Hidden Lake
Sockeye Salmon Enhancement
Progress Report
2004

Prepared by:
Trenten T. Dodson, CIAA Biologist
March 2005

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 the Southeast Sustainable Salmon Fund received from the National Oceanic and Atmospheric Administration.

This page intentionally left blank

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.

This page intentionally left blank

ACKNOWLEDGEMENTS

Many individuals contributed to the successful 2004 field season at the Hidden Lake Salmon Enhancement Project. Special thanks is offered to CIAA Executive Director, Gary Fandrei, for is leadership and guidance. Appreciation is extended to Cook Inlet Aquaculture Association seasonal employees Joellel Mulder, Armila Hasanbegovic, Matt Duguay, Darin Dodson, and Alger Aleck, as well as Ronald Carlson, Cook Inlet Aquaculture Association Project Technician, who endured many long hours in the field. Trail Lakes Hatchery personnel Robert Blankenship, Tom Prochazka, and Mark Thomas, are also recognized for their efforts during fry release and egg collection exercises. Appreciation is extended to Terri Tobias of the Alaska Department of Fish and Game for reading the adult scale samples. Thanks to lab assistants Cathy Cline and Bridget Dodson for the efforts in the otolith lab. The Cook Inlet Aquaculture Association Board of Directors, the Alaska Department of Fish and Game, and the Kenai National Wildlife Refuge are recognized for the support they have provided to the Hidden Lake Sockeye Salmon Enhancement Project since its inception. Finally thank you to the U.S. Fish and Wildlife Service and Senator Ted Stevens for providing the funding for the evaluation of this important salmon resource.

This page intentionally left blank

TABLE OF CONTENTS

This page intentionally left blank

LIST OF FIGURES

This page intentionally left blank

LIST OF TABLES

This page intentionally left blank

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 13 May 2004, an estimated 646,000 unfed sockeye fry were released into Hidden Lake. All 646,000 fry were released at the west end of the lake and all the released fish were otolith marked.

During 2004, smolt emigration monitoring began on 26 May and continued daily until 28 June. During this time a total of 193,800 sockeye (*O. nerka*) and 48,200 coho (*O. kisutch*) smolts emigrated from the lake.

Based on otolith marks, 27% (±3.9%) of the emigrating sockeye smolts were enhanced. An estimated 65.5% (±3.7%) were age 1 and 35.5% (±3.7%) were age 2. The average length and weight of the age 1 sockeye smolts was 140 mm (±0.8 mm) and 24.7 g (±0.8 g). The age 2 sockeye smolts were 179 mm (±3.6 mm) and 60.5 g (±3.7 g).

Of the migrating coho smolts, an estimated 38.6% (±2.6%) were age 1, 59.2% (±2.6%) were age 2 and 2.2% (±0.8%) were age 3. The average length and weight of the age 1 coho smolts was 133 mm (±1.7 mm) and 16.3 g (±0.8 g). The age 2 coho smolts were 141 mm (±1.5 mm) and 20.5 g (±0.8 g) and the age 3 coho smolts were 158 mm (±11.2 mm) and 29.7 g (±7.4 g).

Adult sockeye salmon escapement was monitored from 12 July to 30 August 2004. During this time a total of 19,129 adult sockeye salmon returned to Hidden Creek. The percentage of adult male and adult female fish was 54.1% and 45.9%, respectively. Male fish averaged 546 mm (24.2 in) in length and the females averaged 519 mm (22.9 in). An estimated 66.5% of the fish were age 1.2, 18.9% were age 1.3, 12.4% were 2.2, and 2.2% were 2.3. Angling lures were observed on 58 adult fish as they passed the counting weir.

In addition to enumerating the adult migration, adults returning to Hidden Lake were sampled for a hatchery otolith mark. An estimated 76.8% (±2.7%) of the fish returning to Hidden Lake were marked. One hundred nine otolith samples were also 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 16 September and 2 October 2004, 5.445 million eggs were collected and shipped to Trail Lakes Hatchery for fertilization and incubation. An estimated 4.967 million eggs (91.2%) have survived to the eyed stage.
Sampling for water chemistry and zooplankton analyses was completed 3 times during 2004.

Hidden Lake's water chemistry results have not yet been processed. Zooplankton biomass was higher than it was during the previous four years.

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 had completed the water chemistry, plankton and adult scale analyses. However, ADF&G will no longer perform water chemistry and plankton analyses.

In March 1999, ADF&G conducted a technical review of the Hidden Lake Sockeye Salmon Enhancement Project (Simpson and Edmundson, 1999). Concerns arouse 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).

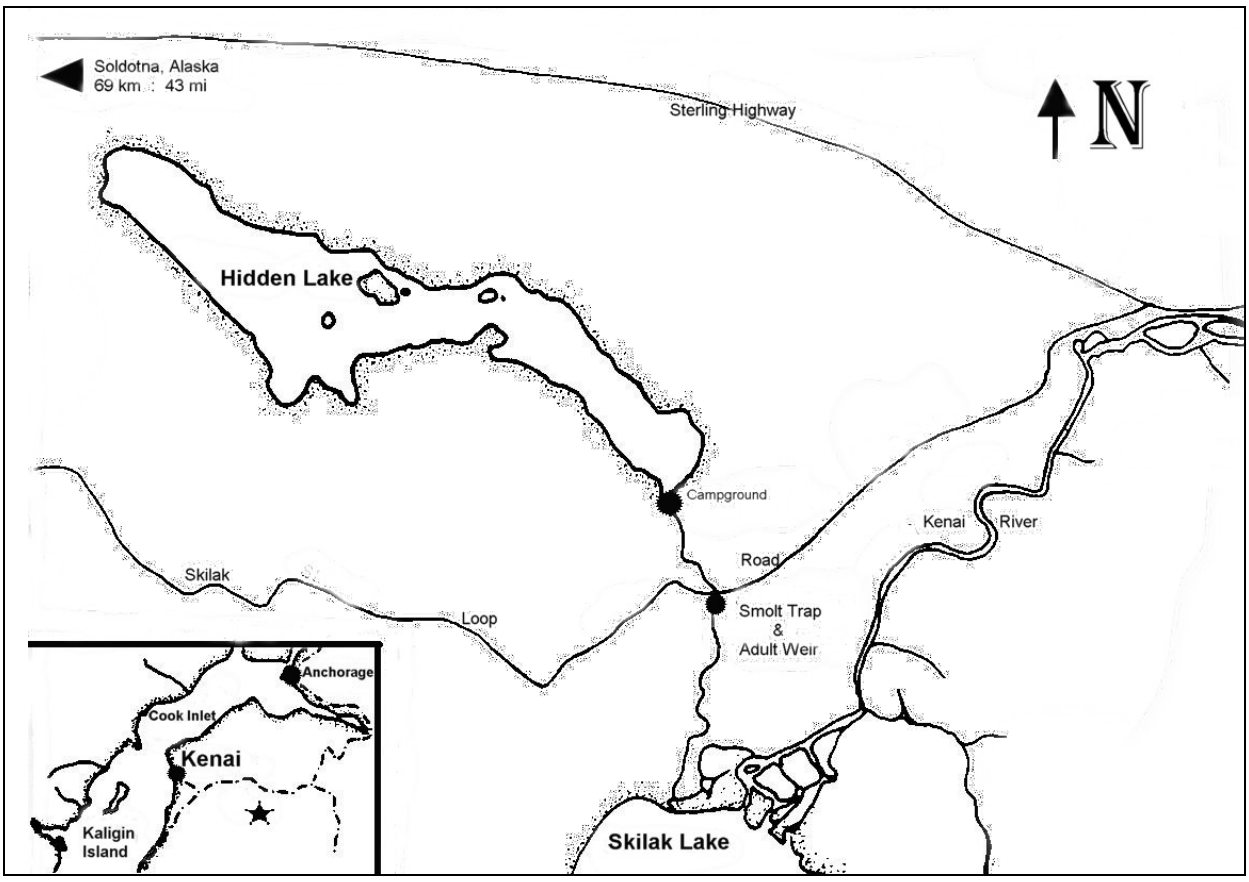


Figure 1. Area Map of Hidden Lake, Kenai Peninsula, Southcentral Alaska.

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

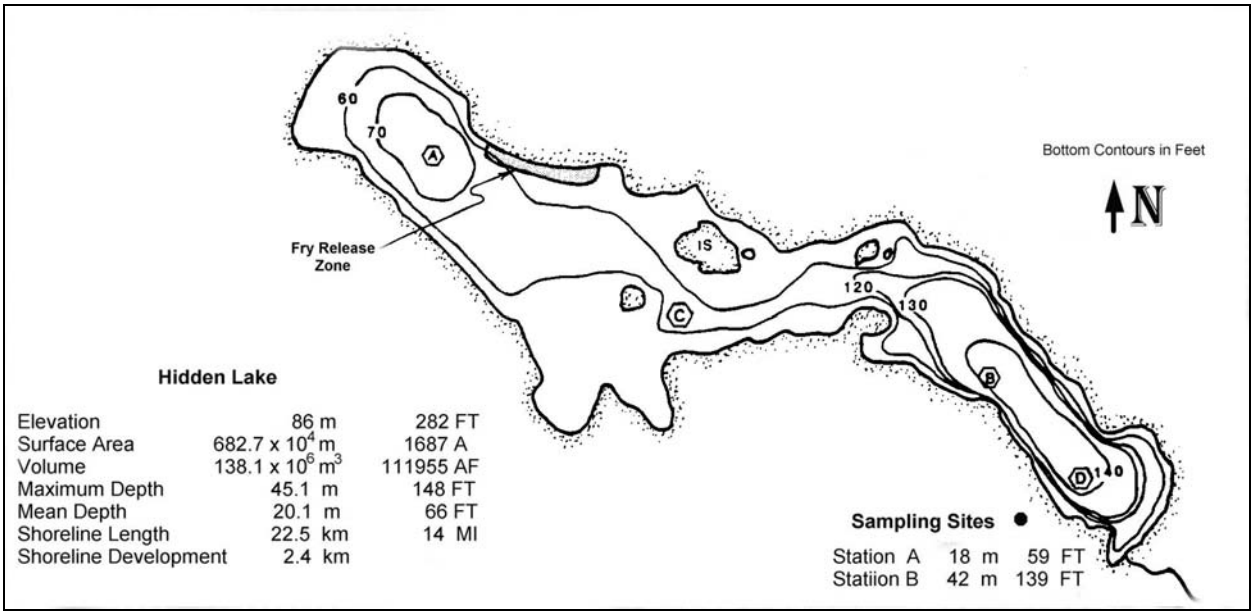


Figure 2. Morphometric map of Hidden Lake showing the two major basins.

The lake's watershed area is 37.4 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 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 (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 (*Gaserosteus 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 2004, assessments of water quality were conducted three times during the open water season from June through August. 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 and water chemistry analysis scheduled to be conducted by ADF&G, has not been completed. Sample collection and analysis procedures are described by Koenings, et al. (1986).

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[1] 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:

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

and 95% confidence limits of:

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

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

In 2004, migrating smolts were enumerated from 26 May through 28 June. The 10% sub-sampling procedure was not used to enumerate smolt migrating in 2004.

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.

[1] Predetermined randomly selected 2-minute sub-sampling intervals assured random distribution within each 20-minute period.

Since 1991, CIAA has also marked the otolith of all salmon fry released to Hidden Lake with a thermal mark[2]. The purpose of this mark is to determine the contribution of released fish to the smolt population. In 2004, the otoliths of sockeye smolts collected for age, weight and length measurements were removed and checked for a thermal mark. Otoliths have not been collected from migrating coho smolts.

In 2004, smolts collected for measurement and otolith removal were sampled in proportion to the daily smolt migration. This was accomplished by collecting approximately every 355th sockeye smolt and every 137th 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 545 sockeye smolts. Age, weight and length measurements were made on 350 coho smolts.

Each smolt collected for evaluation was first measured to the nearest millimeter for fork length[3] and then weighed to the nearest 0.1 gram. Several scales were also removed from the primary growth area[4] 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). Of the 545 sockeye otoliths collected, 526 were readable.

[2] The otolith mark is a hatchery induced thermal band produced by controlled temperature changes during incubation.
[3] Standard fork length was measured from the tip of the snout to the fork of the tail.
[4] 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.

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

If:

N = total number of migrating smolts,

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

n = total number of smolts sampled,

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

a = total number of enhanced smolts sampled,

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

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

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

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

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

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

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

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

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

y = the weight or length of the smolt.

Then, the proportion of enhanced smolts, $\hat{P}$, is:

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

with a variance of:

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

which, under proportional allocation, is like the usual simple random sample estimate. And, the total number of enhanced smolts, $\hat{A}$, is:

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

with a variance of:

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

Since samples sizes 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:

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

with relative errors of:

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

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

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

with a variance of:

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

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

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

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:

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

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[5] of the returning population of fish. In 2004 proportion of enhanced fish in the adult population was also conducted

To enumerate returning salmon, sample and collect sex, age, and length information, an 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 2004, adult escapement was monitored from 12 July to 30 August. After 30 August, the adult migration appeared complete and the counting weir was removed.

In 2004, it was assumed 42,000 adult fish would return to Hidden Creek during the six week period from 12 July to 28 August. Based on this assumption and the goal to obtain an adequate sample size for determining age, sex, and size, approximately every 46th fish counted Upstream was temporarily held, measured, and released upstream. The adult return, however, was less than projected and fewer fish were collected for measurement than expected. To secure a otoliths to

[5]Standard fork length was defined as the measurement from mideye to the fork of the tail.

assess the enhanced proportion of the returning population, samples were taken in multiples of sixty in proportion to the escapment.

In 2004, a total 957 fish were collected on 18, 23, 29 July, 4, 5, 11, 16, and 23, August. All the fish were removed from Hidden Creek and sold; or donated to local dog mushers after the heads were removed. Otoliths were extracted from each head in the lab. 185 adult sockeye salmon were also 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 59,558,000 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 2004, 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 16 September and 2 October 2004, 5.445 million eggs were collected from 2,044 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 4.967 million eggs (91.2%) have survived to the eyed stage. A majority of the resultant fry (4.37 million) will be released the three Lower Cook Inlet Lakes.

The sockeye eggs collected in 2004 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 2005.

Table 1. Summary of sockeye salmon gamete collection and fry releases at Hidden Lake, 1976 - 2004.

Brood Year	No. eggs taken	No. females used	Fecundity	Receiving hatchery	No. fry released	Egg-to-fry survival (%)	No. smolt produced	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.	906,000	61.0	218,000	24.1
2001*	1,326,000	504	2,631	Trail L.	980,000	88.0	249,200	25.4
2002**	1,118,000	433	2,582	Trail L.	629,000	89.0	33,720	5.4
2003^	893,000	371	2,407	Trail L.	646,000	89.4		
2004	5,445,000	2,045	2,663	Trail L.				
Total	64,988,000	24,389			37,561,000		4,260,000	
Mean			2,470		1,436,313	74.7	242,648	16.8

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 caculation 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 88%. Only 980,000 fry released, 190,000 fry were destroyed due to FTP stocking level
**Survival from eyed egg to emergent fry was 89%. Only 629,000 fry released, 293,00o fry were destroyed due to FTP stocking level
^Survival from eyed egg to emergent fry was 89%. Only 646,000 fry released, 152,000 raised to smolt.

incomplete broodyear

Fish Transport and Stocking

Approximately 646,000 of the 798,000 sockeye salmon fry produced from gametes collected from Hidden Lake in 2003 were released to Hidden Lake on 13 May 2004. 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: 2.2H2; Rbr 3:1.2,2.2+3.2]. Otoliths samples were processed to document the marks and are on file at the Kenai Office.

The remaining 152,000 fry are being raised to smolt.

Since 1977, over 37.5 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. Zooplankton data from 2004 are presented in Appendix 1. Historic limnological data presented as open-water season means are presented in Table 2. However, Hidden Lake's 2004 water chemistry results are not yet available. Zooplankton biomass is complete and was higher than previous years.

Environmental conditions during the Hidden Lake smolt migration were monitored from 26 May to 28 June 2004. Stream stage measurements ranged from 0.00 to 1.14 feet (a beaver dam upstream from the trap had reduced flow; it was removed and caused an abnormal increased flow of water). During the period of smolt emigration, stream temperatures averaged 13.6°C and ranged from 7.0 to 23.0°C. Air temperatures averaged 18.5°C and ranged from 11.0 to 28.0°C. Fifty percent of the days were partly cloudy, 26% were completely overcast, while 24% or the days were clear. Rain was recorded on 1 day during the smolt emigration. A total of 2.0 mm of rain fell during this period (Appendix 2).

Environmental conditions during the Hidden Lake adult sockeye migration were monitored from 12 July to 30 August 2004. Stream stage measurements averaged 0.33 feet and ranged from 0.20 to 0.43 feet. Stream temperatures averaged 18.6°C and ranged from 11.0 to 22.0°C and air temperatures averaged 19.6°C and ranged from 14.0 to 28.0°C. Twelve percent of the days were clear, 66% were partly cloudy, and 22% were completely overcast. Rain was recorded on 7 of the days during the adult migration. A total of 15 mm of rain fell during this period (Appendix 2).

Table 2. Average open water season water quality characteristics of Hidden Lake, 1980 - 2004.

AVERAGE WATER QUALITY - 1 METER

Year	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)
1980	145	7.8	66		6.8	120	2.1			
1981	117	7.0	73		6.6	171	0.6			2,381
1982	137	8.1	70		8.6	174	0.4			1,619
1983	144	8.1	72		6.9	176	0.5			3,285
1984	146	7.9	71		6.7	172	0.7			2,248
1985	147	7.9	78	0.7	7.2	177	0.9			1,967
1986	144	7.8	72	0.4	7.5	185	0.3			2,420
1987	147	8.0	70	0.2	6.9	188	0.5			1,390
1988	146	7.8	67	0.6	6.8	197	0.6			2,466
1989	146	8.0	67	0.4	7.8	198	0.4			3,437
1990	147	8.0	73	0.4	7.8	193	0.8			2,258
1991	152	8.0	72	0.7	6.7	171	0.8	20.2	7.3	2,222
1992	145	8.0	66	0.7	7.4	231	1.3	15.2	5.0	1,030
1993	150	7.8	68	0.5	7.0	198	1.5	14.0	6.4	2,030
1994	156	7.8	70	0.5	7.4	210	1.6	19.6	6.7	847
1995	153	7.8	71	0.7	5.7	197	1.8	20.0	7.6	1,520
1996	152	7.8	71	0.7	5.6	188	0.9	19.6	8.4	1,338
1997	153	7.8	73	0.4	6.6	186	0.7	20.2	9.7	2,111
1998	150	8.0	72	0.8	6.4	205	0.8	21.0	7.2	2,358
1999	149	7.6	72	0.7	7.3	234	0.8	18.7	6.7	2,474
2000	150	7.8	69	0.8	7.2	234	1.6	20.4	8.7	3,896
2001	150	7.6	68	0.7	7.8	231	1.1	19.4	7.1	3,398
2002	147	7.7	73	0.4	8.6	257	1.1	17.9	5.9	2,447
2003	148	7.3	70	0.4	8.4	229	2.8	17.1	7.0	959
2004	Results not completed									

Averages prior to 1992 compiled by ADF&G.
EZD and Secchi provided by CIAA.

Open water season only.

AVERAGE WATER QUALITY - HYPOLIMNION

Year	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	Chl a (ug/l)
1980	146	7.8	69		6.1	140	1.8
1981	116	7.0	74		6.5	175	0.5
1982	136	8.0	71		7.2	172	0.5
1983	148	7.8	73		9.2	193	0.8
1984	149	7.7	72	0.6	6.3	168	0.6
1985	147	7.7	79	0.7	8.2	179	0.7
1986	146	7.7	71	0.3	7.6	180	0.3
1987	150	7.8	70	0.3	8.3	191	0.5
1988	150	7.6	67	0.4	7.0	195	0.6
1989	149	7.9	67	0.4	8.0	196	0.4
1990	148	7.8	73	0.4	8.5	187	0.7
1991	154	7.8	73	0.7	8.2	189	0.6
1992	147	7.7	69	0.6	9.5	218	1.1
1993	156	7.6	71	0.4	8.0	203	1.3
1994	157	7.6	70	0.6	7.3	188	0.9
1995	159	7.6	72	0.7	6.5	189	1.6
1996	159	7.7	73	0.7	6.3	190	2.6
1997	153	7.8	73	0.5	9.0	201	1.2
1998	153	7.8	72	0.1	6.6	194	0.6
1999	153	7.5	72	0.7	7.4	221	0.5
2000	151	7.7	70	0.7	7.9	245	1.5
2001	152	7.5	69	0.7	7.5	222	0.9
2002	150	7.6	73	0.5	9.1	239	0.7
2003	149	7.3	68	0.5	8.9	224	1.5
2004	Results not completed						

Averages prior to 1992 compiled by ADF&G.
EZD and Secchi provided by CIAA.

Open water season only.

Smolt Enumeration

In general, the pattern of the 2004 Hidden Lake sockeye smolt migration was similar to previous smolt migrations. The peak, however, of the 2004 smolt migration occurred about 6 & 7 June, earlier than 2003.

Twelve thousand five hundred ninety-five moribund or dead sockeye smolts were observed during the 2004 smolt migration. A majority of the mortality occurred during the end of the migration. These fish were tested by the ADF&G pathology lab (Appendix 3)

Considering the 12,595 sockeye smolts lost during enumeration plus the 545 sockeye smolts used for samples , the final 2004 Hidden Creek sockeye smolt emigration was 180,660. Other fish counted included 47,850 coho smolts (plus 350 for samples), 94 Dolly Varden and 97 rainbow trout (Appendix 4).

Smolt Characteristics and Enhanced Contribution

In 2004, characteristics of the smolt migration were evaluated from scale samples collected throughout the migration and from measurements of length and weight. Based on otolith marks, 27% (±3.9%) of the emigrating sockeye smolts were enhanced. An estimated 65.5% (±3.7%) were age 1 and 35.5% (±3.7%) were age 2. The average length and weight of the age 1 sockeye smolts waere 140 mm (±0.8 mm) and 24.7 g (±0.8 g). The age 2 sockeye smolts were 179 mm (±3.6 mm) and 60.5 g (±3.7 g).

Of the migrating coho smolts, an estimated 38.6% (±2.6%) were age 1, 59.2% (±2.6%) were age 2 and 2.2% (±0.8%) were age 3. The average length and weight of the age 1 coho smolts was 133 mm (±1.7 mm) and 16.3 g (±0.8 g). The age 2 coho smolts were 141 mm (±1.5 mm) and 20.5 g (±0.8 g) and the age 3 coho smolts were 158 mm (±11.2 mm) and 29.7 g (±7.4 g).

The average length and weight measurements of the sockeye smolts were similar to previous sockeye smolt migrations. However, the age structure showed age-1 smolts being less dominate than in previous years due to the smaller emigration of smolts in 2004 compared to 2003. Although average length and weight measurements of the coho smolts were similar to previous years, the age structure showed a more balanced distribution than in 2003.

Table 3. Age structure, length and weight characteristics of Hidden Lake sockeye smolt, 1976 - 2004.

	Age Class (%)				Mean length (mm)				Mean weight (g)			
Smolt Year	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)
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 2004, the

proportion of hatchery-incubated salmon in the sockeye smolt migration was 27.4% (±3.9%) (Table 4). This proportion is lower than all 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 - 2004.

Smolt Year	Total No.	95% C.I.	Wild	Hatchery	% Hatchery %	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)	65,000	163,000	71	(+5.1)
1998	385,300	(±45,000)	85,600	299,700	78	(+3.7)
1999	313,100	(±13,390)	94,300	218,800	70	(+4.2)
2000	475,600	(± 52,609)	108,500	367,100	77	(+3.2)
2001	324,900	(±0)	94,000	230,900	71	(+4.4)
2002	369,900	(±51,400)	133,200	236,700	64	(+4.4)
2003	309,180	(±17,300)	63,800	245,400	79	(+3.1)
2004	193,800	(±0)	140,800	53,000	27	(+3.9)
Mean	343,800		89,600	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.
The mean percent hatchery contribution excludes the 1980 smolt, years when hatchery smolt were not released, and years when no estimate of hatchery smolt was made.
Mean calculated from 1993 to 2003.
Prior to 1990, data summary is from Kyle et al. (1990).

Adult Escapement

Adult sockeye salmon return was monitored from 12 July to 30 August 2004 (Appendix 5). During this time a total of 19,192 adult sockeye salmon returned to Hidden Creek; and 957 adult sockeye salmon were sacrificed to collect hatchery mark samples. Therefore, the Hidden Lake escapement consisted of 18,172 adult sockeye salmon (Table 5).

Table 5. Summary of Hidden Lake salmon escapement, age distribution and fish length. 1976 - 2004.

	Escapement			Major Age Classes					
		Hatchery		1.2		1.3		2.2	
Year	Number	(%)	(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	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
Mean	31,749	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 2000 to 2004 = 38,007
Mean escapement from 1992 to 2004 = 36,682

In 2004, the commercial fishery harvest rate was estimated to be 55%, the personal use fishery harvest rate was estimated to be 5% and sport fishery harvest rate 5% (ADF&G, personal communication). Thus, the estimated total common property harvest rate was 65%. Based on

these harvest rates the total number of Hidden Lake sockeye salmon returning to Cook Inlet was estimated by ADF&G to be 55,223 (Appendix 6).

The percentage of adult male and adult female sockeye salmon returning to Hidden Lake in 2004 was 54.1% and 45.9%, respectively (Table 6) Male fish averaged 546 mm (24.2 in) in length and the females averaged 519 mm (22.9 in). An estimated 66.5% of the fish were age 1.2, 18.9% were age 1.3, 12.4% were 2.2, and 2.2% were 2.3. Angling lures were observed on 58 adult fish as they passed the counting weir.

Table 6. Hidden Lake sockeye salmon escapement and age composition based on scale growth patterns, 2004.

	Age Group				
	1.2	1.3	2.2	2.3	Total
Males	5,999	2,688	1,345	310	10,341
Percent	31.36	14.05	7.03	1.62	54
Sample Size	58	26	13	3	100
Mean Lth (mm)	531	577	545	590	546
Std. Error	3	3	5	6	1
Sample Size	58	26	13	3	100
Females	6,722	932	1,035	103	9,756
Percent	35.14	4.87	5.41	0.54	51
Sample Size	65	9	10	1	85
Mean Lth (mm)	513	543	532	528	519
Std. Error	3	5	8		1
Sample Size	65	9	10	1	85
Both Sexes	12,721	3,619	2,380	413	19,129
Percent	66.49	18.92	12.43	2.16	100
Sample Size	123	35	23	4	185
Mean Lth (mm)	521	568	540	575	534
Std. Error	2	3	4	6	1
Sample Size	123	35	23	4	185

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 were sampled every year from 1999 to 2002 and no hatchery fish have been detected in the Russian River.

To continue monitoring for possible straying sockeye salmon, a small creek on the southeast side of Skilak Lake was sampled for hatchery marked sockeye salmon. In 2004, 109 otolith samples were collected on 1 September, 2004 from sockeye salmon within the small creek on Skilak Lake. Of the 109 otolith samples collected, 109 were readable and none showed a hatchery mark. In 2 years, no hatchery fish have been observed at this creek. Also since 1999, no hatchery fish have been observed at the Trail Lakes Hatchery discharge.

To determine the contribution of hatchery incubated fish to the population of adult sockeye returning to Hidden Lake, CIAA attempted to collect otolith samples in proportion to the return. The otoliths from each fish were removed and processed to identify hatchery incubated fish by a hatchery induced thermal mark. Of the 957 fish collected, 929 otolith samples were extracted and 878 were readable (Table 7).

The proportion of hatchery incubated fish in the adult migration was determined using a stratified sampling method described by David Evans (ADF&G). This statistical method utilizes weekly escapement values and was chosen instead of a daily method because variability in escapement could potentially be caused by the capture method on each sampling day. The

proportion of hatchery incubated fish was 76.8% (±2.7%) and all hatchery marks were from the Hidden Lake stock (Table 7).

Table 7. Hidden Lake adult otolith sampling, 2004.

Date	No. of adults	No. of Samples	No. of Readable Samples	No. Readable Marked	Percent Hatchery Marked	Percent Wild
23-Jul	2,538	175	167	119	71.3	28.7
29-Jul	2,950	166	154	124	80.5	19.5
4-Aug	12,684	588	557	431	77.4	22.6
Total	18,172	929	878	674	76.8	23.2

Note: Because of labeling problems, samples were combined into three strata instead of weekly strata corresponding to the sampling date.

This page is intentionally left blank

RECOMMENDATIONS

No changes or alterations to the Hidden Lake Sockeye Salmon Enhancement Project are recommended.

This page is intentionally left blank

LITERATURE CITED

Barton, L.M. and B.M. Barrett. 1973. Cook Inlet inventory report. Cook Inlet DataReport No. 736. Alaska Department of Fish and Game. Commercial Fish Division. Anchorage, AK. 76 pages.

Bill, D., Namtvedt, T.B., and A.S. Davis 1972. Cook Inlet lake and stream inventory report. Unpublished. Alaska Department of Fish and Game. Commercial Fish Division. Anchorage, AK. 48 pages.

Burke, J. and R. Grischkowsky. 1984. An epizootic caused by infectious haematopoietic necrosis virus in an enhanced population of sockeye salmon, Oncorhynchus nerka (Walbaum), smolts at Hidden Creek, Alaska J. Fish Diseases 7:421-429.

Cook Inlet Aquaculture Association. 2002. Hidden Lake Procedures Manual. CIAA. Soldotna, Alaska.

Cook Inlet Aquaculture Association. 1993. Egg-take Procedures Manual. CIAA. Soldotna, Alaska.

Glick, W.J. and P.A. Shields. 1993. Juvenile Salmonid Otolith Extraction and Preparation Techniques for Microscopic Examination. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development. Report No. 132. Soldotna, AK.

Koenings, J.P., J.A. Edmundson, J.M. Edmundson, and G.B. Kyle. 1986. Limnology Field and Laboratory Manual: Methods for Assessing Aquatic Production. Alaska Department of Fish and Game. Division of Fisheries Rehabilitation, Enhancement and Development. Soldotna, AK. 222 pages.

Kyle, G.B., D.S. Litchfield, and G.L. Todd. 1990. Enhancement of Hidden Lake sockeye salmon (Oncorhynchus nerka): Summary of fisheries production (1976-1989). Alaska Department of Fish and Game. Division of Fisheries Rehabilitation, Enhancement, and Development. Report No. 102. Soldotna, AK. 26 pages.

Simpson, E.M. and J.A. Edmundson. 1999. Hidden Lake Sockeye Enhancement Project Technical Review. Alaska Department of Fish and Game, Division of Commercial Fisheries. Regional Information Report No. 2A99-16. 23 pages.

Wilson, D. and J. Hetrick. 1992. The Trail Lakes Hatchery Manual. March 1992. CIAA, Moose Pass, Alaska. 47 pages.

This page is intentionally left blank

APPENDICES

This page is intentionally left blank

Appendix 1. Hidden Lake 2004 – Macrozooplankton Density.

Site A - Depth 21 - 20 m

Date	Density (No/m^2) 3-Jun	24-Jul	25-Aug	Mean (No/m^2)	Seasonal Mean (No/m^2)
Epischura	5,520	94,268	3,822	34,537	34,537
Cyclops	23,779	17,834	13,588	18,400	18,400
Ovig .*Cyclops*	2,123	849	425	1,132	1,132
Bosmina	94,268	420,382	201,699	238,783	238,783
Ovig. *Bosmina*	2,972	54,352	11,465	22,930	22,930
Daphnia l.	36,943	26,327	13,588	25,619	25,619
Ovig. *Daphnia l.*	2,972	7,643	8,917	6,511	6,511
Daphnia g.		0	425	142	142
Ovig. *Daphnia g.*		0	0		
Total:				348,054	348,054

Site B - Depth 39 - 42 m

Date	Density (No/m^2) 3-Jun	24-Jul	25-Aug	Mean (No/m^2)	Seasonal Mean (No/m^2)
Epischura	10,191	116,242	8,493	44,975	44,975
Cyclops	33,121	1,592	52,017	28,910	28,910
Ovig. *Cyclops*	8,917	1,592	3,185	4,565	4,565
Bosmina	236,943	1,079,618	712,314	676,292	676,292
Ovig. *Bosmina*	7,643	4,777	8,493	6,971	6,971
Daphnia l.	53,505	28,662	66,879	49,682	49,682
Ovig. *Daphnia l.*	3,185	14,331	12,739	10,085	10,085
Daphnia g		0	6,369	2,123	2,123
Ovig. *Daphnia g.*			0	0	0
Total:				823,603	823,603

Site C - Depth 17- 19 m

Date	Density (No/m^2) 3-Jun	24-Jul	25-Aug	Mean (No/m^2)	Seasonal Mean (No/m^2)
Epischura	5,520	40,764	9,342	18,542	18,542
Cyclops	11,890	5,096	10,191	9,059	9,059
Ovig. *Cyclops*	2,548	849	849	1,415	1,415
Bosmina	78,556	508,705	159,660	248,974	248,974
Ovig. *Bosmina*	57,325	124,841	47,558	76,575	76,575
Daphnia l.	41,189	22,930	21,231	28,450	28,450
Ovig. *Daphnia l.*	1,699	4,246	10,191	5,379	5,379
Daphnia g	0	0	1,274	425	425
Ovig. *Daphnia g.*	425		425	283	283
Total:				389,101	389,101

Site D - Depth 40 - 43 m

Date	Density (No/m^2) 3-Jun	24-Jul	25-Aug	Mean (No/m^2)	Seasonal Mean (No/m^2)
Epischura	3,185	5,520	6,369	5,025	5,025
Cyclops	66,879	31,423	213,376	103,893	103,893
Ovig. *Cyclops*	3,185	1,274	12,739	5,733	5,733
Bosmina	77,495	149,469	546,709	257,891	257,891
Ovig. *Bosmina*	3,185	70,913	4,246	26,115	26,115
Daphnia l.	45,648	14,437	31,847	30,644	30,644
Ovig *Daphnia l.*	1,062	6,794	21,231	9,696	9,696
Daphnia g.		0	7,431	2,477	2,477
Ovig. *Daphnia g.*		0	3,185	1,062	1,062
Total:				442,534	442,534

Appendix 1. (cont'd) Hidden Lake 2004 – Macrozooplankton Biomass.

Site A - Depth 20 - 21 m

	Body Size (mm)			Body Size (mm)		Biomass (mg/m^2)	
					Seasonal Weighted		Seasonal Weighted
Date	3-Jun	24-Jul	25-Aug	Mean	Mean	Mean	Mean
Epischura	1.56	0.98	1.45	1.33	1.03	349	168
Cyclops	1.19	1.02	0.91	1.04	1.07	72	76
Ovig .*Cyclops*	1.41	1.29	1.30	1.33	1.37	8	8
Bosmina	0.45	0.42	0.50	0.46	0.45	466	444
Ovig. *Bosmina*	0.65	0.63	0.62	0.63	0.63	89	88
Daphnia l.	0.78	0.97	0.78	0.84	0.85	81	82
Ovig. *Daphnia l.*	0.96	1.33	1.23	1.17	1.23	42	47
Daphnia g.		1.00	0.92	0.96	0.92	0.31	0.27
Ovig. *Daphnia g.*		1.60	1.39	1.50	1.50	0.00	0.00
Total:						1,108	913

Body Size - Site B - Depth 49 - 42 m

	Body Size (mm)			Body Size (mm)		Biomass (mg/m^2)	
					Seasonal Weighted		Seasonal Weighted
Date	3-Jun	24-Jul	25-Aug	Mean	Mean	Mean	Mean
Epischura	1.89	1.03	1.13	1.35	1.10	475	266
Cyclops	1.18	1.16	1.04	1.13	1.10	134	127
Ovig .*Cyclops*	1.33	1.26	1.33	1.31	1.32	29	30
Bosmina	0.51	0.48	0.48	0.49	0.48	1,531	1,489
Ovig. *Bosmina*	0.64	0.66	0.59	0.63	0.62	27	26
Daphnia l.	0.91	0.78	0.80	0.83	0.84	153	155
Ovig. *Daphnia l.*	1.05	1.24	1.33	1.21	1.26	70	76
Daphnia g.		0.96	0.95	0.96	0.95	5	4
Ovig. *Daphnia g.*			1.35	1.35	1.35	0.00	0.00
Total:						2,423	2,173

Body Size - Site C - Depth 17 - 19m

	Body Size (mm)			Body Size (mm)		Biomass (mg/m^2)	
					Seasonal Weighted		Seasonal Weighted
Date	3-Jun	24-Jul	25-Aug	Mean	Mean	Mean	Mean
Epischura	1.50	1.17	1.09	1.25	1.19	158	137
Cyclops	1.22	1.05	1.01	1.09	1.11	39	41
Ovig .*Cyclops*	1.33	1.29	1.32	1.31	1.32	9	9
Bosmina	0.46	0.49	0.44	0.46	0.48	501	531
Ovig. *Bosmina*	0.65	0.61	0.60	0.62	0.62	285	283
Daphnia l.	0.80	0.84	0.77	0.80	0.80	81	81
Ovig. *Daphnia l.*	1.05	1.26	1.18	1.16	1.19	34	36
Daphnia g.		0.93	0.90	0.92	0.90	1	1
Ovig. *Daphnia g.*	1.22		1.36	1.29	1.29	2	2
Total:						1,111	1,120

Body Size - Site D - Depth 40 - 43m

	Body Size (mm)			Body Size (mm)		Biomass (mg/m^2)	
					Seasonal Weighted		Seasonal Weighted
Date	3-Jun	24-Jul	25-Aug	Mean	Mean	Mean	Mean
Epischura	1.89	1.61	1.56	1.69	1.65	100	93
Cyclops	1.13	1.01	1.10	1.08	1.10	441	456
Ovig .*Cyclops*	1.41	1.30	1.33	1.35	1.34	39	39
Bosmina	0.54	0.47	0.56	0.52	0.54	671	718
Ovig. *Bosmina*	0.69	0.69	0.64	0.67	0.69	116	121
Daphnia l.	0.79	0.79	0.73	0.77	0.77	80	80
Ovig. *Daphnia l.*	1.06	1.27	1.27	1.20	1.26	66	74
Daphnia g.		1.16	0.92	1.04	0.92	7	5
Ovig. *Daphnia g.*		1.48	1.44	1.46	1.44	9	9
Total:						1,529	1,595

Appendix 1. (cont'd) Hidden Lake 2004 – 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)
			DATA NOT AVAILABLE											
Mean														
Min														
Max														

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)
			DATA NOT AVAILABLE								
Mean											
Min											
Max											

Appendix 2. Hidden Lake 2004 – Environmental Conditions.

Smolts Date	Sky	Precip. (mm)	Stage (ft)	Flow	Water Temp. (°C)	Air Temp. (°C)
26-May	3	0	1.14	ND	9	12
27-May	3	0	1.10	ND	10	15
28-May	4	0	1.08	ND	7	11
29-May	2	0	1.06	ND	10	15
30-May	3	0	1.02	ND	10	18
31-May	3	0	1.00	ND	10	15
1-Jun	2	0	0.98	ND	11	16
2-Jun	3	0	0.96	ND	11	15
3-Jun	2	0	0.94	ND	10	17
4-Jun	2	0	0.92	ND	11	22
5-Jun	4	0	0.88	ND	10	18
6-Jun	3	0	0.86	ND	13	22
7-Jun	4	0	0.82	ND	13	18
8-Jun	4	0	0.82	ND	12	13
9-Jun	2	0	0.80	ND	14	15
10-Jun	3	0	0.74	ND	10	14
11-Jun	4	0	0.70	ND	12	15
12-Jun	3	0	0.68	ND	12	17
13-Jun	5	0	0.66	ND	13	17
14-Jun	3	0	0.62	ND	15	19
15-Jun	4	0	0.60	ND	12	13
16-Jun	4	2	0.58	ND	12	13
17-Jun	3	0	0.50	ND	11	18
18-Jun	1	0	0.58	ND	13	24
19-Jun	1	0	0.48	ND	15	25
20-Jun	1	0	0.44	ND	17	25
21-Jun	2	0	0.42	ND	19	25
22-Jun	2	0	0.34	ND	20	25
23-Jun	1	0	0.34	ND	21	23
24-Jun	2	0	0.32	ND	21	24
25-Jun	1	0	0.30	ND	22	25
26-Jun	1	0	0.22	ND	23	28
27-Jun	1	0	0.00	ND	19	22
28-Jun	4	0	0.00	ND	14	15
Total		2				

		Precip	Stage	Flow	Water Temp	Air Temp
Smolts	Avg.	0.06	0.67	ND	13.6	18.5
	Min.	0	0.00	ND	7	11
	Max.	2	1.14	ND	23	28
Adults	Avg.	0.29	0.33	ND	18.6	19.6
	Min.	0	0.20	ND	11	14
	Max.	5	0.43	ND	22	28

	Cloud Cover - No. of Days				
	Meas. Rain	100%	<100% >50%	<50% >0%	Clear
Smolts	1	9	10	8	7
Adults	7	11	10	23	6

Adults Date	Sky	Precip. (mm)	Stage (ft)	Flow	Water Temp. (°C)	Air Temp. (°C)
12-Jul	2	0	0.38	ND	22	28
13-Jul	2	0	0.37	ND	22	25
14-Jul	2	0	0.4	ND	20	22
15-Jul	2	0	0.41	ND	21	21
16-Jul	2	0	0.43	ND	21	24
17-Jul	4	0	0.43	ND	19	18
18-Jul	3	0	0.42	ND	19	19
19-Jul	3	0	0.42	ND	19	20
20-Jul	2	0	0.40	ND	19	19
21-Jul	4	0	0.38	ND	18	17
22-Jul	4	0	0.37	ND	18	17
23-Jul	3	0	0.37	ND	19	19
24-Jul	2	0	0.37	ND	19	19
25-Jul	3	0	0.37	ND	17	18
26-Jul	5	3	0.38	ND	16	15
27-Jul	5	5	0.38	ND	14	16
28-Jul	3	0	0.37	ND	18	19
29-Jul	3	4	0.39	ND	18	20
30-Jul	5	2	0.37	ND	11	17
31-Jul	2	0	0.37	ND	18	19
1-Aug	2	0	0.38	ND	19	21
2-Aug	1	0	0.38	ND	19	22
3-Aug	1	0	0.38	ND	20	23
4-Aug	1	0	0.38	ND	19	23
5-Aug	1	0	0.38	ND	19	22
6-Aug	2	0	0.39	ND	19	23
7-Aug	1	0	0.38	ND	20	23
8-Aug	2	0	0.34	ND	20	21
9-Aug	4	0	0.31	ND	18	20
10-Aug	2	0	0.31	ND	18	21
11-Aug	3	0	0.28	ND	20	17
12-Aug	3	0	0.28	ND	20	19
13-Aug	2	0	0.28	ND	19	20
14-Aug	2	0	0.28	ND	19	19
15-Aug	2	0	0.28	ND	20	20
16-Aug	2	0	0.28	ND	19	20
17-Aug	2	0	0.28	ND	21	23
18-Aug	2	0	0.27	ND	20	20
19-Aug	4	0	0.24	ND	19	20
20-Aug	4	0	0.24	ND	19	20
21-Aug	2	0	0.24	ND	18	20
22-Aug	2	0	0.24	ND	18	19
23-Aug	2	0	0.24	ND	19	19
24-Aug	2	0	0.25	ND	19	19
25-Aug	2	0	0.25	ND	19	19
26-Aug	4	0	0.25	ND	16	15
27-Aug	5	0	0.22	ND	16	14
28-Aug	3	0	0.22	ND	17	14
29-Aug	3	0	0.22	ND	17	16
30-Aug	1	0	0.20	ND	17	16
Total		15				

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 2004 – ADF&G Pathology Report

ACCESSION NO: 2004-0088

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF COMMERCIAL FISHERIES - FISH PATHOLOGY SECTION
333 RASPBERRY ROAD, ANCHORAGE, AK 99518-1599 - Phone (907)267-2244/Fax 267-2194

REPORT OF LABORATORY EXAMINATION

LOT (YEAR, STOCK, SPECIES): 2002 Hidden Lake sockeye salmon, *Oncorhynchus nerka*

FACILITY: Trail Lakes Hatchery

CONTACT PERSON/ADDRESS: Robert Blankenship, PO Box 29, Moose Pass, AK 99631

SAMPLE DATE: 6/25/04 **DATE SAMPLE RECEIVED:** 6/25/04

SAMPLE TYPE: Whole fish **LIFE STAGE:** Smolt **STATE:** Live/dead

NUMBER IN SAMPLE: 10 **WILD:** Mixed population, wild and hatchery fish

HISTORY/SIGNS: Mortality of out-migrating sockeye smolt noted starting 6/16/04. Approximately 5.8% of estimated out-migrating smolt have been found dead as of 6/25/04.

REASON FOR SUBMISSION: Diagnostic.

FINAL REPORT DATE: 7/7/04

CLINICAL FINDINGS

NECROPSY:

MORIBUND:

1/2 with fungus patches on skin and fins; fungus characteristic of *Saprolegnia*
1/2 with scale loss
1/2 with fungus on gills
2/2 with few to moderate *Trichophrya* on gills, slight gill hyperplasia present
1/2 with gas bubbles in gill lamellae
1/2 with rod-shaped, motile bacteria in spleen
0/2 with abnormal gut or air bladder

MORTALITIES:

3/3 with fungus patches on skin and fins; fungus characteristic of *Saprolegnia*
3/3 with scale loss
2/3 with slight hemorrhaging at base of pectoral fins
2/3 with few to moderate *Trichophrya* on gills; slight gill hyperplasia present
2/3 with rod-shaped, motile bacteria in spleen
0/2 with abnormal gut or air bladder
2/3 with bacteria and necrotic cells in peripheral blood smear

FAT: 0/5 positive for *Aeromonas salmonicida*
0/5 positive for *Renibacterium salmoninarum*

BACTERIOLOGY: 4 kidneys struck on TSA and TYES and incubated at 18°C for 10 days.

3/4 with light to moderate growth. Bacterial isolate is a motile, oxidase positive, rod-shaped bacteria utilizing glucose fermentatively. Isolate identified as *Aeromonas sobria* by biochemical testing.

VIROLOGY: 2/2 (2 X 5 fish/pool) presumptive positive for IHNV. Kidney/spleen tissues processed by quantal assay on EPC cell line at 15°C for 7 days. Minimum level of detection = 50 infectious particles/gm of pooled sample.

DIAGNOSIS: IHNV, *Trichophrya*, external *Saprolegnia*, *Aeromonas* septicemia

COMMENTS/RECOMMENDATIONS: A variety of pathogens were detected in the samples submitted including a virus, a bacteria, an external protozoan and an external fungus. All of these pathogens are probably contributing to the mortality to some extent. Similar smolt mortality has been observed in the past at this location. Warm water temperatures and other environmental factors are likely stressing these fish and contributing to the mortality.

FISH HEALTH INVESTIGATOR: Burton

TECHNICAL ASSISTANCE: Evans, Starkey

COPIES TO: FY2004, Trail Lakes, Meyers, McGee, Fandrei, Palmer

ACCESSION No. 2004-0088 - 2 -

Appendix 4. Hidden Lake 2004 – Smolt Migration.

	Sockeye			Coho		Rainbow		Dolly Varden	
Date	Daily	Mort.	Total	Daily	Total	Daily	Total	Daily	Total
24-May			0		0		0		0
25-May			0		0		0		0
26-May	25	0	25	27	27	1	1	5	5
27-May	40	0	65	36	63	1	2	0	5
28-May	15	0	80	5	68	0	2	0	5
29-May	26	0	106	87	155	3	5	0	5
30-May	112	0	218	211	366	8	13	4	9
31-May	633	0	851	311	677	13	26	20	29
1-Jun	412	0	1,263	457	1,134	3	29	8	37
2-Jun	1,035	0	2,298	619	1,753	0	29	6	43
3-Jun	746	0	3,044	568	2,321	7	36	8	51
4-Jun	2,159	0	5,203	1,069	3,390	7	43	10	61
5-Jun	4,582	0	9,785	1,466	4,856	8	51	11	72
6-Jun	29,722	0	39,507	6,307	11,163	1	52	1	73
7-Jun	20,927	0	60,434	27,379	38,542	1	53	2	75
8-Jun	9,065	0	69,499	560	39,102	1	54	0	75
9-Jun	21,436	0	90,935	1,243	40,345	4	58	2	77
10-Jun	6,603	0	97,538	748	41,093	0	58	0	77
11-Jun	8,968	0	106,506	480	41,573	2	60	0	77
12-Jun	4,454	0	110,960	274	41,847	0	60	0	77
13-Jun	11,312	0	122,272	426	42,273	1	61	0	77
14-Jun	5,828	0	128,100	342	42,615	0	61	0	77
15-Jun	3,164	0	131,264	217	42,832	0	61	1	78
16-Jun	4,775	213	136,252	1,061	43,893	1	62	2	80
17-Jun	5,895	42	142,189	411	44,304	1	63	2	82
18-Jun	17,285	9	159,483	2,839	47,143	1	64	0	82
19-Jun	4,949	747	165,179	240	47,383	0	64	1	83
20-Jun	5,807	844	171,830	469	47,852	25	89	3	86
21-Jun	2,891	3,010	177,731	243	48,095	7	96	2	88
22-Jun	2,758	3,119	183,608	36	48,131	0	96	0	88
23-Jun	2,063	2,312	187,983	20	48,151	0	96	2	90
24-Jun	1,351	1,987	191,321	8	48,159	0	96	3	93
25-Jun	1,310	267	192,898	7	48,166	0	96	1	94
26-Jun	555	33	193,486	27	48,193	0	96	0	94
27-Jun	234	9	193,729	11	48,204	1	97	0	94
28-Jun	53	3	193,785	3	48,207	0	97	0	94
Total	181,190	12,595	193,785		48,207		97		94

Appendix 5. Hidden Lake 2004 – Adult Migration.

Date	Sockeye Daily	Sockeye Total	Sockeye Lures	Coho Daily	Otolith Collection
10-Jul					
11-Jul					
12-Jul	Weir in Place at 3:15 pm				
13-Jul	0	0			
14-Jul	0	0			
15-Jul	0	0			
16-Jul	6	6			
17-Jul	66	72	1		
18-Jul	38	110			60
19-Jul	1,049	1,159	10		
20-Jul	634	1,793	7		
21-Jul	523	2,316	5		
22-Jul	188	2,504	4		
23-Jul	34	2,538	4		120
24-Jul	544	3,082	3		
25-Jul	1,186	4,268	5		
26-Jul	34	4,302	0		
27-Jul	0	4,302	0		
28-Jul	654	4,956	2		
29-Jul	532	5,488	4		180
30-Jul	1,197	6,685	3		
31-Jul	373	7,058	1		
1-Aug	70	7,128	0		
2-Aug	0	7,128	0		
3-Aug	173	7,301	0		
4-Aug	0	7,301	0		146
5-Aug	107	7,408	1		91
6-Aug	394	7,802	2		
7-Aug	14	7,816	0		
8-Aug	144	7,960	0		
9-Aug	2,193	10,153	0		
10-Aug	31	10,184	0		
11-Aug	329	10,513	1		180
12-Aug	768	11,281	2		
13-Aug	702	11,983	0		
14-Aug	1,320	13,303	1		
15-Aug	181	13,484	0		
16-Aug	40	13,524	0		120
17-Aug	740	14,264	0		
18-Aug	1,191	15,455	0		
19-Aug	46	15,501	0		
20-Aug	17	15,518	0		
21-Aug	466	15,984	0		
22-Aug	787	16,771	0		
23-Aug	37	16,808	0		60
24-Aug	252	17,060	0		
25-Aug	72	17,132	1		
26-Aug	302	17,434	1		
27-Aug	116	17,550			
28-Aug	516	18,066			
29-Aug	0	18,066			
30-Aug	106	18,172			
	18,172		58	0	957
Total	19,129				

% of fish with lures 32%

Appendix 6. Hidden Lake 2004 - Project Update.

Stocking & Misc. Activities

Crew on-site:	26-May	
Ice-out:	20-Apr	(approximate date)
Crew off-site:	30-Aug	
Fry stocking:	13-May	646,000 unfed fry
Adult Otolith Collection	17-Jul 22-Aug	

Egg Take

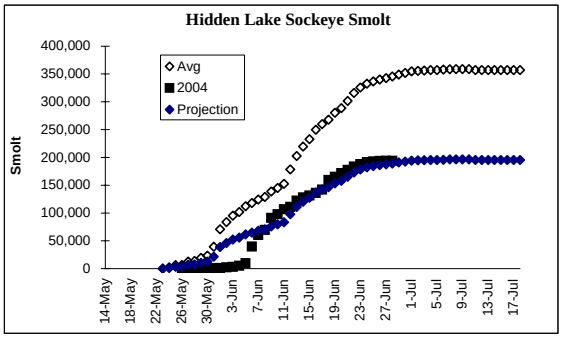
Dates:	16-Sep to 2-Oct	
No. of broodstock used:	4,223	
Green eggs:	5,445,000	
Fecundity:	2,663	
Eyed eggs:	4,967,000	
Survival	91.2%	

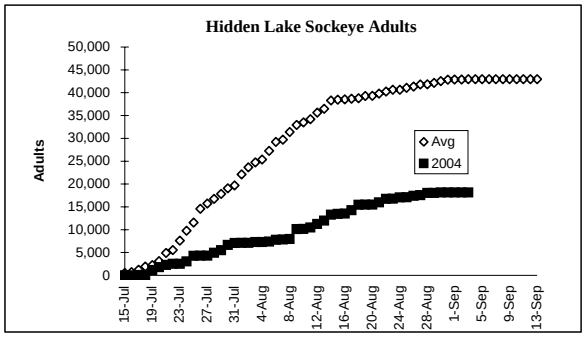
Smolt Migration

Dates:	26-May to 28-Jun	
Sockeyes:	193,800	
Mortalities:	12,595	
Percent age 1:	64.5	
Percent age 2:	35.5	
Percent hatchery:	27.4	
Coho:	48,200	
Dolly Varden:	94	
Rainbow:	97	

Adult Migration

Dates:	12-Jul to 30-Aug	
Sockeye total return:	55,223	(est.)
Hidden Creek return:	19,129	35%
Commercial Harvest	30,433	55%
Sportfish Harvest	2,987	5%
Personal Use Harvest	2,674	5%
Otolith Collection	956	
Mortalites	0	
Lake Escapement:	18,172	
Hatchery broodstock:	4,223	
Lake broodstock:	13,949	
Lures:	58	
Coho	ND	





3/17/2005

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