Hidden Lake
Sockeye Salmon Enhancement
Progress Report
2008

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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.

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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 with the enhancement project in 1988; and, since 1991, has completed all the field activities.

To supplement the Hidden Lake sockeye salmon population, on 27 May 2008, an estimated 917,000 unfed sockeye fry were released into Hidden Lake. All 917,000 fry were released at the west end of the lake and all the released fish were otolith marked.

The Hidden Lake smolt migration was enumerated from 23 May and continued daily until 6 July. During this time an estimated 350,700 (±58,500) sockeye (*O. nerka*) and 12,500 (±7,200) coho (*O. kisutch*) smolts migrated from the lake.

Based on the samples collected, 60% (±4.3%) of the migrating sockeye smolts were incubated at Trail Lakes Hatchery. An estimated 97% (±1.7%) were age 1 and 3% (±1.8%) were age 2. The average length and weight of the age 1 sockeye smolt were 123 mm (±0.9 mm) and 18.0 g (±0.34 g). The average length and weight of the age 2 sockeye smolt were 170 mm (±16.3 mm) and 49.5 g (±12.2 g).

Based on the samples collected, an estimated 36% (±0.8%) of the migrating coho smolts were age 1 and 64% (±0.3%) were age 2. The average length and weight of the age 1 coho smolt were 121 mm (±3.4 mm) and 16.8 g (±1.2 g). The average length and weight of the age 2 coho smolt were 135 mm (±1.9 mm) and 23.0 g (±1.0 g).

The Hidden Lake adult salmon escapement was enumerated from 11 July to 14 September 2008. During this time, an estimated 15,072 adult sockeye (*O. nerka*) and 5 adult coho (*O. kisutch*) salmon returned to Hidden Creek.

Based on otolith marks, an estimated 63% (±1.5%) adult sockeye salmon were incubated at Trail Lakes Hatchery. Of adult sockeyes returning to Hidden Creek, an estimated 86% were age 1.2, 8% were age 1.3, and 6% were age 2.2. Of adult sockeyes returning to Hidden Creek, 39% were male with an average length of 531 mm and 61% were female with an average length of 506 mm.

In order to enhance the Hidden Lake sockeye salmon population, and provide fish for supplementing the Lower Cook Inlet sockeye population, 4.004 million eggs were collected and shipped to Trail Lakes Hatchery for fertilization, incubation, and rearing from 17 September to 12 October 2008. An estimated 91% (3.648 million) fertilized eggs survived to the eyed stage.

Water chemistry and zooplankton samples were collected 3 times during 2008. ADF&G provided the analysis.

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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 could be produced by natural spawning

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

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

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

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

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

In March 1999, ADF&G conducted 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).

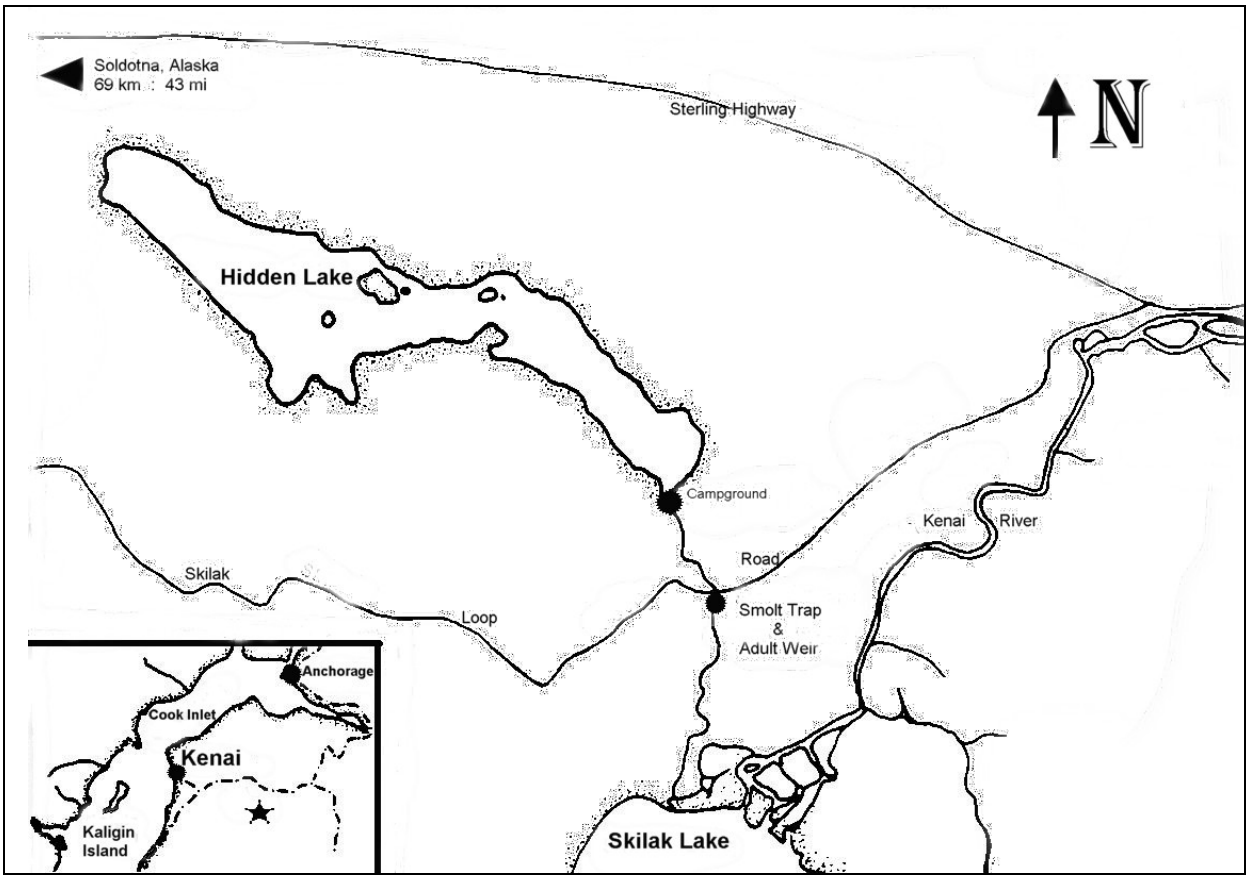

Figure 1. Area Map of Hidden Lake, Kenai Peninsula, Southcentral Alaska.

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.

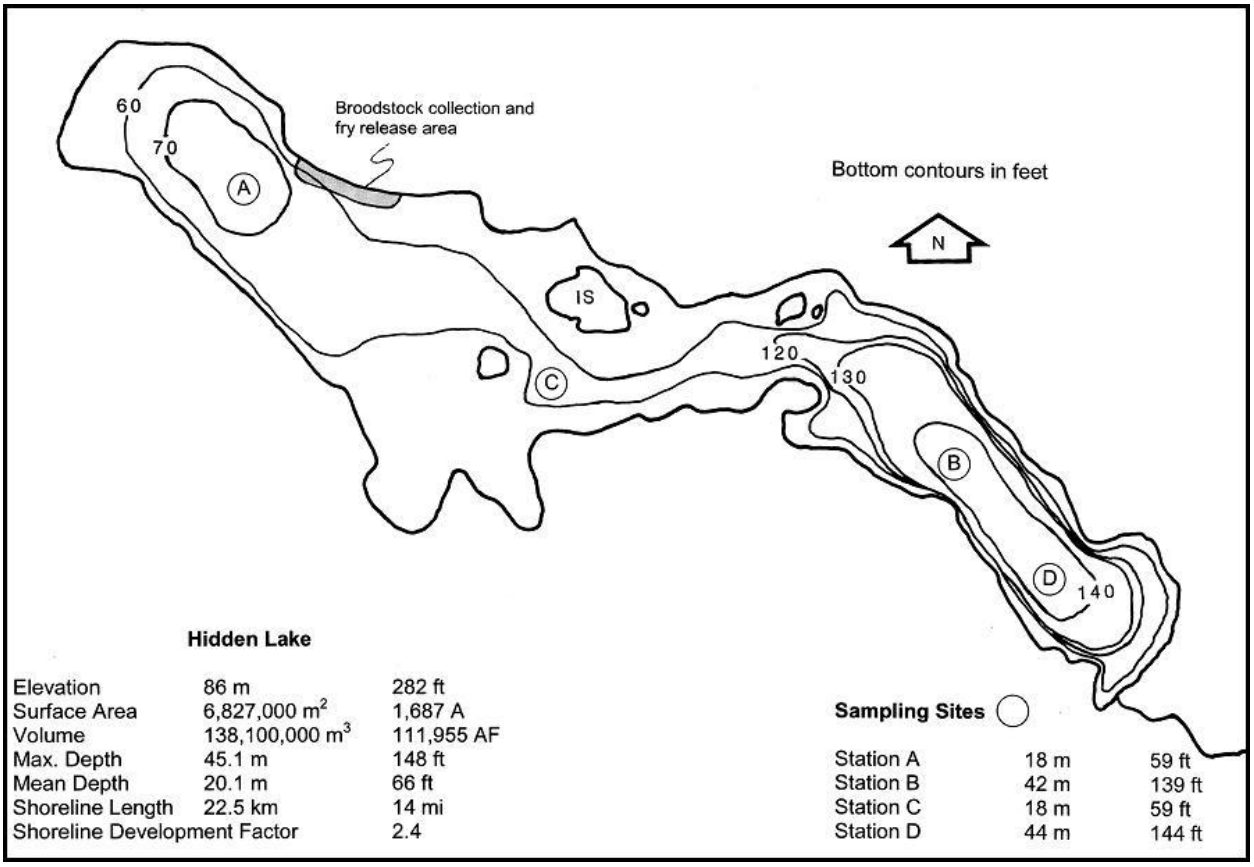

Figure 2. Morphometric map of Hidden Lake showing the two major basins.

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 collection, hatchery incubation, fry rearing, smolt enumeration and adult escapement monitoring follow procedures recommended by ADF&G.

Limnological Sampling and Environmental Conditions

During the 2008 smolt migration, water quality samples were collected three times during the open water season in June, July, and September. Two primary sites, Stations A and B (Figure 2) were sampled for dissolved oxygen, temperature and light transmission profiles, Secchi disk transparency and zooplankton densities. Samples for analysis of phosphorus, carbon, chlorophyll *a*, phaeophytin *a*, nitrogen, calcium, magnesium, iron, conductivity, pH, alkalinity, turbidity, and color were also collected with a Kemmerer sampler one meter below the surface and from the midhypolimnion. In addition to the two primary sites, one secondary site, Station C, was also sampled (Figure 2). Measurements at the secondary site were limited to the zooplankton community and Secchi disk transparency.

Water samples were collected by CIAA. Sample collection procedures are described by Koenings, et al. (1986). Water analysis is completed by ADF&G.

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

Smolt Enumeration

To enumerate the smolt migration, a smolt trap was temporarily placed in Hidden Creek approximately 100 meters downstream of Skilak Lake Loop road. The smolt trap consisted of a

modified fyke net with nylon mesh leads and a double compartment live-box. The leads and fyke net funneled migrating smolt into the live-box. A swing gate remotely controlled by the trap operators directed smolt into one of two live-box compartments where they were enumerated and a smolt sample was collected.

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

To enumerate migrating smolt with the 10% sub-sampling procedure, the counting 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 smolt passed through the trap uncounted. To estimate the number of smolt migrating during the 20-minute interval, the two-minute smolt count was multiplied by 10.

Assuming the two-minute sub-sampling intervals were randomly distributed throughout sub-sampling[1] and smolt moved through the weir randomly, the total smolt migration was estimated as follows:

If:

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

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

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

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

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

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

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

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

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

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.

During the 2008 smolt migration, migrating smolt were enumerated from 23 May through 6 July. The 10% sub-sampling procedure was used to enumerate 54% of the sockeye smolt and 58% of the coho smolt.

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 smolt 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. The otolith mark is a hatchery induced thermal band produced by controlled temperature changes during incubation. The purpose of this mark is to determine the contribution of released fish to the smolt population. In 2008, sockeye smolts were sampled for age, weight, and length measurements. Sockeye smolt otoliths were removed and checked for a thermal mark. Coho smolts were sampled for age, length, and weight measurements. Otoliths were not collected from migrating coho smolts.

During the 2008 smolt migration, smolts collected for measurement and otolith removal were collected in proportion to the daily smolt migration. This was accomplished by attempting to collect every 500th sockeye smolt and every 75th 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.

Each smolt collected for evaluation was first measured to the nearest millimeter for fork length[2] and then weighed to the nearest 0.1 gram. Several scales were also removed from the primary growth area[3] 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, staff at CIAA processed the otoliths and checked each for a hatchery mark following procedures described by Glick and Shields (1993).

During the 2008 smolt migration, age, weight, and length measurements were made on 711 sockeye smolts, of which 495 were read and statistically evaluated. To achieve a sample population that was collected in proportion to the daily migration, 216 samples had to be discarded from the data set. Smolt age was determined from the scale samples collected. When the scale samples were unreadable, smolt age as determined from the otolith was substituted. Age, weight, and length measurements were made on 148 coho smolts, of which 145 samples were readable.

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

If:

N = total number of migrating smolt,

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

[2] Standard fork length was measured from the tip of the snout to the fork of the tail.
[3] The primary growth area is located above the lateral line on a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin.

n = total number of smolt sampled,

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

a = total number of hatchery incubated smolt sampled,

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

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

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

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

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

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

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

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

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

y = the weight or length of the smolt.

Then, the proportion of hatchery incubated smolt, $\hat{P}$, is:

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

with a variance of:

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

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

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

with a variance of:

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

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:

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

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

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

with a variance of:

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

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

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

with a variance of:

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

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

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

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

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

with an approximate variance estimate of:

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

and 95% confidence interval estimates of:

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

Adult 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[4] of the returning

[4]Standard fork length was defined as the measurement from mid-eye to the fork of the tail.

population of fish. To determine the proportion of hatchery incubated fish in the adult population, CIAA normally collects otolith samples from returning fish throughout the migration. However, in 2008, sample collection was abbreviated because fish must be sacrificed for otolith collection and fewer adult fish returned than what was projected.

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 and counted 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.

The Hidden Lake adult salmon escapement was enumerated from 11 July to 14 September 2008. During this time, an estimated 15,072 adult sockeye (*O. nerka*) and 5 adult coho (*O. kisutch*) salmon returned to Hidden Creek.

The returning adult population's characteristics were assessed by collecting a sample of the migrating sockeye adults to determine age, length and weight characteristics. Hatchery contribution was assessed by collecting otoliths from the migrating sockeye adults to identify the hatchery induced thermal band.

CIAA projected 20,200 sockeyes would return to Hidden Creek from 15 July to 25 August 2008. Based on this assumption, it was calculated that 120 fish needed to be sacrificed every 6^{th} day to secure an otolith sample size adequate to assess the enhanced proportion, of the returning fish. However, the adult return was less than expected and CIAA did not implement this procedure. As an alternative, CIAA staff collected otoliths from Hidden Creek during the early part of the return and then collected otoliths from post-spawned adults in Hidden Lake to complete the analysis.

CIAA staff collected 135 otolith pairs from Hidden Creek on the 31 July 2008, of which 126 pairs were readable. The remaining samples were collected from Hidden Lake during CIAA gamete collection and from a genetic study by the Alaska Department of Fish and Game. A total of 628 otolith pairs were collected from Hidden, of which 592 pairs were readable. Of the 628 otolith pairs, 174 were collected on 23 September and 24 September, of which 166 pairs were readable, 165 otolith pairs were collected on 29 September, of which157 pairs were readable, and 154 otolith pairs were collected on 4 October 2008, of which 143 pairs were readable.

During the Hidden Lake adult escapement, fish were collected for age, sex, and length determination. To obtain a representative sample for determining age, sex, and size or the returning population, up to 40 fish were collected daily. Adult sockeyes were captured at the weir, measured for length to the nearest millimeter, sexed, and a scale was removed from the primary growth area. The fish were unharmed and released upstream. CIAA measured and collected scales from 642 adult sockeye scales, of which 544 scales were readable.

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, Tutka Bay Lagoon and three Lower Cook Inlet Lakes. To date, a total of 82,345,000 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.

Table 1. Summary of sockeye salmon gamete collection and fry releases at Hidden Lake, 1976 - 2008.

Brood Year	No. eggs taken	No. females used	Fecundity	Receiving hatchery	Egg-to-fry survival (%)	No. fry released Hidden Lk.	No. smolt produced in Hidden Lk	Fry-to-smolt survival (%)	No. fry Released LCI Lakes	No. fry Held for Smolt	No. Smolt Released Tutka Lagoon	Hatchery Fry-to-smolt survival (%)
1976	832,880	274	3,091	Crooked Cr.	39.6	330,228	58,800	17.8				
1977	406,878	200		Big L.	75.9	308,704	40,600	13.2				
1978	311,808	100	3,118	Crooked Cr.	2.7	8,258						
1979												
1980												
1981												
1982	1,579,188	576	2,741	Trail L.	68.8	1,086,000	231,300	21.3				
1983	1,928,000	639	3,017	Trail L.	64.2	1,236,900	289,100	23.4				
1984	3,766,000	1,310	2,875	Trail L.	47.9	1,805,792						
1985	7,019,000	2,330	3,012	Trail L.		0						
1986	4,740,000	1,580	3,000	Trail L.	78.5	3,718,311						
1987	7,000,184	2,434	2,876	Trail L.	86.9	6,085,307						
1988	2,718,853	891	3,046	Trail L.	91.0	2,470,012	194,400	7.9				
1989	2,220,467	647	2,669	Trail L.	79.0	1,747,900	203,800	11.7				
1990	2,189,000	956	2,290	Trail L.	64.6	1,600,000	214,100	13.4				
1991	2,652,000	1,119	2,370	Trail L.	64.7	1,716,000	330,200	19.2				
1992	2,293,000	1,007	2,277	Trail L.	82.9	1,901,000	365,300	19.2				
1993	2,200,000	934	2,355	Trail L.	81.8	1,800,000	195,000	10.8				
1994	2,156,000	1,017	2,120	Trail L.	78.8	1,700,000	326,600	19.2				
1995	1,893,000	849	2,230	Trail L.	84.5	1,600,000	184,700	11.5				
1996	2,048,000	817	2,507	Trail L.	73.3	1,501,000	305,300	20.3				
1997	2,166,000	936	2,314	Trail L.	47.8	1,035,000	182,900	17.7				
1998	2,303,000	859	2,681	Trail L.	65.4	1,507,100	352,300	23.4				
1999	2,297,000	954	2,408	Trail L.	54.1	1,242,000	254,600	20.5				
2000	1,486,000	607	2,448	Trail L.	60.9	905,500	220,000	24.3				
2001	1,326,000	504	2,631	Trail L.	73.9	980,200	257,800	26.3				
2002	1,118,000	433	2,582	Trail L.	56.3	628,900	46,700	7.4				
2003	893,000	371	2,481	Trail L.	89.4	646,000	214,700	33.2		100,000	96,000	96.0
2004	5,445,000	2,045	2,663	Trail L.	89.5	573,000	104,400	18.2	4,126,000	284,000	260,000	91.5
2005	2,027,000	1,045	1,940	Trail L.	78.6	582,000	136,600	23.5	680,000	193,000	144,000	74.6
2006	5,640,000	2,340	2,450	Trail L.	89.9	658,000	203,719	31.0	3,980,000	570,000	483,000	84.7
2007	5,686,000	2,231	2,549	Trail L.	85.0	917,000	208,985	22.8	4,880,000	317,000		
2008	4,004,000	1,543	2,595	Trail L.	91.1							
Total	82,345,000	31,548				40,290,000	5,122,000					
Mean			2,457		75.4	1,285,531	225,105	17.9				
4-yr Avg.			2,383		86.2	682,500	163,426	23.9				

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 89%. Only 646,000 fry released, 152,000 kept for smolt.
**Survival from eyed egg to emergent fry was 89%. Only 573,000 fry released to Hidden, 4,126,000 fry released to Lower Inlet Lakes, 174,000 kept for smolt
***Survival from eyed egg to emergent fry was 79%. Only 582,000 fry released to Hidden, 680,000 fry released to Lower Inlet Lakes, 193,000 kept for smolt

incomplete broodyear

In 2008, 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 17 September and 12 October 2008, approximately 4.004 million eggs were collected from 1,543 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 activating the sperm with a 0.7% saline solution completed fertilization. An estimated 3.648 million eggs (91%) have survived to the eyed stage.

The sockeye eggs collected in 2008 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 2009 and 2010.

The objective of the Hidden Lake Sockeye Salmon Enhancement Project is to achieve an average adult sockeye escapement of 30,000 fish. CIAA calculates the number of gametes to collect each year to meet this objective based on the most recent 4-year average natural sockeye smolt emigration (118,800 - Table 4), broodyear average green egg-to-fry survival (86.2% - Table 1), fry-to-smolt survival (23.9% - Table 1), smolt-to-adult survival (18.6%), and the average common property harvest rate (60.8%). Based on these averages, to meet a projected adult return of 30,000 adult sockeye to Hidden Creek, CIAA projects 1,160,000 eggs must be collected to supplement the Hidden Lake return. CIAA plans to collect up to 6,190,000 eggs in 2009 to supplement the Hidden Lake return and provide fish for the Lower Cook Inlet projects.

Fish Transport and Stocking

On 27 May 2008, an estimated 917,000 unfed sockeye fry from gametes collected in 2007 were released into Hidden Lake. The unfed fry released to Hidden Lake were transported by truck in oxygenated tanks from Trail Lakes Hatchery to Hidden Lake, transferred to oxygenated fish transport tanks on board a small skiff, motored to the west end of the lake and released near historic spawning areas (Figure 2). All 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: 4,2H; Rbr 1:1.4,2.2]. Otoliths samples were processed to document the marks and are on file at CIAA Headquarters. Since 1977, over 40.2 million fry have been released to Hidden Lake (Table 1).

From 25 June to 28 June 2008, an estimated 4.88 million fry also produced from Hidden Lake gametes collected in 2007 were released to three lower Cook Inlet lakes. On 25 June 2008, an estimated 2.053 million fry were released to Leisure Lake. On 27 June 2008, an estimated 1.161

million sockeye fry were released to Hazel Lake. On 28 June 2008, an estimated 300,000 sockeye fry were released to Kirschner Lake. All fish released to the three lower Cook Inlet lakes were thermally marked with the Hatch Code: 1,3H; Rbr 1:1.1,2.3.

On 12 June 2008, an estimated 483,000 sockeye smolts produced from Hidden Lake gametes collected in 2006, were released to Tutka Bay Lagoon. The fish were thermally marked with the Hatch Code 2,5H; Rbr 1:1.2,2.5.

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RESULTS AND DISCUSSION

Limnology and Environmental Conditions

CIAA has completed limnology sampling at Hidden Lake since 1992. At the time the 2007 Hidden Lake progress report was completed, the 2007 Water quality and zooplankton analyses were not completed. The 2007 water quality and zooplankton data has been reported in Appendix 1. In 2008, water quality and zooplankton samples were collected three times (Appendix 2). Water quality and zooplankton sample analyses were completed by ADF&G and are summarized in Table 2.

Environmental conditions during the Hidden Lake smolt migration were monitored from 23 May to 8 June 2008. Stream stage measurements averaged 0.81 feet and ranged from 0.72 to 0.89 feet. During the period of smolt migration, stream temperatures averaged 12°C and ranged from 6 to 17°C. Air temperatures averaged 15°C and ranged from 9 to 22°C. Three percent of the days were clear, 17% were partly cloudy, and 25% were completely overcast. Measurable rain was recorded on 10 days during the smolt migration. A total of 180 mm of rain fell during this period (Appendix 3).

Environmental conditions during the Hidden Lake adult sockeye migration were monitored from 11 July to 14 September 2008. Stream stage measurements averaged 0.78 feet and ranged from 0.70 to 0.83 feet. Stream temperatures averaged 15°C and ranged from 12 to 18°C and air temperatures averaged 14°C and ranged from 10 to 19°C. Five percent of the days were clear, 17% were partly cloudy, and 59% were completely overcast. Rain was recorded on 23 days during the adult migration. A total of 80 mm of rain fell during this period (Appendix 3).

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

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	141	7.5	70	0.3	11.7	286	0.99	17.1	6.6	1,450
2005	149	7.2	68	0.3	9.8	273	0.5	17.5	7.0	1,693
2006	147	7.3	67	0.1	8.2	237	0.5	23.4	8.0	1,445
2007	151	7.8	71	0.6	8.4	218	0.67	21.4	9.0	1,589
2008	149	7.4	68	0.3	12.4	217	0.64	20.6	7.8	1,436

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	151	7.7	71	0.5	13.1	301	1.04
2005	149	7.2	68	0.1	11.8	277	0.5
2006	148	7.4	68	0.2	8.5	216	0.6
2007	154	7.7	71	0.5	9.9	222	0.89
2008	152	7.3	69	0.2	8.8	201	0.49

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 2008 Hidden Lake sockeye smolt migration was similar to the smolt migrations observed prior to 2005. The smolt migrations observed in 2005 and 2006 were characterized by two peak periods of migratory activity. The 2008 smolt migration and

migrations prior to 2005 were characterized by a single peak period of migratory activity. The peak of the 2008 smolt migration occurred between 6 and 16 June.

The Hidden Lake smolt migration was enumerated from 23 May and continued daily until 6 June. During this time an estimated 350,700 (±58,500) sockeye (*O. nerka*) and 12,500 (±7,200) coho (*O. kisutch*) smolts migrated from the lake. Other fish counted included 19 rainbow trout and 15 Dolly Varden char (Appendix 4).

Smolt Characteristics and Enhanced Contribution

In 2008, characteristics of the smolt population were evaluated from scale samples collected throughout the migration and from measurements of length and weight. Based on these samples and measurements, an estimated 97% (±1.7%) were age 1 and 3% (±1.8%) were age 2. The average length and weight of the age 1 sockeye smolt were 123 mm (±0.9 mm) and 18.0 g (±0.34 g). The average length and weight of the age 2 sockeye smolt were 170 mm (±16.3 mm) and 49.5 g (±12.2 g) (Table 3).

Of the migrating coho smolt, an estimated 36% (±0.8%) were age 1 and 64% (±0.3%) were age 2. The average length and weight of the age 1 coho smolt were 121 mm (±3.4 mm) and 16.8 g (±1.2 g). The average length and weight of the age 2 coho smolt were 135 mm (±1.9 mm) and 23.0 g (±1.0 g).

The age structure, average length, and weight measurements of the sockeye and coho smolt were similar to previous smolt migrations.

Table 3. Age structure, length and weight characteristics of Hidden Lake sockeye smolt, 1976 - 2008.

	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)
2005	91	(±1.8)	9	(±1.9)	140	(±0.5)	179	(±3.6)	24.7	(±2.0)	60.5	(±3.7)
2006	91	(±2.4)	9	(±2.4)	140	(±0.9)	179	(±10.3)	24.7	(±0.5)	60.4	(±8.7)
2007	86	(±2.8)	16	(±3.0)	135	(±0.9)	167	(±3.1)	24.7	(±1.0)	47.4	(±4.8)
2008	97	(±1.8)	3	(±1.7)	123	(±0.9)	170	(±16.3)	18.0	(±0.34)	49.5	(±12.2)
Mean	90		10		136		180		21.9		57.0	

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 smolt between wild and enhanced fish since 1993. In 2008, the

proportion of hatchery-incubated salmon in the sockeye smolt migration was 60% (±4.3%) (Table 4). This proportion is less than the long-term average estimate of the hatchery contribution based on otolith thermal marks, but approximately equal to the most recent 4-year average contribution.

Table 4. The contribution of enhanced sockeye to the Hidden Lake smolt migrations, 1976-2008.

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	(±13,400)	94,300	218,800	70	(±4.2)
2000	475,600	(±52,600)	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	192,800	(±0)	140,800	53,000	27	(±3.9)
2005	290,400	(±15,500)	70,300	220,100	76	(±2.6)
2006	200,800	(±17,900)	106,400	94,400	47	(±3.6)
2007	216,800	(±70,700)	151,100	65,700	70	(±3.4)
2008	350,700	(±58,500)	140,300	210,400	60	(±4.3)
Mean	324,000		96,400	227,500	70	
4-year Mean	264,700		117,000	147,700	63	

Prior to 1993, estimates of smolts originating from hatchery fry releases based on CWT studies.
Since 1993, estimates of smolts originating from hatchery fry releases based on otolith thermal marks.
Mean calculated from 1993 to present.
Prior to 1990, data summary is from Kyle et al. (1990).

Adult Escapement and Enhanced Contribution

The Hidden Lake adult escapement was monitored from 11 July to 14 September 2008. During this time an estimated 15,072 adult sockeye salmon returned to Hidden Creek. Other fish counted during this time was 5 adult coho salmon and 2 adult pink salmon (Appendix 5). The contribution of hatchery incubated adult sockeye population returning to Hidden Lake was 63% (±1.5) (Table 5).

Typically, 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. In 2008, the adult return was less than expected and CIAA did not implement this practice. As an alternative, CIAA staff collected samples from both Hidden Creek and Hidden Lake. Due to variable sample collection procedures, the estimate of the hatchery contribution is not considered statistically valid.

Table 5. Summary of Hidden Lake salmon escapement, age distribution and fish length. 1976 - 2008.

	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*	35,576			90	512	7	557	3	521
1992	32,912			82	505	13	551	5	513
1993	11,582			80	529	9	568	11	536
1994	6,086			60	493	31	557	6	507
1995	7,542			63	514	12	559	21	525
1996	55,526			83	539	7	587	9	540
1997	56,053			77	514	18	566	3	536
1998	67,727			83	510	14	556	3	516
1999	49,406	69.4	(±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	0	62.0	(±3.1)	73	537	18	582	7	544
2003	0	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		79	ND	12	ND	9	ND
2006***	38,535	47		89	502	4	547	7	506
2007***	16,734	56.7	(±7.9)	63	537	23	562	11	520
2008	15,214	62.7	(±1.5)	86	511	8	573	6	517
Mean	25,554	61.4		79	522	12	562	8	536
Min	0	47.0		44	455	1	530	0	502
Max	77,959	76.8		96	550	41	600	34	580

Data prior to 1990 from Kyle, et al. 1990.
Mean escapement from 2005 to 2008 = 20,871
Mean escapement from 1992 to 2008 = 28,037
ND = No Data Collected or Calculated
Note: Total escapement is Lake escapment and not fish returning to wier (morts and sampled fish)
*112,792 fish returned to the weir. 72,060 were harvested in a personal use-dipnet fishery and 5,156 were donated to charity
**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
***Sample collection procedure incomplete. % hatchery estimate is not reliable.

The 2008 estimated commercial fishery harvest of Hidden lake sockeye salmon was 17,938, the estimated personal use fishery harvest was 2,905, and the estimated sport fishery harvest was 2,678 (ADF&G, personal communication).

The percentage of adult male and adult female sockeye salmon returning to Hidden Lake in 2008 was 39% and 61%, respectively. Male fish averaged 531 mm in length and the females averaged

506 mm. An estimated 85.67% of the fish were age 1.2, 7.53% were age 1.3, 6.25% were age 2.2 and 0.55% were age 2.3 (Table 6).

Table 6. Hidden Lake sockeye salmon escapement sex ratio and size data, 2008.

	Age Group						
	1.1	1.2	1.3	2.2	2.3	3.2	Total
Males	0	4,758	755	364	29	0	5,906
Percent	0.00%	31.26%	4.96%	2.39%	0.19%	0.00%	38.80%
Sample Size	0	170	27	13	1	0	211
Mean Lth (mm)		523	580	532	581		531
Std. Error		2	4	6			2
Females	0	8,282	391	588	55	0	9,316
Percent	0.00%	54.41%	2.57%	3.86%	0.36%	0.00%	61.20%
Sample Size	0	296	14	21	2	0	333
Mean Lth (mm)		503	559	509	546		506
Std. Error		2	6	7	3		1
Both Sexes	0	13,041	1,146	951	84	0	15,222
Percent	0.00%	85.67%	7.53%	6.25%	0.55%	0.00%	100.00%
Sample Size	0	466	41	34	3	0	544
Mean Lth (mm)		511	573	517	557		516
Std. Error		1	3	5	3		1

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 were 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 were checked for hatchery incubated fish from 1999 through 2002. 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. No hatchery fish were detected in the Russian River.

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 three years (2003, 2004 and 2005) a total of 311 otolith samples were collected from this creek and its surrounding area. None were found to be of hatchery origin.

In addition, since 1999, the Trail Lakes Hatchery discharge has been checked for fish from Hidden Lake. It is believed returning fish may be attracted to the water they were incubated in; however, no fish collected from the discharge area have been observed with a Hidden Lake thermal mark.

RECOMMENDATIONS

For the 2009 Hidden Lake field season, CIAA may collect adult sockeye otoliths samples from the Kenai River between Skilak Lake and the Russian River. Otoliths will only be collected from sport harvested fish or carcasses.

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APPENDICES

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Appendix 1. Hidden Lake 2007 – Macrozooplankton Density.

Site A - Depth 21 - 20 m

	Density (No/m^2)				Mean	Seasonal Mean
Date	20-Jun	24-Jul	15-Aug	21-Sep	(No/m^2)	(No/m^2)
Epischura	36,518	12,739	30,255	637	20,037	20,037
Cyclops	171,125	51,911	36,624	191	64,963	64,963
Ovig .*Cyclops*	3,822	3,822	2,866	64	2,644	2,644
Bosmina	25,478	67,197	42,994	1,465	34,284	34,284
Ovig. *Bosmina*	11,040	4,140	318	159	3,914	3,914
Daphnia l.	35,669	6,051	25,478	3,248	17,612	17,612
Ovig. *Daphnia l.*	8,493	1,911	3,822	127	3,588	3,588
Daphnia g.	2,548	6,051	14,013	223	5,709	5,709
Ovig. *Daphnia g.*	1,274	1,592	2,866	32	1,441	1,441
Total:					154,191	154,191

Body Size - Site B - Depth 40 - 42 m

	Density (No/m^2)				Mean	Seasonal Mean
Date	20-Jun	24-Jul	15-Aug	21-Sep	(No/m^2)	(No/m^2)
Epischura	5,096	111,465	39,809	9,554	41,481	41,481
Cyclops	492,569	49,834	10,350	346,072	224,706	224,706
Ovig. *Cyclops*	22,930	18,312		6,369	15,870	11,903
Bosmina	39,915	556,529	304,140	131,635	258,055	258,055
Ovig. *Bosmina*	9,342	7,962	796		6,033	4,525
Daphnia l.	17,834	28,662	73,248	25,478	36,306	36,306
Ovig. *Daphnia l.*	7,643	21,497	10,350	1,062	10,138	10,138
Daphnia g	849	11,146	95,541	210,191	79,432	79,432
Ovig. *Daphnia g.*		1,592	15,127	33,970	16,896	12,672
Total:					688,917	679,217

Site C - Depth 17- 19 m

	Density (No/m^2)				Mean	Seasonal Mean
Date	20-Jun	24-Jul	15-Aug	21-Sep	(No/m^2)	(No/m^2)
Epischura	9,554	45,860	16,561	637	18,153	18,153
Cyclops	127,070	22,930	7,962	796	39,690	39,690
Ovig. *Cyclops*	4,459	2,123			3,291	1,646
Bosmina	29,299	224,628	44,268	6,210	76,101	76,101
Ovig. *Bosmina*	8,280	7,219		318	5,272	3,954
Daphnia l.	24,204	16,985	16,879	9,076	16,786	16,786
Ovig. *Daphnia l.*	6,369	7,643	1,911	159	4,021	4,021
Daphnia g	2,548	8,493	15,287	1,752	7,020	7,020
Ovig. *Daphnia g.*	318	3,397	1,592	955	1,566	1,566
Total:					171,899	168,936

Site D - Depth 40 - 43 m

	Density (No/m^2)				Mean	Seasonal Mean
Date	20-Jun	24-Jul	15-Aug	21-Sep	(No/m^2)	(No/m^2)
Epischura	23,089				23,089	23,089
Cyclops	609,873				609,873	609,873
Ovig. *Cyclops*	39,809				39,809	39,809
Bosmina	22,293				22,293	22,293
Ovig. *Bosmina*	7,962				7,962	7,962
Daphnia l.	26,274				26,274	26,274
Ovig *Daphnia l.*	7,962				7,962	7,962
Daphnia g.	1,592				1,592	1,592
Ovig. *Daphnia g.*						
Total:					738,854	738,854

Appendix 1. (cont'd) Hidden Lake 2007 – Macrozooplankton Biomass.

Site A - Depth 20 - 20.5 m

	Body Size (mm)				Body Size (mm)		Biomass (mg/m^2)	
Date	20-Jun	24-Jul	15-Aug	21-Sep	Mean	Seasonal Weighted Mean	Mean	Seasonal Weighted Mean
Epischura	1.04	1.34	1.15	1.00	1.13	1.13	128	127
Cyclops	0.93	1.00	1.09	0.94	0.99	0.97	284	265
Ovig .*Cyclops*	1.24	1.18	1.23	1.24	1.22	1.22	21	21
Bosmina	0.48	0.55	0.58	0.51	0.53	0.55	25	28
Ovig. *Bosmina*	0.67	0.61	0.58	0.54	0.60	0.65	4	5
Daphnia l.	0.78	1.24	1.10	0.72	0.96	0.93	71	65
Ovig. *Daphnia l.*	1.02	1.50	1.53	0.68	1.18	1.22	26	28
Daphnia g.	1.04	1.20	1.58	0.84	1.17			
Ovig. *Daphnia g.*	1.14	1.54		1.38	1.35			
Total:							560	539

Body Size - Site B - Depth 40 - 42 m

	Body Size (mm)				Body Size (mm)		Biomass (mg/m^2)	
Date	20-Jun	24-Jul	15-Aug	21-Sep	Mean	Seasonal Weighted Mean	Mean	Seasonal Weighted Mean
Epischura	1.52	1.13	1.37	1.60	1.41	1.23	490	333
Cyclops	1.06	1.03	1.20	1.41	1.18	1.19	1,599	1,676
Ovig .*Cyclops*	1.22	1.72		1.16	1.37	1.40	130	140
Bosmina	0.47	0.51	0.59	0.56	0.53	0.54	194	200
Ovig. *Bosmina*	0.74	0.56	0.60		0.63	0.65	6	6
Daphnia l.	0.99	0.96	1.14	1.09	1.05	1.08	185	202
Ovig. *Daphnia l.*	1.14	1.40	1.49	1.48	1.38	1.38	113	113
Daphnia g.	1.00	0.92	1.14	1.13	1.05			
Ovig. *Daphnia g.*		1.66	1.57	1.56				
Total:							2,717	2,671

Body Size - Site C - Depth 17 - 19m

	Body Size (mm)				Body Size (mm)		Biomass (mg/m^2)	
Date	20-Jun	24-Jul	15-Aug	21-Sep	Mean	Seasonal Weighted Mean	Mean	Seasonal Weighted Mean
Epischura	1.19	0.98	1.12	0.92	1.05	1.04	94	91
Cyclops	0.89	1.03	1.09	0.96	0.99	0.92	141	120
Ovig .*Cyclops*	1.23	1.22						
Bosmina	0.49	0.46	0.58	0.50	0.51	0.48	186	166
Ovig. *Bosmina*	0.70	0.61		0.69				
Daphnia l.	0.82	1.03	1.03	0.78	0.92	0.92	64	65
Ovig. *Daphnia l.*	1.10	1.37	1.41	1.04				
Daphnia g.	1.00	1.10	1.14	1.26	1.13	1.12	26	26
Ovig. *Daphnia g.*	1.10	1.65	1.55	1.11				
Total:							510	467

Body Size - Site D - Depth 40 - 43m

	Body Size (mm)				Body Size (mm)		Biomass (mg/m^2)	
Date	20-Jun	24-Jul	15-Aug	21-Sep	Mean	Seasonal Weighted Mean	Mean	Seasonal Weighted Mean
Epischura	1.49				1.49	1.49	322	322
Cyclops	0.98				0.98	0.98	2,103	2,103
Ovig .*Cyclops*	1.25							
Bosmina	0.49				0.49	0.49	50	50
Ovig. *Bosmina*	0.69							
Daphnia l.	0.84				0.84	0.84	83	83
Ovig. *Daphnia l.*	0.92							
Daphnia g.	1.35				1.35	1.35	11	11
Ovig. *Daphnia g.*								
Total:							2,569	2,569

Appendix 1. (cont'd) Hidden Lake 2007 – 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)	
6/20/2007	A	1	8.2	3.5	1.9	213.5	8.0	18.0	63	:1	3034	433	0.36	0.05	A	19.5
6/20/2007	A	20	12.3	5.0	2.7	259.6	8.0	8.0	48	:1	3145	472	1.97	0.42		
6/20/2007	B	1	10.7	3.8	2.1	235.2	3.0	8.0	50	:1	3063	469	0.80	0.22	B	18.3
6/20/2007	B	30	7.4	3.8	2.3	210.9	5.0	35.0	74	:1	3410	348	0.47	0.28		
7/24/2007	A	1	8.5	4.0	2.5	226.4	24.0	10.0	62	:1	2966	552	1.04	0.30	A	20.4
7/24/2007	A	11	11.2	4.5	2.8	223.8	12.0	10.0	46	:1	3031	450	0.90	0.44		
7/24/2007	B	1	7.9	4.3	2.7	199.4	9.0	11.0	59	:1	3106	436	0.80	0.29	B	20.4
7/24/2007	B	12	9.4	4.4	3.0	217.3	10.0	9.0	53	:1	3122	411	0.70	0.33		
8/15/2007	A	1	6.6	8.3	5.2	216.1	2.8	11.0	76	:1	3506	343	0.34	0.16	A	24
8/15/2007	A	16	9.4	5.5	2.7	200.7	5.4	10.0	50	:1	3373	321	0.41	0.30		
8/15/2007	B	1	6.1	5.2	3.1	260.9	13.4	18.0	101	:1	3452	368	0.21	0.36	B	30.0
8/15/2007	B	21	8.1	6.2	4.1	261.4	10.7	27.0	79	:1	3588	441	0.27	0.31		
9/21/2007	A	1	7.0	8.7	6.4	199.8	11.5	10.0	66	:1	3745	396	0.54	0.38	A	16.0
9/21/2007	A	15	6.4	5.3	3.6	190.1	12.2	13.0	70	:1	3882	634	0.66	0.43		
9/21/2007	B	1	8.6	5.5	3.9	205.4	7.9	10.0	55	:1	3894	391	0.40	0.26	B	22.9
9/21/2007	B	40	9.4	5.6	3.9	204.1	11.8	12.0	51	:1	3832	396	0.44	0.22		
Mean	1 - Meter		8.0	5.4	3.5	219.6	10.0	12.0	65	:1	3346	423.5	0.6	0.25	Mean	21.4
Min			6.1	3.5	1.9	199.4	2.8	8.0	75	:1	2966	343	0.21	0.05	Min	16.0
Max			10.7	8.7	6.4	260.9	24.0	18.0	58	:1	3894	552	1.04	0.38	Max	30.0
Mean	Hypolimnion		9.2	5.0	3.1	221.0	9.4	15.5	57	:1	3423	434	0.73	0.34		
Min			6.4	3.8	2.3	190.1	5.0	8.0	69	:1	3031	321	0.27	0.22		
Max			12.3	6.2	4.1	261.4	12.2	35.0	53	:1	3882	634	1.97	0.44		

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 Sta	Secchi (meters)
6/20/2007	A	1	149	7.3	70.5	0.1	8	23.3	3.2	8	A	9
6/20/2007	A	20	149	7.3	70.8	0.3	8	23.9	3.3	9	B	7.5
6/20/2007	B	1	147	7.2	70.0	0.2	8	23.2	3.3	10	C	8.5
6/20/2007	B	30	154	7.2	72.6	0.2	6	23.7	3.3	7	D	6.5
7/24/2007	A	1	143	7.1	69.1	0.2	8	22.3	3.7	13	A	6.5
7/24/2007	A	11	148	7.2	70.0	0.3	8	23.1	3.6	8	B	8
7/24/2007	B	1	146	7.4	69.4	0.1	9	23.5	3.7	8	C	7
7/24/2007	B	12	149	7.3	71.3	0.1	8	23.2	3.6	7	D	
8/15/2007	A	1	144	7.0	68.1	0.2	10	22.6	3.6	11	A	8
8/15/2007	A	16	145	6.9	69.6	0.2	6	23.3	3.6	8	B	13
8/15/2007	B	1	144	7.2	68.4	0.5	6	22.5	3.5	9	C	8.5
8/15/2007	B	21	150	7.0	69.6	0.2	6	23.3	3.5	8	A	10
9/21/2007	A	1	145	7.4	69.8	0.3	9	21.9	3.2	10	B	14.5
9/21/2007	A	15	147	7.4	70.0	0.4	8	21.3	3.2	7	C	10.5
9/21/2007	B	1	146	7.4	70.7	0.3	8	21.9	3.2	8		
9/21/2007	B	40	147	7.4	70.5	0.5	6	22.0	3.2	8		
Mean	1 - Meter		146	7.3	69.5	0.2	8	22.7	3.4	10	Mean	9.0
Min			143	7.0	68.1	0.1	6	21.9	3.2	8	Min	6.50
Max			149	7.4	70.7	0.5	10	23.5	3.7	13	Max	14.50
Mean	Hypolimnion		149	7.2	70.6	0.3	7	23.0	3.4	8		
Min			145	6.9	69.6	0.1	6	21.3	3.2	7		
Max			154	7.4	72.6	0.5	8	23.9	3.6	9		

Appendix 2. Hidden Lake 2008 – Macrozooplankton Density.

Site A - Depth 21 - 20 m

	Density (No/m^2)			Mean	Seasonal Mean
Date	12-Jun	25-Jul	11-Sep	(No/m^2)	(No/m^2)
Epischura	50,955	16,561	12,420	26,645	26,645
Cyclops	92,675	58,599	478	50,584	50,584
Ovig .*Cyclops*	1,592	8,493		5,042	5,042
Bosmina	41,083	120,594	12,420	58,033	58,033
Ovig. *Bosmina*	637	425	1,433	832	832
Daphnia l.	28,662	47,134	20,541	32,113	32,113
Ovig. *Daphnia l.*	11,465	24,628	4,777	13,623	13,624
Total:				186,872	186,872

Body Size - Site B - Depth 40 - 42 m

	Density (No/m^2)			Mean	Seasonal Mean
Date	12-Jun	25-Jul	11-Sep	(No/m^2)	(No/m^2)
Epischura	2,548	16,136		9,342	9,342
Cyclops	373,673	531,635		452,654	452,654
Ovig. *Cyclops*	21,231	13,588		17,410	17,410
Bosmina	93,418	272,611		183,015	183,014
Ovig. *Bosmina*		849		849	849
Daphnia l.	15,287	82,378		48,832	48,832
Ovig. *Daphnia l.*	3,397	37,367		20,382	20,382
Total:				732,484	732,483

Site C - Depth 17- 19 m

	Density (No/m^2)			Mean	Seasonal Mean
Date	12-Jun	25-Jul	11-Sep	(No/m^2)	(No/m^2)
Epischura	10,191	11,147	5,945	9,094	9,094
Cyclops	118,153	32,484	4,671	51,769	51,769
Ovig. *Cyclops*	3,503	6,688		5,096	5,096
Bosmina	57,006	32,803	29,724	39,844	39,844
Ovig. *Bosmina*	318	318		318	318
Daphnia l.	43,631	57,643	10,616	37,297	37,297
Ovig. *Daphnia l.*	10,828	23,885	1,274	11,996	11,996
Total:				155,414	155,414

Appendix 2. (cont'd) Hidden Lake 2008 – Macrozooplankton Biomass.

Site A - Depth 20 - 20.5 m

	Body Size (mm)			Body Size (mm)		Biomass (mg/m^2)	
Date	12-Jun	25-Jul	11-Sep	Mean	Seasonal Weighted Mean	Mean	Seasonal Weighted Mean
Epischura		1.57	0.65	1.02	1.48	11	32
Cyclops	1.03	1.07	1.01	1.08	1.04	166	155
Ovig .*Cyclops*	1.27	1.24		1.26	1.25	6	6
Bosmina	0.50	0.44	0.50	0.49	0.48	19	19
Ovig. *Bosmina*	0.66	0.61	0.63	0.63	0.65	14	15
Daphnia l.	0.79	0.95	0.72	0.85	0.89	74	82
Ovig. *Daphnia l.*	1.03	1.02		0.96	1.03	20	23
Daphnia g.	1.12		1.20	1.03	1.11	0	1
Ovig. *Daphnia g.*							
Total:						311	331

Body Size - Site B - Depth 40 - 42 m

	Body Size (mm)			Body Size (mm)		Biomass (mg/m^2)	
Date	12-Jun	25-Jul	11-Sep	Mean	Seasonal Weighted Mean	Mean	Seasonal Weighted Mean
Epischura	0.56	1.34	1.06	1.10	1.11	132	135
Cyclops	1.03	1.01	1.05	1.06	1.03	658	625
Ovig .*Cyclops*	1.26	1.27	1.27	1.27	1.27	84	84
Bosmina	0.44	0.35	0.55	0.48	0.53	811	982
Ovig. *Bosmina*	0.68	0.61	0.59	0.63	0.61	86	80
Daphnia l.	0.86	0.91	0.98	0.95	0.94	398	384
Ovig. *Daphnia l.*	1.13	1.08	1.26	1.10	1.12	134	138
Daphnia g.	0.93	1.24	1.10	1.09	1.08	128	126
Ovig. *Daphnia g.*			1.42	1.41	1.40	38	37
Total:						2,469	2,591

Body Size - Site C - Depth 17 - 19m

	Body Size (mm)			Body Size (mm)		Biomass (mg/m^2)	
Date	12-Jun	25-Jul	11-Sep	Mean	Seasonal Weighted Mean	Mean	Seasonal Weighted Mean
Epischura	0.65	1.12	0.86	0.91	0.97	29	35
Cyclops	0.88	1.11		1.04	0.89	84	60
Ovig .*Cyclops*	1.25	1.30		1.28	1.25	6	6
Bosmina	0.48	0.52	0.50	0.51	0.51	69	67
Ovig. *Bosmina*	0.64	0.64	0.62	0.63	0.64	10	10
Daphnia l.	0.75	0.87	0.74	0.79	0.84	97	111
Ovig. *Daphnia l.*	1.07	1.10	1.20	1.04	1.09	22	24
Daphnia g.	0.80	1.07	1.15	0.98	1.10	1	2
Ovig. *Daphnia g.*				1.41	1.41	1	1
Total:						320	316

Appendix 2. (cont'd) Hidden Lake 2008 – 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)	
6/12/2008	A	1	13.4	8.2	3.2	217.1	2.4	4.1	37 :1	3126	224	0.33	0.14	A	16.3
6/12/2008	A	15	12.6	6.9	3.1	250.2	6.9	4.1	45 :1	3074	212	0.99	0.38		
6/12/2008	B	1	15.3	9.0	3.9	240.1	3.6	4.1	35 :1	3096	215	0.40	0.17	B	19.7
6/12/2008	B	30	13.8	9.8	6.9	218.6	11.7	4.1	36 :1	3202	113	0.53	0.32		
7/25/2008	A	1	11.9	8.9	2.3	214.2	1.8	4.1	41 :1	3072	174	0.75	0.37	A	19.4
7/25/2008	A	16	5.6	4.5	1.6	185.3	3.6	59.4	97 :1	3100	136	0.35	0.32		
7/25/2008	B	1	10.0	7.6	1.9	209.2	4.8	4.1	47 :1	3035	159	0.61	0.32	B	25.8
7/25/2008	B	26	5.9	4.7	2.6	176.4	5.4	17.0	73 :1	3148	103	0.18	0.26		
9/11/2008	A	1	11.4	9.3	2.1	204.2	3.3	4.1	40 :1	3095	165	1.12	0.42	A	22.0
9/11/2008	A	21	6.2	5.4	2.0	177.8	3.1	6.7	66 :1	3234	106	0.42	0.28		
Mean	1 - Meter		12.4	8.6	2.7	217.0	3.2	4.1	39 :1	3,085	187	0.64	0.28	Mean	20.6
Min			10.0	7.6	1.9	204.2	1.8	4.1	46 :1	3,035	159	0.33	0.14	Min	16.3
Max			15.3	9.3	3.9	240.1	4.8	4.1	35 :1	3,126	224	1.12	0.42	Max	25.8
Mean	Hypolimnion		8.8	6.3	3.2	201.7	6.1	18.3	55 :1	3,152	134	0.49	0.31		
Min			5.6	4.5	1.6	176.4	3.1	4.1	71 :1	3,074	103	0.18	0.26		
Max			13.8	9.8	6.9	250.2	11.7	59.4	50 :1	3,234	212	0.99	0.38		

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 Sta	Secchi (meters)
6/12/2008	A	1	149	7.3	69.7	0.3	10	22.0	3.2	11	A	8.5
6/12/2008	A	15	150	7.3	70.2	0.2	9	22.6	2.9	9	B	7.5
6/12/2008	B	1	150	7.3	68.5	0.4	11	22.2	3.2	9	C	7.5
6/12/2008	B	30	151	7.4	69.6	0.3	10	22.5	3.3	9	A	8.5
7/25/2008	A	1	149	7.3	67.7	0.4	10	22.4	2.9	12	B	9.5
7/25/2008	A	16	154	7.4	69.1	0.3	6	22.6	2.9	10	C	8.75
7/25/2008	B	1	150	7.5	67.2	0.4	10	22.2	3.2	10	A	6
7/25/2008	B	26	153	7.2	68.4	0.3	9	22.2	3.1	8	B	ND
9/11/2008	A	1	147	7.6	65.8	0.2	11	22.3	2.6	24	C	6.0
9/11/2008	A	21	151	7.1	67.3	0.1	10	22.7	3.0	22		
Mean	1 - Meter		149	7.4	67.8	0.3	10	22.2	3.0	13	Mean	7.78
Min			147	7.3	65.8	0.2	10	22.0	2.6	9	Min	6.00
Max			150	7.6	69.7	0.4	11	22.4	3.2	24	Max	9.50
Mean	Hypolimnion		152	7.3	68.9	0.2	9	22.5	3.0	12		
Min			150	7.1	67.3	0.1	6	22.2	2.9	8		
Max			154	7.4	70.2	0.3	10	22.7	3.3	22		

Appendix 3. Hidden Lake 2008 – Environmental Conditions.

Smolt Migration

Date	Sky	Precip. (mm)	Stage (ft)	Flow	Water Temp. (°C)	Air Temp. (°C)
23-May	2	ND	0.84	ND	9.5	14.0
24-May	5	65	0.89	ND	6.0	11.0
25-May	3	0	0.86	ND	9.0	11.0
26-May	2	0	0.89	ND	9.0	ND
27-May	1	0	0.89	ND	12.0	16.0
28-May	2	0	0.87	ND	12.1	18.0
29-May	4	0	0.86	ND	12.0	17.0
30-May	2	0	0.89	ND	12.0	16.9
31-May	ND	ND	ND	ND	ND	ND
1-Jun	4	0	0.84	ND	8.0	10.1
2-Jun	4	3	0.84	ND	9.0	13.5
3-Jun	3	0	0.89	ND	10.1	15.0
4-Jun	4	0	0.85	ND	8.9	12.0
5-Jun	4	0	0.87	ND	8.5	10.1
6-Jun	3	0	0.84	ND	11.0	14.1
7-Jun	4	0	0.82	ND	10.0	9.0
8-Jun	3	3	0.84	ND	10.9	ND
9-Jun	3	0	ND	ND	12.0	17.0
10-Jun	4	0	0.83	ND	12.0	14.0
11-Jun	4	0	0.83	ND	11.0	12.5
12-Jun	3	32	0.84	ND	12.0	10.5
13-Jun	3	0	0.82	ND	12.0	15.0
14-Jun	4	1	0.82	ND	12.0	10.0
15-Jun	2	0	0.79	ND	12.0	14.0
16-Jun	3	0	0.83	ND	13.0	17.0
17-Jun	2	0	0.80	ND	15.0	18.0
18-Jun	3	0	0.79	ND	16.0	15.3
19-Jun	4	0	0.76	ND	16.0	15.0
20-Jun	4	0	0.76	ND	16.0	15.0
21-Jun	2	1	0.82	ND	16.0	15.5
22-Jun	3	65	0.80	ND	15.0	14.5
23-Jun	4	0	0.80	ND	14.0	15.0
24-Jun	4	5	0.80	ND	13.0	12.0
25-Jun	3	0	0.78	ND	13.5	14.0
26-Jun	3	0	0.79	ND	12.0	14.0
27-Jun	3	5	0.79	ND	13.0	16.0
28-Jun	3	0	0.76	ND	13.5	14.0
29-Jun	4	1	0.76	ND	13.5	11.0
30-Jun	3	0	0.76	ND	13.0	14.5
1-Jul	2	0	0.76	ND	12.0	20.0
2-Jul	2	0	0.76	ND	17.0	20.0
3-Jul	1	0	0.72	ND	17.0	22.0
4-Jul	3	0	0.72	ND	17.0	16.0
5-Jul	2	0	0.72	ND	15.0	20.0
6-Jul	3	0	0.72	ND	14.0	19.0
7-Jul	3	0	0.74	ND	14.0	15.0
8-Jul	4	0	0.74	ND	14.0	16.0
Total		180				
Avg.		4.0	0.81	ND	12	15
Min.		0	0.72	ND	6	9
Max.		65	0.89	ND	17	22

Summary of Cloud Cover - Percent of Days

	No. Days	Meas. Rain	Overcast	Partly Cloudy	Clear
Smolts	64	16%	25%	17%	3%
Adults	63	40%	59%	17%	5%

1.0 = Clear
2.0 = Cloud Cover <50%
3.0 = Cloud Cover>50%
4.0 = Overcast
5.0 = Rain

ND = No Data Ice out = ND

Adult Migration

Date	Sky	Precip. (mm)	Stage (ft)	Flow	Water Temp. (°C)	Air Temp. (°C)
11-Jul	3	0	0.76	ND	15	16
12-Jul	3	0	0.77	ND	16	17
13-Jul	4	1	0.78	ND	15	15
14-Jul	4	0	0.77	ND	16	16
15-Jul	4	0	0.78	ND	16	15
16-Jul	5	0	0.74	ND	14	14
17-Jul	4	12	0.76	ND	12	12
18-Jul	5	10	0.78	ND	13	12
19-Jul	2	1	0.78	ND	15	14
20-Jul	2	0	0.79	ND	15	14
21-Jul	4	0	0.79	ND	13	11
22-Jul	4	0	0.78	ND	14	13
23-Jul	5	8	0.77	ND	13	11
24-Jul	5	4	0.80	ND	13	10
25-Jul	4	1	0.80	ND	15	15
26-Jul	5	1	0.80	ND	13	12
27-Jul	3	4	0.81	ND	14	14
28-Jul	4	0	0.82	ND	15	15
29-Jul	1	1	0.81	ND	18	19
30-Jul	4	0	0.80	ND	17	19
31-Jul	2	0	0.81	ND	18	18
1-Aug	1	0	0.81	ND	16	18
2-Aug	4	0	0.81	ND	15	16
3-Aug	4	0	0.82	ND	15	14
4-Aug	4	0	0.81	ND	16	14
5-Aug	3	1	0.81	ND	16	15
6-Aug	3	1	0.81	ND	16	17
7-Aug	3	0	0.82	ND	16	16
8-Aug	3	0	0.81	ND	17	18
9-Aug	4	2	0.81	ND	16	12
10-Aug	2	1	0.83	ND	17	16
11-Aug	2	0	0.83	ND	17	16
12-Aug	4	0	0.81	ND	16	14
13-Aug	3	0	0.81	ND	15	15
14-Aug	4	0	0.80	ND	16	15
15-Aug	4	0	0.79	ND	16	15
16-Aug	4	3	0.80	ND	17	15
17-Aug	3	0	0.79	ND	16	14
18-Aug	4	0	0.79	ND	16	15
19-Aug	2	0	0.79	ND	16	17
20-Aug	2	0	0.79	ND	17	18
21-Aug	2	0	0.79	ND	16	16
22-Aug	4	0	0.77	ND	16	15
23-Aug	4	0	0.75	ND	16	15
24-Aug	3	0	0.76	ND	16	15
25-Aug	3	0	0.75	ND	17	16
26-Aug	4	0	0.76	ND	16	15
27-Aug	4	1	0.75	ND	16	13
28-Aug	5	6	0.75	ND	16	14
29-Aug	3	0	0.76	ND	17	16
30-Aug	1	0	0.76	ND	17	16
31-Aug	5	0	0.75	ND	15	12
1-Sep	4	1	0.75	ND	15	12
2-Sep	4	0	0.71	ND	15	12
3-Sep	3	1	0.70	ND	16	15
4-Sep	3	1	0.72	ND	16	14
5-Sep	2	7	0.72	ND	16	14
6-Sep	5	2	0.72	ND	14	10
7-Sep	4	3	0.73	ND	15	12
8-Sep	4	2	0.72	ND	15	13
9-Sep	ND	ND	ND	ND	ND	ND
10-Sep	5	0	0.72	ND	13	11
11-Sep	ND	ND	ND	ND	ND	ND
12-Sep	5	5	0.72	ND	13	12
13-Sep	4	0	0.70	ND	13	11
14-Sep	3	0	0.70	ND	13	11
Total		80				
Avg.		1.3	0.78	ND	15	14
Min.		0	0.70	ND	12	10
Max.		12	0.83	ND	18	19

Appendix 4. Hidden Lake 2008 – Smolt Migration.

	Sockeye			Coho			Rainbow		Dolly Varden	
Date	Daily	Mort.	Total	Daily	Mort.	Total	Daily	Total	Daily	Total
23-May	167	0	167	85	0	85	0	0	0	0
24-May	105	0	272	32	0	117	0	0	0	0
25-May	40	0	312	23	0	140	0	0	0	0
26-May	1,088	0	1,400	36	0	176	0	0	0	0
27-May	1,728	0	3,128	42	0	218	0	0	0	0
28-May	6,079	0	9,207	59	0	277	0	0	0	0
29-May	8,428	0	17,635	100	0	377	0	0	0	0
30-May	782	0	18,417	300	0	677	0	0	0	0
31-May	137	0	18,554	105	0	782	0	0	0	0
1-Jun	291	0	18,845	106	0	888	0	0	0	0
2-Jun	71	0	18,916	33	0	921	0	0	0	0
3-Jun	3,603	0	22,519	120	0	1,041	0	0	0	0
4-Jun	3,081	0	25,600	185	0	1,226	0	0	0	0
5-Jun	540	0	26,140	251	0	1,477	0	0	0	0
6-Jun	114,771	0	140,911	55	0	1,532	0	0	0	0
7-Jun	5,582	0	146,493	31	0	1,563	0	0	0	0
8-Jun	29,764	0	176,257	576	0	2,139	0	0	0	0
9-Jun	56,174	0	232,431	866	0	3,005	0	0	0	0
10-Jun	9,468	0	241,899	976	0	3,981	0	0	0	0
11-Jun	1,313	0	243,212	471	0	4,452	0	0	0	0
12-Jun	26,667	0	269,879	937	0	5,389	1	1	0	0
13-Jun	15,330	0	285,209	485	0	5,874	0	1	0	0
14-Jun	4,471	300	289,980	211	0	6,085	0	1	0	0
15-Jun	19,230	0	309,210	778	0	6,863	2	3	0	0
16-Jun	12,131	0	321,341	1,208	0	8,071	1	4	2	2
17-Jun	7,341	0	328,682	975	0	9,046	3	7	3	5
18-Jun	7,510	0	336,192	742	0	9,788	1	8	0	5
19-Jun	2,332	0	338,524	406	0	10,194	0	8	0	5
20-Jun	1,773	0	340,297	480	0	10,674	3	11	4	9
21-Jun	1,858	0	342,155	305	0	10,979	0	11	4	13
22-Jun	1,121	0	343,276	239	0	11,218	0	11	0	13
23-Jun	651	0	343,927	159	0	11,377	0	11	0	13
24-Jun	436	0	344,363	165	0	11,542	0	11	0	13
25-Jun	157	0	344,520	35	0	11,577	0	11	0	13
26-Jun	632	0	345,152	107	0	11,684	1	12	0	13
27-Jun	671	0	345,823	136	0	11,820	0	12	1	14
28-Jun	1,265	0	347,088	157	0	11,977	1	13	0	14
29-Jun	496	0	347,584	145	0	12,122	2	15	0	14
30-Jun	385	0	347,969	61	0	12,183	0	15	0	14
1-Jul	846	0	348,815	109	0	12,292	1	16	0	14
2-Jul	425	0	349,240	64	0	12,356	0	16	0	14
3-Jul	892	0	350,132	94	0	12,450	3	19	1	15
4-Jul	310	0	350,442	50	0	12,500	0	19	0	15
5-Jul	36	0	350,478	2	0	12,502	0	19	0	15
6-Jul	168	0	350,646	31	0	12,533	0	19	0	15
Total	350,400	300	350,700	12,500	0	12,500		19		15

Appendix 5. Hidden Lake 2008 – Adult Migration.

	Sockeye					Coho		King		Pink		Chum		Rainbow		Dolly Varden	
Date	Daily Escapement	Mort.	Otolith Collection	Total Return	Lures	Daily Escapement	Total Return	Daily Escapement	Total Return	Daily Escapement	Total Return	Daily Escapement	Total Return	Daily Escapement	Total Return	Daily Escapement	Total Return
11-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Jul	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Jul	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Jul	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Jul	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Jul	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jul	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jul	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jul	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jul	157	0	0	159	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jul	0	0	0	159	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Jul	3,528	0	0	3,687	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jul	0	0	0	3,687	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jul	0	0	0	3,687	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Jul	1,190	0	0	4,877	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jul	68	0	0	4,945	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jul	1	0	0	4,946	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jul	23	0	0	4,969	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jul	4	0	0	4,973	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jul	98	0	0	5,071	1	0	0	0	0	0	0	0	0	0	0	0	0
31-Jul	799	0	135	6,005	4	0	0	0	0	0	0	0	0	0	0	0	0
1-Aug	3	0	0	6,008	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Aug	0	0	0	6,008	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Aug	253	0	0	6,261	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Aug	2	0	0	6,263	0	0	0	0	0	0	0	0	0	0	0	0	0
5-Aug	3	0	0	6,266	0	0	0	0	0	0	0	0	0	0	0	0	0
6-Aug	11	0	0	6,277	0	0	0	0	0	0	0	0	0	0	0	0	0
7-Aug	60	0	0	6,337	0	0	0	0	0	0	0	0	0	0	0	0	0
8-Aug	25	0	0	6,362	1	0	0	0	0	0	0	0	0	0	0	0	0
9-Aug	1	0	0	6,363	0	0	0	0	0	0	0	0	0	0	0	0	0
10-Aug	2,245	0	0	8,608	1	0	0	0	0	0	0	0	0	0	0	0	0
11-Aug	1	0	0	8,609	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Aug	67	0	0	8,676	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Aug	12	0	0	8,688	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Aug	17	0	0	8,705	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Aug	289	0	0	8,994	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Aug	134	0	0	9,128	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Aug	115	0	0	9,243	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Aug	95	0	0	9,338	1	0	0	0	0	0	0	0	0	0	0	0	0
19-Aug	2	0	0	9,340	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Aug	20	0	0	9,360	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Aug	23	0	0	9,383	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Aug	0	0	0	9,383	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Aug	1,556	0	0	10,939	1	0	0	0	0	0	0	0	0	0	0	0	0
24-Aug	36	0	0	10,975	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Aug	73	0	0	11,048	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Aug	2	0	0	11,050	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Aug	1,698	0	0	12,748	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Aug	1,050	0	0	13,798	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Aug	4	0	0	13,802	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Aug	3	0	0	13,805	0	0	0	0	0	0	0	0	0	0	0	0	0
31-Aug	11	0	0	13,816	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Sep	2	0	0	13,818	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Sep	167	0	0	13,985	0	4	4	0	0	0	0	0	0	0	0	0	0
3-Sep	65	0	0	14,050	0	1	5	0	0	1	1	0	0	0	0	0	0
4-Sep	184	0	0	14,234	0	0	5	0	0	0	1	0	0	0	0	0	0
5-Sep	595	0	0	14,829	0	0	5	0	0	1	2	0	0	0	0	0	0
6-Sep	57	0	0	14,886	0	0	5	0	0	0	2	0	0	0	0	0	0
7-Sep	6	0	0	14,892	0	0	5	0	0	0	2	0	0	0	0	0	0
8-Sep	188	0	0	15,080	0	0	5	0	0	0	2	0	0	0	0	0	0
9-Sep	2	0	0	15,082	0	0	5	0	0	0	2	0	0	0	0	0	0
10-Sep	2	0	0	15,084	0	0	5	0	0	0	2	0	0	0	0	0	0
11-Sep	0	0	0	15,084	0	0	5	0	0	0	2	0	0	0	0	0	0
12-Sep	4	1	0	15,089	0	0	5	0	0	0	2	0	0	0	0	0	0
13-Sep	111	6	0	15,206	0	0	5	0	0	0	2	0	0	0	0	0	0
14-Sep	8	0	0	15,214	0	0	5	0	0	0	2	0	0	0	0	0	0
Total	15,072	7	135	15,214	9	5		0		2		0		0		0	

* Weir was left open on 7/22 due to bear activity. Count includes an estimated 1,500 adults that passed.

Appendix 6. Hidden Lake 2008 - Update.

Stocking & Misc. Activities

Crew on-site:	19-May	
Ice-out:	NA	(approximate date)
Crew off-site:	13-Sep	
Fry stocking:	27-May	917,000
Adult Otolith Collection	23-Aug and 4-Sep	

Smolt Migration

Dates:	19-May to 27-Jun	
	No.	%
Sockeyes:	350,700	
Mortalities:	300	0.1%
Age 1:	340,000	96.9%
Age 2:	10,700	3.1%
Hatchery:	210,400	60%
Coho:	12,500	
Dolly Varden:	15	
Rainbow:	19	

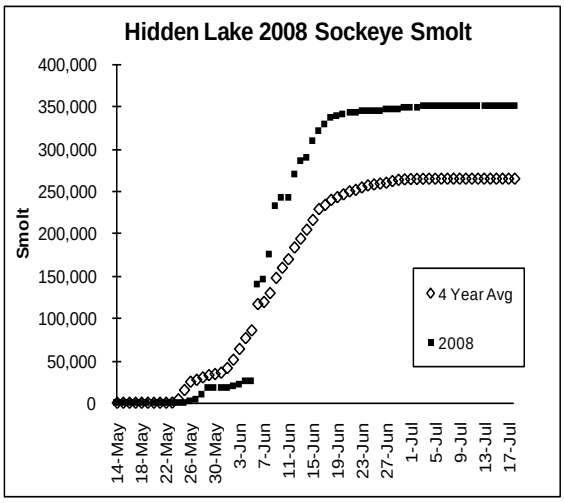
Egg Take

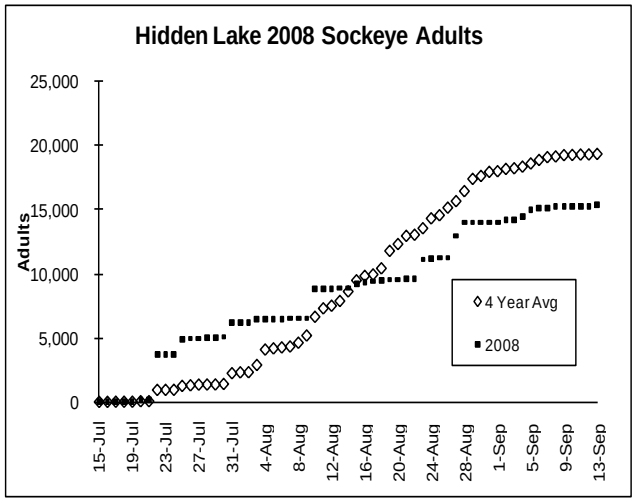
Dates:	17-Sep to 12-Oct	
	No. Female	No. Male
No. of broodstock used:	1,543	1,454
Green eggs:	4,004,000	
Fecundity:	2,595	
Eyed eggs:	3,648,000	
Survival	91.0%	

Adult Migration

Dates:	11-Jul to 14-Sep	
	No.	%
Sockeye total return:	38,735	
Hidden Creek return:	15,214	39.3%
Commercial Harvest:*	17,938	46.3%
Sportfish Harvest:*	2,678	6.9%
Personal Use Harvest:*	2,905	7.5%
Otolith Collection:	628	1.6%
Mortalites:	7	
Lake Escapement:		
Hatchery broodstock:	3,064	7.9%
Lake broodstock:	12,008	
Lures:	15	
Coho:	5	

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





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