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ABSTRACT

A tow net was used to sample the pelagic zone of Harding Lake, Alaska, during September and October of 1989 and 1990. Seventy-five sockeye salmon *Oncorhynchus nerka* and 171 least cisco *Coregonus sardinella* were captured in the 79 tows made in 1989. During 35 tows made in 1990, eight Arctic char *Salvelinus alpinus* and 290 least cisco were captured. Applying area-swept methodology to 1989 tow net catches, 17,278 sockeye salmon and 28,984 least cisco were estimated to have been residing in the pelagic zone of Harding Lake. Average fork length of captured sockeye salmon was 77 millimeters (lengths ranged from 70 to 105 millimeters) and average fork length of captured least cisco was 151 millimeters (lengths ranged from 115 to 187 millimeters) in 1989. Three of the captured sockeye salmon were age 1 (stocked in 1988) and the remaining 72 were age 0 (stocked in 1989). Survival rate of sockeye salmon stocked as fry in June 1989 through the first four months of residence in Harding Lake was estimated to be 3.3 percent. Survival rate of fingerling sockeye salmon from the fall of 1988 until fall of 1989 (12 months) was estimated to be 2.7 percent. Ages of least cisco captured in 1989 ranged from age 1 to age 6. Applying area-swept methodology to catches made in 1990, zero sockeye salmon, 61,891 least cisco and 998 Arctic char were estimated to have been residing in the pelagic zone of Harding Lake. Apparently sockeye salmon stocked as fry in June of 1988, 1989, and 1990 died before fall 1990. Fork lengths of least cisco captured in 1990 averaged 145 millimeters and ages ranged from age 1 to age 4. The eight captured Arctic char were all age 0 (stocked in 1990); mean fork length was 150 millimeters with a range from 135 to 163 millimeters.

KEY WORDS: Sockeye salmon, least cisco, Arctic char, *Oncorhynchus nerka*, *Coregonus sardinella*, *Salvelinus alpinus*, tow netting, abundance, survival rates, catch rates, length-at-age, age composition, Harding Lake.

INTRODUCTION

Harding Lake is located 70 km south and east of Fairbanks, Alaska, near the Richardson Highway at milepost 322. The lake is bowl shaped and landlocked. The lake is fed by springs, hillside runoff, and two small inlets. Surface elevation of Harding Lake is 218 m, maximum depth is 44 m, area is 1,000 ha, and volume is 138 million m^3. It is a clear water lake with secchi disc depths typically ranging from 5 to 10 m. Thirty-six percent of the lake bottom lies within the littoral zone.

Harding Lake is by far the largest road-side lake located close to Fairbanks (the second largest population center in Alaska). Private recreational cabins and homes surround three quarters of the perimeter of Harding Lake. Additionally, a State of Alaska campground and boat launch are located along the western shore of the lake. The lake is used extensively for water sports such as swimming and water skiing. Harding Lake, because of its size, access, and proximity to Fairbanks, has the potential to provide a major sport fishery for interior Alaska anglers.

Although recreational fishing takes place in Harding Lake, there is reason to believe that the lake is not providing an optimal or maximum level of recreational fishing at the present time. In 1989, 2,976 anglers during 4,098 trips that involved 4,935 man-days of sport fishing harvested 1,764 northern pike *Esox lucius*, 456 rainbow trout *Oncorhynchus mykiss*, 141 Arctic char *Salvelinus alpinus*, 119 lake trout *Salvelinus namaycush*, and 10 burbot *Lota lota* from Harding Lake (Mills 1990). Quartz Lake (about 600 ha), located an additional 70 km south on the Richardson Highway provided about 18,300 angler days of recreational fishing in 1989 (Mills 1990). Hence in 1989, Quartz Lake provided about six times the number of fishing days on a per area basis (Quartz Lake: 30 angler days per hectare and Harding Lake: five angler days per hectare), even though Quartz Lake is located about twice as far from Fairbanks and has far fewer recreational cabins and other types of recreational development. Clearly, the sport fishing potential of Harding Lake has not been fully realized by recreational fishermen.

Species native to Harding Lake include northern pike, burbot, least cisco *Coregonus sardinella* and slimy sculpin *Cottus cognatus*. Because native fish stocks are limited and Harding Lake has the potential to support a major recreational fishery, various species of non-native fish have been introduced into the lake by the Alaska Department of Fish and Game (ADFG) and various federal agencies over the past 50 years. Species stocked into Harding Lake include lake trout, coho salmon *Oncorhynchus kisutch*, inconnu or sheefish *Stenodus leucichthys*, rainbow trout, Arctic grayling *Thymallus arcticus*, Arctic char, and sockeye salmon *Oncorhynchus nerka*.

The success of game fish introductions into Harding Lake through the ADFG stocking program has been mixed. The first species introduced into Harding Lake was lake trout. Adult lake trout were first transplanted in 1939. Lake trout grew rapidly and some of the fish naturally reproduced. Since that time, a small lake trout fishery has developed. Rainbow trout were stocked in the mid 1950's. Success of the early rainbow trout stocking program was not

documented. Coho salmon were first stocked into Harding Lake in 1988. Only a few coho salmon were ever harvested by anglers even though the fish that survived grew particularly well. Sheefish were unsuccessfully stocked into Harding Lake during the mid 1980's. Only a few sheefish were ever harvested, even though many thousands of fingerlings of various sizes were stocked. Stocking of large numbers of rainbow trout and Arctic grayling began in 1986. Based upon reported harvests, these two introductions are judged at least partially successful. In total however, the introduction of these five species over the past 20 years has failed to meet ADFG's fishery management objective: to stock game fish and provide the basis for a major recreational fishery in Harding Lake.

Arctic char were first stocked into Harding Lake in 1988. Sockeye salmon were first introduced into Harding Lake in May of 1988 when 500,000 sac-fry from the Gulkana River Incubation Facility were stocked. In 1989 and again in 1990, one half million sockeye salmon sac fry were stocked into the lake (in 1990, a portion of the sac fry were reared in floating net pens for two months). ADFG stocked sockeye salmon into Harding Lake to introduce a game fish that would: (1) occupy the pelagic zone; and, (2) compete with the native stock of stunted least cisco (unused by recreational fishermen). ADFG hoped that these sockeye salmon would eventually provide the first recreational fishery for kokanee in interior Alaska.

The major management questions associated with this stocking program were as follows: Did the stocked fish survive? If so, how many? Are the growth and survival rates adequate such that a target sport fishery could develop? Should the lake be stocked in future years with sockeye salmon? And, if so, at what stocking rate? The specific objectives were to estimate abundance and mean length at age of sockeye salmon residing in the pelagic zone of Harding Lake. Because the majority of sockeye salmon were expected to occupy the pelagic zone at night during the fall of the year (Foerster 1968 and Levy 1987), tow nets were chosen as the sampling tool. Also, because least cisco were the primary species utilizing pelagic waters before the introduction of sockeye salmon, abundance and length-at-age of the least cisco population occupying the pelagic zone were estimated concurrently. Because some Arctic char stocked in 1990 were caught incidentally while tow netting, abundance and average length of Arctic char in the pelagic zone were also estimated.

METHODS

A tow net was used to catch pelagic fish in Harding Lake during late September and early October of 1989 and 1990. Tow netting took place during evening and night-time hours.

Description of Gear

The tow net used in this study was 2.75 m wide by 2.75 m deep by 8.23 m long. The net had nylon taped seams and was dyed green. The forward section (2.44 m long) tapered from 2.75 m to 1.83 m and was made of #40, 37 mm mesh, knotless nylon. The mid-section (2.75 m long) tapered from 1.83 m to a 0.92 m hoop of

9.5 mm stainless steel. The mid-section was made of #16, 13 mm mesh, knotless nylon. The rear section of #16, 6 mm mesh knotless nylon was 3.04 m long and contained a 3 mm mesh liner in the last 0.61 m of length. The cod end of the tow net had a 500 mm zipper for removal of fish. A metal frame (20 mm diameter pipe) was attached to the mouth of the net to provide horizontal and vertical rigidity. Large plastic floats (0.6 m in diameter) were attached to the two top corners of the net (to upper corners for surface tows and with nylon ropes for sub-surface tows). Two 9.14 m bridles of nylon rope were attached to the corners on each side of the frame.

Method of Fishing

Each bridle was usually attached to a boat with a 40 m nylon rope. The two boats were attached to each other at the bow with a 20 m nylon rope. After the net was placed in the water, the boats slowly pulled away from the net and from each other as the attachment ropes were payed out. Once the attachment ropes were fully payed out and tight, the boats came up to speed. Thereafter, each boat maintained its speed with the aid of a tachometer. An exception to this fishing methodology occurred in 1989 when a single boat was used to make some surface and all sub-surface tows.

Tow speeds for various water strata sampled during 1989 and 1990 are provided in Appendix B, part II. Tows were timed and most were 20 minutes in duration. Surface tows sampled the top 2.75 m of water in Harding Lake along a line about one half of the distance across the lake. A third boat equipped with sonar was used to determine the water zone sampled by sub-surface tows (middle zone: 3.4 to 6.1 m; and, deep zone: 6.4 to 9.1 m). A tow was concluded when the outboard engines were turned off and the tow net was pulled by hand into one of the boats. The catch was removed and placed into a labelled plastic jar. The net was either reset immediately or the boats were moved a short distance before the next tow. Starting points for each tow and tow direction were largely a function of the boat drivers intuition concerning which direction a tow could be conducted for a full 20 minutes without hitting the bottom or a shore, while simultaneously fishing throughout the lake during the night.

Fish Sampling

The day following tow netting, sampling jars with respective catches were frozen. Later, these samples were thawed. Catches were sorted by species, counted, and fork lengths (FL) of all fish were measured to the nearest mm. Scales were taken from some of the captured sockeye salmon and least cisco for later determination of ages. Scales were cleaned and placed on gummed cards. Scale impressions on 0.51 mm acetate were made using a Carver press (60,000 kg /cm^2, 93° C) for 30 seconds. Annuli were counted along the dorsal radius with the aid of a microfiche reader.

Data Analysis

The sampling design employed to estimate fish abundance was a stratified, two-stage design with days as primary units and tows within days as secondary units. All primary units were of equal size (the number of possible tows that

could be made was the same from night to night). The strata were three depth zones in the lake (surface, middle, and deep). According to Cochran (1977), the nightly mean catches of fish per tow are:

$$\bar{y}_{hi} = \sum_{j=1}^{m_{hi}} \frac{y_{hij}}{m_{hi}} ; \qquad (1)$$

where:

$\bar{y}_{hi}$ = mean of the catch (by species) per tow in stratum h for night i;

y_{hij} = catch per tow in stratum h for night i during tow j; and,

m_{hi} = number of tows in depth zone h on night i.

The overall mean catch for each depth zone is:

$$\bar{\bar{y}}_h = \sum_{i=1}^{n_h} \frac{\bar{y}_{hi}}{n_h} ; \qquad (2)$$

where:

$\bar{\bar{y}}_h$ = overall mean catch per tow in stratum h; and,

n_h = number of nights spent towing.

The sample variance of the catch for each night's towing in a depth zone is:

$$s_{2hi}^2 = \frac{\sum_{j=1}^{m_{hi}} (y_{hij} - \bar{y}_{hi})^2}{m_{hi} - 1} . \qquad (3)$$

The sample variance of catch among nights of towing in a depth zone is:

$$s_{1h}^2 = \frac{\sum_{i=1}^{n_h} (\bar{y}_{hi} - \bar{\bar{y}}_h)^2}{n_h - 1} . \qquad (4)$$

The variance of the overall mean catch is:

$$\bar{\bar{V}}[y_h] = \frac{s_{1h}^2}{n_h} + \frac{1}{n_h^2} \sum_{i=1}^{n_h} \frac{s_{2hi}^2}{m_{hi}} . \qquad (5)$$

Although there is a finite number of tows possible in Harding Lake before all the water is strained, there is no correction in Equation 6 for this number. The fraction of the water volume involved in the tows was insignificant, so the survey was not a major source of mortality within the studied populations.

The estimated abundance of each species of fish in each depth zone is:

$$\hat{N}_h = M_h \bar{y}_h \; ; \qquad (6)$$

where:

N_h = abundance of each species of fish in stratum h; and,

M_h = the number of possible tows in stratum h (expansion factors; volume of the depth zone divided by the volume of a single tow).

Although tow time varied from 7 to 25 minutes (Appendix A), only tows that ranged from 17 to 23 minutes in duration were used for abundance estimates. Since the lengths (and hence the volume) of tows varied so little, the volume towed was treated as a constant. The variance of the estimated abundance in a depth zone is:

$$V[\hat{N}_h] = M_h^2 V[\bar{y}_h] \; . \qquad (7)$$

The estimated abundance of fish in the entire pelagic zone (herein defined as water 9.1 m in depth or less) is the sum of the estimated abundance across all three water depth strata; the variance of the estimated abundance of fish in the pelagic zone is the sum of the variances.

Inspection of the sockeye salmon catches from the 79 tows made in 1989 (Appendix A) showed that with one exception, no sockeye salmon were caught before 21:00 hours or after 03:00 hours in the same night. Although some sockeye salmon were caught during a tow beginning at 19:40 in the deep zone, none were caught at this time in the mid-water or surface zones. Presuming that the early capture of sockeye salmon in this instance was an interception of juveniles as they moved up through the water column, this datum would not be representative of a stable, nocturnal distribution of sockeye salmon through the depth zones. Therefore, only tows starting between 21:00 and 03:00 hours in the same night were considered as representative of this nocturnal distribution. Consequently, tows that started earlier than 21:00 hours or later than 3:00 hours were discarded and not used to estimate fish abundance.

Equations for randomly selected catches among tows were used because there was no demonstrable contagion among catches. If, during nightly sampling, sockeye salmon move up into the deep zone and then into the higher zones (or vice versa later in the evening), catches of sockeye salmon should be grouped among consecutive tows. If so, there should be a higher probability of having two consecutive tows with catches higher than would be expected based upon chance alone. From 21:00 to 03:00 hours, 56% (35/63) of the tows had catches, and of the tows that immediately followed tows with catches, 53% (16/30) had catches.

Therefore, catch in a tow was considered independent of catch (or lack of catch) in previous tows, and the data was independently distributed.

A comparison of tows made with one boat versus two boats in surface waters during 1989 revealed that single boat tows caught significantly fewer fish. This phenomenon was most likely due to the single boat disrupting fish distribution in surface waters a few seconds before the net had an opportunity to entrap them. Consequently, catch data associated with surface tows made with a single boat were discarded for use in estimating fish abundance. After the three data editing criteria were applied to all catch data (a; no single boat surface tows, b; tow duration range = 17 to 23 minutes, and c; start times from 21:00 hour to 3:00 hour), 41 of 79 (52%) tows made in 1989 and 34 of 35 (97%) tows made in 1990 were used to develop abundance estimates.

Survival rate of the sockeye salmon population between various sampling events was calculated by dividing estimated abundance at time t_1 by estimated abundance at time t_2. Mean lengths (and variances) for sockeye salmon, Arctic char, and least cisco sampled from Harding Lake by tow netting were calculated with standard normal procedures.

Estimation of age composition was as follows:

$$\hat{P}_{ka} = \frac{n_{ka}}{n_k}; \text{ and,} \tag{8}$$

$$V[\hat{P}_{ka}] = \frac{\hat{P}_{ka}(\hat{P}_{ka} - 1)}{(n_k - 1)}; \tag{9}$$

where:

P_{ka} = fraction of species k composed of age a;

n_{ka} = number in sample of species k composed of age a; and,

n_k = number of species k in the sample.

RESULTS AND DISCUSSION

Seventy-five sockeye salmon were caught in 79 tows made in Harding Lake during September and October 1989 (Appendix A). Catches of sockeye salmon ranged from zero to seven fish with the most frequent catch being zero sockeye salmon (42 of 79 cases; 53%). After data editing criteria were applied, 41 tows were used to estimate abundance of fish residing in pelagic waters of Harding Lake in 1989 (Table 1). Sockeye salmon catch ranged from zero to seven fish in 13 surface tows, from zero to two fish in 18 middle tows, and from zero to four fish in 10 deep tows. Mean catch of sockeye salmon in surface tows was 2.056 fish. Fewer sockeye salmon on average were caught in middle and deep tows; middle = 0.816 fish and deep = 1.048 fish. Sockeye salmon abundance in the

Table 1. Fish catches from tow net sampling of Harding Lake used to develop abundance estimates for 1989.

Night of	Tow No.	Tow[a] Depth	Start Time	End Time	Tow Duration (Minutes)	Catch of: Sockeye Salmon	Catch of: Least Cisco
Sep 27	5	Surface	21:00	21:20	20	5	5
Sep 27	6	Surface	21:20	21:40	20	3	1
Sep 27	7	Surface	23:10	23:30	20	0	0
Sep 27	8	Surface	23:45	00:05	20	0	0
Oct 02	1	Surface	21:16	21:36	20	0	7
Oct 02	2	Surface	21:54	22:14	20	2	16
Oct 02	3	Surface	22:24	22:44	20	3	26
Oct 02	4	Surface	22:55	23:15	20	0	0
Oct 02	5	Surface	23:26	23:46	20	0	3
Oct 02	6	Surface	00:10	00:30	20	7	4
Oct 02	7	Surface	00:45	01:05	20	3	9
Oct 02	8	Surface	02:14	02:35	21	3	23
Oct 02	9	Surface	02:50	03:10	20	1	7
Oct 09	3	Middle	21:38	21:58	20	0	0
Oct 09	4	Middle	22:10	22:30	20	1	1
Oct 09	5	Middle	22:40	23:00	20	1	1
Oct 09	7	Middle	23:47	00:07	20	0	0
Oct 09	8	Middle	00:19	00:39	20	2	3
Oct 09	9	Middle	00:59	01:19	20	1	0
Oct 09	10	Middle	01:29	01:49	20	0	0
Oct 09	11	Middle	01:59	02:17	18	2	1
Oct 10	2	Middle	21:11	21:31	20	0	2
Oct 10	3	Middle	21:44	22:04	20	1	0
Oct 10	5	Middle	22:45	23:05	20	2	1
Oct 11	2	Middle	21:00	21:20	20	0	0
Oct 11	3	Middle	21:30	21:50	20	0	0
Oct 11	4	Middle	22:05	22:25	20	1	0
Oct 11	5	Middle	22:35	22:58	23	2	2
Oct 11	6	Middle	23:09	23:29	20	0	1
Oct 11	7	Middle	23:39	23:59	20	1	0
Oct 11	8	Middle	00:16	00:36	20	0	1
Oct 07	6	Deep	21:10	21:30	20	2	3
Oct 07	7	Deep	22:58	23:18	20	0	0
Oct 07	8	Deep	23:35	23:55	20	2	3
Oct 07	9	Deep	00:45	01:05	20	4	3
Oct 07	10	Deep	01:20	01:40	20	1	2
Oct 07	11	Deep	02:08	02:28	20	1	0
Oct 07	12	Deep	02:43	03:05	22	0	1
Oct 11	9	Deep	00:46	01:06	20	1	1
Oct 11	10	Deep	01:20	01:40	20	0	0
Oct 11	11	Deep	01:55	02:15	20	1	1
Totals:			41 tows		824 minutes	53	128

[a] Surface = 0 to 2.7 m (0 - 9 ft) depth zone; middle = 3.4 to 6.1 m (11 - 20 ft) depth zone; and, deep = 6.4 to 9.1 m (21 - 30 ft) depth zone.

pelagic zone of Harding Lake in 1989 was estimated to have been 17,278 fish; S.E. = 3,970 fish (Table 2). During these 41 tows, 128 least cisco were caught (Table 1). The size of the least cisco population residing in the pelagic zone of Harding Lake in 1989 was estimated to have been 28,984 fish; S.E. = 14,070 fish (Table 2).

No sockeye salmon were caught in 35 tows made in Harding Lake during September of 1990, but those tows did capture 290 least cisco and eight Arctic char (Appendix A). Abundance estimates of least cisco and Arctic char residing in the pelagic zone of Harding Lake in 1990 were based upon catches in 34 of 35 tows made. Least cisco catches ranged from 0 to 51 fish and Arctic char catches ranged from zero to two fish (Table 3). Density of least cisco in the middle and deep zones was substantially higher than density of this species in surface waters. Arctic char catches were infrequent in surface and middle zones and were nonexistent in the deep zone. Abundance of least cisco was estimated to have been 61,891 fish; S.E. = 12,200 fish; abundance of Arctic char was estimated to have been 998 fish; S.E. = 400 fish (Table 2).

Fork lengths of the 75 sockeye salmon caught during tow netting of Harding Lake in 1989 averaged 77 mm; SE = 0.69 mm (Table 4). Fork lengths of sockeye salmon ranged from 70 to 105 mm. Based upon a combination of scale patterns and length frequency, it was determined that 72 of the 75 fish (96%) were age 0 and the remaining three (4%) were age 1. Age 0 sockeye salmon averaged 76 mm and age 1 fish averaged 100 mm (Table 4). Reported average fork lengths of age 0 sockeye salmon sampled from late August to early October for populations in a series of eight lakes located in the Bristol Bay and Cook Inlet areas of Alaska ranged from 35.0 to 69.6 mm (Table 5). Mean length of age 0 sockeye salmon sampled from Harding Lake during the fall of both 1988 and 1989 was in the upper range of reported mean lengths of age 0 sockeye salmon from other Alaskan lakes (Table 5).

After applying estimates of age composition to the abundance estimate of 17,278 sockeye salmon residing in Harding Lake in 1989, it was estimated that the age 0 cohort numbered 16,587 fish and the age 1 cohort numbered 691 fish. The age 0 cohort was stocked in late May of 1989 and the age 1 cohort was stocked in late May of 1988 (one-half million sac fry were stocked both years). Survival rate of the age 0 cohort during their first four months of residence in Harding Lake was estimated to have been 3.3%. This survival rate compares to a survival rate of 5.1% for age 0 sockeye salmon stocked in 1988 and residing in Harding Lake for a similar time period (Clark and Doxey 1988). Between fall of 1988 and fall of 1989, survival rate of sockeye salmon stocked as sac fry in 1988 is estimated to have been 2.7% (691 fish in fall of 1989 from this report; and, 25,495 fish in fall of 1988; Clark and Doxey 1988). Either no sockeye salmon stocked in June of 1990 survived or too few survived to result in a measurable population four months later. Abundance of age 1 and age 2 sockeye salmon by fall of 1990 was either zero or abundance was so low that by chance none were caught during tow netting.

In general, the survival rate of sockeye salmon is about 8% from the time the population migrates into a lake after emergence to the time of their seaward migration as smolts, typically 1 to 3 years later (Foerster 1968). Average catches of sockeye salmon during 20-minute tows in a series of eight lakes

Table 2. Abundance estimates for sockeye salmon, Arctic char, and least cisco obtained through tow netting of Harding Lake, 1989 and 1990.

Species	Year	Strata	Expansion Factor[a]	Mean Catch[b]	Var. (mean)	Abundance Estimate (fish)	S.E. of Est.
Sockeye salmon	1989	Surface	2,800	2.056	0.520	5,756	2,020
		Middle	6,460	0.816	0.073	5,268	1,740
		Deep	5,970	1.048	0.243	6,254	2,940
		Total				17,278	3,970
Least cisco	1989	Surface	2,800	6.028	23.154	16,878	13,470
		Middle	6,460	0.774	0.077	4,999	1,790
		Deep	5,970	1.191	0.370	7,107	3,630
		Total				28,984	14,070
Least cisco	1990	Surface	2,060	0.542	0.070	1,116	540
		Middle	1,610	19.500	28.250	31,395	8,560
		Deep	2,260	13.000	14.733	29,380	8,670
		Total				61,891	12,200
Arctic char	1990	Surface	2,060	0.250	0.023	515	310
		Middle	1,610	0.300	0.023	483	250
		Deep	2,260	0	0	0	0
		Total				998	400

[a] See Appendix B for derivation of expansion factors.
[b] See Appendix C for nightly and strata means and variances.

Table 3. Fish catches from tow net sampling of Harding Lake used to develop abundance estimates for 1990.

Night of	Tow No.	Tow[a] Depth	Start Time	End Time	Tow Duration (Minutes)	Catch of: Arctic Char	Catch of: Least Cisco
Sep 26	1	Surface	21:20	21:40	20	0	2
Sep 26	2	Surface	21:55	22:15	20	1	2
Sep 26	3	Surface	22:25	22:45	20	0	0
Sep 26	4	Surface	22:53	23:13	20	2	1
Sep 26	5	Surface	23:24	23:44	20	0	2
Sep 26	6	Surface	23:52	00:12	20	0	0
Sep 26	7	Surface	00:19	00:39	20	0	0
Sep 26	8	Surface	00:48	01:08	20	0	0
Sep 26	9	Surface	01:16	01:36	20	0	0
Sep 26	10	Surface	01:44	02:04	20	0	1
Sep 26	11	Surface	02:14	02:34	20	1	0
Sep 26	12	Surface	02:45	03:05	20	0	1
Sep 27	1	Surface	22:08	22:28	20	0	1
Sep 27	2	Surface	22:35	22:55	20	1	1
Sep 27	3	Surface	23:08	23:28	20	0	0
Sep 27	4	Surface	23:39	23:59	20	0	0
Sep 27	5	Surface	00:06	00:26	20	0	0
Sep 27	6	Surface	00:31	00:51	20	0	0
Sep 25	1	Middle	21:54	22:16	22	1	20
Sep 25	2	Middle	22:42	23:02	20	0	10
Sep 25	3	Middle	23:29	23:49	20	0	5
Sep 25	4	Middle	00:00	00:20	20	0	8
Sep 25	5	Middle	00:58	01:18	20	0	12
Sep 25	6	Middle	01:29	01:49	20	1	1
Sep 25	7	Middle	02:20	02:40	20	0	16
Sep 25	8	Middle	02:50	03:10	20	0	27
Sep 25	9	Middle	03:25	03:45	20	1	51
Sep 25	10	Middle	04:00	04:20	20	0	45
Sep 24	1	Deep	21:08	21:28	20	0	3
Sep 24	2	Deep	21:44	22:04	20	0	28
Sep 24	3	Deep	22:20	22:40	20	0	5
Sep 24	4	Deep	22:55	23:15	20	0	9
Sep 24	5	Deep	23:30	23:50	20	0	19
Sep 24	6	Deep	00:02	00:22	20	0	14
Totals:			34 tows		682 minutes	8	284

[a] Surface = 0 to 2.7 m (0 - 9 ft) depth zone; middle = 3.4 to 6.1 m (11 - 20 ft) depth zone; and, deep = 6.4 to 9.1 m (21 - 30 ft) depth zone.

Table 4. Length and age statistics for sockeye salmon and least cisco caught while tow netting Harding Lake, 1989.

Length Statistics by Age	Sockeye Salmon	Least Cisco
Age 0:		
Sample Size:	72	0
Mean (mm):	76	-
Minimum (mm):	70	-
Maximum (mm):	83	-
Sample Variance (mm):	13.1	-
Standard Error of Mean (mm):	0.42	-
Age 1:		
Sample Size:	3	8
Mean (mm):	100	132
Minimum (mm):	93	125
Maximum (mm):	105	140
Sample Variance (mm):	39.0	28.4
Standard Error of Mean (mm):	3.61	1.88
Age 2:		
Sample Size (mm):	0	34
Mean (mm):	-	154
Minimum (mm):	-	132
Maximum (mm):	-	167
Sample Variance (mm):	-	57.6
Standard Error of Mean (mm):	-	1.30
Age 3:		
Sample Size:	0	5
Mean (mm):	-	156
Minimum (mm):	-	148
Maximum (mm):	-	163
Sample Variance (mm):	-	32.8
Standard Error of Mean (mm):	-	2.56
All Fish Caught in 1989:[a]		
Sample Size:	75	171[b]
Mean (mm):	77	151
Minimum (mm):	70	115
Maximum (mm):	105	187
Sample Variance (mm):	35.7	131.3
Standard Error of Mean (mm):	0.69	0.88

[a] Includes fish for which age is unknown.

[b] Includes one known age 4 fish (165 mm) and one age 6 fish (163 mm).

Table 5. Reported average lengths of age 0 sockeye salmon caught in tow nets fished in various Alaskan lakes.

Source	Location	Year	Length of Age 0 Sockeye Salmon (mm)
Clark & Doxey (1988)	Harding Lake	1988	Ave. = 72.0 mm from 10/3 to 10/7
This Report	Harding Lake	1989	Ave. = 72.0 mm from 9/27 to 10/11
Parker & Barton (1974)	Becharof Lake	1974	Ave. = 69.6 mm from 9/25 to 10/2
Parker & Barton (1974)	Upper Ugashik Lake	1974	Ave. = 60.5 mm from 9/25 to 10/2
Parker & Barton (1974)	Lower Ugashik Lake	1974	Ave. = 55.5 mm from 9/14 to 9/16
Rogers & Newcome (1975)	Amanka Lake	1974	Ave. = 48.4 to 56.3 mm in various areas of the lake on 8/30/74
Rogers & Newcome (1975)	Ualik Lake	1974	Ave. = 35.0 to 57.3 mm in various areas of the lake on 8/27/74
Waltemyer (1981)	Kenai Lake	1974-1979	Ave. = 40.0 to 61.3 mm from 8/27 to 9/26
Waltemyer (1981)	Skilak Lake	1974-1979	Ave. = 43.0 to 59.0 mm from 8/31 to 9/24
Waltemyer (1981)	Tustemena Lake	1974-1979	Ave. = 55.3 to 62.9 mm from 9/4 to 9/24

located in the Bristol Bay and Cook Inlet areas of Alaska ranged from 0.88 to 269 fish (Table 6). Density of age 0 sockeye salmon during the fall of 1988 and during the fall of 1989 in Harding Lake was in the lower range of reported densities of native sockeye salmon stocks of Alaska. Survival rate of sockeye salmon stocked into Harding Lake appears to be in the low range of what one would expect based upon age 0 abundance in 1988 and 1989. It is substantially below what one would expect based upon age 0 abundance in 1990 and based upon age 1 abundance in 1989 and 1990. These poor survival rates will likely preclude sockeye salmon from fulfilling the fishery management goal of the stocking program.

Fork lengths of the 171 least cisco caught during tow netting of Harding Lake in September and October of 1989 averaged 151 mm; SE = 0.88 mm (Table 4). Fork lengths of these least cisco ranged from 115 to 187 mm and ages ranged from age 1 to age 6 (Table 4). Mean fork length of the 290 least cisco caught in September of 1990 was 145 mm; S.E. = 0.6 mm (Table 7). Length ranged from 107 to 173 mm and age ranged from age 1 to age 4 (Table 7). Fork lengths for year classes of least cisco sampled in both 1989 and 1990 overlapped. While sampling the least cisco captured in 1990, it was noted that fish as small as 120 mm were mature females. Abundance estimates obtained through tow netting for least cisco only represent a portion of the population residing in Harding Lake because their distribution in this lake is not confined to pelagic waters.

Mean fork length of Arctic char caught while tow netting was 150 mm; S.E. = 3.28 mm (Table 7). Fork lengths ranged from 135 to 163 mm and all fish were age 0 (stocked in the summer of 1990). Abundance estimates obtained through tow netting for Arctic char only represent a portion of the population residing in Harding Lake. During other studies of Harding Lake, most of the Arctic char captured were found in the littoral and benthic water zones, not in pelagic waters.

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Table 6. Reported catches of age 0 sockeye salmon in tow nets fished for 20 minutes in various Alaskan lakes.

Source	Location	Year	Catch of Age Zero Sockeye Salmon	Comments
Clark (1980)	Becharof Lake	1974	Ave. = 33.6	Speed: 1.10 m per sec.
Clark (1980)	Becharof Lake	1975	Ave. = 269.0 Range (various areas) = 0.4 to 2,188	Speed: 1.10 m per sec.
Clark (1980)	Upper Ugashik Lk.	1974	Ave. = 19.4	Speed: 1.10 m per sec.
Clark (1980)	Lower Ugashik Lk.	1974	Ave. = 4.2	Speed: 1.10 m per sec.
Clark & Doxey (1988)	Harding Lake	1988	Ave. = 4.56	Surface H_2O (0-2.7 m) Speed: 1.15 m per sec.
Clark & Doxey (1988)	Harding Lake	1988	Ave. = 0.98	Subsurface (6.4-9.1 m) Speed: 0.38 m per sec.
This Report	Harding Lake	1989	Ave. = 1.97[a]	Surface (0-2.7 m) Speed: 0.97 m per sec.
This Report	Harding Lake	1989	Ave. = 0.78[a]	Middle (3.4-6.1 m) Speed: 0.36 m per sec.
This Report	Harding Lake	1989	Ave. = 1.01[a]	Deep (6.4-9.1 m) Speed: 0.36 m per sec.
Rogers & Newcome (1975)	Ualik Lake	1974	Ave. = 0.88	5 min. tows @ 3,493 m^3 expanded by 2.94 fold
Rogers & Newcome (1975)	Amanka Lake	1974	Ave. = 47.9	5 min. tows @ 3,493 m^3 expanded by 2.94 fold
Waltemyer (1981)	Kenai Lake	1974 - 1979	Range: 6.2 - 204.0	Speed: 1.20 m per sec.
Waltemyer (1981)	Skilak Lake	1974 - 1979	Range:14.2 - 96.8	Speed: 1.20 m per sec.
Waltemyer (1981)	Tustemena Lake	1974 - 1979	Range:22.4 - 56.4	Speed: 1.20 m per sec.

[a] These estimates are based upon mean catches as reported in Table 2 multiplied by 0.96 (proportion of sockeye salmon determined to be age 0).

Table 7. Length and age statistics for least cisco and Arctic char caught while tow netting Harding Lake, 1990.

Length Statistics by Age	Least Cisco	Arctic Char
Age 0:		
Sample Size:	0	8
Mean (mm):	-	150
Minimum (mm):	-	135
Maximum (mm):	-	163
Sample Variance (mm):	-	86.0
Standard Error of Mean (mm):	-	3.28
Age 1:		
Sample Size:	80	0
Mean (mm):	138	-
Minimum (mm):	112	-
Maximum (mm):	155	-
Sample Variance (mm):	59.7	-
Standard Error of Mean (mm):	0.86	-
Age 2:		
Sample Size:	162	0
Mean (mm):	147	-
Minimum (mm):	128	-
Maximum (mm):	173	-
Sample Variance (mm):	87.4	-
Standard Error of Mean (mm):	0.73	-
Age 3:		
Sample Size:	27	0
Mean (mm):	156	-
Minimum (mm):	136	-
Maximum (mm):	173	-
Sample Variance (mm):	91.0	-
Standard Error of Mean (mm):	1.84	-
Age 4:		
Sample Size:	1	0
Mean (mm):	154	-
Minimum (mm):	-	-
Maximum (mm):	-	-
Sample Variance (mm):	-	-
Standard Error of Mean (mm):	-	-
All Fish Caught in 1990:[a]		
Sample Size:	290	8
Mean (mm):	145	150
Minimum (mm):	107	135
Maximum (mm):	173	163
Sample Variance (mm):	114.5	86.0
Standard Error of Mean (mm):	0.63	3.28

[a] Includes fish for which age is unknown.

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APPENDIX A

Appendix A. Catches of fish while tow netting Harding Lake, 1989 and 1990.

Night of	Tow No.	Depth[b]	Start Time	End Time	Tow Duration (Minutes)	Catch of: Sockeye Salmon	Least Cisco	Other Fish[a]
			1989 Single Boat Tows:					
Sep 28	1	Surface	21:10	21:30	20	0	0	None
Sep 28	2	Surface	21:45	22:05	20	4	0	2-SC
Sep 28	3	Surface	22:12	22:37	25	7	0	None
Sep 28	4	Surface	22:48	23:08	20	1	0	None
Sep 28	5	Surface	23:29	23:49	20	1	1	None
Sep 28	6	Surface	00:00	00:20	20	0	0	None
Sep 28	7	Surface	00:40	01:00	20	0	0	None
Sep 28	8	Surface	01:30	01:50	20	2	0	None
Sep 29	1	Surface	20:58	21:18	20	0	5	None
Sep 29	2	Surface	21:30	21:50	20	0	2	None
Sep 29	3	Surface	21:57	22:18	21	0	9	None
Sep 29	4	Surface	22:31	22:51	20	1	1	None
Sep 29	5	Surface	23:02	23:22	20	0	0	12-SC
Sep 29	6	Surface	00:35	00:55	20	0	1	None
Sep 29	7	Surface	01:04	01:19	15	0	0	None
Sep 29	8	Surface	01:30	01:50	20	1	1	None
Sep 29	9	Surface	01:59	02:19	20	1	0	None
Sep 29	10	Surface	02:28	02:48	20	1	1	None
Sep 30	1	Surface	22:04	22:24	20	0	1	None
Sep 30	2	Surface	22:34	22:56	21	1	1	None
Oct 07	1	Deep	18:31	18:53	22	0	0	None
Oct 07	2	Deep	19:10	19:30	20	0	1	None
Oct 07	3	Deep	19:40	20:00	20	1	0	None
Oct 07	4	Deep	20:10	20:30	20	0	2	1-SC
Oct 07	5	Deep	20:40	21:00	20	1	4	None
Oct 07	6	Deep	21:10	21:30	20	2	3	None
Oct 07	7	Deep	22:58	23:18	20	0	0	None
Oct 07	8	Deep	23:35	23:55	20	2	3	None
Oct 07	9	Deep	00:45	01:05	20	4	3	None
Oct 07	10	Deep	01:20	01:40	20	1	2	None
Oct 07	11	Deep	02:08	02:28	20	1	0	None
Oct 07	12	Deep	02:43	03:05	22	0	1	None
Oct 09	1	Deep	19:30	19:50	20	0	0	None
Oct 09	2	Middle	20:10	20:30	20	0	0	None
Oct 09	3	Middle	21:38	21:58	20	0	0	None
Oct 09	4	Middle	22:10	22:30	20	1	1	None
Oct 09	5	Middle	22:40	23:00	20	1	1	None
Oct 09	6	Middle	23:10	23:25	15	0	2	None
Oct 09	7	Middle	23:47	00:07	20	0	0	None
Oct 09	8	Middle	00:19	00:39	20	2	3	None
Oct 09	9	Middle	00:59	01:19	20	1	0	None
Oct 09	10	Middle	01:29	01:49	20	0	0	None

(continued)

Appendix A. (page 2 of 3)

Night of	Tow No.	Depth[b]	Start Time	End Time	Tow Duration (Minutes)	Catch of: Sockeye Salmon	Least Cisco	Other Fish[a]
			1989 Single Boat Tows (continued):					
Oct 09	11	Middle	01:59	02:17	18	2	1	None
Oct 10	1	Middle	20:39	20:59	20	0	0	None
Oct 10	2	Middle	21:11	21:31	20	0	2	None
Oct 10	3	Middle	21:44	22:04	20	1	0	None
Oct 10	4	Middle	22:16	22:32	16	0	3	None
Oct 10	5	Middle	22:45	23:05	20	2	1	None
Oct 11	1	Middle	20:28	20:48	20	0	0	None
Oct 11	2	Middle	21:00	21:20	20	0	0	None
Oct 11	3	Middle	21:30	21:50	20	0	0	None
Oct 11	4	Middle	22:05	22:25	20	1	0	None
Oct 11	5	Middle	22:35	22:58	23	2	2	None
Oct 11	6	Middle	23:09	23:29	20	0	1	None
Oct 11	7	Middle	23:39	23:59	20	1	0	None
Oct 11	8	Middle	00:16	00:36	20	0	1	None
Oct 11	9	Deep	00:46	01:06	20	1	1	None
Oct 11	10	Deep	01:20	01:40	20	0	0	None
Oct 11	11	Deep	01:55	02:15	20	1	1	None
			1989 Double Boat Tows:					
Sep 27	1	Surface	19:10	19:20	10	0	0	None
Sep 27	2	Surface	20:03	20:13	10	0	0	None
Sep 27	3	Surface	20:20	20:30	10	0	0	None
Sep 27	4	Surface	20:40	20:50	10	0	0	None
Sep 27	5	Surface	21:00	21:20	20	5	5	None
Sep 27	6	Surface	21:20	21:40	20	3	1	None
Sep 27	7	Surface	23:10	23:30	20	0	0	None
Sep 27	8	Surface	23:45	00:05	20	0	0	None
Oct 02	1	Surface	21:16	21:36	20	0	7	None
Oct 02	2	Surface	21:54	22:14	20	2	16	None
Oct 02	3	Surface	22:24	22:44	20	3	26	None
Oct 02	4	Surface	22:55	23:15	20	0	0	None
Oct 02	5	Surface	23:26	23:46	20	0	3	None
Oct 02	6	Surface	00:10	00:30	20	7	4	None
Oct 02	7	Surface	00:45	01:05	20	3	9	None
Oct 02	8	Surface	02:14	02:35	21	3	23	None
Oct 02	9	Surface	02:50	03:10	20	1	7	None
Oct 02	10	Surface	03:23	03:44	21	0	3	None
Oct 02	11	Surface	03:56	04:14	18	0	0	None
Oct 02	12	Surface	04:25	04:45	20	0	5	None
		Surface:	40 tows		762 minutes	47	132	14-SC
1989 Totals:		Middle:	23 tows		452 minutes	14	18	None
		Deep:	16 tows		324 minutes	14	21	1-SC
		All	79 tows		1,538 minutes	75	171	15-SC

(continued)

Appendix A. (page 3 of 3)

Night of	Tow No.	Depth[b]	Start Time	End Time	Tow Duration (Minutes)	Catch of: Sockeye Salmon	Least Cisco	Other Fish[a]
			1990 Double Boat Tows:					
Sep 24	1	Deep	21:08	21:28	20	0	3	None
Sep 24	2	Deep	21:44	22:04	20	0	28	None
Sep 24	3	Deep	22:20	22:40	20	0	5	None
Sep 24	4	Deep	22:55	23:15	20	0	9	None
Sep 24	5	Deep	23:30	23:50	20	0	19	None
Sep 24	6	Deep	00:02	00:22	20	0	14	None
Sep 24	7	Deep	00:35	00:43	7	0	6	None
Sep 25	1	Middle	21:54	22:16	22	0	20	1-AC
Sep 25	2	Middle	22:42	23:02	20	0	10	None
Sep 25	3	Middle	23:29	23:49	20	0	5	None
Sep 25	4	Middle	00:00	00:20	20	0	8	None
Sep 25	5	Middle	00:58	01:18	20	0	12	None
Sep 25	6	Middle	01:29	01:49	20	0	1	1-AC
Sep 25	7	Middle	02:20	02:40	20	0	16	None
Sep 25	8	Middle	02:50	03:10	20	0	27	None
Sep 25	9	Middle	03:25	03:45	20	0	51	1-AC
Sep 25	10	Middle	04:00	04:20	20	0	45	None
Sep 26	1	Surface	21:20	21:40	20	0	2	None
Sep 26	2	Surface	21:55	22:15	20	0	2	1-AC
Sep 26	3	Surface	22:25	22:45	20	0	0	None
Sep 26	4	Surface	22:53	23:13	20	0	1	2-AC
Sep 26	5	Surface	23:24	23:44	20	0	2	None
Sep 26	6	Surface	23:52	00:12	20	0	0	None
Sep 26	7	Surface	00:19	00:39	20	0	0	None
Sep 26	8	Surface	00:48	01:08	20	0	0	None
Sep 26	9	Surface	01:16	01:36	20	0	0	None
Sep 26	10	Surface	01:44	02:04	20	0	1	None
Sep 26	11	Surface	02:14	02:34	20	0	0	1-AC
Sep 26	12	Surface	02:45	03:05	20	0	1	None
Sep 27	1	Surface	22:08	22:28	20	0	1	None
Sep 27	2	Surface	22:35	22:55	20	0	1	1-AC
Sep 27	3	Surface	23:08	23:28	20	0	0	None
Sep 27	4	Surface	23:39	23:59	20	0	0	None
Sep 27	5	Surface	00:06	00:26	20	0	0	None
Sep 27	6	Surface	00:31	00:51	20	0	0	None
		Surface:	18 tows		360 minutes	0	11	5-AC
1990 Totals:		Middle:	10 tows		202 minutes	0	195	3-AC
		Deep:	7 tows		127 minutes	0	84	None
		All	35 tows		689 minutes	0	290	8-AC

[a] Species of other fish: SC = slimy sculpin and AC = Arctic char.

[b] Surface = 0 to 2.7 m (0 - 9 ft) depth zone; middle = 3.4 to 6.1 m (11 - 20 ft) depth zone; and, deep = 6.4 to 9.1 m (21 - 30 ft) depth zone.

APPENDIX B

Appendix B. Depths, areas, volumes, and velocities used to develop abundance estimate expansion factors.

Part I: Estimates of Water Volume Associated with Abundance Estimation Strata

Depth Strata (feet)	Depth Strata (meters)	Lake Area at and above Contour (acres)	(hectares)	(square meters)	Estimated Volume[a] (cubic meters)
0	0	2,470	1,000	10,000,000	13,250,000
5	1.52	2,152	872	8,720,000	11,280,000
10	3.05	1,833	742	7,420,000	10,760,000
15	4.57	1,748	708	7,080,000	10,240,000
20	6.10	1,663	674	6,740,000	9,880,000
25	7.62	1,605	650	6,500,000	9,530,000
30	9.14	1,547	627	6,270,000	9,060,000
35	10.67	1,472	596	5,960,000	8,590,000
40	12.19	1,396	565	5,650,000	8,280,000
45	13.72	1,345	545	5,450,000	7,960,000
50	15.24	1,294	524	5,240,000	

[a] Calculated as the depth (1.52 m) x area of the bottom of the strata.

Part II: Calculation of Expansion Factors

Depth Strata (m)	Associated Water Volumes (cubic meters)	1989 Tows: Velocity of tow (m/sec)	1989 Tows: Volume per Tow[a] (meters^3)	1989 Tows: Expansion[b] Factor	1990 Tows: Velocity of tow (m/sec)	1990 Tows: Volume per Tow[a] (meters^3)	1990 Tows: Expansion[b] Factor
0-3.05	13,250,000						
	11,280,000						
Totals:	24,530,000	0.97	8,765	2,800	1.32	11,930	2,060
3.06-6.10	10,760,000						
	10,240,000						
Totals:	21,000,000	0.36	3,253	6,460	1.44	13,010	1,610
6.11-9.14	9,880,000						
	9,530,000						
Totals:	19,410,000	0.36	3,253	5,970	0.95	8,580	2,260

[a] Calculated as follows: tow velocity (m/sec) x tow duration (20 minutes; 1200 sec) x area of mouth of tow net (7.53 m^2).

[b] Expansion factors are the product of the volume of the lake zone divided by the volume of a 20 minute tow made in that zone in that year.

APPENDIX C

Appendix C. Means and variances of nightly and strata tow net catches used to develop abundance estimates.

Part I: Means and Variances of Nightly Catches

Strata				No. of	Mean	Population	Sampling
Year	Species	Depth	Date	Tows	Catch	Variance	Variance
1989	Sockeye salmon	Surface	Sep 27	4	2.00	6.000	1.500
1989	Sockeye salmon	Surface	Oct 2	9	2.11	5.111	0.570
1989	Least cisco	Surface	Sep 27	4	1.50	5.667	1.417
1989	Least cisco	Surface	Oct 2	9	10.56	82.778	9.197
1989	Sockeye salmon	Middle	Oct 9	8	0.87	0.696	0.087
1989	Sockeye salmon	Middle	Oct 10	3	1.00	1.000	0.333
1989	Sockeye salmon	Middle	Oct 11	7	0.57	0.619	0.088
1989	Least cisco	Middle	Oct 9	8	0.75	1.071	0.134
1989	Least cisco	Middle	Oct 10	3	1.00	1.000	0.333
1989	Least cisco	Middle	Oct 11	7	0.57	0.619	0.088
1989	Sockeye salmon	Deep	Oct 7	7	1.43	1.952	0.279
1989	Sockeye salmon	Deep	Oct 11	3	0.67	0.333	0.111
1989	Least cisco	Deep	Oct 7	7	1.71	1.905	0.272
1989	Least cisco	Deep	Oct 11	3	0.67	0.333	0.111
1990	Arctic char	Surface	Sep 26	12	0.33	0.424	0.035
1990	Arctic char	Surface	Sep 27	6	0.17	0.167	0.028
1990	Least cisco	Surface	Sep 26	12	0.75	0.750	0.063
1990	Least cisco	Surface	Sep 27	6	0.33	0.267	0.044
1990	Arctic char	Middle	Sep 25	10	0.30	0.233	0.023
1990	Least cisco	Middle	Sep 25	10	19.50	282.500	28.250
1990	Arctic char	Deep	Sep 24	6	0	0	0
1990	Least cisco	Deep	Sep 24	6	13.00	88.400	14.733

Part II: Means and Variances for Abundance Estimation Strata

Strata					Sample Var.	
(year - species - depth)	No. of Nights	Mean Catch	S.E. (mean)	Var. (mean)	1st stage	2nd stage
89-Sockeye-Surface	2	2.056	0.721	0.520	0.006	2.068
89-Cisco-Surface	2	6.028	4.812	23.154	41.001	10.614
89-Sockeye-Middle	3	0.815	0.270	0.073	0.049	0.509
89-Cisco-Middle	3	0.774	0.278	0.077	0.046	0.556
89-Sockeye-Deep	2	1.048	0.493	0.243	0.290	0.390
89-Cisco-Deep	2	1.190	0.608	0.370	0.549	0.383
90-A. char-Surface	2	0.250	0.151	0.023	0.014	0.063
90-Cisco-Surface	2	0.542	0.265	0.070	0.087	0.107
90-A. char-Middle	1	0.300	0.153	0.023	-	-
90-Cisco-Middle	1	19.500	5.315	28.250	-	-
90-A. char-Deep	1	0	0	0	-	-
90-Cisco-Deep	1	13.000	88.400	14.733	-	-