Hidden Lake
Sockeye Salmon Enhancement
Progress Report
2016

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March 2017

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 2016 field season at the Hidden Lake Salmon Enhancement Project. Appreciation is extended to the Cook Inlet Aquaculture Association seasonal assistants Eric Bolton, Jared Grangroth and John McNerney; and regular staff members Rodney Hobby, Ron Carlson, and Cathy Cline. 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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EXECUTIVE SUMMARY

This progress report summarizes the 2016 sockeye and coho salmon smolt enumerations and adult sockeye salmon enumeration at Hidden Lake. The report also summarizes a research study on spawning site fidelity within Hidden Lake.

In 2016, an estimated 326,133 (±48,589) live sockeye salmon smolt migrated from Hidden Lake. Based on otolith sampling, 65.4% (±3.7%) were identified as being of hatchery origin and 93.1% (±2.2) were age 1 and the remaining 6.9% (±2.2)% were age 2. For coho salmon, an estimated 43,146 (±11,076) smolt emigrated from the lake of which 46.2% (±4.2%) and 53.8% (±4.2%) were identified as age 1 and age 2 respectively.

For adult sockeye salmon returning to Hidden Lake a total of 1,248 fish were counted through the weir. Due to the low number of returning adults no fish were sacrificed at the weir for otolith extraction. Data regarding hatchery-reared and naturally-reared salmon were gleaned from the otoliths (N=33) taken from expired fish as a part of the Hidden Lake fidelity study. Those otoliths indicated that 48.5% (±17.3) sockeye salmon were reared in Trail Lakes Hatchery and 51.5% (±17.3) were naturally-spawned fish. Results of scale age analysis from scales collected at the weir (N=21) indicate age-1.2 (N=18) were the majority of the return representing 85.7% of the samples, with ages 1.1, 1.3, and 2.2 each represented by N=1 totaling 4.8% of the return for each age class. Age-1.1 adult salmon were not represented in the otolith samples taken during the Hidden Lake spawning site fidelity project but the other three year classes were present indicating age-1.2 fish represented 78.8% (±14.2) of the returning adults with age-1.3 and age-2.2 representing 18.2% (±13.4) and 3.0% (±5.9) respectively.

Otoliths collected for fidelity study at Hidden Lake comparing the eastern (current site used for unfed fry releases) and western (traditional spawning grounds) basins indicated that the adult sockeye salmon return to the eastern region of the lake was comprised of 89% hatchery-origin fish; while the otoliths collected on the south and north side of the western region of the lake showed 25% and 37% hatchery-origin fish respectively.

Trail Lakes Hatchery stocked an estimated 1,231,000 unfed fry (0.09 gm) into Hidden Lake on April 26. Because the threshold level of 1,600 sockeye salmon returning to Hidden was not met, no eggs were collected from Hidden Lake sockeye salmon in 2016.

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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 four 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. No samples of residual sockeye were collected in 2015. Additionally, USFWS requested that CIAA collect length from broodstock used to ensure that broodstock selection was indeed random. In 2016, otoliths for the straying project were not collected because all of the straying sampling goals had been met. Otolith samples were collected for the fidelity project from all three sites within Hidden Lake in 2016.

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).

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 Loop Road (Figure 1).

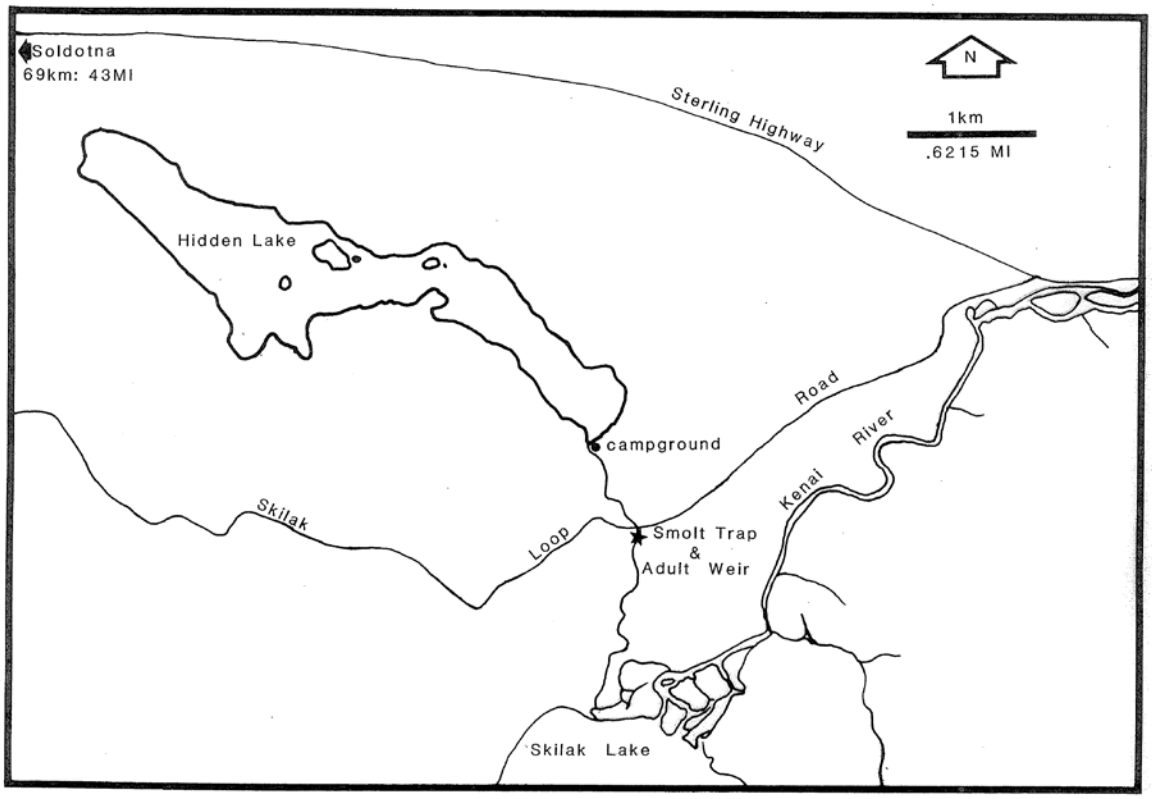

Figure 1. Area map of Hidden Lake, Kenai Peninsula, Southcentral Alaska

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 et al., 1990).

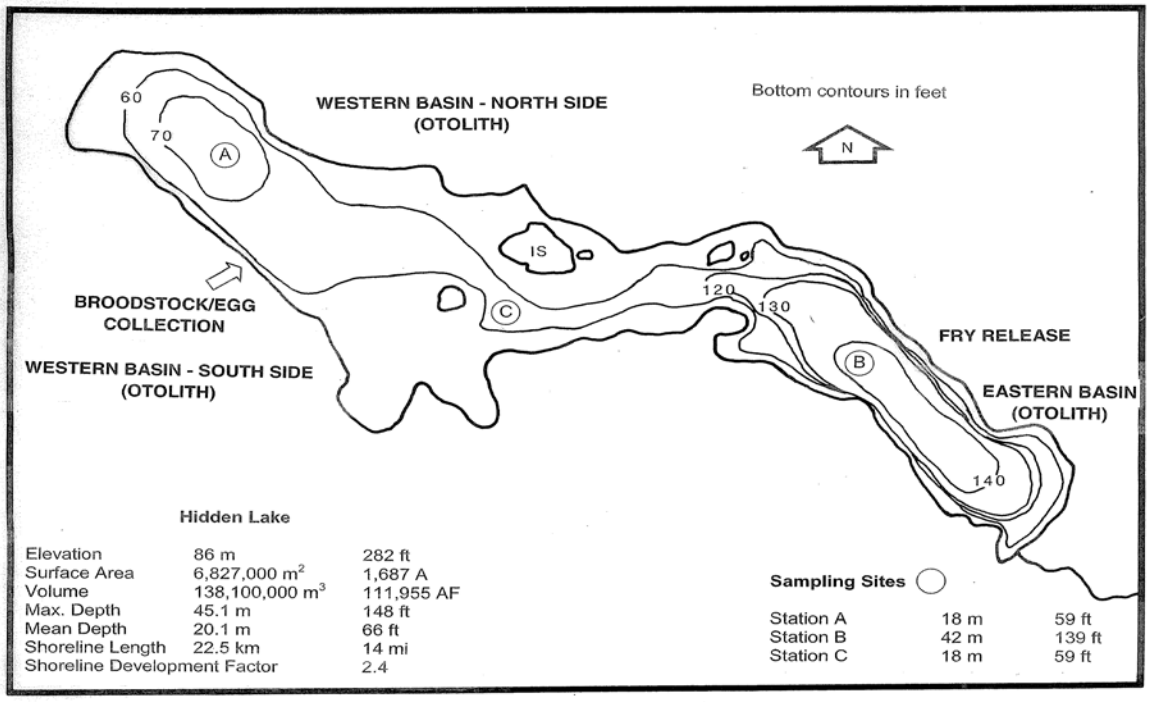

Figure 2. Morphometric map of Hidden Lake showing the two major basins

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 et al., 1990). Based on these concentrations, Hidden Lake is considered an oligotrophic-mesotrophic system.

Two cladocerans, (*Bosmina longirostris* and *Daphnia longiremus*), two copepoda (*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 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 2016, water quality samples were collected four times during the open water season near the end of the months of May, June, July, and August.

Two primary sites, Stations A and B (Figure 2) were sampled for dissolved oxygen, temperature and light transmission profiles, Secchi disk transparency, and zooplankton densities. Samples for analysis of phosphorus, carbon, chlorophyll *a*, phaeophytin *a*, nitrogen, calcium, magnesium, iron, conductivity, pH, alkalinity, turbidity, and color were also collected with a 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. No zooplankton sample was taken from Station C during the first visit on May 27.

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

In addition to the limnological samples collected from Hidden Lake, percent cloud cover was estimated and precipitation measured to the nearest millimeter at 5:00 pm each day. Hidden Creek water and air temperatures were recorded using a data logger (Hobo®) that 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 at 5:00 pm each day, and therefore results prior to this date may not be comparable to subsequent years.

Smolt Enumeration

To enumerate the smolt migration, a smolt trap was temporarily placed in Hidden Creek approximately 50 meters downstream of Skilak 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 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.

A detailed description of smolt enumeration procedures is available in CIAA's 2016 Hidden Lake Smolt Enumeration Procedures Manual (CIAAa, 2016).

Smolt Characteristics and Enhanced Contribution

During the smolt enumeration CIAA analyzed age, weight, and length characteristics of emigrating sockeye and coho salmon smolts. Hatchery contribution was also assessed by collecting otolith samples from sockeye salmon smolt. 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. No otolith sampling was conducted on any other species. However, scale samples for age determination were collected from the coho smolt.

During the 2016 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 2016,

0.2% of the migrating sockeye salmon were sampled (every 500th fish) and 1.3% of the migrating coho salmon were sampled (every 75th fish). The numbering sequence began when the first fish passed through the trap and continued consecutively until the smolt migration was complete. A total of 575 coho salmon were sampled and all samples were readable. Of the 650 sockeye smolt otoliths collected at the weir, all were readable. Mean smolt lengths are presented in this report plus or minus the 95% confidence interval.

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 10 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. Coho salmon smolt were released unharmed after biological data was recorded.

Statistical analysis of coho characteristics follows the same equation used to assess sockeye salmon smolt. Since there is no hatchery component to the Hidden Lake coho population, and $\alpha_h=0$.

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,

[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.

$n_h =$ 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:

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

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:

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

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

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

with a variance of:

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

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

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

with a variance of:

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

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

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

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

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

with an approximate variance estimate of:

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

and 95% confidence interval estimates of:

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

Adult Enumeration and Enhanced Contribution

The 2016 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.

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, scale samples were collected along with lengths from every 50^{th} adult sockeye salmon that passed through the weir and sex was recorded. The mean adult lengths for age-1.2 fish are presented in this report plus or minus one standard deviation of the sample mean. No mean or standard deviations are available for ages 1.1, 1.3, or 2.2 fish because they were represented by only one sample.

For 2016, 2.0% of the returning adult salmon were sampled. 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 spawned dead adult sockeye salmon to identify the hatchery induced thermal band. Staff attempted to collect as many readable otolith pairs for evaluation as was possible from the shoreline of Hidden Lake during three trips in September and October as a part of the Hidden Lake Fidelity Study. Beginning from the Hidden Lake access at the eastern end the crew surveyed the entire north shoreline to the western end continuing on through the spawning grounds on the south shore of the western basin. Every expired fish that could be reached along this path was taken for otolith extraction. For 2016, 33 otolith samples were collected of which all were readable, (N=9) from fish from the Eastern Basin, (N=20) from the Western Basin-North Side, and (n=4) from Western Basin-South Side. Otoliths were analyzed for age structure and presence of thermal mark. The otolith pairs were analyzed by CIAA staff to estimate hatchery contribution.

Marine survival for all fish (hatchery and natural production) was determined for each complete brood year by dividing the total adult return (for all age classes by a particular year class) by the number of migrating smolts for that same year class. The total adult return was determined by dividing the number of fish that were counted at the weir by 1 minus the harvest rate (as provided by ADF&G) for that return year.

A detailed description of adult escapement enumeration procedures is available in the 2016 CIAA Hidden Lake Adult Enumeration Procedures Manual (CIAA, 2016b).

Gamete Collection, Incubation and Rearing

Gamete collection did not occur in 2016 because the threshold of 1,600 returning adult sockeye was not met.

Fish Transport and Stocking

A sample of representative sample of unfed fry were measured for weight to the nearest 0.01 gram prior to being 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 collect the otoliths from as many expired fish as possible from each of three different spawning 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 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 in 2015.

Straying Study

No samples were collected on any of the straying sites in 2016, with agreement by USFWS and ADF&G. For data regarding the Hidden Lake Straying study refer to the 2015 Hidden Lake progress report (Wizik & Cherry, 2016).

RESULTS AND DISCUSSION

Limnology and Environmental Conditions

Limnology sampling at Hidden Lake has been completed by CIAA since 1992. Prior to CIAA's involvement in Hidden Lake, water quality samples were conducted by ADF&G. In 2016, water quality, and zooplankton samples were collected four times (May, June, July, and August). 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
2015	158	7.9	76	0.2	8.0	236	1.0	20.0	7.9	1,239	160	7.7	77	0.2	7.5	220	0.6
2016	153	7.9	65	0.3	6.1	361	0.8	23.4	8.9	1,117	157	7.7	73	0.2	6.2	350	0.9

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.
2016 TP data did not fit the model used to calculate TP in that the sum of the parts was less than the total phosphorus calculated

Environmental conditions during the Hidden Lake smolt migration were monitored from May 16 to July 5, 2016. Stream stage measurements were variable over the course of the smolt migration because of beaver activity near the outlet of Hidden Lake. The average change in stage height over this time period was +0.14 ft (±0.10 ft). During the period of smolt migration, stream temperatures averaged 13.9°C (±3.1°C). Air temperatures averaged 16.6°C (±3.9°C). Eight percent of the days were clear, 27% had less than 50% cloud cover, 33% had more than 50% cloud cover, and 32% were completely overcast. Measurable rain was recorded on 12 days (24%) of day the days during the smolt migration. A total of 35 mm of rain fell during this period.

Environmental conditions during the Hidden Lake adult sockeye salmon migration were monitored from July 13 to September 14, 2016. Stream stage measurements were fairly stable during adult monitoring. The average change in stage height over this time period was -0.03 ft (±0.03 ft). Stream temperatures averaged 17.4°C (±2.2°C) and air temperatures averaged 17.0°C (±3.4°C). Fourteen percent of the days were clear, 16% had less than 50% cloud cover, 14% had more than 50% cloud cover, and 56% were completely overcast. Measurable rain was recorded on 44 days (69%) during the adult migration. A total of 146 mm of rain fell during this period.

Smolt Enumeration

The Hidden Lake smolt migration was enumerated from May 16 and continued daily until July 5. The total estimated number of smolts at the trap was 326,133 (±48,589) sockeye and 43,146 (±11,076) coho salmon. The 2016 Hidden Lake sockeye salmon smolt migration was above the four-year average smolt emigration of 277,798 (Table 3). Six-hundred and fifty sockeye salmon smolt were sacrificed for otolith collection resulting in 325,486 live sockeye salmon smolt migrating out of the lake. The live smolt migration for the coho salmon is the same as the total migration (43,146). Other fish counted included 297 rainbow trout (*O. mykiss*), and 1,189 Dolly Varden (*S. malma*). The 10% sub-sampling procedure was used 82 times during the migration accounting for 47% of the sockeye smolt estimate and 14% of the coho smolt estimate.

Smolt Characteristics and Enhanced Contribution

Otolith, weight, and length measurements were collected and analyzed on 650 sockeye salmon smolt of which all of the samples were readable. Based on the otolith samples collected, 65.4% (±3.7%) of the migrating sockeye salmon smolt were incubated at Trail Lakes Hatchery. An estimated 93.1% (±2.2%) were age 1 and 6.9% (±2.2%) were age 2. The average length and weight of the age 1 sockeye salmon smolt were 132.8mm (±0.6 mm) and 22.9 g (±1.0 g). The average length and weight of the age 2 sockeye salmon smolt were 164.3 mm (±15.0 mm) and 48.52 g (±8.0 g).

Scale age, weight, and length measurements were made on 575 coho salmon smolt, of which 573 scale samples were readable. Based on the scale samples collected, an estimated 46.2% (±4.2%) of the migrating coho salmon smolt were age 1. An estimated 53.8% (±4.2%) were age 2. The average length and weight of the age 1 coho smolt were 123.4 mm (±7.9 mm) and 19.2 g (±1.2 g). The average length and weight of the age 2 coho salmon smolt were 135.4 mm (±0.9 mm) and 25.3 g (±0.5 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 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 salmon smolt between wild and enhanced fish since 1993.

In 2016, the proportion of hatchery-incubated salmon in the sockeye salmon smolt migration was 65.4% (±3.7%) (Table 3). The 2016 hatchery contribution falls between the 1993–2015 average of 66% and with the most recent four year average of 63%. Without knowing the success of natural spawning within the system (i.e., green egg number; survival to eyed stage; survival to emergence), no comparison of survival between the two groups can be made. Fry-to-smolt survival for hatchery fish can be determined on a year class basis. For the most recent completed year class (BY2011), the fry-to-smolt survival is estimated at 20.2%. It should be noted that

because the hatchery fish are stocked as unfed fry, they are subject to the same environmental conditions as the naturally-produced fish. Therefore, if there is a lower survival of naturally-produced fish, it is most likely occurring between the green egg to emergence stage.

Adult Enumeration and Enhanced Contribution

The Hidden Lake adult salmon escapement was enumerated from July 13 to September 14, 2016. During this time, a total of 1,248 adult sockeye salmon (*O. nerka*) and zero adult coho salmon (*O. kisutch*) returned to Hidden Creek. No other fish were reported. Because of the low number of returning adults, none were sampled at the weir for otolith collection leaving a live escapement of 1,248 to the lake. There were no living adult sockeye salmon sampled as part of the fidelity study (because all of the fish sampled were collected after natural mortality occurred in the lake) and no sockeye salmon were used for hatchery brood stock, leaving all escaping adults in Hidden Lake as potential spawners.

During the 2016 Hidden Lake field season, 25 adult sockeye salmon were measured and had scale samples collected at the weir. Twenty-one of those samples were read by ADF&G technicians. The percentage of adult males was 52.4% and adult females represented 47.6% of sockeye salmon returning to Hidden Lake in 2016. The age classes represented in the sample were age-1.2 (85.7%) with ages 1.1, 1.3, and 2.2 representing 4.8% each determined by one sample from each year class. Because of the small sample size the average lengths of those year classes is unknown. Mean length of age-1.2 adult sockeye was 522 mm (±27mm). Table 4 provides historical Hidden Lake sockeye AWL data over the last 40 years for each age class.

The only data available to assess the contribution of hatchery-incubated fish to the population of adult sockeye salmon returning to Hidden Lake comes from the 33 otoliths collected by CIAA staff during three sampling trips for the fidelity study in September and October. Because CIAA was sampling fish that had already spawned and succumb to natural mortality, no AWL measurements were taken. Based on examination of these 33 otoliths, 16, or 48.5% of the adult sockeye salmon samples were determined to be incubated at Trail Lakes Hatchery. Twenty-six

were age class 1.2 representing 78.8% of the sample. Ages classes 1.3 and 2.2 were also represented as (N=6) or 18.2% and (N=1) or 3.0% respectively.

Prior to 1999, the hatchery contribution of adult sockeye returns was not evaluated. The Hidden Lake adult hatchery contribution of adult returns from 1999–2015 has averaged 62%. 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. For 2016, hatchery contribution to Hidden Lake sockeye escapement was assessed using the otoliths collected as part of the Hidden Lake Fidelity Study. Those otoliths indicated that the hatchery contribution to the 2016 escapement was 48.5% (±17.3). Looking at the most recent four year average, the number of adult sockeye salmon attributable to the hatchery program was 68%. Table 4 summarizes historical sockeye salmon escapements and major age classes based on calendar year and Table 5 summarizes AWL data but on a brood year basis and for enhanced contribution only. On a brood year basis, the enhanced characteristics of smolts are a predictor of what the adult returns will be for that same year class.

The 2016 estimated commercial fishery harvest of Hidden Lake sockeye salmon (enhanced and wild) was 1,013. Personal use and sport fishery combined was estimated at 549 (M. Willette, Commercial Fisheries Biologist, ADF&G, Soldotna, personal communication, 2016). Common property harvest was estimated to be 58.0% and escapement to Hidden Lake was 42.0% (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 94,009,000 eggs

have been collected for incubation at Crooked Creek, Big Lake, and Trail Lakes Hatcheries. Since 1983 all Hidden Lake sockeye egg incubation has taken 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.

Because the threshold of 1,600 adult sockeye salmon was not met in 2016, no gametes were collected at Hidden Lake.

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 (101,700 Table 3), brood year average green egg-to-fry survival (89.0%, Table 8), fry-to-smolt survival (16.8%, Table 8), smolt-to-adult survival (18.2%, Table 7), and the average common property harvest rate (56.3%, Table 6). Based on these averages, to meet a projected adult return of 30,000 adult sockeye salmon to Hidden Creek, CIAA projected 1,640,299 eggs should have been collected in 2016 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)

101,700* 19.6% = 19,737

Equation 2: Natural Return (Hidden Lake)

2016 total fishery return (Equation 1) * (1 - Common Property %) = est. natural return to lake

19,737* (1-0.588) = 8,132

Equation 3: Enhanced Return (Hidden Lake)

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

30,000 – 8,132 = 21,868

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.%

21,316/0.898/0.168/0.196/0.440 = 1,640,299

However, due to space limitations at the hatchery, only 1,250,000 eggs will be collected.

Table 2. Age structure, length and weight characteristics of Hidden Lake sockeye salmon smolt, 1976–2016

		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)
2015	335,923	95	(±2.0)	318,726	5	(±2.0)	17,197	129	(±0.7)	153	(±27.4)	23.7	(±1.1)	37.7	(±9.0)
2016	326,133	93	(±2.2)	303,555	7	(±2.2)	22,578	133	(±0.6)	164	(±15.0)	22.9	(±1.0)	48.5	(±8.0)
Mean	287,846	90			10			135		180		21.9		57.0	

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, 1976–2016

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)
2015	335,923	(±0)	150,764	185,159	55	(±4.0)
2016	326,133	(±48,589)	112,892	213,241	65	(±3.7)
Mean	312,000		100,700	211,300	66	
4-Year mean	279,800		102,300	177,600	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).

This summary is total migration minus the mortalities.

4-Year mean calculated from 2013–2016

Table 4. Summary of Hidden Lake adult sockeye salmon escapement, age distribution, and fish length, 1976–2016

						Major Age Classes								
						1.2			1.3			2.2		
Year	Lake Escapement	Hatchery Return (%)	(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%)	15,788	6,050	79	17,263	500	11	2,498	552	9	1,910	514
2015	18,785	68%	(±3.8%)	12,730	6,055	87	16,770	492	9	1,819	524	4	796	490
2016	1,248	49%	(±17.3%)	605	643	86	1,070	522	5	60	590	4.8	60	480
Mean	26,576	61%		16,787	10,339	79	21,762	519	12	2,788	560	8	1,772	530
4 Year Avg	15,757	66%		11,326	4,431	81	12,520	507	11	3,064	555	7	1,130	503
Min	1,055	41%		605	643	63	1,070	455	1	21	524	0	0	480
Max	77,959	77%		44,629	27,354	91	52,548	550	41	12,957	600	34	9,355	580

Shaded areas are not means because they were represented by only one sample

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, 1991–2013

	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	72	28
2011	57	43	68	32
2012	74	26		
2013	56	44		
4-year average	63	37	68	32

*4-year average is for complete brood years only

Table 6. Historical common property harvests and escapement to Hidden Lake, 1996–2016

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%
2015	55%	45%
2016	59%	41%
Average	60%	40%
4-year average	56%	43%

Table 7. Marine survival by brood year for returns to Hidden Lake, 1988–2012

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	19.9%
2010	14.1%
2011	20.2%
4-year average	19.6%

*4-year average is for complete brood years

*Red numbers indicate incomplete brood years

Table 8. Summary of sockeye salmon gamete collection and fry releases at Hidden Lake, 1976–2016

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	213,368	24.81%				
2013	1,685,000	728	2,315	Trail L.	91.4%	1,540,000	190,685	12.38%				
2014	1,647,600	710	2,321	Trail L.	90.8%	1,497,000	303,555	20.28%				
2015	1,445,598	635	2,277	Trail L.	87.6%	1,231,000						
2016	0	0	NA	NA								
Total	94,009,000	36,785				47,970,000	6,068,000		19,483,000	2,164,000	1,754,000	
Mean			2,462		77.8%	1,236,486	211,944	19.48%				83.50%
4-yr Avg.			2,489		89.8%	1,098,000	176,578	16.79%				

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.
NA means the category was not aplicable since no eggs were collected for that year
incomplete broodyear

Fish Transport and Stocking

On April 26, 2016, an estimated 1,231,000 unfed sockeye salmon fry at approximately 0.09 g from gametes collected in 2015 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. None of the released fry were externally marked or tagged; however, the otoliths of all the released fry were marked with thermal bands [Hatch Code: 3,2,1H]. Since 1977, nearly 48 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. Releasing hatchery-reared sockeye salmon fry to the eastern basin of the lake will also reduce F1 hatchery-origin adult influence at the two primary spawning areas located in the western basin of the lake and the number of hatchery-produced fish spawning with naturally-produced fish will be reduced.

During late September and early October 2016 otoliths were collected and analyzed for thermal marks from dead spawned adult sockeye salmon in the Eastern Basin (9), Western Basin-North Side (20), and Western Basin-South Side (4) sampling locations. Table 9 summarizes the results. The Eastern Basin had the highest percentage of hatchery-reared fish at 88.8%, followed by the Western Basin-North Side (35.0%), and Western Basin-South Side (25.0%). Table 10 summarizes the results over the last 4 years.

Field season 2016 is the second year of realized returns from the new stocking location at the eastern region of the lake. As predicted based on fidelity studies performed by Habicht et al. (2013), there was an increase in the ratio of hatchery fish at this new release location.

Table 9. Distribution of hatchery and natural reared adult sockeye salmon in Hidden Lake, 2016

Location	No. of Samples	No. of Readable Samples	No. Readable Marked	Percent Hatchery Marked	Percent Wild
Eastern	9	9	8	88.9%	11.1%
Western-North	20	20	7	35.0%	65.0%
Western-South	4	4	1	25.0%	75.0%

Table 10. Distribution of hatchery and natural reared adult sockeye salmon in Hidden Lake, 2012–2016

	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	90.0	10.0	84.1	15.9	91.8	8.2
2015	97.8	2.2	74.9	25.1	30.5	69.5
2016	88.9	11.1	35.0	65.0	25.0	75.0
Average	91.3	8.7	70.3	29.7	51.0	49.0

Straying Study

Because all of the goals set forth regarding straying were met, no straying sampling was conducted in 2016. Results of the straying study can be found in the 2015 Hidden Lake progress report (Wizik & Cherry, 2016).

RECOMMENDATIONS

The causative factors contributing to the low number of returning adult sockeye to Hidden Lake in 2016 are not clear at this time. Several possibilities have been raised such as fishing pressure at the mouth of Hidden Creek, thermal barriers, and possible correlations with other salmon runs that under performed in 2016. Although there is little that could be done regarding water temperatures and marine survival, ensuring that fishermen are not salmon fishing near the mouth of Hidden Creek in 2017 is one factor that can be monitored to possibly improve future escapement numbers.

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 occurred in 2015. As hypothesized and based on the fidelity characteristics of sockeye salmon, the number of fish in the eastern region that are of hatchery origin increased, while in the western basin the hatchery contribution decreased at both the south and north locations.

The new fry release site should continue to be used when progeny are available for stocking and the 2017 egg take should be from the western basin south side because this is the site that held the lowest proportion of hatchery produced sockeye in 2016.

Studying the straying rate from Hidden Lake hatchery reared sockeye was included as a part of the 2012–2017 Hidden Lake Operational Plan (CIAA et al., 2012). 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, no strays from the Hidden Lake stocking program have been documented. Because the attainable goals of this study have been met and the consideration for the fiscal and personnel resources necessary to complete further straying studies, CIAA recommends that straying sampling requirements continue to be waived in 2017.

With the 2012–2017 Hidden Lake Operational Plan (CIAA et al., 2012) coming to a closure, CIAA, ADFG, and USFWS will begin drafting a new work plan to cover the years 2018–2022.

Data collected during 2012–2017 seasons should serve as a guide to informing the direction of the next operational plan.

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APPENDICES

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Appendix 1. Hidden Lake 2016 - 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)	
5/27/2016	A	1	5.8	2.7	1.3	374.7	0.0	1.1	143	:1	2820	172	0.45	0.11	A	21
5/27/2016	A	14	9.2	3.9	1.5	382.2	4.2	0.0	93	:1	2848	232	1.49	0.48		
5/27/2016	B	1	6.7	2.6	1.2	325.9	0.0	0.8	108	:1	2789	195	0.72	0.20	B	29.6
5/27/2016	B	28	7.6	3.4	1.0	342.9	6.1	4.2	102	:1	2889	196	1.24	0.67		
6/22/2016	A	1	9.3	3.1	0.9	371.7	3.9	0.0	89	:1	2698	181	0.42	0.22	A	21.1
6/22/2016	A	16	7.4	3.2	1.0	419.0	3.1	0.0	126	:1	2788	172	1.22	0.60		
6/22/2016	B	1	7.1	3.9	1.0	408.6	4.0	0.0	129	:1	2705	148	0.72	0.20	B	20.0
6/22/2016	B	24	6.6	3.2	1.1	352.7	4.9	3.0	120	:1	2828	108	0.66	0.56		
7/27/2016	A	1	4.1	3.4	1.0	351.8	2.6	0.0	191	:1	2731	185	0.86	0.26	A	23.3
7/27/2016	A	16	5.9	4.9	1.9	319.2	2.1	0.0	121	:1	2728	107	0.56	0.49		
7/27/2016	B	1	4.7	4.5	1.7	307.4	2.4	2.2	146	:1	2826	63	0.41	0.41	B	21.5
7/27/2016	B	20	4.9	4.0	1.6	348.0	0.0	0.0	157	:1	2767	131	0.94	0.30		
8/22/2016	A	1	5.6	4.7	1.1	388.0	5.4	0.0	156	:1	2769	185	1.30	0.41	A	24.6
8/22/2016	A	18	5.0	3.6	1.2	319.1	1.5	0.0	143	:1	2888	101	0.55	0.51		
8/22/2016	B	1	5.4	4.8	1.0	361.7	3.8	0.0	150	:1	2734	78	1.12	0.37	B	26.0
8/22/2016	B	25	3.4	4.0	1.1	318.3	0.0	15.8	207	:1	2894	78	0.39	0.29		
Mean	1 - Meter		6.1	3.7	1.2	361	2.8	0.5	139.0	:1	2759.0	150.8	0.8	0.3	Mean	23.4
Min			4.1	2.6	0.9	307	0.0	0.0	89.4	:1	2698.0	62.6	0.4	0.1	Min	20.0
Max			9.3	4.8	1.7	409	5.4	2.2	191.4	:1	2826.0	194.7	1.3	0.4	Max	29.6
Mean	Hypolimnion		6.2	3.8	1.3	350	2.7	2.9	133.7	:1	2,829	141	0.9	0.5		
Min			3.4	3.2	1.0	318	0.0	0.0	93.0	:1	2,728	78	0.4	0.3		
Max			9.2	4.9	1.9	419	6.1	15.8	207.3	:1	2,894	232	1.5	0.7		

Total phosphorus numbers do not line up with the model (Total numbers are leess than the sum of components)

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)
5/27/2016	A	1	139	7.8	75.2	0.5	8	23.5	2.3	< 3	A	8.0
5/27/2016	A	14	143	7.8	74.9	0.4	6	23.5	2.4	< 3		
5/27/2016	B	1	147	7.9	74.4	0.3	8	23.6	2.2	< 3	B	10.0
5/27/2016	B	28	150	7.7	74.3	0.5	6	23.8	1.0	0		
6/22/2016	A	1	158	8.0	74.5	0.1	4	22.6	2.6	4	A	9.0
6/22/2016	A	16	158	7.8	73.8	0.1	6	22.9	2.8	3		
6/22/2016	B	1	158	8.0	73.7	0.2	4	23.4	2.4	22	B	12.0
6/22/2016	B	24	161	7.7	75.1	0.1	4	23.3	2.6	11		
7/27/2016	A	1	159	8.2	7.0	0.2	4	23.0	2.1	< 3	A	8.0
7/27/2016	A	16	169	7.6	72.0	0.2	5	23.5	2.1	0		
7/27/2016	B	1	168	7.5	71.6	0.2	5	23.3	2.3	14	B	9.0
7/27/2016	B	20	164	7.9	69.0	0.2	5	21.7	2.4	3		
8/22/2016	A	1	147	7.9	70.7	0.3	4	22.9	2.1	3	A	6.5
8/22/2016	A	18	153	7.4	71.6	0.2	4	23.0	2.1	< 3		
8/22/2016	B	1	151	7.8	71.3	0.3	5	22.6	2.2	6	B	9.0
8/22/2016	B	25	158	7.4	72.6	0.2	5	23.2	2.4	9		
Mean	1 - Meter		153	7.9	64.8	0.3	5	23.1	2.3	10	Mean	8.9
Min			139	7.5	7.0	0.1	4	22.6	2.1	3	Min	6.5
Max			168	8.2	75.2	0.5	8	23.6	2.6	22	Max	12.0
Mean	Hypolimnion		157	7.7	72.9	0.2	5	23.1	2.2	4		
Min			143	7.4	69.0	0.1	4	21.7	1.0	0		
Max			169	7.9	75.1	0.5	6	23.8	2.8	11		

Appendix 2. Hidden Lake 2016 - Zooplankton (Density)

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

	27-May	22-Jun	27-Jul	22-Aug	Mean (No/m2)	Seasonal Mean (No/m2)
Ergasilus						
Ovig Ergasilus						
Epischura	4,586	17,516	21,019	1,178	11,075	11,075
Ovig Epischura						
Diaptomus						
Ovig Diaptomus						
Cyclops	116,943	23,885	19,873	2,006	40,677	40,677
Ovig. Cyclops	3,822	4,459	191		2,824	2,118
Bosmina	64,968	197,452	168,153	5,318	108,973	108,973
Ovig. Bosmina	1,529		3,439	96	1,688	1,266
Daphnia l.	70,064	40,127	6,688	573	29,363	29,363
Ovig. Daphnia l.	5,350	7,006	1,911		4,756	3,567
Daphnia g.	19,108	10,510	7,070	287	9,244	9,244
Ovig. Daphnia g.	4,076	7,962	1,146	32	3,304	3,304
Chydorinae						
Polyphemus						
Total:	290,446	308,917	229,490	9,490	211,903	209,586
Ave:	32,272	38,615	25,499	1,356	23,545	23,287
STDEV:	41,654	65,235	54,051	1,882	34,740	34,909

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

	27-May	22-Jun	27-Jul	22-Aug	Mean (No/m2)	Seasonal Mean (No/m2)
Ergasilus						
Ovig Ergasilus						
Epischura	17,834	33,439	29,809	8,153	22,309	22,309
Ovig Epischura						
Diaptomus						
Ovig Diaptomus						
Cyclops	289,363	269,108	358,854	150,828	267,038	267,038
Ovig. Cyclops	19,618	29,459	6,879	2,548	14,626	14,626
Bosmina	362,930	369,427	131,083	432,102	323,886	323,886
Ovig. Bosmina	1,783	796	478		1,019	764
Daphnia l.	43,248	87,580	21,401	28,025	45,064	45,064
Ovig. Daphnia l.	20,510	24,682	6,115	4,076	13,846	13,846
Daphnia g.	11,146	19,108	23,694	24,459	19,602	19,602
Ovig. Daphnia g.	3,121	7,962	3,439	1,019	3,885	3,885
Chydorinae						
Polyphemus						
Total:	769,553	841,561	581,752	651,210	711,274	711,019
Ave:	85,506	93,507	64,639	81,401	79,030	79,002
STDEV:	138,193	132,711	117,452	150,203	124,164	124,184

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

	27-May	22-Jun	27-Jul	22-Aug	Mean (No/m2)	Seasonal Mean (No/m2)
Ergasilus						
Ovig Ergasilus						
Epischura		4,299	3,185	924	2,803	2,102
Ovig Epischura						
Diaptomus						
Ovig Diaptomus						
Cyclops		7,006	1,178	6,433	4,872	3,654
Ovig. Cyclops				191	191	48
Bosmina		23,885	4,650	5,892	11,476	8,607
Ovig. Bosmina			478	32	255	128
Daphnia l.		13,376	701	223	4,767	3,575
Ovig. Daphnia l.		796	64		430	215
Daphnia g.		3,822	191	382	1,465	1,099
Ovig. Daphnia g.				32	32	8
Chydorinae						
Polyphemus						
Total:		53,184	10,447	14,109	26,290	19,435
Ave:		8,864	1,492	1,764	2,921	2,159
STDEV:		8,495	1,748	2,733	3,736	2,827

Appendix 3. Hidden Lake 2016 - Zooplankton (Size and Biomass)

	Body Size - Site A - Depth 18m - 21m (mm)				Seasonal Means				
	27-May	22-Jun	27-Jul	22-Aug	Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m2)	Weighted Biomass (mg/m2)	% by Species
Ergasilus									
Ovig Ergasilus									
Epischura	1.00	1.29	1.21	0.81	1.08	1.21	62	85	13%
Ovig Epischura									
Diaptomus									
Ovig Diaptomus									
Cyclops	0.99	1.02	1.03	1.01	1.01	1.00	150	146	22%
Ovig. Cyclops	1.35	1.35	1.23		1.31	1.35	14	14	2%
Bosmina	0.51	0.50	0.53	0.49	0.51	0.51	266	272	42%
Ovig. Bosmina	0.56		0.62	0.47	0.55	0.60	4	4	1%
Daphnia l.	0.73	0.97	1.08	0.79	0.89	0.83	106	91	14%
Ovig. Daphnia l.	1.03	1.31	1.31		1.22	1.21	25	25	4%
Daphnia g.	0.66	1.16	1.05	0.77	0.91	0.88	17	15	2%
Ovig. Daphnia g.	1.26	1.59	1.38	1.40	1.4075		26		
Chydorinae									
Polyphemus									
TOTAL:							668	653	100%

	Body Size - Site B - Depth 38m - 40m (mm)				Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m2)	Weighted Biomass (mg/m2)	% by Species
	27-May	22-Jun	27-Jul	22-Aug					
Ergasilus									
Ovig Ergasilus									
Epischura	1.25	1.40	1.42	1.23	1.33	1.36	223	241	9%
Ovig Epischura									
Diaptomus									
Ovig Diaptomus									
Cyclops	1.02	1.05	1.00	1.07	1.04	1.03	1,035	1,020	39%
Ovig. Cyclops	1.36	1.32	1.28	1.24	1.30	1.33	92	96	4%
Bosmina	0.52	0.54	0.56	0.50	0.53	0.52	865	842	32%
Ovig. Bosmina	0.66	0.62	0.62		0.63	0.64	3	3	0%
Daphnia l.	0.89	1.16	1.08	0.97	1.03	1.06	219	233	9%
Ovig. Daphnia l.	1.14	1.30	1.35	1.07	1.22	1.23	97	100	4%
Daphnia g.	1.00	1.15	1.03	1.11	1.07	1.08	62	63	2%
Ovig. Daphnia g.	1.42	1.55	1.43	1.48	1.47	1.49	35	37	1%
Chydorinae									
Polyphemus									
TOTAL:							2,631	2,635	100%

	Body Size - Site C - Depth 12m - 18m (mm)				Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m2)	Weighted Biomass (mg/m2)	% by Species
	27-May	22-Jun	27-Jul	22-Aug					
Ergasilus									
Ovig Ergasilus									
Epischura		1.27	0.80	0.76	0.94	1.04	8	10	17%
Ovig Epischura									
Diaptomus									
Ovig Diaptomus									
Cyclops		0.94	0.98	1.03	0.98	0.98	13	13	20%
Ovig. Cyclops				1.23	1.23	1.23	0	0	
Bosmina		0.50	0.50	0.48	0.49	0.50	20	20	32%
Ovig. Bosmina			0.59	0.56	0.58	0.59	0	0	1%
Daphnia l.		0.97	1.00	0.93	0.97	0.97	15	15	24%
Ovig. Daphnia l.		1.27	1.14		1.21	1.26	1	2	3%
Daphnia g.		0.96	0.91	0.80	0.89	0.94	2	2	4%
Ovig. Daphnia g.				1.36	1.36	1.36	0	0	0%
Chydorinae									
Polyphemus									
TOTAL:							60	63	100%

Appendix 4. Hidden Lake 2016 - Environmental Conditions

Smolt Migration

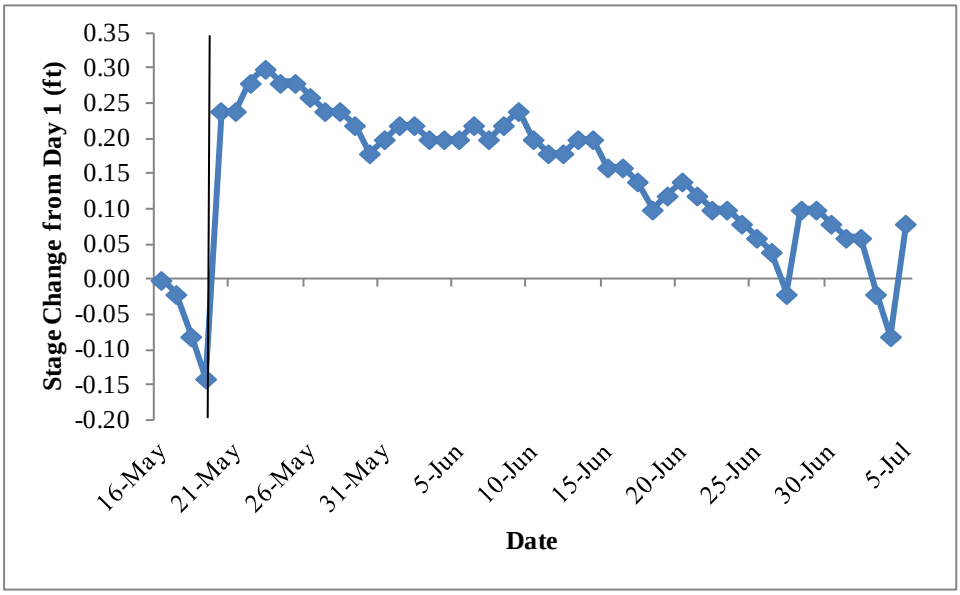
Date	Sky	Precip. (mm)	Stage (ft)	Stage Change (ft)	Water Temp. (°C)	Air Temp. (°C)
16-May	2	0.0	0.36	0.00	11.0	8
17-May	3	0.0	0.34	-0.02	10.0	16
18-May	4	0.0	0.28	-0.08	9.0	14.5
19-May	2	0.0	0.22	-0.14	10.0	15
20-May	4	0.0	0.60	0.24	6.5	10
21-May	4	0.1	0.60	0.24	7.0	12
22-May	3	0.0	0.64	0.28	10.0	14.5
23-May	3	0.1	0.66	0.30	11.0	15.5
24-May	2	0.0	0.64	0.28	10.0	12
25-May	3	0.0	0.64	0.28	13.5	18.5
26-May	1	0.0	0.62	0.26	15.0	20
27-May	2	0.0	0.60	0.24	16.0	21.5
28-May	2	0.0	0.60	0.24	15.0	20
29-May	5	0.0	0.58	0.22	12.0	11.5
30-May	2	0.1	0.54	0.18	11.5	17
31-May	3	0.0	0.56	0.20	11.5	16
1-Jun	3	0.0	0.58	0.22	13.0	17
2-Jun	2	0.0	0.58	0.22	13.0	17.5
3-Jun	3	0.0	0.56	0.20	12.0	14
4-Jun	4	0.0	0.56	0.20	12.0	14.5
5-Jun	3	0.0	0.56	0.20	12.5	16
6-Jun	5	1.3	0.58	0.22	12.0	9
7-Jun	3	0.0	0.56	0.20	14.0	16.5
8-Jun	1	0.0	0.58	0.22	15.5	20
9-Jun	2	0.0	0.60	0.24	17.0	21
10-Jun	4	0.0	0.56	0.20	13.0	14
11-Jun	3	0.0	0.54	0.18	13.5	14.5
12-Jun	4	0.1	0.54	0.18	12.0	13
13-Jun	2	0.1	0.56	0.20	15.0	19
14-Jun	2	0.0	0.56	0.20	17.0	19.5
15-Jun	1	0.0	0.52	0.16	19.0	22.5
16-Jun	1	0.0	0.52	0.16	20.5	25
17-Jun	3	0.0	0.5	0.14	16.5	17.5
18-Jun	3	0.0	0.46	0.1	13.0	16
19-Jun	4	0.0	0.48	0.12	9.5	14
20-Jun	3	0.1	0.50	0.14	14.0	15
21-Jun	2	0.0	0.48	0.12	18.0	22
22-Jun	2	0.0	0.46	0.10	20.0	28.5
23-Jun	3	0.0	0.46	0.10	18.0	19.5
24-Jun	5	0.1	0.44	0.08	14.0	14.5
25-Jun	4	0.0	0.42	0.06	16.0	17
26-Jun	3	0.0	0.40	0.04	17.0	19.5
27-Jun	3	0.0	0.34	-0.02	15.0	18
28-Jun	2	0.0	0.46	0.10	16.0	18
29-Jun	2	0.0	0.46	0.10	16.0	18
30-Jun	5	1.0	0.44	0.08	15.0	14
1-Jul	4	0.1	0.42	0.06	15.5	10.5
2-Jul	4	0.0	0.42	0.06	16.5	16.5
3-Jul	4	0.1	0.34	-0.02	15.0	17
4-Jul	3	0.0	0.28	-0.08	17.0	19
5-Jul	5	0.2	0.44	0.08	15.5	15
Total		3.5				
Avg.		0.1	0.50	0.14	13.9	16.6
Min.		0.0	0.22	-0.14	6.5	8.0
Max.		1.3	0.66	0.30	20.5	28.5
SD		0.2	0.10	0.10	3.1	3.9

Adult Migration

Date	Sky	Precip. (mm)	Stage (ft)	Stage Change (ft)	Water Temp. (°C)	Air Temp. (°C)
13-Jul	4	0.0	0.44	0.00	20.0	20.0
14-Jul	2	0.0	0.42	-0.02	21.0	22.5
15-Jul	3	0.0	0.42	-0.02	20.0	22.0
16-Jul	4	0.0	0.42	-0.02	20.0	21.0
17-Jul	2	0.0	0.4	-0.04	23.0	25.0
18-Jul	1	0.0	0.38	-0.06	23.0	25.0
19-Jul	2	0.0	0.36	-0.08	23.0	25.0
20-Jul	2	0.0	0.42	-0.02	24.0	25.0
21-Jul	3	1.6	0.42	-0.02	22.0	23.0
22-Jul	5	0.4	0.41	-0.03	18.0	16.0
23-Jul	4	9.0	0.42	-0.02	18.0	16.0
24-Jul	4	3.4	0.41	-0.03	16.0	15.0
25-Jul	4	7.8	0.42	-0.02	16.0	13.0
26-Jul	4	0.6	0.38	-0.06	16.0	15.0
27-Jul	4	0.4	0.38	-0.06	18.5	16.0
28-Jul	4	5.4	0.38	-0.06	18.5	18.0
29-Jul	2	0.6	0.33	-0.11	18.5	19.0
30-Jul	3	0.0	0.44	0.00	16.5	17.0
31-Jul	4	0.0	0.43	-0.01	18.0	17.5
1-Aug	4	0.2	0.42	-0.02	17.0	17.0
2-Aug	4	3.6	0.42	-0.02	17.0	17.0
3-Aug	2	0.3	0.41	-0.03	22.0	22.0
4-Aug	4	6.3	0.37	-0.07	17.0	15.0
5-Aug	4	5.3	0.38	-0.06	18.0	17.0
6-Aug	4	7.2	0.38	-0.06	17.0	16.5
7-Aug	4	1.8	0.38	-0.06	16.0	16.5
8-Aug	5	7.8	0.3	-0.14	16.0	13.0
9-Aug	4	2.3	0.43	-0.01	17.0	16.0
10-Aug	3	0.5	0.44	0.00	17.0	17.0
11-Aug	4	5.8	0.45	0.01	16.0	13.5
12-Aug	3	1.3	0.45	0.01	16.0	15.0
13-Aug	4	0.5	0.44	0.00	16.0	15.5
14-Aug	4	0.5	0.4	-0.04	17.0	16.0
15-Aug	3	0.3	0.44	0.00	17.0	18.5
16-Aug	2	0.2	0.44	0.00	17.5	20.0
17-Aug	5	1.8	0.43	-0.01	15.5	13.0
18-Aug	3	4.3	0.42	-0.02	17.0	16.5
19-Aug	4	0.7	0.42	-0.02	16.0	15.0
20-Aug	3	0.2	0.42	-0.02	17.0	18.5
21-Aug	4	0.0	0.41	-0.03	16.0	14.5
22-Aug	5	2.4	0.43	-0.01	16.0	12.0
23-Aug	4	5.2	0.42	-0.02	16.0	15.0
24-Aug	4	0.5	0.41	-0.03	16.0	18.0
25-Aug	4	14.0	0.44	0.00	16.0	16.0
26-Aug	2	0.5	0.44	0.00	16.0	18.5
27-Aug	2	0.0	0.44	0.00	16.0	18.0
28-Aug	1	0.0	0.44	0.00	16.0	20.0
29-Aug	1	0.0	0.44	0.00	16.0	19.0
30-Aug	1	0.0	0.4	-0.04	16.0	19.0
31-Aug	1	0.0	0.43	-0.01	16.0	18.0
1-Sep	1	0.0	0.42	-0.02	18.0	18.0
2-Sep	1	0.0	0.42	-0.02	19.0	19.5
3-Sep	5	0.0	0.4	-0.04	17.0	15.5
4-Sep	5	5.8	0.42	-0.02	15.5	12.5
5-Sep	5	10.0	0.41	-0.03	16.0	13.0
6-Sep	4	9.0	0.43	-0.01	16.0	12.0
7-Sep	2	0.0	0.45	0.01	17.0	16.0
8-Sep	3	3.2	0.43	-0.01	16.0	11.5
9-Sep	4	2.0	0.42	-0.02	16.0	12.5
10-Sep	1	0.5	0.42	-0.02	17.0	16.5
11-Sep	5	5.4	0.38	-0.06	15.0	13.5
12-Sep	5	5.4	0.43	-0.01	15.0	13.0
13-Sep	1	1.5	0.43	-0.01	15.5	14.5
14-Sep	4	0.3	0.44	0.00	14.5	12.0
Total		145.8				
Avg.		2.3	0.41	-0.03	17.38	16.99
Min.		0.0	0.30	-0.14	14.50	11.50
Max.		14.0	0.45	0.01	24.00	25.00
SD		3.2	0.03	0.03	2.19	3.44

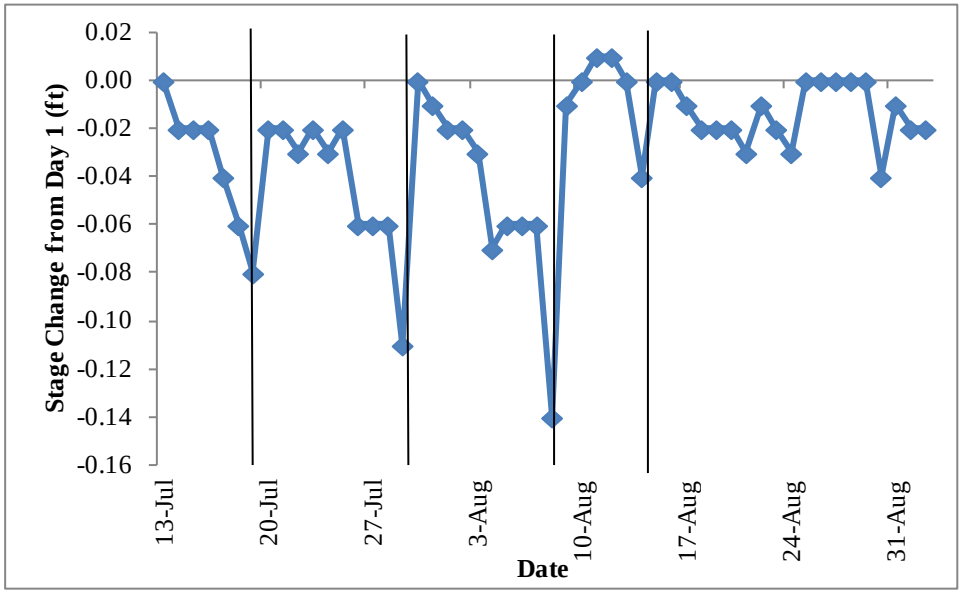
Appendix 5. Hidden Lake 2016 - Stage Height Changes

Smolt Migration



*Line indicates the date of beaver dam notching

Adult Migration



*Lines indicate dates of beaver dam notching

Appendix 6. Hidden Lake 2016 - Daily Smolt Migration

	Sockeye					Coho		Rainbow		Dolly Varden	
Date	Daily	Morts	Otoliths	Total	% Smpl	Daily	Total	Daily	Total	Daily	Total
16-May	780	0	1	780	0.13%	1	1	4	4	3	3
17-May	321	0	1	1,101	0.31%	1	2	6	10	9	12
18-May	247	0	0	1,348	0.00%	1	3	6	16	5	17
19-May	43	0	0	1,391	0.00%	4	7	2	18	6	23
20-May	644	0	1	2,035	0.16%	31	38	16	34	52	75
21-May	387	0	1	2,422	0.26%	16	54	14	48	62	137
22-May	403	0	1	2,825	0.25%	4	58	19	67	61	198
23-May	609	0	1	3,434	0.16%	2	60	16	83	38	236
24-May	1,045	0	2	4,479	0.19%	560	620	16	99	78	314
25-May	2,636	0	6	7,115	0.23%	782	1,402	15	114	45	359
26-May	3,105	0	6	10,220	0.19%	1,180	2,582	12	126	53	412
27-May	9,264	0	18	19,484	0.19%	2,252	4,834	5	131	57	469
28-May	5,666	0	11	25,150	0.19%	2,528	7,362	13	144	66	535
29-May	5,734	0	11	30,884	0.19%	1,866	9,228	6	150	50	585
30-May	3,804	0	9	34,688	0.24%	2,242	11,470	2	152	20	605
31-May	3,490	0	7	38,178	0.20%	2,719	14,189	4	156	37	642
1-Jun	11,732	0	22	49,910	0.19%	2,889	17,078	3	159	36	678
2-Jun	16,675	0	35	66,585	0.21%	3,791	20,869	7	166	39	717
3-Jun	17,920	0	35	84,505	0.20%	4,042	24,911	8	174	86	803
4-Jun	35,919	0	55	120,424	0.15%	3,433	28,344	12	186	47	850
5-Jun	37,113	0	58	157,537	0.16%	2,719	31,063	3	189	11	861
6-Jun	14,757	0	48	172,294	0.33%	1,328	32,391	5	194	43	904
7-Jun	35,511	0	36	207,805	0.10%	2,829	35,220	0	194	11	915
8-Jun	27,407	0	52	235,212	0.19%	1,237	36,457	11	205	43	958
9-Jun	36,881	0	68	272,093	0.18%	978	37,435	13	218	14	972
10-Jun	14,116	0	88	286,209	0.62%	1,010	38,445	5	223	28	1,000
11-Jun	14,463	0	30	300,672	0.21%	1,358	39,803	12	235	15	1,015
12-Jun	5,098	0	9	305,770	0.18%	1,184	40,987	4	239	17	1,032
13-Jun	4,543	0	9	310,313	0.20%	562	41,549	2	241	18	1,050
14-Jun	5,581	0	11	315,894	0.20%	322	41,871	2	243	13	1,063
15-Jun	2,442	0	5	318,336	0.20%	226	42,097	1	244	13	1,076
16-Jun	1,431	0	4	319,767	0.28%	250	42,347	0	244	4	1,080
17-Jun	1,670	0	2	321,437	0.12%	134	42,481	0	244	6	1,086
18-Jun	574	0	2	322,011	0.35%	68	42,549	5	249	4	1,090
19-Jun	472	0	0	322,483	0.00%	76	42,625	0	249	7	1,097
20-Jun	89	0	0	322,572	0.00%	63	42,688	1	250	9	1,106
21-Jun	488	0	0	323,060	0.00%	74	42,762	0	250	2	1,108
22-Jun	687	0	0	323,747	0.00%	128	42,890	2	252	13	1,121
23-Jun	298	0	0	324,045	0.00%	38	42,928	0	252	5	1,126
24-Jun	387	0	0	324,432	0.00%	62	42,990	0	252	5	1,131
25-Jun	193	0	0	324,625	0.00%	20	43,010	2	254	3	1,134
26-Jun	378	0	0	325,003	0.00%	10	43,020	3	257	3	1,137
27-Jun	280	0	0	325,283	0.00%	27	43,047	9	266	5	1,142
28-Jun	278	0	1	325,561	0.36%	43	43,090	20	286	13	1,155
29-Jun	138	0	0	325,699	0.00%	8	43,098	2	288	6	1,161
30-Jun	82	0	0	325,781	0.00%	5	43,103	2	290	2	1,163
1-Jul	54	0	0	325,835	0.00%	12	43,115	4	294	9	1,172
2-Jul	93	0	0	325,928	0.00%	15	43,130	2	296	4	1,176
3-Jul	77	0	0	326,005	0.00%	8	43,138	0	296	3	1,179
4-Jul	49	0	1	326,054	2.04%	4	43,142	0	296	4	1,183
5-Jul	79	0	0	326,133	0.00%	4	43,146	1	297	6	1,189
Total	**325,486**	**0**	**647**	**326,133**	**0.20%**	**43,146**	**43,146**	**297**	**297**	**1,189**	**1,189**

Appendix 7. Hidden Lake 2016 - Daily 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
13-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Jul	16	0	16	0	0	0	0	0	0	0	0	0	0	0	0
23-Jul	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0
24-Jul	5	0	21	0	0	0	0	0	0	0	0	0	0	0	0
25-Jul	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0
26-Jul	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0
27-Jul	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0
28-Jul	1	0	22	0	0	0	0	0	0	0	0	0	0	0	0
29-Jul	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0
30-Jul	44	0	66	0	0	0	0	0	0	0	0	0	0	0	0
31-Jul	40	0	106	0	0	0	0	0	0	0	0	0	0	0	0
1-Aug	47	0	153	0	0	0	0	0	0	0	0	0	0	0	0
2-Aug	12	0	165	0	0	0	0	0	0	0	0	0	0	0	0
3-Aug	0	0	165	0	0	0	0	0	0	0	0	0	0	0	0
4-Aug	2	0	167	0	0	0	0	0	0	0	0	0	0	0	0
5-Aug	32	0	199	0	0	0	0	0	0	0	0	0	0	0	0
6-Aug	4	0	203	0	0	0	0	0	0	0	0	0	0	0	0
7-Aug	9	0	212	0	0	0	0	0	0	0	0	0	0	0	0
8-Aug	104	0	316	0	0	0	0	0	0	0	0	0	0	0	0
9-Aug	61	0	377	0	0	0	0	0	0	0	0	0	0	0	0
10-Aug	46	0	423	0	0	0	0	0	0	0	0	0	0	0	0
11-Aug	51	0	474	0	0	0	0	0	0	0	0	0	0	0	0
12-Aug	0	0	474	0	0	0	0	0	0	0	0	0	0	0	0
13-Aug	25	0	499	0	0	0	0	0	0	0	0	0	0	0	0
14-Aug	28	0	527	0	0	0	0	0	0	0	0	0	0	0	0
15-Aug	12	0	539	0	0	0	0	0	0	0	0	0	0	0	0
16-Aug	66	0	605	0	0	0	0	0	0	0	0	0	0	0	0
17-Aug	40	0	645	0	0	0	0	0	0	0	0	0	0	0	0
18-Aug	51	0	696	0	0	0	0	0	0	0	0	0	0	0	0
19-Aug	80	0	776	0	0	0	0	0	0	0	0	0	0	0	0
20-Aug	0	0	776	0	0	0	0	0	0	0	0	0	0	0	0
21-Aug	0	0	776	0	0	0	0	0	0	0	0	0	0	0	0
22-Aug	16	0	792	0	0	0	0	0	0	0	0	0	0	0	0
23-Aug	60	0	852	0	0	0	0	0	0	0	0	0	0	0	0
24-Aug	38	0	890	0	0	0	0	0	0	0	0	0	0	0	0
25-Aug	39	0	929	0	0	0	0	0	0	0	0	0	0	0	0
26-Aug	19	0	948	0	0	0	0	0	0	0	0	0	0	0	0
27-Aug	22	0	970	0	0	0	0	0	0	0	0	0	0	0	0
28-Aug	25	0	995	0	0	0	0	0	0	0	0	0	0	0	0
29-Aug	12	0	1,007	0	0	0	0	0	0	0	0	0	0	0	0
30-Aug	30	0	1,037	0	0	0	0	0	0	0	0	0	0	0	0
31-Aug	29	0	1,066	0	0	0	0	0	0	0	0	0	0	0	0
1-Sep	17	0	1,083	0	0	0	0	0	0	0	0	0	0	0	0
2-Sep	4	0	1,087	0	0	0	0	0	0	0	0	0	0	0	0
3-Sep	13	0	1,100	0	0	0	0	0	0	0	0	0	0	0	0
4-Sep	63	0	1,163	0	0	0	0	0	0	0	0	0	0	0	0
5-Sep	23	0	1,186	0	0	0	0	0	0	0	0	0	0	0	0
6-Sep	27	0	1,213	0	0	0	0	0	0	0	0	0	0	0	0
7-Sep	1	0	1,214	0	0	0	0	0	0	0	0	0	0	0	0
8-Sep	2	0	1,216	0	0	0	0	0	0	0	0	0	0	0	0
9-Sep	8	0	1,224	0	0	0	0	0	0	0	0	0	0	0	0
10-Sep	0	0	1,224	0	0	0	0	0	0	0	0	0	0	0	0
11-Sep	2	0	1,226	0	0	0	0	0	0	0	0	0	0	0	0
12-Sep	11	0	1,237	0	0	0	0	0	0	0	0	0	0	0	0
13-Sep	0	0	1,237	0	0	0	0	0	0	0	0	0	0	0	0
14-Sep	11	0	1,248	0	0	0	0	0	0	0	0	0	0	0	0
Total	1,248	0	1,248	0		0		0		0		0		0	

Appendix 8. Hidden Lake 2016 - Adult Sockeye Salmon Escapement Sex Ratio and Size Data

Age Composition-Hidden Lake Sockeye 2016- Weir Return

	Age						
	1.1	1.2	1.3	2.1	2.2	2.3	Total
Sample Period:	30 July - 14 September						
Males (No.)	59	535	59	0	0	0	654
Percent	9.1%	81.8%	9.1%	0.0%	0.0%	0.0%	52.4%
Sample Size	1	9	1	0	0	0	11
Total Sample Size							13
Mean Length (mm)	330	523	590				509
Std. Deviation		31.3					63.7
Std. Error		10.4					17.7
Females (No.)	0	535	0	0	59	0	594
Percent	0.0%	90.0%	0.0%	0.0%	10.0%	0.0%	47.6%
Sample Size	0	9	0	0	1	0	10
Total Sample Size							12
Mean Length (mm)		520			480		512
Std. Deviation		24.6					25.9
Std. Error		8.2					7.5
Both Sexes (No.)	59	1,070	59	0	59	0	1,248
Percent	4.8%	85.7%	4.8%	0.0%	4.8%	0.0%	95.2%
Sample Size	1	18	1	0	1	0	21
Total Sample Size							25
Mean Length (mm)	330	522	590		480		511
Std. Deviation		27.3					48.3
Std. Error		6.4					9.7

Gray shaded areas indicate only one sample so value represents that sample and not a mean value

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

Appendix 9. Hidden Lake 2016 - Update

Stocking & Misc. Activities

Ice-out:	NA
Smolt crew on-site:	16-May
Smolt crew off-site:	5-Jul
Adult crew on-site:	13-Jul
Adult crew off-site:	14-Sep
Fry stocking:	26-Apr
Adult Otolith Collection	NA

Egg Take

Dates: **No Egg Take in 2016**

	No. Female	No. Male
No. of broodstock used:		
Green eggs:		
Fecundity:		
Eyed eggs:		
Survival		

Smolt Migration

Dates: 16-May to 5-Jul

	No.	%
Sockeyes:	**325,486**	
Mortalities:	0	0.0%
Age 1:	303,555	93.3%
Age 2:	22,578	6.9%
Hatchery:	213,241	65.5%
Coho:	**43,146**	
Dolly Varden:	**1,189**	
Rainbow:	**297**	

Adult Migration

Dates: 13-Jul to 14-Sep

		No.	%
Sockeye total return:	**3,024**		
Hidden Creek return:		1,248	41.3%
Commercial Harvest:*		1,170	38.7%
Personal Use/Sport Fish Harvest:*		607	20.1%
Otolith Collection:		0	0.0%
Lake otolith collection:		0	
Mortalites:			
Lake Escapement:	**1,248**		
Hatchery broodstock:	0		
Lake broodstock:	1248		
Lake otolith collection:	0		
Coho:			

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