Hidden Lake
Sockeye Salmon Enhancement
Progress Report
2014

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February 2015

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 harvest and sale of surplus fish.

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DISCLAIMER

The Cook Inlet Aquaculture Association (CIAA) conducts salmon enhancement and restoration projects in Area H, Cook Inlet and associated waters. As an integral part of these projects a variety of monitoring and evaluation studies are conducted. The following progress report is a synopsis of the monitoring and evaluation studies conducted for the Hidden Lake sockeye salmon enhancement project.

The purpose of the progress report is to provide a vehicle to distribute the information produced by the monitoring and evaluation studies. Data collected each year are presented with a summary of the information previously collected for comparative purposes. These reports are intended to provide a general description of project activity and are not an exhaustive evaluation of any restoration or enhancement project. The information presented in this report has not undergone an extensive review. As reviews are completed, the information may be updated and presented in later progress reports.

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ACKNOWLEDGEMENTS

Many individuals contributed to the 2014 field season at the Hidden Lake Salmon Enhancement Project. Appreciation is extended to the Cook Inlet Aquaculture Association seasonal assistants and full-time staff who invested many hours in planning and executing this project. Exceptional appreciation is extended to the Cook Inlet Aquaculture Association Board of Directors, the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service Kenai Field Office, and the Kenai National Wildlife Refuge.

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ABSTRACT

This progress report summarizes the 2014 sockeye and coho salmon smolt and adult sockeye salmon enumeration at Hidden Lake. The report also summarizes two research studies done on fidelity straying within Hidden Lake and straying outside of the lake as well as the gamete collection.

In 2014, 272,932 live sockeye salmon smolt migrated from Hidden Lake. Based on otolith sampling, 76% (±3.6) were identified as being of hatchery origin and 97% (±1.7) were age 1 and the remaining 3% (±1.7) were Age 2. For coho, 32,653 smolt emigrated from the lake of which 43.0% (±5.0) and 56.3% (±5.0) were identified as age 1 and age 2 respectively.

For adult sockeye salmon return to Hidden Lake a total of 21,838 fish were counted through the weir. Otolith analysis indicated that 72% (±3.5) were identified as being of hatchery origin. Age 1.2 were the majority of the return (79%), followed by age 1.3 (11%) and finally age 2.2 (9%).

The fidelity study at Hidden Lake indicated that the adult sockeye salmon that return to the north side of the western region of the lake were predominantly hatchery-origin fish at 84.1%, while the south side of the same region of the lake had 91.8% and the eastern region of the lake had 90%. No Hidden Lake strays were identified in any of the areas sampled, which included the Kenai-Skilak confluence and the south and north shores of Skilak Lake.

Trail Lakes Hatchery stocked 1,540,000 unfed fry (0.08 gm) into Hidden Lake in mid-May. In September, the hatchery staff collected 1,647,600 green sockeye salmon eggs from 710 females and 710 males for release in 2015.

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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 (Barton & Barrett, 1973 and Bill, Namtvedt, & Davis, 1972). Based on these investigations it appeared that Hidden Lake had the potential for increased production of sockeye salmon (*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 (FREDD) of ADF&G. Initial enhancement activities involved the collection of basic fisheries and limnological data and the gathering of a small number of sockeye salmon eggs to evaluate incubation and fry rearing procedures (Kyle, Litchfield, & Todd, 1990).

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

Based on the potential of Hidden Lake to rear sockeye salmon 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 salmon escapement of 30,000 fish was considered an appropriate management strategy and could be accomplished by:

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

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

In March 1999, ADF&G conducted the Hidden Lake Sockeye Salmon Enhancement Project Technical Review (Simpson & Edmundson, 1999). Concerns arose regarding the amount of sockeye salmon entering Hidden Lake. In 2000, CIAA took steps to alleviate this concern by using 4-year floating averages of survival rates (egg-to-fry, fry-to-smolt, and smolt-to-adult) and ADF&G estimated harvests to calculate a stocking rate that would best allow for an annual target escapement of 30,000 sockeye salmon into Hidden Lake. Also based on the technical review, ADF&G recommended that two special studies be conducted: one study to determine if hatchery-incubated fish released to Hidden Lake were straying into other Kenai River system spawning populations and a second study to determine the contribution of hatchery-incubated fish to the sockeye salmon population returning to Hidden Lake.

In 2012, ADF&G, United States Fish and Wildlife Services (USFWS), Kenai Wildlife Refuge and CIAA participated in a review of the Hidden Lake project. Concerns over two conditions in the Special Use Permit were voiced by USFWS that they wanted to address. These two concerns were (1) the ratio of hatchery to natural fish in the spawning population and (2) the straying study had yet to be completed with statistically valid numbers. Based on these concerns all three parties agreed to the following changes to take place starting in 2012:

1. Change the release of hatchery reared unfed fry to the eastern basin of the lake;
2. Change the location of broodstock and egg collection to the western basin-south side of the lake;
3. Collect otoliths during spawning from three regions on the lake (Eastern Basin - new fry release, Western Basin-South Side - new brood and egg collection site and Western Basin-North Side);
4. Collect otoliths from Skilak Lake (North [n=220] and South [n=220] side), Skilak Lake - Dunes area (n=440) and Kenai River - Jim's Landing to Skilak Confluence (n=220); and
5. Collect otoliths from n=250 residual salmon during egg collection activities.

Items 1, 2, and 3 were changes that would occur each year between 2012 and 2017, while items number 4 and 5 were to be assessed at the end of the 2012 season to determine if further sampling was necessary. Due to flood conditions in 2012, sufficient samples could not be collected for the straying study (item number 4). It was concluded that CIAA would perform this sampling objective again in 2013. CIAA was successful in collecting sufficient samples from the Dunes area in 2013. However, it was agreed that CIAA would sample the other three areas (Kenai-Skilak confluence, north and south shores of Skilak Lake) and the supposed residual sockeye salmon again in 2014 due to discrepancies in reading the age from the otoliths. Additionally, USFWS requested that CIAA collect length from broodstock used to ensure that broodstock selection was indeed random.

Details of the above changes can be found in the Hidden Lake Operational Plan 2012 (Cook Inlet Aquaculture Association, United States Fish and Wildlife Service, Kenai Wildlife Refuge, Alaska Department of Fish and Game, 2012).

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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).

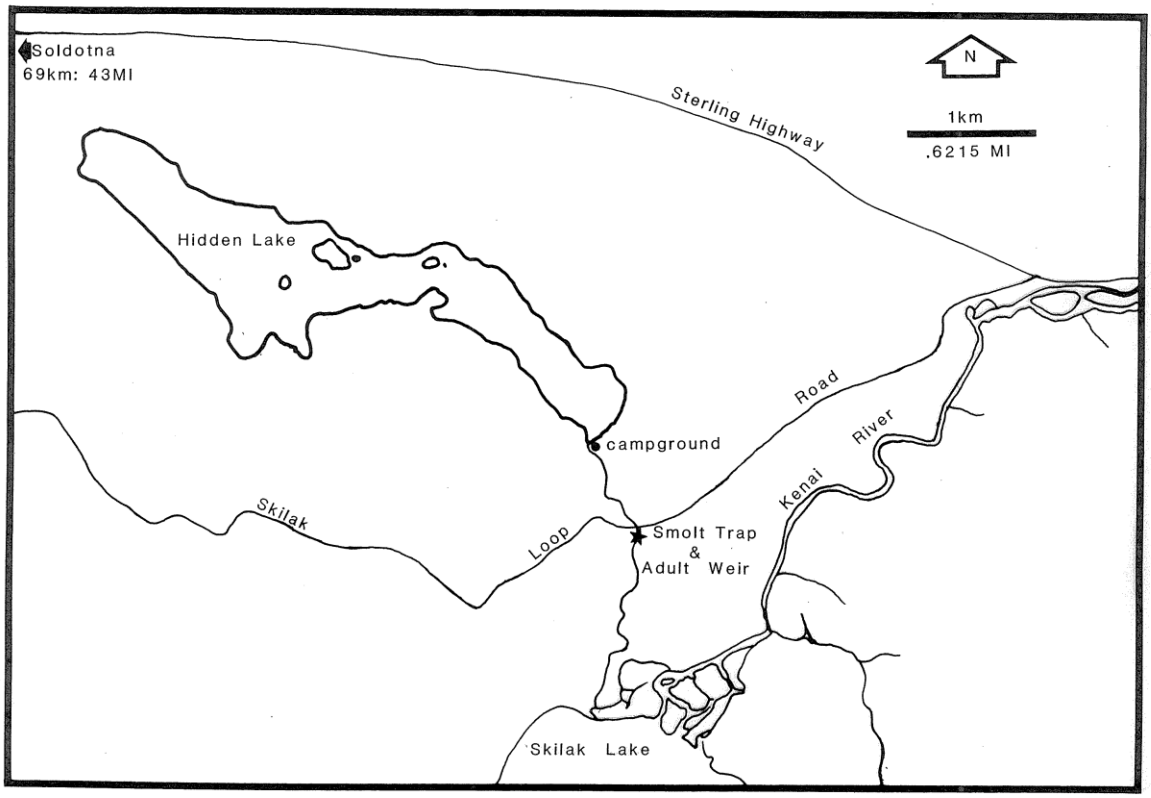

Figure 1. Area Map of Hidden Lake, Kenai Peninsula, Southcentral Alaska

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 (Kyle, Litchfield, & Todd, 1990).

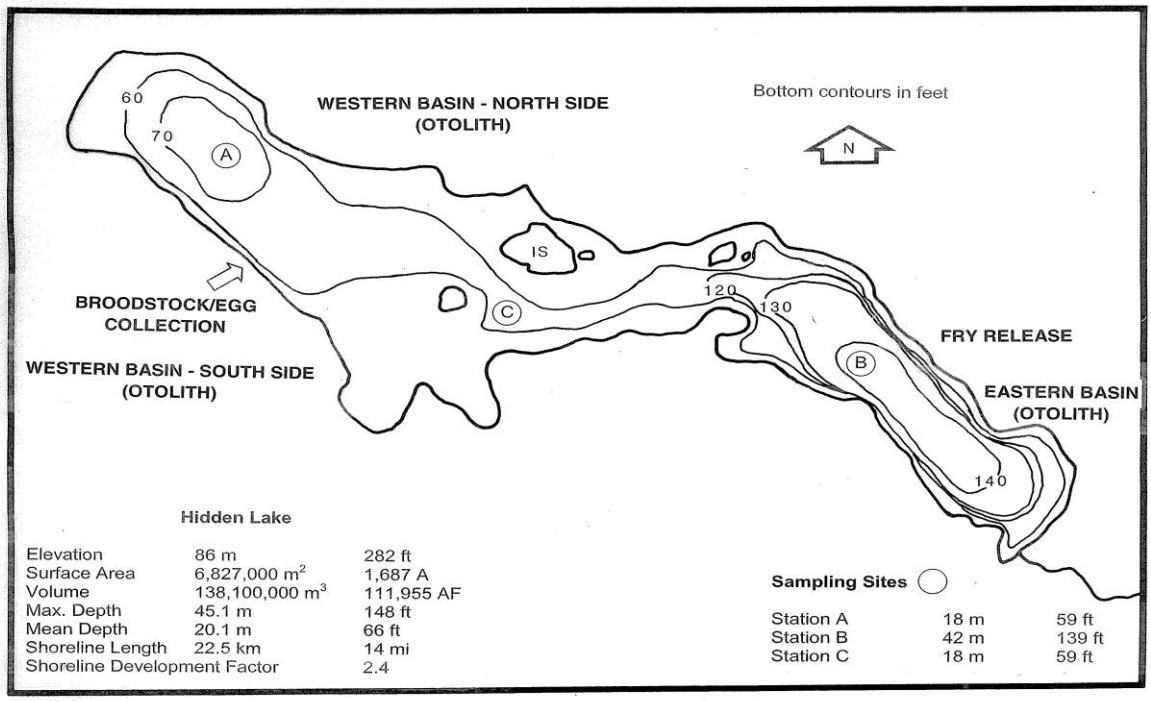

Figure 2. Morphometric map of Hidden Lake showing the two major basins

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. Historically, during the open water season, the total phosphorus concentration averaged 7 μg/l, the total nitrogen concentration was 178 μg/l and the chlorophyll a concentration was 0.6 μg/l (Kyle, Litchfield, & Todd, 1990). Based on these concentrations, Hidden Lake is considered an oligotrophic-mesotrophic system.

Two cladocerans, (*Bosmina longirostris* and *Daphnia longiremus*), three copepoda (*Diaptomus pribolofensis*, *Epischura nevadensis*, and *Cyclops columbians*), and numerous species of rotifers make up the zooplankton community of Hidden Lake. Historically, fish present in the lake include five species of Pacific salmon (*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, Litchfield, & Todd,1990).

METHODS

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

Limnological Sampling and Environmental Conditions

During 2014, water quality samples were collected four times during the open water season in June, July, August, 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 horizontal Van Dorn beta sampler one meter below the surface and from the midhypolimnion. In addition to the two primary sites, one secondary site, Station C, was sampled (Figure 2). Measurements at the secondary site were limited to the zooplankton community and Secchi disk transparency.

The water sample procedures followed are described in the Limnology Field and Laboratory Manual: Methods for Assessing Aquatic Production (Koenings, Edmundson, Edumndson, & Kyle, 1986). Analysis was completed by ADF&G. Due to equipment failures at the ADF&G lab, analysis of TKN could not be completed.

In addition to the limnological samples collected from Hidden Lake, percent cloud cover was estimated, precipitation measured to the nearest millimeter, and Hidden Creek water and air temperatures were recorded using a data logger (Hobo®) which recorded water and air temperature every four hours. Recordings were then averaged over a 24-hour period to provide a daily average air and water temperature. Previous to 2013, water and air temperatures were measured using a thermometer, and therefore results prior to this date may not be comparable to the last two years.

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 migration 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 could be used to enumerate the fish. In 2014, the rate of fish migration was such that the 10% sub-sampling procedure was not required.

A detailed description of smolt enumeration procedures is available in CIAA's 2014 Hidden Lake Smolt Enumeration Procedures Manual.

Smolt Characteristics and Enhanced Contribution

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

During the 2014 smolt migration, smolt samples were collected in proportion to the projected emigration. This was accomplished by attempting to collect every 500th sockeye salmon smolt

and every 75th coho salmon smolt that was counted and passed through the smolt trap. In 2014, 0.2% of the migrating sockeye salmon were sampled (every 500th fish) and 1.3% of the migrating coho salmon were sampled (every 75th coho). The numbering sequence began when the first fish passed through the trap and continued consecutively until the smolt migration was complete. A total of 435 coho salmon were sampled, but a number of samples had to be discarded since staff had mistakenly sampled coho fry, which were residing in the creek. A total of 366 samples could be read.

The fish collected for sampling were placed in a plastic container filled with a diluted solution of 99.5% pure Tricaine Methanesulfonate Finquel® MS-222® and water to anesthetize the fish during the sampling event. Sockeye and coho salmon smolts were first measured to the nearest millimeter for fork length[1] and then weighed to the nearest 0.1 gram. Up to ten scales were removed from the primary growth area[2] and mounted on a glass slide for subsequent age determination for coho salmon only. The otoliths from sockeye salmon smolt were extracted following procedures by Glick and Shields (1993) and placed in a labeled one-dram vial. A dilute ethanol solution was added to the vial to cover the otoliths.

Sockeye salmon smolt characteristics, the proportion of hatchery incubated sockeye salmon smolt, and the proportion of age 1 and 2 sockeye salmon 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, $\left(N = \sum N_h\right)$,

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, $\left(a = \sum a_h\right)$,

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

$p_h = a_h / n_h$, 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:

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

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

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

with a variance of:

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

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 $= i$ smolt in the migration was also estimated as:

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

with a variance of:

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

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

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

with a variance of:

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

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

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

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

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

with an approximate variance estimate of:

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

and 95% confidence interval estimates of:

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

Adult Enumeration and Enhanced Contribution

The 2014 Hidden Lake adult escapement was monitored to assess the returning fish population. To enumerate and sample returning salmon, 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. The weir consisted of an upper and lower half that were erected perpendicular to the flow and positioned at an approximate distance of 5 yards of each other creating a trap between the two halves. The double weir configuration comfortably held fish for a short period while field personnel safely operated the weir. During day time hours, field personnel passed fish upstream or downstream through both sections of the weir. As the number

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

The returning adult population's characteristics were assessed by collecting a sample of the migrating sockeye salmon adults to determine age, sex, and length characteristics. To obtain a representative sample for determining age, sex, and length of the returning adult sockeye salmon population, biological samples were collected from every 50th adult sockeye salmon that passed through the weir.

For 2014, 2.0% of the returning adult salmon were sampled (every 50th fish). Adult sockeye salmon were captured at the weir, measured for standard fork length to the nearest millimeter, sex determined, and a scale was removed from the primary growth area. The fish were released upstream unharmed. Reading and statistical analysis of adult sockeye salmon scales were conducted by ADF&G.

Hatchery contribution was assessed by collecting otoliths from returning adult sockeye salmon to identify the hatchery induced thermal band. Staff attempted to collect a total of 600 readable otolith pairs for evaluation with equal number of samples (n=200) collected over the beginning, middle, and end of the escapement. For 2013, 612 otolith samples were collected of which 610 were readable. The otolith pairs were analyzed by CIAA staff to estimate hatchery contribution.

A detailed description of adult escapement enumeration procedures is available in the 2014 CIAA Hidden Lake Adult Enumeration Procedures Manual.

Gamete Collection, Incubation and Rearing

Gamete collection occurred between 17 September and 22 September 2014. Adult sockeye salmon were collected using a beach seine from the spawning area located in the western basin on the south shore, checked for ripeness, and placed into net pens. This collection location is different from previous years (before 2012) and is part of the changes implemented in 2012 to the Hidden Lake Operational Plan.

During the gamete collection, those fish used as broodstock for the first two eggtakes were measured for length following similar procedures used for measuring the length at the weir. At total of 450 fish were sampled (225 for each sex). Gamete collection followed ADF&G Sockeye Salmon protocol. Equipment was disinfected between each fish. Iced coolers of eggs and milt in individual containers were transported to Trail Lakes Hatchery. Containers were disinfected prior to admission to the facility. Single family delayed fertilization and water hardening disinfecting techniques were used. Newly fertilized eggs were water hardened in iodophor solution for 2 hours before being placed into Kitoi incubators. Once eggs reached the eyed stage, eggs were shocked, picked, and inventoried. Resulting live eggs were placed into Kitoi incubators for hatching and emergence. The sockeye salmon eggs collected in 2014 are currently being incubated at Trail Lakes Hatchery. Incubation followed standard hatchery procedures and water temperature has been regulated to thermally mark the otoliths of fish scheduled for release in 2015 (2,1,2H).

Fish Transport and Stocking

Prior to fish release, a sample of surviving unfed fry collected from adult sockeye salmon in 2013 was sent to ADF&G Pathology Lab for disease screening. A sample of the surviving unfed fry was also measured for weight to the nearest 0.1 gram. The remaining unfed fry were transferred to fish transport tanks and transported to Hidden Lake. Staff transported the sockeye salmon fry via boat to the east basin of the lake and released the fry near the north shore. This location is different from previous years (prior to 2012) and is part of the changes implemented in 2012 to the Hidden Lake Operational Plan.

Evaluation of Adult Sockeye Salmon Fidelity in Hidden Lake at Spawning

Continuing an evaluation on spawning fidelity by ADF&G (2008 through 2010), which indicated that the hatchery-reared fish have returned to their release location at a higher proportion than to other areas of the lake (Habicht et al. 2013), CIAA attempted to collected 250 otoliths per location from the spawning population at three different locations. These three locations were the

western basin at the (1) north (Western Basin-North Side) and (2) south side of the lake (Western Basin-South Side) and (3) an aggregate of the eastern basin (Eastern Basin). The south side of the western basin corresponds to the new broodstock/egg collection area while the aggregate of the eastern basis corresponds to the new fry release site. The north side of the western basin corresponds to the gamete collection site prior to 2012.

In 2014, otoliths were collected from 10, 250, and 236 fish from the Eastern Basin, Western Basin-North Side, and Western Basin-South Side regions respectively. Spawning fish were collected via beach seine, killed with a blow to the head, and staff removed the otoliths. Otoliths were analyzed for age structure and presence of thermal mark.

Residual Salmon Monitoring

It has been suggest that a population of smaller sockeye salmon resides in Hidden Lake. It is believed that these fish do not migrate to the ocean at any point in their life cycle and hence are residual or Kokanee salmon. To assess the age structure and enhanced contribution of this population, CIAA staff attempted to collect 250 of the smaller sockeye salmon (250-300 mm) caught in the beach seine during egg collection activities to determine age structure and thermal mark. In 2014, 84 small sockeye salmon were collected and otoliths removed.

Straying Study

Based on the genetic mapping, which was summarized in a ADF&G report (Barclay et al. 2010), three populations were identified as possible concerns for straying (1) Skilak Lake Outlet, (2) Kenai River between Skilak and Kenai lakes, and (3) Skilak Lake beach spawners (north and south side of the lake). Along with ADF&G and USWFS, CIAA agreed to analyze the straying rate of enhanced fish from Hidden Lake into other populations based on the entire stock-complex (i.e., the entire Kenai River stock complex excluding Hidden Lake). The parameters under which this analysis will occur are: 2% overall stray rate at a precision of 35% with a 90% confidence interval. Due to the excessive samples that would be required to have statistical validation of these three key populations (1,100/population; 3,300 total samples), all parties agreed to monitor

the aggregate of these populations, therefore requiring 1,100 samples to be collected in total, distributed among the four areas. These four areas and number of samples to be collected are (1) Skilak Lake - South (n=220), (2) Skilak Lake - North (n=220), (3) Kenai River - Jim's Landing to Skilak Lake confluence (n=220) and (4) Skilak - Dunes (n=440).

CIAA met the sampling goal of the Skilak - Dunes area in 2013 and hence this area was not sampled in 2014. CIAA attempted to collect otoliths from carcasses found in the remaining three areas on eleven different occasions between 18 September and 14 October. A total of 54 samples were collected from Kenai-Skilak confluence, 0 samples from Skilak-North and 1 sample from Skilak-South.

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RESULTS AND DISCUSSION

Limnology and Environmental Conditions

Limnology sampling at Hidden Lake has been completed by CIAA since 1992. In 2014, water quality, and zooplankton samples were collected four times (June, July, August, and September). Water quality and zooplankton analysis was completed by ADF&G and are summarized in Table 1.

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

	AVERAGE WATER QUALITY - 1 METER										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)	EZD (m)	Secchi (m)	Zooplankton (mg/m2)	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb. (NTU)	TP (ug/l)	TKN (ug/l)	Chl a (ug/l)
1980	145	7.8	66		6.8	120	2.1				146	7.8	69		6.1	140	1.8
1981	117	7.0	73		6.6	171	0.6			2,381	116	7.0	74		6.5	175	0.5
1982	137	8.1	70		8.6	174	0.4			1,619	136	8.0	71		7.2	172	0.5
1983	144	8.1	72		6.9	176	0.5			3,285	148	7.8	73		9.2	193	0.8
1984	146	7.9	71		6.7	172	0.7			2,248	149	7.7	72	0.6	6.3	168	0.6
1985	147	7.9	78	0.7	7.2	177	0.9			1,967	147	7.7	79	0.7	8.2	179	0.7
1986	144	7.8	72	0.4	7.5	185	0.3			2,420	146	7.7	71	0.3	7.6	180	0.3
1987	147	8.0	70	0.2	6.9	188	0.5			1,390	150	7.8	70	0.3	8.3	191	0.5
1988	146	7.8	67	0.6	6.8	197	0.6			2,466	150	7.6	67	0.4	7.0	195	0.6
1989	146	8.0	67	0.4	7.8	198	0.4			3,437	149	7.9	67	0.4	8.0	196	0.4
1990	147	8.0	73	0.4	7.8	193	0.8			2,258	148	7.8	73	0.4	8.5	187	0.7
1991	152	8.0	72	0.7	6.7	171	0.8	20.2	7.3	2,222	154	7.8	73	0.7	8.2	189	0.6
1992	145	8.0	66	0.7	7.4	231	1.3	15.2	5.0	1,030	147	7.7	69	0.6	9.5	218	1.1
1993	150	7.8	68	0.5	7.0	198	1.5	14.0	6.4	2,030	156	7.6	71	0.4	8.0	203	1.3
1994	156	7.8	70	0.5	7.4	210	1.6	19.6	6.7	847	157	7.6	70	0.6	7.3	188	0.9
1995	153	7.8	71	0.7	5.7	197	1.8	20.0	7.6	1,520	159	7.6	72	0.7	6.5	189	1.6
1996	152	7.8	71	0.7	5.6	188	0.9	19.6	8.4	1,338	159	7.7	73	0.7	6.3	190	2.6
1997	153	7.8	73	0.4	6.6	186	0.7	20.2	9.7	2,111	153	7.8	73	0.5	9.0	201	1.2
1998	150	8.0	72	0.8	6.4	205	0.8	21.0	7.2	2,358	153	7.8	72	0.1	6.6	194	0.6
1999	149	7.6	72	0.7	7.3	234	0.8	18.7	6.7	2,474	153	7.5	72	0.7	7.4	221	0.5
2000	150	7.8	69	0.8	7.2	234	1.6	20.4	8.7	3,896	151	7.7	70	0.7	7.9	245	1.5
2001	150	7.6	68	0.7	7.8	231	1.1	19.4	7.1	3,398	152	7.5	69	0.7	7.5	222	0.9
2002	147	7.7	73	0.4	8.6	257	1.1	17.9	5.9	2,447	150	7.6	73	0.5	9.1	239	0.7
2003	148	7.3	70	0.4	8.4	229	2.8	17.1	7.0	959	149	7.3	68	0.5	8.9	224	1.5
2004	141	7.5	70	0.3	11.7	286	1.0	17.1	6.6	1,450	151	7.7	71	0.5	13.1	302	1.0
2005	149	7.2	68	0.3	9.8	273	0.5	17.5	7.0	1,693	149	7.2	68	0.1	11.8	277	0.5
2006	147	7.3	67	0.1	8.2	237	0.5	23.4	8.0	1,445	148	7.4	68	0.2	8.5	216	0.6
2007	151	7.8	71	0.6	8.4	218	0.7	21.4	9.0	1,589	154	7.7	71	0.5	9.9	222	0.9
2008	149	7.4	68	0.3	12.4	217	0.6	20.6	7.8	1,373	152	7.3	69	0.2	8.8	202	0.5
2009	151	7.4	69	0.3	8.8	229	0.5	20.0	8.1	1,515	151	7.3	68	0.2	8.1	219	0.6
2010	154	7.5	66	0.2	7.7	NA	0.6	20.2	7.4	955	152	7.5	66	0.6	7.5	NA	0.9
2011	160	8.0	73	0.8	6.5	NA	0.9	24.0	8.5	1,313	162	7.9	72	0.3	12	NA	2.4
2012	160	7.9	69	0.4	6.5	NA	1.0	20.6	7.7	1,419	163	7.7	70	0.5	6.2	NA	1.0
2013	160	7.8	65	0.3	6.7	NA	0.9	23.2	8.3	1,874	165	7.6	67	0.3	7.7	NA	1.1
2014	158	7.5	70	0.2	7.4	NA	1.0	17.7	6.6	1,423	160	7.4	72	0.2	7.2	NA	0.6

Averages prior to 1992 compiled by ADF&G.

EZD and Secchi provided by CIAA.

Open water season only.

Zooplankton data was corrected for 2008 onward.

Environmental conditions during the Hidden Lake smolt migration were monitored from 19 May to 01 July 2014. Stream stage measurements declined over the course of the smolt migration but began to increase in the later part of June. The average change in stage height over this time period was -0.05 ft (±0.02 ft). During the period of smolt migration, stream temperatures averaged 11.5°C (±1.7°C). Air temperatures averaged 11.6°C (±2.1°C). Zero percent of the days were clear, 27% had less than 50% cloud cover, 30% had more than 50% cloud cover, and 36% were completely overcast. Measurable rain was recorded on 17 days (37%) during the smolt migration. A total of 58 mm of rain fell during this period.

Environmental conditions during the Hidden Lake adult sockeye salmon migration were monitored from 17 July to 12 September 2014. Stream stage measurements were fairly stable during the first month of monitoring but started to increase for the remainder of the period. The average change in stage height over this time period was 0.01 ft (±0.03 ft). Stream temperatures averaged 15.4°C (±1.2°C) and air temperatures averaged 13.4°C (±2.1°C). Zero percent of the days were clear, 34% had less than 50% cloud cover, 31% had more than 50% cloud cover, and 24% were completely overcast. Measurable rain was recorded on 33 days (57%) during the adult migration. A total of 103 mm of rain fell during this period.

Smolt Enumeration

The Hidden Lake smolt migration was enumerated from 19 May and continued daily until 01 July. During this time, 276,587 sockeye and 32,653 coho salmon smolt migrated from the lake. Sockeye salmon smolt mortalities were 3,110 and 545 fish were sampled for otolith collection providing 272,932 as live sockeye salmon smolt migration. The live smolt migration for the coho salmon smolt is the same as the total migration. Other fish counted included 439 rainbow trout (*O. mykiss*), and 469 Dolly Varden (*S. malma*). The 10% sub-sampling procedure was not used.

The pattern of the 2014 Hidden Lake sockeye salmon smolt migration was comparable to smolt migrations over the last ten years.

Smolt Characteristics and Enhanced Contribution

Otolith, weight, and length measurements were collected and analyzed on 545 sockeye salmon smolts. However, only 539 of these samples were readable. Based on the otolith samples collected, 75.5% (±3.6%) of the migrating sockeye salmon smolt were incubated at Trail Lakes Hatchery. An estimated 97% (±1.7%) were age 1 and 3% (±1.7%) were age 2. The average length and weight of the age 1 sockeye salmon smolt were 141.8 mm (±0.6 mm) and 28.6 g (±0.4 g). The average length and weight of the age 2 sockeye salmon smolt were 177.6 mm (±11.1 mm) and 61.9 g (±12.5 g).

Scale age, weight, and length measurements were made on 435 coho salmon smolt, of which 366 samples were readable and not from coho fry. Based on the scale samples collected, an estimated 32.2% (±4.8%) of the migrating coho salmon smolt were age 1. An estimated 66.9% (±4.8%) were age 2. The average length and weight of the age 1 coho smolt were 102 mm (±3.9 mm) and 13.6 g (±3.6 g). The average length and weight of the age 2 coho salmon smolt were 138 mm (±0.5 mm) and 26.6 g (±0.8 g). Table 2 summarizes the age structure, average length, and weight measurements since 1976.

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

In 2014, the proportion of hatchery-incubated salmon in the sockeye salmon smolt migration was 76% (±3.6%) (Table 3). The 2014 hatchery contribution is more than the 1993–2014 average of 66% and with the most recent 4 year average of 61%.

Adult Enumeration and Enhanced Contribution

The Hidden Lake adult salmon escapement was enumerated from 17 July to 12 September 2014. During this time, a total of 21,838 adult sockeye salmon (*O. nerka*) and 0 adult coho salmon (*O. kisutch*) returned to Hidden Creek. No other fish were reported. Six hundred and twelve fish were sampled for otolith collection leaving a live escapement of 21,226 to the lake. An additional 496 adult sockeye salmon were sampled as part of the fidelity study and 1,420 were used for hatchery broodstock, leaving 19,310 fish as potential spawners.

Personnel collected scales from 297 adult sockeye salmon, of which all samples were readable. The percentage of adult male and adult female sockeye salmon returning to Hidden Lake was 53% and 47%, respectively. Male fish averaged 515 mm (±28 mm) in length and the females averaged 497 mm (±30 mm). An estimated 79.1% were age 1.2, 11.5% were age 1.3, 8.8% were age 2.2, 0.7% were age 2.3, and 0.0% were age 1.4.

To determine the contribution of hatchery-incubated fish to the population of adult sockeye salmon returning to Hidden Lake, CIAA staff collected 612 otolith pairs from Hidden Creek on 07 August, 14 August, and 22 August 2014, of which 610 pairs were readable. Based on otolith marks, an estimated 72.3% (±3.5%) adult sockeye salmon were incubated at Trail Lakes Hatchery.

Prior to 1999, the hatchery contribution of adult sockeye returns was not evaluated. The Hidden Lake adult hatchery contribution of adult returns from 1999–2014 was 61%. Hatchery contribution could not be assessed in 2005 and 2006 due to inconsistency in daily escapement that created an unpredictable sampling technique and rendered statistically inconclusive results. Looking at the most recent 4-year average, the number of adult sockeye attributable to the hatchery program increased to 63%. Table 4 summarizes historical sockeye salmon escapements and major age classes based on calendar year and Table 5 summarizes the same information but on a brood year basis and for enhanced characteristics only. On a brood year basis, the enhanced characteristics of smolts are a good predictor of what the adult returns will be for that same year class.

The 2014 estimated commercial fishery harvest of Hidden Lake sockeye salmon (enhanced and wild) was 14,331 and personal use and sport fishery combined was estimated at 11,447 (M. Willette, 2014). Common property harvest was estimated to be 53.5% and escapement to Hidden Lake was 46.5% (Table 6).

Based on information collected from migrating sockeye salmon smolt and returning sockeye salmon adults, it is possible to provide an estimate of the survival of each brood year in the marine environment (Table 7).

Gamete Collection, Incubation and Rearing

Since 1976, the collection of sockeye salmon gametes and the release of hatchery-incubated fry have been used to enhance the sockeye salmon population in Hidden Lake, Tutka Bay Lagoon, Leisure (China Poot) Lake, Hazel Lake, and Kirschner Lake. To date, a total of 91,916,000 eggs have been collected for incubation at Crooked Creek, Big Lake, and Trail Lakes Hatcheries. Current egg incubation is taking place at Trail Lakes Hatchery. As of 2009, CIAA is no longer using the Hidden Lake sockeye salmon population to enhance systems other than Hidden Lake. The annual gamete collections conducted since 1976 are summarized in Table 8.

Between 17 September and 22 September 2014, approximately 1,647,600 eggs were collected from 710 female sockeye salmon and shipped to Trail Lakes Hatchery for fertilization. This involves mixing the eggs from each female with the milt from one male and activating the sperm with a 0.7% saline solution. An estimated 1,497,000 eggs (91%) have survived to the eyed stage. Average length of the male broodstock was 499 mm (±25.0 mm) and the female broodstock was 538 mm (±28.1 mm). In comparison the average length of adult male sockeye at the weir was 515 mm (±28.0 mm) and female length was 497 mm (±30 mm).

The objective of the Hidden Lake Sockeye Salmon Enhancement Project is to achieve an average adult sockeye salmon escapement of 30,000 fish. The number of gametes to collect each year to meet this objective is calculated based on the most recent 4-year average natural sockeye salmon

smolt emigration (103,100, Table 3), brood year average green egg-to-fry survival (87.6%, Table 8), fry-to-smolt survival (16.7%, Table 8), smolt-to-adult survival (20.7%, Table 7), and the average common property harvest rate (56.1%, Table 6). Based on these averages, to meet a projected adult return of 30,000 adult sockeye salmon to Hidden Creek, CIAA projects 1,552,000 eggs must be collected in 2015 to supplement the Hidden Lake return.

Calculations:

Equation 1: Natural Return (Total Fishery Return)

4-year avg. natural smolt * smolt-to-adult survival = est. 2015 natural return (total fishery return)

$$103{,}100 * 20.7\% = 21{,}342$$

Equation 2: Natural Return (Hidden Lake)

2015 total fishery return (Equation 1) * (1 - Common Property %) = est. natural return to lake

$$21{,}342 * (1\text{-}0.561) = 9{,}369$$

Equation 3: Enhanced Return (Hidden Lake)

return goal – est. natural return to lake (Equation 2) = est. enhanced return to lake

$$30{,}000 - 9{,}369 = 20{,}631$$

Equation 4: Enhanced Green Egg Collection Requirement

est. enhanced return to lake/green-to-eyed surv./fry-to-smolt surv./smolt-to-adult surv/escape.%

$$20{,}631/0.876/0.167/0.207/0.439 = 1{,}552{,}000$$

Table 2. Age structure, length and weight characteristics of Hidden Lake sockeye salmon smolt, 1976–2014

		Age Class 1.0			Age Class 2.0			Mean Length (mm)				Mean weight (g)			
Smolt	#		95%			95%		Age	95%	Age	95%	Age	95%	Age	95%
Year	Live Migr.	%	C.I.	#	%	C.I.	#	1.0	C.I.	2.0	C.I.	1.0	C.I.	2.0	C.I.
1976	29,639	80		23,711	20		5,928	130		146		NA		NA	
1977	17,670	83		14,666	17		3,004	144		199		NA		NA	
1978	111,466	88		98,090	12		13,376	133		190		22.4		79.3	
1979	94,347	85		80,195	15		14,152	145		177		30.7		57.2	
1980	81,748	90		73,573	10		8,175	143		200		27.3		83.9	
1981	161,522	98		158,292	2		3,230	144		198		28.5		81.4	
1982	222,673	99		220,446	1		2,227	145		174		27.3		55.3	
1983	235,233	94		221,119	6		14,114	132		186		21.3		66.1	
1984	419,376	95		398,407	5		20,969	144		170		28.7		49.2	
1985	396,000	97		384,120	3		11,880	141		185		26.3		63.7	
1986	651,889	96		625,813	4		26,076	134		180		22.4		55.6	
1987	68,980	81		55,874	19		13,106	143		175		28.0		54.3	
1988	471,625	94		443,328	6		28,298	128		179		18.7		59.1	
1989	719,527	94		676,355	6		43,172	126		163		17.6		43.5	
1990	231,300	78		180,414	21		48,573	140		191		30.0		71.6	
1991	208,500	93		193,905	6		12,510	140		205		25.4		88.9	
1992	191,900	95		182,305	5		9,595	133		172		21.5		47.1	
1993	388,500	89		345,765	10		38,850	130		183		20.4		61.2	
1994	414,400	94		389,536	6		24,864	130		179		18.1		49.8	
1995	293,700	86		252,582	13		38,181	128		181		18.3		56.5	
1996	427,400	95	(±2.1)	406,030	5	(±2.1)	21,370	135	(±0.5)	190	(±4.5)	19.1	(±0.3)	59.4	(±6.5)
1997	228,400	96	(±2.7)	219,264	4	(±2.7)	9,136	123	(±0.6)	190	(±15.9)	15.9	(±0.3)	72.7	(±19.7)
1998	384,800	91	(±2.9)	350,168	9	(±2.9)	34,632	129	(±0.7)	203	(±5.8)	20.0	(±0.4)	82.3	(±6.5)
1999	312,644	86	(±3.6)	268,874	14	(±3.6)	43,770	132	(±0.6)	173	(±5.1)	23.0	(±0.3)	51.1	(±4.8)
2000	474,900	93	(±2.2)	441,657	8	(±2.2)	37,992	138	(±0.5)	182	(±7.3)	25.0	(±0.3)	64.0	(±7.8)
2001	324,400	94	(±2.6)	304,936	6	(±2.5)	19,464	134	(±0.5)	165	(±8.6)	22.3	(±0.3)	45.0	(±8.0)
2002	366,600	86	(±2.2)	315,276	13	(±2.2)	47,658	134	(±0.8)	165	(±6.0)	22.2	(±0.4)	45.0	(±4.8)
2003	308,500	94	(±2.2)	289,990	6	(±2.2)	18,510	140	(±0.5)	179	(±0.8)	24.7	(±0.2)	60.5	(±6.5)
2004	180,600	64	(±3.7)	115,584	36	(±3.7)	65,016	140	(±0.8)	179	(±3.6)	24.7	(±0.8)	60.5	(±3.7)
2005	289,300	91	(±1.8)	263,263	9	(±1.9)	26,037	140	(±0.5)	179	(±3.6)	24.7	(±2.0)	60.5	(±3.7)
2006	200,000	91	(±2.4)	182,000	9	(±2.4)	18,000	140	(±0.9)	179	(±10.3)	24.7	(±0.5)	60.4	(±8.7)
2007	216,000	86	(±2.8)	185,760	16	(±3.0)	34,560	135	(±0.9)	167	(±3.1)	24.7	(±1.0)	47.4	(±4.8)
2008	349,600	97	(±1.8)	339,112	3	(±1.7)	10,488	123	(±0.9)	170	(±16.3)	18.0	(±0.3)	49.5	(±12.2)
2009	315,200	88	(±2.4)	277,376	12	(±2.4)	37,824	131	(±0.5)	175	(±3.0)	22.9	(±0.5)	55.7	(±3.7)
2010	283,300	84	(±3.4)	237,972	16	(±3.4)	45,328	120	(±7.0)	188	(±13.0)	17.0	(±2.5)	67.8	(±5.9)
2011	298,700	70	(±4.2)	207,895	30	(±4.2)	90,805	137	(±5.0)	197	(±2.5)	24.5	(±0.9)	77.8	(±2.9)
2012	312,100	95	(±2.1)	296,495	5	(±2.1)	15,605	122	(±0.7)	181	(±4.8)	16.6	(±0.6)	53.5	(±9.3)
2013	184,300	96	(±2.3)	177,568	4	(±2.3)	7,399	130	(±1.0)	172	(±12.9)	20.7	(±0.5)	53.0	(±11.0)
2014	272,900	97	(±1.7)	267,863	3	(±1.7)	8,724	142	(±0.6)	178	(±11.1)	28.6	(±0.4)	61.9	(±12.5)
Mean		90			10			135		181		21.9		57.7	

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

Table 3. The contribution of enhanced sockeye salmon to the Hidden Lake smolt migrations, 1976–2014

Smolt Year	Total # Live Migr.	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	414,400	(±40,400)	53,900	360,500	87	(±3.9)
1995	293,700	(±33,400)	79,300	214,400	73	(±6.5)
1996	427,400	(±15,700)	94,000	333,400	78	(±3.6)
1997	228,400	(±0)	66,200	162,200	71	(±5.1)
1998	384,800	(±45,000)	84,700	300,100	78	(±3.7)
1999	312,644	(±13,400)	93,800	218,900	70	(±4.2)
2000	474,900	(±52,600)	109,200	365,700	77	(±3.2)
2001	324,400	(±0)	94,100	230,300	71	(±4.4)
2002	366,600	(±51,400)	132,000	234,600	64	(±4.4)
2003	308,500	(±17,300)	64,800	243,700	79	(±3.1)
2004	180,600	(±0)	131,800	48,800	27	(±3.9)
2005	289,300	(±15,500)	69,400	219,900	76	(±2.6)
2006	200,000	(±17,900)	106,000	94,000	47	(±3.6)
2007	216,000	(±70,700)	64,800	151,200	70	(±3.4)
2008	349,600	(±58,500)	139,800	209,800	60	(±4.3)
2009	315,200	(±9,000)	154,400	160,800	51	(±3.4)
2010	283,300	(±13,530)	140,200	143,100	51	(±4.1)
2011	298,700	(±17,639)	157,400	141,300	47	(±3.8)
2012	312,100	(±11,000)	109,600	203,100	65	(±4.0)
2013	184,300	(±0)	81,400	102,900	56	(±5.1)
2014	272,900	(±0)	64,000	208,900	76	(±3.6)
Mean	310,300		97,900	212,500	66	
4-year Mean	267,000		103,100	164,100	61	

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).

This summary is total migration minus the mortalities and otolith collections.

Table 4. Summary of Hidden Lake adult sockeye salmon escapement, age distribution, and fish length, 1976–2014

						Major Age Classes								
	Lake	Hatchery Return				1.2			1.3			2.2		
Year	Escapement	(%)	(C.I.)	Hatchery	Wild	(%)	#	Lth(mm)	(%)	#	Lth(mm)	(%)	#	Lth(mm)
1976	4,860					79	3,839	540	1	49	530	20	972	550
1977	1,055					64	675	550	2	21	600	34	359	570
1978	4,647					88	4,089	530	10	465	540	2	93	540
1979	5,762					90	5,186	540	4	230	560	6	346	550
1980	27,488					92	25,289	530	1	275	560	1	275	530
1981	15,939					78	12,432	530	15	2,391	560	7	1,116	555
1982	9,790					70	6,853	520	23	2,252	560	4	392	520
1983	11,297					87	9,828	530	11	1,243	550	2	226	530
1984	27,784					92	25,561	520	3	834	570	5	1,389	550
1985	24,784					77	19,084	520	13	3,222	570	9	2,231	580
1986	17,530					85	14,901	530	9	1,578	570	6	1,052	540
1987	43,487					96	41,748	530	3	1,305	540	0	0	540
1988	50,907					94	47,853	540	4	2,036	570	2	1,018	570
1989	7,770					44	3,419	550	41	3,186	580	15	1,166	540
1990	77,959					86	67,045	507	2	1,559	565	12	9,355	516
1991	35,576					90	32,018	512	7	2,490	557	3	1,067	521
1992	32,912					82	26,988	505	13	4,279	551	5	1,646	513
1993	11,582					80	9,266	529	9	1,042	568	11	1,274	536
1994	6,086					60	3,652	493	31	1,887	557	6	365	507
1995	7,542					63	4,751	514	12	905	559	21	1,584	525
1996	55,526					83	46,087	539	7	3,887	587	9	4,997	540
1997	56,053					77	43,161	514	18	10,090	566	3	1,682	536
1998	67,727					83	56,213	510	14	9,482	556	3	2,032	516
1999	49,406	69%	(±3.7%)	34,288	15,118	89	43,971	455	6	2,964	549	5	2,470	502
2000	45,685	62%	(±3.6%)	28,325	17,360	82	37,462	519	9	4,112	560	8	3,655	530
2001	42,462	58%	(±4.0%)	24,585	17,877	63	26,827	525	20	8,548	564	12	5,282	544
2002	71,983	62%	(±3.1%)	44,629	27,354	73	52,548	537	18	12,957	582	7	5,039	544
2003	11,734	58%	(±5.2%)	6,794	4,940	70	8,214	517	24	2,816	568	6	704	570
2004	18,172	77%	(±2.7%)	13,956	4,216	67	12,175	521	19	3,453	568	12	2,181	540
2005	13,000	ND	ND	ND	ND	79	10,270	ND	12	1,560	ND	9	1,170	ND
2006	38,535	ND	ND	ND	ND	89	34,296	502	4	1,541	547	7	2,697	506
2007	16,735	57%	(±7.9%)	9,489	7,246	63	10,618	537	23	3,864	562	11	1,888	520
2008	15,072	41%	(±1.5%)	6,104	8,968	86	12,962	511	8	1,206	573	6	904	517
2009	11,002	67%	(±1.8%)	7,338	3,664	65	7,151	518	21	2,310	553	8	880	518
2010	40,503	56%	(±1.7%)	22,560	17,943	91	36,781	500	1	522	543	8	3,196	496
2011	17,771	51%	(±3.8%)	9,117	8,654	84	14,887	506	8	1,441	546	7	1,290	496
2012	30,466	53%	(±3.9%)	16,100	14,366	79	24,068	500	13	3,961	547	7	2,133	521
2013	21,157	77%	(±3.3%)	16,179	4,978	71	14,979	514	19	3,978	555	8	1,756	527
2014	21,838	72%	(±3.5%)	15,295	6,543	79	17,263	500	11	2,498	552	9	1,910	514
Mean	27,425	61%		18,197	11,373	79	22,780	520	12	3,608	560	8	2,312	532
4 Year Avg	22,808	63%		14,173	8,635	78	17,799	505	13	2,969	550	8	1,772	515
Min	1,055	41%		6,104	3,664	44	7,151	455	1	522	530	0	704	496
Max	77,959	77%		44,629	27,354	96	52,548	550	41	12,957	600	34	5,282	580

Data prior to 1990 from Kyle, et al. 1990.
ND = No Data Collected or Calculated.
Note: Total is escapment to the lake and not fish returning to weir (morts and sampled fish).
1991 - Total sockeye return to weir was 112,792. Personal use-dipnet fishery harvested 72,060. 5,156 were donated to charity.
2005 - A hole was detected in the weir, CIAA counted 6,745 sockeye salmon. 13,000 is based on prior counts and ADF&G fish wheel estimates.
2008 - Total estimated return includes 1,500 sockeye estimated due to high bear activity.

Table 5. Summary of enhanced contribution for sockeye salmon smolt and adult migrations by brood year, 1991 – 2011

	Smolt Migration		Adult Migration	
Brood Year	% Hatchery	% Wild	% Hatchery	% Wild
1991	84	16	Incomplete Brood Years	
1992	86	14		
1993	73	27		
1994	78	22		
1995	72	28	68	32
1996	77	23	61	39
1997	71	29	60	40
1998	77	23	62	38
1999	70	30	64	36
2000	65	35	Incomplete Brood Years	
2001	69	31		
2002	36	64		
2003	74	26	55	45
2004	51	49	46	54
2005	69	31	63	37
2006	59	41	56	44
2007	51	49	51	49
2008	50	50	57	43
2009	49	51	75	25
2010	65	35		
2011	57	43		
4 yr avg.	55	45	60	40

*4 year average is for complete brood years only

Table 6. Historical common property harvests and escapement to Hidden Lake, 1996–2014

Year	% Harvest	% Escapement
1996	75%	25%
1997	55%	45%
1998	50%	50%
1999	50%	50%
2000	52%	48%
2001	71%	29%
2002	71%	29%
2003	69%	31%
2004	65%	35%
2005	72%	28%
2006	43%	57%
2007	67%	33%
2008	61%	39%
2009	58%	42%
2010	56%	44%
2011	51%	49%
2012	63%	37%
2013	57%	42%
2014	54%	46%
Average	60%	40%
4 yr avg.	56%	44%

Table 7. Marine survival by brood year for returns to Hidden Lake, 1988–2010

BY	Marine Survival (%)
1988	51.2%
1989	23.0%
1990	9.6%
1991	13.7%
1992	48.7%
1993	45.1%
1994	29.7%
1995	42.6%
1996	31.7%
1997	50.1%
1998	41.1%
1999	10.6%
2000	10.0%
2001	12.8%
2002	50.8%
2003	13.8%
2004	18.9%
2005	13.1%
2006	23.6%
2007	14.8%
2008	24.0%
2009	20.4%
2010	*12.4%*
2011	
2012	
4-year avg.	20.7%

*4-year average is for complete brood years only.

Table 8. Summary of sockeye salmon gamete collection and fry releases at Hidden Lake, 1976–2014

Brood Year	No. eggs taken	No. females used	Fecundity	Receiving hatchery	Egg-to-fry survival (%)	No. fry released Hidden Lk.	No. Hatchery Smolt Migrated	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	59,076	17.89%				
1977	406,878	200		Big L.	75.9%	308,704	40,342	13.07%				
1978	311,808	100	3,118	Crooked Cr.	27.0%	8,258	2,207	26.73%				
1979												
1980												
1981												
1982		576	2,741	Trail L.	68.8%	1,086,000	250,633	23.08%				
1983	1,928,000	639	3,017	Trail L.	64.2%	1,236,900	49,148	3.97%				
1984	3,766,000	1,310	2,875	Trail L.	47.9%	1,805,792	488,134	27.03%				
1985	7,019,000	2,330	3,012	Trail L.		0	No otolith					
1986	4,740,000	1,580	3,000	Trail L.	78.5%	3,718,311	No otolith					
1987	7,000,184	2,434	2,876	Trail L.	86.9%	6,085,307	No otolith					
1988	2,718,853	891	3,046	Trail L.	91.0%	2,470,012	No otolith					
1989	2,220,467	647	2,669	Trail L.	79.0%	1,747,900	No otolith					
1990	2,189,000	956	2,290	Trail L.	64.6%	1,600,000	No otolith					
1991	2,652,000	1,119	2,370	Trail L.	64.7%	1,716,000	317,634	18.51%				
1992	2,293,000	1,007	2,277	Trail L.	82.9%	1,901,000	369,549	19.44%				
1993	2,200,000	934	2,355	Trail L.	81.8%	1,800,000	201,475	11.19%				
1994	2,156,000	1,017	2,120	Trail L.	78.8%	1,700,000	331,201	19.48%				
1995	1,893,000	849	2,230	Trail L.	84.5%	1,600,000	182,930	11.43%				
1996	2,048,000	817	2,507	Trail L.	73.3%	1,501,000	304,170	20.26%				
1997	2,166,000	936	2,314	Trail L.	47.8%	1,035,000	217,783	21.04%				
1998	2,303,000	859	2,681	Trail L.	65.4%	1,507,100	354,418	23.52%				
1999	2,297,000	954	2,408	Trail L.	54.1%	1,242,000	247,614	19.94%				
2000	1,486,000	607	2,448	Trail L.	60.9%	905,500	218,330	24.11%				
2001	1,326,000	504	2,631	Trail L.	73.9%	980,200	249,711	25.48%				
2002	1,118,000	433	2,582	Trail L.	56.3%	628,900	53,455	8.50%				
2003	893,000	371	2,481	Trail L.	89.4%	646,000	210,499	32.58%		100,000	96,000	96.0%
2004	5,445,000	2,045	2,663	Trail L.	89.5%	573,000	111,447	19.45%	4,126,000	284,000	260,000	91.5%
2005	2,027,000	1,045	1,940	Trail L.	78.6%	582,000	136,827	23.51%	680,000	193,000	144,000	74.6%
2006	5,640,000	2,340	2,450	Trail L.	89.9%	658,000	223,452	33.96%	3,980,000	570,000	483,000	84.7%
2007	5,686,000	2,231	2,549	Trail L.	85.0%	917,000	165,098	18.00%	4,880,000	317,000	301,000	95.0%
2008	4,004,000	1,543	2,595	Trail L.	90.4%	911,000	164,166	18.02%	2,411,000	290,000	278,000	95.9%
2009	5,140,000	1,849	2,780	Trail L.	92.4%	880,000	108,633	12.34%	3,406,000	410,000	192,000	46.8%
2010	1,241,000	500	2,517	Trail L.	84.1%	1,044,000	197,234	18.89%				
2011	1,119,600	445	2,516	Trail L.	84.7%	948,000	105,025	11.08%				
2012	964,000	370	2,606	Trail L.	89.2%	860,000	208,851	24.29%				
2013	1,685,000	728	2,315	Trail L.	91.4%	1,540,000						
2014	1,647,600	710	2,321	Trail L.								
Total	92,563,000	36,150				46,473,000	5,569,000		19,483,000	2,164,000	1,754,000	
Mean			2,469		77.3%	1,226,677	212,705	19.77%				83.50%
4-yr Avg.			2,605		87.6%	933,000	154,936	16.65%				

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.
2003-Survival from eyed egg to emergent fry was 89%. Only 646,000 fry released, 152,000 kept for smolt.
Survival from eyed egg to emergent fry was 89%. Only 573,000 fry released to Hidden, 4,126,000 fry released to Lower Inlet Lakes, 174,000 kept for smolt.
***Survival from eyed egg to emergent fry was 79%. Only 582,000 fry released to Hidden, 680,000 fry released to Lower Inlet Lakes, 193,000 kept for smolt.

incomplete broodyear

Fish Transport and Stocking

On 14 May to 21 May, 2014, an estimated 1,540,000 unfed sockeye salmon fry at approximately 0.08 g from gametes collected in 2013 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, and motored to the east end of the lake (Figure 2) where they were released along the north shoreline. All fry were screened for diseases prior to release. There was no detection of infectious hematopoietic necrosis virus (IHNV). None of the released fry were externally marked or tagged; however, the otoliths of all the released fry were marked with thermal bands [Hatch Code: 2,2,2H]. Since 1977, over 46 million fry have been released to Hidden Lake (Table 8).

Evaluation of Adult Sockeye Salmon Fidelity in Hidden Lake at Spawning

It is hypothesized that by imprinting hatchery reared sockeye salmon fry to the eastern basin of the lake where spawning conditions are marginal, returning F1 hatchery-origin adults will not be successful at spawning and subsequent egg and fry survival will be lower, thus decreasing the number of F2 smolts and adults. With reduced F1 hatchery adult influence at the two primary spawning areas located in the western basin of the lake, the number of hatchery-produced fish spawning with naturally produced fish will be reduced.

During the month of September otoliths were collected and analyzed for thermal marks from 11, 250, and 236 actively spawning adult sockeye salmon in the Eastern Basin, Western Basin-North Side, and Western Basin-South Side sampling locations respectively. The number of samples in the Eastern basin is a reflection of the number of fish located in this area and not a lack of effort or inability to capture the fish. Table 9 summarizes the results. The Western Basin-South Side had the highest percentage of hatchery-reared fish at 91.1%, followed by the Eastern Basin (90.0%), and Western Basin-North Side (84.1%). Table 10 summarizes the results over the last three years.

Table 9. Distribution of hatchery and natural reared adult sockeye salmon in Hidden Lake, 2014

Location	No. of Samples	No. of Readable Samples	No. Readable Marked	Percent Hatchery Marked	Percent Wild
Eastern	10	10	9	90.0%	10.0%
Western-North	250	246	207	84.1%	15.9%
Western-South	236	232	213	91.8%	8.2%

Table 10. Distribution of hatchery and natural reared adult sockeye salmon in Hidden Lake, 2012–2014

	Eastern Region		Western-North		Western-South	
Year	% Hatchery	% Wild	% Hatchery	% Wild	% Hatchery	% Wild
2012	94.1	5.9	73.0	27.0	51.7	48.3
2013	85.5	14.5	84.4	15.6	56.0	44.0
2014	90	10	84.1	15.9	91.8	8.2
Average	89.9	10.1	80.5	19.5	66.5	33.5

Residual Salmon Monitoring

A total of 84 smaller-size sockeye salmon (in spawning colors; average length = 304 mm) were caught during the egg collection procedures in September. The number of fish sampled is once again a reflection of availability versus lack of effort or inability to capture the fish. Otoliths were analyzed for age and thermal mark characteristics. Thermal mark analysis indicated that nearly 15.5% were of hatchery-origin while 84.5% were from natural production.

Analysis of the otoliths indicated that all fish except eight had migrated and spent at least one year residing in the ocean before returning to Hidden Lake. Those eight fish which did not migrate to seawater, were all from natural production. Age 1.1 was the largest age class contributor with 52.3%. This was followed by 20.2%, 17.9 % and 9.5% for age 1.2, age 2.1, and age 2.0 respectively. The summary of results from the last three years of sampling is provided in Table 11.

Table 11. Summary of results from sampling residual sockeye salmon, 2012–2014

Year	# of Fish Sampled	% Hatchery	% Wild	Comment
2012	48	88	12	All fish spent at least 1 year in the ocean.
2013	46	83	17	All fish spent at least 1 year in the ocean.
2014	84	16	84	All but 8 fish spent at least 1 year in the ocean. All 8 fish not migrating to the ocean were from natural production.

Straying Study

Between 18 September and 14 October 2014, staff attempted to sample carcasses on 11 separate occasions at Skilak-North, Skilak-South, and Kenai River-Skilak Confluence (Table 11). In an aerial survey on 24 September with Nate Olson from USFWS, CIAA staff only observed six fish offshore in Skilak Lake indicating that the number of fish in the area was low.

Based on the samples that were collected, no hatchery-reared fish were detected at any location. Table 12 presents the results for 2014, and Table 13 summarizes the results over the last three years.

Table 12. Dates, location, and number of adult sockeye salmon sampled for straying study, 2014

Date	Kenai River - Confluence	Skilak North	Skilak - South	Comments
9/18/2014	Did not survey	Did not survey	1	No sign of spawning fish. Found one fish appx. 1/2 mile east of Cottonwood Creek washed upon the beach.
9/22/2014	27			
9/24/2014	Did not survey	0	0	Matt surveyed shoreline with Nate Olson from Kenai National Wildlife Refuge. Six sockeye were observed offshore, meaning it would be hard to determine their origin.
9/29/2014	Did not survey	Did not survey	Did not survey	Made attempt, too windy on lake.
9/30/2014	Did not survey	Did not survey	0	Nice flat day. No fish found.
10/2/2014	Did not survey	0	Did not survey	Nice weather. No fish found.
10/3/2014	12	Did not survey	Did not survey	
10/6/2014	Did not survey	Did not survey	Did not survey	Issues with boat trailer. Did not make it to the lake.
10/8/2014	15	Did not survey	Did not survey	
10/10/2014	Did not survey	Did not survey	0	
10/14/2014	Did not survey	0	0	
Total	**54**	**0**	**1**	

Table 13. Number of fish sampled and percentage of hatchery produced fish located in areas surrounding Hidden Lake, 2012–2014

	Kenai-Skilak Confluence		Skilak South		Skilak North		Skilak Dunes	
Year	# Fish	% Hatchery	# Fish	% Hatchery	# Fish	% Hatchery	# Fish	% Hatchery
2012	ND	ND	ND	ND	69	0.0	100	0.0
2013	10	0.0	16	0.0	5	0.0	434	0.0
2014	51	0.0	1	0.0	0	0.0	not required	
Total	61		17		74		534	
Average		0.0		0.0		0.0		0.0

Flood events in 2012 & 2013 limited sampling efforts.

RECOMMENDATIONS

For the 2015 field season, in order to meet the projected adult return of 30,000 adult sockeye salmon to Hidden Creek, CIAA projects 1,552,000 eggs must be collected to supplement the Hidden Lake return. The new fry release site and egg collection site should continue to be used in 2015.

In 2012, CIAA changed the stocking location to the eastern basin of Hidden Lake. The first return of adult sockeye salmon to this new stocking location will occur in 2015. Based on the fidelity characteristics of sockeye salmon, it is expected that the number of fish in the eastern region which are of hatchery origin should increase, while in the western basin the hatchery contribution should decrease.

Since 1999, CIAA has spent significant resources documenting the possible straying of the Hidden Lake stock to nearby lakes, streams, creeks and rivers. In that time period, over 2,119 fish have been sampled in the Lower Russian River, 407 fish from Skilak Lake, and within the Kenai River (includes the Dunes) a total of 1,187 have been sampled. Not one Hidden Lake stray has been documented. For this reason as well as the consideration for the fiscal and personnel resources necessary to complete such an extended evaluation study, CIAA recommends that no further annual evaluations of straying into nearby water sources take place.

Over the last three years, 178 smaller spawning fish believed to be Kokanee were sampled. During this time period, only 8 fish were identified as never migrating to the ocean. All 8 fish have been identified as natural production. CIAA recommends that no further evaluation is necessary.

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APPENDICES

Appendix 1. Hidden Lake 2014 - Water Quality
Nutrients and Primary Productivity

Date	Sta	Depth (m)	TP (ug/l)	TFP (ug/l)	FRP (ug/l)	TKN (ug/l)	NH3+NH4 (ug/l)	NO2+NO3 (ug/l)	TN:TP		RSi (ug/l)	Org C (ug/l)	Chla (ug/l)	Phaeo (ug/l)	EZD (m)	
6/12/2014	A	1	7.4	4.0	2.4	ND	5.7	2.3	ND	:1	3,312	208	0.42	0.16	A	22
		14	7.9	4.3	2.7	ND	1.9	2.1	ND	:1	3,346	240	0.88	0.35		
6/12/2014	B	1	7.8	4.4	2.6	ND	2.3	1.8	ND	:1	3,312	193	0.51	0.18	B	22.5
		27	7.8	4.8	3.7	ND	1.0	9.1	ND	:1	3,443	217	0.35	0.34		
7/14/2014	A	1	7.4	3.1	3.2	ND	3.7	1.6	ND	:1	3,313	190	0.47	0.29	A	18.3
		16	6.3	3.7	3.2	ND	1.4	1.6	ND	:1	3,504	139	0.39	0.29		
7/14/2014	B	1	6.9	3.5	3.2	ND	2.0	1.1	ND	:1	3,291	151	0.46	0.31	B	13.8
		21	5.8	ns	ns	ND	ns	ns	ND	:1	3,543	65	0.41	0.28		
8/12/2014	A	1	7.1	3.2	0.8	ND	1.7	0.8	ND	:1	3,255	246	1.67	0.37	A	13.4
		17	6.8	3.8	1.1	ND	1.0	1.6	ND	:1	3,408	142	0.61	0.44		
8/12/2014	B	1	6.8	3.4	0.9	ND	1.0	1.3	ND	:1	3,219	190	1.50	0.52	B	16.5
		28	9.8	6.2	2.7	ND	1.8	35.9	ND	:1	3,750	119	0.38	0.31		
9/16/2014	A	1	8.6	3.8	1.3	ND	1.5	1.3	ND	:1	3,285	220	1.52	0.82	A	14.6
		16	7.8	3.3	1.5	ND	1.0	1.6	ND	:1	3,277	193	1.35	0.67		
9/16/2014	B	1	7.0	3.4	1.8	ND	0.5	2.1	ND	:1	3,257	217	1.33	0.77	B	20.6
		20	5.6	3.0	1.5	ND	4.9	2.1	ND	:1	3,432	95	0.67	0.55		
Mean	1 - Meter		7.4	3.6	2.0	ND	2.3	1.5	ND	:1	3280.5	201.9	1.0	0.4	Mean	17.7
Min			6.8	3.1	0.8	0	0.5	0.8	ND	:1	3219.0	151.0	0.4	0.2	Min	13.4
Max			8.6	4.4	3.2	0	5.7	2.3	ND	:1	3313.0	246.0	1.7	0.8	Max	22.5
Mean	Hypolimnion		7.2	4.2	2.3	ND	1.9	3.0	ND	:1	3,463	151	0.6	0.4		
Min			5.6	3.0	1.1	0	1.0	1.6	ND	:1	3,277	65	0.4	0.3		
Max			9.8	6.2	3.7	0	4.9	35.9	ND	:1	3,750	240	1.4	0.7		

*The yellow highlighted number is not included in the average. Out of range-possible contamination.

General Tests and Metals

Date	Sta	Depth (m)	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb (NTU)	Color (Pt)	Ca (mg/l)	Mg (mg/l)	Fe (ug/l)	Secchi Sta	Secchi (meters)
6/12/2014	A	1	150	7.7	70.2	0.1	8	23.3	3.0	4	A	6.5
		14	153	7.6	70.2	0.1	8	22.9	3.3	4	B	7.1
	B	1	152	7.7	70.0	0.1	6	23.3	3.2	9	C	7.8
		27	154	7.6	71.0	0.1	5	23.3	3.1	15		
7/14/2014	A	1	158	7.4	70.0	0.2	10	22.9	3.1	7	A	8.0
		16	161	7.3	73.5	0.3	13	23.1	3.2	5	B	9.0
	B	1	159	7.1	69.0	0.3	11	22.7	3.0	5	C	8.0
		21	161	7.3	71.0	0.3	5	23.5	3.1	7		
8/6/2013	A	1	156	7.6	70.9	0.1	6	21.9	2.9	9	A	5.5
		17	161	7.4	71.5	0.1	8	23.1	3.2	4	B	7.0
	B	1	158	7.3	71.6	0.2	9	22.2	3.1	4	C	6.5
		28	163	7.4	71.5	0.2	9	23.2	3.0	5		
9/16/2014	A	1	164	7.4	67.4	0.2	5	22.2	3.5	15	A	5.5
		16	163	7.5	71.4	0.2	10	22.4	2.9	20	B	4.0
9/16/2014	B	1	164	7.5	71.8	0.4	6	22.3	3.1	7	C	4.5
		20	167	7.4	72.9	0.3	9	23.1	3.5	4		
Mean	1 - Meter		158	7.5	70.1	0.2	8	22.6	3.1	7	Mean	6.6
Min			150	7.1	67.4	0.1	5	21.9	2.9	4	Min	4.0
Max			164	7.7	71.8	0.4	11	23.3	3.5	15	Max	9.0
Mean	Hypolimnion		160	7.4	71.6	0.2	8	23.1	3.2	8		
Min			153	7.3	70.2	0.1	5	22.4	2.9	4		
Max			167	7.6	73.5	0.3	13	23.5	3.5	20		

Appendix 2. Hidden Lake 2014 - Zooplankton (Density)

Macrozooplankton Density - Site A - Depth 18m - 21m
(No/m2)

	12-Jun	14-Jul	12-Aug	16-Sep		Mean (No/m2)	Seasonal Mean (No/m2)
Ergasilus							
Ovig Ergasilus							
Epischura	16,242	4,618	3,185	287		6,083	6,083
Ovig Epischura							
Diaptomus							
Ovig Diaptomus							
Cyclops	133,949	39,013	35,032			69,331	51,999
Ovig. Cyclops	3,057	1,752	265			1,691	1,269
Bosmina	76,815	92,516	35,297	127		51,189	51,189
Ovig. Bosmina	764	1,752	2,123	127		1,192	1,192
Daphnia l.	10,892	15,446	5,706	191		8,059	8,059
Ovig. Daphnia l.		9,395	398			4,897	2,448
Daphnia g.	1,146	5,732	4,379			3,752	2,814
Ovig. Daphnia g.	191	1,752	796			913	685
Chydorinae							
Polyphemus							
Total:	243,056	171,976	87,181	732	0	147,107	125,736
Ave:	30,382	19,108	9,687	183		16,345	13,971
STDEV:	49,066	29,969	14,560	76		25,416	21,468

Macrozooplankton Density - Site B - Depth 38m - 40m
(No/m2)

	12-Jun	14-Jul	12-Aug	16-Sep		Mean (No/m2)	Seasonal Mean (No/m2)
Ergasilus							
Ovig Ergasilus							
Epischura	5,605	3,822	48,917	5,350		15,924	15,924
Ovig Epischura							
Diaptomus							
Ovig Diaptomus							
Cyclops	565,605	739,873	1,178,599	177,898		665,494	665,494
Ovig. Cyclops	14,268	15,287	9,682	955			10,048
Bosmina	149,299	98,217	215,032	24,076		121,656	121,656
Ovig. Bosmina	6,115	764	6,624	2,866		4,092	4,092
Daphnia l.	52,994	12,229	20,892	5,159		22,819	22,819
Ovig. Daphnia l.	9,682	2,293	1,019	3,822		4,204	4,204
Daphnia g.	30,064	16,051	37,707	8,025		22,962	22,962
Ovig. Daphnia g.	7,643	6,497	4,586	2,866		5,398	5,398
Chydorinae							
Polyphemus							
Total:	841,275	895,033	1,523,058	231,017	0	862,548	872,596
Ave:	93,475	99,448	169,229	25,669		107,818	96,955
STDEV:	182,927	242,062	384,383	57,499		228,676	216,375

Macrozooplankton Density - Site C - Depth 12m - 18m
(No/m2)

	12-Jun	14-Jul	12-Aug	16-Sep		Mean (No/m2)	Seasonal Mean (No/m2)
Ergasilus							
Ovig Ergasilus							
Epischura	6,210	24,841	8,838	64		9,988	9,988
Ovig Epischura							
Diaptomus							
Ovig Diaptomus							
Cyclops	48,248	25,223	9,554	64		20,772	20,772
Ovig. Cyclops	1,592	1,529	159				820
Bosmina	81,051	387,898	11,067	287		120,076	120,076
Ovig. Bosmina	2,389	2,293	318			1,667	1,250
Daphnia l.	15,764	24,841	1,115	414		10,534	10,534
Ovig. Daphnia l.	3,344	5,350		32		2,909	2,182
Daphnia g.	1,433	50,828	2,309			18,190	13,643
Ovig. Daphnia g.		13,758				13,758	3,440
Chydorinae							
Polyphemus							
Total:	160,031	536,561	33,360	861	0	197,893	182,703
Ave:	20,004	59,618	4,766	172		24,737	20,300
STDEV:	29,288	124,074	4,823	169		39,091	38,007

Appendix 3. Hidden Lake 2014 - Zooplankton (Size and Biomass)

	Body Size - Site A - Depth 18m - 21m (mm)				Seasonal Means				
	12-Jun	**14-Jul**	**12-Aug**	**16-Sep**	Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m2)	Weighted Biomass (mg/m2)	% by Species
Ergasilus									
Ovig Ergasilus									
Epischura	1.21	1.66	1.46	0.71	1.26	1.32	52.8	60.5	13%
Ovig Epischura									
Diaptomus									
Ovig Diaptomus									
Cyclops	0.92	0.97	1.01		0.97	0.94	174	166	36%
Ovig. Cyclops	1.29	1.23	1.14		1.22	1.26	7	8	2%
Bosmina	0.52	0.57	0.55	0.36	0.50	0.55	121	147	31%
Ovig. Bosmina	0.81	0.66	0.64	0.42	0.63	0.67	5	5	1%
Daphnia l.	0.87	1.25	1.09	0.67	0.97	1.09	35	45	10%
Ovig. Daphnia l.		1.41	1.39		1.40	1.41	23	24	5%
Daphnia g.	1.41	1.13	1.23		1.17	1.17	12	12	3%
Ovig. Daphnia g.	1.22	1.66	1.43		1.44		6		
Chydorinae									
Polyphemus									
TOTAL:							436	468	100%

	Body Size - Site B - Depth 38m - 40m (mm)				Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m2)	Weighted Biomass (mg/m2)	% by Species
	12-Jun	**14-Jul**	**12-Aug**	**16-Sep**					
Ergasilus									
Ovig Ergasilus									
Epischura	1.40	1.56	1.19	1.48	1.41	1.26	189	137	4%
Ovig Epischura									
Diaptomus									
Ovig Diaptomus									
Cyclops	0.99	1.01	1.00	1.00	1.00	1.00	2,396	2,399	76%
Ovig. Cyclops	1.28	1.27	1.17	1.15	1.22	1.25	55	58	2%
Bosmina	0.52	0.53	0.52	0.46	0.51	0.52	297	311	10%
Ovig. Bosmina	0.70	0.71	0.62	0.54	0.64	0.64	16	16	1%
Daphnia l.	0.88	1.17	1.02	1.02	1.02	0.96	110	96	3%
Ovig. Daphnia l.	1.11	1.47	1.22	1.21	1.25	1.19	32	28	1%
Daphnia g.	1.11	1.21	1.04	0.89	1.06	1.08	70	74	2%
Ovig. Daphnia g.	1.44	1.75	1.26	1.19	1.41	1.46	42	47	1%
Chydorinae									
Polyphemus									
TOTAL:							3,207	3,166	100%

	Body Size - Site C - Depth 12m - 18m (mm)				Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m2)	Weighted Biomass (mg/m2)	% by Species
	12-Jun	**14-Jul**	**12-Aug**	**16-Sep**					
Ergasilus									
Ovig Ergasilus									
Epischura	1.30	1.37	0.89	0.77	1.08	1.25	56	85	13%
Ovig Epischura									
Diaptomus									
Ovig Diaptomus									
Cyclops	0.96	1.00	1.01	0.79	0.94	0.98	66	71	11%
Ovig. Cyclops	1.26	1.28	1.19		1.24	1.27	5	5	
Bosmina	0.51	0.54	0.45	0.40	0.48	0.53	255	324	51%
Ovig. Bosmina	0.67	0.66	0.60		0.64	0.66	5	5	1%
Daphnia l.	0.94	1.02	0.84	0.64	0.86	0.98	35	47	7%
Ovig. Daphnia l.	1.16	1.28		0.82	1.09	1.23	12	16	3%
Daphnia g.	0.92	1.16	0.89		0.99	1.14	33	53	8%
Ovig. Daphnia g.		1.46			1.46	1.46	30	30	5%
Chydorinae									
Polyphemus									
TOTAL:							497	636	100%

Appendix 4. Hidden Lake 2014 - Environmental Conditions

Smolt Migration

Date	Sky	Precip. (mm)	Stage (ft)	Stage Change (ft)	Water Temp. (°C)	Air Temp. (°C)
19-May	4	0	0.45	0.00		
20-May	2	0	0.46	0.01		
21-May	4	0	0.42	-0.03		
22-May	2	0	0.42	-0.03		
23-May	3	0	0.41	-0.04	10.2	9.2
24-May	3	0	0.41	-0.04	11.2	10.7
25-May	3	0	0.40	-0.05	8.3	10.3
26-May	3	0	0.41	-0.04	9.9	10.8
27-May	4	1.6	0.41	-0.04	10.1	11.9
28-May	5	0	0.41	-0.04	9.7	11.1
29-May	4	0	0.40	-0.05	8.7	11.8
30-May	3	0	0.40	-0.05	8.8	9.2
31-May	3	5.2	0.40	-0.05	8.5	7.6
1-Jun	4	2.2	0.40	-0.05	8.5	8.6
2-Jun	2	0.9	0.41	-0.04	10.1	12.3
3-Jun	2	0	0.41	-0.04	11.7	14.9
4-Jun	2	0	0.41	-0.04	12.2	14.2
5-Jun	2	0	0.40	-0.05	11.6	12.2
6-Jun	2	0	0.39	-0.06	10.3	12.3
7-Jun	4	0	0.39	-0.06	10.1	11.9
8-Jun	3	0	0.39	-0.06	11.6	10.6
9-Jun	4	1	0.40	-0.05	11.5	9.7
10-Jun	4	2.7	0.40	-0.05	11.4	9.2
11-Jun	4	0.45	0.39	-0.06	11.0	8.4
12-Jun	4	0	0.38	-0.07	11.1	9.6
13-Jun	4	1	0.38	-0.07	11.0	10.7
14-Jun	4	0.5	0.38	-0.07	11.6	12.5
15-Jun	3	2.6	0.38	-0.07	12.8	10.5
16-Jun	4	0.4	0.38	-0.07	11.7	11.8
17-Jun	2	2.5	0.38	-0.07	12.5	11.8
18-Jun	3	0	0.38	-0.07	12.3	13.0
19-Jun	2	0	0.38	-0.07	11.9	12.7
20-Jun	2	0	0.38	-0.07	13.0	10.1
21-Jun	4	15.8	0.38	-0.07	12.4	11.4
22-Jun	3	0.3	0.40	-0.05	12.8	11.7
23-Jun	2	3	0.40	-0.05	13.4	12.9
24-Jun	2	0	0.40	-0.05	13.2	10.6
25-Jun	5	9.8	0.40	-0.05	12.6	10.0
26-Jun	4	8.2	0.42	-0.03	12.0	11.6
27-Jun	4	0	0.42	-0.03	12.9	14.4
28-Jun	3	0	0.42	-0.03	14.7	16.7
29-Jun	3	0	0.42	-0.03	14.8	14.7
30-Jun	3	0	0.42	-0.03	14.0	14.9
1-Jul	5	0	0.42	-0.03	14.6	15.9
2-Jul						
3-Jul						
4-Jul						
5-Jul						
6-Jul						
7-Jul						
Total		58				
Avg.		1.3	0.40	-0.05	11.5	11.6
Min.		0.0	0.38	-0.07	8.3	7.6
Max.		15.8	0.46	0.01	14.8	16.7
SD		3.1	0.02	0.02	1.7	2.1

Adult Migration

Date	Sky	Precip. (mm)	Stage (ft)	Stage Change (ft)	Water Temp. (°C)	Air Temp. (°C)
17-Jul	4	0	0.36	0.00	15.5	16.0
18-Jul	2	0	0.36	0.00	16.0	15.5
19-Jul	2	0.3	0.36	0.00	16.6	14.0
20-Jul	2	0.3	0.36	0.00	15.8	15.1
21-Jul	2	0	0.36	0.00	16.5	16.1
22-Jul	2	0	0.36	0.00	17.1	14.7
23-Jul	3	2.4	0.34	-0.02	17.0	16.3
24-Jul	4	0	0.34	-0.02	17.2	12.7
25-Jul	5	4	0.34	-0.02	16.1	12.8
26-Jul	3	6.5	0.36	0.00	16.1	14.9
27-Jul	3	0	0.34	-0.02	16.6	13.6
28-Jul	5	1	0.34	-0.02	16.1	14.2
29-Jul	2	9.6	0.36	0.00	16.3	17.4
30-Jul	3	0	0.36	0.00	17.3	16.6
31-Jul	2	0	0.36	0.00	17.1	16.5
1-Aug	2	0	0.36	0.00	17.4	15.9
2-Aug	2	0	0.37	0.01	14.3	15.0
3-Aug	3	6.8	0.36	0.00	17.9	11.9
4-Aug	3	2.3	0.37	0.01	16.0	14.6
5-Aug	3	0.2	0.36	0.00	16.4	15.1
6-Aug	3	0	0.36	0.00	16.7	13.0
7-Aug	4	1.2	0.36	0.00	15.9	14.7
8-Aug	4	0	0.36	0.00	15.2	14.7
9-Aug	4	0	0.36	0.00	15.5	16.6
10-Aug	3	0	0.36	0.00	16.4	16.1
11-Aug	4	0	0.36	0.00	16.1	13.8
12-Aug	4	0.4	0.36	0.00	15.1	14.7
13-Aug	3	0	0.34	-0.02	15.2	15.7
14-Aug	3	0.4	0.33	-0.03	15.5	12.5
15-Aug	3	0.7	0.36	0.00	14.6	14.1
16-Aug	3	0	0.36	0.00	15.0	12.9
17-Aug	5	3.9	0.36	0.00	14.5	13.6
18-Aug	2	0.2	0.37	0.01	15.1	13.3
19-Aug	2	0	0.3	-0.06	15.4	15.9
20-Aug	2	0	0.3	-0.06	16.3	13.8
21-Aug	2	0.4	0.33	-0.03	15.8	14.2
22-Aug	2	0	0.38	0.02	16.2	11.7
23-Aug	4	3.7	0.36	0.00	15.6	11.9
24-Aug	5	5	0.36	0.00	14.7	11.5
25-Aug	3	9.8	0.38	0.02	14.6	11.2
26-Aug	4	0.3	0.38	0.02	14.4	13.1
27-Aug	4	0	0.39	0.03	14.6	12.8
28-Aug	4	0	0.38	0.02	14.3	11.1
29-Aug	3	17	0.41	0.05	14.3	9.6
30-Aug	2	0.8	0.42	0.06	13.9	8.0
31-Aug	2	0.2	0.43	0.07	13.2	9.0
1-Sep	3	0	0.42	0.06	13.4	12.4
2-Sep	2	0	0.41	0.05	14.3	11.7
3-Sep	2	0	0.42	0.06	14.7	11.1
4-Sep	5	8.5	0.42	0.06	14.0	11.0
5-Sep	5	10.5	0.42	0.06	13.9	11.7
6-Sep	2	2.5	0.42	0.06	14.3	10.0
7-Sep	2	0.5	0.4	0.04	13.8	11.3
8-Sep	4	0.4	0.4	0.04	14.0	12.7
9-Sep	4	0.4	0.42	0.06	13.8	12.8
10-Sep	4	1.3	0.4	0.04	13.8	10.8
11-Sep	3	0.2	0.38	0.02	13.2	15.4
12-Sep	3	1	0.42	0.06	13.5	14.9
Total		103				
Avg.		1.8	0.37	0.01	15.35	13.52
Min.		0.0	0.30	-0.06	13.20	8.00
Max.		17.0	0.43	0.07	17.90	17.40
SD		3.4	0.03	0.03	1.21	2.11

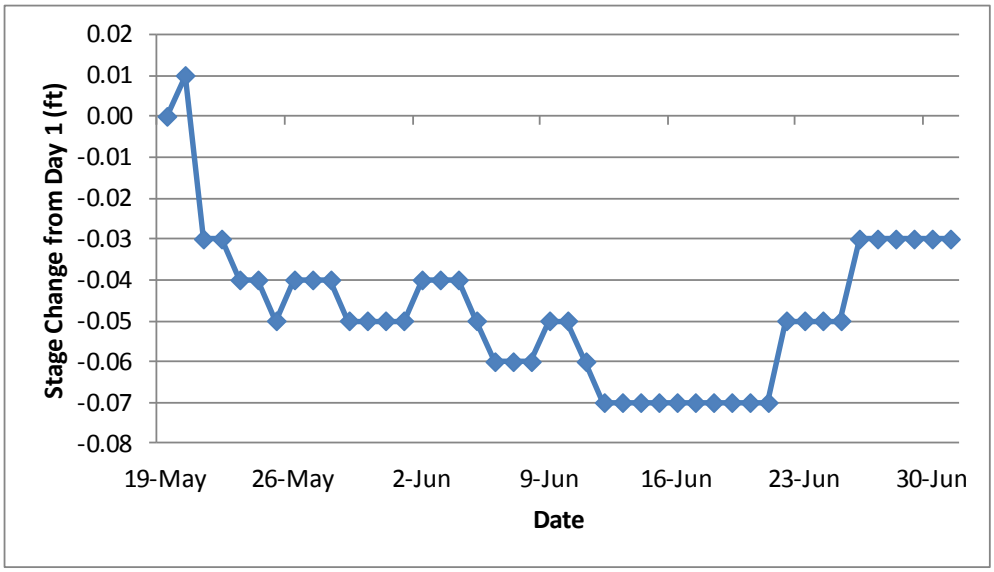
Summary of Cloud Cover - Percent of Days

	No. Days	Meas. Rain	Rain	100% Overcast	> 50% Overcast	<50% Overcast	Clear
Smolts	44.0	39%	7%	36%	30%	27%	0%
Adults	58.0	57%	10%	24%	31%	34%	0%

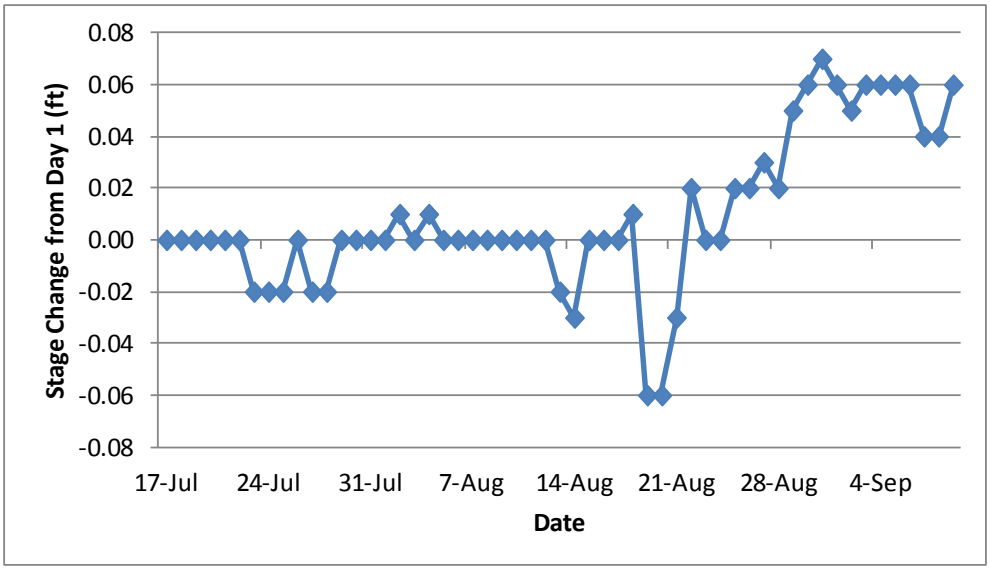
1 = Clear
2 = Cloud Cover < 50%
3 = Cloud Cover > 50%
4 = 100% Overcast
5 = Rain
ND = No Data

Appendix 5. Hidden Lake 2014 - Stage Height Changes

Smolt Migration



Adult Migration



Appendix 6. Hidden Lake 2014 - Smolt Migration

	Sockeye					Coho		Rainbow		Dolly Varden	
Date	Daily	Morts	Otoliths	Total	% Smpl	Daily	Total	Daily	Total	Daily	Total
19-May	738		1	738		347	347	16	16	10	10
20-May	833		2	1,571		303	650	7	23	4	14
21-May	364	7		1,942		347	997	5	28	3	17
22-May	614		2	2,556		234	1,231	4	32	11	28
23-May	764	3	1	3,323	0.13%	178	1,409	11	43	5	33
24-May	406		1	3,729	0.25%	360	1,769	2	45	8	41
25-May	514		1	4,243	0.19%	262	2,031	1	46	9	50
26-May	1,402		1	5,645	0.07%	308	2,339	19	65	22	72
27-May	1,185		3	6,830	0.25%	604	2,943	2	67	7	79
28-May	747		1	7,577	0.13%	386	3,329	3	70	5	84
29-May	694		2	8,271	0.29%	506	3,835	5	75	4	88
30-May	690		1	8,961	0.14%	304	4,139	5	80	5	93
31-May	891		1	9,852	0.11%	751	4,890	8	88	10	103
1-Jun	962		3	10,814	0.31%	635	5,525	7	95	9	112
2-Jun	10,215		2	21,029	0.02%	1,732	7,257	30	125	47	159
3-Jun	20,032		26	41,061	0.13%	4,178	11,435	34	159	21	180
4-Jun	32,558		43	73,619	0.13%	3,587	15,022	33	192	14	194
5-Jun	22,237		91	95,856	0.41%	2,245	17,267	33	225	13	207
6-Jun	14,391			110,247	0.00%	649	17,916	8	233	6	213
7-Jun	13,589		30	123,836	0.22%	652	18,568	2	235	2	215
8-Jun	19,925		28	143,761	0.14%	836	19,404	20	255	28	243
9-Jun	19,910		32	163,671	0.16%	1,096	20,500	15	270	15	258
10-Jun	13,803		31	177,474	0.22%	918	21,418	9	279	14	272
11-Jun	16,941		24	194,415	0.14%	1,105	22,523	18	297	25	297
12-Jun	12,729		38	207,144	0.30%	934	23,457	4	301	11	308
13-Jun	9,163		14	216,307	0.15%	611	24,068	2	303	3	311
14-Jun	15,149		30	231,456	0.20%	671	24,739	1	304	1	312
15-Jun	11,302		42	242,758	0.37%	1,169	25,908	15	319	16	328
16-Jun	5,664	332	34	248,754	0.60%	555	26,463	7	326	6	334
17-Jun	4,555	700	11	254,009	0.24%	849	27,312	9	335	16	350
18-Jun	2,923	564	7	257,496	0.24%	586	27,898	3	338	4	354
19-Jun	3,454	299	13	261,249	0.38%	360	28,258	1	339	4	358
20-Jun	3,461	404	7	265,114	0.20%	520	28,778	9	348	23	381
21-Jun	2,664	270	8	268,048	0.30%	435	29,213	10	358	9	390
22-Jun	1,929	153		270,130	0.00%	373	29,586	2	360	5	395
23-Jun	1,617	128	8	271,875	0.49%	635	30,221	16	376	6	401
24-Jun	1,533	52	3	273,460	0.20%	666	30,887	13	389	14	415
25-Jun	924	20		274,404	0.00%	614	31,501	31	420	16	431
26-Jun	436	11		274,851	0.00%	216	31,717	5	425	9	440
27-Jun	44	0		274,895	0.00%	44	31,761	0	425	1	441
28-Jun	220	22		275,137	0.00%	187	31,948	5	430	11	452
29-Jun	294	22		275,453	0.00%	206	32,154	5	435	4	456
30-Jun	232	123	3	275,808	1.29%	174	32,328	2	437	5	461
1-Jul	779			276,587	0.00%	325	32,653	2	439	8	469
2-Jul				276,587	#DIV/0!		32,653		439		469
3-Jul				276,587	#DIV/0!		32,653		439		469
4-Jul				276,587	#DIV/0!		32,653		439		469
5-Jul				276,587	#DIV/0!		32,653		439		469
6-Jul				276,587	#DIV/0!		32,653		439		469
7-Jul				276,587	#DIV/0!		32,653		439		469
8-Jul				276,587	#DIV/0!		32,653		439		469
Total	**273,477**	**3,110**	**545**	**276,587**	**0.20%**		**32,653**		**439**		**469**

Appendix 7. Hidden Lake 2014 - Adult Migration

	Sockeye			Coho		King		Pink		Chum		Rainbow		Dolly Varden	
Date	Daily	Otolith	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total
8-Jul					0		0		0		0		0		0
9-Jul					0		0		0		0		0		0
10-Jul					0		0		0		0		0		0
11-Jul					0		0		0		0		0		0
12-Jul					0		0		0		0		0		0
13-Jul					0		0		0		0		0		0
14-Jul					0		0		0		0		0		0
15-Jul					0		0		0		0		0		0
16-Jul					0		0		0		0		0		0
17-Jul	0		0		0		0		0		0		0		0
18-Jul	0		0		0		0		0		0		0		0
19-Jul	0		0		0		0		0		0		0		0
20-Jul	0		0		0		0		0		0		0		0
21-Jul	0		0		0		0		0		0		0		0
22-Jul	0		0		0		0		0		0		0		0
23-Jul	0		0		0		0		0		0		0		0
24-Jul	0		0		0		0		0		0		0		0
25-Jul	0		0		0		0		0		0		0		0
26-Jul	45		45		0		0		0		0		0		0
27-Jul	86		131		0		0		0		0		0		0
28-Jul	48		179		0		0		0		0		0		0
29-Jul	88		267		0		0		0		0		0		0
30-Jul	71		338		0		0		0		0		0		0
31-Jul	108		446		0		0		0		0		0		0
1-Aug	6		452		0		0		0		0		0		0
2-Aug	166		618		0		0		0		0		0		0
3-Aug	644		1,262		0		0		0		0		0		0
4-Aug	478		1,740		0		0		0		0		0		0
5-Aug	2058		3,798		0		0		0		0		0		0
6-Aug	1098		4,896		0		0		0		0		0		0
7-Aug	1738	198	6,634		0		0		0		0		0		0
8-Aug	201		6,835		0		0		0		0		0		0
9-Aug	0		6,835		0		0		0		0		0		0
10-Aug	827		7,662		0		0		0		0		0		0
11-Aug	128		7,790		0		0		0		0		0		0
12-Aug	474		8,264		0		0		0		0		0		0
13-Aug	506		8,770		0		0		0		0		0		0
14-Aug	470	204	9,240		0		0		0		0		0		0
15-Aug	1314		10,554		0		0		0		0		0		0
16-Aug	237		10,791		0		0		0		0		0		0
17-Aug	12		10,803		0		0		0		0		0		0
18-Aug	82		10,885		0		0		0		0		0		0
19-Aug	65		10,950		0		0		0		0		0		0
20-Aug	74		11,024		0		0		0		0		0		0
21-Aug	100		11,124		0		0		0		0		0		0
22-Aug	2442	208	13,566		0		0		0		0		0		0
23-Aug	936		14,502		0		0		0		0		0		0
24-Aug	52		14,554		0		0		0		0		0		0
25-Aug	3405		17,959		0		0		0		0		0		0
26-Aug	8		17,967		0		0		0		0		0		0
27-Aug	341		18,308		0		0		0		0		0		0
28-Aug	52		18,360		0		0		0		0		0		0
29-Aug	240		18,600		0		0		0		0		0		0
30-Aug	1249		19,849		0		0		0		0		0		0
31-Aug	10		19,859		0		0		0		0		0		0
1-Sep	40		19,899		0		0		0		0		0		0
2-Sep	634		20,533		0		0		0		0		0		0
3-Sep	18		20,551		0		0		0		0		0		0
4-Sep	11		20,562		0		0		0		0		0		0
5-Sep	636		21,198		0		0		0		0		0		0
6-Sep	0		21,198		0		0		0		0		0		0
7-Sep	487		21,685		0		0		0		0		0		0
8-Sep	4		21,689		0		0		0		0		0		0
9-Sep	92		21,781		0		0		0		0		0		0
10-Sep	50		21,831		0		0		0		0		0		0
11-Sep	2		21,833		0		0		0		0		0		0
12-Sep	5		21,838		0		0		0		0		0		0
Total	21,838	610	21,838	0		0		0		0		0		0	

Appendix 8. Hidden Lake 2014 Adult Sockeye Salmon Escapement Sex Ratio and Size Data

	Age					
	1.2	1.3	1.4	2.2	2.3	Total
Sample Period:	July 27 - September 11, 2014					
Males (No.)	8,448	1,983		955	147	11,533
Percent	73.2%	17.2%		8.3%	1.3%	52.9%
Sample Size	115	27		13	2	157
Total Sample Size						229
Mean Length (mm)	505	555		524	565	515
St Dev	21	22		9	24	28
Females (No.)	8,815	514		955		10,284
Percent	85.7%	5.0%		9.3%		47.1%
Sample Size	120	7		13		140
Total Sample Size						297
Mean Length (mm)	496	540		505		497
St Dev	33	27		17		30
Both Sexes (No.)	17,263	2,498		1,910	147	21,817
Percent	79.1%	11.5%		8.8%	0.7%	100.0%
Sample Size	235	34		26	2	297
Total Sample Size						
Mean Length (mm)	500	552		514	565	506
St Dev	28	24		16	24	30

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

Appendix 9. Hidden Lake 2014 - Update

Stocking & Misc. Activities

Ice-out:	NA		
Smolt crew on-site:	19-May		
Smolt crew off-site:	1-Jul		
Adult crew on-site:	17-Jul		
Adult crew off-site:	12-Sep		
Fry stocking:	May 14 to May 21		
Adult Otolith Collection	7-Aug	14-Aug	22-Aug

Egg Take

Dates:	17-Sep	to	22-Sep
		No. Female	No. Male
No. of broodstock used:		710	710
Green eggs:		1,647,000	
Fecundity:		2,321	
Eyed eggs:		1,497,000	
Survival		91%	

Smolt Migration

Dates:	19-May	to	1-Jul	
			No.	%
Sockeyes:			**276,587**	
Mortalities:			3,110	1.12%
Age 1:			267,863	97%
Age 2:			8,724	3%
Hatchery:			208,900	76%
Coho:			**32,653**	
Dolly Varden:			**469**	
Rainbow:			**439**	

Adult Migration

Dates:	to		
		No.	%
Sockeye total return:	**48,228**		
Hidden Creek return:		21,838	45.3%
Commercial Harvest:*		14,331	29.7%
Personal Use/Sport Fish Harvest:*		11,447	23.7%
Otolith Collection:		612	1.3%
Lake otolith collection:		496	
Mortalites:		0	
Lake Escapement:	**21,838**		
Hatchery broodstock:		1,420	
Lake broodstock:		19,922	
Lake otolith collection:		496	
Coho:	**0**		

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