

**Bear Lake
Salmon Enhancement
Progress Report
2012**

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This year's operation of the Bear Lake Sockeye and Coho Enhancement Project was made possible through enhancement taxes paid by the commercial fishermen in Area H, Cook Inlet and associated waters and through the harvest and sale of surplus fish.

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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 2012 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. Appreciation is extended to Icicle SeaFoods for the collection of sockeye salmon otoliths from the commercial and common property harvests in Resurrection Bay.

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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 2012, 2.490 million sockeye fry (BY11) and 220,000 coho fry (BY11) were released into Bear Lake. At the time of release, the sockeye fry averaged 0.61 grams and the coho fry averaged 1.68 grams. All released fry were of Bear Lake origin. In addition to the fry stocking, 1,305 M sockeye smolts (BY10) averaging 10.8 grams were released into Resurrection Bay. An addition, 93,000 coho smolts (BY10) averaging 12.3 grams were released into Bear Creek.

Smolt migration monitoring began on 15 May and continued daily until 08 July. During this time a total of 467,000 ($\pm 28,700$) sockeye and 45,900 (± 970) coho smolts migrated from the lake.

Based on otolith marks, 99.3% ($\pm 0.8\%$) of the emigrating sockeye smolts were enhanced. An estimated 97.4% ($\pm 1.7\%$) smolts were age 1 and 2.6% ($\pm 1.7\%$) were age 2. The average length and weight of the age 1 sockeye smolts was 93 mm (± 0.8 mm) and 6.9 g (± 0.2 g) respectively. The age 2 sockeye smolts were 132 mm (± 6.3 mm) and 20.7 g (± 2.4 g).

Based on otolith marks, 98.1% ($\pm 1.5\%$) of the emigrating coho smolts were enhanced. An estimated 35.9% ($\pm 5.9\%$) smolts were age 1 and 64.1% ($\pm 5.9\%$) were age 2. The average length and weight of the age 1 coho smolts was 101 mm (± 2.4 mm) and 8.1 g (± 2.7 g) respectively. The age 2 coho smolts were 122 mm (± 0.5 mm) and 19.6 g (± 0.9 g).

A total of 14,381 adult sockeye returned to Bear Creek in 2012. The returning sockeye salmon were age 1.2 (41.3%), age 1.3 (42.0%), age 2.2 (15%) and age 2.3 (1.4%). A total of 12,459 were passed into the lake, while the remaining 1,922 were harvested at the weir for cost recovery. An additional 81,531 were harvested in Resurrection Bay in cost recovery. In the common property, 0 were harvested in the commercial fishery and the fish were caught in the sport fishery is unknown at this time. Total return of sockeye to Resurrection Bay was 95,892.

A total of 924 adult coho returned to Bear Creek weir in 2012. The returning fish were age 1.1 (7.8%), age 2.1 (85.9%) or 3.1 (6.3%). Of the adult coho returning, 31 were harvested and sold for cost recovery or donated, 395 were held and used as hatchery broodstock, and 498 were passed into Bear Lake.

From 02 August to 17 August 2012, 6,041,114 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 2,168 females were fertilized with milt from 2,168 males. All female adult sockeye salmon were injected with an antibiotic (erythromycin) prior to be passed up into the

lake in order to reduce the prevalence of BKD in the spawning population.

From 02 October to 10 October 2012, 638,551 coho eggs were collected from 156 females and fertilized with milt from 104 males. In addition, the Alaska Department of Fish and Game (ADF&G) collected 137,496 coho salmon eggs.

A total of 120 gallons of fertilizer was applied to Bear Lake in 2012. Limnological samples were collected in June, July and August (2x).

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.

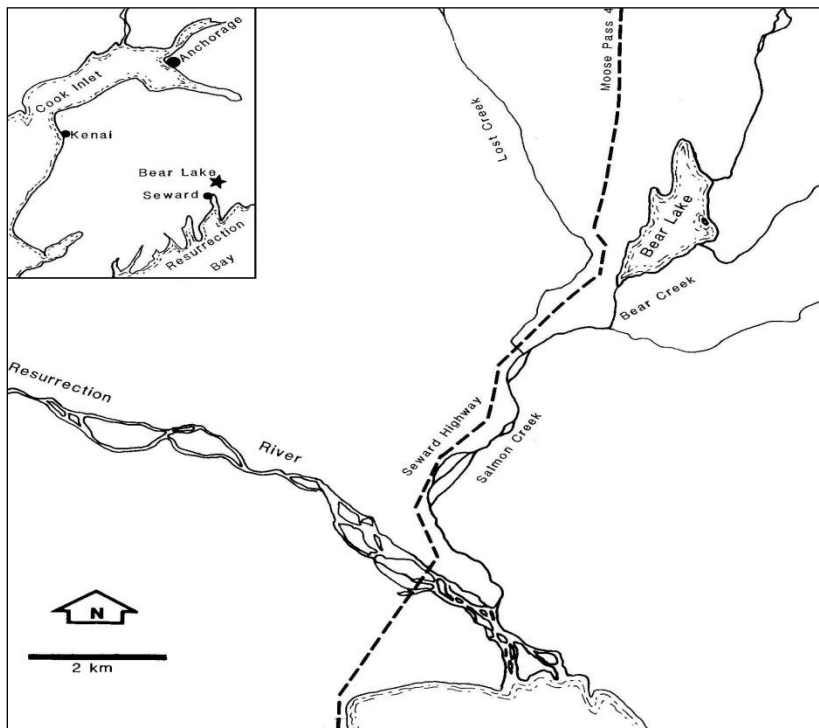


Figure 1. Map showing location of Bear Lake near Seward, Alaska.

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.

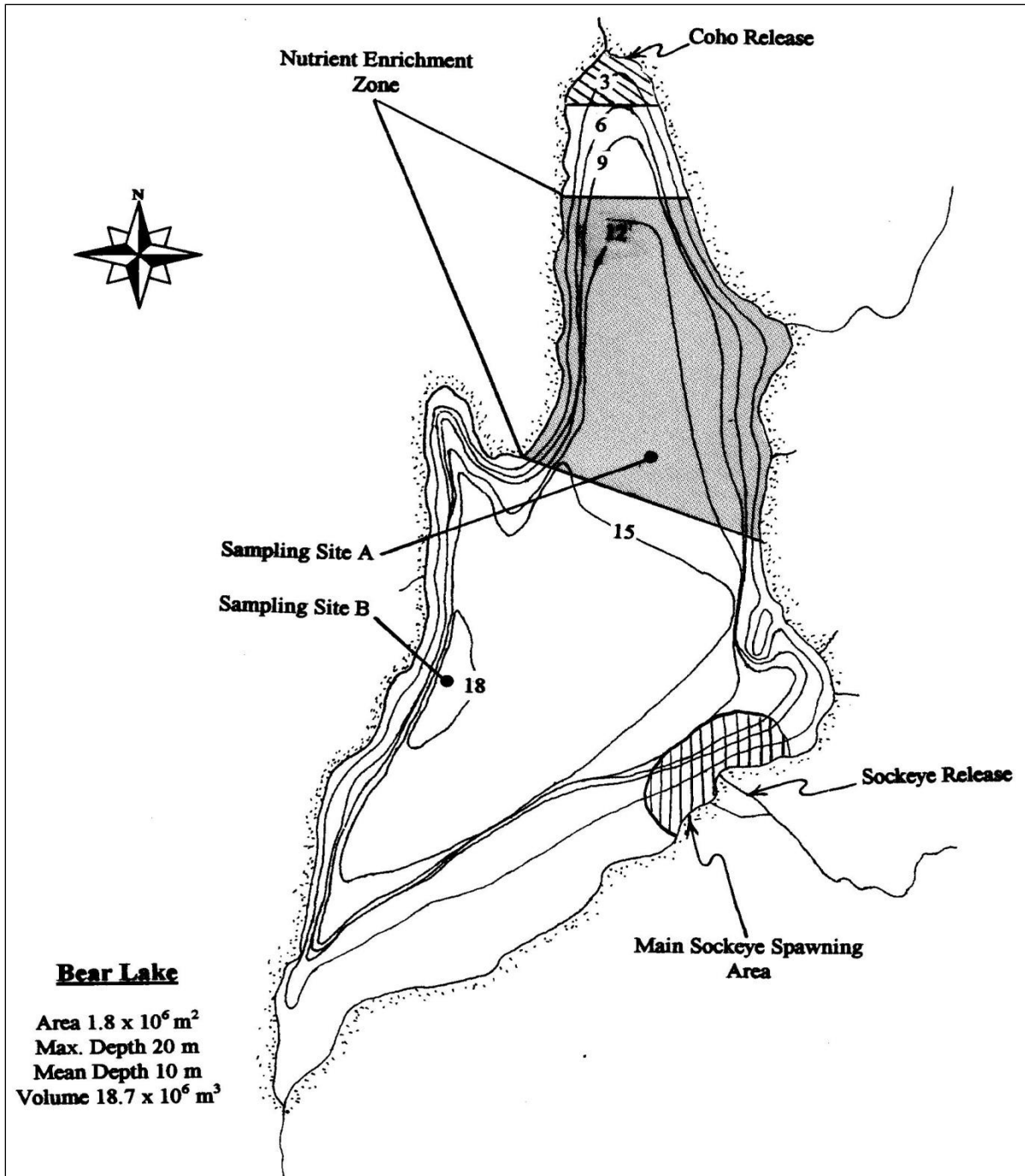


Figure 2. Bear Lake near Seward, Alaska

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 2012 were consistent with previous limnological sampling activities with the exception of the water sampler used (Kemmerer versus Van Dorn). These procedures are described by Koenings, et al. (1986).

During 2012, assessments of water quality were conducted 4 times (June, July, August (2x)) throughout the open water season. 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 water sampler (horizontal configuration) 1 meter below the surface and from the hypolimnion. One secondary site, site A, (Figure 2) was also sampled for Secchi disk transparency and zooplankton densities. All water samples were collected by CIAA and analyses completed by ADF&G. Due to equipment failure, total nitrogen could not be analyzed.

In addition to the water chemistry analysis, daily observations of other environmental conditions at Bear Lake were made. These observations, completed at 5:00 P.M. throughout the summer field season, included percent cloud cover, precipitation to the nearest millimeter, air temperature, Bear Creek water temperature and Bear Creek stage. Bear Creek stage height is recorded in two different locations. The upper gauge is used to monitor pool height above the weir while the lower gauge monitors the water level below the weir. Both heights are dependent on the addition or removal of dam boards. Between 04 September and 08 September, no data was recorded as staff was offsite performing the Shell Lake egtake.

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 08 July to 28 July. The amount of fertilizer to apply was calculated using the mean fall total phosphorus concentration recorded in 2011 using the calculation model supplied by ADF&G. The actual application rate was 75% of total recommended. 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 2012 to identify, count and control the migration of all fish moving into or out of Bear Lake.

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

To enumerate migrating smolts with the 10% sub-sampling procedure, the counting period was divided into 20 minute intervals. During each 20 minute interval, migrating fish were directed into the live-box for two minutes and then counted. During the remaining 18 minutes, migrating smolts were passed through the weir structure uncounted. The two-minute smolt count was multiplied by 10 to estimate the number of smolts migrating during the twenty minute interval.

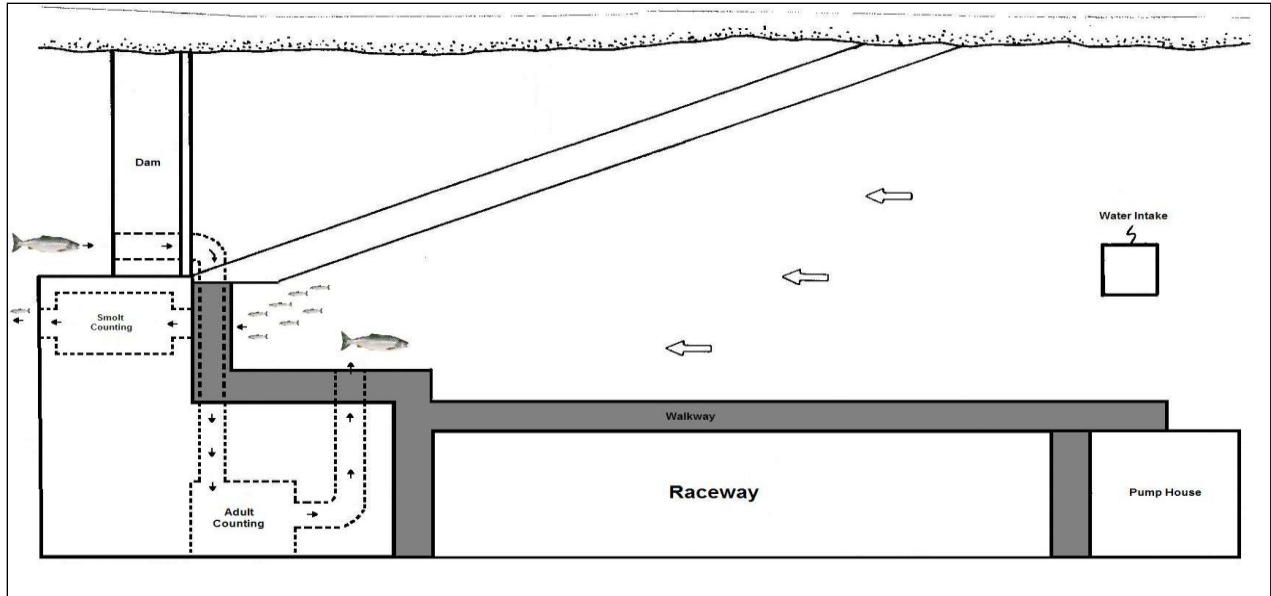


Figure 3. The Bear Creek weir, smolt trap and adult counting complex (Top View).

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

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

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

and the variance is,

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

And:

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

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

Smolt Characteristics and Enhanced Contribution

CIAA has released sockeye and coho salmon fry to Bear Lake since 1990. To evaluate this enhancement procedure, CIAA has collected a sample of sockeye and coho smolts migrating each year to determine age, weight, and length characteristics of the migrating populations. Since 1993, CIAA has also marked the otolith of all salmon fry released to Bear Lake with a thermal mark³. The purpose of this mark is to determine the contribution of released hatchery fish to the Bear Lake smolt population.

In 2012, smolts collected for measurement, age determination, and otolith removal were sampled in proportion to the daily smolt migration. This was accomplished by collecting every 985th sockeye smolt and every 145th 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 available on 474 sockeye smolts (0.10%) and 316 coho smolts (0.69%).

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

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.

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,

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:

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

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.

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

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

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

with a variance of:

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

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

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

and, the relative error is:

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

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

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

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

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

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

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

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

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

with an approximate variance estimate of:

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

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

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

Adult Escapement

The weir structure that was used for enumerating the smolt migration was also used to identify, count, and control the migration of adult fish returning to Bear Lake. The escapement enumeration included the assessment of the sex, age, and weight of the returning population of fish.

To enumerate the adult migration, fish attempting to migrate upstream were directed by the weir into a live box attached to a mechanical lift. Once in the live box, the fish were lifted above the weir, identified, and counted. Counted fish were either passed into the Bear Lake system or collected for other uses (harvest; hatchery broodstock). All female sockeye salmon that were passed into the lake received an erythromycin injection (0.17 - 0.20 mg/kg fish weight) to reduce the prevalence of BKD (Bacterial Kidney Disease) at the spawning ground.

Every 13th sockeye was sampled to assess sex, age and weight. For the coho adult migration, every 10th coho was sampled. In 2012, measurements were collected from 961 sockeye (7.7%) and 90 coho (9.7%).

Gamete Collection, Incubation and Rearing - Sockeye

Since 1989, egg collection, incubation and rearing of sockeye salmon have been done to develop a Bear Lake sockeye fishery. Prior to 1993, sockeye salmon returning to the Big River Lakes area on the west side of Cook Inlet or to Upper Russian Lake on the Kenai Peninsula served as broodstock for the Bear Lake sockeye stocking program. Fry from eggs collected from one or both of these broodstocks were released into Bear Lake each spring from 1990 through 1993. In 1993, adults resulting from the Bear Lake stocking program returned to Bear Lake in numbers large enough (>5,000) to provide broodstock for the hatchery. Since 1993, all sockeye gametes collected for the Bear Lake stocking program were collected from adults returning to Bear Lake.

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

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

Male and female adult sockeye salmon from the spawning areas were killed and stripped of their gametes. The gametes were shipped to Trail Lakes Hatchery for fertilization, incubation and rearing. The 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 – 4,2H; Smolt – 3,3,2H).

During the eggtake, sixty female fish were sampled for routine disease screening (included bacteriology, BKD and virology) on two occasions. The first sampling consisted of fish known to have been injected with the erythromycin at the weir (identified with floy tag). The second sampling consisted of fish that either lost their floy tag or had misidentified as male at the weir and injection status was unknown.

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, all females used for gamete collection 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 2 different lots. Incubation followed standard hatchery procedures and water temperature was regulated to thermally mark the 2 different lot (Fry – 4,3H, Smolt 3,2H). Coho salmon eggs were also collected by ADF&G Ft. Richardson Hatchery staff.

Fish Transport and Stocking

Sockeye fry have been stocked into Bear Lake since 1990. For stocking, all fry were transported by truck from Trail Lakes Hatchery to Bear Lake in oxygenated transport tanks. In 2012, fry were transported by truck in oxygenated tanks to a small tributary stream, 0.5 kilometers from Bear Lake (Figure 2). Fry were held in large containers and supplied with creek water for four hours to imprint them to the stream. After imprinting the fry were released into the tributary. In addition to the fry stocking, sockeye smolts were stocked into net pens located in Resurrection Bay for short-term rearing before release.

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 addition to the fry stocking, coho smolts were transported and placed into the raceways at Bear Creek weir for 5 to 7 days before being released into Bear Creek.

Otolith Collection in Resurrection Bay

With the stocking of sockeye salmon smolts into net pens in Resurrection Bay instead of Bear Lake, it became necessary to collect otoliths from fish harvested in Resurrection Bay (cost recovery and commercial harvests) in order to determine the percentage of return attributable to lake production versus net pen production (fry versus smolt production). In 2010 and 2011, the Alaska SeaLife Center (ASLC) performed this sampling as part of their salmon project requirements. Fish heads were collected on a weekly basis at the fish processing plant (Icicle Seafoods) and otoliths were removed. Otoliths were sent to the ADF&G Mark Lab for analysis. In 2012, CIAA staff performed this sampling following the same procedures with the exception that otoliths were analyzed by CIAA staff.

RESULTS AND DISCUSSION

Limnology, Environmental Conditions and Lake Fertilization

Bear Lake's limnological characteristics have been monitored for several years. The 2012 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). Please note that zooplankton data from 2004 to 2011 has been updated from previous reports.

Table 1. Water quality characteristics of Bear Lake at 1 meter, 1979 to 2012.

Year	1 meter depth											
	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	NO2+NO3 (ug/l)	TN:TP	Chl a (ug/l)	EZD (m)	Secchi (m)	Zooplankton (mg/m2)
1979	76	7.4	30		8.0		8.3					
1980	74	7.3	29		7.7	138	9.8	42 :1	3.4			
1981	68	6.3	28		7.2	101	14.0	35 :1	3.4			734
1982	77	7.6	29		9.9	149	47.0	44 :1	1.9			704
1983	86	7.6	32		8.7	175	41.6	55 :1	2.0			914
1984	88	7.4	32	2.5	10.6	204	24.0	48 :1	3.6			836
1985	87	7.2	36	1.7	11.3	177	89.7	52 :1	2.6			429
1986	82	7.3	32	2.3	12.3	188	12.4	36 :1	2.9			583
1987	81	7.4	29	1.3	9.7	135	2.1	31 :1	1.6			401
1988												
1989												
1990	78	7.4	29	1.6	6.5	170	54.1	76 :1	1.9	11.2	3.6	1,134
1991	84	7.6	28	2.4	8.5	183	52.1	67 :1	2.8	7.4	3.2	467
1992	80	7.2	26	1.7	7.5	166	89.1	85 :1	1.7	9.0	3.8	395
1993	82	7.1	27	1.2	7.3	134	37.4	58 :1	1.9	8.7	4.4	804
1994	88	6.9	27	1.8	7.8	132	14.9	45 :1	2.1	11.4	5.0	743
1995	80	7.2	27	1.9	7.6	116	12.0	37 :1	2.7	10.1	4.4	377
1996	86	7.3	30	2.3	6.3	191	7.5	70 :1	3.1	9.0	3.8	949
1997	89	7.5	33	2.3	7.4	161	17.8	56 :1	3.0	8.2	4.4	556
1998	79	7.2	29	1.2	7.6	176	18.7	66 :1	0.6	8.5	5.3	515
1999	82	7.2	30	1.2	5.6	126	9.0	53 :1	0.9	9.7	5.6	771
2000	80	7.0	28	2.2	6.8	125	3.4	42 :1	3.4	8.9	4.6	356
2001	79	7.1	27	1.2	6.0	124	4.0	35 :1	2.0	9.2	5.0	288
2002	78	7.1	29	0.7	7.0	117	12.4	42 :1	2.4	10.4	5.0	525
2003	74	6.7	26	0.6	6.7	124	6.8	44 :1	2.1	11.0	6.4	333
2004	72	6.8	27	1.0	7.3	176	26.5	38 :1	1.5	9.2	3.8	107
2005	81	6.7	27	0.4	8.6	137	22.7	41 :1	0.9	9.2	5.4	698
2006	82	6.6	28	1.2	12.3	158	8.5	30 :1	2.5	8.3	3.2	412
2007	81	6.7	30	1.2	8.1	121	9.3	37 :1	1.6	11.9	4.3	322
2008	79	7.1	28	1.5	12.7	106	4.1	16 :1	2.6	8.9	4.0	292
2009	81	7.2	30	1.0	7.6	151	4.1	35 :1	1.2	8.4	4.5	407
2010	82	7.0	27	1.3	5.5	NA	4.1	NA :1	2.0	9.2	4.2	768
2011	85	7.6	30	1.4	15.2	NA	4.1	NA :1	3.2	8.6	4.4	658
2012	82	7.3	29	1.0	6.4	NA	25.3	NA :1	1.6	11.8	5.1	222

Averages prior to 1992 compiled by ADF&G.

EZD, Secchi and atomic ratio provided by CIAA.

Open water season only.

2010 data is a combination of both Site A & B

2010, 2011, 2012 TKN analysis is not complete due to equipment failure

Table 2. Water quality characteristics of Bear Lake in the hypolimnion, 1979 to 2012.

Year	Hypolimnion								
	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	NO2+NO3 (ug/l)	TN:TP	Chl a (ug/l)
1979	79	7.3	30		18.3		16.2		
1980	81	7.2	31		13.9	168	14.3	29 :1	8.8
1981	69	6.3	29		11.3	124	19.3	28 :1	5.5
1982	78	7.4	28		16.6	177	37.6	29 :1	5.8
1983	88	7.3	32		14.7	259	43.1	46 :1	6.8
1984	96	7.1	34	6.3	13.9	269	29.9	48 :1	7.7
1985	90	6.9	36	2.8	11.6	253	76.6	63 :1	4.1
1986	89	6.7	32	4.1	14.4	244	34.1	43 :1	3.9
1987	85	7.1	29	2.1	15.2	222	20.8	35 :1	
1988									
1989									
1990	83	7.1	29	2.9	11.2	248	47.4	58 :1	5.4
1991	88	7.1	29	3.3	10.6	203	55.9	55 :1	3.4
1992	84	7.0	26	2.9	8.1	194	82.7	83 :1	3.2
1993	88	7.0	29	1.9	8.8	140	65.6	62 :1	1.1
1994	88	6.9	29	1.9	13.6	185	17.7	34 :1	5.6
1995	83	7.0	28	4.7	12.8	202	8.3	36 :1	8.1
1996	87	7.0	30	4.6	12.4	273	1.9	49 :1	7.6
1997	93	7.3	34	8.3	17.1	332	4.3	44 :1	9.7
1998	89	7.1	32	2.9	8.5	188	34.5	63 :1	1.6
1999	86	6.9	30	4.2	14.7	222	12.2	38 :1	3.8
2000	81	7.2	28	1.9	6.9	127	3.0	41 :1	4.6
2001	80	7.0	27	1.9	5.8	137	3.9	37 :1	3.2
2002	80	7.0	31	0.9	10.1	127	15.2	32 :1	2.4
2003	73	6.8	26	0.7	6.7	116	7.1	41 :1	2.2
2004*	74	6.7	27	0.9	28.1	275	78.9	32 :1	1.7
2005	79	6.7	27	0.2	8.9	135	16.3	38 :1	0.9
2006	83	6.7	28	2.1	12.5	149	6.8	28 :1	2.4
2007	82	6.5	29	1.8	15.0	169	21.5	29 :1	3.2
2008	81	6.7	28	3.0	13.0	148	23.4	31 :1	2.2
2009	84	6.8	29	4.0	17.2	222	5.2	29 :1	4.8
2010	86	6.7	28	4.1	23.0	NA	8.0	NA :1	8.9
2011	92	7.1	32	2.6	17.0	NA	5.3	NA :1	5.4
2012	83	6.8	28	1.8	12.3	NA	47.3	NA :1	2.9

Averages prior to 1992 compiled by ADF&G.

EZD, Secchi and atomic ratio provided by CIAA

Open water season only

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

2010 data is combination of both Site A and B.

2010, 2011, 2012 TKN analysis is not complete due to equipment failure.

The environmental conditions recorded in 2012 are presented in Appendix 2. Between 16 May and 30 June, the average air temperature was 12.3°C (± 3.0°C) while water temperature averaged 6.2°C (± 3.2°C). Average stage height below the weir was 1.2 ft (± 0.36 ft) and above the weir it was 1.4 ft (± 0.46 ft) for the same time period. Between 01 July and 15 October, the average air temperature was 10.1°C (± 3.4°C) while water temperature averaged 10.8°C (± 2.3°C). Average stage height below the weir was 2.52 ft (± 2.06 ft) and above the weir it was 1.69 ft (± 1.98 ft). It should be noted that between 04 September and 08 September no data was recorded as staff was

off-site performing an eggtake at Shell Lake. In addition, due to a series of storms, a large amount of precipitation was observed and the Bear Creek was in flood stage for nearly half of September. The environmental conditions observed in 2012 are compared to other years in Table 3.

Table 3. Environmental conditions observed at Bear Lake, 1990 to 2012.

Year	May thru June 30										Temperature (C)			
	Total Days	Clear	No. of Days			Rain	Days Meas. Precip	Precip (mm)	Air		Water			
			<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	64	12	(4-18)	8	(3-13)		
2009	61	21	6	8	19	7	14	102	12	(2-18)	9	(2-14)		
2010	46	8	11	8	11	8	14	70	12	(7-20)	11	(4-14)		
2011	47	7	2	4	23	10	23	111	10	(3-17)	9	(4-14)		
2012	46	11	7	7	13	8	25	149	12	(6-20)	6	(2-12)		

Year	July thru Sept/Oct/Nov										Temperature (C)			
	Total Days	Clear	No. of Days			Rain	Days Meas. Precip	Precip (mm)	Air		Water			
			<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)		
2009	110	23	5	16	42	24	55	761	12	(6-27)	13	(7-18)		
2010	111	25	5	14	46	21	39	678	11	(2-18)	13	(7-16)		
2011	93	18	6	16	32	21	44	671	10	(1-22)	13	(6-18)		
2012	102	18	7	5	40	32	51	1083	10	(2-18)	11	(5-15)		

*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 25 of the last 32 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 2012.

Year	32-0-0 (gal)	27-7-0 (gal)	20-5-0 (gal)	N (Kg)	P (Kg)	Dates	Comments
1981	2,760			4,441		9/01 - 10/31	Every 10 days
1982	3,240			5,213		7/15 - 10/31	Every 10 days
1983	4,080			6,565		6/01 - 10/04	Every 3 days
1984	1,960	1,120		4,760	181	6/01 - 9/15	Every 3 days
1985	2,800			4,505		6/01 - 9/15	Every 3 days
1986	1,680	1,120		4,309	181	7/01 - 9/15	Every 3 days
1987							No application
1988							No application
1989							No application
1990	2,640		420	4,644	43	6/05 - 8/28	Every 2 days, 20-5-0 first
1991	2,340		390	4,133	40	5/30 - 8/14	Daily, 20-5-0 first
1992	3,264		390	5,620	40	6/04 - 8/09	4 to 6 times/week
1993			960	905	98	5/25 - 8/07	3 times/week
1994							No application
1995							No Application
1996	2,280		600	4,234	61	6/03 - 9/01	Daily, 20-5-0 mid-summer
1997	1,620		540	3,116	55	6/01 - 8/4	2 bbl. a day 4 times a wk.
1998			990	934	101	6/24 - 8/10	Every day
1999			1,050	990	107	6/17 - 8/25	Every other day
2000			840	792	86	6/12 - 8/26	Every other day
2001							No application
2002			900	849	92	6/27 - 8/18	Every other day
2003			1,050	990	107	6/26 - 8/8	Mon, Wed, Fri
2004			1,260	1,188	129	6/22 - 8/20	Every other day
2005			1,050	990	107	6/16 - 8/6	3 times/ week
2006			1,200	1,132	122	7/1 - 8/21	2 to 3 times/ week
2007			330	311	34	7/7 - 8/29	1 time/ week
2008			810	764	83	7/3 - 8/13	Varied
2009			300	283	31	8/12 - 8/28	Almost daily
2010			600	566	61	6/13 - 8/22	Varied
2011			870	820	89	6/16 - 7/30	3 times/ week
2012			120	113	12	7/8-7/28	1 time/week

Smolt Enumeration - Sockeye

Enumeration of Bear Lake sockeye smolts occurred between 17 May and 08 July. A total of 467,000 ($\pm 28,700$) sockeye smolts migrated from Bear Lake in 2012 (Appendix 3). The 10% sub-sampling procedure was used to count 43.8% of the migrating sockeye salmon.

An estimated 97.4% ($\pm 1.7\%$) smolts were age 1 and 2.6% ($\pm 1.7\%$) were age 2. The age 1.0 smolts averaged 93 mm (± 0.8 mm) in length and 6.9 g (± 0.2 g) in weight. The age 2.0 smolts averaged 132 mm (± 6.3 mm) in length and 20.7 g (± 2.4 g) in weight (Table 5). Based on the presence of hatchery induced thermal marks in the otoliths of 474 smolts, it was estimated that 99.3% ($\pm 0.8\%$) of the sockeye smolts were of hatchery origin.

Smolt Enumeration - Coho

A total of 45,900 (± 970) coho salmon smolts migrated from Bear Lake in 2012 (Appendix 3) between 19 May and 30 June. The 10% sub-sampling procedure was used to count 9.9% of the migrating coho smolts.

An estimated 35.9% ($\pm 5.9\%$) smolts were age 1 and 64.1% ($\pm 5.9\%$) were age 2. The age 1.0 smolts averaged 101 mm (± 2.4 mm) in length and 8.1 g (± 2.7 g) in weight. The age 2.0 smolts averaged 122 mm (± 0.5 mm) in length and 19.6 g (± 0.9 g) in weight (Table 5). Based on the presence of hatchery induced thermal marks in the otoliths of 316 smolts, it was estimated that 98.1% ($\pm 1.5\%$) of the coho smolts were of hatchery origin.

Adult Escapement - Sockeye

Adult sockeye salmon began arriving at the weir on 02 June 2012 and continued to migrate until 31 July 2012 (Appendix 4). During this time, 14,381 adults were captured and counted at the weir (Table 7). The returning major age groups for adult sockeye included ages 1.2 (41.3%), 1.3 (42.0%), 2.2 (15.0%) and 2.3 (1.4%). Of the 14,381 adult sockeye that migrated to Bear Creek in 2012, 1,922 were harvested for cost recovery and 12,459 were passed to the lake. Mortalities at the weir were 0 fish. An additional 0 fish were harvested in the seine fishery and an additional 81,531 fish in the saltwater cost recovery harvest. The number of fish caught in sport fishery is unknown at this time. Total return to Resurrection Bay of 95,892 sockeye salmon.

A summary of mean age and weight, by age class, for adult sockeye salmon escapement to the Bear Creek weir site for 2012 is presented in Appendix 6.

Adult Escapement - Coho

Adult coho salmon began arriving at the weir on 29 August 2012 and continued to migrate until 13 October (Appendix 5). During this time, 924 adults were captured and counted at the weir (Table 7). The returning major age groups for adult coho included ages 1.1 (7.8%), 2.1 (85.9%), and 3.1 (6.3%).

Of the 924 adult coho that were counted at the Bear Creek weir site, 31 were harvested, 395 were held for broodstock purposes and 498 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 2012 is presented in Appendix 7.

Table 5. Sockeye smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2012.

Year	Number		% Hatch.		No. Wild	Age Composition						Average Length (mm) ⁶					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	8.0	21,900			68,000	1,600	5,500	1,000			122		156		17.9		37.2			
1996	156,000	9,600	64.2	3.5	55,400			149,400	9,400	6,400	2,100			117	0.6	120	2.1	11.8		16.2			
1997	276,000	64,000	74.6	3.6	70,100			270,500	64,000	5,500	3,500			104	0.5	143	7.6	10.1	0.2	26.7	4.4		
1998	107,800	15,500	72.2	5.8	30,000			81,800	13,600	25,500	7,200	500	1,400	115	1.1	151	3.6	13.1	0.5	35.2	2.5		
1999	75,800	6,800	74.5	5.5	19,300			59,800	5,400	15,400	4,000	700	900	132	1.2	163	6.3	20.3	0.6	31.4	2.1		
2000	162,500	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	45,700			346,600	12,900	28,600	7,400	12,200	4,900	103	0.8	131	0.4	10.1	6.5	28.9	11.9		
2002	107,200	7,100	28.4	3.2	76,800			85,100	6,300	20,800	3,300	1,300	800	115	0.6	146	1.5	15.1	0.7	35.1	1.0		
2003	1,326,500	24,100	92.4	1.7	100,800			1,306,200	22,000	23,000	10,000			92	0.8	140	7.7	7.5	0.2	30.4	4.9		
2004	123,200		96.2	2.4	4,700			76,500	7,800	46,700	7,800			115	1.3	139	0.8	14.2	1.4	26.1	1.2		
2005	1,420,400	412,100	97.4	0.9	36,900			1,388,400	12,500	29,900	12,000			88	0.5	88		6.4	0.0	6.1			
2006	1,962,400	147,000	94.3	1.0	111,900			1,692,900	34,500	183,000	28,900			85	0.5	105	1.2	5.7	0.2	11.1	0.6		
2007	1,347,900	88,300	96.4	1.0	48,500			1,262,900	20,000	84,900	20,000			89	0.6	92	2.3	6.6	0.1	7.0	0.5		
2008	308,500	19,000	94.5	2.4	17,000			281,900	94,000	26,600	9,400			88	0.4	96	1.1	6.2	0.2	8.3	0.5		
2009	241,100	29,500	97.1	1.6	7,000			235,400	3,900	5,700	9,400			91	0.6	126	NA	6.7	0.1	17.6	NA		
2010	598,900	47,500	93.9	1.8	36,500			544,800	14,000	53,300	14,100			88	0.5	124	1.4	5.9	0.2	16.7	0.8		
2011 ⁷	477,800	52,300	96.8	1.8	15,300			442,000	13,700	35,800	13,700			94	0.9	126	2.6	7.3	0.2	17.7	1.0		
2012	467,000	28,700	99.3	0.8	3,600			454,800	8,100	12,200	8,100			93	0.8	132	6.3	6.9	0.2	20.7	2.4		
Avg. ⁴	538,400	60,100	83.7	2.9	43,400	11,400	5,600	495,929	20,800	36,300	9,500	3,800	2,300	119	103	0.8	130	3.7	17	10.5	0.7	24.2	3.1
Total ⁵	10,640,600					157,600		9,700,200		682,250		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 2011.

⁵Total values calculated from 1980 to 2012.

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

⁷Due to vandalism at the weir, some samples (68) (scales/otoliths) were missing or destroyed. For the samples that are missing length/weight as well enhanced and age characteristics were not used for calculations.

Table 6. Coho smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2012.

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	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		92.4	2.6	54,200	3,500	19,200	3,500				103	1.2	128	1.6					11.5	0.8	22.1	1.2				
2005		65,400	3,700	96.4	1.5	56,500	2,000	9,000	2,000				97	1.0	121	2.3					9.5	0.5	18.2	1.5				
2006		50,000	4,300	92.1	3.1	37,300	2,900	12,700	2,600				93	2.2	128	2.6					8.4	0.9	21.7	1.4				
2007		79,000	2,500	93.2	2.8	43,100	5,200	35,900	5,200				86	1.8	112	0.8					6.0	2.2	14.7	1.1				
2008		63,900	3,800	97.4	1.5	34,800	3,400	29,200	3,400				95	1.1	117	0.4					8.6	1.3	16.9	0.8				
2009		54,800	4,100	98.1	1.2	33,000	2,500	21,900	2,500				98	1.4	115	0.7					9.6	1.2	15.8	0.7				
2010		48,900	2,700	98.4	1.3	21,000	3,000	27,900	3,000				101	2.5	124	0.6					10.9	2.4	20.1	1.03				
2011 ⁵		40,400	3,800	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA					NA	NA	NA	NA				
2012		45,900	970	98.1	1.5	16,500	2,700	29,400	2,700				101	2.4	122	0.5					8.1	2.7	19.6	0.9				
Ave ²		87,003	7,900	93.1	2.2	58,100	4,600	29,000	5,800	3,200	2,900		110		128						13.4		20.8		25.3		35.6	
Total ³		2,871,100				1,819,100		927,900		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 2011.

³Total values calculated from 1980 to 2012.

⁴1980 thru 1992 averages are arithmetic, 1993 and later are weighted averages.

⁵Due to vandalism at the weir nearly all (184) of the 249 samples collected (scales/otoliths) were destroyed or missing therefore it is impossible to provide statistical validation to enhanced contribution, age contribution and length/weight information

Table 7. Historic returns of Coho and Sockeye Salmon to Bear Lake weir, 1980 to 2012.

Year	Weir Return	Coho Salmon Age Composition			Weir Return	Sockeye Salmon Age Composition											
	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	0	
1981	3,924	2,252	1,627	45	704	0	0	0	5	0	631	0	63	5	0	0	
1982	2,122	NA	NA	NA	472	0	0	0	407	0	26	0	6	28	0	0	
1983	5,797	5,261	510	25	627	0	0	0	275	0	316	0	25	11	0	0	
1984	3,375	3,969	401	5	3,552	0	0	0	3,432	0	74	0	31	10	0	0	
1985	4,825	4,222	603	0	1,235	0	0	0	245	0	935	0	52	3	0	0	
1986	5,479	5,384	95	0	830	0	0	0	356	0	425	0	44	6	0	0	
1987	6,021	5,888	133	0	212	0	0	0	75	0	102	0	26	5	0	0	
1988	2,174	1,818	356	0	106	0	0	0	51	0	44	0	3	8	0	0	
1989	5,106	4,174	932	0	185	0	0	0	174	0	11	0	0	0	0	0	
1990	7,525	7,179	346	0	1,071	0	0	0	390	0	627	0	---11---			0	0
1991	7,331	6,328	1,003	0	741	0	0	0	232	0	409	0	90	5	0	0	
1992	3,055	2,444	611	0	1,925	1,398	33	0	246	0	225	0	17	6	0	0	
1993	8,671	8,136	535	0	6,708	84	17	4,068	2,336	0	135	0	17	17	0	0	
1994	5,995	4,643	1,352	0	16,752	4,399	149	196	4,813	44	6,198	0	802	129	20	0	
1995	3,295	883	2,346	66	29,203	29	380	4,877	4,877	117	17,317	29	876	672	0	0	
1996	1,711	495	1,216	0	15,957	34	101	1,280	7,002	0	5,555	0	1,919	67	0	0	
1997	3,569	618	2,883	68	17,965	0	663	26	4,849	0	10,080	0	1,123	1,174	26	26	
1998	11,023	935	9,531	557	29,447	0	49	25	24,613	0	4,245	0	344	172	0	0	
1999	3,811	529	2,991	291	17,439	0	0	0	9,004	0	6,802	25	1,534	74	0	0	
2000	6,765	1,172	5,465	129	13,716	0	136	0	2,139	0	10,253	0	917	272	0	0	
2001	2,913	1,515	1,265	133	16,364	0	0	0	5,187	0	9,705	0	736	736	0	0	
2002	3,484	1,475	1,884	124	15,227	0	0	0	11,235	0	3,064	0	859	70	0	0	
2003	3,506	2,727	752	27	16,010	0	58	0	7,219	0	6,404	0	1,921	408	0	0	
2004	2,672	1,255	1,369	49	11,923	0	992	0	2,639	0	6,904	20	1,131	238	0	0	
2005	2,947	795	2,095	58	45,312	0	0	0	37,729	0	5,898	0	1,026	659	0	0	
2006	2,089	1,058	952	79	43,069	0	0	0	5,153	0	35,000	0	2,236	681	0	0	
2007	1,113	596	517	0	20,090	0	0	0	10,472	0	8,121	0	321	1,175	0	0	
2008	1,467	489	960	18	17,142	0	61	0	5,896	0	10,030	0	912	243	0	0	
2009	1,245	392	819	34	45,859	0	0	0	1,663	0	43,017	0	151	1,028	0	0	
2010	1,230	805	395	30	15,864	0	18	0	12,323	0	2,095	0	1,369	59	0	0	
2011	850	198	629	23	18,116	0	25	0	6,576	0	11,187	25	151	151	0	0	
2012	924	72	794	58	14,381	0	27	0	6,129	0	6,235	0	2,229	212	0	0	
Avg ¹	3,190	1,087	2,011	92	22,097	235	140	337	8,922	8	10,953	5	1,082	433	2	1	
% of Avg	100%	34.1%	63.1%	2.9%	100%	1.1%	0.6%	1.5%	40.4%	0.0%	49.6%	0.02%	4.9%	2.0%	0.01%	0.1%	

¹ Average calculation is based on 1994 data onward.

Hatchery Activities

Stocking

In 2012, 2,490 million sockeye fry (BY11; 2,4H) and 222,000 coho fry (BY11; 4,3H) were released into Bear Lake. These fish will migrate in 2013/2014 as smolts. At the time of release, the sockeye fry averaged 0.61 g and the coho fry averaged 1.68 g.

In addition to the fry stocking, 1.305 M sockeye smolts (BY10; 3,2,3H) were short-term reared in net pens located in Resurrection Bay before being released. Approximately, 93,000 coho smolts (BY10; 4,3H) were short-termed reared in raceways (5 - 7 days) at Bear Creek weir, before being released into Bear Creek. At the time of release, the sockeye smolts averaged 10.8 g and the coho smolts averaged 12.3 g. A summary of releases are provide in Table 8.

Eggtake

Between 02 August and 17 August 2012, a total of 6,041,114 sockeye salmon eggs were collected. A total of 4,28 broodfish (includes broodstock, mortalities and inviable) were used providing an average fecundity of 2,786 eggs/female. The first sampling for disease screening in which it was known that all females had received an erythromycin injection indicated that 3.1% of the samples collected were positive for *R. salmoninarum*. The second sampling for disease screening in which it was not known if all females had received an erythromycin injection indicated that 67.7% of the samples collected were positive for *R. salmoninarum*.

From 02 October to 10 October 2012, a total of 638,551 coho eggs were collected from 156 females and fertilized with milt from 104 males. Average fecundity was 4,044 eggs/female. An additional 137,496 coho eggs were collected by ADF&G Fort Richardson Hatchery. Of the 156 females sampled for disease screening, only one fish was identified as being positive for *R. salmoninarum*.

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

Fry-to-Smolt Survival

Migrating smolts in 2012 were stocked either as fry in 2010 (BY09 - Age 2) and 2011 (BY10 - Age 1). Based on age classification from otoliths/scales, the fry-to-smolt survival for each brood year of fry stocking can be determined. Total smolt migration count (count plus fish sampled for otolith and mortalities) was used to determine fry to smolt survival. 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. Using otolith data collected by the ASLC (2010 and 2011) and by CIAA in 2012, the percentage of the total return attributable to the lake production (fry stocking program) and the net pen production (smolt stocking program) can be calculated (BY2006 onward). This information is summarized below in Table 11.

Table 8. Coho and sockeye salmon releases at Bear Lake, 1986 to 2012.

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	0.60			1,600,000	10.4
2009 ⁶	270,000	1.3	68,000	13.5	2,543,000	0.50			1,675,000	13.2
2010 ⁶	435,000	1.2			2,200,000	0.65			1,650,000	13.6
2011 ⁷	437,000	1.0			2,488,000	0.60				
2012	222,000	1.7	93,000	12.3	2,490,000	0.61			1,305,000	10.8
Total	10,355,800		2,768,330		38,728,000		2,009,000		9,363,200	
Ave	369,850	0.99	153,796	11.5	1,613,667	0.50	669,667	3.96	851,200	9.70

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

⁷No smolts into Resurrection Bay in 2011 due to IHN outbreak at hatchery. All smolts destroyed (BY09).

Table 9. Eggs collected for Bear Lake enhancement, 1989 to 2012.

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	1,414,800	1,252,800	88.5	Bear L	4,002,000	3,618,000	90.4
2006	Bear L	1,084,000	990,000	91.3	Bear L	6,087,000	5,444,000	89.44
2007	Bear L	748,000	581,000	77.7	Bear L	6,071,000	5,398,000	88.91
2008	Bear L	574,000	283,000	49.3	Bear L	6,033,000	5,531,000	91.68
2009	Bear L	545,000	462,000	84.8	Bear L	5,009,000	4,531,000	90.5
2010	Bear L	647,000	501,000	77.4	Bear L	5,400,000	4,810,000	89.1
2011	Bear L	577,700	312,400	54.1	Bear L	5,984,100	5,586,600	93.4
2012	Bear L	638,600	518,300	81.2	Bear L	6,041,114	5,611,491	92.9
Total		21,419,272	17,923,492			95,677,814	82,686,491	
Ave				82.1				82.9

Table 10. Bear Lake smolt production by brood years.

Brood Year	Coho						Brood Year	Sockeye						
	Escap.	No. Fry Stocked	Size (g)	No. Smolt	Hatch Smolt	% Hatch. Survival		Escap.	No. Fry Stocked	Size (g)	No. Smolt	Hatch. Smolt	% Hatch. Survival	
1985	4,421	445,700	1.64	74,520			1985	1,235			19,740			
1986	5,115	226,300	1.46	54,700			1986	830			8,450			
1987	5,653	347,200	1.00	111,570			1987	212			4,320			
1988	1,640	491,300	0.75	78,680			1988	106			4,030			
1989	475	333,200	1.30	91,280			1989	185	2,260,000	0.80	345,000			
1990	919	390,600	1.42	118,000			1990	1,071	1,530,000	0.35	157,800			
1991	227	203,800	0.49	86,470			1991	741	1,796,000	0.72	910,600			
1992	332	450,000	0.30	91,950			1992	1,925	1,813,000	0.38	288,200			
1993	560	335,000	0.22	62,800			1993	5,045	170,000	0.15	74,400	51,800	30.5	
1994	475	509,000	0.75	204,100			1994	8,430	330,000	0.37	154,900	100,000	30.3	
1995	444	350,000	0.70	84,600			1995	8,334	781,000	0.37	296,500	220,600	28.2	
1996	380	448,700	0.63	64,500			1996	8,012	788,000	0.34	97,900	71,100	9.0	
1997	276	409,000	0.66	57,700			1997	7,945	265,000	0.56	84,800	64,200	24.2	
1998	350	306,000	0.82	74,827			1998	8,427	1,380,000	0.25	179,400	135,100	9.8	
1999	368	316,100	0.94	100,200	83,300	26.4	1999	7,815	1,796,400	0.80	368,700	312,800	17.4	
2000	429	311,000	0.99	114,300	97,300	31.3	2000	11,828	144,500	0.30	108,100	45,400	31.4	
2001	495	405,000	1.04	187,000	163,600	40.4	2001	12,801	3,209,000	0.49	1,352,900	917,900	28.6	
2002	875	405,000	1.37	63,200	58,800	14.5	2002	12,504	1,467,000	0.42	106,400	102,800	7.0	
2003	395	406,000	1.07	69,200	66,200	16.3	2003	13,233	3,012,000	0.63	1,571,400	1,122,900	37.3	
2004	572	405,000	1.30	73,200	67,800	16.7	2004	8,061	3,020,000	1.17	1,777,800	699,200	23.2	
2005	546	447,000	0.84	72,300	68,600	15.3	2005	10,285	2,414,000	0.52	1,289,500	623,600	25.8	
2006	500	521,000	1.0	56,700	55,400	10.6	2006	8,338	2,437,000	0.65	287,600	271,900	11.2	
2007	386	360,000	1.4	60,900	59,900	16.6	2007	8,420	2,400,000	0.60	288,700	278,600	11.6	
2008	368	270,000	1.3	IC	IC	IC	2008	8,992	2,543,000	0.50	580,600	546,200	21.5	
2009	*	535	435,000	1.2	IC	IC	2009	9,977	2,200,000	0.65	454,200	440,000	20.0	
2010	*	492	437,000	1.0	16,500	16,200	3.7	2010	8,564	2,488,000	0.60	454,800	451,616	18.2
2011	*	359	222,000	1.68			2011	9,389	2,490,000	0.61				
2012	*	315					2012	8,031						
Ave ¹	456	384,100	1.00	89,702	80,100	20.9	Ave ¹	9,222	1,754,500	0.53	538,700	347,800	21.7	

* Incomplete broodyear

¹Average data is for 1993 onward. For # Smolt, Hatchery Smolt and % Survival only includes completed years only. Smolt numbers are rounded to the nearest 100 fish.

Note: Number of Hatchery Smolt is based on otolith mark data.. IC- data can't be completed due to samples being lost/destroyed

* Incomplete broodyear

¹Average data is for 1993 onward. For # Smolts, Hatchery Smolt and % Survival only includes completed years only. Smolt numbers are rounded to the nearest 100 fish.

Note: Number of 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

BY2006 - BY2010 hatchery smolt is from fry stocking only. Smolt stocking went to Resurrection Bay

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

BY	Lake (Fry) Marine Survival	(Smolt) Marine
1989 ^a	5.0	
1990	24.9	
1991	5.4	
1992	15.5	
1993	17.3	
1994	34.4	
1995	16.2	
1996	15.9	
1997	15.9	
1998	18.9	
1999	8.4	
2000	17.3	
2001	9.8	
2002	26.6	
2003	6.1	
2004	11.1	
2005 ^b	1.2	
2006 ^{c,d}	60.5	0.1
<i>2007^d</i>	<i>43.9</i>	<i>3.2</i>
<i>2008</i>	<i>3.2</i>	<i>0.5</i>
AVE	18.2	0.1

^a1989-2005 Lake survival includes enhanced + wild returns

^b2005 cannot be complete since sampling methodology changed between the 2 and 3 yr old returns.

^c2006 - 2009 Lake survival uses enhanced returns only but since the number of wild returns are low this is a good estimate for the entire lake return.

^dSurvival rates are higher than expected, otoliths reads need to be verified by second reader (later 2013)

numbers in red and italicized are incomplete broodyears and are not included in calculation of the average.

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RECOMMENDATIONS

A more indepth examination is required to determine the possible reasons for the decline in coho smolt production and the adult returns to Bear Lake. In order to assess the marine survival for coho salmon, an assessment on the number of fish harvested in the sport fishery is necessary. CIAA and ADFG should collaborate on performing this assessment.

An assessment of the number of fish harvested in the sport fishery is also necessary for the adult sockeye salmon returns.

An evaluation of the Trail Lakes Hatchery marking program should be performed to ensure that the different thermal marks are easily distinguishable and of high quality.

The erythromycin injection project is working and should be continued until 2015. In 2015, all returns (2 and 3 year old) will be from broodstock that were injected with erythromycin and should therefore have a lower incidence of BKD. In 2015, an assessment of the BKD incidence for injected and non-injected fish should be performed. Greater care is also required in tagging (for later identification) and identifying females correctly at the weir for injections.

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APPENDICES

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Appendix 1. Bear Lake 2012 - 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)
6/7/2012	B	1	9.3	2.8	2.0		7.2	73.0	:1	3057	439	2.55	0.64	9.5
	B	14	8.6	2.9	1.9		5.5	71.0	:1	3019	424	2.44	1.09	
7/6/2012	B	1	6.5	2.6	1.6		3.7	9.0	:1	2984	408	1.48	1.35	8.5
	B	12	13.1	4.2	1.9		21.7	57.0	:1	3144	321	2.64	0.45	
8/3/2012	B	1	4.4	3.1	2.0		6.6	9.0	:1	3556	281	1.00	0.25	11.6
	B	13	12.6	3.2	2.8		8.3	36.0	:1	3484	575	3.06	0.03	
8/31/2012	B	1	5.5	2.3	2.0		4.1	10.0	:1	3074	254	1.17	0.33	17.4
	B	14	14.8	4.2	3.1		34.9	25.0	:1	3549	451	3.53	0.00	
Mean			9.4	3.2	2.2	NA	11.5	36.3	NA :1	3233	394	2.2	0.5	11.8
Min			4.4	2.3	1.6	0.0	3.7	9.0	NA :1	2984	254	1.0	0.0	8.5
Max			14.8	4.2	3.1	0.0	34.9	73.0	NA :1	3556	575	3.5	1.4	17.4
1m Ave			6.4	2.7	1.9	NA	5.4	25.3	NA :1	3167.8	345.5	1.6	0.6	11.8
Hypo Ave			12.3	3.6	2.4	NA	17.6	47.3	NA :1	3299.0	442.8	2.9	0.4	

* Possible contamination of hypolimnion sample.

General Tests and Metals

Date	Sta	Depth (m)	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb (NTU)	Color (Pt)	Ca (mg/l)	Mg (mg/l)	Fe (ug/l)	Secchi (meters)
6/7/2012	B	1	81	7.0	28.6	1.2	4	12.9	0.3	38	4.5
	B	14	81	7.0	28.6	1.1	5	12.8	0.5	26	
7/6/2012	B	1	82	7.4	28.0	1.1	4	12.5	0.3	28	4.5
	B	12	85	6.9	27.8	1.5	3	13.1	0.4	38	
8/3/2012	B	1	81	7.5	28.3	0.8	4	12.9	0.3	10	6.5
	B	10	83	6.7	27.8	2.2	5	12.8	0.3	17	
8/31/2012	B	1	83	7.3	29.0	0.9	3	13.1	0.3	24	5.0
	B	15	84	6.6	28.4	2.5	3	13.1	0.3	61	
Mean			83	7.1	28.3	1.4	3.9	12.9	0.3	30.3	5.1
Min			81	6.6	27.8	0.8	3.0	12.5	0.3	10.0	4.5
Max			85	7.5	29.0	2.5	5.0	13.1	0.5	61	6.5
1m Ave			81.8	7.3	28.5	1.0	3.8	12.9	0.3	25.0	5.1
Hypo Ave			83.3	6.8	28.2	1.8	4.0	13.0	0.4	35.5	

Appendix 1. (continued) Bear Lake 2012 - Zooplankton Analysis

Macrozooplankton Density - Site A - Depth 12.5m - 14m
(No/m²)

					Mean (No/m ²)	Seasonal Mean (No/m ²)
	7-Jun	6-Jul	3-Aug	31-Aug		
Ergasilus						
Ovig Ergasilus						
Epischura		1,720	764	1,274	1,253	940
Ovig Epischura						0
Diaptomus		3,822	510	1,911		1,561
Ovig Diaptomus						0
Cyclops	732	16,624	6,369	17,197		10,231
Ovig. Cyclops		96	127	318		135
Bosmina	414	4,108	73,503	70,701	37,182	37,182
Ovig. Bosmina	64	4,586	34,904	20,701	15,064	15,064
Daphnia l.	732	4,013	15,287	55,732	18,941	18,941
Ovig. Daphnia l.	96	669	8,153	37,261	11,545	11,545
Daphnia g.						0
Chydorinae				318	318	80
Polyphemus						
Total:	2,038	35,638	139,617	205,413	0	84,302
Ave:	408	4,455	17,452	22,824		14,050
STDEV:	326	5,205	25,428	26,302		13,555

Macrozooplankton Density - Site B - Depth 16m - 18m
(No/m²)

					Mean (No/m ²)	Seasonal Mean (No/m ²)
	7-Jun	6-Jul	3-Aug	31-Aug		
Ergasilus						
Ovig Ergasilus						
Epischura		10,892	1,146	764	4,267	3,201
Ovig Epischura						0
Diaptomus		1,911	955	1,529		1,099
Ovig Diaptomus						0
Cyclops	191	85,414	13,567	15,287	28,615	28,615
Ovig. Cyclops		955	573			382
Bosmina	127	6,306	91,720	96,306	48,615	48,615
Ovig. Bosmina		9,172	41,847	23,694	24,904	18,678
Daphnia l.	318	4,204	27,516	81,274	28,328	28,328
Ovig. Daphnia l.		1,529	17,962	50,446	23,312	17,484
Daphnia g.						
Chydorinae						
Polyphemus						
Total:	636	120,383	195,286	269,300	0	158,042
Ave:	212	15,048	24,411	38,471		26,340
STDEV:	97	28,663	30,852	38,433		14,168

Appendix 1. (continued) Bear Lake 2012 - Zooplankton Analysis

	Body Size - Site A - Depth 12.5m - 14m (mm)				Seasonal Means				
					Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m2)	Weighted Biomass (mg/m2)	% by Species
Ergasilus									
Ovig Ergasilus									
Epischura	0.94	0.68	1.03		0.88	0.92	3.0	3.3	2%
Ovig Epischura									
Diaptomus	0.90	1.22	1.06		1.06	0.98	8	6	
Ovig Diaptomus									
Cyclops	0.60	0.91	0.85	0.68	0.76	0.80	20	23	15%
Ovig. Cyclops		1.22	1.29	1.12	1.21	1.18	1	1	
Bosmina	0.30	0.39	0.37	0.37	0.36	0.37	43	47	30%
Ovig. Bosmina	0.38	0.41	0.40	0.39	0.40	0.40	22	22	14%
Daphnia l.	0.60	0.68	0.64	0.55	0.62	0.58	31	26	17%
Ovig. Daphnia l.	0.71	0.77	0.86	0.71	0.76	0.74	29	27	18%
Daphnia g.									0%
Chydorinae			0.36		0.36	0.36	0.09	0.09	0%
Polyphemus									
TOTAL:							157	155	100%

	Body Size - Site B - Depth 16m - 18m (mm)				Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m2)	Weighted Biomass (mg/m2)	% by Species
	3-Jun	29-Jun	1-Aug	9-Sep					
Ergasilus									
Ovig Ergasilus									
Epischura		0.99	1.13	1.07	1.06	1.01	17	15	5%
Ovig Epischura									
Diaptomus		0.84	1.33	1.05	1.07	1.02	6	5	
Ovig Diaptomus									
Cyclops	0.80	0.96	0.91	0.78	0.86	0.93	75	88	31%
Ovig. Cyclops		1.26	1.24		1.25	1.25	2	2	
Bosmina	0.36	0.36	0.39	0.37	0.37	0.38	61	64	22%
Ovig. Bosmina		0.41	0.40	0.39	0.40	0.40	28	27	9%
Daphnia l.	0.61	0.71	0.67	0.55	0.64	0.59	49	41	14%
Ovig. Daphnia l.		0.85	0.88	0.73	0.82	0.77	52	46	16%
Daphnia g.									
Chydorinae									
Polyphemus									
TOTAL:							290	288	100%

Appendix 2. Bear Lake 2012 - Environmental Conditions

Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)	Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-May							1-Jun	2	0.0	1.90	0.98	4	16
2-May							2-Jun	2	0.0	1.90	0.97	4	15
3-May							3-Jun	4	1.0	1.85	0.98	4	10
4-May							4-Jun	3	0.5	1.85	0.99	4	11
5-May							5-Jun	1	0.0	1.85	0.98	4	19
6-May							6-Jun	3	0.5	1.85	0.98	4	10
7-May							7-Jun	2	0.0	1.85	0.99	4	15
8-May							8-Jun	1	0.0	1.85	0.96	6	20
9-May							9-Jun	2	2.0	1.85	0.96	6	10
10-May							10-Jun	3	0.0	0.98	1.85	8	14
11-May							11-Jun	2	0.0	0.98	1.85	8	14
12-May							12-Jun	5	8.4	1.10	1.85	6	9
13-May							13-Jun	4	12.0	1.00	1.84	6	12
14-May							14-Jun	4	6.2	0.98	1.82	8	10
15-May							15-Jun	1	0.0	0.94	1.80	8	12
16-May	1	0.0	0.38	1.22	2	6	16-Jun	1	0.0	0.92	1.68	8	12
17-May	1	0.0	1.70	1.06	2	7	17-Jun	2	0.0	0.92	1.66	8	13
18-May	2	0.6	1.65	1.98	3	8	18-Jun	5	8.0	0.92	1.40	8	14
19-May	5	3.5	1.70	1.70	3	10	19-Jun	5	0.0	0.91	0.90	8	15
20-May	5	0.4	1.60	1.80	3	9	20-Jun	4	0.0	0.91	0.90	9	14
21-May	4	0.3	1.70	1.00	3	12	21-Jun	1	0.0	0.91	0.90	10	15
22-May	3	0.5	1.70	0.95	3	15	22-Jun	1	0.0	0.91	0.90	10	15
23-May	1	0.0	1.80	1.00	4	15	23-Jun	1	0.0	0.92	0.91	11	18
24-May	4	0.0	1.70	1.20	3	12	24-Jun	4	5.0	0.93	0.92	10	10
25-May	5	5.0	1.85	1.10	3	7	25-Jun	5	5.0	0.94	0.93	11	10
26-May	4	2.0	1.80	1.00	3	12	26-Jun	4	15.0	0.94	0.93	12	12
27-May	3	0.3	1.80	1.00	3	13	27-Jun	5	0.5	0.94	0.94	12	13
28-May	3	0.1	1.85	1.00	4	11	28-Jun	4	0.0	0.96	0.95	10	13
29-May	3	50.0	1.85	1.00	4	12	29-Jun	1	0.0	0.96	0.95	12	12
30-May	4	21.0	1.90	1.10	4	10	30-Jun	4	0.0	0.96	0.95	11	13
31-May	4	1.2	1.85	1.10	4	10							

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 2012 - Environmental Conditions

Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)	Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Jul	4	0.0	0.95	1.65	12	12	8/1/2012*	1	3.2	0.54		11	10
2-Jul	1	0.0	0.96	1.67	11	15	2-Aug	4	1.0	0.53		11	10
3-Jul	5	0.0	0.95	1.66	11	7	3-Aug	2	0.0	0.53		11	12
4-Jul	5	11.0	0.88	1.58	11	12	4-Aug	4	0.0	0.56		12	11
5-Jul	5	11.0	0.93	1.60	11	14	5-Aug	4	3.2	0.58		12	11
6-Jul	4	15.5	0.97	1.65	11	12	6-Aug	3	0.0	0.60		12	11
7-Jul	4	10.2	0.98	1.66	12	10	7-Aug	4	0.0	0.60		12	11
8-Jul	4	0.2	0.96	1.65	12	12	8-Aug	4	0.0	0.59		12	11
9-Jul	5	0.3	0.96	1.65	12	13	9-Aug	4	0.0	0.58		12	12
10-Jul	5	0.0	0.96	1.65	11	8	10-Aug	4	0.0	0.58		11	11
11-Jul	5	6.2	0.88	1.63	11	9	11-Aug	1	0.0	0.58		11	11
12-Jul	5	0.4	0.90	1.65	11	8	12-Aug	2	0.0	0.58		12	13
13-Jul	4	8.0	0.89	1.66	11	11	13-Aug	1	0.0	0.58		12	15
14-Jul	4	0.0	0.89	1.66	11	9	14-Aug	4	0.0	0.82		12	12
15-Jul	4	0.2	0.89	1.66	11	14	15-Aug	4	0.0	0.82		12	12
16-Jul	1	0.0	0.88	1.65	11	16	16-Aug	3	0.0	0.82		11	12
17-Jul	1	0.0	0.88	0.65	14	14	17-Aug	5	0.0	0.82		11	10
18-Jul	1	0.0	0.88	0.65	14	13	18-Aug	4	0.0	0.82		11	10
19-Jul	1	0.0	0.87	0.65	14	16	19-Aug	4	22.5	0.85		11	10
20-Jul	4	0.0	0.87	0.65	12	15	20-Aug	4	4.0	0.86		10	11
21-Jul	5	17.5	0.80	0.64	14	11	21-Aug	1	2.2	0.91		10	12
22-Jul	4	12.6	0.60	0.65	14	10	22-Aug	1	0.0	0.90		12	16
23-Jul	5	7.2	0.65	0.70	14	8	23-Aug	4	12.5	0.92		12	11
24-Jul	4	0.0	0.65	0.70	14	11	24-Aug	4	0.0	0.91		13	15
25-Jul	1	0.0	0.64	0.70	14	15	25-Aug	4	0.0	0.91		13	14
26-Jul	1	0.0	0.64	0.70	15	13	26-Aug	2	2.4	0.91		13	13
27-Jul	1	0.0	0.55	0.67	11	18	27-Aug	2	7.0	0.90		13	14
28-Jul	5	0.0	0.55	0.63	11	11	28-Aug	1	0.0	0.90		12	16
29-Jul	4	0.5	0.55	0.63	11	11	29-Aug	1	0.0	0.90		12	16
30-Jul	4	3.2	0.55	0.63	11	10	30-Aug	5	3.2	0.88		12	9
31-Jul	4	0.0	0.54	0.63	11	12	31-Aug	4	4.2	0.88		12	10

Sky Conditions

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

*Dam boards were removed from the weir on August 1, 2012. No difference in upper and lower staff gauge

Appendix 2 (continued). Bear Lake 2012 - Environmental Conditions

Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)	Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)	
1-Sep	4	3.2	0.88		12	10	1-Oct	2	0.0			9	6	
2-Sep	4	6.4	0.88		12	9	2-Oct	5	12.5			5	6	
3-Sep	5	7.2	0.88		12	8	3-Oct	5	4.6			5	6	
4-Sep	No Data Recorded. Staff at Shell Lake Eggtake							4-Oct	4	6.0			5	8
5-Sep								5-Oct	5	24.0		7	10	
6-Sep								6-Oct	4	28.0	7.5	7.1	7	9
7-Sep								7-Oct	5	3.2	7.0	7.0	5	8
8-Sep								8-Oct	4	3.0	6.8	6.8	5	8
9-Sep	5	84.0	0.96		11	13	9-Oct	2	2.4	6.0	6.2	5	6	
10-Sep	1	0.0	0.96		11	10	10-Oct	4	0.0	5.8	6.0	5	5	
11-Sep	4	0.0	0.90		10	8	11-Oct	1	0.0	5.6	5.8	7	3	
12-Sep	4	0.0	0.90		10	9	12-Oct	1	0.0	5.2	5.6	7	2	
13-Sep	3	0.0	0.88		11	10	13-Oct	5	1.0	4.0		5	2	
14-Sep	5	4.4	0.88		11	11	14-Oct	5	1.8	3.9		5	4	
15-Sep	5	34.2	0.90		11	10	15-Oct	4	3.6	3.2		5	4	
16-Sep	5	95.0	1.00		11	5	16-Oct	Weir Closed For Season						
17-Sep	3	40.3	1.70		11	7	17-Oct							
18-Sep	5	87.9			11	9	18-Oct							
9/19/2012*	5	70.2	4.00	4.50	11	9	19-Oct							
20-Sep	5	72.8	5.40	4.70	11	9	20-Oct							
21-Sep	5	81.0	6.90	4.80	11	9	21-Oct							
22-Sep	5	92.2	8.00	5.30	11	8	22-Oct							
23-Sep	4	40.2	7.50	5.00	11	11	23-Oct							
24-Sep	5	4.0	4.70	4.70	11	10	24-Oct							
25-Sep	5	40.2	2.00	4.20	11	5	25-Oct							
26-Sep	5	48.0		3.92	11	4	26-Oct							
27-Sep	5	4.6		2.75	11	4	27-Oct							
28-Sep	4	3.0		2.00	11	5	28-Oct							
29-Sep	3	4.2		1.80	10	4	29-Oct							
30-Sep	2	0.0		1.79	10	3	30-Oct							
							31-Oct							

*Dam boards in for adult coho migration

**Flood conditions for most of September.

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 2012 - Smolt Migration.

Date	Sockeye				Coho				Dolly Varden		Rainbow Trout	
	Daily	Otoliths	Cumm	% Smpl	Daily	Otoliths	Cumm	% Smpl	Daily	Cumm	Daily	Cumm
17-May	2	0	2	0.00%	5	0	5	0.00%	0	0	0	0
18-May	9	0	11	0.00%	9	0	14	0.00%	0	0	0	0
19-May	22	0	33	0.00%	9	0	23	0.00%	0	0	0	0
20-May	11	0	44	0.00%	11	0	34	0.00%	0	0	0	0
21-May	13	0	57	0.00%	7	0	41	0.00%	1	1	0	0
22-May	20	0	77	0.00%	24	0	65	0.00%	1	2	0	0
23-May	34	0	111	0.00%	357	0	422	0.00%	0	2	0	0
24-May	42	3	153	7.14%	371	8	793	2.16%	3	5	0	0
25-May	86	0	239	0.00%	74	0	867	0.00%	11	16	0	0
26-May	206	0	445	0.00%	145	0	1,012	0.00%	0	16	0	0
27-May	371	0	816	0.00%	91	0	1,103	0.00%	16	32	0	0
28-May	1,327	0	2,143	0.00%	118	0	1,221	0.00%	12	44	0	0
29-May	1,494	2	3,637	0.13%	109	0	1,330	0.00%	7	51	0	0
30-May	9,623	2	13,260	0.02%	159	0	1,489	0.00%	20	71	0	0
31-May	36,751	5	50,011	0.01%	571	8	2,060	1.40%	53	124	1	1
01-Jun	24,349	80	74,360	0.33%	392	1	2,452	0.26%	135	259	0	1
02-Jun	43,857	0	118,217	0.00%	689	0	3,141	0.00%	136	395	0	1
03-Jun	33,175	46	151,392	0.14%	679	0	3,820	0.00%	80	475	2	3
04-Jun	29,343	20	180,735	0.07%	853	10	4,673	1.17%	66	541	0	3
05-Jun	36,976	0	217,711	0.00%	950	0	5,623	0.00%	12	553	0	3
06-Jun	14,847	29	232,558	0.20%	774	5	6,397	0.65%	49	602	1	4
07-Jun	33,271	45	265,829	0.14%	726	19	7,123	2.62%	56	658	1	5
08-Jun	31,211	38	297,040	0.12%	1,786	0	8,909	0.00%	98	756	0	5
09-Jun	16,945	31	313,985	0.18%	1,789	13	10,698	0.73%	151	907	0	5
10-Jun	32,084	0	346,069	0.00%	2,135	0	12,833	0.00%	127	1,034	0	5
11-Jun	18,442	58	364,511	0.31%	1,827	39	14,660	2.13%	59	1,093	2	7
12-Jun	3,311	25	367,822	0.76%	1,111	22	15,771	1.98%	74	1,167	0	7
13-Jun	23,945	0	391,767	0.00%	4,250	0	20,021	0.00%	61	1,228	2	9
14-Jun	18,766	0	410,533	0.00%	714	0	20,735	0.00%	91	1,319	0	9
15-Jun	10,019	29	420,552	0.29%	283	24	21,018	8.48%	34	1,353	0	9
16-Jun	6,010	0	426,562	0.00%	112	0	21,130	0.00%	10	1,363	0	9
17-Jun	3,933	0	430,495	0.00%	122	0	21,252	0.00%	6	1,369	0	9
18-Jun	1,176	18	431,671	1.53%	276	0	21,528	0.00%	10	1,379	0	9
19-Jun	3,927	8	435,598	0.20%	1,000	0	22,528	0.00%	7	1,386	0	9
20-Jun	1,513	0	437,111	0.00%	956	13	23,484	1.36%	5	1,391	0	9
21-Jun	1,789	0	438,900	0.00%	912	0	24,396	0.00%	2	1,393	1	10
22-Jun	3,118	0	442,018	0.00%	845	0	25,241	0.00%	1	1,394	0	10
23-Jun	3,628	7	445,646	0.19%	2,011	22	27,252	1.09%	0	1,394	0	10
24-Jun	3,022	0	448,668	0.00%	2,565	18	29,817	0.70%	2	1,396	1	11
25-Jun	2,509	0	451,177	0.00%	4,620	52	34,437	1.13%	9	1,405	0	11
26-Jun	2,379	0	453,556	0.00%	2,805	0	37,242	0.00%	3	1,408	1	12
27-Jun	3,864	6	457,420	0.16%	1,631	15	38,873	0.92%	2	1,410	0	12
28-Jun	2,025	8	459,445	0.40%	1,156	0	40,029	0.00%	0	1,410	0	12
29-Jun	2,653	0	462,098	0.00%	973	0	41,002	0.00%	9	1,419	0	12
30-Jun	1,140	0	463,238	0.00%	668	0	41,670	0.00%	3	1,422	0	12
01-Jul	255	0	463,493	0.00%	160	0	41,830	0.00%	0	1,422	0	12
02-Jul	1,320	8	464,813	0.61%	880	19	42,710	2.16%	0	1,422	0	12
03-Jul	515	6	465,328	1.17%	443	6	43,153	1.35%	1	1,423	1	13
04-Jul	490	0	465,818	0.00%	738	0	43,891	0.00%	1	1,424	0	13
05-Jul	319	0	466,137	0.00%	486	0	44,377	0.00%	0	1,424	0	13
06-Jul	316	0	466,453	0.00%	744	0	45,121	0.00%	0	1,424	0	13
07-Jul	360	0	466,813	0.00%	492	15	45,613	3.05%	1	1,425	1	14
08-Jul	177	0	466,990	0.00%	323	7	45,936	2.17%	0	1,425	2	16
Totals	466,990	474	466,990	0.10%	45,936	316	45,936	0.69%	1,425	1,425	16	16

Appendix 4. Bear Lake 2012 - Adult Sockeye Salmon Migration.

Date	Lake Escapement			Donate & Harvest	Morts	Daily Total	Cumm. Total
	Males	Females	Combined				
02-Jun	1	0	1			1	1
03-Jun	0	0	0			0	1
04-Jun	0	0	0			0	1
05-Jun	0	0	0			0	1
06-Jun	5	7	12			12	13
07-Jun	0	0	0			0	13
08-Jun	0	0	0			0	13
09-Jun	59	32	91			91	104
10-Jun	127	28	155			155	259
11-Jun	14	22	36			36	295
12-Jun	17	0	17			17	312
13-Jun	47	12	59			59	371
14-Jun	67	31	98			98	469
15-Jun	165	27	192			192	661
16-Jun	100	32	132			132	793
17-Jun	33	0	33			33	826
18-Jun	183	57	240			240	1,066
19-Jun	85	51	136			136	1,202
20-Jun	150	64	214			214	1,416
21-Jun	225	98	323			323	1,739
22-Jun	265	109	374			374	2,113
23-Jun	386	175	561			561	2,674
24-Jun	232	74	306			306	2,980
25-Jun	224	107	331			331	3,311
26-Jun	316	132	448			448	3,759
27-Jun	390	249	639			639	4,398
28-Jun	477	296	773			773	5,171
29-Jun	449	378	827			827	5,998
30-Jun	665	525	1,190	12		1,202	7,200
01-Jul	446	373	819	0	0	819	8,019
02-Jul	743	634	1,377	0	0	1,377	9,396
03-Jul	58	356	414	247	0	661	10,057
04-Jul	17	622	639	247	0	886	10,943
05-Jul	34	393	427	8	0	435	11,378
06-Jul	29	482	511	496	0	1,007	12,385
07-Jul	26	243	269	31	4	304	12,689
08-Jul	0	114	114	16	1	131	12,820
09-Jul	0	96	96	194	3	293	13,113
10-Jul	0	71	71	16	1	88	13,201
11-Jul	0	59	59	19	0	78	13,279
12-Jul	0	98	98	8	1	107	13,386
13-Jul	0	80	80	18	0	98	13,484
14-Jul	0	62	62	199	0	261	13,745
15-Jul	0	31	31	5	0	36	13,781
16-Jul	0	41	41	4	0	45	13,826
17-Jul	0	0	0	85	0	85	13,911
18-Jul	0	41	41	28	0	69	13,980
19-Jul	0	17	17	29	17	63	14,043
20-Jul	0	0	0	14	22	36	14,079
21-Jul	0	47	47	5	16	68	14,147
22-Jul	0	21	21	19	14	54	14,201
23-Jul	0	0	0	27	17	44	14,245
24-Jul	0	21	21	33	9	63	14,308
25-Jul	0	0	0	7	6	13	14,321
26-Jul	0	16	16	2	4	22	14,343
27-Jul	0	0	0	10	2	12	14,355
28-Jul	0	0	0	8	3	11	14,366
29-Jul	0	0	0	9	0	9	14,375
30-Jul	0	0	0	0	0	0	14,375
31-Jul	0	0	0	6	0	6	14,381
Total	6,035	6,424	12,459	1,802	120	14,381	14,381

Appendix 5. Bear Lake 2012 - 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			
29-Aug	1	0	1			0			0	1	0		1	1
30-Aug	0	0	0			0			0	0	0		0	1
31-Aug	0	0	0			0			0	0	0		0	1
01-Sep	0	0	0			0			0	0	0		0	1
02-Sep	0	0	0			0			0	0	0		0	1
03-Sep	0	0	0			0			0	0	0		0	1
04-Sep	0	0	0			0			0	0	0		0	1
05-Sep	0	0	0			0			0	0	0		0	1
06-Sep	0	0	0			0			0	0	0		0	1
07-Sep	0	0	0			0			0	0	0		0	1
08-Sep	0	0	0			0			0	0	0		0	1
09-Sep	7	1	8			0			0	7	1		8	9
10-Sep	16	1	17			0			0	16	1		17	26
11-Sep	12	2	14			0			0	12	2		14	40
12-Sep	3	1	4			0			0	3	1		4	44
13-Sep	1	1	2			0			0	1	1		2	46
14-Sep	12	4	16			0			0	12	4		16	62
15-Sep	7	3	10			0			0	7	3		10	72
16-Sep	29	8	37			0			0	29	8		37	109
17-Sep	108	52	160			0			0	108	52		160	269
18-Sep	0	38	38	68	0	68			0	68	38	0	106	375
19-Sep	0	1	1	50	25	75			0	50	26	0	76	451
20-Sep	0	0	0	5	8	13			0	5	8	0	13	464
21-Sep	0	0	0	3	4	7			0	3	4	0	7	471
22-Sep	0	0	0	25	7	32			0	25	7	0	32	503
23-Sep	0	0	0	16	3	19			0	16	3	0	19	522
24-Sep	0	0	0	18	12	30			0	18	12	0	30	552
25-Sep	0	0	0	25	31	56			0	25	31	0	56	608
26-Sep	0	0	0	23	28	51			0	23	28	0	51	659
27-Sep	2	1	3	29	39	68			0	31	40	0	71	730
28-Sep	0	1	1	7	12	19	6	0	6	13	13	0	26	756
29-Sep	2	1	3	0	29	29	21	0	21	23	30	0	53	809
30-Sep	0	0	0	0	8	8	4	0	4	4	8	0	12	821
01-Oct	0	0	0	7	8	15			0	7	8	0	15	836
02-Oct	0	0	0	0	7	7			0	0	7	0	7	843
03-Oct	0	0	0	6	16	22			0	6	16	0	22	865
04-Oct	0	0	0	12	9	21			0	12	9	0	21	886
05-Oct	0	0	0	1	3	4			0	1	3	0	4	890
06-Oct	0	0	0	3	16	19			0	3	16	0	19	909
07-Oct	0	0	0	5	6	11			0	5	6	0	11	920
08-Oct	0	0	0	0	0	0			0	0	0	0	0	920
09-Oct	0	0	0	0	0	0			0	0	0	0	0	920
10-Oct	0	0	0	0	0	0			0	0	0	0	0	920
11-Oct	0	0	0	2	0	2			0	2	0	0	2	922
12-Oct	0	0	0	1	0	1			0	1	0	0	1	923
13-Oct	0	0	0	0	1	1			0	0	1	0	1	924
14-Oct	0	0	0	0	0	0			0	0	0	0	0	924
15-Oct	0	183	183	0	0	(183)			0	0	183	0	183	924
16-Oct			0			0			0	0	0	0	0	924
Total	200	298	498	306	272	395	31	0	31	537	387	0	924	

Appendix 6. Bear Lake 2012 – Adult Sockeye Age and Sex Characteristics

	Age						Total
	1.1	1.2	1.3	2.1	2.2	2.3	
Sample Period:	24 May through 22 July						
Males (No.)	0	690	663	0	159	27	1,539
Percent	0.0%	44.8%	43.1%	0.0%	10.3%	1.7%	10.4%
Sample Size	0	26	25	0	6	1	58
Total Sample Size							103
Mean Length (mm)							
Std. Deviation							
Std. Error							0.0
Mean Weight (kg)		2.09	2.88		2.48	2.30	2.45
Std. Deviation		0.34	0.47		0.53		0.56
Std. Error		0.07	0.09		0.22		0.05
Females (No.)	27	5,439	5,572	0	2,069	186	13,292
Percent	0.2%	40.9%	41.9%	0.0%	15.6%	1.4%	89.6%
Sample Size	1	205	210	0	78	7	501
Total Sample Size							802
Mean Length (mm)							
Std. Deviation							
Std. Error							
Mean Weight (kg)	1.00	1.88	2.49		2.02	2.47	2.17
Std. Deviation		0.25	0.32		0.34	0.29	0.40
Std. Error		0.02	0.02		0.04	0.11	0.01
Both Sexes (No.)	27	6,129	6,235	0	2,229	212	14,831
Percent	0.2%	41.3%	42.0%	0.0%	15.0%	1.4%	99.8%
Sample Size	1	231	235	0	84	8	559
Total Sample Size							905
Mean Length (mm)							
Std. Deviation							
Std. Error							
Mean Weight (kg)	1.00	1.90	2.53		2.05	2.45	2.18
Std. Deviation		0.27	0.35		0.37	0.27	0.43
Std. Error		0.02	0.02		0.04	0.10	0.01

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

Appendix 7. Bear Lake 2012 – Adult Coho Age and Sex Characteristics

	Age			Total
	1.1	2.1	3.1	
Sample Period:	09 Sept. through 04 Oct.			
Males (No.)	58	664	29	751
Percent	7.7%	88.5%	3.8%	81.3%
Sample Size	4	46	2	52
Total Sample Size				26
Mean Length (mm)	500	549	570	541
Std. Deviation	13.7	41.7	42.4	43.6
Std. Error	6.9	6.1	30.0	8.5
Mean Weight (kg)				
Std. Deviation				
Std. Error				
Females (No.)	0	5	1	6
Percent	0.0%	83.3%	16.7%	0.6%
Sample Size	0	5	1	6
Total Sample Size				4
Mean Length (mm)		575	603	573
Std. Deviation		47.2		43.4
Std. Error		21.1		21.7
Mean Weight (kg)				
Std. Deviation				
Std. Error				
Both Sexes (No.)	72	794	58	924
Percent	7.8%	85.9%	6.3%	100.0%
Sample Size	5	55	4	64
Total Sample Size				30
Mean Length (mm)	497	549	570	544
Std. Deviation				43.6
Std. Error				8.0
Mean Weight (kg)				
Std. Deviation				
Std. Error				

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

Appendix 8. Bear Lake 2012 – Sockeye Smolt Hourly Counts

Time	17-May	18-May	19-May	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-Jun	10-Jun	11-Jun	####	13-Jun	14-Jun	15-Jun	
6:00 AM			6	7							2																				
7:00 AM		6				1	0	1	2	1	4	1	4	221	2	0	253	163	1,048	911	1,960	521	174	0	342	42	0	1	182	0	
8:00 AM					1			2	0	5	0	0	0	32	0	1	5	0	186	13	84	82	1	0	168	382	0	0	16	0	
9:00 AM	1						1	2	0	1	1	1	0	0	1	0	2	3	0	0	1	114	0	0	1	205	0	0	22	0	
10:00 AM			1	3	1		0	0	2	1	0	0	0	2	1	0	0	5	0	0	1	0		1	0	493	0	0	121	99	
11:00 AM	1	0				1	0	1	0	1	0	1	1	0	0	1	0	0	3	0	0	1	0	20	0	689	0	232	212	175	
12:00 PM			0				0	0	1	0	0	0	0	0	1	0	5	0	1	1	1	0	0	0	117	0	117	0	84	178	123
1:00 PM				0	0	3	1		1	0	1	1	1	0	1	0	39	1	1	1	1	112	1,556	47	82	265	28	354	709	110	
2:00 PM					6	2	0	0	0	1	0	0	1	0	1	0	51	0	0	1	0	596	9	2	952	1,034	0	180	478	338	
3:00 PM					4	1	0	0	0	2		0	3	0	0	2	644	1	0	1	1	20	87	2	932	1,371	51	402	663	70	
4:00 PM							1	0	0	0	0	0	1	0	0	17	688	140	2	14	0	36	50	0	169	860	366		301	82	
5:00 PM		0	0		1	5		7	0		2	1	0	1	1	729	580	154	0	2,899	0	754	49	65	311	1,449	177	11			
6:00 PM								0	0		0	0	0	0	0	642					42	4,016	194	312		1,863	83	921	249		
7:00 PM		2						1	2	2	0	0	1	2	0		2,780	113	2,532	1,056	700	3,260	3,213	101	83	818	307	625	515	1,593	
8:00 PM					10	0		2	2	0	0	0	3	0	1	1,211	5,080	849	2,058	2,026	445	3,023	12,530	668	371	525	794	477	965	896	
9:00 PM				1				0	0	1	0	1	1	92	334	782	3,070	1,012	483	1,405	814	8,630	1,410	1,014	4,353	816	182	187	1,139	603	
10:00 PM	1	0	15				0	2	17	32	0	0	6	862	455	305	95	813	424	3,374	1,626	2,740	1,444	1,370	5,450	2,046	178	581	2,797	264	
11:00 PM							6	13	34	45	35	151	29	960	856	525	799	1,563	346	7,200	1,064	2,570	2,739	1,885	2,820	3,676	270	1,049	1,960	1,332	
12:00 AM							13	11	26	64	103	172	136	1,587	1,954	3,017	2,972	1,183	2,275	3,280	1,627	1,407	1,206	1,611	1,360	870	253	2,609	1,776	2,097	
1:00 AM							9			5	187	539	587	2,722	4,983	5,640	1,970	3,025	3,334	2,430	2,402	1,768	2,681	1,892	3,390	618	326	3,720	1,709	831	
2:00 AM										32	33	389	576	2,119	15,460	2,990	4,934	10,360	5,780	5,354	2,121	1,748	2,637	3,135	5,300	303	379	6,240	2,178	914	
3:00 AM										12	3	70	144	1,023	6,860	3,017	16,560	9,030	8,000	4,820	1,523	1,863	1,231	4,820	6,000			6,050	1,924	243	
4:00 AM															5,840	5,470	3,330	4,760	2,870	2,190	435									1,060	
5:00 AM																															
Total	2	9	22	11	13	20	34	42	86	206	371	1,327	1,494	9,623	36,751	24,349	43,857	33,175	29,343	36,976	14,847	33,271	31,211	16,945	32,084	18,442	3,311	23,945	18,766	10,019	

Time	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul							
6:00 AM																														
7:00 AM	1	0	0	27	82	114		54	0	392	46	87	120	28	85		22	51	0	0		7	15							
8:00 AM	0	0	41	31	139	8	0	88	198	103	98	143	66	247	9		10	0	102	0	0	0	0							
9:00 AM	1	0	109	54	52	0	0	124	0	116	197	100	0	56			21	17	0	0		27								
10:00 AM	7	0	0	4	3	35	0	30	0	152		212	32	176	189		41	0	64	0	52	0	0							
11:00 AM	32	0	30	455	19	55	117	38	313	99	154	19		469	251		105	39	22	21	32	0	9							
12:00 PM	186	0	132	168	6	61	335	59	337	179	301	105	9	736			113	0	0	0	19									
1:00 PM	224	246	10	106	0	64	508	420	495	372	81	287	18	103			127	53	0	12	0	33								
2:00 PM	37	27	46	3	2	339	56	213	36	261		333	130	69	101		151	139	0	22		0								
3:00 PM	380	1	44	160	6	121	69	0	85	248	373	85	0	103			136	4	51	0	57	34								
4:00 PM	54	176	160	92	6	288	25	0	19	360	161	144	163				0	0	0	0	0	0								
5:00 PM	62	1,212	77	139	14	28	80	219	236		409	124					0	0	0	0	0	0								
6:00 PM	0	310	15	144	64	17	146	174	102	2	41		71	42			0	0	51	0	100	15								
7:00 PM	18	298	16	245	7	24	23		92	5					139		297	0	0	0		158	60							
8:00 PM	141	675	42	204	114	191	18	148	133	3	192	169	260	301	44		0	0	14	170	30	0								
9:00 PM	643	261	50	53	67	1	78	172	278	251	107	321	163	23			125	212	0	0	0	45								
10:00 PM	1,339	474	244	78	439	8	84	765	254	42	89	275	242	32			20	0	0	0	0	0								
11:00 PM	706	95	66	613	83	114	827	270	351	185		705	120	44			0	0	94	45	55	60								
12:00 AM	1,729	103	54	700	261	214	724	572	65	33	108	284	112	26	108		99		161			0								
1:00 AM	275	55	40	549	91	107	28	218	109	140	265	106	86				53		25											
2:00 AM	175			102	58			64	23	70	92	96	85	86																
3:00 AM																														
4:00 AM																														
5:00 AM																														
Total	6,010	3,933	1,176	3,927	1,513	1,789	3,118	3,628	3,022	2,509	2,379	3,864	2,025	2,653	1,140	0	1,320	515	490	319	316	360	177							

Appendix 9. Bear Lake 2012 – Coho Smolt Hourly Counts

Time	17-May	18-May	19-May	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-Jun	10-Jun	11-Jun	12-Jun	13-Jun	14-Jun	15-Jun	
6:00 AM			5	3		12			0	3	0	2	5	10	4	3	11	47	20	15	183	18	71	8	31	82	40	29	36	0	
7:00 AM		3																													
8:00 AM					1		5	1	1	6	1	4	1	4	6	1	2	2	12	3	16	17	4	8	23	237	48	0	71	0	
9:00 AM		2						3	2	0	2	1	0	1	6	2	2	3	1	4	4	0	3	0	2	65	6	0	7	7	
10:00 AM			3	5	0		1	2	2	0	0	1	1	5	1	2	3	5	0	5	3	0		15	11	139	57	84	13	14	
11:00 AM		2				1	0	0	1	0	0	5	0	2	2	2	4	2	9	2	6	6	13	53	0	69	0	1,119	19	20	
12:00 PM			0				0	1		0	0	1	2	3	1	2	6	2	25	9	3	33	35		0	12	0	57	33	12	
1:00 PM		2		1	0	3	8		3	1	1	0	9	4	7	3	6	2	14	3	5	9	276	35	53	57	93	131	52	13	
2:00 PM						5	27		2	3	1	4	2	2	2	5	7	0	0	4	4	28	3	15	188	122	56	26	30	6	
3:00 PM						0	38	2	2	2	2	1	1	2	1	12	12	4	10	7	4	6	111	28	94	156	88	169	35	4	
4:00 PM							27	2	1	1		5	1	3	4	14	19	23	27	7	4	27	111	18	67	200	67		10	7	
5:00 PM	1	0	0		5	3	28	1	0		2	2	1	4	3	15	22	7	0	116	6	52	26	95	44	100	53	70	20	20	
6:00 PM				2				97	2		3	2	0	0	0	11					17	100	77	133		222		218	44	26	
7:00 PM		0						2	1	4	2	1	0	2	3		38	18	101	38	71	10	256	39	67	74	86	369	19	19	
8:00 PM						0		5	2	4	5	1	3	2	3	20	30	15	26	46	41	49	340	81	139	33	35	151	34	11	
9:00 PM					1			4	0	4	1	0	3	3	36	23	0	7	16	36	39	30	70	140	321	35	60	123	27	7	
10:00 PM	4	0	1	0			3	1	4	18	2	9	1	12	19	3	2	7	12	68	37	40	39	75	400	35	104	397	47	25	
11:00 PM							48	10	8	17	7	32	17	27	15	8	19	19	30	70	36	60	71	84	180	78	60	331	43	43	
12:00 AM							95	122	43	41	21	9	34	25	52	35	18	41	72	80	61	94	52	218	75	20	79	376	70	27	
1:00 AM							77	118		17	24	27	17	17	96	50	40	75	88	90	92	65	114	245	140	50	121	280	73	20	
2:00 AM										18	9	5	8	23	130	60	128	160	200	307	71	45	79	309	200	41	58	150	40	2	
3:00 AM										6	6	6	3	8	140	71	280	170	180	40	51	37	35	190	100			120	11		
4:00 AM											2				40	50	40	70	10	0	20							50			
5:00 AM																															
Total	5	9	9	11	7	24	357	371	74	145	91	118	109	159	571	392	689	679	853	950	774	726	1,786	1,789	2,135	1,827	1,111	4,250	714	283	

Time	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	
6:00 AM																								
7:00 AM	10	0	0	54	47	140		197	0	3,209	269	177	98	50	89		65	105	0	0		66	39	
8:00 AM	3	0	19	22	112	19	0	188	202	300	185	247	62	268	30		45	0	194	0		0		
9:00 AM	2	0	9	46	79	0	0	230	0	258	381	129	0	49			29	45	0	0		143		
10:00 AM	1	0	0	28	6	118	0	143	0	159		236	127	122	77		56	0	168	0	152	0		
11:00 AM	7	0	27	113	71	54	69	147	102	107	382	36		114	143		73	48	44	177	155	0	70	
12:00 PM	6	0	12	27	32	26	165	77	184	101	495	123	46	98			64	0	0	0		76		
1:00 PM	1	22	6	26	0	31	189	235	273	108	87	100	74	86			72	46	0	96		0	84	
2:00 PM	6	2	26	1	42	161	12	113	62	105		159	87	21	83		63	106	0	64		0		
3:00 PM	2	3	29	88	44	104	52		0	97	222	87	100	0	70		100	30	132	0	156	40		
4:00 PM	3	4	33	104	59	125	22		0	82	302	126	50	25			0	0	0	0		0		
5:00 PM	2	19	17	99	82	9	41	89	282			52	42				0	0	0	0		0		
6:00 PM	0	6	1	71	39	4	53	85	180	4	40		14	10			0	0	92	0	188	3		
7:00 PM	6	9	4	95	18	7	19		130	0					82		138	0	0	0		116	85	
8:00 PM	7	18	8	50	85	72	2	103	240	4	130	56	121	60	19		0	0	25	92	23	0		
9:00 PM	2	8	10	47	26	2	9	59	359	33	135		69	64	9		45	62	0	0		36		
10:00 PM	4	10	25	21	102	7	18	153	225	8	69	41	120		9		52	1	0	0		0		
11:00 PM	11	1	29	45	38	5	117	68	197	20		12	78	21			0	0	57	70	12	45		
12:00 AM	21	9	14	41	42	19	64	91	63	5	39	37	37	9			60	75				0		
1:00 AM	13	11	7	20	29	9	13	20	64	7	68	7	18		8		18		8					
2:00 AM	4			2	3			13	2	13	1	6	13	25										
3:00 AM																								
4:00 AM																								
5:00 AM																								
Total	111	122	276	1,000	956	912	845	2,011	2,565	4,620	2,805	1,631	1,156	973	668	0	880	443	738	486	744	492	323	

Appendix 10. Bear Lake 2012 – Project Updates

Sockeye Salmon Project

Stocking & Misc. Activities

Crew on-site:	15-May		
Ice-out:	NA		
Crew off-site:	16-Oct		
Fry stocking:	16-Jun	2,490,000	0.61 g
PreSmolt stocking:	None		
Smolt stocking:(Res Bay)	23-May	1,305,000	10.8 g
Fertilizer application:	8-Jul to 28-Jul	120 gallons	

Smolt Migration

Dates:	17-May to 8-Jul		
Sockeyes:		467,000	
Percent age 1:		454,800	97.4%
Percent age 2:		12,200	2.6%
Percent age 3:		0	0.0%
Percent hatchery:		463,731	99.3%
Dolly Varden:		1,425	

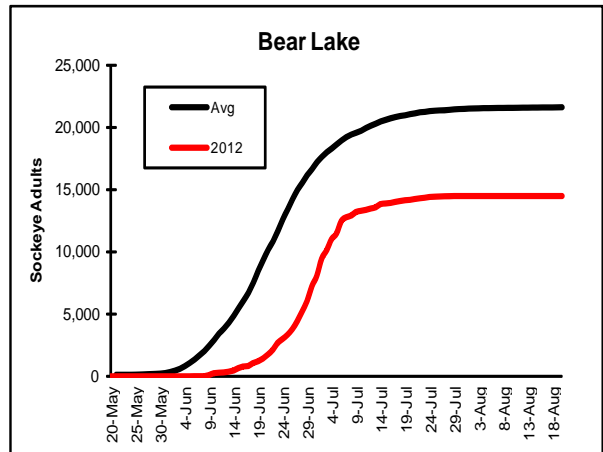
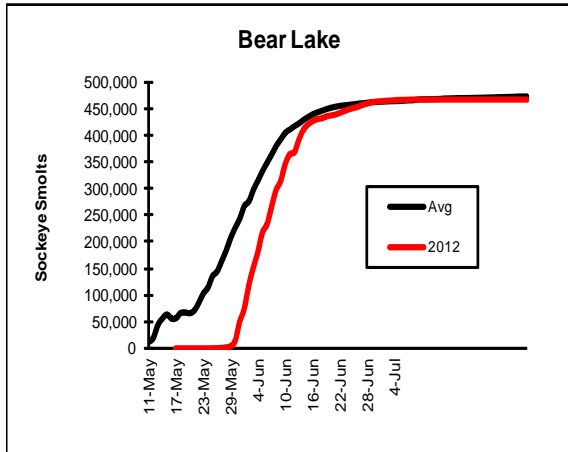
Egg Take

Dates:	2-Aug to 17-Aug	
No. of broodstock used*:	4,428	
Green eggs:	6,041,114	
Fecundity:	2,786	
Eyed eggs:	5,611,491	
% Survival	92.9%	

Adult Migration

Dates:	2-Jun to 31-Jul		
Total return:		95,892	
Commercial & Sport Fish harvest:		0	0.0%
C.R. harvest(FW & SW):		83,453	87.0%
Lake:		12,439	13.0%
Mortalities		0	
Hatchery broodstock:		4,431	
Lake broodstock:		8,008	

*Includes mortalities and inviables



Appendix 10 (continued). Bear Lake 2012 – Project Updates

Coho Salmon Project

Stocking & Misc. Activities

Crew on-site:	15-May		
Ice-out:	NA		
Crew off-site:	16-Oct		
Fry stocking:	19-Jul	222,000	1.68 g
Smolt stocking Bear Lake	2-Jun	93,000	12.3 g
Fertilizer application:	8-Jul to 28-Jul	120 gallons	

Egg Take

Dates:	2-Oct to 10-Oct	
No. of broodstock used:		395
Green eggs:		638,551
Fecundity:		4,044
Eyed eggs:		518,315
% Survival		81.2%

*Includes broodstock for ADFG and CIAA but green eggs are CIAA only.

Smolt Migration

Dates:	17-May to 8-Jul	
Cohos:		45,900
Percent age 1:	16,500	35.9%
Percent age 2:	29,400	64.1%
Percent age 3:	0	0.0%
Percent hatchery:	45,028	98.1%
Dolly Varden:	1,425	

Adult Migration

Dates:	22-Aug to 20-Oct	
Coho total creek return:	924	
Weir return:	924	100%
C.R. harvest:	31	3%
Lake:	498	54%
Hatchery broodstock:	395	43%
Est. Remaining in Bear Ck:	0	0%
Est. Remaining in Salmon Ck:	0	0%

CR Harvest = donations

