

**Hidden Lake  
Sockeye Salmon Enhancement  
Progress Report  
2005**

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**This year's operation of 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 and through a grant from the Southeast Sustainable Salmon Fund received from the National Oceanic and Atmospheric Administration.**

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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 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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## **ACKNOWLEDGEMENTS**

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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. The Cook Inlet Aquaculture Association (CIAA) began assisting ADF&G in the enhancement project in 1988; and, since 1991, has completed all the field activities.

On 16 June 2005, an estimated 573,000 unfed sockeye fry were released into Hidden Lake. All 573,000 fry were released at the west end of the lake and all the released fish were otolith marked.

During 2005, smolt migration monitoring began on 18 May and continued daily until 26 June. During this time an estimated 290,387 sockeye (*O. nerka*) and 41,627 coho (*O. kisutch*) smolts migrated from the lake.

Based on otolith marks, 75.7% ( $\pm 2.6\%$ ) of the migrating sockeye smolts were enhanced. An estimated 91.0% ( $\pm 1.8\%$ ) were age 1 and 9.0% ( $\pm 1.9\%$ ) were age 2. The average length and weight of the age 1 sockeye smolts was 140 mm ( $\pm 0.5$  mm) and 24.7 g ( $\pm 2.0$  g). The age 2 sockeye smolts were 179 mm ( $\pm 3.6$  mm) and 60.5 g ( $\pm 3.7$  g).

Of the migrating coho smolts, an estimated 3.1% ( $\pm 2.6\%$ ) were age 1 and 96.9% ( $\pm 2.6\%$ ) were age 2. The average length and weight of the age 1 coho smolts was 127 mm ( $\pm 4.4$  mm) and 20.6 g ( $\pm 2.2$  g). The age 2 coho smolts were 140 mm ( $\pm 0.8$  mm) and 29.8 g ( $\pm 7.5$  g).

Adult sockeye salmon escapement was monitored from 15 July to 18 September 2005. During this time an estimated 13,000 adult sockeye salmon returned to Hidden Creek. The percentage of adult male and adult female fish was 59.0% and 41.0%, respectively. Male fish averaged 533 mm (21.0 in) in length and the females averaged 501 mm (19.7 in). Scale samples were collected, however the samples were damaged and age composition was unable to be determined.

Otolith samples were not collected from fish returning to the weir on Hidden Creek. Otolith samples were collected from sockeye salmon returning to a small creek at the East end of Skilak Lake. None of the fish returning to the creek were marked and no fish were observed at the Trail Lakes Hatchery discharge.

Between 21 September and 11 October 2005, 2.027 million eggs were collected and shipped to Trail Lakes Hatchery for fertilization and incubation. An estimated 1.642 million eggs (81.0%) have survived to the eyed stage.

Water chemistry and zooplankton samples were collected 4 times during 2005. However, analyses have not yet been completed.

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## 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 (Bill, et al. 1972; Barton and Barrett, 1973). Based on these investigations it appeared that Hidden Lake had the potential for increased production of sockeye salmon (*Oncorhynchus nerka*).

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, et al. 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 (Kyle, et al. 1990). 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 that 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 enhanced 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 maximum production of adult fish while maintaining the fry-rearing environment. An average adult sockeye escapement of 30,000 fish was considered an appropriate management objective and could be accomplished by the following goals:

1. Annually collecting up to 2.3 million eggs and releasing up to 2 million sockeye fry to the lake;
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. Since 1989, CIAA, with assistance from ADF&G, also conducted the smolt migration and adult escapement monitoring; beginning in 1991, CIAA 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 a technical review of the Hidden Lake Sockeye Salmon Enhancement Project (Simpson and Edmundson, 1999). Concerns arose regarding the amount of sockeye salmon entering Hidden Lake. In 2000, CIAA took steps to alleviate 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.



## 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).

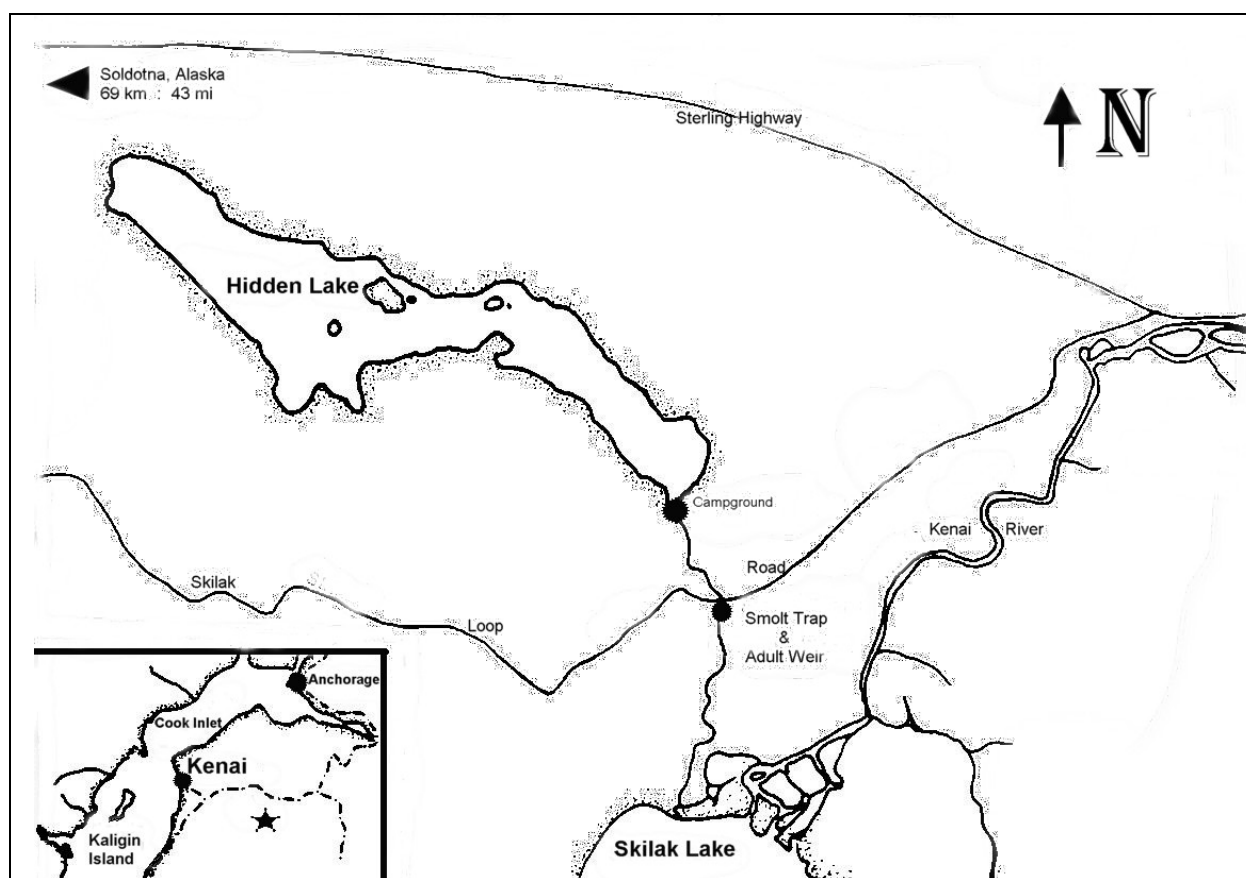


Figure 1. Area Map of Hidden Lake, Kenai Peninsula, Southcentral Alaska.

Hidden Lake (Figure 2) is steep sided with two major basins. It has a surface area of 6.8 km<sup>2</sup>, a mean depth of 20.1 m, a maximum depth of 45.1 m, and a volume of 138.1 X 10<sup>6</sup> m<sup>3</sup>. 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.

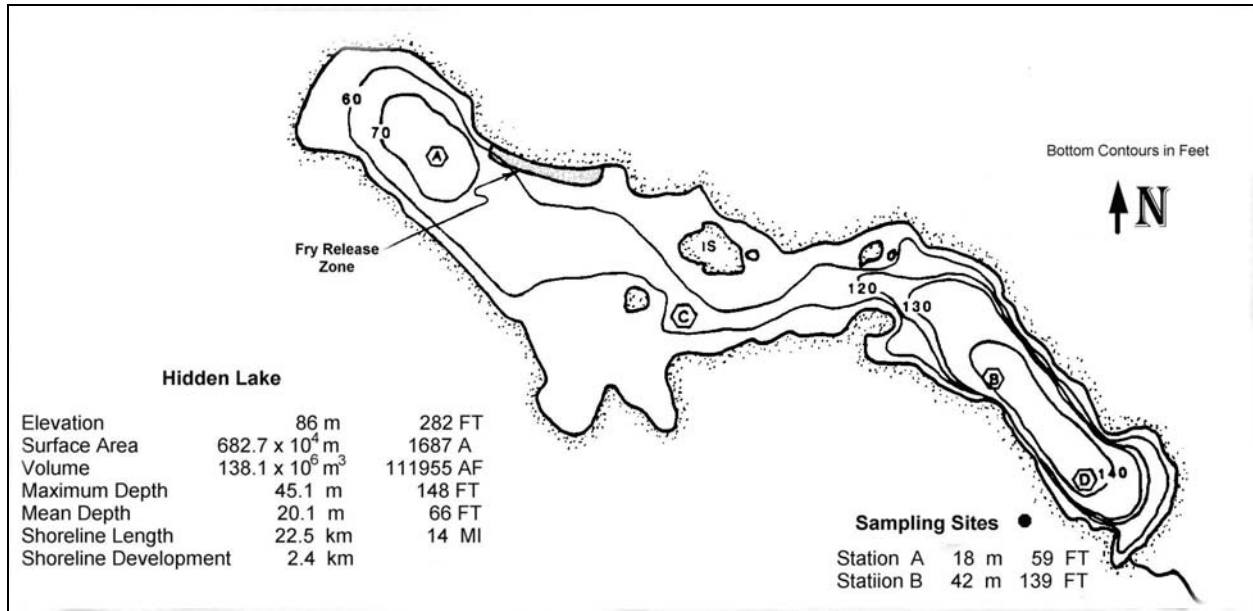


Figure 2. Morphometric map of Hidden lake showing the two major basins.

The lake's watershed area is  $37.4 \text{ km}^2$  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  $7 \mu\text{g/l}$ , the total nitrogen concentration is  $178 \mu\text{g/l}$  and the chlorophyll *a* concentration is  $0.6 \mu\text{g/l}$ . Based on these concentrations, Hidden Lake is considered an oligotrophic-mesotrophic system (Kyle, et al. 1990).

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. Fish present in the lake include five species of Pacific salmon (*O. nerka*, *O. kisutch*, *O. tshawytscha*, *O. gorbuscha*, and *O. mykiss*), lake trout (*Salvelinus namaycush*), Dolly Varden char (*S. malma*), threespine stickleback (*Gasterosteus aculeatus*), and coastrange sculpin (*Cottus aleuticus*) (Kyle, et al. 1990).

## **METHODS**

In general, Hidden 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 2005, water quality samples were collected four times during the open water season from May through October. Two primary sites (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, two secondary sites were also sampled (Figure 2). Measurements at the secondary sites were limited to the zooplankton community and Secchi disk transparency.

Water samples were collected by CIAA. Sample collection procedures are described by Koenings, et al. (1986). Water analysis has historically been completed by ADF&G, since their limnology lab has closed, analysis has not been completed.

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.

### **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 smolts into the live-box. A swing gate remotely controlled by the trap operators directed smolts into one of two live-box compartments where they were counted and released downstream, momentarily held for a sub-sample count, or passed through the trap system uncounted.

Total counts of smolts migrating from Hidden Lake were 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 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 counted. During the remaining 18 minutes, migrating smolts passed through the trap uncounted. To estimate the number of smolts 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-sampling<sup>1</sup> and smolts 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, 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.

In 2005, migrating smolts were enumerated from 18 May through 26 June. The 10% sub-sampling procedure was used to enumerate 33% of the sockeye smolt and 13% of the coho smolt migrating in 2005.

A detailed description of smolt enumeration procedures is available in CIAA's Hidden Lake Enhancement Project procedure manual (CIAA, 2002).

### **Smolt Characteristics and Enhanced Contribution**

CIAA has released sockeye salmon fry to Hidden Lake since 1989. To evaluate this enhancement procedure, CIAA collects a sample of the sockeye and coho smolts migrating each year to determine age, weight, and length characteristics of the migrating populations.

Since 1991, CIAA has marked the otolith of all salmon fry released to Hidden Lake with a thermal mark<sup>2</sup>. The purpose of this mark is to determine the contribution of released fish to the smolt population. In 2005, the otoliths of sockeye smolts collected for age, weight and length measurements were removed and checked for a thermal mark. Otoliths were not collected from migrating coho smolts.

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<sup>1</sup> Predetermined random 2-minute sampling intervals assured random distribution within each 20-minute period.

In 2005, smolts collected for measurement and otolith removal were sampled in proportion to the daily smolt migration. This was accomplished by collecting approximately every 250<sup>th</sup> sockeye smolt and every approximately 60<sup>th</sup> 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. Age, weight and length measurements were made on and otoliths removed from 1,094 sockeye smolts. Age, weight and length measurements were made on 681 coho smolts.

Each smolt collected for evaluation was first measured to the nearest millimeter for fork length<sup>3</sup> and then weighed to the nearest 0.1 gram. Several scales were also removed from the primary growth area<sup>4</sup> and mounted on a glass slide for subsequent age determination. The otoliths were then removed and placed in a labeled one-dram vial. A dilute ethanol solution was added to the vial to cover the otoliths.

After the smolt migration was complete, the otoliths were shipped to Trail Lakes Hatchery. Staff at Trail Lakes Hatchery processed the otoliths and checked each for a hatchery mark following procedures described by Glick and Shields (1993). Field staff collected 1,094 pairs of sockeye, of which 1,051 were readable.

Sockeye smolt characteristics, the proportion of enhanced sockeye smolt and the proportion of age 1 and 2 sockeye smolt in the migrating population, were estimated with the following notations and formulas provided by ADF&G.

If:

$N$  = total number of migrating smolts,

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

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<sup>2</sup>The otolith mark is a hatchery induced thermal band produced by controlled temperature changes during incubation.

<sup>3</sup>Standard fork length was measured from the tip of the snout to the fork of the tail.

<sup>4</sup>The primary growth area is located above the lateral line on a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin.

$n$  = total number of smolts sampled,

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

$a$  = total number of enhanced smolts sampled,

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

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

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

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

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

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

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

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

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

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

Then, the proportion of enhanced smolts,  $\hat{P}$ , 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 enhanced smolts,  $\hat{A}$ , 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 =  $i$  smolts 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 =  $i$  smolts 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 Escapement**

Each year CIAA enumerates the escapement of adult fish to Hidden Lake. The escapement enumeration includes an assessment of the sex, age, and standard fork length<sup>5</sup> of the returning population of fish. To determine the proportion of enhanced fish in the adult population, CIAA has, in the past, collected otolith samples from returning fish. However, in 2005, it was decided that fish were not to be sacrificed for otolith collection when return numbers to the weir were extremely lower than expected.

To enumerate returning salmon, sample and collect sex, age, and length information, a “V” shaped adult counting weir was temporarily installed in Hidden Creek. The weir was 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.

By removing one or two pickets fish were permitted to pass through the weir. Field personnel counted the adult fish as they ascended Hidden Creek. Initially counts were made at least twice a day. As the number of fish ascending Hidden Creek increased, counts were made more frequently to prevent fish from accumulating behind the weir.

In 2005, adult escapement was monitored from 15 July to 18 September. After 18 September, the adult migration appeared complete and the counting weir was removed.

In 2005, it was assumed 29,206 adult fish would return to Hidden Creek during a six week period from 15 July to 25 August. Based on this assumption, it was calculated that 120 fish needed to be collected every 6<sup>th</sup> day to secure a sample size adequate to assess the enhanced proportion, of the returning fish. To obtain an adequate sample size for determining age, sex, and size, a daily sample was taken on approximately every 50<sup>th</sup> fish counted upstream. However, the adult return was less than projected and a hole was detected in the weir on 11 August, thus fewer fish were collected for measurement than was expected.

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<sup>5</sup>Standard fork length was defined as the measurement from mideye to the fork of the tail.

In 2005, no otolith samples were collected and 140 adult sockeye salmon were sampled for age, length and weight.

A detailed description of adult escapement enumeration procedures is available in the Hidden Lake Enhancement Project procedure manual (CIAA, 2002).

### **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. To date, a total of 67,015,000 eggs have been collected for incubation at Crooked Creek, Big Lake and Trail Lakes Hatcheries. The annual gamete collections conducted since 1976 are summarized in Table 1.

In 2005, male and female adult sockeye salmon in spawning areas were collected by beach seine and artificially spawned. Gametes were collected, transported and fertilized using a delayed fertilization technique. Gamete collection procedures are described in CIAA's "Egg-Take Procedures" manual (CIAA, 1993b).

Between 21 September and 11 October 2005, 2.027 million eggs were collected from 1,045 female salmon and shipped to Trail Lakes Hatchery for fertilization. Mixing the eggs from each female with a portion of the milt from eight to ten males and then activating the sperm with a 0.7% saline solution completed fertilization. An estimated 1.642 million eggs (81.0%) have survived to the eyed stage.

The sockeye eggs collected in 2005 are currently being incubated at Trail Lakes Hatchery. Incubation will follow standard hatchery procedures (Wilson and Hetrick, 1992) and water temperature will be regulated to thermally mark the otoliths of fish scheduled for release in 2006.

Table 1. Summary of sockeye salmon gamete collection and fry releases at Hidden Lake, 1976 - 2005.

Brood Year	No. eggs taken	No. females used	Fecundity	Receiving hatchery	No. fry released	Egg-to-fry survival (%)	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	Fry-to-smolt survival (%)
1976	832,880	274	3,091	Crooked Cr.	330,228	39.6	58,800	17.8				
1977	406,878	200		Big L.	308,704	75.9	40,600	13.2				
1978	311,808	100	3,118	Crooked Cr.	8,258	2.7						
1979												
1980												
1981												
1982	1,579,188	576	2,741	Trail L.	1,086,000	68.8	231,300	21.3				
1983	1,928,000	639	3,017	Trail L.	1,236,900	64.2	289,100	23.4				
1984	3,766,000	1,310	2,875	Trail L.	1,805,792	47.9						
1985	7,019,000	2,330	3,012	Trail L.	0							
1986	4,740,000	1,580	3,000	Trail L.	3,718,311	78.5						
1987	7,000,184	2,434	2,876	Trail L.	6,085,307	86.9						
1988	2,718,853	891	3,046	Trail L.	2,470,012	91.0	194,400	7.9				
1989	2,220,467	647	2,669	Trail L.	1,747,900	79.0	203,800	11.7				
1990	2,189,000	956	2,290	Trail L.	1,600,000	64.6	214,100	13.4				
1991	2,652,000	1,119	2,370	Trail L.	1,716,000	64.7	330,200	19.2				
1992	2,293,000	1,007	2,277	Trail L.	1,901,000	82.9	365,300	19.2				
1993	2,200,000	934	2,355	Trail L.	1,800,000	81.8	195,000	10.8				
1994	2,156,000	1,017	2,120	Trail L.	1,700,000	78.8	326,600	19.2				
1995	1,893,000	849	2,230	Trail L.	1,600,000	84.5	184,700	11.5				
1996	2,048,000	817	2,507	Trail L.	1,501,000	73.3	305,300	20.3				
1997	2,166,000	936	2,314	Trail L.	1,035,000	47.8	182,900	17.7				
1998	2,303,000	859	2,681	Trail L.	1,507,100	65.4	352,300	23.4				
1999	2,297,000	954	2,408	Trail L.	1,242,000	54.1	284,200	22.9				
2000	1,486,000	607	2,448	Trail L.	905,500	60.9	218,000	24.1				
2001	1,326,000	504	2,631	Trail L.	980,200	73.9	249,200	25.4				
2002	1,118,000	433	2,582	Trail L.	628,900	56.3	59,974	9.5				
2003*	893,000	371	2,407	Trail L.	646,000	89.4	264,133	40.9		152,000	92,200	60.7
2004**	5,445,000	2,045	2,663	Trail L.	573,000	89.5			4,126,000	174,000		
2005	2,027,000	1,045	1,940	Trail L.								
Total	67,015,000	25,434			38,133,000		4,286,000					
Mean			2,441		1,385,507	72.8	245,632	18.6				

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.

The number of smolt produced was derived from the recovery of marked fish.

\*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

incomplete broodyear

## Fish Transport and Stocking

Approximately 573,000 of the 4,917,000 sockeye salmon fry produced from gametes collected from Hidden Lake in 2004 were released to Hidden Lake on 6 June 2005. The unfed fry 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 the fry appeared healthy at the time of release. 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: 3, 3H; Rbr 1:1.3, 2.3]. Otoliths samples were processed to document the marks and are on file at CIAA Headquarters.

Approximately 4,126,000 fry were released to Leisure, Hazel and Kirschner Lakes. All fish were thermally marked with the same bands as those released to Hidden Lake.

The remaining, 174,000 fry are being held at Trail Lakes Hatchery to be released in 2006 at Tutka Bay Lagoon.

Since 1977, over 38.1 million fry have been released to Hidden Lake (Table 1).

## **RESULTS AND DISCUSSION**

### **Limnology and Environmental Conditions**

Hidden Lake limnological characteristics have been monitored for several years. Water chemistry and zooplankton samples from 2005 have not been analyzed (Table 2).

Environmental conditions during the Hidden Lake smolt migration were monitored from 18 May to 26 June 2005. Stream stage measurements averaged 0.12 feet and ranged from 0.00 to 0.18 feet. During the period of smolt migration, stream temperatures averaged 12.6°C and ranged from 8 to 19°C. Air temperatures averaged 16.8°C and ranged from 12 to 25°C. Fifty-Three percent of the days were partly cloudy, 40% were completely overcast, and 7% clear days were recorded. Rain was recorded on 1 day during the smolt migration. A total of 2 mm of rain fell during this period (Appendix 2).

Environmental conditions during the Hidden Lake adult sockeye migration were monitored from 15 July to 18 September 2005. Stream stage measurement data was incomplete.. Stream temperatures averaged 16.1°C and ranged from 12.0 to 22.0°C and air temperatures averaged 16.4°C and ranged from 10.0 to 26.0°C. Seventeen percent of the days were clear, 41% were partly cloudy, and 42% were completely overcast. Rain was recorded on 30 of the days during the adult migration. A total of 99 mm of rain fell during this period (Appendix 2).

Table 2. Average open water season water quality characteristics of Hidden Lake

<b>NO DATA</b>
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### **Smolt Enumeration**

In general, the pattern of the 2005 Hidden Lake sockeye smolt migration seemed to have two distinct peaks – dissimilar to previous smolt migrations. Additionally, the migration appeared to begin and peak earlier than in previous years. The peak of the 2005 smolt migration occurred about 24 and 25 May and again between 1 and 3 June.

One thousand five hundred eight moribund or dead sockeye smolts were observed during the 2005 smolt migration. A majority of the mortality occurred prior to the fish entering the trap.

Not considering the 1,508 sockeye smolts lost during enumeration, the final 2005 Hidden Creek sockeye smolt migration was estimated at 290,387 ( $\pm 15,500$ ). Other fish counted included 41,627 ( $\pm 15,300$ ) coho smolts (Appendix 3).

### **Smolt Characteristics and Enhanced Contribution**

In 2005, characteristics of the smolt migration were evaluated from scale samples collected throughout the migration and from measurements of length and weight. Based on these samples and measurements, an estimated 91.0% ( $\pm 2.6\%$ ) of the sockeye smolts were age 1 and 9.0% ( $\pm 1.9\%$ ) were age 2. The average length and weight of the age 1 sockeye smolts was 140 mm

( $\pm 0.5$  mm) and 24.7 g ( $\pm 2.0$  g). The age 2 sockeye smolts were 179 mm ( $\pm 3.6$  mm) and 60.5 g ( $\pm 3.7$ g). There were no age 3 smolts (Table 3).

Of the migrating coho smolts, an estimated 3.1% ( $\pm 2.6\%$ ) were age 1 and 96.9% ( $\pm 2.6\%$ ) were age 2. There were no age 3 smolts. The average length and weight of the age 1 coho smolts was 127 mm ( $\pm 4.4$  mm) and 20.6 g ( $\pm 2.2$  g) and the age 2 coho smolts were 140 mm ( $\pm 0.8$  mm) and 29.8 g ( $\pm 7.5$  g).

The age structure, average length, and weight measurements of the sockeye smolts were similar to previous sockeye smolt migrations. Although average length and weight measurements of the coho smolts were similar to previous years, the age structure showed age-2 smolts to be the dominate age class of the coho smolt migration

Table 3. Age structure, length and weight characteristics of Hidden Lake sockeye smolt, 1976 - 2005.

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	( $\pm 2.1$ )	5	( $\pm 2.1$ )	135	( $\pm 0.5$ )	190	( $\pm 4.5$ )	19.1	( $\pm 0.3$ )	59.4	( $\pm 6.5$ )
1997	96	( $\pm 2.7$ )	4	( $\pm 2.7$ )	123	( $\pm 0.6$ )	190	( $\pm 15.9$ )	15.9	( $\pm 0.3$ )	72.7	( $\pm 19.7$ )
1998	91	( $\pm 2.9$ )	9	( $\pm 2.9$ )	129	( $\pm 0.7$ )	203	( $\pm 5.8$ )	20.0	( $\pm 0.4$ )	82.3	( $\pm 6.5$ )
1999	86	( $\pm 3.6$ )	14	( $\pm 3.6$ )	132	( $\pm 0.6$ )	173	( $\pm 5.1$ )	23.0	( $\pm 0.3$ )	51.1	( $\pm 4.8$ )
2000	93	( $\pm 2.2$ )	8	( $\pm 2.2$ )	138	( $\pm 0.5$ )	182	( $\pm 7.3$ )	25.0	( $\pm 0.3$ )	64.0	( $\pm 7.8$ )
2001	94	( $\pm 2.6$ )	6	( $\pm 2.5$ )	134	( $\pm 0.5$ )	165	( $\pm 8.6$ )	22.3	( $\pm 0.3$ )	45.0	( $\pm 8.0$ )
2002	86	( $\pm 2.2$ )	13	( $\pm 2.2$ )	134	( $\pm 0.8$ )	165	( $\pm 6.0$ )	22.2	( $\pm 0.4$ )	45.0	( $\pm 4.8$ )
2003	94	( $\pm 2.2$ )	6	( $\pm 2.2$ )	140	( $\pm 0.5$ )	179	( $\pm 0.8$ )	24.7	( $\pm 0.2$ )	60.5	( $\pm 6.5$ )
2004	64	( $\pm 3.7$ )	36	( $\pm 3.7$ )	140	( $\pm 0.8$ )	179	( $\pm 3.6$ )	24.7	( $\pm 0.8$ )	60.5	( $\pm 3.7$ )
2005	91	( $\pm 1.8$ )	9	( $\pm 1.9$ )	140	( $\pm 0.5$ )	179	( $\pm 3.6$ )	24.7	( $\pm 2.0$ )	60.5	( $\pm 3.7$ )
Mean	90		10		136		181		21.7		57.4	

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

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, et al. 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 smolts between wild and enhanced fish since 1993. In 2005, the proportion of hatchery-incubated salmon in the sockeye smolt migration was 75.7% ( $\pm 2.6\%$ ) (Table 4). This proportion is similar to previous estimates of the hatchery contribution based on otolith thermal marks.

Table 4. The contribution of enhanced sockeye to the Hidden Lake smolt migrations, 1976 - 2005.

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	( $\pm 21,100$ )	62,200	326,300	84	(+4.8)
1994	414,700	( $\pm 40,400$ )	53,900	360,800	87	(+3.9)
1995	293,700	( $\pm 33,400$ )	79,300	214,400	73	(+6.5)
1996	428,100	( $\pm 15,700$ )	94,200	333,900	78	(+3.6)
1997	228,800	( $\pm 0$ )	65,000	163,000	71	(+5.1)
1998	385,300	( $\pm 45,000$ )	85,600	299,700	78	(+3.7)
1999	313,100	( $\pm 13,390$ )	94,300	218,800	70	(+4.2)
2000	475,600	( $\pm 52,609$ )	108,500	367,100	77	(+3.2)
2001	324,900	( $\pm 0$ )	94,000	230,900	71	(+4.4)
2002	369,900	( $\pm 51,400$ )	133,200	236,700	64	(+4.4)
2003	309,180	( $\pm 17,300$ )	63,800	245,400	79	(+3.1)
2004	192,800	( $\pm 0$ )	140,800	53,000	27	(+3.9)
2005	290,400	( $\pm 15,500$ )	220,100	70,300	76	(+2.6)
Mean	339,600		99,600	254,200	72	

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 2005.

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



## Adult Escapement

Adult sockeye salmon return was monitored from 15 July to 18 September 2005 (Appendix 4). During this time an estimated 13,000 adult sockeye salmon returned to Hidden Creek. (Table 5).

Table 5. Summary of Hidden Lake salmon escapement, age distribution and fish length. 1976 - 2005.

Year	Escapement		Major Age Classes					
	Number	Hatchery (%) (C.I.)	1.2 (%)	1.2 Lth(mm)	1.3 (%)	1.3 Lth(mm)	2.2 (%)	2.2 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	112,792		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	69.4 (±3.7)	89	455	6	549	5	502
2000	45,685	62.0 (±3.6)	82	519	9	560	8	530
2001	42,462	57.9 (±4.0)	63	525	20	564	12	544
2002	71,983	62.0 (±3.1)	73	537	18	582	7	544
2003	11,734	57.9 (±5.2)	70	517	24	568	6	570
2004	18,172	76.8 (±2.7)	67	521	19	568	12	540
2005*	13,000	ND	ND	ND	ND	ND	ND	ND
Mean	31,124	64.3	79	523	12	563	8	538
Min	1,055	57.9	44	455	1	530	0	502
Max	112,792	76.8	96	550	41	600	34	580

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

Mean escapement from 2001 to 2005 = 31,470

Mean escapement from 1992 to 2005 = 34,991

\*In 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

ND = No Data Collected or Calculated

Note: Total escapement is Lake escapement and not fish returning to wier (morts and sampled fish)

The 2005 allocation data for commercial fishery harvest, the personal use fishery harvest, and sport fishery harvest is not yet complete (ADF&G, personal communication).

The percentage of adult male and adult female sockeye salmon returning to Hidden Lake in 2005 was 59.0% and 51.0%, respectively (Table 6). Male fish averaged 533 mm (21.0in) in length and the females averaged 501 mm (19.7 in). An age estimation was unable to be calculated because all scales samples were destroyed by mold. Average age proportions are represented in Table 5. CIAA has no reason to believe that the age composition in 2006 would greatly deviate from the average.

Table 6. Hidden Lake sockeye salmon escapement sex ratio and size data, 2005.

<b>All Sockeyes</b>		
Number Samples	Average Length (mm)	Average Weight (kg)
140	520	2.29
<b>Males</b>		
Percent	Average Length (mm)	Average Weight (kg)
59%	533	2.38
<b>Females</b>		
Percent	Average Length (mm)	Average Weight (kg)
41%	501	2.17

### **Special Studies – Adults**

In March 1999, ADF&G conducted a technical review of the Hidden Lake Sockeye Salmon Enhancement Project (Simpson and Edmundson, 1999). Based on this review, ADF&G recommended that two special studies be conducted. One study was to determine if hatchery incubated fish released to Hidden Lake are straying into other Kenai River system spawning populations and the other was to determine the contribution of hatchery incubated fish to the sockeye population returning to Hidden Lake.

To determine if hatchery incubated fish were straying into other Kenai River spawning populations; late run adult sockeye salmon returning to the Russian River and the Trail Lakes Hatchery discharge were checked for hatchery incubated fish. The Russian River was checked for fish from Hidden Lake because the Russian River is upstream of Hidden Lake and fish returning to the Russian River migrate up the Kenai River with fish bound for Hidden Lake. Sockeye Salmon have been sampled every year from 1999 to 2000 and no hatchery fish have been detected in the Russian River. Thus, 2002 was the last year Russian River sockeye salmon were sampled for hatchery marks.

To continue monitoring for possible straying sockeye salmon in 2003, a small creek on the southeast side of Skilak Lake was sampled for hatchery marked sockeye salmon. Over the next past three years a total of 311 otolith samples have been collected from this creek and its surrounding area (none were found to be of hatchery origin). In addition, the hatchery discharge was checked for fish from Hidden Lake because it is believed returning fish may be attracted to the water they were incubated in.

In 2005, 160 otolith samples were collected from sockeye salmon within the small creek on Skilak Lake. Of the 160 otolith samples collected, 154 were readable and none showed a hatchery mark.

To determine the contribution of hatchery incubated fish to the population of adult sockeye returning to Hidden Lake, CIAA annually attempts to collect otolith samples from approximately 120 fish every sixth day throughout the migration. Unfortunately, due to the sporadic nature of the adult migration, and the apparent low return, CIAA did not sacrifice any fish for otolith samples.

However, the average hatchery proportion of returning adult sockeye salmon is 64.3% (Table 5). CIAA has no reason to believe that the proportion in 2006 would greatly deviate from this average.

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## **RECOMMENDATIONS**

Though several problems occurred in 2005, CIAA feels that no changes or alterations to the Hidden Lake Sockeye Salmon Enhancement Project should be implemented.

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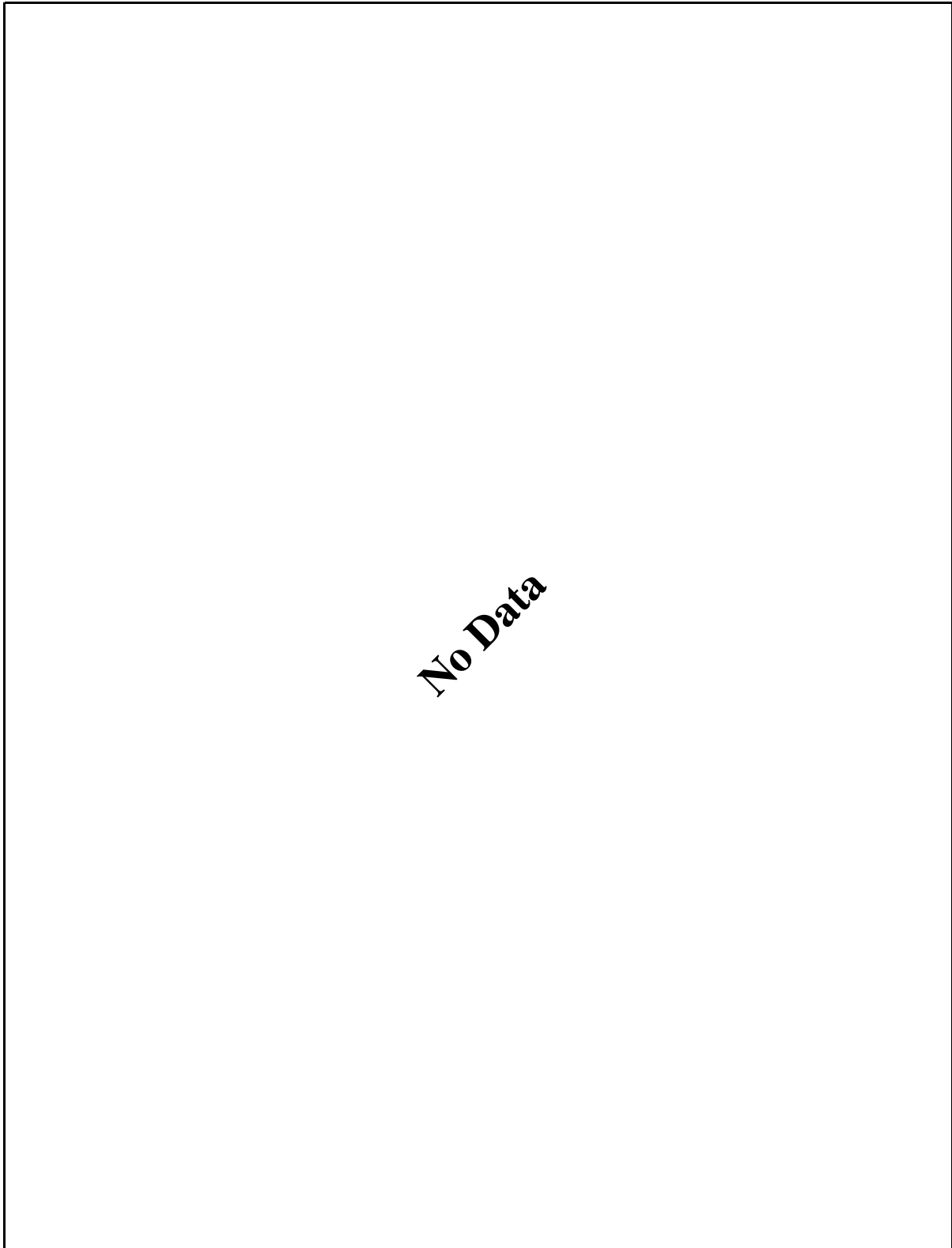
## **APPENDICES**

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Appendix 1. Hidden Lake 2005 – Macrozooplankton Density.

***No Data***

Appendix 1. (cont'd) Hidden Lake 2005 – Macrozooplankton Biomass.



**No Data**

## Appendix 2. Hidden Lake 2005 – Environmental Conditions.

Smolts							Adults						
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)
18-May	3	0	0.00	ND	10.0	16.0	15-Jul	3	0	ND	ND	19.0	22.5
19-May	2	0	0.12	ND	16.0	21.0	16-Jul	4	0	ND	ND	15.0	16.0
20-May	4	0	0.12	ND	12.5	15.5	17-Jul	2	0	ND	ND	18.0	21.5
21-May	4	0	0.14	ND	9.0	14.5	18-Jul	4	12	ND	ND	16.0	14.0
22-May	5	2	0.16	ND	8.0	13.0	19-Jul	4	4	ND	ND	17.0	15.0
23-May	3	0	0.16	ND	13.0	15.5	20-Jul	2	7	ND	ND	19.0	20.0
24-May	3	0	0.18	ND	13.5	16.0	21-Jul	5	0	ND	ND	18.0	14.0
25-May	3	0	0.16	ND	11.0	15.0	22-Jul	2	0	ND	ND	20.0	22.0
26-May	2	0	0.16	ND	10.5	15.5	23-Jul	2	0	ND	ND	20.0	21.0
27-May	4	0	0.14	ND	8.5	13.0	24-Jul	3	0	ND	ND	17.0	19.0
28-May	4	0	0.14	ND	9.0	14.5	25-Jul	4	3	ND	ND	17.0	16.0
29-May	3	0	0.14	ND	8.5	15.0	26-Jul	5	1	ND	ND	17.0	14.0
30-May	4	0	0.14	ND	10.0	15.0	27-Jul	3	1	ND	ND	16.5	17.0
31-May	3	0	0.14	ND	10.0	15.0	28-Jul	4	0	ND	ND	16.0	13.5
1-Jun	3	0	0.14	ND	10.0	13.0	29-Jul	4	1	ND	ND	16.0	15.0
2-Jun	4	0	0.14	ND	11.0	12.5	30-Jul	4	0	ND	ND	15.0	15.0
3-Jun	2	0	0.14	ND	13.0	17.0	31-Jul	5	2	ND	ND	15.0	14.0
4-Jun	3	0	0.13	ND	13.5	17.5	1-Aug	4	8	ND	ND	15.0	16.0
5-Jun	3	0	0.13	ND	12.0	14.5	2-Aug	4	9	ND	ND	15.0	15.0
6-Jun	3	0	0.14	ND	11.0	12.0	3-Aug	4	2	ND	ND	16.0	14.0
7-Jun	4	0	0.12	ND	9.5	13.5	4-Aug	4	1	ND	ND	16.0	15.0
8-Jun	4	0	0.14	ND	10.0	13.5	5-Aug	3	0	ND	ND	17.0	17.0
9-Jun	3	0	0.10	ND	11.0	16.0	6-Aug	2	0	ND	ND	16.0	18.0
10-Jun	2	0	0.12	ND	12.0	19.0	7-Aug	3	0	ND	ND	15.0	16.5
11-Jun	2	0	0.12	ND	14.0	16.0	8-Aug	1	0	ND	ND	20.0	24.0
12-Jun	1	0	0.10	ND	12.0	18.0	9-Aug	1	0	ND	ND	21.0	24.0
13-Jun	1	0	0.10	ND	13.5	17.0	10-Aug	1	0	ND	ND	21.0	23.0
14-Jun	3	0	0.11	ND	15.0	22.0	11-Aug	1	0	ND	ND	22.0	25.0
15-Jun	1	0	0.10	ND	17.5	22.0	12-Aug	1	0	ND	ND	22.0	26.0
16-Jun	3	0	0.10	ND	17.5	25.0	13-Aug	1	0	ND	ND	20.0	22.0
17-Jun	3	0	0.10	ND	19.0	23.0	14-Aug	3	0	ND	ND	17.0	16.0
18-Jun	4	0	0.10	ND	13.5	16.0	15-Aug	3	0	ND	ND	19.0	18.0
19-Jun	4	0	0.10	ND	13.5	15.0	16-Aug	3	0	ND	ND	18.0	20.0
20-Jun	4	0	0.08	ND	13.0	18.0	17-Aug	3	1	ND	ND	17.0	17.0
21-Jun	3	0	0.08	ND	17.0	21.5	18-Aug	3	0	ND	ND	17.0	17.0
22-Jun	4	0	0.08	ND	13.0	15.0	19-Aug	2	1	ND	ND	18.0	18.0
23-Jun	4	0	0.08	ND	14.0	18.5	20-Aug	3	0	ND	ND	18.0	17.0
24-Jun	4	0	0.06	ND	15.0	19.0	21-Aug	2	14	ND	ND	16.0	18.0
25-Jun	4	0	0.08	ND	15.5	21.0	22-Aug	4	0	ND	ND	16.0	16.0
26-Jun	3	0	0.07	ND	18.0	21.5	23-Aug	3	1	ND	ND	15.0	17.0
Total	40	2					24-Aug	5	0	ND	ND	15.0	13.0
							25-Aug	3	0	ND	ND	15.0	16.0
							26-Aug	5	9	ND	ND	15.0	14.0
							27-Aug	1	2	ND	ND	15.0	16.0
							28-Aug	4	1	ND	ND	15.0	14.0
							29-Aug	5	1	ND	ND	15.0	12.5
							30-Aug	4	2	ND	ND	15.0	15.0
							31-Aug	3	1	ND	ND	15.0	15.0
							1-Sep	2	0	ND	ND	15.0	13.0
							2-Sep	2	0	ND	ND	15.0	15.0
							3-Sep	4	0	ND	ND	13.0	12.0
							4-Sep	5	2	ND	ND	13.0	12.0
							5-Sep	4	1	ND	ND	14.0	15.0
							6-Sep	3	4	ND	ND	14.0	14.0
							7-Sep	2	0	ND	ND	15.0	16.0
							8-Sep	1	0	ND	ND	15.0	16.5
							9-Sep	5	1	ND	ND	13.0	14.0
							10-Sep	2	0	ND	ND	15.0	16.5
							11-Sep	3	0	ND	ND	13.5	14.0
							12-Sep	1	2	ND	ND	12.5	14.0
							13-Sep	1	0	ND	ND	13.0	15.0
							14-Sep	1	0	ND	ND	14.0	16.0
							15-Sep	5	0	ND	ND	12.0	11.0
							16-Sep	5	2	ND	ND	12.5	11.5
							17-Sep	5	2	ND	ND	12.5	11.0
							18-Sep	4	1	ND	ND	12.4	10.0
							Total	66	99				

		Precip	Stage	Flow	Water Temp	Air Temp
Smolts	Avg.	0.05	0.12	ND	12.6	16.8
	Min.	0	0.00	ND	8	12
	Max.	2	0.18	ND	19	25
Adults	Avg.	1.50	ND	ND	16.1	16.4
	Min.	0	ND	ND	12	10
	Max.	14	ND	ND	22	26

Cloud Cover - No. of Days					
	Meas.	<100%	<50%	>50%	>0%
	Rain	100%	>50%	>0%	Clear
Smolts	1	40%	40%	13%	7%
Adults	30	42%	24%	17%	17%

ND = No Data

1 = Clear  
2 = Cloud Cover <50%  
3 = Cloud Cover >50%  
4 = Overcast  
5 = Rain  
Ice out = April 20

Appendix 3. Hidden Lake 2005 – Smolt Migration.

Date	Sockeye			Coho	
	Daily	Mort.	Total	Daily	Total
15-May					
16-May					
17-May					
18-May	0		0	0	
19-May	0		0	0	
20-May	38		38	0	
21-May	63		101	5	
22-May	527		628	11	
23-May	15,395		16,023	219	219
24-May	43,958	250	60,231	306	525
25-May	37,082		97,313	464	989
26-May	4,299	27	101,639	89	1,078
27-May	1,607	7	103,253	127	1,205
28-May	2,104	6	105,363	789	1,994
29-May	3,206	4	108,573	871	2,865
30-May	4,659	8	113,240	1398	4,263
31-May	19,962	3	133,205	3044	7,307
1-Jun	31,227	33	164,465	3248	10,555
2-Jun	27,732	23	192,220	4663	15,218
3-Jun	29,361	34	221,615	5467	20,685
4-Jun	17,370	46	239,031	1969	22,654
5-Jun	4,722	44	243,797	1076	23,730
6-Jun	2,958	36	246,791	1516	25,246
7-Jun	5,193	61	252,045	1616	26,862
8-Jun	3,053	46	255,144	947	27,809
9-Jun	2,521	54	257,719	1717	29,526
10-Jun	5,359	50	263,128	3636	33,162
11-Jun	5,290	61	268,479	1752	34,914
12-Jun	6,150	55	274,684	1797	36,711
13-Jun	4,812	123	279,619	1315	38,026
14-Jun	1,460		281,079	697	38,723
15-Jun	1,968	256	283,303	635	39,358
16-Jun	1,343	87	284,733	207	39,565
17-Jun	746	122	285,601	167	39,732
18-Jun	2,069		287,670	92	39,824
19-Jun	739		288,409	106	39,930
20-Jun	683	15	289,107	378	40,308
21-Jun	667	22	289,796	372	40,680
22-Jun	1,133	12	290,941	218	40,898
23-Jun	420	2	291,363	92	40,990
24-Jun	426	6	291,795	252	41,242
25-Jun	21	6	291,822	4	41,246
26-Jun	64	9	291,895	21	41,267
Total	290,387	1,508	291,895		41,267

Appendix 4. Hidden Lake 2005 – Adult Migration.

Date	Sockeye		Lures	Coho Daily	Otolith Collection	Mortalities
	Daily	Total				
10-Jul						
11-Jul						
12-Jul						
13-Jul	Weir Installed					
14-Jul						
15-Jul	Counts Began on 12:00 pm					
16-Jul	0	0				
17-Jul	0	0				
18-Jul	0	0				
19-Jul	0	0				
20-Jul	0	0				
21-Jul	0	0				
22-Jul	2	2				
23-Jul	0	2				
24-Jul	2	4				
25-Jul	0	4				
26-Jul	4	8				
27-Jul	22	30				
28-Jul	8	38				
29-Jul	0	38				
30-Jul	0	38				
31-Jul	0	38				
1-Aug	5	43				
2-Aug	27	70				
3-Aug	21	91				
4-Aug	21	112				
5-Aug	19	131				
6-Aug	7	138				
7-Aug	2	140				
8-Aug	30	170				
9-Aug	0	170				
10-Aug	1	171				
11-Aug	0	171				
12-Aug	13	184				
13-Aug	196	380				
14-Aug	273	653				
15-Aug	375	1,028				
16-Aug	352	1,380				
17-Aug	239	1,619				
18-Aug	1,134	2,753				
19-Aug	673	3,426				
20-Aug	217	3,643				
21-Aug	456	4,099				
22-Aug	315	4,414				
23-Aug	239	4,653				
24-Aug	54	4,707				
25-Aug	302	5,009			1	
26-Aug	140	5,149			1	
27-Aug	15	5,164				
28-Aug	43	5,207				
29-Aug	302	5,509			4	
30-Aug	93	5,602				
31-Aug	239	5,841			4	

Hole  
found  
in Weir





Appendix 4 (con't). Hidden Lake 2005 - Adult migration.

1-Sep	55	5,896			
2-Sep	24	5,920			
3-Sep	73	5,993			
4-Sep	73	6,066		1	
5-Sep	116	6,182			
6-Sep	217	6,399			
7-Sep	18	6,417		1	
8-Sep	1	6,418			
9-Sep	223	6,641		48	
10-Sep	19	6,660		18	
11-Sep	2	6,662			
12-Sep	8	6,670		3	
13-Sep	52	6,722		4	
14-Sep	0	6,722			
15-Sep	0	6,722			
16-Sep	6	6,728		1	
17-Sep	17	6,745		4	
18-Sep	4	6,749			
	6,749		0	90	0
					0

Appendix 5. Hidden Lake 2005 - Update.

Stocking & Misc. Activities

Crew on-site:	18-May	
Ice-out:	20-Apr	(approximate date)
Crew off-site:	16-Sep	
Fry stocking:	6-Jun	573,000 unfed fry
Adult Otolith Collection	NA	NA

Smolt Migration

Dates:	18-May to 26-Jun
Sockeyes:	290,387
Mortalities:	1,508
Percent age 1:	91.0
Percent age 2:	9.0
Percent hatchery:	75.7
Coho:	41,267
Dolly Varden:	0
Rainbow:	0

Egg Take

Dates:	21-Sep to 11-Oct
No. of broodstock used:	2,093
Green eggs:	2,027,411
Fecundity:	1,940
Eyed eggs:	1,642,256
Survival:	81.0%

Adult Migration

Dates:	15-Jul to 16-Sep
Sockeye total return:	(est.)
Hidden Creek return:	13,000
Commercial Harvest	Data Not Available
Sportfish Harvest	
Personal Use Harvest	
Otolith Collection	0
Mortalities	0
Lake Escapement:	13,000
Hatchery broodstock:	2,093
Lake broodstock:	10,907
Lures:	0
Coho	90

