

**Hidden Lake
Sockeye Salmon Enhancement
Progress Report
2011**

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May 2011**

The Hidden Lake Sockeye Salmon Enhancement Project was made possible through enhancement taxes paid by the commercial fishermen in Area H, Cook Inlet and associated waters.

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DISCLAIMER

The Cook Inlet Aquaculture Association (CIAA) 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 Hidden Lake sockeye 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

Many individuals contributed to the 2011 field season at the Hidden Lake Salmon Enhancement Project. Special thanks are offered to CIAA interns Alexander Sitek, Kiley Brothers, Nick Deutsch, Daniel Martin, Madison Hanks, and Seasonal Assistants Brian McKenna, Larry Gallagher, Matt Smukall, Cathy Cline, and Terry Magee for their work during the smolt and adult salmon enumeration. Exceptional appreciation is extended to the Cook Inlet Aquaculture Association Board of Directors, the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service Kenai Field Office, the Kenai National Wildlife Refuge, and the Student Conservation Association for support during the Hidden Lake Sockeye Salmon Enhancement Project.

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ABSTRACT

Hidden Lake, located on the Kenai Peninsula 69 kilometers east of Soldotna, Alaska, has been managed by the Alaska Department of Fish and Game (ADF&G) for sockeye salmon (*Oncorhynchus nerka*) enhancement since 1976. Initial salmon enhancement activities were conducted by ADF&G and in 1988 Cook Inlet Aquaculture Association (CIAA) began assisting with the enhancement project. Since 1991 CIAA has completed all field activities.

To supplement the Hidden Lake sockeye salmon population, on 28 May 2011, an estimated 1,044,000 unfed sockeye fry were released into Hidden Lake. All fry were released at the west end of the lake near the north shore.

The Hidden Lake smolt migration was enumerated from 23 May and continued daily until 16 July. During this time an estimated 299,348 ($\pm 17,639$) sockeye (*Oncorhynchus nerka*) and 22,925 (± 701) coho (*Oncorhynchus kisutch*) smolt migrated from the lake. The 10% sub-sampling procedure was used to estimate the smolt migration during peak run periods. Of the total smolt migration 43% ($\pm 14\%$), or 128,390 ($\pm 17,639$), sockeye smolt and 12% ($\pm 26\%$), or 2,670 (± 701), coho smolt were sub-sampled.

Based on the sockeye samples collected ($n=596$), 47% ($\pm 3.8\%$) of the migrating sockeye smolt were incubated at Trail Lakes Hatchery. An estimated 70% ($\pm 4.2\%$) were age 1 and 30% ($\pm 4.2\%$) were age 2. The average length and weight of the age 1 sockeye smolt were 137 mm (± 5 mm) and 24.5 g (± 0.9 g). The average length and weight of the age 2 sockeye smolt were 196 mm (± 2.5 mm) and 77.8 g (± 2.9 g).

Based on the coho samples collected ($n=754$), an estimated 62% ($\pm 0.1\%$) of the migrating coho smolt were age 1. An estimated 38% ($\pm 0.1\%$) were age 2. The average length and weight of the age 1 coho smolt were 125 mm (± 1 mm) and 19.6 g (± 0.4 g). The average length and weight of the age 2 coho smolt were 138 mm (± 0.9 mm) and 26.5 g (± 0.6 g).

The Hidden Lake adult salmon escapement was enumerated from 16 July to 1 September 2011. During this time, an estimated 17,771 adult sockeye and 2 adult coho salmon returned to Hidden Creek.

Of adult sockeyes returning to Hidden Creek, an estimated 0.43% were age 1.1, 83.77% were age 1.2, 8.11% were age 1.3, 7.26% were age 2.2, and 0.43% were 2.3. Of adult sockeyes returning to Hidden Creek, 47% were male with an average length of 517 mm (± 4 mm) and 53% were female with an average length of 502 mm (± 2 mm). Based on adult otolith samples (n=610), an estimated 51% ($\pm 0.2\%$) adult sockeye salmon were incubated at Trail Lakes Hatchery.

In order to enhance the Hidden Lake sockeye salmon population, 1.119 million eggs were collected and shipped to Trail Lakes Hatchery for fertilization, incubation, and rearing from 20 September to 21 September 2011. An estimated 88% (981,259) fertilized eggs survived to the eyed stage. The surviving unfed fry will be stocked at Hidden Lake in 2012.

In 2011, CIAA continued an ongoing special study to search for hatchery-reared Hidden Lake adult sockeye suspected of straying into the surrounding Kenai and Skilak Lake system. CIAA and U.S. Fish and Wildlife Service Kenai Field Office personnel, collected otolith samples from adult sockeye carcasses from various locations from the Russian River ferry to the mouth of the Kenai River entering Skilak Lake. On 21 September, a total of 364 otolith samples were collected and analyzed. None of the analyzed samples were of hatchery origin. Since 1999, a total of 3,315 otolith samples have been collected and analyzed to assess the straying capacity of Hidden Lake adult sockeye. To date, zero hatchery reared adult sockeye have been found in the sampling.

Water chemistry and zooplankton samples were collected 4 times during 2011. ADF&G provided the analysis. Zooplankton analysis is currently incomplete for 2010 and 2011.

INTRODUCTION AND PURPOSE

In 1972 and 1973, the Commercial Fisheries Division of the Alaska Department of Fish and Game (ADF&G) conducted biological, chemical, and physical inventories of numerous lakes throughout the Cook Inlet basin (Barton & Barrett, 1973 and Bill, Namtvedt, & Davis, 1972). Based on these investigations it appeared that Hidden Lake had the potential for increased production of sockeye salmon.

In 1976, activities to enhance the production of sockeye salmon in Hidden Lake were initiated by the Fisheries Rehabilitation, Enhancement and Development Division (FRED) of ADF&G. Initial enhancement activities involved the collection of basic fisheries and limnological data and the gathering of a small number of sockeye salmon eggs to evaluate incubation and fry rearing procedures (Kyle, Litchfield, & Todd, 1990).

Between 1976 and 1989, ADF&G collected more information on Hidden Lake. Based on this information, ADF&G was able to conclude that at an adult escapement of 10,000 sockeye, wild smolt production leveled off because the natural spawning area was limited and/or egg to fry survival was poor. ADF&G also concluded the lake's zooplankton community was being underutilized by sockeye salmon fry rearing in the lake. Thus, more sockeye fry could rear in the lake than could be produced by natural spawning

Since 1976, Hidden Lake has been enhanced by annually collecting eggs from adult sockeye returning to the lake and releasing the resulting fry back to the lake. Enhancement by collecting eggs and releasing fry back to Hidden Lake bypasses some of the critical life stages that occur in the lake and takes advantage of the lake's underutilized zooplankton community.

As the Hidden Lake enhancement project was being developed, it was feared salmon enhancement itself could be detrimental to the fry-rearing environment. The escapement of large numbers of fish may, by increasing the available nutrients, alter the level of primary productivity and shift the zooplankton community to species not utilized by rearing sockeye fry.

Based on the potential of Hidden Lake to rear sockeye fry and the limitations imposed by large adult escapements, the project objective became the production of the maximum number of adult fish while maintaining the fry-rearing environment. To meet this objective, an average adult sockeye escapement of 30,000 fish was considered an appropriate management strategy and could be accomplished by:

1. Annually collecting sockeye eggs and releasing sockeye fry to the lake to target an annual average adult return of 30,000;
2. Monitoring lake water quality through the collection and analysis of representative samples;
3. Enumerating smolt migration from the lake, and;
4. Enumerating adult escapement to the lake.

In 1988, the Cook Inlet Aquaculture Association (CIAA) became involved in the Hidden Lake Enhancement Project by conducting the gamete collection, incubation, and fry release activities. In 1989, CIAA, with assistance from ADF&G, also conducted the smolt migration and adult escapement monitoring; and, in 1991, assumed responsibility for conducting the limnological sampling. For data consistency, ADF&G has completed and will continue to complete the water chemistry, plankton and adult scale analyses.

In March 1999, ADF&G conducted the Hidden Lake Sockeye Salmon Enhancement Project Technical Review (Simpson & Edmundson, 1999). Concerns arose regarding the amount of sockeye salmon entering Hidden Lake. In 2000, CIAA took steps to alleviate this concern by utilizing four year floating averages of survival rates (egg to fry, fry to smolt, and smolt to adult) and ADF&G estimated harvests to calculate a stocking rate that would best allow for an annual target escapement of 30,000 sockeye salmon into Hidden Lake. Also based on the technical review, ADF&G recommended that two special studies be conducted. One study to determine if hatchery incubated fish released to Hidden Lake were straying into other Kenai River system spawning populations and a second study to determine the contribution of hatchery incubated fish to the sockeye population returning to Hidden Lake.

PROJECT AREA

Hidden Lake is located on the Kenai Peninsula 69 kilometers east of Soldotna, Alaska and lies entirely within the Kenai National Wildlife Refuge. The lake is accessible by the Sterling Highway and the Skilak Lake Loop Road (Figure 1).

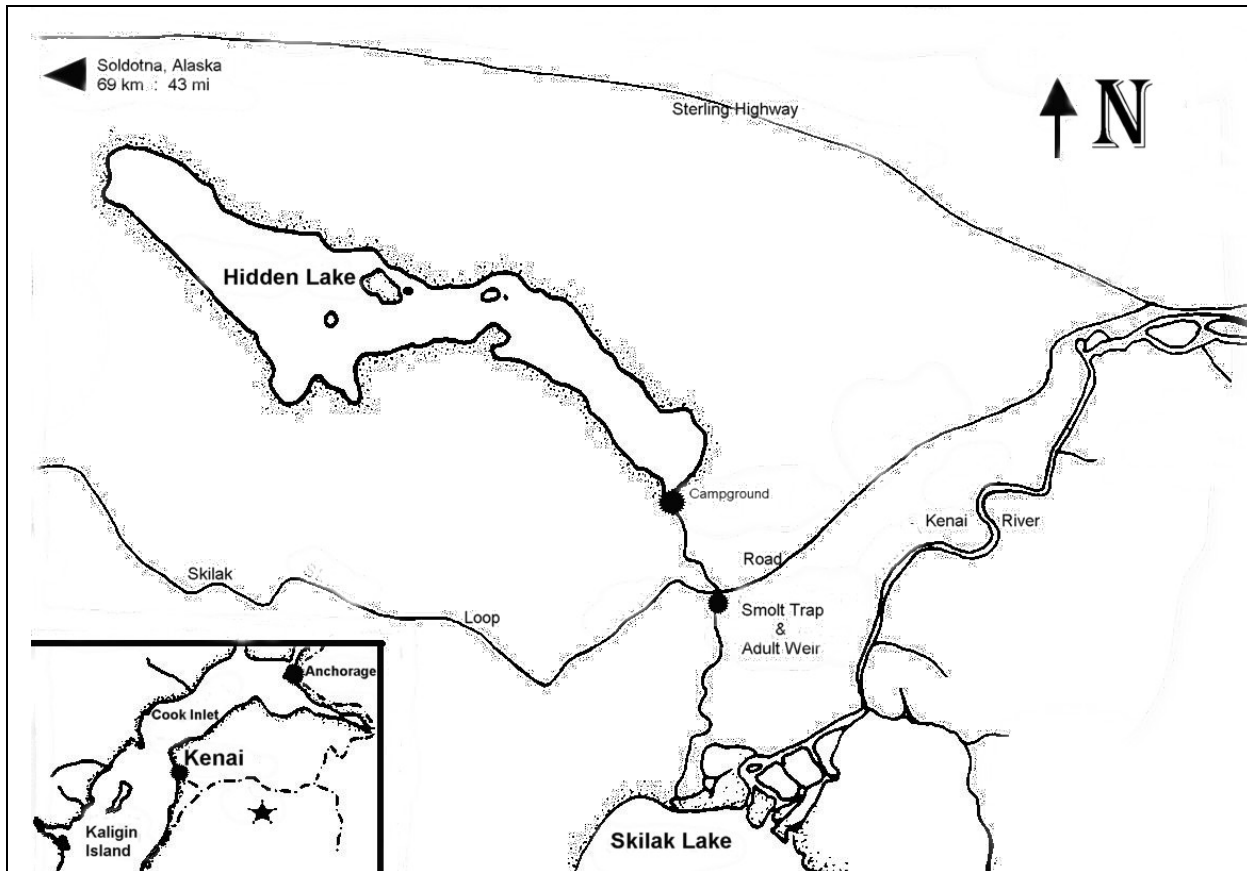


Figure 1. Area Map of Hidden Lake, Kenai Peninsula, Southcentral Alaska.

Hidden Lake (Figure 2) is steep sided with two major basins. It has a surface area of 6.8 km², a mean depth of 20.1 m, a maximum depth of 45.1 m, and a volume of 138.1 X 10⁶ m³. The mean depth of the euphotic zone is 20 m. There is one outlet, Hidden Creek, which flows 5 km to Skilak Lake, the Kenai River and Cook Inlet.

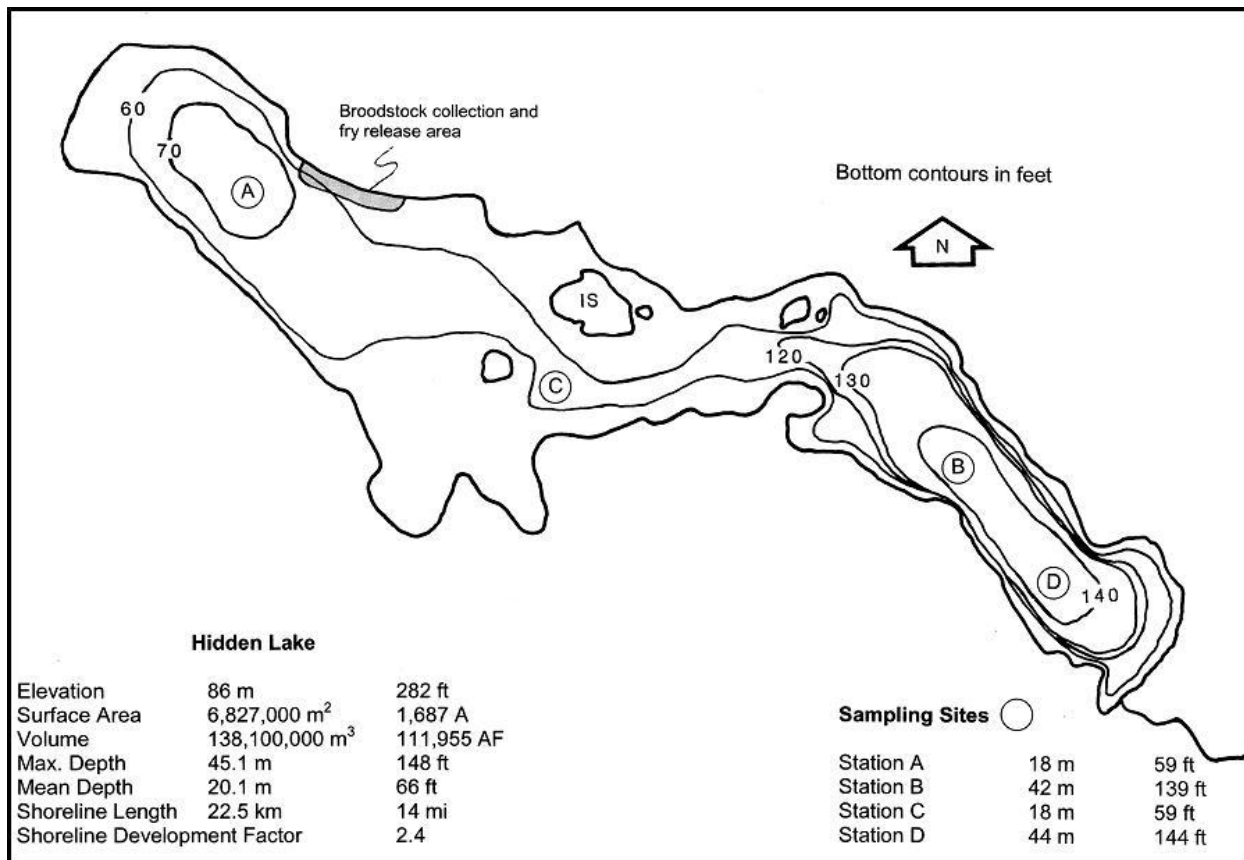


Figure 2. Morphometric map of Hidden Lake showing the two major basins.

The lake's watershed area is 37.4 km² and has an average annual precipitation of 44 cm. The estimated water residence time is 11.7 years. During the open water season, the total phosphorus concentration averages 7 µg/l, the total nitrogen concentration is 178 µg/l and the chlorophyll a concentration is 0.6 µg/l. Based on these concentrations, Hidden Lake is considered an oligotrophic-mesotrophic system.

Two cladocerans, (*Bosmina longirostris* and *Daphnia longiremus*), three copepoda (*Diaptomus pribolofensis*, *Epischura nevadensis*, and *Cyclops columbians*), and numerous species of rotifers make up the zooplankton community of Hidden Lake. Historically, fish present in the lake include five species of Pacific salmon (*Oncorhynchus nerka*, *Oncorhynchus kisutch*, *Oncorhynchus tshawytscha*, *Oncorhynchus gorbuscha*, and *Oncorhynchus mykiss*), lake trout (*Salvelinus namaycush*), Dolly Varden char (*S. malma*), threespine stickleback (*Gasterosteus aculeatus*), and coastrange sculpin (*Cottus aleuticus*) (Kyle, Litchfield, & Todd, 1990).

METHODS

In general, Hidden Lake limnological sampling, salmon egg collection, hatchery incubation, fry rearing, smolt enumeration and adult escapement monitoring follow procedures recommended by ADF&G.

Limnological Sampling and Environmental Conditions

During 2011, water quality samples were collected four times during the open water season in June, July, and August. Two primary sites, Stations A and B (Figure 2) were sampled for dissolved oxygen, temperature and light transmission profiles, Secchi disk transparency and zooplankton densities. Samples for analysis of phosphorus, carbon, chlorophyll *a*, phaeophytin *a*, nitrogen, calcium, magnesium, iron, conductivity, pH, alkalinity, turbidity, and color were also collected with a Kemmerer sampler one meter below the surface and from the midhypolimnion. In addition to the two primary sites, one secondary site, Station C, was also sampled (Figure 2). Measurements at the secondary site were limited to the zooplankton community and Secchi disk transparency.

CIAA followed water sample procedures described in the Limnology Field and Laboratory Manual: Methods for Assessing Aquatic Production (Koenings, Edmundson, Edmundson, & Kyle, 1986). Analysis was completed by ADF&G.

In addition to the limnological samples collected from Hidden Lake, percent cloud cover was estimated, precipitation measured to the nearest millimeter and Hidden Creek water and air temperatures were recorded at 5:00 PM each day during the field monitoring activities.

Smolt Enumeration

To enumerate the smolt migration, a smolt trap was temporarily placed in Hidden Creek approximately 100 meters downstream of Skilak Lake Loop road. The smolt trap consisted of a modified fyke net with nylon mesh leads and a double compartment live-box. The leads and fyke net funneled migrating smolt into the live-box. A swing gate remotely controlled by the trap operators directed smolt into one of two live-box compartments where they were enumerated and a smolt sample was collected.

A total count of smolt migrating from Hidden Lake was made until the migration of fish exceeded 1,000 to 2,000 fish per hour. At migrations rates greater than 2,000 fish per hour, fish densities in the trap become too great and the fish become stressed. To avoid stressing the fish during periods of peak migration, a 10% sub-sampling procedure was used to enumerate the fish.

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

Assuming the two-minute sub-sampling intervals were randomly distributed throughout sub-sampling¹ 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,

¹ Predetermined random 2-minute sampling intervals assured random distribution within each 20-minute period.

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

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

Then, the total smolt migration (\hat{T}) is:

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

with a variance of:

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

and 95% confidence limits of:

$$\hat{T}_s \pm 2\sqrt{v(\hat{T}_s)}.$$

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.

A detailed description of smolt enumeration procedures is available in CIAA's 2011 Hidden Lake Smolt Enumeration Procedures Manual.

Smolt Characteristics and Enhanced Contribution

During the smolt enumeration CIAA analyzed age, weight, and length characteristics on emigrating sockeye and coho smolt salmon. Additionally hatchery contribution was also assessed by collecting otolith samples from sockeye smolt salmon. No otolith sampling was conducted on any other species. Since 1991, CIAA has marked the otolith of all sockeye salmon fry released to Hidden Lake with a thermal mark. The otolith mark is a hatchery induced thermal band produced by controlled temperature changes during incubation.

During the 2011 smolt migration, smolt samples were collected in proportion to the projected emigration. This was accomplished by attempting to collect every 500th sockeye smolt and every 30th coho smolt that was counted and 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.

The fish were placed in a plastic container filled with a diluted solution of 99.5% pure Tricaine Methanesulfonate Finquel® MS-222® and water to anesthetize the fish during the sampling event. Sockeye and coho smolt were first measured to the nearest millimeter for fork length² and then weighed to the nearest 0.1 gram. Up to ten scales were removed from the primary growth area³ and mounted on a glass slide for subsequent age determination. The otoliths from sockeye smolt were extracted following procedures by Glick and Shields (1993) and placed in a labeled one-dram vial. A dilute ethanol solution was added to the vial to cover the otoliths. CIAA staff analyzed the scale and otolith samples at CIAA headquarters. The sockeye smolt were euthanized and returned to the creek after sampling was complete. Each coho smolt was placed in a recovery tank filled with creek water and monitored during the recovery period. The fish were released downstream once they regained power.

Sockeye smolt characteristics, the proportion of hatchery incubated 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 smolt,

N_h = number of smolt in stratum h , ($N = \sum N_h$),

n = total number of smolt sampled,

n_h = number of smolt sampled in stratum h , ($n = \sum n_h$),

a = total number of hatchery incubated smolt sampled,

a_h = number of hatchery incubated smolt sampled in stratum h , ($a = \sum a_h$),

$p_h = a_h / n_h$, the proportion of hatchery incubated smolt in stratum h ,

² Standard fork length was measured from the tip of the snout to the fork of the tail.

³ 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.

$q_h = 1 - p_h$, the proportion of wild smolt in stratum h ,

c_i = number of age = i smolt sampled,

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

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

$m_{hi} = 1 - l_{hi}$, the proportion of other than age = i smolt 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 hatchery incubated smolt, \hat{P} , is:

$$\hat{P} = a / n;$$

with a variance of:

$$v(\hat{P}) = (1 - f)(1/n) \sum W_h p_h q_h;$$

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

And, the total number of hatchery incubated smolt, \hat{A} , is:

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

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 are large and \hat{P} is not extreme, the normal approximation without a correction for continuity, can be used to develop the relative error. Thus, the 95% confidence interval estimates for \hat{P} and \hat{A} are:

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

with relative errors of:

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

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

$$\hat{L}_i = c_i / n;$$

with a variance of:

$$v(\hat{L}_i) = (1-f) \frac{1}{n} \sum_h W_h l_{hi} m_{hi};$$

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

$$\hat{C}_i = N(\hat{L}_i);$$

with a variance of:

$$v(\hat{C}_i) = N^2 v(\hat{L}_i).$$

Confidence intervals (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:

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

and 95% confidence interval estimates of:

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

Adult Enumeration and Enhanced Contribution

The 2011 Hidden Lake adult escapement was monitored to assess the returning fish population. To enumerate and sample returning salmon, two adult counting weirs were temporarily installed in Hidden Creek. The weirs were constructed of 1.9 cm galvanized pipe and 7.6 cm aluminum channel. The galvanized pipe was picketed through 1.9 cm holes in the aluminum channel spaced 2.54 cm apart. The weirs were erected perpendicular to the flow and positioned at an approximate distance of 10 yards of each other creating a trap between the two weirs. The double weir configuration comfortably held fish for a short period while field personnel safely operated the weir. During day time hours, field personnel passed fish upstream or downstream through both weirs. Personnel initially made hourly counts when the numbers of fish were few.

As the number of fish ascending Hidden Creek increased, counts were made more frequently to prevent fish from accumulating behind the weir.

The returning adult population's characteristics were assessed by collecting a sample of the migrating sockeye adults to determine age, length and weight characteristics. To obtain a representative sample for determining age, sex, and size of the returning adult sockeye population, samples were collected for every 500th adult sockeye which passed through the weir. Adult sockeyes were captured at the weir, measured for standard fork length to the nearest millimeter, sex determined, and a scale was removed from the primary growth area. The fish were unharmed and released upstream. Reading and statistical analysis of adult sockeye scales was conducted by the ADF&G.

Hatchery contribution was assessed by collecting otoliths from returning adult sockeye to identify the hatchery induced thermal band. CIAA attempted to collect a total of 600 readable otolith pair for evaluation with equal number of samples (n=200) collected over the beginning, middle, and end of the escapement. The otolith pairs were analyzed to CIAA headquarters to estimate hatchery contribution.

A detailed description of adult escapement enumeration procedures is available in the 2011 CIAA Hidden Lake Adult Enumeration Procedures Manual.

Gamete Collection, Incubation and Rearing

Gamete collection occurred on 20 and 21 September 2011. Adult sockeye were collected using a beach seine from spawning areas, checked for ripeness and placed into net pens. Gamete collection followed ADF&G Sockeye Salmon protocol. Equipment was disinfected between each fish. Single family delayed fertilization and water hardening disinfecting techniques were used. Iced coolers of eggs and milt in individual containers were transported to Trail Lakes Hatchery. Containers are disinfected prior to admission to the facility. Newly fertilized eggs are

water hardened in iodophor solution for 2 hours before being placed into Kitoi incubators. Once eggs have reached the eyed stage, eggs are shocked, picked and inventoried. Resulting live eggs are placed into Kitoi incubators for hatching and emergence. The sockeye eggs collected in 2011 are currently being incubated at Trail Lakes Hatchery. Incubation will follow standard hatchery procedures and water temperature will be regulated to thermally mark the otoliths of fish scheduled for release in 2012.

Fish Transport and Stocking

Prior to fish transport, fish samples were sent to ADF&G Pathology Lab for disease screening. The surviving unfed fry collected from adult sockeye in 2010 were measured for weight to the nearest 0.1 gram, transferred to fish stocking tanks and transported to Hidden Lake. CIAA staff transported the sockeye fry via boat to the west end of the lake and released near the north shore.

RESULTS AND DISCUSSION

Limnology and Environmental Conditions

CIAA has completed limnology sampling at Hidden Lake since 1992. In 2011, water quality and zooplankton samples were collected four times. Water quality analysis was completed by ADF&G and is summarized in Table 1. Zooplankton analysis is incomplete for 2010 and 2011 field seasons.

Table 1. Average open water season water quality characteristics of Hidden Lake

Year	AVERAGE WATER QUALITY - 1 METER										AVERAGE WATER QUALITY - HYPOLIMNION						
	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	Chl a (ug/l)	EZD (m)	Secchi (m)	Zooplankton (mg/m2)	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	Chl a (ug/l)
1980	145	7.8	66		6.8	120	2.1				146	7.8	69		6.1	140	1.8
1981	117	7.0	73		6.6	171	0.6			2,381	116	7.0	74		6.5	175	0.5
1982	137	8.1	70		8.6	174	0.4			1,619	136	8.0	71		7.2	172	0.5
1983	144	8.1	72		6.9	176	0.5			3,285	148	7.8	73		9.2	193	0.8
1984	146	7.9	71		6.7	172	0.7			2,248	149	7.7	72	0.6	6.3	168	0.6
1985	147	7.9	78	0.7	7.2	177	0.9			1,967	147	7.7	79	0.7	8.2	179	0.7
1986	144	7.8	72	0.4	7.5	185	0.3			2,420	146	7.7	71	0.3	7.6	180	0.3
1987	147	8.0	70	0.2	6.9	188	0.5			1,390	150	7.8	70	0.3	8.3	191	0.5
1988	146	7.8	67	0.6	6.8	197	0.6			2,466	150	7.6	67	0.4	7.0	195	0.6
1989	146	8.0	67	0.4	7.8	198	0.4			3,437	149	7.9	67	0.4	8.0	196	0.4
1990	147	8.0	73	0.4	7.8	193	0.8			2,258	148	7.8	73	0.4	8.5	187	0.7
1991	152	8.0	72	0.7	6.7	171	0.8	20.2	7.3	2,222	154	7.8	73	0.7	8.2	189	0.6
1992	145	8.0	66	0.7	7.4	231	1.3	15.2	5.0	1,030	147	7.7	69	0.6	9.5	218	1.1
1993	150	7.8	68	0.5	7.0	198	1.5	14.0	6.4	2,030	156	7.6	71	0.4	8.0	203	1.3
1994	156	7.8	70	0.5	7.4	210	1.6	19.6	6.7	847	157	7.6	70	0.6	7.3	188	0.9
1995	153	7.8	71	0.7	5.7	197	1.8	20.0	7.6	1,520	159	7.6	72	0.7	6.5	189	1.6
1996	152	7.8	71	0.7	5.6	188	0.9	19.6	8.4	1,338	159	7.7	73	0.7	6.3	190	2.6
1997	153	7.8	73	0.4	6.6	186	0.7	20.2	9.7	2,111	153	7.8	73	0.5	9.0	201	1.2
1998	150	8.0	72	0.8	6.4	205	0.8	21.0	7.2	2,358	153	7.8	72	0.1	6.6	194	0.6
1999	149	7.6	72	0.7	7.3	234	0.8	18.7	6.7	2,474	153	7.5	72	0.7	7.4	221	0.5
2000	150	7.8	69	0.8	7.2	234	1.6	20.4	8.7	3,896	151	7.7	70	0.7	7.9	245	1.5
2001	150	7.6	68	0.7	7.8	231	1.1	19.4	7.1	3,398	152	7.5	69	0.7	7.5	222	0.9
2002	147	7.7	73	0.4	8.6	257	1.1	17.9	5.9	2,447	150	7.6	73	0.5	9.1	239	0.7
2003	148	7.3	70	0.4	8.4	229	2.8	17.1	7.0	959	149	7.3	68	0.5	8.9	224	1.5
2004	141	7.5	70	0.3	11.7	286	1.0	17.1	6.6	1,450	151	7.7	71	0.5	13.1	302	1.0
2005	149	7.2	68	0.3	9.8	273	0.5	17.5	7.0	1,693	149	7.2	68	0.1	11.8	277	0.5
2006	147	7.3	67	0.1	8.2	237	0.5	23.4	8.0	1,445	148	7.4	68	0.2	8.5	216	0.6
2007	151	7.8	71	0.6	8.4	218	0.7	21.4	9.0	1,589	154	7.7	71	0.5	9.9	222	0.9
2008	149	7.4	68	0.3	12.4	217	0.6	20.6	7.8	1,436	152	7.3	69	0.2	8.8	202	0.5
2009	151	7.4	69	0.3	8.8	229	0.5	20.0	8.1	1,313	151	7.3	68	0.2	8.1	219	0.6
2010	154	7.5	66	0.2	7.7	-	0.6	20.2	7.4		152	7.5	66	0.6	7.5	-	0.9
2011	160	8.0	73	0.8	6.5	-	0.9	24.0	8.5		162	7.9	72	0.3	12	-	2.4

Averages prior to 1992 compiled by ADF&G.

EZD and Secchi provided by CIAA.

Open water season only.

Environmental conditions during the Hidden Lake smolt migration were monitored from 24 May to 13 July 2011. Stream stage measurements averaged 0.44 feet (± 0.02 feet) and ranged from 0.40 to 0.49 feet. During the period of smolt migration, stream temperatures averaged 14°C ($\pm 3^\circ\text{C}$) and ranged from 9 to 19°C. Air temperatures averaged 16°C ($\pm 3^\circ\text{C}$) and ranged from 11

to 24°C. Six percent of the days were clear, 20% had less than 50% cloud cover, 41% had more than 50% cloud cover, 20% were completely overcast, and 14% were recorded rain. Measurable rain was recorded on 22 days (43%) during the smolt migration. A total of 190 mm of rain fell during this period.

Environmental conditions during the Hidden Lake adult sockeye migration were monitored from 16 July to 1 September 2011. Stream stage measurements averaged 0.45 feet (± 0.06 feet) and ranged from 0.32 to 0.58 feet. Stream temperatures averaged 18°C ($\pm 2^\circ\text{C}$) and ranged from 14 to 20°C and air temperatures averaged 17°C ($\pm 3^\circ\text{C}$) and ranged from 11 to 24°C. Two percent of the days were clear, 22% had less than 50% cloud cover, 27% had more than 50% cloud cover, 31% were completely overcast, and 18% were recorded rain. Rain was recorded on 34 days (69%) during the adult migration. A total of 709 mm of rain fell during this period.

Smolt Enumeration

The Hidden Lake smolt migration was enumerated from 23 May and continued daily until 16 July. During this time an estimated 299,348 ($\pm 17,639$) sockeye and 22,925 (± 701) coho smolt salmon migrated from the lake. There were 50 sockeye smolt and 14 coho smolt mortalities included in the total estimated migration. Other fish counted included 89 rainbow trout (*Oncorhynchus mykiss*), and 165 dolly varden (*Salvelinus malma*). The 10% sub-sampling procedure was used to enumerate 43% ($\pm 14\%$) of the total sockeye smolt and 12% ($\pm 26\%$) of the total coho smolt.

In general, the pattern of the 2011 Hidden Lake sockeye smolt migration was similar to the smolt migrations observed prior to 2005. The smolt migrations observed in 2005 and 2006 were characterized by two peak periods of migratory activity. The 2008 smolt migration and migrations prior to 2005 were characterized by a single peak period of migratory activity. The 2011 smolt migration peak occurred between 7 and 8 June.

Smolt Characteristics and Enhanced Contribution

Otolith, scale, weight, and length measurements were collected and analyzed on 596 sockeye smolts. Based on the otolith samples collected, 47% ($\pm 3.8\%$) of the migrating sockeye smolt were incubated at Trail Lakes Hatchery. Based on the scale samples collected, an estimated 70% ($\pm 4.2\%$) were age 1 and 30% ($\pm 4.2\%$) were age 2. The average length and weight of the age 1 sockeye smolt were 137 mm (± 5 mm) and 24.5 g (± 0.9 g). The average length and weight of the age 2 sockeye smolt were 196 mm (± 2.5 mm) and 77.8 g (± 2.9 g).

Scale age, weight, and length measurements were made on 754 coho smolt, of which 750 samples were readable. Based on the scale samples collected, an estimated 62% ($\pm 0.1\%$) of the migrating coho smolt were age 1. An estimated 38% ($\pm 0.1\%$) were age 2. The average length and weight of the age 1 coho smolt were 125 mm (± 1 mm) and 19.6 g (± 0.4 g). The average length and weight of the age 2 coho smolt were 138 mm (± 0.9 mm) and 26.5 g (± 0.6 g).

The age structure, average length, and weight measurements of the sockeye and coho smolt were similar to historical smolt migrations (Table 2).

Prior to 1988, estimates of the enhanced contribution of sockeye to the Hidden Lake sockeye smolt migration were based on coded wire tag studies. Estimates of the proportion of hatchery fish ranged from 3 to 78% (Kyle, Litchfield, & Todd, 1990). Since 1991, the otoliths of all hatchery-incubated fry released to Hidden Lake were thermally marked. These hatchery marks have been used to apportion migrating sockeye smolt between wild and enhanced fish since 1993.

Table 2. Age structure, length and weight characteristics of Hidden Lake sockeye smolt, 1976 - 2011.

Smolt Year	Age Class (%)				Mean length (mm)				Mean weight (g)			
	Age 1.0	95% C.I.	Age 2.0	95% C.I.	Age 1.0	95% C.I.	Age 2.0	95% C.I.	Age 1.0	95% C.I.	Age 2.0	95% C.I.
1976	80		20		130		146		NA		NA	
1977	83		17		144		199		NA		NA	
1978	88		12		133		190		22.4		79.3	
1979	85		15		145		177		30.7		57.2	
1980	90		10		143		200		27.3		83.9	
1981	98		2		144		198		28.5		81.4	
1982	99		1		145		174		27.3		55.3	
1983	94		6		132		186		21.3		66.1	
1984	95		5		144		170		28.7		49.2	
1985	97		3		141		185		26.3		63.7	
1986	96		4		134		180		22.4		55.6	
1987	81		19		143		175		28.0		54.3	
1988	94		6		128		179		18.7		59.1	
1989	94		6		126		163		17.6		43.5	
1990	78		21		140		191		30.0		71.6	
1991	93		6		140		205		25.4		88.9	
1992	95		5		133		172		21.5		47.1	
1993	89		10		130		183		20.4		61.2	
1994	94		6		130		179		18.1		49.8	
1995	86		13		128		181		18.3		56.5	
1996	95	(±2.1)	5	(±2.1)	135	(±0.5)	190	(±4.5)	19.1	(±0.3)	59.4	(±6.5)
1997	96	(±2.7)	4	(±2.7)	123	(±0.6)	190	(±15.9)	15.9	(±0.3)	72.7	(±19.7)
1998	91	(±2.9)	9	(±2.9)	129	(±0.7)	203	(±5.8)	20.0	(±0.4)	82.3	(±6.5)
1999	86	(±3.6)	14	(±3.6)	132	(±0.6)	173	(±5.1)	23.0	(±0.3)	51.1	(±4.8)
2000	93	(±2.2)	8	(±2.2)	138	(±0.5)	182	(±7.3)	25.0	(±0.3)	64.0	(±7.8)
2001	94	(±2.6)	6	(±2.5)	134	(±0.5)	165	(±8.6)	22.3	(±0.3)	45.0	(±8.0)
2002	86	(±2.2)	13	(±2.2)	134	(±0.8)	165	(±6.0)	22.2	(±0.4)	45.0	(±4.8)
2003	94	(±2.2)	6	(±2.2)	140	(±0.5)	179	(±0.8)	24.7	(±0.2)	60.5	(±6.5)
2004	64	(±3.7)	36	(±3.7)	140	(±0.8)	179	(±3.6)	24.7	(±0.8)	60.5	(±3.7)
2005	91	(±1.8)	9	(±1.9)	140	(±0.5)	179	(±3.6)	24.7	(±2.0)	60.5	(±3.7)
2006	91	(±2.4)	9	(±2.4)	140	(±0.9)	179	(±10.3)	24.7	(±0.5)	60.4	(±8.7)
2007	86	(±2.8)	16	(±3.0)	135	(±0.9)	167	(±3.1)	24.7	(±1.0)	47.4	(±4.8)
2008	97	(±1.8)	3	(±1.7)	123	(±0.9)	170	(±16.3)	18.0	(±0.3)	49.5	(±12.2)
2009	88	(±2.4)	12	(±2.4)	131	(±0.5)	175	(±3.0)	22.9	(±0.5)	55.7	(±3.7)
2010	84	(±3.4)	16	(±3.4)	120	(±7.0)	188	(±13.0)	17.0	(±2.5)	67.8	(±5.9)
2011	70	(±4.2)	30	(±4.2)	137	(±5.0)	197	(±2.5)	24.5	(±0.9)	77.8	(±2.9)
Mean	89		11		135		181		21.8		57.9	

Prior to 1990, data summary is from Kyle et al. (1990).

In 2011, the proportion of hatchery-incubated salmon in the sockeye smolt migration was 47% (±3.8%) (Table 3). The 2011 hatchery contribution is less than the 1993-2011 average of 66% and the most recent 4 year average of 52%.

Table 3. The contribution of enhanced sockeye to the Hidden Lake smolt migrations, 1976-2011.

Smolt Year	Total		Wild	Hatchery	% Hatchery	
	No.	95% C.I.			%	95% C.I.
1976	29,639		29,639	0	0	
1977	17,670		17,670	0	0	
1978	111,466		52,745	58,721	53	
1979	94,347		46,828	47,519	50	
1980	81,748		79,458	2,290	3	
1981	161,522		161,522	0	0	
1982	222,673		222,673	0	0	
1983	235,233		235,233	0	0	
1984	419,376		175,876	243,500	58	
1985	396,000		98,000	298,000	75	
1986	651,889		140,965	510,924	78	
1987	68,980		68,980	0	0	
1988	471,625					
1989	719,527					
1990	231,300					
1991	208,500					
1992	191,900					
1993	388,500	(±21,100)	62,200	326,300	84	(±4.8)
1994	414,700	(±40,400)	53,900	360,800	87	(±3.9)
1995	293,700	(±33,400)	79,300	214,400	73	(±6.5)
1996	428,100	(±15,700)	94,200	333,900	78	(±3.6)
1997	228,800	(±0)	66,400	162,400	71	(±5.1)
1998	385,300	(±45,000)	84,800	300,500	78	(±3.7)
1999	313,100	(±13,400)	93,900	219,200	70	(±4.2)
2000	475,600	(±52,600)	109,400	366,200	77	(±3.2)
2001	324,900	(±0)	94,200	230,700	71	(±4.4)
2002	367,100	(±51,400)	132,200	234,900	64	(±4.4)
2003	309,180	(±17,300)	64,900	244,300	79	(±3.1)
2004	180,660	(±0)	131,900	48,800	27	(±3.9)
2005	290,400	(±15,500)	69,700	220,700	76	(±2.6)
2006	200,800	(±17,900)	106,400	94,400	47	(±3.6)
2007	216,800	(±70,700)	65,000	151,800	70	(±3.4)
2008	350,400	(±58,500)	140,200	210,200	60	(±4.3)
2009	315,950	(±9,000)	154,800	161,100	51	(±3.4)
2010	283,897	(±13,530)	140,500	143,400	51	(±4.1)
2011	299,300	(±17,639)	157,700	141,600	47	(±3.8)
Mean	319,300		100,100	219,200	66	
4-year Mean	312,400		148,300	164,100	52	

Prior to 1993, estimates of smolts originating from hatchery fry releases based on CWT studies.

Since 1993, estimates of smolts originating from hatchery fry releases based on otolith thermal marks.

Mean calculated from 1993 to present.

Prior to 1990, data summary is from Kyle et al. (1990).

Adult Enumeration and Enhanced Contribution

The Hidden Lake adult salmon escapement was enumerated from 16 July to 1 September 2011. During this time, an estimated 17,771 adult sockeye salmon (*Oncorhynchus nerka*) and 2 adult coho salmon (*Oncorhynchus kisutch*) returned to Hidden Creek. Other fish counted included 1 rainbow trout (*Oncorhynchus mykiss*). Personnel collected scales from 292 adult sockeye, of

which 243 scales were readable. The percentage of adult male and adult female sockeye salmon returning to Hidden Lake was 47% and 53%, respectively. Male fish averaged 517 mm (± 4 mm) in length and the females averaged 502 mm (± 2 mm). An estimated 0.43% were age 1.1, 83.77% were age 1.2, 8.11% were age 1.3, 7.26% were age 2.2, and 0.43% were 2.3.

To determine the contribution of hatchery incubated fish to the population of adult sockeye returning to Hidden Lake, CIAA staff collected 610 otolith pairs from Hidden Creek on 3 August, 13 August, and 30 August 2011, of which 608 pairs were readable. Based on otolith marks, an estimated 51% ($\pm 0.2\%$) adult sockeye salmon were incubated at Trail Lakes Hatchery. The 610 fish collected for otolith extraction were not included in the total escapement.

Prior to 1999 adult hatchery contribution was not evaluated. The Hidden Lake adult hatchery contribution from 1999-2011 was 62%. Hatchery contribution was not included in the analysis in 2005 and 2006 due to inconsistency in daily escapement which created an unpredictable sampling technique and rendered statistically inconclusive results. Hatchery contribution decreased to 59% when looking at the most recent 4 year average hatchery return from 2008-2011. The 2011 adult hatchery population, 51%, was the lowest hatchery return to date. Table 5 summarizes historical sockeye escapements and major age classes. The 2011 proportion of returning adult hatchery sockeye was equivalent to the proportion of migrating smolt hatchery sockeye in 2009.

The 2011 estimated commercial fishery harvest of Hidden Lake enhanced sockeye salmon was 13,931 and the estimated personal use and sport fishery harvest combined was 5,167 (Cherry, 2011).

An amendment to the 2008 data should be noted in Table 4. The table displays the total number of adult sockeye salmon that were available for lake spawning. It does not include the number of mortalities or adult sockeye taken for otolith sampling at the weir. The 2008 data reflects a change from 15,335 adult sockeye to 15,072 adult sockeye which passed through the weir and were available to spawn in the lake. Additionally in 2008, it was reflected that 63% ($\pm 1.5\%$) of the adult sockeye escapement were of hatchery origin. This percentage represents an average

hatchery contribution from adult sockeyes taken for otolith sampling at the weir and the lake. Due to an inconsistent adult return CIAA personnel were not able to collect a statistically significant number of samples at the weir. Of 135 adult sockeye taken for otolith sampling at the weir 126 were readable and resulted in 51 samples, or 41% ($\pm 1.5\%$) were of hatchery origin. Combining the total number of otolith samples collected at the weir and the lake a total of 628 samples were collected, 592 of these samples were readable, and 371 of the readable otolith samples or 63% ($\pm 1.5\%$) were of hatchery origin. For the purposes of this report it should be noted that 41% hatchery contribution is of the samples collected at the weir.

Table 4. Summary of Hidden Lake salmon escapement, age distribution and fish length. 1976 - 2011.

Year	Lake Escapement	Hatchery Return (C.I.)		Hatchery	Wild	Major Age Classes					
						1.2		1.3		2.2	
		(%)	(C.I.)			(%)	Lth(mm)	(%)	Lth(mm)	(%)	Lth(mm)
1976	4,860					79	540	1	530	20	550
1977	1,055					64	550	2	600	34	570
1978	4,647					88	530	10	540	2	540
1979	5,762					90	540	4	560	6	550
1980	27,488					92	530	1	560	1	530
1981	15,939					78	530	15	560	7	555
1982	9,790					70	520	23	560	4	520
1983	11,297					87	530	11	550	2	530
1984	27,784					92	520	3	570	5	550
1985	24,784					77	520	13	570	9	580
1986	17,530					85	530	9	570	6	540
1987	43,487					96	530	3	540	0	540
1988	50,907					94	540	4	570	2	570
1989	7,770					44	550	41	580	15	540
1990	77,959					86	507	2	565	12	516
1991	35,576					90	512	7	557	3	521
1992	32,912					82	505	13	551	5	513
1993	11,582					80	529	9	568	11	536
1994	6,086					60	493	31	557	6	507
1995	7,542					63	514	12	559	21	525
1996	55,526					83	539	7	587	9	540
1997	56,053					77	514	18	566	3	536
1998	67,727					83	510	14	556	3	516
1999	49,406	69%	($\pm 3.7\%$)	34,288	15,118	89	455	6	549	5	502
2000	45,685	62%	($\pm 3.6\%$)	28,325	17,360	82	519	9	560	8	530
2001	42,462	58%	($\pm 4.0\%$)	24,585	17,877	63	525	20	564	12	544
2002	71,983	62%	($\pm 3.1\%$)	44,629	27,354	73	537	18	582	7	544
2003	11,734	58%	($\pm 5.2\%$)	6,794	4,940	70	517	24	568	6	570
2004	18,172	77%	($\pm 2.7\%$)	13,956	4,216	67	521	19	568	12	540
2005	13,000	ND	ND	ND	ND	79	ND	12	ND	9	ND
2006	38,535	ND	ND	ND	ND	89	502	4	547	7	506
2007	16,735	57%	($\pm 7.9\%$)	9,489	7,246	63	537	23	562	11	520
2008	15,072	41%	($\pm 1.5\%$)	6,104	8,968	86	511	8	573	6	517
2009	11,002	67%	($\pm 1.8\%$)	7,338	3,664	65	518	21	553	8	518
2010	40,503	56%	($\pm 1.7\%$)	22,560	17,943	91	500	1	543	8	496
2011	17,771	51%	($\pm 3.8\%$)	9,117	8,654	84	506	8	546	7	496
Mean	27,670	60%		18,835	12,122	79	521	12	561	8	533
4 Year Avg	21,087	54%		11,280	9,807	81	509	10	554	7	507
Min	1,055	41%		6,104	3,664	44	455	1	530	0	496
Max	77,959	77%		44,629	27,354	96	550	41	600	34	580

Data prior to 1990 from Kyle, et al. 1990.

ND = No Data Collected or Calculated

Note: Total is escapement to the lake and not fish returning to weir (morts and sampled fish)

1991 - Total sockeye return to weir was 112,792. Personal use-dipnet fishery harvested 72,060. 5,156 were donated to charity

2005 - A hole was detected in the weir, CIAA counted 6,745 sockeye salmon. 13,000 is based on prior counts and ADF&G fish wheel estimates

2008 - Total estimated return includes 1,500 sockeye estimated due to high bear activity.

2008 - An amendment to the lake escapement and hatchery contribution.

During the adult escapement, beaver dams prevented adult fish migration. On 28 July, CIAA personnel documented extremely low water level in Hidden Creek below Skilak Loop Road. Personnel hiked upstream of the culvert to identify and notch one beaver dam preventing adult fish passage. After an aerial survey on 10 August, one beaver dam was documented deterring fish passage in Hidden Creek. Approximately 500 adult sockeye were observed at the mouth of Hidden Creek. Field personnel hiked approximately 0.8 mile to notch the beaver dam and no fish were observed ascending the creek during this time.

Gamete Collection, Incubation and Rearing

Since 1976, the collection of sockeye gametes and the release of hatchery incubated fry have been used to enhance the sockeye population in Hidden Lake, Tutka Bay Lagoon, Leisure (China Poot) Lake, Hazel Lake, and Kirschner Lake. To date, a total of 89,846,000 eggs have been collected for incubation at Crooked Creek, Big Lake, and Trail Lakes Hatcheries. Current egg incubation is taking place at Trail Lakes Hatchery. As of 2009, CIAA is no longer utilizing the Hidden Lake sockeye population to enhance systems other than Hidden Lake. The annual gamete collections conducted since 1976 are summarized in Table 5.

Table 5. Summary of sockeye salmon gamete collection and fry releases at Hidden Lake, 1976 - 2011.

Brood Year	No. eggs taken	No. females used	Fecundity	Receiving hatchery	Egg-to-fry survival (%)	No. fry released Hidden Lk.	No. smolt produced in Hidden Lk	Fry-to-smolt survival (%)	No. fry Released LCI Lakes	No. fry Held for Smolt	No. Smolt Released Tutka Lagoon	Hatchery Fry-to-smolt survival (%)
1976	832,880	274	3,091	Crooked Cr.	39.6	330,228	58,800	17.8				
1977	406,878	200		Big L.	75.9	308,704	40,600	13.2				
1978	311,808	100	3,118	Crooked Cr.	2.7	8,258						
1979												
1980												
1981												
1982		576	2,741	Trail L.	68.8	1,086,000	231,300	21.3				
1983	1,928,000	639	3,017	Trail L.	64.2	1,236,900	289,100	23.4				
1984	3,766,000	1,310	2,875	Trail L.	47.9	1,805,792						
1985	7,019,000	2,330	3,012	Trail L.		0						
1986	4,740,000	1,580	3,000	Trail L.	78.5	3,718,311						
1987	7,000,184	2,434	2,876	Trail L.	86.9	6,085,307						
1988	2,718,853	891	3,046	Trail L.	91.0	2,470,012	194,400	7.9				
1989	2,220,467	647	2,669	Trail L.	79.0	1,747,900	203,800	11.7				
1990	2,189,000	956	2,290	Trail L.	64.6	1,600,000	214,100	13.4				
1991	2,652,000	1,119	2,370	Trail L.	64.7	1,716,000	330,200	19.2				
1992	2,293,000	1,007	2,277	Trail L.	82.9	1,901,000	365,300	19.2				
1993	2,200,000	934	2,355	Trail L.	81.8	1,800,000	195,000	10.8				
1994	2,156,000	1,017	2,120	Trail L.	78.8	1,700,000	326,600	19.2				
1995	1,893,000	849	2,230	Trail L.	84.5	1,600,000	184,700	11.5				
1996	2,048,000	817	2,507	Trail L.	73.3	1,501,000	305,300	20.3				
1997	2,166,000	936	2,314	Trail L.	47.8	1,035,000	182,900	17.7				
1998	2,303,000	859	2,681	Trail L.	65.4	1,507,100	352,300	23.4				
1999	2,297,000	954	2,408	Trail L.	54.1	1,242,000	254,600	20.5				
2000	1,486,000	607	2,448	Trail L.	60.9	905,500	220,000	24.3				
2001	1,326,000	504	2,631	Trail L.	73.9	980,200	257,800	26.3				
2002	1,118,000	433	2,582	Trail L.	56.3	628,900	46,700	7.4				
2003	893,000	371	2,481	Trail L.	89.4	646,000	214,700	33.2		100,000	96,000	96.0
2004	5,445,000	2,045	2,663	Trail L.	89.5	573,000	104,400	18.2	4,126,000	284,000	260,000	91.5
2005	2,027,000	1,045	1,940	Trail L.	78.6	582,000	136,600	23.5	680,000	193,000	144,000	74.6
2006	5,640,000	2,340	2,450	Trail L.	89.9	658,000	203,719	31.0	3,980,000	570,000	483,000	84.7
2007	5,686,000	2,231	2,549	Trail L.	85.0	917,000	208,985	22.8	4,880,000	317,000	301,000	95.0
2008	4,004,000	1,543	2,595	Trail L.	90.4	911,000	161,160	17.7	2,411,000	290,000	278,000	95.9
2009	5,140,000	1,849	2,780	Trail L.	92.4	880,000	188,011	21.4	3,406,000	410,000	192,000	46.8
2010	1,241,000	500	2,517	Trail L.	90.6	1,044,000	140,694	13.5	0	0	0	0.0
2011	1,119,528	445	2,516	Trail L.								
Total	88,267,000	34,342				43,125,000	5,612,000					
Mean			2,474		76.7	1,241,114	217,042	18.9				
4-yr Avg.			2,593		89.6	841,500	190,469	18.8				

The 1977 sockeye salmon were taken from anadromous and residual fish.

BY 1978 eggs suffered high mortality due to complications with the hatchery source water.

The 1985 hatchery broodstock (fry) became infected with IHN virus and were destroyed.

Egg collection data prior to 1989 is from on Kyle, et al. 1990.

Mean calculation is based on broodyear 1988 to present.

2003-Survival from eyed egg to emergent fry was 89%. Only 646,000 fry released, 152,000 kept for smolt.

Survival from eyed egg to emergent fry was 89%. Only 573,000 fry released to Hidden, 4,126,000 fry released to Lower Inlet Lakes, 174,000 kept for smolt

***Survival from eyed egg to emergent fry was 79%. Only 582,000 fry released to Hidden, 680,000 fry released to Lower Inlet Lakes, 193,000 kept for smolt

incomplete broodyear

On 20 September and 21 September 2011, approximately 1.119 million eggs were collected from 445 female salmon and shipped to Trail Lakes Hatchery for fertilization. Fertilization involves mixing the eggs from each female with a portion of the milt from eight to ten males and activating the sperm with a 0.7% saline solution. An estimated 981,259 eggs (88%) have survived to the eyed stage.

The objective of the Hidden Lake Sockeye Salmon Enhancement Project is to achieve an average adult sockeye escapement of 30,000 fish. CIAA calculates the number of gametes to collect

each year to meet this objective based on the most recent 4-year average natural sockeye smolt emigration (148,400 - Table 4), broodyear average green egg-to-fry survival (89.6% - Table 1), fry-to-smolt survival (18.8% - Table 1), smolt-to-adult survival (24.1%), and the average common property harvest rate (51%). Based on these averages, to meet a projected adult return of 30,000 adult sockeye to Hidden Creek, CIAA projects 958,000 eggs must be collected in 2012 to supplement the Hidden Lake return.

Fish Transport and Stocking

On 28 May 2011, an estimated 1,044,000 unfed sockeye fry at approximately 0.09 g from gametes collected in 2010 were released into Hidden Lake. The unfed fry released to Hidden Lake were transported by truck in oxygenated tanks from Trail Lakes Hatchery to Hidden Lake, transferred to oxygenated fish transport tanks on board a small skiff, motored to the west end of the lake and released near historic spawning areas (Figure 2). All fry were screened for diseases prior to release. There was no detection of infectious hematopoietic necrosis virus (IHN). None of the released fry were externally marked or tagged; however, the otoliths of all the released fry were marked with thermal bands [Hatch Code: 2,2,2H; Rbr 1:1.2,2.2,3.2]. Otolith samples were processed to document the marks and are on file at CIAA Headquarters. Since 1977, over 43 million fry have been released to Hidden Lake (Table 1).

An estimated 410,000 sockeye smolt produced from Hidden Lake gametes collected in 2009 were being reared at Trail Lakes Hatchery and scheduled to be released to Tutka Bay Lagoon in 2011. However, a raceway contaminated with IHN was discovered and all fish in that raceway were destroyed. An estimated 197,000 sockeye smolt released to Tutka Bay Lagoon. The fish were thermally marked with the Hatch Code 3,3H; Rbr 1:1.3,2.3.

Special Studies

In March 1999, ADF&G conducted the Hidden Lake Sockeye Salmon Enhancement Project Technical Review (Simpson & Edmundson, 1999). Based on this review, ADF&G recommended a study to determine if hatchery incubated fish released at Hidden Lake were straying into other Kenai River system spawning populations. CIAA agreed to examine surrounding spawning regions to evaluate if hatchery fish were straying. The otolith pairs were brought to CIAA headquarters for age and hatchery mark determination.

From 1999-2002, CIAA began sampling late run adult sockeye salmon returning to the Russian River. CIAA personnel collected otolith samples from 2,119 adult sockeye salmon during this time. The otolith pairs were brought to CIAA headquarters to evaluate hatchery thermal mark and age composition. Of the samples collected, 1,994 were readable. None of the evaluated otoliths were of hatchery origin.

Based on the ADF&G recommendation, to test the theory if hatchery incubated sockeye could be attracted to the water of origin used during incubation from 1999-2003 the Trail Lakes Hatchery discharge water was monitored for adult sockeye salmon. In 1999, otoliths from 4 sockeye salmon were collected and evaluated. None of the evaluated otoliths were of hatchery origin. CIAA staff continued to monitor the discharge for adult sockeye salmon in 2002 and 2003 and no fish were observed.

From 2003-2005, a small creek on the southeast side of Skilak Lake CIAA sampled sockeye salmon carcasses. During this time, a total of 316 otolith samples were collected from this creek and its surrounding area. Of the samples collected, 309 were readable. None of the evaluated otoliths were of hatchery origin.

In 2010, CIAA collected otoliths from sockeye carcasses along a stretch of the Kenai River starting at the Cooper Landing Bridge to Jim's Landing near Skilak Lake Loop Road. Of 249 adult sockeye carcasses sampled, 168 otoliths were readable. All otoliths were read for a

hatchery induced thermal mark, but none were of hatchery origin. Additionally, CIAA crew surveyed for sockeye carcasses 3 times in September at Jean Lake and Skilak Lake (mouth of Kenai River). The few carcasses found were heavily decomposed and no otoliths could be taken from Jean Lake or Skilak Lake.

In 2011, CIAA in conjunction with USFWS Kenai Field Office collected otoliths from adult sockeye carcasses along a stretch of the Kenai River starting from the boat launch at the Russian River ferry to the confluence of Skilak Lake. Of 424 samples collected, 360 were readable. Of the readable otoliths none were of hatchery origin.

RECOMMENDATIONS

For the 2012 field season, in order to meet a projected adult return of 30,000 adult sockeye to Hidden Creek, CIAA projects 957,299 eggs must be collected to supplement the Hidden Lake return. Impediments to adult fish passage should be monitored during the adult escapement. Cook Inlet Aquaculture Association, Alaska Department of Fish and Game, and United States Fish and Wildlife Service should hold discussions regarding the future of the hatchery sockeye salmon straying study.

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APPENDICES

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Appendix 1. Hidden Lake 2010 – Water quality.

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)	Org C (ug/l)	Chla (ug/l)	Phaeo (ug/l)	EZD (m)
9-Jun	A	1	9.8	7.2	1.1	ND	8.8	6.0	ND :1	3357	260	0.34	0.14	A 21.1
9-Jun	A	13	8.7	5.5	1.3	ND	4.6	4.1	ND :1	3206	220	0.97	0.22	B 18.7
9-Jun	B	1	11.0	6.6	1.4	ND	6.2	4.5	ND :1	3319	255	0.46	0.15	
9-Jun	B	25	8.1	4.8	1.3	ND	6.3	15.5	ND :1	3304	176	1.00	0.36	
9-Jul	A	1	7.0	4.1	1.8	ND	1.9	4.1	ND :1	3078	199	0.84	0.29	A 14.8
9-Jul	A	17	7.1	4.1	1.6	ND	2.2	4.1	ND :1	3203	135	1.69	1.42	B 19.4
9-Jul	B	1	5.8	3.7	1.8	ND	5.0	4.5	ND :1	3143	114	0.72	0.23	
9-Jul	B	30	7.6	4.3	2.2	ND	6.9	5.2	ND :1	3348	126	0.75	0.65	
6-Aug	A	1	6.7	3.6	1.2	ND	5.5	7.6	ND :1	3006	199	0.80	0.24	A 23.9
6-Aug	A	16	7.6	3.5	1.2	ND	6.2	4.1	ND :1	2979	196	0.97	0.36	B 22.3
6-Aug	B	1	6.5	3.6	1.1	ND	3.6	9.2	ND :1	2968	155	0.66	0.20	
6-Aug	B	24	5.9	4.2	1.2	ND	4.6	4.1	ND :1	3238	85	0.36	0.26	
27-Aug	A	1	7.0	3.8	1.5	ND	3.6	12.2	ND :1	2983	164	0.60	0.14	A 19.1
27-Aug	A	16	7.5	3.8	1.4	ND	4.7	11.5	ND :1	3064	179	0.73	0.29	B 22.3
Mean	1 - Meter		7.7	4.7	1.4	ND	4.9	6.9	ND :1	3,122	192	0.63	0.20	Mean 20.2
Min	1 - Meter		5.8	3.6	1.1	ND	1.9	4.1	ND :1	2,968	114	0.34	0.14	Min 14.8
Max	1 - Meter		11.0	7.2	1.8	ND	8.8	12.2	ND :1	3,357	260	0.84	0.29	Max 23.9
Mean	Hypolimnion		7.5	4.3	1.5	ND	5.1	6.9	ND ND	3191.7	160	0.9	0.5	
Min	Hypolimnion		5.9	3.5	1.2	ND	2.2	4.1	ND ND	2979.0	85	0.4	0.2	
Max	Hypolimnion		8.7	5.5	2.2	ND	6.9	15.5	ND ND	3348.0	220	1.7	1.4	

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)
9-Jun	A	1	154	7.4	66.1	0.2	14	22.7	3.5	6	A 7
9-Jun	A	13	155	7.4	66.5	0.2	10	22.8	3.4	7	B 7.5
9-Jun	B	1	153	7.5	66.4	0.3	15	22.8	3.5	9	C 7
9-Jun	B	25	155	7.4	66.1	0.2	12	23.2	3.5	8	A 7
9-Jul	A	1	152	7.5	66.5	1.3	11	23.0	3.8	12	B 7
9-Jul	A	17	154	7.3	65.2	0.3	10	23.2	3.7	10	C 8
9-Jul	B	1	154	7.5	65.6	0.4	12	22.7	3.4	13	A 6.5
9-Jul	B	30	156	7.3	66.4	0.3	10	23.3	3.4	14	B 5.5
6-Aug	A	1	151	7.6	65.5	0.3	11	23.2	3.5	4	C 6.5
6-Aug	A	16	149	7.4	64.6	0.3	9	23.0	3.3	4	A 9
6-Aug	B	1	150	7.3	65.8	0.3	10	23.2	3.1	4	B 9
6-Aug	B	24	154	7.3	65.7	0.3	8	23.6	3.1	4	C 8.5
27-Aug	A	1	150	7.8	64.5	0.2	10	22.4	3.0	3	
27-Aug	A	16	150	7.5	65.3	0.4	9	22.6	3.0	8	
Mean	1 - Meter		154	7.5	65.6	0.2	11	22.9	3.4	7	Mean 7.4
Min	1 - Meter		150	7.3	64.5	0	10	22.4	3.0	3	Min 5.5
Max	1 - Meter		155	7.8	66.5	0	12	23.2	3.7	10	Max 9.0
Mean	Hypolimnion		152	7.5	66.0	1	11	23.0	3.4	8	
Min	Hypolimnion		150	7.3	65.3	0	8	22.6	3.0	4	
Max	Hypolimnion		154	7.5	66.5	1	15	23.6	3.8	12	

Appendix 2. Hidden Lake 2011 – Water quality.

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)	Org C (ug/l)	Chla (ug/l)	Phaeo (ug/l)	EZD (m)
3-Jun	A	1	6.9	3.7	1.1	ND	2.6	4.1	ND :1	3246	180	0.84	0.14	A ND
3-Jun	A	21	12.7	4.2	2.0	ND	1.7	4.1	ND :1	3263	324	2.34	0.39	B ND
3-Jun	B	1	7.2	3.9	1.4	ND	1.7	4.1	ND :1	3432	224	1.13	0.22	
3-Jun	B	25	34.5	4.2	1.8	ND	2.3	4.1	ND :1	3214	573	9.26	2.30	
30-Jun	A	1	6.0	3.5	1.5	ND	2.0	4.1	ND :1	3241	185	0.75	0.13	A 26.9
30-Jun	A	18	8.6	4.0	1.7	ND	3.1	4.1	ND :1	3491	335	3.74	0.00	B 11.2
30-Jun	B	1	5.6	3.6	1.5	ND	2.3	4.1	ND :1	3136	246	0.43	0.10	
30-Jun	B	30	7.7	3.9	1.8	ND	4.1	4.1	ND :1	3123	174	0.88	0.37	
1-Aug	A	1	7.0	4.3	2.5	ND	2.9	14.0	ND :1	2637	213	0.72	0.11	A 29.1
1-Aug	A	13	10.1	3.0	1.5	ND	2.5	9.0	ND :1	2692	187	0.77	0.15	B 28.2
1-Aug	B	1	5.4	2.5	1.3	ND	2.3	12.0	ND :1	2651	176	0.95	0.15	
1-Aug	B	25	9.3	3.7	1.8	ND	7.5	26.0	ND :1	3084	153	0.27	0.12	
8-Sep	A	1	6.9	3.5	2.5	ND	2.6	4.1	ND :1	2547	133	1.03	0.29	A 20.5
8-Sep	A	15	7.3	3.6	2.3	ND	5.2	13.0	ND :1	2536	147	1.08	0.35	B 27.8
8-Sep	B	1	7.2	3.7	2.5	ND	6.5	46.0	ND :1	2501	130	0.97	0.24	
8-Sep	B	20	5.7	3.5	2.5	ND	6.4	35.0	ND :1	2580	110	0.46	0.21	
Mean	1 - Meter		6.5	3.6	1.8	ND	2.9	11.6	ND :1	2,924	186	0.85	0.17	Mean 24.0
Min	1 - Meter		5.4	2.5	1.1	0	1.7	4.1	ND :1	2,501	130	0.43	0.10	Min 11.2
Max	1 - Meter		7.2	4.3	2.5	0	6.5	46.0	ND :1	3,432	246	1.13	0.29	Max 29.1
Mean	Hypolimnion		12.0	3.8	1.9	ND	4.1	12.4	ND :1	2,998	250	2.35	0.49	
Min	Hypolimnion		5.7	3.0	1.5	0	1.7	4.1	ND :1	2,536	110	0.27	0.00	
Max	Hypolimnion		34.5	4.2	2.5	0	7.5	35.0	ND :1	3,491	573	9.26	2.30	

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)
3-Jun	A	1	161	8.1	72.5	0.3	10	22.7	3.2	3	A 7
3-Jun	A	21	163	8.0	73.4	1.0	10	23.0	3.3	54	B 6
3-Jun	B	1	163	8.0	72.7	0.3	10	22.6	3.2	3	C 10
3-Jun	B	25	163	7.9	74.2	2.0	9	23.7	3.2	125	A 7
30-Jun	A	1	162	8.0	71.9	0.3	8	23.1	3.3	3	B 9
30-Jun	A	18	166	7.9	73.5	0.2	8	23.4	3.3	3	C 9
30-Jun	B	1	163	8.1	72.3	0.4	10	23.3	3.4	3	A 8
30-Jun	B	30	168	7.9	74.4	0.2	9	23.0	3.2	3	B 9
1-Aug	A	1	161	8.2	68.8	0.3	11	22.6	3.4	10	C 9
1-Aug	A	13	165	8.1	71.4	0.4	9	22.8	3.3	12	A 8
1-Aug	B	1	164	8.2	70.1	0.2	10	22.4	3.2	6	B 11
1-Aug	B	25	171	7.8	73.4	0.2	8	21.3	4.2	8	
8-Sep	A	1	154	8.0	70.7	0.4	12	21.6	3.7	5	
8-Sep	A	15	154	8.0	70.7	0.3	11	22.0	3.4	9	
8-Sep	B	1	155	8.0	70.7	0.2	12	22.8	3.7	3	
8-Sep	B	20	159	7.8	72.7	0.2	10	23.2	3.6	4	
Mean	1 - Meter		160	8.0	73	0.8	10	22.9	3.4	38	Mean 8.5
Min	1 - Meter		154	7.9	71	0.2	8	21.6	3.2	3	Min 6.0
Max	1 - Meter		166	8.0	74	2.0	12	23.7	3.7	125	Max 11.0
Mean	Hypolimnion		162	7.9	72	0.3	9	22.4	3.5	5	
Min	Hypolimnion		154	7.8	71	0.2	8	21.3	3.2	3	
Max	Hypolimnion		171	8.0	73	0.3	11	23.2	4.2	9	

Appendix 3. Hidden Lake 2011 – Environmental Conditions.

Smolt Migration							Adult Migration						
Date	Sky	Precip. (mm)	Stage (ft)	Flow	Water Temp. (°C)	Air Temp. (°C)	Date	Sky	Precip. (mm)	Stage (ft)	Flow	Water Temp. (°C)	Air Temp. (°C)
24-May	2	0.0	0.43	ND	10	18	16-Jul	2	0.0	0.40	ND	18	20
25-May	2	0.0	0.43	ND	10	11	17-Jul	4	0.0	0.32	ND	16	16
26-May	3	0.0	0.42	ND	9	20	18-Jul	2	52.0	0.48	ND	18	18
27-May	1	0.0	0.42	ND	12	21	19-Jul	3	0.0	0.47	ND	19	23
28-May	5	2.0	0.42	ND	11	16	20-Jul	3	20.0	0.46	ND	19	20
29-May	4	5.0	0.43	ND	11	15	21-Jul	2	0.0	0.44	ND	19	21
30-May	1	0.0	0.42	ND	16	24	22-Jul	1	40.0	0.42	ND	20	24
31-May	4	0.0	0.42	ND	14	18	23-Jul	5	10.0	0.40	ND	16	13
1-Jun	5	8.0	0.42	ND	12	14	24-Jul	5	95.0	0.42	ND	15	12
2-Jun	4	16.0	0.42	ND	12	16	25-Jul	5	70.0	0.40	ND	15	16
3-Jun	4	0.0	0.40	ND	10	14	26-Jul	3	8.0	0.40	ND	16	16
4-Jun	4	1.0	0.40	ND	10	11	27-Jul	3	3.0	0.36	ND	16	17
5-Jun	3	1.0	0.42	ND	11	12	28-Jul	2	0.0	0.46	ND	18	20
6-Jun	3	0.0	0.42	ND	11	14	29-Jul	2	0.0	0.40	ND	19	21
7-Jun	3	0.0	0.40	ND	11	12	30-Jul	3	0.0	0.40	ND	19	22
8-Jun	3	0.0	0.40	ND	12	14	31-Jul	4	0.0	0.36	ND	17	17
9-Jun	3	0.0	0.42	ND	11	13	1-Aug	4	20.0	0.46	ND	17	17
10-Jun	3	0.0	0.42	ND	13	15	2-Aug	4	60.0	0.43	ND	14	15
11-Jun	3	0.0	0.40	ND	12	14	3-Aug	4	0.0	0.46	ND	14	17
12-Jun	3	1.0	0.40	ND	13	15	4-Aug	4	0.0	0.36	ND	17	17
13-Jun	5	6.0	0.41	ND	12	12	5-Aug	2	20.0	0.45	ND	16	15
14-Jun	5	49.0	0.45	ND	11	12	6-Aug	4	2.0	0.54	ND	14	12
15-Jun	5	46.0	0.46	ND	12	12	7-Aug	3	28.0	0.48	ND	19	15
16-Jun	5	5.0	0.49	ND	13	13	8-Aug	5	0.5	0.48	ND	17	14
17-Jun	2	0.0	0.46	ND	17	19	9-Aug	3	1.0	0.48	ND	18	16
18-Jun	3	0.0	0.46	ND	16	18	10-Aug	2	5.0	0.48	ND	18	16
19-Jun	3	13.0	0.47	ND	14	14	11-Aug	3	0.5	0.48	ND	19	19
20-Jun	2	5.0	0.46	ND	15	16	12-Aug	3	0.0	0.48	ND	20	19
21-Jun	3	2.0	0.47	ND	15	16	13-Aug	3	0.4	0.40	ND	17	18
22-Jun	3	0.0	0.47	ND	16	16	14-Aug	2	3.2	0.49	ND	18	15
23-Jun	3	0.0	0.47	ND	18	19	15-Aug	3	6.0	0.50	ND	18	18
24-Jun	2	0.0	0.47	ND	18	22	16-Aug	3	0.5	0.50	ND	20	21
25-Jun	3	3.0	0.46	ND	17	19	17-Aug	4	1.0	0.50	ND	18	16
26-Jun	2	2.0	0.46	ND	17	17	18-Aug	5	6.0	0.50	ND	18	18
27-Jun	3	0.0	0.46	ND	13	14	19-Aug	4	78.0	0.53	ND	18	13
28-Jun	3	10.0	0.46	ND	13	14	20-Aug	4	2.0	0.53	ND	18	14
29-Jun	1	0.0	0.45	ND	17	20	21-Aug	5	10.0	0.50	ND	20	15
30-Jun	2	0.0	0.44	ND	17	18	22-Aug	5	0.7	0.52	ND	19	18
1-Jul	5	0.1	0.44	ND	15	13	23-Aug	4	96.0	0.58	ND	17	11
2-Jul	3	12.5	0.45	ND	16	18	24-Aug	4	7.0	0.57	ND	18	14
3-Jul	3	0.5	0.45	ND	16	17	25-Aug	4	4.0	0.57	ND	18	13
4-Jul	4	1.7	0.45	ND	15	16	26-Aug	2	3.0	0.50	ND	18	18
5-Jul	2	0.2	0.46	ND	17	24	27-Aug	4	0.0	0.48	ND	18	15
6-Jul	2	0.0	0.45	ND	19	19	28-Aug	2	0.0	0.40	ND	19	17
7-Jul	2	0.0	0.45	ND	18	17	29-Aug	2	0.0	0.34	ND	20	19
8-Jul	3	0.0	0.44	ND	19	17	30-Aug	4	0.0	0.51	ND	18	15
9-Jul	3	0.0	0.45	ND	16	17	31-Aug	5	13.0	0.42	ND	18	16
10-Jul	4	0.0	0.46	ND	16	17	1-Sep	3	37.0	0.39	ND	19	15
11-Jul	4	0.0	0.46	ND	17	18	2-Sep	5	6.0	0.34	ND	18	12
12-Jul	4	0.0	0.45	ND	15	16							
13-Jul	4	0.0	0.44	ND	18	18							
Total		190					Total		709				
Avg.		3.7	0.44	ND	14	16	Avg.		14.5	0.45	ND	18	17
Min.		0.0	0.40	ND	9	11	Min.		0.0	0.32	ND	14	11
Max.		49.0	0.49	ND	19	24	Max.		96.0	0.58	ND	20	24

Summary of Cloud Cover - Percent of Days

	No. Days	Meas. Rain	Percent of Days				
			5	4	3	2	1
Smolts	51	43%	14%	20%	41%	20%	6%
Adults	49	69%	18%	31%	27%	22%	2%

1 = Clear
 2 = Cloud Cover <50%
 3 = Cloud Cover >50%
 4 = Overcast
 5 = Rain
 ND = No Data

Appendix 4. Hidden Lake 2011 – Smolt Migration.

Date	Sockeye				Coho				Rainbow		Dolly Varden	
	Daily	Mort.	Total	Fry	Daily	Mort.	Total	Fry	Daily	Total	Daily	Total
23-May	13	0	13	0	98	11	98	128	3	3	0	0
24-May	22	0	35	0	0	3	98	274	0	3	0	0
25-May	44	0	79	0	1	0	99	326	0	3	0	0
26-May	174	0	253	0	14	0	113	0	0	3	0	0
27-May	786	0	1,039	0	52	0	165	0	0	3	1	1
28-May	4,440	0	5,479	0	198	0	363	0	0	3	12	13
29-May	41,227	0	46,706	0	824	0	1,187	0	0	3	10	23
30-May	43,798	0	90,504	0	1,370	0	2,557	0	0	3	30	53
31-May	10,225	0	100,729	0	762	0	3,319	0	3	6	8	61
1-Jun	684	0	101,413	0	120	0	3,439	0	1	7	1	62
2-Jun	15,662	0	117,075	0	1,419	0	4,858	0	0	7	0	62
3-Jun	2,375	0	119,450	0	480	0	5,338	0	10	17	0	62
4-Jun	3,399	0	122,849	0	258	0	5,596	0	0	17	0	62
5-Jun	6,560	0	129,409	0	1,278	0	6,874	0	1	18	3	65
6-Jun	12,071	0	141,480	0	1,537	0	8,411	0	0	18	0	65
7-Jun	2,965	0	144,445	0	387	0	8,798	0	1	19	2	67
8-Jun	7,534	0	151,979	0	260	0	9,058	0	1	20	3	70
9-Jun	28,367	0	180,346	0	843	0	9,901	0	30	50	20	90
10-Jun	15,517	0	195,863	0	1,031	0	10,932	0	0	50	0	90
11-Jun	10,712	0	206,575	0	221	0	11,153	0	1	51	0	90
12-Jun	5,225	0	211,800	0	227	0	11,380	0	0	51	0	90
13-Jun	11,690	0	223,490	0	607	0	11,987	0	0	51	0	90
14-Jun	2,369	0	225,859	0	177	0	12,164	0	0	51	0	90
15-Jun	7,032	0	232,891	0	766	0	12,930	0	3	54	5	95
16-Jun	13,867	0	246,758	0	2,438	0	15,368	0	5	59	8	103
17-Jun	10,001	0	256,759	0	1,126	0	16,494	0	3	62	6	109
18-Jun	4,772	0	261,531	0	532	0	17,026	0	1	63	3	112
19-Jun	3,369	0	264,900	0	524	0	17,550	0	0	63	0	112
20-Jun	2,801	0	267,701	0	111	0	17,661	0	1	64	1	113
21-Jun	3,099	0	270,800	0	309	0	17,970	0	2	66	9	122
22-Jun	2,447	0	273,247	0	361	0	18,331	0	1	67	2	124
23-Jun	2,799	0	276,046	0	255	0	18,586	0	2	69	1	125
24-Jun	2,050	0	278,096	0	119	0	18,705	0	2	71	1	126
25-Jun	1,847	0	279,943	0	157	0	18,862	0	1	72	1	127
26-Jun	1,375	0	281,318	0	72	0	18,934	0	0	72	0	127
27-Jun	1,285	0	282,603	0	33	0	18,967	0	0	72	0	127
28-Jun	939	0	283,542	0	58	0	19,025	0	0	72	0	127
29-Jun	2,440	0	285,982	0	204	0	19,229	0	2	74	4	131
30-Jun	2,411	0	288,393	0	362	0	19,591	0	0	74	3	134
1-Jul	2,136	0	290,529	0	774	0	20,365	0	1	75	3	137
2-Jul	1,422	50	292,001	0	391	0	20,756	0	1	76	6	143
3-Jul	1,964	0	293,965	0	614	0	21,370	0	0	76	4	147
4-Jul	1,042	0	295,007	0	341	0	21,711	0	0	76	2	149
5-Jul	1,268	0	296,275	0	360	0	22,071	0	9	85	3	152
6-Jul	1,012	0	297,287	0	411	0	22,482	0	3	88	10	162
7-Jul	894	0	298,181	0	173	0	22,655	0	1	89	2	164
8-Jul	545	0	298,726	0	105	0	22,760	0	0	89	1	165
9-Jul	267	0	298,993	0	69	0	22,829	0	0	89	0	165
10-Jul	149	0	299,142	0	34	0	22,863	0	0	89	0	165
11-Jul	106	0	299,248	0	20	0	22,883	0	0	89	0	165
12-Jul	46	0	299,294	0	9	0	22,892	0	0	89	0	165
13-Jul	54	0	299,348	0	19	0	22,911	0	0	89	0	165
Total	299,298	50	299,348	0	22,911	14	22,925	728		89		165

Appendix 5. Hidden Lake 2011 – Adult Migration.

Date	Sockeye				Lures	Coho		King		Pink		Chum		Rainbow		Dolly Varden	
	Daily	Mort.	Otolith	Total		Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total
16-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Jul	69	0	0	69	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jul	0	0	0	69	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jul	58	0	0	127	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jul	90	0	0	217	0	0	0	0	0	0	0	0	1	1	0	0	0
29-Jul	523	0	0	740	0	0	0	0	0	0	0	0	0	1	1	0	0
30-Jul	202	0	0	942	0	0	0	0	0	0	0	0	0	1	1	0	0
31-Jul	1,515	0	0	2,457	0	0	0	0	0	0	0	0	0	1	1	0	0
1-Aug	607	0	0	3,064	0	0	0	0	0	0	0	0	0	1	1	0	0
2-Aug	154	0	0	3,218	0	0	0	0	0	0	0	0	0	1	1	0	0
3-Aug	2,794	0	210	6,012	0	0	0	0	0	0	0	0	0	1	1	0	0
4-Aug	1	0	0	6,013	0	0	0	0	0	0	0	0	0	1	1	0	0
5-Aug	148	0	0	6,161	0	0	0	0	0	0	0	0	0	1	1	0	0
6-Aug	347	0	0	6,508	0	0	0	0	0	0	0	0	0	1	1	0	0
7-Aug	1,157	0	0	7,665	0	0	0	0	0	0	0	0	0	1	1	0	0
8-Aug	0	0	0	7,665	0	0	0	0	0	0	0	0	0	1	1	0	0
9-Aug	190	0	0	7,855	0	0	0	0	0	0	0	0	0	1	1	0	0
10-Aug	4	0	0	7,859	0	0	0	0	0	0	0	0	0	1	1	0	0
11-Aug	133	0	0	7,992	0	0	0	0	0	0	0	0	0	1	1	0	0
12-Aug	16	0	0	8,008	0	0	0	0	0	0	0	0	0	1	1	0	0
13-Aug	4,058	0	200	12,066	0	0	0	0	0	0	0	0	0	1	1	0	0
14-Aug	363	0	0	12,429	0	0	0	0	0	0	0	0	0	1	1	0	0
15-Aug	83	0	0	12,512	0	0	0	0	0	0	0	0	0	1	1	0	0
16-Aug	4	0	0	12,516	0	0	0	0	0	0	0	0	0	1	1	0	0
17-Aug	4	0	0	12,520	0	0	0	0	0	0	0	0	0	1	1	0	0
18-Aug	28	0	0	12,548	0	0	0	0	0	0	0	0	0	1	1	0	0
19-Aug	154	0	0	12,702	0	0	0	0	0	0	0	0	0	1	1	0	0
20-Aug	0	0	0	12,702	0	0	0	0	0	0	0	0	0	1	1	0	0
21-Aug	3,154	0	0	15,856	0	1	1	0	0	0	0	0	0	1	1	0	0
22-Aug	0	0	0	15,856	0	0	1	0	0	0	0	0	0	1	1	0	0
23-Aug	0	0	0	15,856	0	0	1	0	0	0	0	0	0	1	1	0	0
24-Aug	235	0	0	16,091	0	0	1	0	0	0	0	0	0	1	1	0	0
25-Aug	0	0	0	16,091	0	0	1	0	0	0	0	0	0	1	1	0	0
26-Aug	24	0	0	16,115	0	1	2	0	0	0	0	0	0	1	1	0	0
27-Aug	0	0	0	16,115	0	0	2	0	0	0	0	0	0	1	1	0	0
28-Aug	0	0	0	16,115	0	0	2	0	0	0	0	0	0	1	1	0	0
29-Aug	0	0	0	16,115	0	0	2	0	0	0	0	0	0	1	1	0	0
30-Aug	1,411	0	200	17,526	0	0	2	0	0	0	0	0	0	1	1	0	0
31-Aug	162	0	0	17,688	0	0	2	0	0	0	0	0	0	1	1	0	0
1-Sep	83	0	0	17,771	0	0	2	0	0	0	0	0	0	1	1	0	0
Total	17,771	0	610	17,771	0	2		0		0		0		1		0	

Appendix 6. Hidden Lake adult sockeye salmon escapement sex ratio and size data, 2011.

	Age Group					Total
	1.1.	1.2	1.3	2.2	2.3	
Males	0	6,911	682	682	76	8,352
Percent	0.00%	38.89%	3.84%	3.84%	0.43%	47%
Sample Size	0	91	9	9	1	110
Mean Lth (mm)	-	511	566	520	560	517
Std. Error	-	5	5	6	-	4
Females	76	7,976	759	608		9,419
Percent	0.43%	44.88%	4.27%	3.42%	0.00%	53%
Sample Size	1	105	10	8	0	124
Mean Lth (mm)	380	501	528	506	-	502
Std. Error	-	3	12	9	-	2
Both Sexes	76	14,887	1,441	1,290	76	17,771
Percent	0.43%	83.77%	8.11%	7.26%	0.43%	100%
Sample Size	1	196	19	61	1	234
Mean Lth (mm)	380	506	546	496	560	509
Std. Error	-	3	7	1	-	2

Appendix 7. Summary of Hidden Lake enhanced adult sockeye straying in Kenai River system, 1999-2011.

		Lower Russian River ADF&G Weir Site											
Age Class	8/3/99	8/10/99	8/20/99	7/28/00	8/2/00	8/17/00	8/1/01	8/9/01	8/23/01	7/30/02	8/14/02	8/23/02	
1.2	5	5	10	8	4	3	20	9	8	31	16	18	
1.3	1	1	1	47	10	10	34	13	2	12	8	23	
2.1	0	1	20	0	73	0	17	81	118	0	0	0	
2.2	157	155	141	50	73	39	61	57	32	106	117	98	
2.3	11	5	1	65	37	33	39	11	9	14	30	36	
2.4	0	0	0	0	0	0	0	0	0	0	0	0	
3.1	0	0	2	0	0	0	1	1	3	0	0	0	
3.2	0	0	0	0	0	0	0	1	0	0	0	0	
3.3	0	0	0	0	0	0	0	0	0	0	0	0	
NR	1	8	1	0	0	0	1	0	1	3	4	0	
NS	0	0	0	2	0	3	0	0	0	9	0	0	
Total Sample	175	175	176	172	197	88	173	173	173	175	175	175	
Hatchery %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Total	2,119												

NR=Non Readable

NS=No Sample

		Skilak Lake small creek on SE side		
Age Class	Jun-05	Sep-04	Sep-05	
1.2	21	0	0	
1.3	23	32	0	
2.1	0	0	0	
2.2	0	9	0	
2.3	8	68	0	
2.4	0	0	0	
3.1	0	0	0	
3.2	0	0	0	
3.3	0	0	0	
NR	0	0	6	
NS	1	0	0	
No. Samples	53	109	6	
Hatchery %	0%	0%	0%	
Total	316			

NR=Non Readable

NS=No Sample

		Kenai River		
Age Class	Cooper LDG to Jim's LDG	Russian River (Sportsman's Lnd) to Jim's LDG	Jim's LDG to Skilak Confluence	
	*9/3/2010	9/21/2011	9/21/2011	
1.2	10	2	1	
1.3	91	25	15	
2.1	0	0	0	
2.2	30	10	5	
2.3	37	191	99	
2.4	0	0	2	
3.1	0	0	0	
3.2	0	1	0	
3.3	0	4	5	
NR	0	4	0	
NS	0	30	30	
No. Samples	168	267	157	
Hatchery %	0%	0%	0%	
Total	592			

NR=Non Readable

NS=No Sample

*Sept. 2010 - CIAA also searched for carcasses at Jean Lake and Skilak Lake (mouth of Kenai River), none were recoverable.

Appendix 8. Hidden Lake 2011 - Update.

Stocking & Misc. Activities			
Ice-out:	NA	(approximate date)	
Smolt crew on-site:	23-May		
Smolt crew off-site:	13-Jul		
Adult crew on-site:	16-Jul		
Adult crew off-site:	11-Sep		
Fry stocking:	28-May		
Adult Otolith Collection	3-Aug	13-Aug	30-Aug

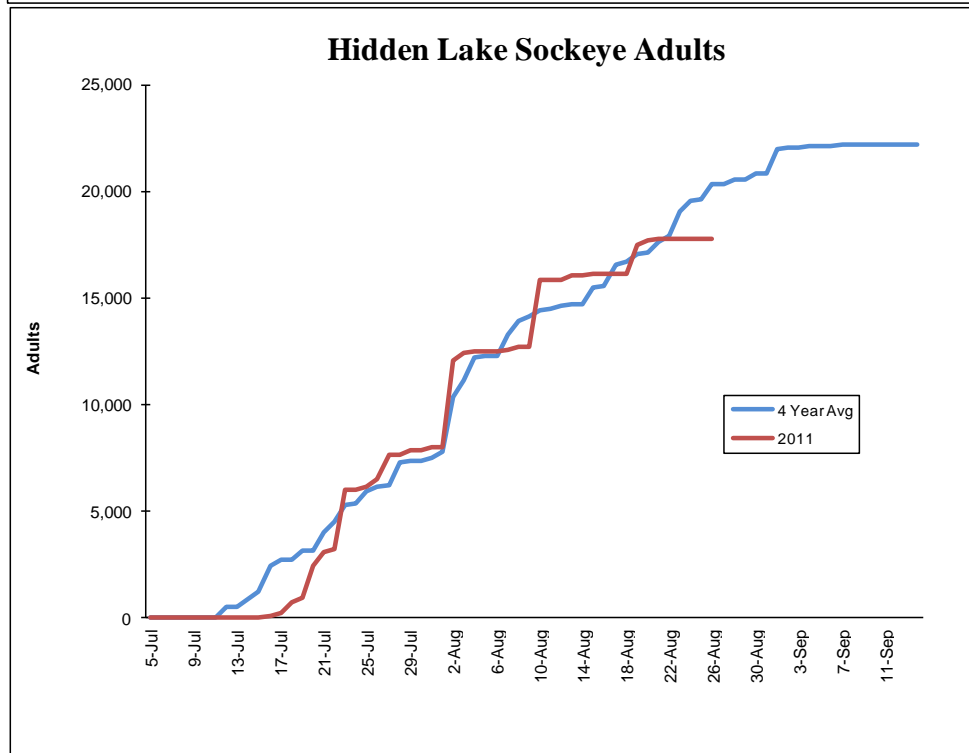
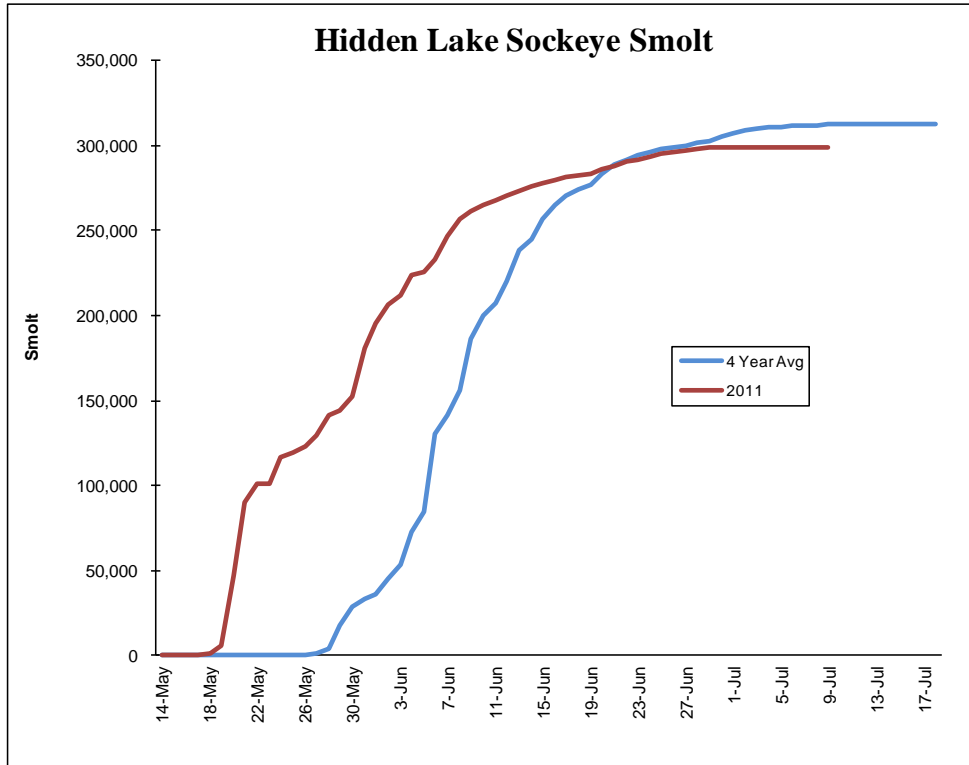
Smolt Migration			
Dates:	23-May	to	16-Jul
		No.	%
Sockeyes:		299,348	
Mortalities:		50	0.02%
Age 1:		208,439	70%
Age 2:		90,909	30%
Hatchery:		141,638	47%
Coho:		22,925	
Dolly Varden:		165	
Rainbow:		89	

Egg Take			
Dates:	20-Sep	to	21-Sep
		No. Female	No. Male
No. of broodstock used:		456	448
Green eggs:		1,119,538	
Fecundity:		2,516	
Eyed eggs:		981,259	
Survival		88%	

Adult Migration			
Dates:	16-Jul	to	1-Sep
		No.	%
Sockeye total return:		37,479	
Hidden Creek return:		17,771	47.4%
Commercial Harvest:*		13,931	37.2%
Personal Use/Sport Fish Harvest:*		5,167	13.8%
Otolith Collection:		610	
Lake otolith collection:		0	
Mortalities:		0	
Lake Escapement:			
Hatchery broodstock:		904	
Lake broodstock:		16,867	
Lures:		-	
Coho:		2	

* Commercial, sportfish and personal use harvests provided by ADF & G.

Appendix 8. Hidden Lake 2011 – Update (Continued).



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