

**Bear Lake
Salmon Enhancement
Progress Report
2008**

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

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ACKNOWLEDGEMENTS

The 2008 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 2008, 2.4 million sockeye fry (BY07) and 360,000 coho fry (BY07) were released into Bear Lake. At the time of release, the sockeye fry averaged 0.60 grams and the coho fry averaged 1.4 grams. All released fry were of Bear Lake origin. Approximately 1.6 million sockeye smolts (BY06) were released into Resurrection Bay at an average of 10.4 grams. For the coho smolts approximately 142,000 coho smolts (BY06) were released into Bear Lake/Creek at an average of 12.4 grams.

Smolt migration monitoring began on 26 May and continued daily until 07 July. During this time a total of 308,459 ($\pm 18,982$) sockeye and 63,943 ($\pm 3,835$) coho smolts migrated from the lake.

Based on otolith marks, 94.5% ($\pm 2.4\%$) of the emigrating sockeye smolts were enhanced. An estimated 91.4% smolts were age 1 and 8.6% were age 2. The average length and weight of the age 1 sockeye smolts was 88 mm (± 0.4 mm) and 6.2 g (± 0.2 g) respectively. The age 2 sockeye smolts were 96 mm (± 1.1 mm) and 8.3 g (± 0.5 g).

Based on otolith marks, 97.3% ($\pm 1.5\%$) of the emigrating coho smolts were enhanced. An estimated 54.7% of coho smolt were age 1 and 44.9% were age 2. The average length and weight of the age 1 coho smolts was 95 mm (± 1.1 mm) and 8.6 g (± 1.3 g) and the age 2 coho smolts were 117 mm (± 0.4 mm) and 16.9 g (± 0.8 g).

A total of 17,142 adult sockeye returned to Bear Creek in 2008. The returning sockeye salmon were age 1.2 (34.4%) or age 1.3 (58.5%). A total of 13,436 were passed into the lake, while the remaining 3,706 were harvested at the weir for cost recovery. An additional 29,338 were harvested in Resurrection Bay in cost recovery. In the common property, 57,043 were harvested and an estimated 5,600 fish were caught in the sport fishery. Total return of sockeye to Resurrection Bay was 110,149.

A total of 1,467 adult coho returned to Bear Creek weir in 2008. The returning fish were age 1.1 (33.3%), age 2.1 (65.5%) or 3.1 (1.2%). Of the adult coho returning, 403 were harvested and sold for cost recovery or donated, 643 were held and used as hatchery broodstock, and 368 were passed into Bear Lake. There were also 54 mortalities.

From 02 August to 26 August 2008, 6,033,000 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 2,086 females were fertilized with milt from 2,086 males.

From 7 October to 30 October 2008, 574,000 coho eggs were collected from 132 females and fertilized with milt from 88 males. In addition, the Alaska Department of Fish and Game (ADF&G) collected 492,000 coho salmon eggs.

A total of 810 gallons of fertilizer was applied to Bear Lake in 2008. 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 species¹.

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.

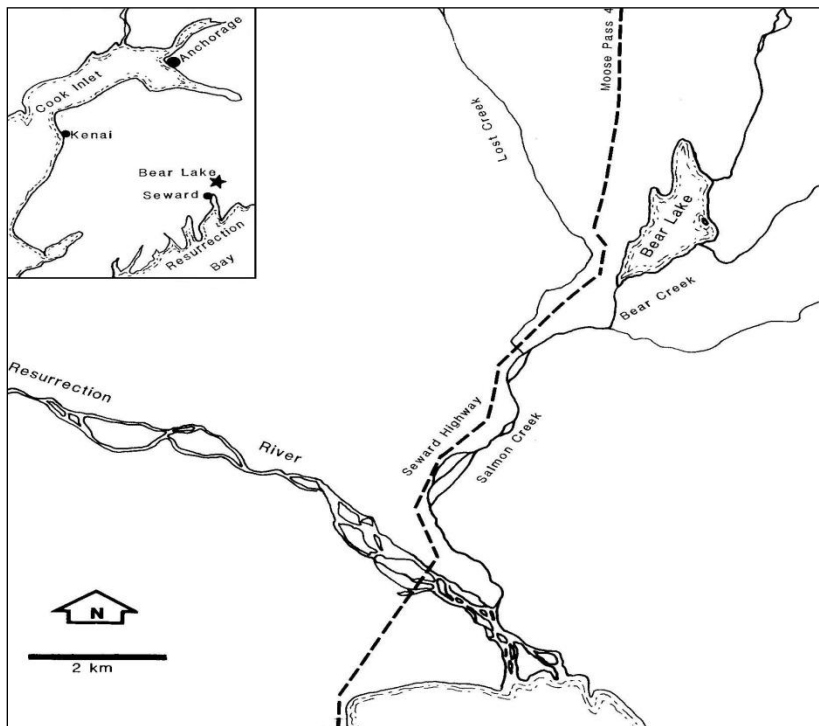


Figure 1. Map showing location of Bear Lake near Seward, Alaska.

Bear Lake has a watershed area of 15 km² 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.

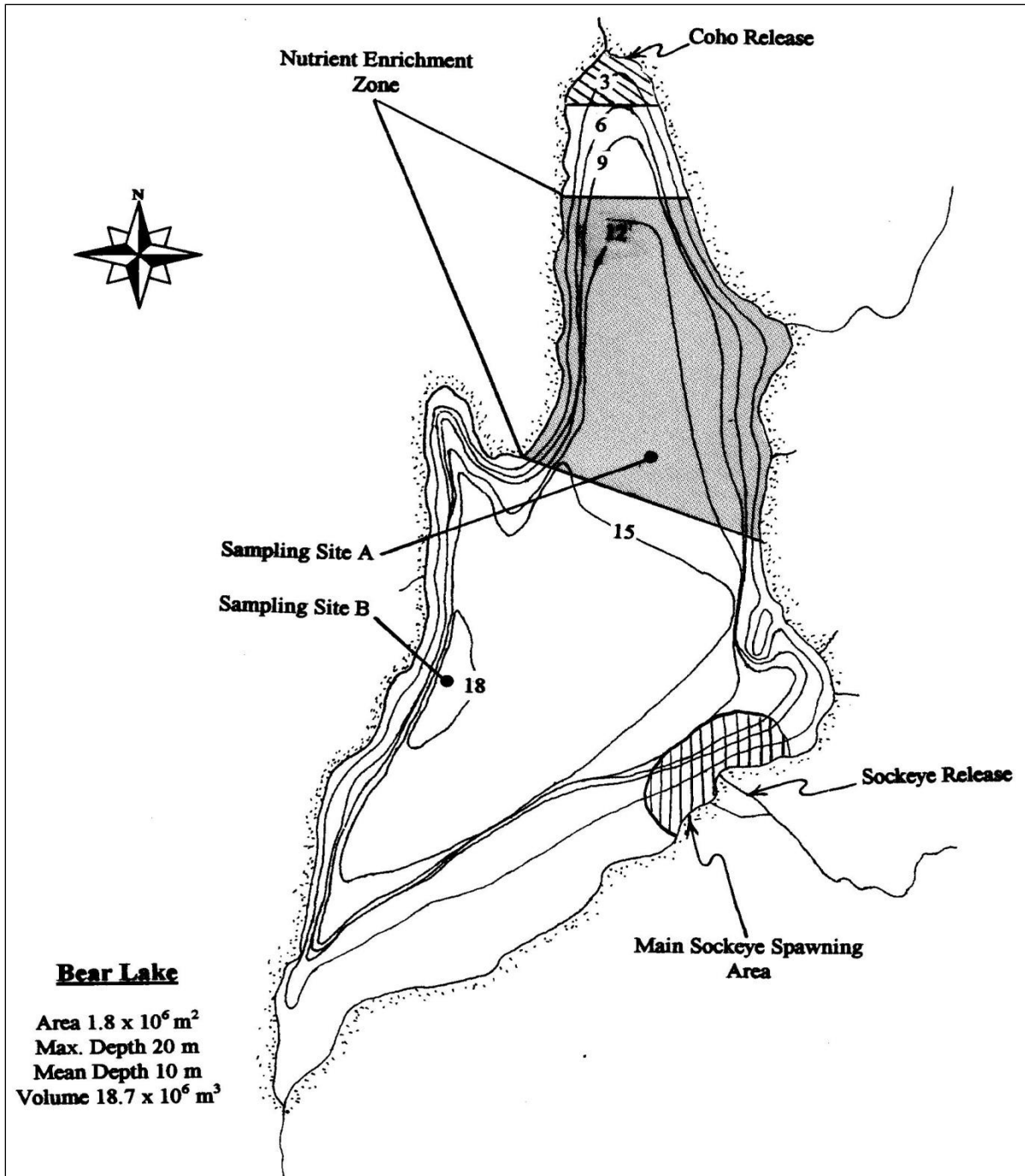


Figure 2. Bear Lake near Seward, Alaska

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 2008 were consistent with previous limnological sampling activities. These procedures are described by Koenings, et al. (1986).

During 2008, assessments of water quality were conducted 3 times (June, July, 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 Van Dorn water 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 03 July to 13 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 2008 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.

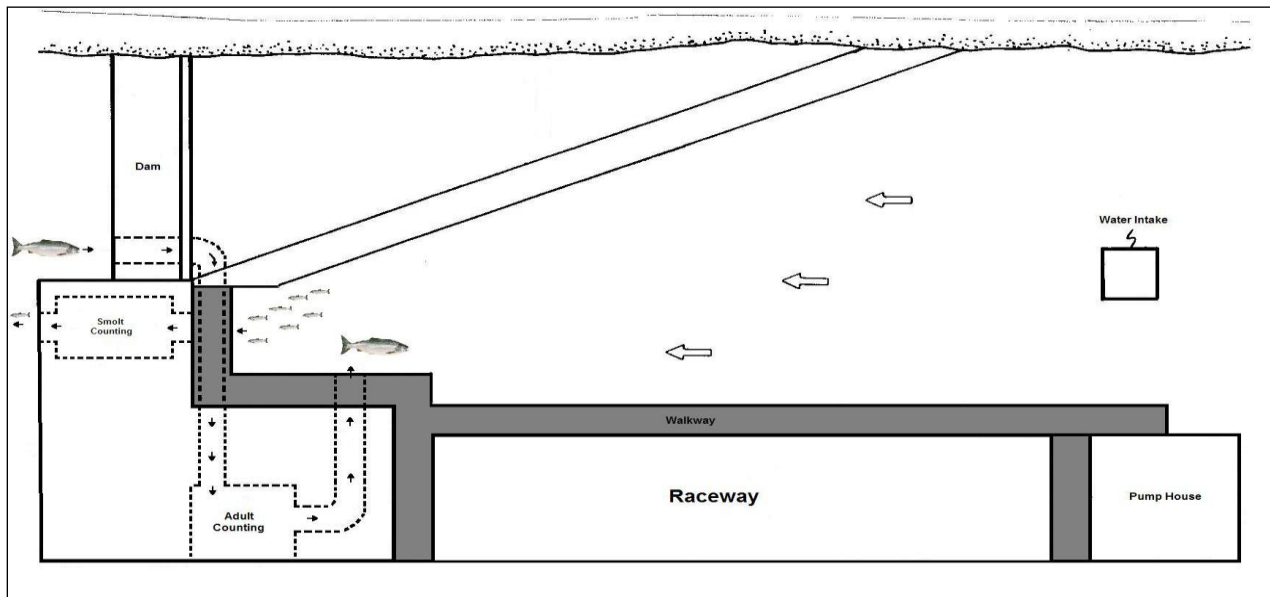


Figure 3. The Bear Creek weir, smolt trap and adult counting complex (Top View).

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-sampling² 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,

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

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.

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 mark³. The purpose of this mark is to determine the contribution of released hatchery fish to the Bear Lake smolt population.

In 2008, smolts collected for measurement, age determination, and otolith removal were sampled in proportion to the daily smolt migration. This was accomplished by collecting every 880th sockeye smolt and every 135th 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 349 sockeye smolts and 453 coho smolts.

Each smolt collected for evaluation was first measured to the nearest millimeter for fork length⁴ and weighed to the nearest 0.1 gram. Several scales were then removed from the primary growth area⁵ 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, ($N = \sum N_h$),
 n = total number of smolts sampled,
 n_h = number of smolts sampled in stratum h, ($n = \sum n_h$),
 a = total number of enhanced smolts sampled,
 a_h = number of enhanced smolts sampled in stratum h, ($a = \sum a_h$),
 $p_h = a_h / n_h$, The proportion of enhanced smolts in stratum h,
 $q_h = 1 - p_h$, The proportion of wild smolts in stratum h,
 c_i = number of age = i smolts sampled,
 c_{hi} = number of age = i smolts sampled in stratum h, ($c_i = \sum c_{hi}$),
 $l_{hi} = c_{hi} / n_{hi}$, The proportion of age = i smolts in stratum h,
 $m_{hi} = 1 - l_{hi}$, The proportion of other than age = i smolts in stratum h,
 $f = n / N$, The sampling fraction (assumed equal in all strata),
 $W_h = N_h / N$, The stratum weight, and,
 y = the weight or length of the smolt.

Then the proportion of enhanced smolts, \hat{P} , was estimated as:

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

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

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

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

with a variance of:

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

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

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

and, the relative error is:

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

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

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

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

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

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

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

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

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

with an approximate variance estimate of:

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

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

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

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 length⁶ 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 50th adult sockeye and 6th adult coho were sampled. In 2008, measurements were collected from 328 sockeye (1.91%) and 227 coho (15.47%).

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. At the time of stripping a selected number of females (495 samples total) had a small section of kidney removed for the screening of *Renibacterium salmoninarum*, the causative pathogen for Bacterial Kidney Disease (BKD). Eggs were fertilized and mating crosses were recorded. Once the eggs reached the eyed stage and the BKD pathology results were received any crosses which had a high OD (optical density) value were culled. 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 – H4; Smolt – 2,1H).

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 – H5). 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 2008, 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). In contrast, all coho smolts were transported by truck in oxygenated tanks and placed into raceways at the weir for imprinting prior to release to Bear Creek.

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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 2008 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 2008.

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 ²)
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*	79.3	7.1	28	1.5	12.7	106	4.1	16 :1	2.6	8.9	4	NA

Averages prior to 1992 compiled by ADF&G.

EZD, Secchi and atomic ratio provided by CIAA.

Open water season only.

*2004 - 2008 - zooplankton data analysis is incomplete.

Table 2. Water quality characteristics of Bear Lake in the hypolimnion, 1979 to 2008.

Year	Hypolimnion								
	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	NO ₂ +NO ₃ (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
2008	81	6.7	28	3	13	148	23.4	31 :1	2.2

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 2008 are presented in Appendix 2. Between 01 May and 30 June, the average air temperature was 11.9°C (± 2.9°C) while water temperature averaged 7.8°C (± 3.1°C). Average stage height below the weir was 0.88 ft (±0.3 ft) and above the weir it was 1.95 ft (± 0.5 ft) for the same time period. Between 01 July and 31 October, the average air temperature was 9.3°C (± 5.0°C) while water temperature averaged 10.6°C (± 3.6°C). Average stage height below the weir was 0.78 ft (± 0.8 ft) and above the weir it was 1.56 ft (± 0.2 ft). The environmental conditions observed in 2008 are compared to other years in Table 3.

Table 3. Environmental conditions observed at Bear Lake, 1990 to 2008.

Year	May thru June 30											
	Total Days	Clear	No. of Days			Rain	Days Meas. Precip	Precip (mm)	Temperature (C)			
			<50% Cloud Cover	>50% Cloud Cover	100% Overcast				Avg	Range	Avg	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)
2008	61	7	8	11	11	9	19	63.8	12	(4-18)	8	(3-13)

Year	July thru Sept/Oct/Nov											
	Total Days	Clear	No. of Days			Rain	Days Meas. Precip	Precip (mm)	Temperature (C)			
			<50% Cloud Cover	>50% Cloud Cover	100% Overcast				Avg	Range	Avg	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)
2008	123	22	4	12	53	32	57	813	9	(0-22)	11	(3-15)

*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 21 of the last 28 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 2008

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			1260	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

Smolt Enumeration - Sockeye

Enumeration of Bear Lake sockeye smolts occurred between 26 May and 07 July. A total of 308,459 ($\pm 18,982$) sockeye smolts migrated from Bear Lake in 2008 (Appendix 3). The 10% sub-sampling procedure was used to count 30.2% of the migrating sockeye salmon.

The age 1.0 smolts averaged 88 mm (± 0.4 mm) in length and 6.2 g (± 0.2 g) in weight. The age 2.0 smolts averaged 96 mm (± 1.1 mm) in length and 8.3 g (± 0.5 g) in weight (Table 5). Based on the presence of hatchery induced thermal marks in the otoliths of 349 smolts, it was estimated that 94.5% ($\pm 2.4\%$) of the sockeye smolts were of hatchery origin.

Table 5. Sockeye smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2008.

Year	Number		% Hatch.		No. Wild	Age Composition						Average Length (mm) ⁵				Average Weight (g) ⁶							
	95%CI		95%CI			0.0	95%CI	1.0	95%CI	2.0	95%CI	3.0	95%CI	0.0	1.0	CI	2.0	CI	0.0	1.0	CI	2.0	CI
1980	3,400							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		
2008	308,459	18,982	94.5	2.4	16,965			281,868	9,399	26,591	9,399			88	0.4	96	1.1	6.2	0.2	8.3	0.5		
Avg. ⁴	579,900	67,700	78.9	3.4	51,000	11,400	5,600	528,116	17,500	38,100	8,800	3,800	2,300	119	107	0.8	134	4.1	17	11.8	1.0	27.0	3.9
Total ⁵	8,868,276					157,600		7,961,974		574,553		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.

¹In 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.

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

³In 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

⁴Average values calculated from smolt year 1995 to 2007.

⁵Total values calculated from 1980 to 2008.

⁶1980 thru 1992 averages are arithmetic, 1993 and later are weighted averages.

Smolt Enumeration - Coho

A total of 63,943 (\pm 3,835) coho salmon smolts migrated from Bear Lake in 2008 (Appendix 3) between 26 May and 07 July. The 10% sub-sampling procedure was used to count 12.4% of the migrating coho smolts.

The average size (Table 6) of the age 1.0 coho smolts was 95 mm (\pm 1.1 mm) and 8.6 g (\pm 1.3

g). Age 2.0 smolts were 117 mm (± 0.4 mm) and 16.9 g (± 0.8 g). Based on the presence of hatchery induced thermal marks in the otoliths of 453 coho smolt, it was estimated that 97.3% ($\pm 1.5\%$) 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 2008.

Year	Number		% Hatch.		Age Composition						Average Length (mm) ⁴						Average Weight (g) ⁴											
	95% CI		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				
2008		63,943	3,835	97.3	1.5	34,957	3,382	28,694	3,381					95	1.1	117	0.4				8.6	1.3	16.9	0.8				
Avg ²		93,472	9,400	90.4	2.7	61,100	5,000	29,300	6,400	3,200	2,900	500	600	111		129		135		157	13.8		21.1	25.3		35.6		
Total ³		2,681,152				1,746,421		848,198		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.

¹Percent Hatchery calculated for Age 1.0 smolts only

²Average values calculated from smolt year 1980 to 2007.

³Total values calculated from 1980 to 2008.

⁴1980 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 2008 and continued to migrate until 31 July 2008 (Appendix 4). During this time, 17,142 adults were captured and counted at the weir (Table 7). The returning major age groups for adult sockeye included ages 1.2 (34.4%), 1.3 (58.5%), 2.2 (5.3%) and 2.3 (1.4%). Of the 17,142 adult sockeye that migrated to Bear Creek in 2008, 3,698 were harvested for cost recovery and 13,436 were passed to the lake. Mortalities at the weir were 8 fish. An additional 57,043 fish were harvested in the seine fishery and an additional 29,338 fish in the saltwater cost recovery harvest. It was estimated that 5,494 fish were harvested in the sport fishery for a total return to Resurrection Bay of 110,149 sockeye salmon (an additional 950 fish were estimated to have been illegally caught (poached) in the sport fishery).

A summary of mean age and weight, by age class, for adult sockeye salmon escapement to the Bear Creek weir site for 2008 is presented in Appendix 6.

Adult Escapement - Coho

Adult coho salmon began arriving at the weir on 04 September 2008 and continued to migrate until 21 October (Appendix 5). During this time, 1,467 adults were captured and counted at the weir (Table 7). The returning major age groups for adult coho included ages 1.1 (33.3%), 2.1 (65.5%), and 3.1 (1.2%).

Of the 1,467 adult coho that were counted at the Bear Creek weir site, 403 were harvested, 643 were held for broodstock purposes and 368 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 2008 is presented in Appendix 7.

Table 7. Historic returns of Coho and Sockeye Salmon to Bear Lake weir, 1980 to 2008.

Year	Coho Salmon				Sockeye Salmon												
	Weir Return Total	Age Composition			Weir Return 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	
Avg ¹	3,757	1,279	2,372	107	21,708	297	173	427	9,522	11	9,705	5	1,110	451	3	2	
% of Avg	100%	34.0%	63.1%	2.8%	100%	1.4%	0.8%	2.0%	43.9%	0.0%	44.7%	0.02%	5.1%	2.1%	0.01%	0.1%	

¹ Average calculation is based on 1994 data onward.

Hatchery Activities

Stocking

In 2008, 2.4 million sockeye fry (BY07; 1,4H) and 360,000 coho fry (BY07; H6) were released into Bear Lake. These fish will migrate in 2009/2010 as smolts. At the time of release, the sockeye fry averaged 0.60 gm and the coho fry averaged 1.4 gm.

Approximately, 1.6 million sockeye smolts (BY06; 1,3H) averaging 10.4 gm were released into

Resurrection Bay. For the coho, approximately 142,000 coho smolts (BY06: H3,3) averaging 12.5 gm were released into Bear Lake/Bear Creek. 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 02 August and 26 August 2008, a total of 6,033,000 sockeye salmon eggs were collected. A total of 4,172 broodfish were used (2,086 females; 2,086 males) providing an average fecundity of 2,892 eggs/female. A total of 272 fish were either inviable or mortalities. Pathology results indicated a very high prevalence of BKD in the population (44.2%). Due to this high prevalence it was not feasible to cull all family crosses. Only those samples which had a high OD value were culled. In total, 263,000 eggs were culled.

From 7 October to 30 October 2008, a total of 574,000 coho eggs were collected from 132 females and fertilized with milt from 88 males. Average fecundity was 4,348 eggs/female. An additional 492,000 coho eggs were collected by ADF&G Fort Richardson Hatchery. Pathology results indicated that BKD was prevalent 3 mating crosses. These eggs were culled (13,000). In addition, due to biomass issues and poor fertilization, the survival to eyed egg was only 49.3%.

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

Fry-to-Smolt Survival

Migrating smolts in 2008 were stocked either as fry in 2006 (BY05 - Age 2) and 2007 (BY06 - 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 2008.

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 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
2008 ⁶	360,000	1.4	142,000	12.5	2,400,000	0.6			1,600,000	10.4
Total	8,991,800		2,607,330		29,007,000		2,009,000		4,733,200	
Ave	374,658	0.93	162,958	11.3	1,450,350	0.48	669,667	3.96	591,650	8.64

¹ Released into Bear Lake

² Extra Fry Released into Bear Creek

³ sockeye fry release, 445, 300 @ .36g & 335,300 @ .38g

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

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

⁶Sockeye smolt stocking was into net pens at Resurrection Bay not Bear Lake

Table 9. Eggs collected for Bear Lake enhancement, 1989 to 2008.

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	91.33	Bear L	6,087,000	5,444,000	89.44
2007	Bear L	748,000	581,000	77.67	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
Total Ave		19,010,963	16,129,806	83.7		73,243,600	62,147,400	81.5

Table 10. Bear Lake smolt production by brood years.

Brood Year	Escap.	Coho				Brood Year	Escap.	Sockeye					
		No. Stocked	Size (g)	No. Smolt	Hatch Smolt % Hatch. Survival			No. Stocked	Size (g)	No. Smolt	Hatch. Smolt % Hatch. Survival		
1985	4,421	445,700	1.64	74,520		1,235		19,740					
1986	5,115	226,300	1.46	54,700		830		8,450					
1987	5,653	347,200	1.00	111,570		212		4,320					
1988	1,640	491,300	0.75	78,680		106		4,030					
1989	475	333,200	1.30	91,280		185	2,260,000	0.80	345,000				
1990	919	390,600	1.42	118,000		1,071	1,530,000	0.35	157,800				
1991	227	203,800	0.49	86,470		741	1,796,000	0.72	910,600				
1992	332	450,000	0.30	91,950		1,925	1,813,000	0.38	288,200				
1993	560	335,000	0.22	62,800		5,045	170,000	0.15	69,100	47,600	28.0		
1994	475	509,000	0.75	204,100		8,430	330,000	0.37	155,400	100,400	30.4		
1995	444	350,000	0.70	84,600		8,334	781,000	0.37	296,700	220,700	28.3		
1996	380	448,700	0.63	64,500		8,012	788,000	0.34	101,400	73,800	9.4		
1997	276	409,000	0.66	57,700		7,945	265,000	0.56	92,500	71,100	26.8		
1998	350	306,000	0.82	74,827		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	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	11,828	144,500	0.30	105,400	42,923	29.7	
2001	495	405,000	1.04	186,900	163,400	40.3	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	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	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	8,061	3,020,000	1.17	1,692,890	699,283	23.2	
2005	546	447,000	0.84	70,760	66,957	15.0	10,285	2,414,000	0.52	1,777,850	623,875	25.8	
2006 *	500	521,000	1.0	34,957	34,013	6.5	8,338	2,437,000	0.65	281,868	266,365	10.9	
2007 *	386	360,000	1.4				8,420	2,400,000	0.6				
2008 *	368						8,992						
Ave ¹	470	395,600	0.92	93,169	85,150	22.3	Ave ¹	9,299	1,574,300	0.51	582,222	338,084	22.3

* Incomplete broodyear

¹Average 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

¹Average 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.

BY2001, BY2003, BY2004 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 hatchery smolt is from fry stocking only. Smolt stocking went to Res. Bay

Table 11. Marine survival for sockeye at Bear Lake (BY1989 to BY2006)

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	<i>5.8</i>
2004	<i>2.1</i>
2005	<i>0.0</i>
2006	<i>0.0</i>
AVE	16.6

Red/italics indicates incomplete brood year.

RECOMMENDATIONS

Family tracking for BKD should continue for both sockeye and coho during eggtakes. CIAA should explore other options to reduce the incidence of BKD in the population aside from culling (erythromycin injection of broodstock, in-feed antibiotic for resulting progeny). Continue to stock smolts in Resurrection Bay after a short-term rearing in net pens.

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APPENDICES

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Appendix 1. Bear Lake 2008 - Water Chemistry Analysis

Nutrients and Primary Productivity

Date	Sta	Depth (m)	TP	TFP	FRP	TKN	NH3+NH4	NO2+NO3	TN:TP	RSi	Carbon	Chla	Phaeo	EZD
			(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)		(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)
6/12/2008	B	1	20.1	11.2	3.8	106	4.5	4.1	12 :1	2464	501	3.03	0.27	8.7
		13	12.9	5.3	2.2	147	4.3	28.4	30 :1	2391	352	2.75	1.53	
7/25/2008	B	1	9.5	6.9	2.2	95	4.7	4.1	23 :1	2320	226	1.17	0.32	9.0
		14	13.7	6.4	3.5	143	83.1	25.2	27 :1	2625	495	3.52	0.38	
9/11/2008	B	1	21.2	15.0	2.4	117	5.7	4.1	13 :1	2144	565	3.59	na	9.1
		15	11.0	12.4	8.0	154	204.2	16.6	34 :1	3021	136	0.36	na	
Mean			14.7	9.5	3.7	126.9	51.1	13.8	23 :1	2494	379	2.4	0.6	8.9
Min			9.5	5.3	2.2	95.0	4.3	4.1	12 :1	2144	136	0.4	0.3	8.7
Max			21.2	15.0	8.0	153.9	204.2	28.4	34 :1	3021	565	3.6	1.5	9.1

1m Ave			12.7	11.0	2.8	106.1	5.0	4.1	16.0 :1	2309	430.7	2.6	0.3	8.9
Hypo Ave			12.5	8.0	4.6	147.7	97.2	23.4	30.5 :1	2679	327.7	2.2	1.0	

* Possible contamination of hypolimnion sample.

General Tests and Metals

Date	Sta	Depth (m)	Sp. Cond	pH	Alk	Turb	Color	Ca	Mg	Fe	Secchi
			(umhos/cm)	(SU)	(mg/l)	(NTU)	(Pt)	(mg/l)	(mg/l)	(ug/l)	(meters)
6/12/2008	B	1	79	7.0	28.5	1.0	9	12.4	0.2	31	3.5
		13	79	6.9	27.5	1.9	8	11.8	0.5	31	
7/25/2008	B	1	78	7.1	28.3	0.7	6	12.1	0.4	12	5.5
		14	82	6.7	28.4	3.0	8	11.5	0.8	56	
9/11/2008	B	1	81	7.1	27.9	2.8	5	12.5	0.8	27	3.0
		15	82	6.6	27.7	4.1	9	12.4	0.9	15	
Mean			80	6.9	28.1	2.3	7.5	12.1	0.6	28.7	4.0
Min			78	6.6	27.5	0.7	5.0	11.5	0.2	12.0	3.0
Max			82	7.1	28.5	4.1	9.0	12.5	0.9	56.0	5.5

1m Ave			79.3	7.1	28.2	1.5	6.7	12.3	0.5	23.3	4.0
Hypo Ave			81.0	6.7	27.9	3.0	8.3	11.9	0.7	34.0	

Appendix 1. (continued) Bear Lake 2008 - Zooplankton Analysis

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

Appendix 2. Bear Lake 2008 - Environmental Conditions

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-May						
2-May						
3-May						
4-May						
5-May						
6-May						
7-May						
8-May						
9-May						
10-May						
11-May						
12-May						
13-May						
14-May						
15-May						
16-May	1	0		2.78	4	13
17-May	1	0		2.78	4	12
18-May	3	0		2.78	4	10
19-May	3	0		2.78	4	10
20-May	2	0		2.78	4	12
21-May	3	0		2.78	4	10
22-May	4	4.8	0.08	2.78	4	6
23-May	5	4.5	0.08	2.78	4	8
24-May	5	2.4	0.12	2.78	4	8
25-May	3	0	0.18	2.82	4	12
26-May	2	0	0.84	2.78	4	12
27-May	1	0	0.98	1.78	3	13
28-May	2	0	1.02	1.78	4	18
29-May	4	0	1.06	1.8	6	17
30-May	3	0	1.12	1.8	6	14
31-May	5	1	1.12	1.88	6	9

Date	Sky	Precip. (mm)	Lower Gauge (ft)	Upper Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Jun	1	3	1.12	1.78	6	11
2-Jun	5	2	1.06	1.78	7	10
3-Jun	5	3	1.02	1.8	7	7
4-Jun	4	1.2	1	1.78	7	9
5-Jun	5	6	1.02	1.79	7	4
6-Jun	3	1	0.96	1.68	7	12
7-Jun	1	3.4	0.96	1.68	7	16
8-Jun	1	0	0.96	1.68	8	16
9-Jun	1	0	0.92	1.68	7	12
10-Jun	4	0	0.92	1.72	7	10
11-Jun	5	3	0.96	1.66	8	9
12-Jun	2	0.5	0.92	1.66	9	14
13-Jun	3	0	0.84	1.66	9	14
14-Jun	4	0	0.92	1.66	9	15
15-Jun	2	0	0.94	1.68	10	14
16-Jun	3	0	0.96	1.62	10	14
17-Jun	2	0	0.96	1.62	11	14
18-Jun	4	0	0.94	1.61	11	12
19-Jun	3	0	0.88	1.64	11	15
20-Jun	4	0	0.88	1.64	11	14
21-Jun	2	0	0.88	1.64	11	14
22-Jun	4	12.5	0.9	1.62	11	12
23-Jun	2	0	0.9	1.6	12	14
24-Jun	4	0	0.94	1.6	12	13
25-Jun	5	3.4	0.9	1.58	12	12
26-Jun	5	6.2	0.9	1.62	12	10
27-Jun	4	4.4	0.86	1.6	12	9
28-Jun	4	0.5	1.1	1.62	12	11
29-Jun	3	1	1	1.62	12	12
30-Jun	3	0	0.96	1.58	13	16

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 2008 - 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	1	4	0.94	1.58	13	12	1-Aug	4	4	0.46	1.44	13	12
2-Jul	3	3.6	0.91	1.58	13	12	2-Aug	4	3.6	0.42	1.44	12	11
3-Jul	4	0	0.92	1.58	13	11	3-Aug	4	0	0.42	1.42	13	10
4-Jul	4	0	0.9	1.58	13	11	4-Aug	5	0	0.42	1.42	14	14
5-Jul	1	3.6	0.93	1.58	13	15	5-Aug	3	3.6	0.38	1.42	14	14
6-Jul	4	0	0.96	1.58	13	13	6-Aug	3	0	0.38	1.42	14	16
7-Jul	4	0	0.98	1.6	13	12	7-Aug	4	0	0.36	1.42	14	16
8-Jul	4	0	0.99	1.6	13	14	8-Aug	4	0	0.34	1.4	14	16
9-Jul	3	8.8	0.98	1.61	13	17	9-Aug	4	8.8	0.3	1.38	14	15
10-Jul	2	0	0.98	1.6	14	16	10-Aug	5	0	0.28	1.38	13	14
11-Jul	4	0	0.98	1.58	14	15	11-Aug	5	0	0.28	1.38	13	14
12-Jul	4	0	0.98	1.58	14	14	12-Aug	4	0	0.26	1.38	13	14
13-Jul	4	0	0.98	1.58	14	15	13-Aug	5	0	0.26	1.38	13	13
14-Jul	4	0	0.98	1.58	14	14	14-Aug	4	0	0.24	1.38	14	14
15-Jul	4	0	0.98	1.58	14	9	15-Aug	3	0	0.2	1.36	14	15
16-Jul	4	0	0.98	1.58	14	9	16-Aug	4	0	0.18	1.3	14	14
17-Jul	4	3.2	0.98	1.58	15	12	17-Aug	4	3.2	0.16	1.28	14	14
18-Jul	4	1.36	0.72	1.6	15	12	18-Aug	4	1.36	0.16	1.28	14	11
19-Jul	3	0	0.72	1.56	14	15	19-Aug	4	0	0.16	1.28	14	11
20-Jul	1	0	0.72	1.52	14	16	20-Aug	4	0	0.15	1.27	14	10
21-Jul	5	4.8	0.71	1.48	13	11	21-Aug	2	4.8	0.15	1.27	14	10
22-Jul	5	3.4	0.71	1.48	13	9	22-Aug	4	3.4	0.15	1.26	13	12
23-Jul	5	10.2	0.7	1.48	13	8	23-Aug	4	10.2	0.14	1.26	13	13
24-Jul	5	28	0.78	1.55	13	8	24-Aug	4	28	0.14	1.26	13	11
25-Jul	4	12.2	0.75	1.55	13	15	25-Aug	4	12.2	0.14	1.26	13	11
26-Jul	4	0	0.52	1.55	13	13	26-Aug	4	0		1.25	13	11
27-Jul	4	1.2	0.46	1.55	13	14	27-Aug	4	1.2		1.25	12	12
28-Jul	5	2.8	0.48	1.55	13	12	28-Aug	4	2.8	0.64	1.25	12	14
29-Jul	1	0	0.48	1.55	13	22	29-Aug	1	0	0.64	1.24	11	14
30-Jul	4	0	0.46	1.48	13	14	30-Aug	1	0	0.63	1.24	11	9
31-Jul	4	0	0.46	1.48	13	14	31-Aug	5	0	0.65	1.24	11	9

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 2008 - 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	5	30.2	0.88	1.4	13	9	1-Oct	1	0		1.55	7	7
2-Sep	5	10	0.89	1.4	13	11	2-Oct	1	0		1.55	6	4
3-Sep	5	0	0.9	1.44	13	14	3-Oct	4	0	3	1.5	6	4
4-Sep	5	8	0.94	1.44	13	14	4-Oct	4	3.2	3	1.5	6	4
5-Sep	5	40	0.96	1.48	13	14	5-Oct	4	3.1	3	1.5	6	1
6-Sep	5	3.6	0.96	1.48	13	11	6-Oct	5	0	4.8	1.5	6	3
7-Sep	5	42	0.62	1.58	13	11	7-Oct	3	4.2	3	1.5	6	1
8-Sep	5	8.2	0.5	1.59	13	10	8-Oct	2	0	3	1.5	6	2
9-Sep	5	16.2	0.52	1.59	12	10	9-Oct	4	65	2.5	1.8	6	2
10-Sep	5	4.2	0.55	1.6	11	8	10-Oct	4	16.2	2	1.8	6	5
11-Sep	5	8.3	0.55	1.61	11	8	11-Oct	3	4.2		1.99	6	2
12-Sep	5	16.2	0.57	1.63	11	8	12-Oct	3	10		1.99	6	2
13-Sep	5	32.2	0.57	1.63	11	9	13-Oct	4	0		1.99	5	1
14-Sep	5	24.5	0.57	1.63	10	8	14-Oct	4	0		1.92	6	4
15-Sep	4	15.2	0.2	1.64	11	11	15-Oct	4	12.5		1.89	5	4
16-Sep	5	8.2	0.22	1.65	11	10	16-Oct	3	2		1.89	5	3
17-Sep	5	4.5	0.23	1.66	11	9	17-Oct	1	0		1.88	5	1
18-Sep	5	52	0.21	1.74	11	12	18-Oct	3	0		1.86	5	3
19-Sep	5	16.5		1.74	11	11	19-Oct	3	0		1.83	5	2
20-Sep	5	36		1.74	11	10	20-Oct	4	0		1.8	5	3
21-Sep	4	4.6		1.72	11	8	21-Oct	4	40		1.8	5	1
22-Sep	5	40		1.67	10	8	22-Oct	4	12.5		1.8	5	0
23-Sep	4	32		1.65	10	8	23-Oct	1	0		1.79	5	0
24-Sep	5	12.5		1.63	10	7	24-Oct	1	0		1.79	4	0
25-Sep	4	1		1.6	7	9	25-Oct	1	0		1.78	4	1
26-Sep	1	0		1.6	7	7	26-Oct	1	0		1.77	4	1
27-Sep	1	0		1.6	7	6	27-Oct	1	0		1.77	3	2
28-Sep	1	0	0.12	1.6	7	6	28-Oct	1	0		1.76	3	0
29-Sep	1	0	0.12	1.6	7	6	29-Oct	1	0		1.74	3	0
30-Sep	1	0	0.12	1.58	7	6	20-Oct	2	0		1.73	3	0
							31-Oct	1	0		1.72	3	0

Sky Conditions

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

Appendix 3. Bear Lake 2008 - 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	0	0	0	0	0	0	0	0
20-May	0	0	0	0	0	0	0	0
21-May	0	0	0	0	0	0	0	0
22-May	0	0	0	0	0	0	0	0
23-May	0	0	0	0	0	0	0	0
24-May	0	0	0	0	0	0	0	0
25-May	0	0	0	0	0	0	0	0
26-May	3,857	3,857	174	174	1	1	0	0
27-May	19,386	23,243	284	458	0	1	0	0
28-May	10,286	33,529	269	727	0	1	0	0
29-May	27,040	60,569	637	1,364	0	1	0	0
30-May	6,124	66,693	215	1,579	0	1	0	0
31-May	9,387	76,080	384	1,963	0	1	0	0
01-Jun	9,563	85,643	303	2,266	1	2	0	0
02-Jun	25,793	111,436	474	2,740	0	2	0	0
03-Jun	5,026	116,462	653	3,393	1	3	0	0
04-Jun	19,160	135,622	1,825	5,218	0	3	0	0
05-Jun	3,032	138,654	289	5,507	1	4	0	0
06-Jun	4,891	143,545	532	6,039	0	4	0	0
07-Jun	18,288	161,833	790	6,829	0	4	0	0
08-Jun	28,736	190,569	817	7,646	0	4	0	0
09-Jun	15,368	205,937	937	8,583	9	13	0	0
10-Jun	13,169	219,106	1,545	10,128	7	20	0	0
11-Jun	9,590	228,696	7,564	17,692	12	32	0	0
12-Jun	16,120	244,816	6,270	23,962	1	33	0	0
13-Jun	2,681	247,497	4,223	28,185	11	44	0	0
14-Jun	6,230	253,727	4,660	32,845	4	48	0	0
15-Jun	2,330	256,057	4,230	37,075	0	48	0	0
16-Jun	8,610	264,667	6,390	43,465	10	58	0	0
17-Jun	6,890	271,557	5,360	48,825	0	58	0	0
18-Jun	10,600	282,157	2,480	51,305	0	58	0	0
19-Jun	9,830	291,987	4,300	55,605	0	58	0	0
20-Jun	7,640	299,627	950	56,555	0	58	0	0
21-Jun	3,000	302,627	730	57,285	0	58	0	0
22-Jun	1,634	304,261	1,191	58,476	0	58	0	0
23-Jun	897	305,158	128	58,604	0	58	0	0
24-Jun	1,314	306,472	204	58,808	0	58	0	0
25-Jun	956	307,428	383	59,191	0	58	0	0
26-Jun	32	307,460	617	59,808	0	58	0	0
27-Jun	167	307,627	128	59,936	1	59	0	0
28-Jun	139	307,766	1,206	61,142	0	59	0	0
29-Jun	216	307,982	808	61,950	0	59	1	1
30-Jun	61	308,043	202	62,152	0	59	0	1
01-Jul	80	308,123	348	62,500	0	59	0	1
02-Jul	186	308,309	525	63,025	0	59	0	1
03-Jul	16	308,325	127	63,152	1	60	0	1
04-Jul	23	308,348	118	63,270	0	60	0	1
05-Jul	48	308,396	168	63,438	0	60	0	1
06-Jul	36	308,432	292	63,730	0	60	0	1
07-Jul	27	308,459	213	63,943	0	60	0	1
08-Jul		308,459		63,943		60		1
09-Jul		308,459		63,943		60		1
10-Jul		308,459		63,943		60		1
11-Jul		308,459		63,943		60		1
Totals		308,459		63,943		60		1

Appendix 4. Bear Lake 2008 - Adult Sockeye Salmon Migration.

Date	Lake Escapement			Donate & Harvest	Morts	Daily Total	Cumm. 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	0	0	0	0
26-May	0	0	0	0	0	0	0
27-May	0	0	0	0	0	0	0
28-May	0	0	0	0	0	0	0
29-May	0	0	0	0	0	0	0
30-May	2	1	3	0	0	3	3
31-May	0	1	1	0	0	1	4
01-Jun	3	2	5	0	0	5	9
02-Jun	14	4	18	0	0	18	27
03-Jun	10	8	18	0	0	18	45
04-Jun	42	21	63	0	0	63	108
05-Jun	28	12	40	0	0	40	148
06-Jun	63	14	77	0	0	77	225
07-Jun	39	19	58	0	0	58	283
08-Jun	101	74	175	0	0	175	458
09-Jun	40	19	59	0	0	59	517
10-Jun	94	54	148	0	0	148	665
11-Jun	35	7	42	0	0	42	707
12-Jun	67	10	77	0	0	77	784
13-Jun	90	24	114	0	0	114	898
14-Jun	60	34	94	0	0	94	992
15-Jun	134	62	196	0	0	196	1,188
16-Jun	122	70	192	0	0	192	1,380
17-Jun	157	72	229	0	0	229	1,609
18-Jun	244	52	296	0	0	296	1,905
19-Jun	135	50	185	0	0	185	2,090
20-Jun	75	21	96	0	0	96	2,186
21-Jun	89	31	120	0	0	120	2,306
22-Jun	112	78	190	0	0	190	2,496
23-Jun	187	107	294	0	0	294	2,790
24-Jun	237	215	452	0	0	452	3,242
25-Jun	198	646	844	0	0	844	4,086
26-Jun	615	946	1,561	0	7	1,568	5,654
27-Jun	432	539	971	0	0	971	6,625
28-Jun	334	396	730	0	0	730	7,355
29-Jun	407	510	917	0	0	917	8,272
30-Jun	252	359	611	0	1	612	8,884
01-Jul	135	170	305	0	0	305	9,189
02-Jul	241	214	455	0	0	455	9,644
03-Jul	195	302	497	0	0	497	10,141
04-Jul	347	850	1,197	0	0	1,197	11,338
05-Jul	182	235	417	0	0	417	11,755
06-Jul	369	605	974	0	0	974	12,729
07-Jul	237	232	469	0	0	469	13,198
08-Jul	96	62	158	0	0	158	13,356
09-Jul	36	22	58	0	0	58	13,414
10-Jul	1	0	1	281	0	282	13,696
11-Jul	0	0	0	462	0	462	14,158
12-Jul	0	0	0	988	0	988	15,146
13-Jul	0	0	0	428	0	428	15,574
14-Jul	3	5	8	287	0	295	15,869
15-Jul	11	10	21	40	0	61	15,930
16-Jul	0	0	0	263	0	263	16,193
17-Jul	0	0	0	80	0	80	16,273
18-Jul	0	0	0	164	0	164	16,437
19-Jul	0	0	0	212	0	212	16,649
20-Jul	0	0	0	63	0	63	16,712
21-Jul	0	0	0	43	0	43	16,755
22-Jul	0	0	0	106	0	106	16,861
23-Jul	0	0	0	63	0	63	16,924
24-Jul	0	0	0	46	0	46	16,970
25-Jul	0	0	0	50	0	50	17,020
26-Jul	0	0	0	57	0	57	17,077
27-Jul	0	0	0	12	0	12	17,089
28-Jul	0	0	0	12	0	12	17,101
29-Jul	0	0	0	41	0	41	17,142
30-Jul	0	0	0	0	0	0	17,142
31-Jul	0	0	0	0	0	0	17,142
01-Aug			0			0	17,142
02-Aug			0			0	17,142
03-Aug			0			0	17,142
04-Aug			0			0	17,142
05-Aug			0			0	17,142
06-Aug			0			0	17,142
07-Aug			0			0	17,142
08-Aug			0			0	17,142
Total	6,271	7,165	13,436	3,698	8	17,142	

Appendix 5. Bear Lake 2008 - 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			
04-Sep	1	1	2	0	0	0	0	0	0	1	1	0	2	2
05-Sep	4	24	28	0	0	0	0	0	0	4	24	0	28	30
06-Sep	9	22	31	0	0	0	0	0	0	9	22	0	31	61
07-Sep	25	45	70	0	0	0	0	0	0	25	45	0	70	131
08-Sep	7	10	17	0	0	0	0	0	0	7	10	0	17	148
09-Sep	1	3	4	0	0	0	0	0	0	1	3	0	4	152
10-Sep	2	8	10	0	0	0	0	0	0	2	8	0	10	162
11-Sep	1	7	8	0	0	0	0	0	0	1	7	0	8	170
12-Sep	1	2	3	0	0	0	0	0	0	1	2	0	3	173
13-Sep	36	0	36	0	65	65	0	0	0	36	65	0	101	274
14-Sep	10	0	10	0	14	14	0	0	0	10	14	0	24	298
15-Sep	48	13	61	0	62	62	0	0	0	48	75	0	123	421
16-Sep	0	10	10	40	38	78	0	0	0	40	48	0	88	509
17-Sep	0	0	0	44	0	44	0	0	0	44	0	0	44	553
18-Sep	0	0	0	62	0	62	0	58	58	62	58	0	120	673
19-Sep	0	0	0	48	0	48	0	58	58	48	58	0	106	779
20-Sep	0	0	0	48	0	48	0	0	0	48	0	0	48	827
21-Sep	0	0	0	0	0	0	0	55	55	0	55	0	55	882
22-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	882
23-Sep	0	0	0	0	0	0	0	196	196	0	196	0	196	1,078
24-Sep	1	9	10	31	21	52	0	35	35	32	65	1	98	1,176
25-Sep	2	14	16	32	7	39	0	0	0	34	21	0	55	1,231
26-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	1,231
27-Sep	0	0	0	7	5	12	0	0	0	7	5	0	12	1,243
28-Sep	0	0	0	10	7	17	0	0	0	10	7	0	17	1,260
29-Sep	0	0	0	0	0	0	0	0	0	0	0	0	0	1,260
30-Sep	0	0	0	6	2	8	0	0	0	6	2	0	8	1,268
01-Oct	0	0	0	2	4	6	0	0	0	2	4	0	6	1,274
02-Oct	0	0	0	0	4	4	0	0	0	0	4	0	4	1,278
03-Oct	0	0	0	1	2	3	0	0	0	1	2	0	3	1,281
04-Oct	0	0	0	2	2	4	0	0	0	2	2	0	4	1,285
05-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,285
06-Oct	0	0	0	1	1	2	0	0	0	1	1	0	2	1,287
07-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,287
08-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,287
09-Oct	0	0	0	1	0	1	0	0	0	1	0	0	1	1,288
10-Oct	0	0	0	8	10	18	0	0	0	8	10	0	18	1,306
11-Oct	1	3	4	24	18	42	0	0	0	25	21	0	46	1,352
12-Oct	2	1	3	41	26	67	0	0	0	43	27	0	70	1,422
13-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,422
14-Oct	11	4	15	0	0	0	0	0	0	11	4	0	15	1,437
15-Oct	5	5	10	0	0	0	0	0	0	5	5	0	10	1,447
16-Oct	4	6	10	0	0	0	0	0	0	4	6	0	10	1,457
17-Oct	0	1	1	0	0	0	0	0	0	0	1	0	1	1,458
18-Oct	0	1	1	0	0	0	0	0	0	0	1	0	1	1,459
19-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,459
20-Oct	4	2	6	0	0	0	0	0	0	4	2	0	6	1,465
21-Oct	1	1	2	0	0	0	0	0	0	1	1	0	2	1,467
22-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
23-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
24-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
25-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
26-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
27-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
28-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
29-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
30-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
31-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
01-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
02-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
03-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
04-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
05-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	1,467
Total	176	192	368	408	288	696	0	402	402	584	882	1	1,467	

Appendix 6. Bear Lake 2008 – Adult Sockeye Age and Sex Characteristics

	Age						Total
	1.1	1.2	1.3	2.1	2.2	2.3	
Sample Period:	30 May through 31 July						
Males (No.)	391	17,968	26,561	0	2,344	391	47,653
Percent	0.8%	37.7%	55.7%	0.0%	4.9%	0.8%	43.3%
Sample Size	1	46	68	0	6	1	122
Total Sample Size							110
Mean Length (mm)	336	492	555		520	644	530
Std. Deviation		34.4	25.4		49.0		46.8
Std. Error		5.1	3.1		20.0		4.5
Mean Weight (kg)	1.26	1.86	2.72		2.20	3.90	2.37
Std. Deviation		0.47	0.48		0.18		0.64
Std. Error		0.07	0.06		0.07		0.06
Females (No.)	0	19,921	37,107	0	3,515	1,172	61,715
Percent	0.0%	32.3%	60.1%	0.0%	5.7%	1.9%	56.0%
Sample Size	0	51	95	0	9	3	158
Total Sample Size							161
Mean Length (mm)		486	532		440	530	512
Std. Deviation		28.5	25.3		148.5	27.9	48.8
Std. Error		4.0	2.6		49.5	16.1	3.8
Mean Weight (kg)		1.69	2.34		1.80	2.13	2.08
Std. Deviation		0.33	0.42		0.38	0.45	0.48
Std. Error		0.05	0.04		0.13	0.26	0.04
Both Sexes (No.)	61	5,896	10,030	0	912	243	17,142
Percent	0.4%	34.4%	58.5%	0.0%	5.3%	1.4%	99.6%
Sample Size	1	97	165	0	15	4	282
Total Sample Size							271
Mean Length (mm)	336	489	542		472	559	519
Std. Deviation		31.4	27.6		123.0	61.2	48.6
Std. Error		3.2	2.1		31.8	30.6	2.9
Mean Weight (kg)	1.26	1.77	2.51		1.96	2.57	2.17
Std. Deviation		0.41	0.49		0.37	0.96	0.58
Std. Error		0.04	0.04		0.10	0.48	0.04

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

Appendix 7. Bear Lake 2008 – Adult Coho Age and Sex Characteristics

	Age			Total
	1.1	2.1	3.1	
Sample Period:	04 September through 21 October			
Males (No.)	409	756	18	1,182
Percent	34.6%	63.9%	1.5%	80.6%
Sample Size	46	85	2	133
Total Sample Size				139
Mean Length (mm)	580	603	596	590
Std. Deviation	53.4	62.7	11.3	60.3
Std. Error	7.9	6.8	8.0	5.1
Mean Weight (kg)	3.42	3.85	3.72	3.60
Std. Deviation	1.06	1.18	0.79	1.16
Std. Error	0.16	0.13	0.56	0.10
Females (No.)	9	23	0	32
Percent	28.1%	71.9%	0.0%	2.2%
Sample Size	9	23	0	32
Total Sample Size				32
Mean Length (mm)	559	616		604
Std. Deviation	61.5	43.0		52.5
Std. Error	20.5	9.0		9.3
Mean Weight (kg)	3.18	4.04		3.89
Std. Deviation	0.84	0.85		0.91
Std. Error	0.28	0.18		0.16
Both Sexes (No.)	489	960	18	1,467
Percent	33.3%	65.5%	1.2%	100.0%
Sample Size	55	108	2	165
Total Sample Size				171
Mean Length (mm)	577	606	596	597
Std. Deviation	54.8	59.1	11.3	59.1
Std. Error	7.4	5.7	8.0	3.9
Mean Weight (kg)	3.38	3.89	3.72	3.68
Std. Deviation	1.02	1.12	0.79	1.12
Std. Error	0.14	0.11	0.56	0.09

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

Appendix 8. Bear Lake 2008 – Project Updates

Sockeye Salmon Project

Stocking & Misc. Activities

Crew on-site:	16-May		
Ice-out:	NA		
Crew off-site:	31-Oct		
Fry stocking:	3-Jun	2,400,000	0.6 g
PreSmolt stocking:			
Smolt stocking:(Res Bay)	12-Jun	1,600,000	10.4 g
Fertilizer application:	3-Jul to 13-Aug	810 gallon	

Smolt Migration

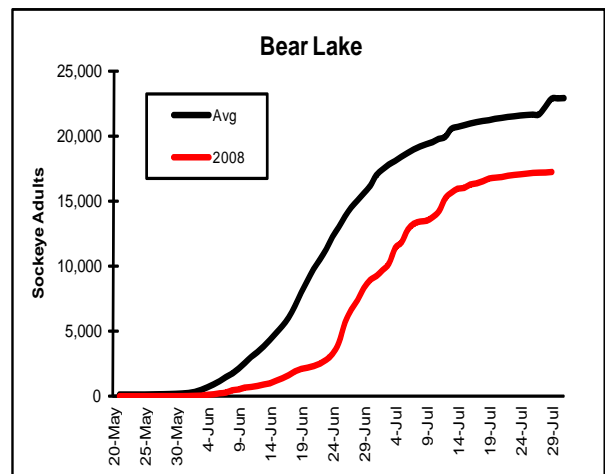
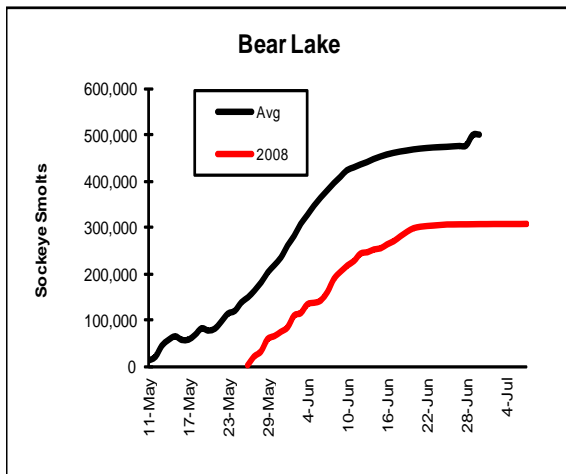
Dates:	26-May to 7-Jul	
Sockeyes:		308,459
Percent age 1:		91.4%
Percent age 2:		8.6%
Percent age 3:		0.0%
Percent hatchery:		94.5%
Dolly Varden:		60

Egg Take

Dates:	2-Aug to 26-Aug	
No. of broodstock used:		4,172
Green eggs:		6,033,000
Fecundity:		2,892
Eyed eggs:		5,531,000
% Survival		91.7%

Adult Migration

Dates:	28-May to 31-Jul	
Total return:		110,149
Commercial & Sport Fish harvest:		63,677 58%
C.R. harvest(FW & SW):		33,036 30%
Lake:		13,436 12%
Mortalities		0
Hatchery broodstock:		4,444
Lake broodstock:		8,992



Appendix 8 (continued). Bear Lake 2008 – Project Updates

Coho Salmon Project

Stocking & Misc. Activities

Crew on-site:	16-May		
Ice-out:	NA		
Crew off-site:	31-Oct		
Fry stocking:	10-Jun	360,000	1.4 g
Smolt stocking Bear Cr.	6-Jun	142,000	12.5 g
Smolt stocking Lowell Cr			
Fertilizer application:	3-Jul to 13-Aug	810	gallon

Egg Take

Dates:	7-Oct to 30-Oct	
No. of females used:		220
Green eggs:		574,000
Fecundity:		4,348
Eyed eggs:		283,000
% Survival		49.3%

Smolt Migration

Dates:	26-May to 7-Jul	
Cohos:		63,943
Percent age 1:		54.7%
Percent age 2:		44.9%
Percent age 3:		0.0%
Percent hatchery:		97.3%
Dolly Varden:		60

Adult Migration

Dates:	4-Sep to 21-Oct	
Coho total creek return:	1,467	
Weir return:	1,467	100%
C.R. harvest:	0	0%
Lake:	368	25%
Hatchery broodstock:	696	47%
Est. Remaining in Bear Ck:	0	0%
Est. Remaining in Salmon Ck:	0	0%

