Bear Lake
Salmon Enhancement
Progress Report
2013

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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 2013 Bear Lake smolt migration, fry release, adult count, and gamete collection exercise were conducted by the Cook Inlet Aquaculture Association. 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 2013, 2.548 million sockeye fry (BY12) and 405,000 coho fry (BY12) were released into Bear Lake. At the time of release, the sockeye fry averaged 0.49 g and the coho fry averaged 1.0 g. All released fry were of Bear Lake origin. In addition to the fry stocking, 2.090 million sockeye smolt (BY11) averaging 14.7 g were released into Resurrection Bay. No coho smolt were released into Bear Creek.

Smolt migration monitoring began on 19 May and continued daily until 10 July. During this time a total of 791,700 (± 79,800) sockeye and 36,200 (± 3,200) coho smolts migrated from the lake.

Based on otolith marks, 99.2% (± 0.6%) of the emigrating sockeye salmon smolt were of hatchery origin. An estimated 93.6% (± 2.0%) smolt were age 1 and 6.4% (± 2.0%) were age 2. The average length and weight of the age 1 sockeye smolt was 82 mm (± 0.3 mm) and 4.7 g (± 0.1 g) respectively. The age 2 sockeye smolt were 99 mm (± 0.3 mm) and 9.1 g (± 0.5 g).

Based on otolith marks, 96.2% (± 2.4%) of the emigrating coho smolts were enhanced. An estimated 38.4% (± 7.1%) smolts were age 1, 59.5% (± 8.2%) were age 2 and 2.1% (±1.8%) were age 3. The average length and weight of the age 1 coho smolts was 98 mm (± 4.1 mm) and 9.9 g (± 3.5 g) respectively. The age 2 coho smolts were 121 mm (± 1.0 mm) and 17.3 g (± 0.9 g). The age 3 coho smolts were 135 mm (±13.6 mm) and 23.6 g (±7.2 g).

A total of 15,820 adult sockeye returned to Bear Creek weir in 2013. The returning sockeye salmon were age 1.1 (0.4%), age 1.2 (46.1%), age 1.3 (44.9%), age 2.1 (1.4%), age 2.2 (6.9%)

and age 2.3 (0.4%). A total of 12,605 were passed into the lake, while 1,964 were harvested at the weir for cost recovery and 1,255 were donated to the Senior Center and Food Bank. An additional 41,405 were harvested in Resurrection Bay in cost recovery. In the common property, none were harvested in the commercial fishery and the fish caught in the sport fishery was estimated at 20,000. Total return of sockeye to Resurrection Bay was 77,300.

A total of 3,122 adult coho returned to Bear Creek weir in 2013. The returning fish were age 1.1 (50.0%), age 2.1 (45.4%) or 3.1 (4.6%). Of the adult coho returning, 1,997 were harvested and donated, 498 were held and used as hatchery broodstock, and 300 were passed into Bear Lake. An additional 93 adults were sampled for otoliths and 234 adults were used for ADF&G broodstock purposes as well as Salmon in the Classroom. Sport fish harvest is estimated at 5,400. Total return of coho was 8,500.

From 31 July to 23 August 2013, 5,325,000 sockeye salmon eggs were collected for incubation, rearing, and release to Bear Lake. The eggs were obtained from Bear Lake broodstock, shipped to CIAA's Trail Lakes Hatchery, and fertilized using a delayed fertilization technique. Eggs from 1,696 females were fertilized with milt from 1,696 males. All female adult sockeye salmon were injected with an antibiotic (erythromycin) prior to being passed up into the lake in order to reduce the prevalence of Bacterial Kidney Disease (BKD) in the spawning population.

From 26 September to 10 October 2013, 635,000 coho eggs were collected from 168 females and fertilized with milt from 168 males. In addition, the Alaska Department of Fish and Game (ADF&G) collected 315,000 coho salmon eggs.

A total of 1,140 gallons of fertilizer was applied to Bear Lake in 2013. Limnological samples were collected in June, July, August and September. Zooplankton results are not yet available.

INTRODUCTION AND PURPOSE

Bear Lake is located on Alaska's Kenai Peninsula near the community of Seward, Alaska and has been the site of salmon enhancement activities since 1962. Initial enhancement activities, conducted by the Alaska Department of Fish and Game (ADF&G) Sport Fish Division, focused on coho salmon (*Oncorhynchus kisutch*) and the control of predator and competitor species[1].

In 1988, the Alaska Board of Fisheries revised the management plan for Bear Lake. The revision allowed for the enhancement of sockeye salmon (*Oncorhynchus nerka*).

The revised Bear Lake management plan developed in 1988 was soon followed by a cooperative agreement between ADF&G, Sport Fish Division, ADF&G Fisheries Rehabilitation, Enhancement and Development (FRED) Division, and the Cook Inlet Aquaculture Association (CIAA). The cooperative agreement, which became effective in August 1989, allowed CIAA to operate and maintain the Bear Lake coho salmon enhancement project and to begin sockeye enhancement activities in the lake. The agreement also provided CIAA with the responsibility of operating and maintaining the Bear Creek weir site.

Current enhancement activities at Bear Lake now target both sockeye and coho salmon with control of predator and competitor species. The objectives are to create a commercial sockeye fishery and to maintain the coho sport fishery enhancement program. To accomplish the objectives CIAA will

1) Maintain the level of coho salmon production.
2) Maintain sockeye and coho lake spawning escapement goals.
3) Annually describe the timing, abundance, size, and percent of wild and enhanced sockeye and coho in smolt migrations.
4) Annually describe the timing, abundance, and size of sockeye and coho salmon in adult migrations.
5) Monitor the number of marked fish resulting from fry, pre-smolt, and smolt releases in sockeye and coho adult migrations and evaluate the success of enhancement through the recovery of marked fish.

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

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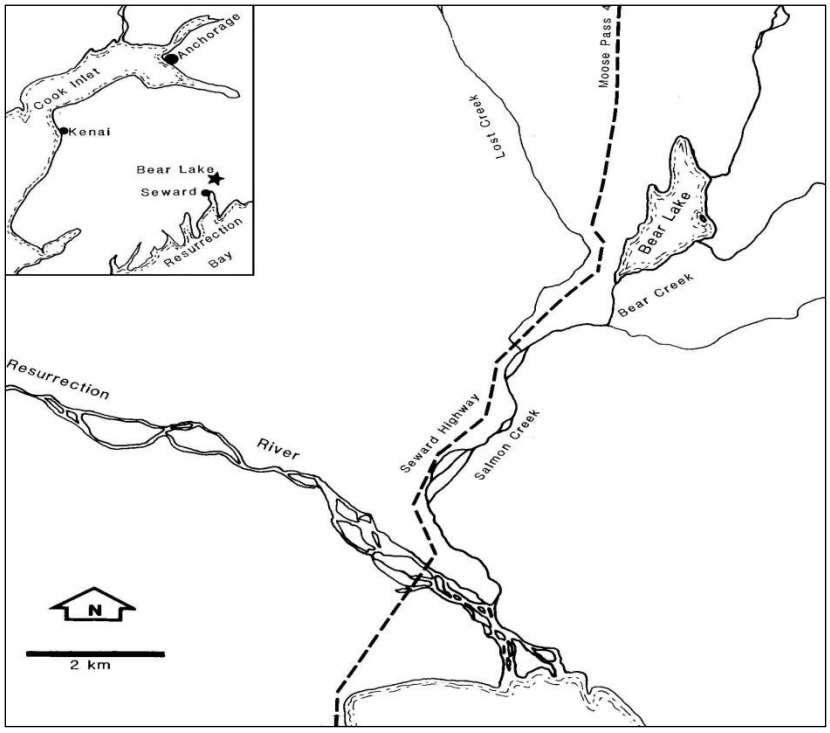
PROJECT AREA

Bear Lake is located on Alaska's Kenai Peninsula 9 km north of Seward, Alaska. It is the largest clear water lake in the Resurrection Bay drainage.



Bear Lake has a watershed area of 15 km^2 and one outlet, which drains into Resurrection Bay through Bear Creek, Salmon Creek and the Resurrection River (Figure 1). 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. Map showing location of Bear Lake near Seward, Alaska.

Bear Lake (Figure 2) is oligotrophic with a surface area of 180 hectares. It has a mean depth of 10 meters, a maximum depth of 20 meters, a lake volume of 18.7 X 10^6 m^3 and a water residence time of 0.75 years. There is one small island located along the east shore. The shoreline is heavily wooded and shoreline substrates vary from exposed bedrock, to large cobble, sand and organic muck.

In the fall of 2012, the small tributary stream used for acclimation of sockeye fry and main spawning area, changed course during a flood event. The amount of water flowing through this creek channel decreased substantially in comparison to previous years.

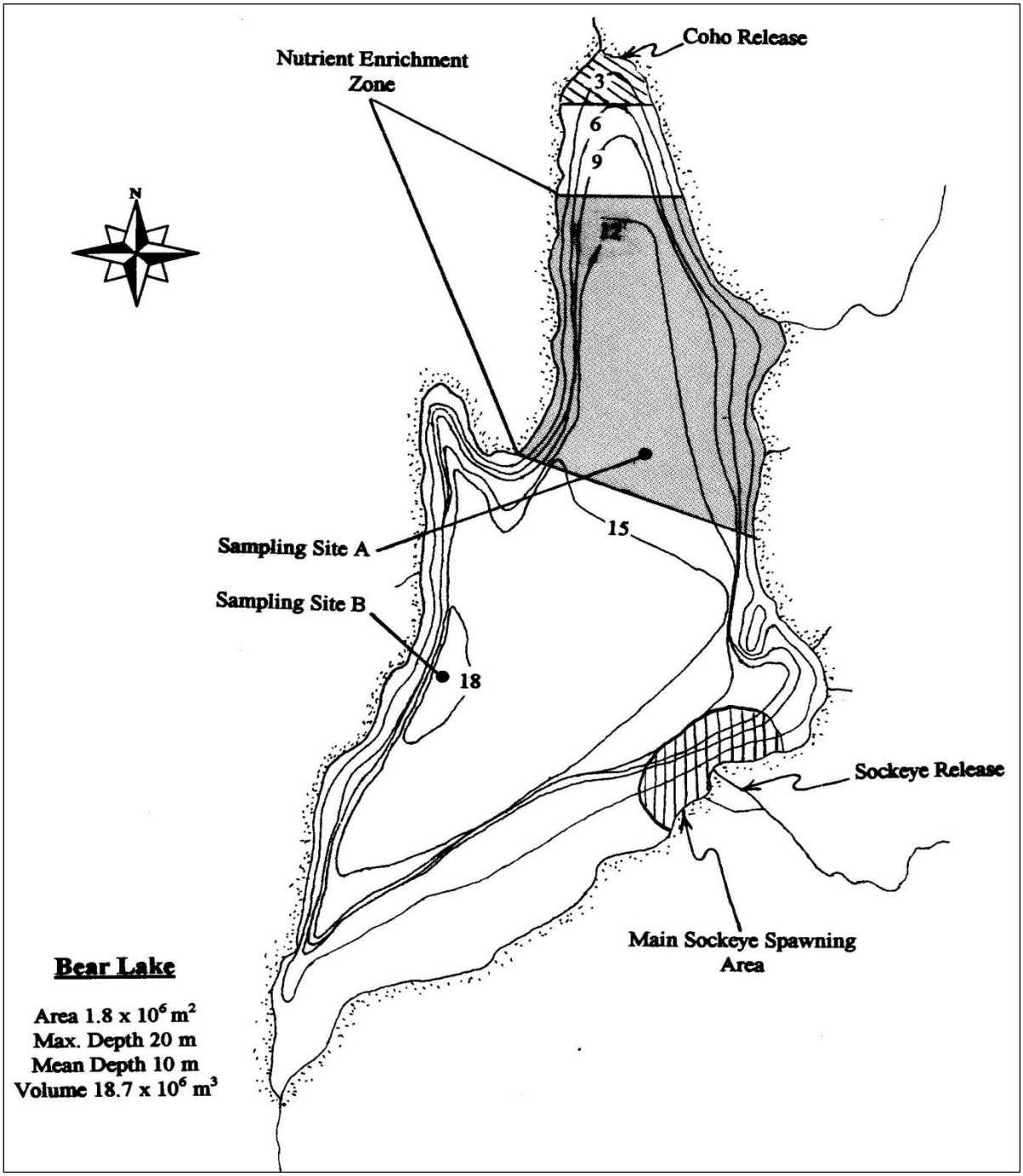


Figure 2. Bear Lake near Seward, Alaska

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

During 2013, assessments of water quality were conducted 4 times (June, July, August, September) throughout the open water season using a Van Dorn water sampler. Sampling and analysis followed the procedures described by Koening et al. (1986). A 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 1 meter below the surface and from the hypolimnion. A 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. Zooplankton results are not yet available.

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 was recorded in two different locations. The upper gauge was used to monitor pool height above the weir while the lower gauge monitors the water level below the weir. Both heights were dependent on the addition or removal of dam boards.

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 01 July to 03 August. The amount of fertilizer to apply was calculated using the mean fall total phosphorus concentration recorded in 2012 and a lake nutrient 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 2013 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 20-minute interval.

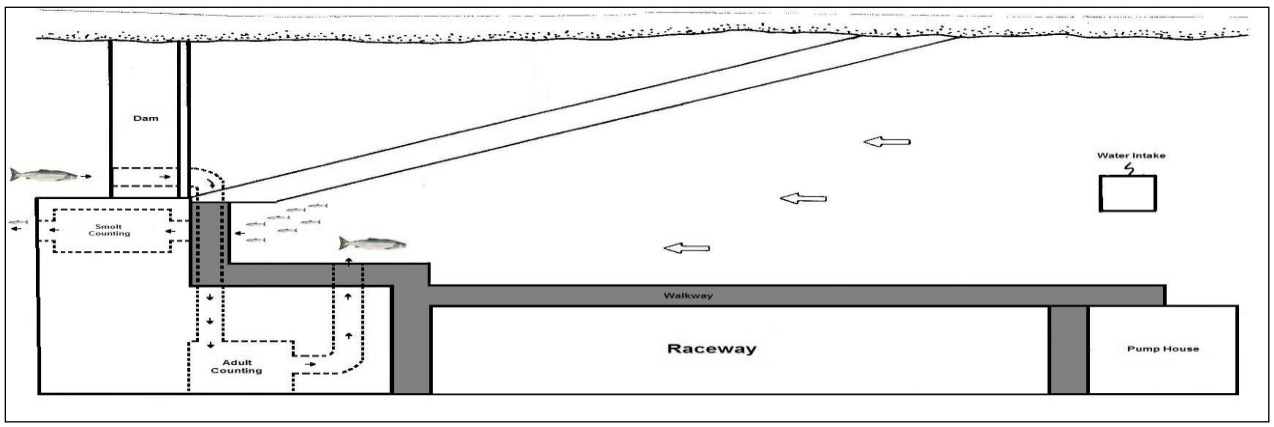


Figure 3. The Bear Creek weir, smolt trap and adult counting complex (Top View).

Assuming the two minute sub-sampling intervals were randomly distributed throughout sub-sampling[2] and smolt moved through the weir randomly, the total smolt migration was estimated as follows:

If:

T_c = number of fish counted with the total count procedure,

$\hat{T}_s$ = number of fish counted with the 10% sub-sampling procedure,

$\hat{T}$ = the total smolt migration,

y = the number of fish counted in each two minute sub-sampling interval,

n = the number of two minute sub-sampling intervals sampled, and

N = the number of possible two minute sub-sampling intervals,

Then:

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

and the variance is,

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

And:

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

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

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

Smolt Characteristics and Enhanced Contribution

CIAA has released sockeye and coho salmon fry to Bear Lake since 1990. To evaluate this enhancement procedure, CIAA has collected a sample of sockeye and coho smolts migrating each year to determine age, weight, and length characteristics of the migrating populations. Since 1993, CIAA has also marked the otolith of all salmon fry released to Bear Lake with a thermal mark[3]. The purpose of this mark is to determine the contribution of released hatchery fish to the Bear Lake smolt population.

In 2013, smolts collected for measurement, age determination, and otolith removal were sampled in proportion to the daily smolt migration. This was accomplished by collecting every 1000th sockeye smolt and every 150th 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 788 sockeye smolt (0.10%) and 240 coho smolt (0.66%).

Each smolt collected for evaluation was first measured to the nearest millimeter for fork length[4] and weighed to the nearest 0.1 gram. 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 and aged 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, $\left(N = \sum N_h\right)$,

n = total number of smolts sampled,

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

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.

a = total number of enhanced smolts sampled,

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

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

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

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

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

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

$m_{hi} = 1 - l_{hi}$, The proportion of other than age $= i$ smolts in stratum h,

$f = n / N$, The sampling fraction (assumed equal in all strata),

$W_h = N_h / N$, The stratum weight, and,

$y =$ the weight or length of the smolt.

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

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

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

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

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

with a variance of:

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

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

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

and, the relative error is:

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

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

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

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. A catch and release study using adult sockeye required that 284 adult fish be passed into the lake without the erythromycin injection. Any eggs collected from these fish would be kept separate and culled once they reach the eyed stage and the study is complete.

Every 20th sockeye was sampled to assess sex, age (via scale analysis) and weight. For the coho adult migration, every 30th coho was sampled. In 2013, measurements were collected from 640 sockeye (4.0%) of which 510 were readable and 115 coho (3.4%) of which 108 were readable.

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 gillnetting 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. However, flood conditions in the fall of 2012 dramatically changed the amount of water flowing in this small tributary stream. The number of brood fish returning to this stream in 2013 was lower in comparison to previous years, but it is not know whether this

is related to the change in stream flow or the elevated water temperatures also experienced this year.

Male and female adult sockeye salmon from the spawning areas were harvested 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 – 4H; Smolt – 2,4H).

During the eggtake, 60 female fish were sampled for routine disease screening (included bacteriology, BKD and virology).

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 *Renibacterium. 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 lots (Fry – 3,3H, Smolt 2,2H). Coho salmon eggs were also collected by ADF&G staff for their stocking programs as well as for Salmon in the Classroom.

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 2013, 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 smolt 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). No coho smolt were released into Bear Creek in 2013.

Otolith Collection in Resurrection Bay

With the stocking of sockeye salmon smolt 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. Starting in 2012, CIAA staff performed this sampling following the same procedures with the exception that otoliths were analyzed by CIAA staff.

The proportion of enhanced adult sockeye were estimated using the following notations and formulas.

If:

N = total number of adults captured in fishery (from fish tickets),

n = total number of adults captured in fishery that were sampled,

a = total number of enhanced adults captured in fishery from the fry program,

p = the proportion of enhanced adults captured in fishery from the fry program,

Then the proportion of enhanced adults from the fry program, $\hat{P}$, was estimated as:

$$\hat{P} = a/n; \text{ with a variance of } v\left(\hat{P}\right) = (a/n)(1-a/n)/n-1$$

The total number of enhanced adults from the fry program, $\hat{A}$, was also estimated as:

$$\hat{A} = N(a/n) = N\hat{P}; \text{ with a variance of: } v\left(\hat{A}\right) = v\left(\hat{P}\right)N^2.$$

Thus the 95% confidence interval estimate for

$$\hat{A} = 1.96\sqrt{v\left(\hat{A}\right)}$$

To compare the age structure of the net pen returns (smolt program) and lake releases (fry program, scale samples were collected at the weir throughout the return. Additionally, during the fishery and at the weir, it was noted that there was a large number of smaller fish (jacks) being caught. To assess age structure and hatchery contribution otolith samples were collected from the returning jacks at the weir (n= 25) and from the fishery (n=13).

RESULTS AND DISCUSSION

Limnology, Environmental Conditions and Lake Fertilization

Bear Lake's limnological characteristics have been monitored for several years. The 2013 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). Zooplankton results are not yet available.

Table 1. Water quality characteristics of Bear Lake at 1 meter, 1979 to 2013.

Year	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	NO2+NO3 (ug/l)	TN:TP	Chl a (ug/l)	EZD (m)	Secchi (m)	Zooplankton (mg/m2)
1979	76	7.4	30		8.0		8.3					
1980	74	7.3	29		7.7	138	9.8	42 :1	3.4			
1981	68	6.3	28		7.2	101	14.0	35 :1	3.4			734
1982	77	7.6	29		9.9	149	47.0	44 :1	1.9			704
1983	86	7.6	32		8.7	175	41.6	55 :1	2.0			914
1984	88	7.4	32	2.5	10.6	204	24.0	48 :1	3.6			836
1985	87	7.2	36	1.7	11.3	177	89.7	52 :1	2.6			429
1986	82	7.3	32	2.3	12.3	188	12.4	36 :1	2.9			583
1987	81	7.4	29	1.3	9.7	135	2.1	31 :1	1.6			401
1988												
1989												
1990	78	7.4	29	1.6	6.5	170	54.1	76 :1	1.9	11.2	3.6	1,134
1991	84	7.6	28	2.4	8.5	183	52.1	67 :1	2.8	7.4	3.2	467
1992	80	7.2	26	1.7	7.5	166	89.1	85 :1	1.7	9.0	3.8	395
1993	82	7.1	27	1.2	7.3	134	37.4	58 :1	1.9	8.7	4.4	804
1994	88	6.9	27	1.8	7.8	132	14.9	45 :1	2.1	11.4	5.0	743
1995	80	7.2	27	1.9	7.6	116	12.0	37 :1	2.7	10.1	4.4	377
1996	86	7.3	30	2.3	6.3	191	7.5	70 :1	3.1	9.0	3.8	949
1997	89	7.5	33	2.3	7.4	161	17.8	56 :1	3.0	8.2	4.4	556
1998	79	7.2	29	1.2	7.6	176	18.7	66 :1	0.6	8.5	5.3	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 :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
2013	76	7.3	24.6	0.9	9.6	NA	4.1	NA :1	1.9	9	4.1	

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, 2013 TKN analysis is not complete due to equipment failure

Table 2. Water quality characteristics of Bear Lake in the hypolimnion, 1979 to 2013.

Year	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	NO2+NO3 (ug/l)	TN:TP	Chl a (ug/l)
1979	79	7.3	30		18.3		16.2		
1980	81	7.2	31		13.9	168	14.3	29 :1	8.8
1981	69	6.3	29		11.3	124	19.3	28 :1	5.5
1982	78	7.4	28		16.6	177	37.6	29 :1	5.8
1983	88	7.3	32		14.7	259	43.1	46 :1	6.8
1984	96	7.1	34	6.3	13.9	269	29.9	48 :1	7.7
1985	90	6.9	36	2.8	11.6	253	76.6	63 :1	4.1
1986	89	6.7	32	4.1	14.4	244	34.1	43 :1	3.9
1987	85	7.1	29	2.1	15.2	222	20.8	35 :1	
1988									
1989									
1990	83	7.1	29	2.9	11.2	248	47.4	58 :1	5.4
1991	88	7.1	29	3.3	10.6	203	55.9	55 :1	3.4
1992	84	7.0	26	2.9	8.1	194	82.7	83 :1	3.2
1993	88	7.0	29	1.9	8.8	140	65.6	62 :1	1.1
1994	88	6.9	29	1.9	13.6	185	17.7	34 :1	5.6
1995	83	7.0	28	4.7	12.8	202	8.3	36 :1	8.1
1996	87	7.0	30	4.6	12.4	273	1.9	49 :1	7.6
1997	93	7.3	34	8.3	17.1	332	4.3	44 :1	9.7
1998	89	7.1	32	2.9	8.5	188	34.5	63 :1	1.6
1999	86	6.9	30	4.2	14.7	222	12.2	38 :1	3.8
2000	81	7.2	28	1.9	6.9	127	3.0	41 :1	4.6
2001	80	7.0	27	1.9	5.8	137	3.9	37 :1	3.2
2002	80	7.0	31	0.9	10.1	127	15.2	32 :1	2.4
2003	73	6.8	26	0.7	6.7	116	7.1	41 :1	2.2
2004*	74	6.7	27	0.9	28.1	275	78.9	32 :1	1.7
2005	79	6.7	27	0.2	8.9	135	16.3	38 :1	0.9
2006	83	6.7	28	2.1	12.5	149	6.8	28 :1	2.4
2007	82	6.5	29	1.8	15.0	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
2013	81	6.9	25.4	2.5	17.3	NA	6.6	NA :1	4.2

Averages prior to 1992 compiled by ADF&G.
EZD, Secchi and atomic ratio provided by CIAA
Open water season only
*2004 - possible contamination of hypolimnion sample (7/14/2004)
2010 data is combination of both Site A and B.
2010, 2011, 2012, 2013 TKN analysis is not complete due to equipment failure.

The environmental conditions recorded in 2013 are presented in Appendix 2. Between 19 May and 30 June, the average air temperature was 12.8°C (± 4.3°C) while water temperature averaged 8.9°C (± 4.4°C). Average stage height below the weir was 1.8 ft (± 0.14 ft) and above the weir it was 0.9 ft (± 0.05 ft) for the same time period. Between 01 July and 10 October, the average air temperature was 13.7°C (± 4.4°C) while water temperature averaged 14.0°C (± 3.1°C). Average stage height below the weir was 1.1 ft (± 0.55 ft) and above the weir it was 0.8 ft (± 0.17 ft). The environmental conditions observed in 2013 are compared to other years in Table 3 and 4.

Table 3. Environmental conditions observed at Bear Lake during smolt migration, 1990 to 2013.

May thru June 30

		No. of Days							Temperature (C)			
			<50%	>50%			Days		Air		Water	
Year	Total Days	Clear	Cloud Cover	Cloud Cover	100% Overcast	Rain	Meas. Precip	Precip (mm)	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)
2013	43	19	7	6	9	2	13	42	13	(3-21)	9	(2-15)

Table 4. Environmental conditions observed at Bear Lake during adult migration, 1990 to 2013

	July thru Sept/Oct/Nov											
			No. of Days						Temperature (C)			
			<50%	>50%			Days		Air		Water	
Year	Total Days	Clear	Cloud Cover	Cloud Cover	100% Overcast	Rain	Meas. Precip	Precip (mm)	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)
2013	102	28	5	10	40	19	32	607	14	(5-26)	14	(9-19)

Smolt Enumeration - Sockeye

Enumeration of Bear Lake sockeye smolt occurred between 19 May and 10 July. A total of 791,700 (± 79,800) sockeye smolt migrated from Bear Lake in 2013 (Appendix 3). The 10% sub-sampling procedure was used to count 63.1% of the migrating sockeye salmon.

An estimated 93.6% (± 2.0%) smolt were age 1 and 6.4% (± 2.0%) were age 2. The age 1.0 smolt averaged 82 mm (± 0.8 mm) in length and 4.7 g (± 0.1 g) in weight. The age 2.0 smolt averaged 100 mm (± 1.5 mm) in length and 9.1 g (± 0.5 g) in weight (Table 5). Based on the presence of hatchery induced thermal marks in the otoliths of 788 smolt, it was estimated that 99.2% (± 0.6%) of the sockeye smolt were of hatchery origin.

Smolt Enumeration - Coho

A total of 36,200 (± 3,200) coho salmon smolt migrated from Bear Lake in 2013 (Appendix 3) between 19 May and 10 July. The 10% sub-sampling procedure was used to count 34.2% of the migrating coho smolt.

An estimated 38.4% (± 7.1%) smolt were age 1, 59.5% (± 8.2%) were age 2. and 2.1% (±1.8%) were age 3. The age 1.0 smolt averaged 98 mm (± 4.1 mm) in length and 9.9 g (± 3.5 g) in weight. The age 2.0 smolt averaged 121 mm (± 1.0 mm) in length and 17.3 g (± 0.9 g) in weight. The age 3.0 smolt averaged 135 mm (± 13.6 mm) in length and 23.6 g (± 7.2 g) in weight (Table 5). Based on the presence of hatchery induced thermal marks in the otoliths of 240 smolts, it was estimated that 96.2% (± 2.4%) of the coho smolt were of hatchery origin.

Adult Escapement - Sockeye

Adult sockeye salmon began arriving at the weir on 06 June 2013 and continued to migrate until 26 July 2013 (Appendix 4). During this time, 15,820 adults were captured and counted at the weir (Table 7). The returning major age groups (via scale samples) for adult sockeye included ages 1.1 (0.4%), 1.2 (46.1%), 1.3 (44.9%), 2.1 (1.4%), 2.2 (6.9%) and 2.3 (0.4%). Of the 15,820 adult sockeye that migrated to Bear Creek in 2013, 1,964 were harvested for cost recovery, 1,255 were donated to the Senior Center and Food Bank and 12,606 were passed to the lake. There were no mortalities at the weir. No fish were harvested in the common property seine fishery and 41,405 fish were harvested in the saltwater cost recovery harvest. The number of fish caught in sport fishery is estimated at 20,000 based on personal communication with property owner in which most of the sport fishery occurs. The total return to Resurrection Bay was estimated to be 77,200 sockeye salmon.

A summary of mean age and weight, by age class, for adult sockeye salmon escapement to the Bear Creek weir site for 2013 is presented in Appendix 6.

Adult Escapement - Coho

Adult coho salmon began arriving at the weir on 30 August 2013 and continued to migrate until 10 October (Appendix 5). During this time, 3,122 adults were captured and counted at the weir (Table 7). The returning major age groups for adult coho included ages 1.1 (50.0%), 2.1 (45.4%), and 3.1 (4.6%).

Of the 3,122 adult coho that were counted at the Bear Creek weir site, 1,997 were harvested and donated, 498 were held for broodstock purposes and 300 were passed into the lake. Also 93 adult coho salmon were sampled for otolith collection and an additional 234 fish were used for ADF&G eggtake and Salmon in the Classroom.

The adult return in 2013 would be comprised of returns from the fry (437,000 [BY10]) and smolt (93,000 [BY10]) releases. However, since the 93,000 smolt released were excess from the fry program both release groups have the same thermal mark. Therefore, it is not possible to determine the contribution from each release group.

A summary of mean age and weight, by age class for adult salmon escapement to the Bear Creek weir site for 2013 is presented in Appendix 7.

Table 5. Sockeye smolt migrations: mean length and weight, by age class, for Bear Lake, 1980 to 2013.

						Age Composition								Average Length (mm)[6]					Average Weight (g)[6]				
Year	Number	95%CI	% Hatch.	95%CI	No. Wild	0.0	95% CI	1.0	95% CI	2.0	95% CI	3.0	95% CI	0.0	1.0	CI	2.0	CI	0.0	1.0	CI	2.0	CI
1980	3,400							3,400		20		20			119		187			NA		NA	
1981	3,500							2,800		700		0			117		158			16.2		41.6	
1982	46,300							46,100		100		0			110		144			14.0		29.7	
1983	13,000							11,000		2,000		40			112		149			13.5		32.9	
1984	10,500							7,700		2,500		300			116		153			15.4		35.8	
1985	1,600							1,300		300		30			126		176			20.2		51.4	
1986	1,000							800		100		0			123		167			18.3		47.2	
1987	18,200							17,800		300		100			112		172			12.8		46.5	
1988	9,100							7,200		1,900		30			120		155			16.0		34.9	
1989	5,100							3,700		1,300		200			122		152			18.8		35.6	
1990[1]	53,400					52,500		800		30		3		NA	113		125		NA	15.2		28.4	
1991[2]	122,000							119,900		1,600		600			125		164			18.7		40.4	
1992[3]	133,800					38,400		78,000		15,800		1,600		110	118		170		15.4	16.7		49.4	
1993	345,800					54,600		285,500		4,900				115	123		152		18.1	18.7		35.3	
1994	253,900					700		228,600		21,200				102	121		154		11.0	17.4		37.0	
1995	73,500	1,900	70.2	8.0	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
2013	791,700	79,800	99.2	0.6	4,942			740,700	15,500	51,000	15,500				82	0.3	100	1.5		4.7	0.1	9.0	0.5
Avg.[4]	534,400	58,200	83.7	2.9	41,200	11,400	5,600	493,644	20,100	35,000	9,400	3,800	2,300	119	102	0.8	131	3.7	17	10.3	0.7	24.0	3.1
Total[5]	11,432,300					157,600		10,440,900		733,250		21,923											

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

[1]In 1990, the migration of juvenile sockeye salmon consisted of three groups of fish: 870 wild smolts of age 1.0 or older, 227,906 age 0.0 fingerlings and 52, 491 age 0.0 smolts. Age, length and weight data for age 0.0 smolts have been lost. Summary statistics are based on the wild smolt migration.

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

[3]In 1992, an additional 68,505 sockeye fingerlings migrated from Bear Lake. These small fingerlings were expected to have low survivals and AWL data was not collected

[4]Average values calculated from smolt year 1995 to 2012.

[5]Total values calculated from 1980 to 2013.

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

[7]Due 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 2013.

					Age Composition								Average Length (mm)[4]								Average Weight (g)[4]							
Year	Number	95% CI	% Hatch.	95%CI	1.0	95% CI	2.0	95% CI	3.0	95% CI	4.0	95% CI	1.0	95% CI	2.0	95% CI	3.0	95% CI	4.0	95% CI	1.0	95% CI	2.0	95% CI	3.0	95% CI	4.0	95% CI
1980	75,000				54,600		20,300		100				122		135						19.3		24.0					
1981	72,900				10,900		61,800		200				122		127						18.4		19.8					
1982	143,700				134,000		9,600		100				116		127						15.0		20.4					
1983	108,400				100,400		7,900		100				115		129						14.3		20.2					
1984	93,800				78,300		15,200		300				116		134						15.0		22.4					
1985	105,900				104,300		1,600		0				125		168						18.1		41.5					
1986	72,700				60,900		11,500		300				126		137						19.5		24.9					
1987	80,200				61,200		18,700		250				109		145						11.6		27.9					
1988	63,800				50,500		13,300		0				118		133						16.4		22.3					
1989	99,400				96,200		3,200		0				116		134						18.8		23.0					
1990	83,400				67,500		14,800		1,000				119		139						15.7		24.1					
1991	97,600				86,500		10,600		500				121		138						18.0		25.5					
1992	112,900				107,500		4,700		600				120		137						17.1		25.7					
1993	53,500				42,300		10,400		0				124		137						19.5		25.8					
1994	54,400				6,000		43,700		0				115		128						14.4		20.7					
1995	89,200	4,000			3,500	1,000	85,000	3,800	500	400	100	150	103		121						11.4		18.0					
1996	154,900	15,300			16,100	4,700	137,300	14,400	1,400	1,400	0		95		112						8.4		13.5					
1997	114,100	24,100			3,500	1,900	68,800	20,500	40,600	12,600	1,200	1,000	100		109		124		146		9.7		12.9		19.2		30.7	
1998	92,200	7,200			8,200	2,500	73,000	6,000	10,900	2,800	600	700	100		114		140		168		8.4		13.6		26.2		40.5	
1999	106,800	11,700			44,300	7,400	54,500	8,600	8,000	2,600			113		123		128				13.5		18.3		19.4			
2000	70,900	4,600			55,600	3,300	13,500	2,900	1,800	1,200			109		128		144				13.0		20.4		28.9			
2001[1]	101,400	12,600	91.8	2.2	80,200	11,800	19,900	4,100	1,300	900			104		117		125				11.6		17.0		20.5			
2002	94,200	11,700	84.5	3.0	82,400	11,300	11,500	3,000	300	500			109		119		148				11.9		16.2		36.5			
2003	208,100	10,900	86.9	3.1	167,800	7,700	31,900	6,700	8,500	3,700			108.7		119		138				11.9		16.3		26.5			
2004	73,400		92.4	2.6	54,200	3,500	19,200	3,500					103.3	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				
2013	36,200	3,200	96.2	2.4	13,900	1,300	21,500	1,500	800	300			98	4.1	121	1.0	135	13.6			9.9	3.5	17.3	0.9	23.6	7.2		
Avg[2]	87,003	7,500	93.6	2.2	56,800	4,500	28,200	5,600	3,500	2,900	500	600	109		127		135		157		13.2		20.7		25.3		35.6	
Total[3]	2,907,300				1,833,000		949,400		77,550		1,900																	

Note: Averages for age 3.0 and 4.0 smolts are based on a small sample size.

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

[1]Percent Hatchery calculated for Age 1.0 smolts only

[2]Average values calculated from smolt year 1980 to 2012.

[3]Total values calculated from 1980 to 2013.

[4]1980 thru 1992 averages are arithmetic, 1993 and later are weighted averages.

[5]Due 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 2013.

	Weir	Coho Salmon			Weir	Sockeye Salmon										
	Retun	Age Composition			Retun	Age Composition										
Year	Total	1.1	2.1	3.1	Total	0.2	1.1	0.3	1.2	0.4	1.3	2.1	2.2	2.3	3.2	3.3
1980	4,520	NA	NA	NA	1,462	0	0	0	1,447	0		0	15	0	0	0
1981	3,924	2,252	1,627	45	704	0	0	0	5	0	631	0	63	5	0	0
1982	2,122	NA	NA	NA	472	0	0	0	407	0	26	0	6	28	0	0
1983	5,797	5,261	510	25	627	0	0	0	275	0	316	0	25	11	0	0
1984	3,375	3,969	401	5	3,552	0	0	0	3,432	0	74	0	31	10	0	0
1985	4,825	4,222	603	0	1,235	0	0	0	245	0	935	0	52	3	0	0
1986	5,479	5,384	95	0	830	0	0	0	356	0	425	0	44	6	0	0
1987	6,021	5,888	133	0	212	0	0	0	75	0	102	0	26	5	0	0
1988	2,174	1,818	356	0	106	0	0	0	51	0	44	0	3	8	0	0
1989	5,106	4,174	932	0	185	0	0	0	174	0	11	0	0	0	0	0
1990	7,525	7,179	346	0	1,071	0	0	0	390	0	627	0	---11---		0	0
1991	7,331	6,328	1,003	0	741	0	0	0	232	0	409	0	90	5	0	0
1992	3,055	2,444	611	0	1,925	1,398	33	0	246	0	225	0	17	6	0	0
1993	8,671	8,136	535	0	6,708	84	17	4,068	2,336	0	135	0	17	17	0	0
1994	5,995	4,643	1,352	0	16,752	4,399	149	196	4,813	44	6,198	0	802	129	20	0
1995	3,295	883	2,346	66	29,203	29	380	4,877	4,877	117	17,317	29	876	672	0	0
1996	1,711	495	1,216	0	15,957	34	101	1,280	7,002	0	5,555	0	1,919	67	0	0
1997	3,569	618	2,883	68	17,965	0	663	26	4,849	0	10,080	0	1,123	1,174	26	26
1998	11,023	935	9,531	557	29,447	0	49	25	24,613	0	4,245	0	344	172	0	0
1999	3,811	529	2,991	291	17,439	0	0	0	9,004	0	6,802	25	1,534	74	0	0
2000	6,765	1,172	5,465	129	13,716	0	136	0	2,139	0	10,253	0	917	272	0	0
2001	2,913	1,515	1,265	133	16,364	0	0	0	5,187	0	9,705	0	736	736	0	0
2002	3,484	1,475	1,884	124	15,227	0	0	0	11,235	0	3,064	0	859	70	0	0
2003	3,506	2,727	752	27	16,010	0	58	0	7,219	0	6,404	0	1,921	408	0	0
2004	2,672	1,255	1,369	49	11,923	0	992	0	2,639	0	6,904	20	1,131	238	0	0
2005	2,947	795	2,095	58	45,312	0	0	0	37,729	0	5,898	0	1,026	659	0	0
2006	2,089	1,058	952	79	43,069	0	0	0	5,153	0	35,000	0	2,236	681	0	0
2007	1,113	596	517	0	20,090	0	0	0	10,472	0	8,121	0	321	1,175	0	0
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
2013	3,122	1,561	1,416	145	15,820	0	62	0	7,290	0	7,103	217	1,086	62	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 2013, 2.548 million sockeye fry (BY12; Hatch Code - 4,2H) and 405,000 coho fry (BY12; Hatch Code - 4,3H) were released into Bear Lake. These fish will migrate in 2014/2015 as smolts. At the time of release, the sockeye fry averaged 0.49 g and the coho fry averaged 1.0 g.

In addition to the fry stocking, 2.090 million sockeye smolt (BY11; Hatch Code - 1,3H & Hatch Code - 3,2H5) were short-term reared in net pens located in Resurrection Bay before being released. At the time of release, the sockeye smolts averaged 14.7 g. A summary of releases are provide in Table 8.

No coho smolt were released into Bear Creek.

Eggtake

Between 31 July and 23 August 2013, a total of 5,325,000 sockeye salmon eggs were collected. A total of 3,606 broodfish (includes broodstock, mortalities and inviable) were used providing an average fecundity of 3,140 eggs/female. Disease screening analysis indicated that 8.3% of the samples collected were positive for *R. salmoninarum*.

From 26 September to 10 October 2013, a total of 635,000 coho eggs were collected from 168 females and fertilized with milt from 168 males. Average fecundity was 3,780 eggs/female. An additional 315,000 coho eggs were collected by ADF&G Fort Richardson Hatchery. Of the 168 females sampled for disease screening, only two fish was identified as being positive for *Renibacterium salmoninarum.*

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

Fry-to-Smolt Survival

Migrating smolts in 2013 were stocked either as fry in 2011 (BY10 - Age 2) and 2012 (BY11 - 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. In 2013, the fry-to-smolt survival for sockeye salmon from BY09 was finalized at 21.5%, while BY10 is at 20.1% (incomplete data) and BY11 is at 26.7% (incomplete data). For coho salmon, the fry-to-smolt survival is estimated at 8.4% for BY10 (incomplete data) and at 6.0% for BY11 (incomplete data). BY09 fry-to-smolt data cannot be finalized due to samples being lost/destroyed in 2010. This information is summarized in Table 10.

Otolith Analysis

Otolith analysis of adult sockeye (n=488) caught during the Resurrection Bay fishery (02 June to 18 June) indicated that 88.5% (± 2.8%) were from the fry stocking program while 9.2% (± 2.6%) were from the smolt program and the remaining 2.3% (± 1.3%) were natural production. As there was no age 2 SW expected to return in 2013 from the smolt program (no smolt releases due to IHN) this breakdown was expected. This information along with age analysis is summarized in Table 11. Age analysis indicated that from the fry stocking program 3.5% were from BY07, 85% from BY08 and 11.6% from BY09. For the smolt stocking program, 6.7% were from BY07, 93.3% from BY08 and 0% from BY09 (no BY09 smolts were stocked).

At the weir, scale analysis (n=510) of adult sockeye caught and passed into the lake throughout the migration (June 6 - July 10) indicated that brood year class breakdown was as follows: BY07 = 0.4%; BY08 = 51.8%; BY09 = 46.1% and BY10 = 1.8% (Table 11). All fish were assumed to be from the fry program.

Comparing the year class contribution for the fry stocking program between the two fisheries (Resurrection Bay and the weir), it is noted that they are not the same. It is assumed age analysis either by otolith or by scale sample are similar. One would expect the year class contribution to

be the same at the weir and fishery if all year classes were equally represented in each fishery. However, it would seem like the Resurrection Bay fishery is skewed for 3 SW component of the return and thereby missing the 2 SW component.

The total return of adult sockeye salmon to Bear Lake is a composite of returns caught in the commercial and cost recovery harvests, sport fish harvest and escapement. Since the age composition between the two fisheries (weir and Resurrection Bay) are not the same, the total return of adult sockeye must correspondingly be evaluated differently (i.e., results from otolith sampling in the Resurrection Bay fishery cannot be used to determine age composition at the weir). It is assumed that those fish caught in the sport fishery will have the same age composition as those sampled at the weir. However, without analysis of otoliths this cannot be certain.

Analysis of the otoliths collected from jacks in both the Resurrection Bay fishery and at the weir, determined that all were indeed age 1.1 (BY10) and came from both the smolt and fry programs.

Marine Survival

Based on information collected from migrating sockeye smolt 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 (2012 onward), 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 (BY06 onward). This information is summarized below in Table 12. Caution should be used in interpreting the results for BY05 through BY07. Due to poor thermal marking, there are a number of different variations of the thermal mark making it very difficult to determine the program (fry or smolt) contribution to the total return. Steps have been taken to correct this problem. Additionally as noted above, based on otolith analysis in 2013, it is probable that the Resurrection Bay sampling is skewed and a number of 2 SW returns (from both the fry and smolt programs) may not be included and survivals are underestimated.

For the return in 2013, age composition as determined by otolith collection in the Resurrection Bay fishery is applied only to the commercial and cost recovery harvests. Age composition for sport fishery and escapement uses the information as provided by scale analysis at the weir.

Table 8. Coho and sockeye salmon releases at Bear Lake, 1986 to 2013.

	Coho				Sockeye					
Release Year	Fry	Size (g)	Smolt	Size (g)	Fry	Size (g)	Pre-Smolt	Size (g)	Smolt	Size (g)
1986	445,700	1.64								
1987	226,300	1.46								
1988	347,200	1.00								
1989	491,300	0.75								
1990	333,200	1.30	93,700	20.0	2,260,200	0.80			158,800	7.1
1991	390,000	1.42			1,533,800	0.35			74,900	3.9
1992	203,800	0.49	51,730	10.1	1,795,500	0.72			565,500	4.4
1993[1]	450,000	0.30			47,000	0.15				
1993[2]	170,600	0.30			1,765,900	0.38				
1994	335,000	0.22			170,000	0.35				
1995	509,000	0.75	7,400	6.5	330,000	0.37				
1996[3]	350,000	0.70	75,000	11.2	780,600	0.37				
1997	448,700	0.63	153,000	8.0	788,000	0.34				
1998	409,000	0.66	117,000	8.3	265,000	0.56				
1999	306,000	0.82	51,000	7.8	1,380,000	0.26				
2000[4]	316,000	0.94	102,000	12.8	1,796,000	0.69				
2001	311,000	0.99	120,500	12.8	145,000	0.30				
2002	405,000	1.04	124,000	13.6	2,407,000	0.49	802,000	4.50		
2003[5]	405,000	1.37	253,000	13.7	1,467,000	0.42			334,000	11.8
2004	406,000	1.07	477,000	11.51	2,409,000	0.63	603,000	4.50		
2005	405,000	1.30	488,000	12.40	2,416,000	0.74	604,000	2.87	402,000	11.6
2006	447,000	0.84	115,000	10.8	2,414,000	0.52			979,000	10.0
2007	521,000	1.0	237,000	8.86	2,437,000	0.65			619,000	9.9
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
2013	405,000	1.0			2,548,000	0.49			2,090,000	14.7
Total	10,760,800		2,768,330		41,276,000		2,009,000		11,453,200	
Ave	371,062	0.99	153,796	11.5	1,651,040	0.50	669,667	3.96	954,433	10.12

[1] Released into Bear Lake
[2] Extra Fry Released into Bear Creek
[3] sockeye fry relase, 445, 300 @ .36g & 335,300 @ .38g
[4] sockeye fry release, 1,573,000 @ (.35-.45 g) & 223,000 @2.7 g
[5] An additional 103,000 coho smolts @ 12.7g (Bear Lake brood year 2001) were released at the Homer Spit.
[6] Sockeye smolt stocking was into net pens at Resurrection Bay not Bear Lake
[7] No 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 2013.

	Coho				Sockeye			
Brood Year	Brood Stock	Green Eggs	Eyed Eggs	%	Brood Stock	Green Eggs	Eyed Eggs	%
1989	Bear L	932,300	711,800	76.3	SF Big R	3,119,300	2,713,700	87.0
					U Russian L	57,400	47,700	83.1
1990	Bear L	798,200	669,300	83.9	SF Big R	134,000	100,700	75.1
					U Russian L	2,602,800	1,721,500	66.1
1991	Bear L	695,600	533,400	76.7	SF Big R	2,534,500	1,794,500	70.8
					U Russian L	1,441,800	974,400	67.6
1992	Bear L	802,700	749,900	93.4	SF Big R	3,428,100	2,976,000	86.8
					Bear L	47,000	45,100	96.0
1993	Bear L	735,500	696,000	94.6	Bear L	276,700	172,800	62.5
1994	Bear L	847,000	739,600	87.3	Bear L	530,000	420,000	79.2
1995	Bear L	867,500	737,600	85.0	Bear L	2,040,000	1,672,000	82.0
1996	Bear L	968,000	829,000	85.6	Bear L	1,481,000	1,039,000	70.2
1997	Bear L	687,000	606,000	88.2	Bear L	502,000	363,000	72.3
1998	Bear L	805,000	727,000	90.3	Bear L	2,645,000	2,377,000	89.9
1999	Bear L	867,000	637,000	73.5	Bear L	2,436,000	1,902,000	78.1
2000	Bear L	972,300	785,800	80.8	Bear L	5,093,000	4,402,000	86.4
2001	Bear L	1,052,000	864,000	82.1	Bear L	6,017,000	5,127,000	85.2
2002	Bear L	1,237,500	1,085,700	87.7	Bear L	6,004,000	4,921,000	82.0
2003	Bear L	1,249,572	1,093,892	87.5	Bear L	5,000,000	4,398,000	88.0
2004	Bear L	1,673,000	1,557,000	93.1	Bear L	5,661,000	4,989,000	88.1
2005	Bear L	1,414,800	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	89.4
2007	Bear L	748,000	581,000	77.7	Bear L	6,071,000	5,398,000	88.9
2008	Bear L	574,000	283,000	49.3	Bear L	6,033,000	5,531,000	91.7
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
2013	Bear L	630,000	577,000	91.6	Bear L	5,325,100	4,774,200	89.7
Total		22,049,272	18,500,492			101,002,914	87,460,691	
Ave				82.5				83.2

Table 10. Bear Lake smolt production by brood years.

Brood Year	Coho Escap.	No. Fry Stocked	Size (g)	No. Smolt	Hatch Smolt	% Hatch. Survival	Brood Year	Sockeye Escap.	No. Fry Stocked	Size (g)	No. Smolt	Hatch. Smolt	% Hatch. Survival
1985	4,421	445,700	1.64	74,520			1985	1,235			19,740		
1986	5,115	226,300	1.46	54,700			1986	830			8,450		
1987	5,653	347,200	1.00	111,570			1987	212			4,320		
1988	1,640	491,300	0.75	78,680			1988	106			4,030		
1989	475	333,200	1.30	91,280			1989	185	2,260,000	0.80	345,000		
1990	919	390,600	1.42	118,000			1990	1,071	1,530,000	0.35	157,800		
1991	227	203,800	0.49	86,470			1991	741	1,796,000	0.72	910,600		
1992	332	450,000	0.30	91,950			1992	1,925	1,813,000	0.38	288,200		
1993	560	335,000	0.22	62,800			1993	5,045	170,000	0.15	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	1.00	56,700	55,400	10.6	2006	8,338	2,437,000	0.65	287,600	271,900	11.2
2007	386	360,000	1.40	60,900	59,900	16.6	2007	8,420	2,400,000	0.60	288,700	278,600	11.6
2008	368	270,000	1.30	IC	IC	IC	2008	8,992	2,543,000	0.50	580,600	546,200	21.5
2009	535	435,000	1.20	IC	IC	IC	2009	9,977	2,200,000	0.65	454,200	440,000	20.0
2010 *	492	437,000	1.00	*38,000*	*36,900*	*8.4*	2010 *	8,564	2,488,000	0.60	*503,800*	*500,200*	*20.1*
2011 *	359	222,000	1.68	*13,900*	*13,372*	*6.0*	2011 *	9,389	2,490,000	0.61	*670,000*	*664,000*	*26.7*
2012 *	315	405,000	1.00				2012 *	8,031	2,548,000	0.49			
2013 *	300						2013 *	8,999					
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

[1]Average data is for 1993 onward. For # Smolt, Hatchery Smolt and % Survival only includes completed years only.

Smolt numbers are rounded to the nearest 100 fish.

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

IC- data can't be completed due to samples being lost/destroyed

* Incomplete broodyear

[1]Average data is for 1993 onward. For # Smolts, Hatchery Smolt and % Survival only includes 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, BY2005 hatchery smolt do not include the number that were stocked as smolts into Beak Lake

BY2006 - BY2011 hatchery smolt is from fry stocking only. Smolt stocking went to Resurrection Bay

Table 11. Age Composition of Adult Sockeye in Resurrection Bay Fishery and Bear Creek Weir.

				Year Class		
Sample Location	**# of Samples**	**Dates**	**Mark ID**	**BY07**	**BY08**	**BY09**
Resurrection Bay	488	June 2 - June 18	Fry	3.50%	85.00%	11.60%
			Smolt	6.70%	93.30%	0.00%
			Wild	9.10%	90.90%	0.00%
Bear Creek Weir	510	June 6 - July 10	Fry	0.40%	51.80%	46.10%

Table 11. Marine survival for sockeye at Bear Lake

BY	Lake (Fry) Marine Survival	NetPen (Smolt) Marine Survival
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]	60.6	0.1
2007[d]	48.3	3.4
2008	*13.1*	*0.9*
2009	*4.7*	*NA*
AVE	18.2	0.1

[a]1989-2005 Lake survival includes enhanced + wild returns

[b]2005 cannot be complete since sampling methodology changed between the 2 and 3 yr old returns.

[c]2006 - 2009 Lake survival uses enhanced returns only but since the number of wild returns are low <1% this is a good estimate for the entire lake return.

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

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RECOMMENDATIONS

A more in-depth 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 ADF&G should collaborate on performing this assessment.

In light of the differences in age composition between the Resurrection Bay fishery and the weir for adult sockeye salmon, an assessment on the number of fish harvested and their age composition in the sport fishery is necessary. CIAA and ADF&G should collaborate on performing this assessment.

Based on the results from the otolith sampling at Resurrection Bay and weir, it is probable that the 2 SW contribution to the fishery is being missed. While this could be a one year anomaly because the number of 2 SW fish expected was low (missing the smolt program contribution due to no stocking [destroyed due to IHN]), and thereby the fishery ended earlier, it might be necessary to either sample more or extend the sampling period from the Resurrection Bay fishery. Conversely, sampling from the sport fishery may also fill in some of the information being missed. This is important in order to properly assess the contribution both the fry and smolt programs have to the total return of adult sockeye to Resurrection Bay/Bear Lake.

An evaluation to compare the two methods of aging (otolith and scale samples) should be performed to determine if there is sufficient correlation between the methods.

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.

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APPENDICES

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Appendix 1. Bear Lake 2013 - 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)
6/12/2013	B	1	11.8	3.6	1.5		4.8	4.1		2689	478	2.38	0.32	
		11	12.2	3.4	1.6		20.0	14.0		2603	441	2.40	0.23	8.7
7/3/2013	B	1	8.6	3.3	1.8		6.6	4.1		2423	395	1.66	0.37	
		12	13.6	3.1	1.8		5.1	4.1		2706	534	4.05	0.39	12.8
8/1/2013	B	1	11.6	4.0	2.1		5.4	4.1		2224	386	1.99	0.17	
		13	22.4	3.5	1.8		4.5	4.1		2816	503	7.37	0.10	8.8
9/5/2013	B	1	6.3	3.1	1.2		5.9	4.1		2327	311	1.46	0.20	
		12	20.9	3.7	2.0		5.6	4.1		2826	503	3.10	0.30	5.6
Mean			13.4	3.5	1.7	NA	7.2	5.3	NA :1	2577	444	3.1	0.3	9.0
Min			6.3	3.1	1.2	0.0	4.5	4.1	NA :1	2224	311	1.5	0.1	5.6
Max			22.4	4.0	2.1	0.0	20.0	14.0	NA :1	2826	534	7.4	0.4	12.8
1m Ave			9.6	3.5	1.7	NA	5.7	4.1	NA :1	2415.8	392.5	1.9	0.3	9.0
Hypo Ave			17.3	3.4	1.8	NA	8.8	6.6	NA :1	2737.8	495.3	4.2	0.3	

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)
6/12/2013	A	1	76	7.2	25.1	0.8	9	11.2	0.6	28	3.5
	B	11	80	7.1	25.5	1.1	8	11.5	0.8	108	3.5
7/3/2013	A	1	74	7.3	24.6	0.8	6	11.5	0.9	17	4.0
	B	12	78	7.0	24.9	1.9	8	11.5	0.9	51	4.0
8/1/2013	A	1	78	7.5	24.9	0.8	5	11.6	0.7	9	4.0
	B	13	82	6.7	25.6	3.8	6	11.5	0.7	32	4.0
9/5/2013	A	1	76	7.3	23.7	1.0	6	11.7	0.5	27	5.0
	B	12	84	6.6	25.5	3.0	8	12.2	0.9	61	5.0
Mean			79	7.1	25.0	1.7	7.0	11.6	0.8	41.6	4.1
Min			74	6.6	23.7	0.8	5.0	11.2	0.5	9.0	3.5
Max			84	7.5	25.6	3.8	9.0	12.2	0.9	108	4.0
1m Ave			76.0	7.3	24.6	0.9	6.5	11.5	0.7	20.3	4.1
Hypo Ave			81.0	6.9	25.4	2.5	7.5	11.7	0.8	63.0	

Appendix 1. (continued) Bear Lake 2013 - Zooplankton Analysis

Data for zooplankton is not yet available. This data will be updated in the next progress report.

Appendix 1. (continued) Bear Lake 2013 - Zooplankton Analysis

Data for zooplankton is not yet available. This data will be updated in the next progress report.

Appendix 2. Bear Lake 2013 - Environmental Conditions

Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-May						
2-May						
3-May						
4-May						
5-May						
6-May						
7-May						
8-May						
9-May						
10-May						
11-May						
12-May						
13-May						
14-May						
15-May						
16-May						
17-May						
18-May						
19-May	1	0.00	0.95	n/a	2.0	4.0
20-May	1	0.00	0.95	n/a	2.0	3.0
21-May	4	0.00	0.90	n/a	4.0	7.0
22-May	4	0.00	0.89	n/a	4.0	9.0
23-May	3	0.00	0.89	n/a	4.0	10.0
24-May	1	0.00	0.90	1.60	5.0	11.0
25-May	1	0.00	0.95	1.65	4.0	6.6
26-May	4	0.00	0.98	1.70	4.0	6.0
27-May	1	6.00	1.00	1.70	5.0	11.0
28-May	1	0.00	1.05	1.80	5.5	20.0
29-May	1	0.00	0.93	1.90	6.0	13.0
30-May	2	0.00	0.85	1.95	5.5	11.0
31-May	4	0.00	0.90	1.95	5.0	9.0

Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Jun	5	3.50	0.90	1.95	5.0	8.0
2-Jun	1	0.00	0.90	2.00	5.0	11.0
3-Jun	5	4.00	0.90	2.00	5.0	10.0
4-Jun	4	5.00	0.90	2.00	5.0	9.0
5-Jun	4	2.00	0.93	1.80	6.0	12.0
6-Jun	1	0.00	0.90	1.80	6.0	13.0
7-Jun	2	0.00	0.90	1.80	6.0	14.0
8-Jun	1	0.00	0.85	1.80	8.0	17.0
9-Jun	1	0.00	0.85	1.80	10.0	17.0
10-Jun	1	0.00	0.85	1.85	10.0	18.0
11-Jun	1	0.00	0.85	1.85	10.0	18.0
12-Jun	2	3.50	0.85	1.85	10.0	14.0
13-Jun	3	5.50	0.85	1.90	9.0	10.5
14-Jun	1	1.00	0.80	1.85	10.0	13.0
15-Jun	1	0.00	0.80	1.80	11.0	16.0
16-Jun	1	0.00	0.90	1.80	14.0	20.0
17-Jun	1	0.00	0.90	1.80	15.0	21.0
18-Jun	1	0.00	0.90	1.80	11.0	16.0
19-Jun	4	2.00	0.90	1.70	14.0	11.0
20-Jun	3	0.00	0.90	1.70	14.0	11.0
21-Jun	2	0.00	0.90	1.70	14.0	18.0
22-Jun	2	0.00	0.80	1.70	13.0	14.0
23-Jun	1	0.00	0.80	1.70	13.0	14.0
24-Jun	2	0.00	0.90	1.60	14.0	14.0
25-Jun	3	0.00	0.90	1.60	15.0	17.0
26-Jun	3	1.20	0.90	1.60	15.0	18.0
27-Jun	2	0.00	0.80	1.60	15.0	16.0
28-Jun	3	3.10	0.90	1.50	15.0	15.0
29-Jun	4	3.60	0.90	1.50	15.0	15.0
30-Jun	4	1.20	0.80	1.50	15.0	10.0

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 2013 - Environmental Conditions

Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Jul	4	10.00	0.86	1.80	14.0	11.0
2-Jul	4	9.20	0.86	1.80	14.0	11.0
3-Jul	4	2.10	0.86	1.80	14.0	11.0
4-Jul	5	3.10	0.86	1.70	13.0	11.0
5-Jul	5	5.20	0.85	1.70	13.0	11.0
6-Jul	5	8.40	0.85	1.70	13.0	11.0
7-Jul	4	15.50	0.82	1.70	13.0	12.0
8-Jul	4	0.00	0.92	1.70	14.0	12.0
9-Jul	3	1.00	0.88	1.60	14.0	16.0
10-Jul	2	0.00	0.82	1.60	14.0	22.0
11-Jul	1	0.00	0.82	1.60	15.0	22.0
12-Jul	1	0.00	0.82	1.60	16.0	21.0
13-Jul	1	0.00	0.82	1.60	16.0	21.0
14-Jul	1	0.00	0.80	1.50	16.0	16.0
15-Jul	4	0.00	0.80	1.50	16.0	17.0
16-Jul	3	0.00	0.80	1.40	16.0	18.0
17-Jul	2	0.00	0.80	1.40	17.0	18.0
18-Jul	4	0.00	0.86	1.40	18.0	21.0
19-Jul	2	0.00	0.86	4.30	18.0	22.0
20-Jul	1	0.00	0.87	1.20	18.0	23.0
21-Jul	1	0.00	0.86	1.10	18.0	24.0
22-Jul	1	0.00	0.85	1.00	18.0	26.0
23-Jul	1	0.00	0.85	1.00	18.0	26.0
24-Jul	1	0.00	0.84	1.00	18.0	22.0
25-Jul	1	0.00	0.83	0.90	18.0	22.0
26-Jul	1	0.00	0.83	0.90	18.0	22.0
27-Jul	1	0.00	0.83	0.90	18.0	23.0
28-Jul	1	0.00	0.82	0.90	19.0	22.0
29-Jul	1	0.00	0.82	0.90	19.0	18.0
30-Jul	3	0.00	0.82	0.90	19.0	15.0
31-Jul	4	1.00	0.82	0.89	19.0	14.0

Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Aug	4	0.00	0.82	0.89	19.0	16.0
2-Aug	4	0.00	0.82	0.89	18.0	15.0
3-Aug	5	30.80	0.90	0.90	17.0	12.0
4-Aug	5	3.60	0.90	0.90	17.0	12.0
5-Aug	4	1.30	0.91	0.90	17.0	12.0
6-Aug	4	8.40	0.91	0.90	17.0	11.0
7-Aug	4	6.00	0.91	0.90	17.0	11.0
8-Aug	4	3.40	0.92	0.90	17.0	11.0
9-Aug	4	17.20	0.93	0.90	16.0	12.0
10-Aug	3	15.60	0.94	0.90	16.0	12.0
11-Aug	5	52.00	0.93	0.90	16.0	11.0
12-Aug	4	15.00	0.93	0.90	16.0	13.0
13-Aug	4	0.00	0.93	0.86	16.0	13.0
14-Aug	1	0.00	0.93	0.75	16.0	15.0
15-Aug	1	0.00	0.93	0.78	16.0	13.0
16-Aug	5	10.00	0.91	0.78	16.0	16.0
17-Aug	1	0.00	0.90	0.77	15.0	15.0
18-Aug	4	5.00	0.90	0.69	15.0	13.0
19-Aug	5	1.20	0.88	0.69	15.0	13.0
20-Aug	5	4.20	0.89	0.69	15.0	13.0
21-Aug	5	7.20	0.89	0.57	15.0	13.0
22-Aug	4	0.00	0.86	0.55	15.0	13.0
23-Aug	2	14.20	0.85	0.55	15.0	14.0
24-Aug	2	0.00	0.85	0.55	15.0	16.0
25-Aug	1	0.00	0.84	0.55	15.0	15.0
26-Aug	4	0.00	0.84	0.52	15.0	14.0
27-Aug	1	0.00	0.82	0.50	15.0	16.0
28-Aug	5	3.50	0.81	0.50	15.0	13.0
29-Aug	5	65.50	0.81	0.52	15.0	13.0
30-Aug	4	0.00	0.81	0.52	15.0	16.0
31-Aug	4	2.60	0.81	0.52	15.0	13.0

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 2013 - Environmental Conditions

Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Sep	4	0.00	1.22	0.56	14.0	12.0
2-Sep	5	7.20	1.00	0.58	14.0	11.0
3-Sep	4	12.80	0.90	0.60	14.0	11.0
4-Sep	4	44.80	0.80	0.64	13.0	11.0
5-Sep	4	0.00	0.80	0.64	13.0	11.0
6-Sep	5	17.60	0.81	0.90	13.0	10.0
7-Sep	4	4.40	0.81	0.90	13.0	11.0
8-Sep	4	2.20	0.82	0.90	13.0	11.0
9-Sep	5	17.50	0.60	1.10	13.0	11.0
10-Sep	5	40.00	0.88	1.30	12.0	12.0
11-Sep	4	0.00	0.68	1.24	12.0	12.0
12-Sep	3	13.50	0.69	1.20	12.0	12.0
13-Sep	5	7.00	0.60	1.20	12.0	12.0
14-Sep	4	2.20	0.57	1.82	12.0	12.0
15-Sep	1	0.00	0.52	1.62	12.0	14.0
16-Sep	4	0.00	0.52	1.60	12.0	12.0
17-Sep	4	0.00	0.52	1.60	11.0	12.0
18-Sep	4	0.00	0.52	1.58	11.0	12.0
19-Sep	3	3.40	0.51	1.58	11.0	11.0
20-Sep	3	2.30	0.50	1.56	10.0	11.0
21-Sep	1	1.00	0.19	*	10.0	10.0
22-Sep	4	12.50	0.48		10.0	10.0
23-Sep	4	1.00	0.48		10.0	5.0
24-Sep	4	0.00	0.49		10.0	9.0
25-Sep	4	0.00	0.49		10.0	8.0
26-Sep	5	13.50	0.49		10.0	10.0
27-Sep	4	2.20	0.50		10.0	10.0
28-Sep	3	0.00	0.51		9.0	12.0
29-Sep	1	0.00	0.48		9.0	12.0
30-Sep	1	0.00	0.47		9.0	10.0

*Dam boards in for adult coho migration

Date	Sky	Precip. (mm)	Upper Gauge (ft)	Lower Gauge (ft)	Water Temp (oC)	Air Temp (oC)
1-Oct	1	0.00	0.48		9.0	10.0
2-Oct	4	17.60	0.49		9.0	9.0
3-Oct	4	0.00			9.0	8.0
4-Oct	1	0.00			9.0	9.0
5-Oct	3	0.00			9.0	9.0
6-Oct	1	0.00			9.0	9.0
7-Oct	1	17.00			9.0	9.0
8-Oct	1	20.00			9.0	9.0
9-Oct	3	0.00			9.0	9.0
10-Oct	5	25.00			9.0	9.0
11-Oct						
12-Oct						
13-Oct						
14-Oct						
15-Oct						
16-Oct						
17-Oct						
18-Oct						
19-Oct						
20-Oct						
21-Oct						
22-Oct						
23-Oct						
24-Oct						
25-Oct						
26-Oct						
27-Oct						
28-Oct						
29-Oct						
30-Oct						
31-Oct						

Sky Conditions

1 = clear

2 = less than 50% cloud cover

3 = more than 50% cloud cover

4 = 100% overcast

5 = rain

Appendix 3. Bear Lake 2013 - Smolt Migration.

	Sockeye				Coho				Dolly Varden		Rainbow Trout	
Date	Daily	Otoliths	Cumm	% Smpl	Daily	Otoliths	Cumm	% Smpl	Daily	Cumm	Daily	Cumm
19-May	2	0	2	0.00%	3	0	3	0.00%	0	0	0	0
20-May	3	0	5	0.00%	12	0	15	0.00%	0	0	0	0
21-May	2	0	7	0.00%	8	0	23	0.00%	0	0	0	0
22-May	1	0	8	0.00%	8	0	31	0.00%	0	0	0	0
23-May	1	0	9	0.00%	8	0	39	0.00%	0	0	0	0
24-May	6	0	15	0.00%	9	0	48	0.00%	0	0	0	0
25-May	2	0	17	0.00%	11	0	59	0.00%	0	0	0	0
26-May	0	0	17	#DIV/0!	5	0	64	0.00%	0	0	0	0
27-May	925	0	942	0.00%	88	0	152	0.00%	27	27	0	0
28-May	3,055	4	3,997	0.13%	72	0	224	0.00%	32	59	0	0
29-May	4,663	3	8,660	0.06%	260	0	484	0.00%	23	82	0	0
30-May	9,566	8	18,226	0.08%	337	6	821	1.78%	58	140	0	0
31-May	15,404	10	33,630	0.06%	341	0	1,162	0.00%	45	185	0	0
01-Jun	17,915	23	51,545	0.13%	319	4	1,481	1.25%	0	185	0	0
02-Jun	36,874	26	88,419	0.07%	429	0	1,910	0.00%	167	352	0	0
03-Jun	36,262	25	124,681	0.07%	440	5	2,350	1.14%	51	403	0	0
04-Jun	56,013	76	180,694	0.14%	875	1	3,225	0.11%	3	406	0	0
05-Jun	62,408	45	243,102	0.07%	458	0	3,683	0.00%	90	496	0	0
06-Jun	74,579	80	317,681	0.11%	762	16	4,445	2.10%	51	547	0	0
07-Jun	46,157	43	363,838	0.09%	818	10	5,263	1.22%	38	585	0	0
08-Jun	54,535	95	418,373	0.17%	1,399	0	6,662	0.00%	10	595	0	0
09-Jun	53,015	55	471,388	0.10%	1,739	11	8,401	0.63%	50	645	0	0
10-Jun	26,127	18	497,515	0.07%	1,407	11	9,808	0.78%	15	660	2	2
11-Jun	38,493	14	536,008	0.04%	2,309	13	12,117	0.56%	4	664	3	5
12-Jun	35,251	19	571,259	0.05%	3,330	23	15,447	0.69%	1	665	0	5
13-Jun	9,381	59	580,640	0.63%	2,216	10	17,663	0.45%	7	672	0	5
14-Jun	74,627	22	655,267	0.03%	4,502	23	22,165	0.51%	33	705	0	5
15-Jun	18,674	61	673,941	0.33%	2,479	31	24,644	1.25%	1	706	0	5
16-Jun	9,258	0	683,199	0.00%	1,942	0	26,586	0.00%	10	716	2	7
17-Jun	23,359	0	706,558	0.00%	1,372	12	27,958	0.87%	25	741	0	7
18-Jun	5,741	28	712,299	0.49%	1,116	7	29,074	0.63%	3	744	0	7
19-Jun	16,259	10	728,558	0.06%	1,335	21	30,409	1.57%	5	749	2	9
20-Jun	15,304	0	743,862	0.00%	331	0	30,740	0.00%	2	751	0	9
21-Jun	11,679	27	755,541	0.23%	95	0	30,835	0.00%	0	751	0	9
22-Jun	0	0	755,541	#DIV/0!	0	0	30,835	#DIV/0!	0	751	0	9
23-Jun	0	0	755,541	#DIV/0!	0	0	30,835	#DIV/0!	0	751	0	9
24-Jun	8,356	0	763,897	0.00%	390	0	31,225	0.00%	2	753	0	9
25-Jun	761	0	764,658	0.00%	153	0	31,378	0.00%	0	753	0	9
26-Jun	9,165	10	773,823	0.11%	375	6	31,753	1.60%	0	753	0	9
27-Jun	4,163	0	777,986	0.00%	412	0	32,165	0.00%	1	754	0	9
28-Jun	4,402	0	782,388	0.00%	399	0	32,564	0.00%	0	754	0	9
29-Jun	1,004	20	783,392	1.99%	298	0	32,862	0.00%	3	757	0	9
30-Jun	3,020	0	786,412	0.00%	514	0	33,376	0.00%	0	757	0	9
01-Jul	1,550	0	787,962	0.00%	284	0	33,660	0.00%	2	759	0	9
02-Jul	587	0	788,549	0.00%	328	0	33,988	0.00%	0	759	0	9
03-Jul	615	0	789,164	0.00%	96	0	34,084	0.00%	0	759	0	9
04-Jul	342	0	789,506	0.00%	81	0	34,165	0.00%	0	759	0	9
05-Jul	202	0	789,708	0.00%	131	21	34,296	16.03%	0	759	0	9
06-Jul	444	0	790,152	0.00%	352	0	34,648	0.00%	0	759	0	9
07-Jul	711	0	790,863	0.00%	740	0	35,388	0.00%	0	759	0	9
08-Jul	199	0	791,062	0.00%	470	0	35,858	0.00%	0	759	0	9
09-Jul	114	0	791,176	0.00%	172	0	36,030	0.00%	0	759	0	9
10-Jul	529	7	791,705	1.32%	189	9	36,219	4.76%	0	759	0	9
11-Jul												
Totals	791,705	788	791,705	0.10%	36,219	240	36,219	0.66%	759	759	9	9

Appendix 4. Bear Lake 2013 - Adult Sockeye Salmon Migration.

Date	Lake Escapement			Donate &		Daily	Cumm.
	Females	Males	Combined	Harvest	Morts	Total	Total
06-Jun	0	21	21	0	0	21	21
07-Jun	46	98	144	0	0	144	165
08-Jun	38	71	109	0	0	109	274
09-Jun	0	79	79	0	0	79	353
10-Jun	124	170	294	0	0	294	647
11-Jun	72	161	233	0	0	233	880
12-Jun	65	128	193	0	0	193	1,073
13-Jun	24	171	195	0	0	195	1,268
14-Jun	148	259	407	0	3	410	1,678
15-Jun	123	229	352	0	0	352	2,030
16-Jun	177	343	520	0	0	520	2,550
17-Jun	302	443	745	16	1	762	3,312
18-Jun	210	344	554	30	0	584	3,896
19-Jun	235	257	492	0	0	492	4,388
20-Jun	146	189	335	29	0	364	4,752
21-Jun	271	240	511	0	0	511	5,263
22-Jun	204	307	511	29	0	540	5,803
23-Jun	270	379	649	18	0	667	6,470
24-Jun	412	652	1,064	44	2	1,110	7,580
25-Jun	621	581	1,202	53	1	1,256	8,836
26-Jun	400	463	863	102	0	965	9,801
27-Jun	428	207	635	53	0	688	10,489
28-Jun	330	143	473	362	3	838	11,327
29-Jun	300	116	416	67	2	485	11,812
30-Jun	225	59	284	286	0	570	12,382
01-Jul	370	124	494	249	4	747	13,129
02-Jul	178	5	183	0	0	183	13,312
03-Jul	91	6	97	46	0	143	13,455
04-Jul	65	5	70	0	0	70	13,525
05-Jul	95	10	105	284	6	395	13,920
06-Jul	121	10	131	103	0	234	14,154
07-Jul	103	9	112	45	0	157	14,311
08-Jul	78	0	78	158	0	236	14,547
09-Jul	0	0	0	30	0	30	14,577
10-Jul	0	0	0	0	0	0	14,577
11-Jul	0	0	0	362	0	362	14,939
12-Jul	0	0	0	226	0	226	15,165
13-Jul	0	0	0	73	0	73	15,238
14-Jul	0	0	0	16	0	16	15,254
15-Jul	0	0	0	287	0	287	15,541
16-Jul	0	0	0	21	0	21	15,562
17-Jul	0	0	0	15	0	15	15,577
18-Jul	0	0	0	102	0	102	15,679
19-Jul	0	0	0	22	0	22	15,701
20-Jul	0	0	0	24	0	24	15,725
21-Jul	0	0	0	28	0	28	15,753
22-Jul	0	0	0	28	0	28	15,781
23-Jul	0	0	0	39	0	39	15,820
24-Jul	0	0	0	0	0	0	15,820
25-Jul	0	0	0	0	0	0	15,820
26-Jul	0	0	0	0	0	0	15,820
Total	6,272	6,279	12,551	3,247	22	15,820	

Appendix 5. Bear Lake 2013 - Adult Coho Salmon Migration.

	Lake Escapement			Broodstock			Harvest			Total		Raceway	Daily	Cumm
Date	Female	Males	Combined	Female	Males	Combined	Females	Males	Combined	Females	Males	Morts	Total	Total
30-Aug	1	9	10	0	0	0	0	0	0	1	9	0	10	10
31-Aug	3	9	12	0	0	0	0	0	0	3	9	0	12	22
01-Sep	4	22	26	0	0	0	0	0	0	4	22	0	26	48
02-Sep	3	3	6	0	0	0	0	0	0	3	3	0	6	54
03-Sep	2	13	15	0	0	0	0	0	0	2	13	0	15	69
04-Sep	6	24	30	0	0	0	0	0	0	6	24	0	30	99
05-Sep	9	43	52	0	0	0	0	0	0	9	43	0	52	151
06-Sep	35	27	62	0	29	29	0	0	0	35	56	0	91	242
07-Sep	73	0	73	0	90	90	0	0	0	73	90	0	163	405
08-Sep	14	0	14	11	41	52	0	0	0	25	41	0	66	471
09-Sep	0	0	0	39	71	110	0	0	0	39	71	0	110	581
10-Sep	0	0	0	62	19	81	0	0	0	62	19	0	81	662
11-Sep	0	0	0	63	69	132	0	78	78	63	147	0	210	872
12-Sep	0	0	0	57	21	78	0	0	0	57	21	0	78	950
13-Sep	0	0	0	40	65	105	0	220	220	40	285	0	325	1,275
14-Sep	0	0	0	0	0	0	0	207	207	0	207	0	207	1,482
15-Sep	0	0	0	0	0	0	0	211	211	0	211	0	211	1,693
16-Sep	0	0	0	0	0	0	0	252	252	0	252	0	252	1,945
17-Sep	0	0	0	0	0	0	0	252	252	0	252	24	252	2,197
18-Sep	0	0	0	0	0	0	0	211	211	0	211	0	211	2,408
19-Sep	0	0	0	11	0	11	0	220	220	11	220	0	231	2,639
20-Sep	0	0	0	0	0	0	0	103	103	0	103	0	103	2,742
21-Sep	0	0	0	3	0	3	0	12	12	3	12	18	15	2,757
22-Sep	0	0	0	14	0	14	0	54	54	14	54	0	68	2,825
23-Sep	0	0	0	4	0	4	0	8	8	4	8	0	12	2,837
24-Sep	0	0	0	12	7	19	0	0	0	12	9	0	21	2,858
25-Sep	0	0	0	51	23	74	0	0	0	51	23	42	74	2,932
26-Sep	0	0	0	38	38	76	0	0	0	38	38	0	76	3,008
27-Sep	0	0	0	4	0	4	0	2	2	4	2	0	6	3,014
28-Sep	0	0	0	12	0	12	0	98	98	12	98	7	110	3,124
29-Sep	0	0	0	27	0	27	0	10	10	27	10	0	37	3,161
30-Sep	0	0	0	51	26	77	0	0	0	51	26	9	77	3,238
01-Oct	0	0	0	22	3	25	0	0	0	22	3	0	25	3,263
02-Oct	0	0	0	16	7	23	0	0	0	16	7	0	23	3,286
03-Oct	0	0	0	0	0	0	0	12	12	0	12	0	12	3,298
04-Oct	0	0	0	25	3	28	0	0	0	25	3	16	28	3,326
05-Oct	0	0	0	0	0	0	0	47	47	0	47	0	47	3,373
06-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	3,373
07-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	3,373
08-Oct	0	0	0	0	0	0	0	0	0	0	0	32	0	3,373
09-Oct	0	0	0	0	0	0	0	0	0	0	0	22	0	3,373
10-Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	3,373
	Miscounting			-125	-126	-251			0	-125	-126		-251	3,122
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	3,122

Appendix 6. Bear Lake 2013 – Adult Sockeye Age and Sex Characteristics

	Age						
	1.1	1.2	1.3	2.1	2.2	2.3	Total
Sample Period:	June 6 - July 26, 2013						
Males (No.)	62	4,157	3,257	155	713	62	8,406
Percent	0.7%	49.4%	38.7%	1.8%	8.5%	0.7%	53.1%
Sample Size	2	134	105	5	23	2	271
Total Sample Size							348
Mean Length (mm)							
Std. Deviation							
Std. Error							
Mean Weight (kg)	0.40	2.32	3.13	2.33	2.50	3.88	2.65
Std. Deviation	0.28	0.45	0.47	0.15	0.58	0.60	0.65
Std. Error	0.20	0.04	0.05	0.07	0.12	0.42	0.03
Females (No.)	0	3,102	3,846	62	372	0	7,383
Percent	0.0%	42.0%	52.1%	0.8%	5.0%	0.0%	46.7%
Sample Size	0	100	124	2	12	0	238
Total Sample Size							291
Mean Length (mm)							
Std. Deviation							
Std. Error							
Mean Weight (kg)		2.16	2.73	1.75	2.51		2.47
Std. Deviation		0.48	0.35	0.21	0.38		0.48
Std. Error		0.05	0.03	0.15	0.11		0.03
Both Sexes (No.)	62	7,290	7,103	217	1,086	62	15,820
Percent	0.4%	46.1%	44.9%	1.4%	6.9%	0.4%	99.6%
Sample Size	2	235	229	7	35	2	510
Total Sample Size							639
Mean Length (mm)							
Std. Deviation							
Std. Error							
Mean Weight (kg)	0.40	2.25	2.91	2.16	2.50	3.88	2.57
Std. Deviation	0.28	0.47	0.45	0.32	0.51	0.60	0.58
Std. Error	0.20	0.03	0.03	0.12	0.09	0.42	0.02

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

Appendix 7. Bear Lake 2013 – Adult Coho Age and Sex Characteristics

	Age			
	1.1	2.1	3.1	Total
Sample Period:	Sept 9 - Oct 4, 2013			
Males (No.)	723	809	29	1,561
Percent	46.3%	51.9%	1.9%	50.0%
Sample Size	25	28	1	54
Total Sample Size				59
Mean Length (mm)	501	559	610	535
Std. Deviation	45.1	53.5		59.3
Std. Error	9.0	10.1		7.7
Mean Weight (kg)	1.95	2.97	3.50	2.52
Std. Deviation	0.57	0.95		0.96
Std. Error	0.11	0.18		0.12
Females (No.)	838	607	116	1,561
Percent	53.7%	38.9%	7.4%	50.0%
Sample Size	29	21	4	54
Total Sample Size				56
Mean Length (mm)	547	585	618	564
Std. Deviation	47.2	35.7	17.1	48.0
Std. Error	8.8	7.8	8.5	6.4
Mean Weight (kg)	2.63	3.26	3.93	2.93
Std. Deviation	0.61	0.58	0.29	0.72
Std. Error	0.11	0.13	0.14	0.10
Both Sexes (No.)	1,561	1,416	145	3,122
Percent	50.0%	45.4%	4.6%	100.0%
Sample Size	54	49	5	108
Total Sample Size				115
Mean Length (mm)	526	570	616	549
Std. Deviation	51.1	48.1	15.2	55.8
Std. Error	7.0	6.9	6.8	5.2
Mean Weight (kg)	2.31	3.09	3.84	2.72
Std. Deviation	0.68	0.81	0.31	0.87
Std. Error	0.09	0.12	0.14	0.08

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

Appendix 8. Bear Lake 2013 – Project Updates

Sockeye Salmon Project

Stocking & Misc. Activities

Crew on-site:	19-May		
Ice-out:	NA		
Crew off-site:	10-Oct		
Fry stocking:	20-Jun	2,548,000	0.49 g
PreSmolt stocking:			
Smolt stocking:(Res Bay)	15-Jun	2,090,000	14.7 g
Fertilizer application:	1-Jul to 3-Aug	1,140 gallons	

Egg Take

Dates:	31-Jul to 23-Aug	
No. of broodstock used*:		3,606
Green eggs:		5,325,000
Fecundity:		3,140
Eyed eggs:		4,774,000
% Survival		89.7%

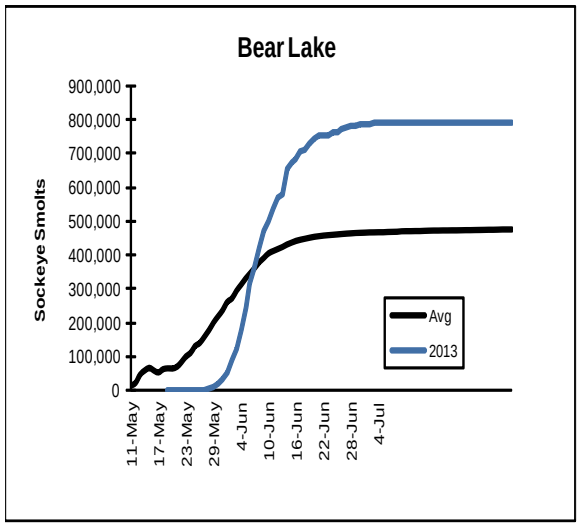
Smolt Migration

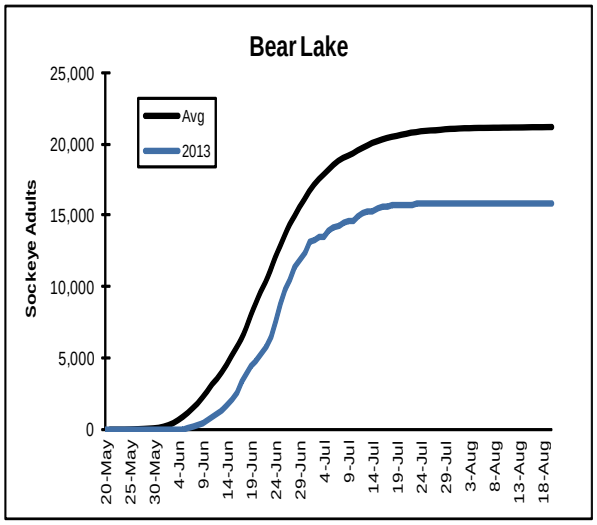
Dates:	19-May to 10-Jul		
Sockeyes:		**791,700**	
Percent age 1:		740,700	93.6%
Percent age 2:		51,000	6.4%
Percent age 3:		0	0.0%
Percent hatchery:		785,584	99.2%
Dolly Varden:		759	

Adult Migration

Dates:	6-Jun to 26-Jul		
Total return:		**77,300**	
Commercial & Sport Fish harvest:		20,000	25.9%
C.R. harvest(FW & SW):		43,369	56.1%
Lake:		**15,820**	20.5%
Donated		1,255	
Hatchery broodstock:		3,606	
Lake broodstock:		8,999	

*Includes mortalities and inviables





Coho Salmon Project

Stocking & Misc. Activities

Crew on-site:	19-May			
Ice-out:	NA			
Crew off-site:	10-Oct			
Fry stocking:	24-Jun		405,000	1.0 g
Smolt Stocking to Res Bay	NA		NA	NA
Fertilizer application:	1-Jul	to 3-Aug	1,140 gallons	

Egg Take

Dates:	26-Sep to 3-Oct	
No. of broodstock used:		732
Green eggs:		635,000
Fecundity:		3,780
Eyed eggs:		577,000
% Survival		90.9%

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

Smolt Migration

Dates:	19-May to 10-Jul		
Cohos:		**36,200**	
Percent age 1:		13,900	38.4%
Percent age 2:		21,500	59.4%
Percent age 3:		800	2.2%
Percent hatchery:		34,825	96.2%
Dolly Varden:		759	0.02097

Adult Migration

Dates:	30-Aug to 10-Oct		
Coho total creek return:		**8,522**	
Weir return:		3,122	37%
Donated		1,997	23%
Lake:		300	4%
Hatchery broodstock:		825	10%
Est. Remaining in Bear Ck:		0	0%
Est. Remaining in Salmon Ck:		0	0%

CR Harvest = donations