0	51	23	0	74	335
02-Oct	0	15	15	46	18	64	0	0	0	46	33	0	79	414
03-Oct	0	8	8	11	14	25	0	0	0	11	22	0	33	447
04-Oct	0	3	3	5	11	16	0	0	0	5	14	0	19	466
05-Oct	0	7	7	13	20	33	0	0	0	13	27	0	40	506
06-Oct	0	13	13	27	25	52	0	0	0	27	38	0	65	571
07-Oct	0	6	6	11	6	17	0	0	0	11	12	3	26	597
08-Oct	0	0	0	3	3	6	0	0	0	3	3	0	6	603
09-Oct	0	0	0	1	0	1	0	0	0	1	0	0	1	604
10-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	604
11-Oct	0	0	0	0	2	2	0	0	0	0	2	3	5	609
12-Oct	0	0	0	3	0	3	0	0	0	3	0	0	3	612
13-Oct	0	0	0	4	3	7	0	0	0	4	3	0	7	619
14-Oct	0	0	0	4	11	15	0	0	0	4	11	0	15	634
15-Oct	0	0	0	33	21	54	0	0	0	33	21	0	54	688
16-Oct	0	0	0	22	39	61	0	0	0	22	39	0	61	749
17-Oct	0	0	0	8	21	29	0	0	0	8	21	0	29	778
18-Oct	0	0	0	0	24	24	0	0	0	0	24	0	24	802
19-Oct	0	0	0	1	14	15	0	0	0	1	14	8	23	825
20-Oct	0	0	0	1	7	8	0	0	0	1	7	0	8	833
21-Oct	0	0	0	0	3	3	0	0	0	0	3	0	3	836
22-Oct	0	0	0	0	0	0	0	0	0	0	0	5	5	841
23-Oct	0	0	0	0	1	1	0	0	0	0	1	5	6	847
24-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	847
25-Oct	0	0	0	0	7	7	0	0	0	0	7	0	7	854
26-Oct	0	0	0	0	4	4	0	0	0	0	4	0	4	858
27-Oct	0	0	0	0	7	7	0	0	0	0	7	0	7	865
28-Oct	0	2	2	0	2	2	0	0	0	0	4	0	4	869
29-Oct	33	1	34	0	2	2	0	0	0	33	3	0	36	905
30-Oct	18	1	19	9	31	40	0	0	0	27	32	23	82	987
31-Oct	13	0	13	18	31	49	0	0	0	31	31	0	62	1,049
01-Nov	11	0	11	4	16	20	0	0	0	15	16	0	31	1,080
02-Nov	9	0	9	0	13	13	0	0	0	9	13	0	22	1,102
03-Nov	0	0	0	0	2	2	0	0	0	0	2	0	2	1,104
04-Nov	0	0	0	0	2	2	0	0	0	0	2	0	2	1,106
05-Nov	0	0	0	0	0	0	0	0	0	0	0	7	7	1,113
Total	240	146	386	299	374	673	0	0	0	539	520	54	1,113	

Appendix 6. Bear Lake 2007 – Adult Sockeye Age and Sex Characteristics

	Age						
	1.1	1.2	1.3	2.1	2.2	2.3	Total
Sample Period:	28 May through 31 July						
Males (No.)	0	6,198	4,168	0	214	748	11,327
Percent	0.0%	54.7%	36.8%	0.0%	1.9%	6.6%	56.4%
Sample Size	0	116	78	0	4	14	212
Total Sample Size							208
Mean Length (mm)		496	563		534	566	525
Std. Deviation		38.1	31.6		20.6	55.2	51.4
Std. Error		3.5	3.6		10.3	14.8	3.6
Mean Weight (kg)		1.91	2.65		2.07	2.81	2.23
Std. Deviation		0.42	0.52		0.14	0.44	0.60
Std. Error		0.04	0.06		0.07	0.12	0.04
Females (No.)	0	4,274	3,954	0	107	427	8,763
Percent	0.0%	48.8%	45.1%	0.0%	1.2%	4.9%	43.6%
Sample Size	0	80	74	0	2	8	164
Total Sample Size							177
Mean Length (mm)		493	537		499	557	517
Std. Deviation		26.7	32.1		8.5	31.3	36.6
Std. Error		3.0	3.7		6.0	11.1	2.8
Mean Weight (kg)		1.70	2.33		1.86	2.37	2.02
Std. Deviation		0.27	0.34		0.10	0.42	0.43
Std. Error		0.03	0.04		0.07	0.15	0.03
Both Sexes (No.)	0	10,472	8,121	0	321	1,175	20,090
Percent	0.0%	52.1%	40.4%	0.0%	1.6%	5.9%	100.0%
Sample Size	0	196	152	0	6	22	376
Total Sample Size							385
Mean Length (mm)		495	550		522	563	522
Std. Deviation		2.4	2.8		9.9	10.1	45.6
Std. Error		1.8	2.5		2.0	2.6	2.3
Mean Weight (kg)		1.83	2.50		2.00	2.65	2.13
Std. Deviation		0.38	0.47		0.16	0.48	0.54
Std. Error		0.03	0.04		0.06	0.10	0.03

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

Appendix 7. Bear Lake 2007 – Adult Coho Age and Sex Characteristics

	Age			
	1.1	2.1	3.1	Total
Sample Period:	18 September through 05 November			
Males (No.)	596	517	0	1,113
Percent	53.5%	46.5%	0.0%	100.0%
Sample Size	38	33	0	71
Total Sample Size				79
Mean Length (mm)	544	539		544
Std. Deviation	42.2	105.5		74.4
Std. Error	6.8	18.4		8.4
Mean Weight (kg)	2.47	2.85		2.67
Std. Deviation	0.70	0.68		0.69
Std. Error	0.11	0.12		0.08
Females (No.)				0
Percent				0.0%
Sample Size	0	0	0	0
Total Sample Size				0
Mean Length (mm)				
Std. Deviation				
Std. Error				
Mean Weight (kg)				
Std. Deviation				
Std. Error				
Both Sexes (No.)	596	517	0	1,113
Percent	53.5%	46.5%	0.0%	100.0%
Sample Size	38	33	0	71
Total Sample Size				79
Mean Length (mm)	544	539		544
Std. Deviation	42.2	105.5		74.4
Std. Error	6.8	18.4		8.4
Mean Weight (kg)	2.47	2.85		2.67
Std. Deviation	0.70	0.68		0.69
Std. Error	0.11	0.12		0.08

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

Appendix 8. Bear Lake 2007 – Project Updates

Sockeye Salmon Project

Stocking & Misc. Activities

Crew on-site:	1-May		
Ice-out:	NA		
Crew off-site:	5-Nov		
Fry stocking:	3-Jun	2,437,000	0.65 g
PreSmolt stocking:			
Smolt stocking:	18-May	619,000	9.9 g
Fertilizer application:	7-Jul to 29-Aug	330 gallon	

Egg Take

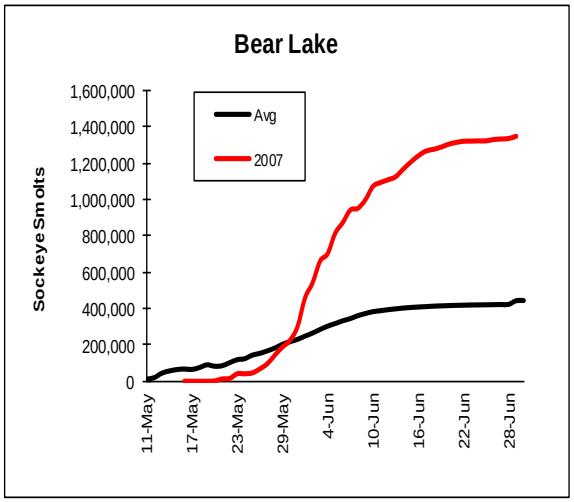
Dates:	28-Jul to 25-Aug	
No. of broodstock used:		4,420
Green eggs:		6,071,000
Fecundity:		2,848
Eyed eggs:		5,398,000
% Survival		88.9%

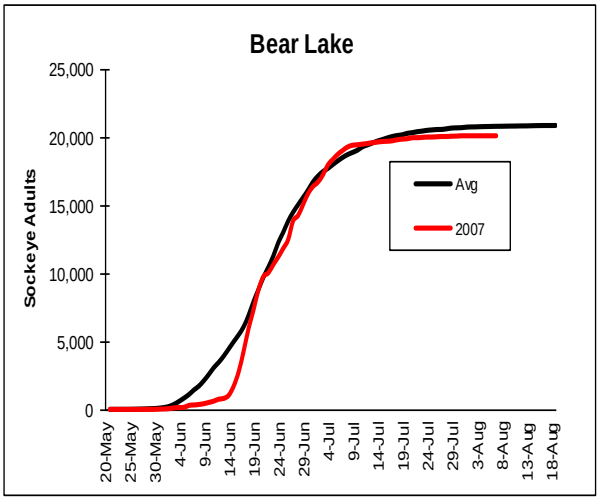
Smolt Migration

Dates:	16-May to 30-Jun	
Sockeyes:		1,347,874
Percent age 1:		93.7%
Percent age 2:		6.3%
Percent age 3:		0.0%
Percent hatchery:		96.4%
Dolly Varden:		64

Adult Migration

Dates:	28-May to 31-Jul		
Total return:		40,927	
Commercial & Sport Fish harvest:		19,125	47%
Creek return:		20,090	49%
C.R. harvest:		8,962	22%
Mortalities:		0	0%
Lake:		12,398	30%
Hatchery broodstock:		4,420	11%
Lake broodstock:		8,420	21%





Coho Salmon Project

Stocking & Misc. Activities

Crew on-site:	1-May		
Ice-out:	NA		
Crew off-site:	5-Nov		
Fry stocking:	7-Jun	521,000	1.0 g
Smolt stocking Bear Cr.	13-Jun	237,000	10.8 g
Smolt stocking Lowell Cr			
Fertilizer application:	7-Jul to 29-Aug	330 gallon	

Egg Take

Dates:	7-Oct to 5-Nov	
No. of females used:		417
Green eggs:		748,000
Fecundity:		3,290
Eyed eggs:		581,000
% Survival		77.7%

Smolt Migration

Dates:	20-May to 30-Jun	
Cohos:		78,891
Percent age 1:		53.3%
Percent age 2:		46.7%
Percent age 3:		0.0%
Percent hatchery:		92.8%
Dolly Varden:		64

Adult Migration

Dates:	18-Sep to 5-Nov		
Coho total creek return:		1,113	
Weir return:		1,113	100%
C.R. harvest:		0	0%
Lake:		386	35%
Hatchery broodstock:		673	60%
Est. Remaining in Bear Ck:		0	0%
Est. Remaining in Salmon Ck:		0	0%