Sockeye salmon smolt age, length, and weight from the 2005 outmigration on the Kvichak, Nonvianuk, and Alagnak rivers in Bristol Bay, Alaska

Final Report

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EXECUTIVE SUMMARY

The 2005 sockeye salmon smolt migration was sampled in the Kvichak, Alagnak and Nonvianuk rivers in Bristol Bay, Alaska. The study objectives were to: 1) describe the timing and diel patterns of the smolt migration 2) provide a relative index of abundance, 3) collect age, weight and length data and, 4) record hydrologic and climate data during the smolt outmigration period. Sampling was conducted with a fyke net having a 1.2 m^2 opening and 3.0 m wings. Sampling on the Kvichak River was conducted on most days between May 18 and June 11. Sampling was conducted daily on the Nonvianuk River between May 24 and June 8 and on the Alagnak River between May 25 and June 8. The Kvichak smolt run peaked on May 21 with a daily catch per unit effort (CPUE, fish/min) of 11.03 while both Alagnak and Nonvianuk rivers peaked on June 3 with CPUE of 0.74 and 28.75 respectively. The smolt sampled in all three rivers were overwhelmingly age-1 (>99%). There were no significant length or weight differences between age-1 smolt in the three rivers. Age-2 fish were only found in the Kvichak and Nonvianuk rivers, and while there was no significant difference in length, the Nonvianuk age-2 smolt were heavier than Kvichak age-2 smolt ($p=0.0036$). Peak CPUE on the Kvichak was between 2200-0200 hours while peak CPUE on the Nonvianuk was between 0200-0600 hours and 0600-1000 hours was the period of peak CPUE on the Alagnak. Water temperatures taken over the course of the sampling averaged 6.6^0 C, 9.7^0 C and 8.8^0 C on the Alagnak, Nonvianuk, and Kvichak rivers respectively.

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
TABLE OF CONTENTS ii
LIST OF TABLES iii
INTRODUCTION 1
STUDY AREA 1
OBJECTIVES 1
METHODS 1
Sampling Gear and Protocol 1
Sampling Dates 2
Age and Weight Estimation 2
RESULTS 3
Run Timing and Relative Abundance 3
Diel Patterns in the Migration 4
Age Composition 4
Length and Weight By Age and River 4
Hydrologic and Climate Observations 4
DISCUSSION 5
Kvichak River 5
Alagnak and Nonvianuk Rivers 5
ACKNOWLEDGEMENTS 6
LITERATURE CITED 7
Appendix A. Lead Fisheries Technicians report: Alagnak and Nonvianuk Rivers. 20
Appendix B. Lead Fisheries Technicians report: Kvichak River. 24
Appendix C. Climate and stream observation data, Kvichak River, 2005. 26
Appendix D. Climate and stream observation data, Alagnak watershed, 2005. 28
Appendix E. Fyke-net effort and catch data for individual sampling events on the Alagnak, Nonvianuk and Kvichak Rivers, 2005. 29

LIST OF TABLES

Table 1. Total sockeye salmon smolt catch, length frequency (LF), and age, weight and length (AWL) sample sizes by river, 2005. 8
Table 2. Daily sockeye salmon smolt catch, effort, and CPUE (fish/min) by river, 2005. .. 9
Table 3. Cumulative percent of sockeye salmon smolt outmigration on Kvichak River, by year. Historical percent passage based on sonar estimates of fish abundance (Crawford, 2001); 2005 percent based on fyke net CPUE. 10
Table 4. Average daily fyke net CPUE (sockeye salmon smolt/min) observed on the Kvichak River, 1996-2001 and 2005 (Crawford and Cross 1997; Crawford and Cross 1998; Crawford and Cross 1999; Crawford 2000; Crawford 2001; Crawford and West 2001). 11
Table 5. The measured (scale analysis), estimated (discriminatory length criteria), and combined age composition of emigrating sockeye salmon smolts by river, 2005. 12
Table 6. Kvichak sockeye salmon smolt age composition (%) from 1994 to 2001 compared to 2005 (Crawford 2001). 12
Table 7. Parameters used to estimate age- and river-specific weights of sockeye salmon smolt based on measured lengths, 2005..... 13
Table 8. Comparison of age-specific average length and weight for 2005 Kvichak sockeye salmon smolt and Kvichak smolt historical (1955-2000) record (Crawford 2001). 13

LIST OF FIGURES

Figure 1. Sockeye salmon smolt fyke net sampling locations on the Kvichak (A), Alagnak (B) and the Nonvianuk (C) Rivers, 2005. 14
Figure 2. Diagram of fyke net used for sockeye salmon smolt emigration sampling on the Kvichak, Alagnak, and Nonvianuk Rivers, 2005. 15
Figure 3. Sockeye salmon smolt catch per unit effort (CPUE; fish/min) for the Alagnak, Kvichak, and Nonvianuk rivers, 2005. 16
Figure 4. Average sockeye salmon smolt CPUE by time period for the Alagnak, Kvichak, and Nonvianuk rivers, 2005. Whiskers reflect one standard deviation. Total number of sampling events is shown across the top of each chart. 17
Figure 5. Length and weight distributions for age-1 sockeye salmon smolt by river, 2005. The point represents the median value, the box represents the limits of the 1st and 3rd quartiles, and the whiskers show the minimum and maximum values..... 18
Figure 6. Length and weight distributions for age-2 sockeye salmon smolt by river, 2005. Age-2 smolts were not caught in the Alagnak. The point represents the median value, the box represents the limits of the 1st and 3rd quartiles, and the whiskers show the minimum and maximum values. 19

INTRODUCTION

In 2005 the Bristol Bay Science and Research Institute (BBSRI) and Alaska Department of Fish and Game (ADF&G) worked cooperatively to sample sockeye salmon smolts on the Kvichak and Alagnak (Branch) rivers. This report documents that effort and the results. The work on the Kvichak River was a scaled-down version of what has been done in recent years (i.e., there was no acoustic program). The work on the Alagnak River was new and was done as part of a series of studies to assess the impacts of record high sockeye salmon escapement in 2003 (3.6 million) and in 2004 (5.4 million). Other work (done by ADF&G) to assess the effects of the large escapement in 2004 included characterizing the distribution of spawning fish within the watershed, pre-spawning mortality, egg retention, changes in nutrient and zooplankton levels, and mean size of rearing juveniles.

STUDY AREA

The sampling location on the Kvichak River was approximately 6 km downstream from Igiugig, a village located at the outlet of Lake Iliamna (Figure 1). The river is a single channel approximately 110 m wide at this location, and is a same sampling site used by ADF&G for smolt sampling. The Alagnak River system was sampled in two locations; one on the Alagnak River and one on the Nonvianuk River (Figure 1). After some initial testing, sites were chosen that were used for the duration of the project. Sampling locations were characterized by a single, fast-flowing channel that was 50-80 m wide.

OBJECTIVES

The purpose of this project was to characterize the size, age, and relative abundance of sockeye salmon smolts on the Alagnak and Kvichak rivers. Specific objectives of the project were to:

1. Describe timing and diel patterns of the smolt migration.
2. Provide an index of smolt abundance over the migration.
3. Collect smolt age, weight, and length data.
4. Record hydrologic and climate data that might be relevant to the smolt migration.

METHODS

Sampling Gear and Protocol

Fyke nets were used to sample sockeye smolts (Figure 2). The nets had a 1.2 m^2 opening and 3.0 m wings that extended beyond the opening to direct smolts towards the net; the net tapered down to a 0.5 m diameter detachable cod end where captured fish were collected. The detachable zippered cod ends were set and retrieved from a skiff. The nets were placed in areas with a smooth bottom (small gravel or sand), which allowed for proper anchoring and stability. Fyke nets were set at water depths near 1.2 m so the cod end could be retrieved. Sampling on the

Kvichak was conducted primarily between 2200 hours and 0600 hours. This nighttime sampling protocol was adopted from the historical ADF&G smolt work on this river. Sampling on the Alagnak and Nonvianuk rivers was not limited to a specific time period because smolt migration patterns were not known; fishing was conducted opportunistically. Time of capture was determined based on the midpoint of each sampling event; capture times were grouped into periods of 4 hours to investigate diel emigration patterns. The duration of each sampling period was not predetermined. Rather, fishing time was based on the number of fish captured; no more than 200 fish were desired for any sampling session in order to minimize stress from capture, holding, and handling. The daily sampling goal was 600 fish, preferably from at least six sampling sessions; distributing the sampling effort over multiple sessions allowed for a daily sample that was more representative of the emigration.

The catch was transferred to shore in plastic buckets. Fish were anesthetized in a 10mg/L solution of tricaine methanesulfonate (MS-222) prior to handling (Crawford and Tilly 1995). The fork length of all captured fish was measured to the nearest mm using a measuring board. A subset of the total catch was weighed and scales were collected for age determination. Individual weights were measured to the nearest 0.1g on a standard laboratory scale. Multiple scales were collected from the flank of the fish between the lateral line and the posterior insertion of the dorsal fish and mounted on a glass slide for later age determination (Koo 1962). When catches were high (>200), excess fish were immediately released. If the catch was low (<100 fish), length and weight was measured for all captured fish and scales were collected for age. At intermediate catch levels, all fish were measured for length while as many fish as logistically possible were also measured for weight and had scales collected for age.

Sampling Dates

Sampling on the Kvichak River was conducted daily from May 18 through June 11, except for June 8 (24 days). Sampling was conducted daily on the Nonvianuk River from May 24 through June 8 (16 days) and on the Alagnak River from the May 25 through June 8 (15 days).

Age and Weight Estimation

The fish with measured length, weight, and age information were used to establish age and river-specific relationships between length and weight and between length and age. These relationships were used to extrapolate age and weight for all sampled fish.

Scales collected for aging were examined using a 10x dissecting microscope. Age was determined based on the number of over-winter annuli present (e.g., age-1 fish have spent one winter in freshwater and have one freshwater annuli). Combining age information with known length data and examining the resulting distributions, we identified a discriminatory length for each river which allowed us to distinguish age-1 from age-2 fish. This discriminatory length was determined by examining the observed probability of a fish with known length being age-1 or age-2. The length at which the probability of being age-1 was less than the probability of being age-2 was considered the discriminatory length. Thus, any fish of unknown age that was shorter than the discriminatory length were considered age-1 and fish longer than the discriminatory

length were considered age-2. Age-1 fish were considered progeny of the 2003 brood year and age- 2 fish were the progeny of the 2002 brood year.

The length and age data was used to estimate weights for those fish that had not been weighed. For each river (i) and age class (j), weight was estimated using the Ricker (1975) equation:

$$W_{ij} = \alpha L_{ij}^{\beta}$$

Where L_{ij} is the fork length of smolt in river (i) and age (j) and α and β are parameters derived using the least squares method.

RESULTS

Catch

The total 2005 catch was 10,728 sockeye smolts, with 696 smolt from the Alagnak, 6,349 smolt from the Kvichak, and 3,683 smolt from the Nonvianuk (Table 1). An average of 16% of the catch in each river was sampled for age, weight, and length and an average of 72% of the catch in each river was sampled for lengths only (Table 1). The remaining fish (11% of the total catch) were not sampled.

In all three rivers, threespine sticklebacks (*Gasterosteus aculeatus*), ninespine sticklebacks (*Pungitius pungitius*), Chinook salmon smolt, (*O. tshawytscha*), and pink salmon smolt (*O. gorbuscha*) were also caught. Sculpins (*Cottidae spp*.) were also captured in the Kvichak and Alagnak rivers, and chum salmon smolts (*O. keta*) were captured in the Alagnak and Nonvianuk rivers. Pink salmon smolts were particularly abundant in the Alagnak system with large numbers captured in both the Alagnak and Nonvianuk rivers.

Run Timing and Relative Abundance

Peak catch per unit effort (CPUE; fish/min) was on June 3 in both the Alagnak and Nonvianuk rivers (Table 2). The Kvichak emigration was earlier, with peak CPUE on May 21. The Alagnak daily CPUE was never greater than 1 fish/min, while the Nonvianuk daily CPUE peaked at just under 29 fish/min and the Kvichak daily CPUE peaked just over 11 fish/min (Table 2 and Figure 3).

Cumulative CPUE checkpoints (10%, 50%, and 90%) occurred at least five days earlier than the 1983-2000 cumulative sonar counts (Table 3). The 2005 Kvichak smolt CPUE was low compared to recent years, with the average daily CPUE lower than the fyke net CPUE from 1996-2001 (Table 4; Crawford and Cross 1997; Crawford and Cross 1998; Crawford and Cross 1999; Crawford 2000; Crawford 2001; Crawford and West 2001).

Diel Patterns in the Migration

On the Kvichak River, the highest CPUEs were recorded between 2200 and 0200 hours whereas on the Nonvianuk, the highest CPUEs were recorded between 0200-0600 hours (Figure 4). Because of high variability in CPUE over the duration of the run, however, there was no single time period in which CPUE was statistically higher on either river. On the Alagnak River, the highest CPUEs were from 0600 to 1400 hours, but the variability was again too high to detect significant differences among time periods.

Age Composition

Based on scale analysis, most sockeye smolts were age-1 (Table 5). No age-2 smolts were found in the Alagnak River, while only 0.58% of the measured and aged smolts in the Nonvianuk River were age-2 whereas 1.38% of the measured and aged fish from the Kvichak River were age-2. The age composition based on the discriminatory length criteria was similar to the age composition measured from scales (Table 5). The percentage of age-2 smolts in the Kvichak was the lowest in recent years (Table 6; Crawford 2001).

The discriminate lengths used to distinguish between age-1 and age-2 fish were 102mm for the Kvichak River and 105mm for the Nonvianuk River. A discriminate length was not determined for the Alagnak River because age-2 fish were not captured. For the Kvichak River, the threshold length (102mm) was relatively large compared to other years of available data; this threshold value ranged between 95 and 101mm from 1997 to 2001 (Crawford 2001).

Length and Weight By Age and River

For those sockeye salmon smolts that were not directly weighed, weight was estimated using the derived parameters for the Ricker (1975) weight/length equation for each combination of river and age (Table 7). The length (F=7.6E-133) and weight (F=1.8E-52) of age-1 smolts were not significantly different among the three rivers (Figure 5). Although there were no statistical differences, there may be biologically significant differences in lengths or weights among the three rivers. Nonvianuk age-1 smolts were longer and heavier than Alagnak age-1 smolts; while Kvichak age-1 smolt were of an intermediate length and weight.

There was no significant (p=0.57) length difference between the age-2 smolt from the Kvichak and the Nonvianuk rivers, however, the Nonvianuk smolt were significantly heavier than their Kvichak counterparts (p=0.0036; Figure 6). Kvichak age-2 smolt length and weight was more variable than Nonvianuk age-2 smolts. The length and weight of 2005 age-1 and age-2 Kvichak smolt was similar to the 1955-2000 means (Table 8).

Hydrologic and Climate Observations

When the 2005 smolt sampling began, there was no ice within the Alagnak system and flowing ice blocks on the Kvichak River. On the Kvichak River, water temperature was 7°C on May 17th and generally increased over the course of the smolt run, peaking at 12°C on June 5th. In the Alagnak River, the water temperature remained relatively constant, ranging from 6 to 7.5°C. The

Nonvianuk River was consistently about 3-4°C warmer than the Alagnak. The water at all sampling sites was generally clear. Detailed data and observations are found in Appendices A through D.

DISCUSSION

Kvichak River

The 2005 smolt outmigration on the Kvichak River was almost completely age-1. The percent of 2005 age-1 smolt (>99%) was the highest recorded between 1955 and 2005 (age data were not collected from 2000-2004). Previously, the highest recorded percent of age-1 smolt (98%) occurred in 1958 (Crawford 2001). Stationary fyke nets can be biased towards small fish, but this seems an unlikely explanation for the low percent of age-2 fish observed in 2005 because the methods, gear, and sampling location used in 2005 were consistent with sampling in previous years on the Kvichak River.

Although cumulative fyke net CPUE and cumulative sonar counts are not directly comparable, it appears that the 2005 Kvichak River sockeye smolt migration was around five days earlier than the 1983-2000 average run timing (Table 3; Crawford 2001). Also, the low fyke net CPUE suggests that the 2005 run was somewhat less abundant than recent years (Table 4; Crawford and Cross 1997; Crawford and Cross 1998; Crawford and Cross 1999; Crawford 2000; Crawford 2001; Crawford and West 2001). The weights and lengths of Kvichak smolt were similar to smolts in other years (Table 8; Crawford 2001).

The 2005 Kvichak River smolt migration had the lowest proportion of age-2 fish ever recorded (Table 6; Crawford 2001). Historically, the age-2 smolt on the Kvichak emigrate earlier than the age-1 smolt (Crawford 2001). While we make no analysis of the timing of the various age component due to the extremely low numbers of age-2 fish, we note the anecdotal report from the crew leader (Appendix C) that repeats a locals observation that some fish may have moved down-river during ice breakup and prior to our sampling effort and note that we might have missed some age-2 fish prior to our sampling effort getting underway.

Alagnak and Nonvianuk Rivers

Within the Alagnak system, the Nonvianuk River daily average sockeye smolt CPUE was 6.72 and the Alagnak River daily average sockeye smolt CPUE was 0.13. However, the actual 2005 smolt emigration was probably not as different between the two streams as the CPUE differences would sugest. Explanations for why the Alagnak catch was lower than the Nonvianuk include: 1) a poor net location, 2) the run was early, 3) the run was late, or 4) abundance was low.

Catch per unit of effort on the Alagnak River may have been biased low because of ineffective smolt sampling (relative to the Nonvianuk River). It was difficult to sample the Alagnak River due to high water velocity and poor anchoring terrain. We were never able to test different sites and it is possible that we missed a lot of fish. The crew leader on this project thought that the net

was in a poor location and noted high levels of bird feeding (presumably on smolts) downstream of the sampling site during periods when catches were low on the Alagnak side (Appendix A).

There is no conclusive evidence that run timing was a factor in the low catches on the Alagnak River. Alagnak River sockeye smolt catch and CPUE were initially low at the beginning of sampling (Table 2 and Figure 3); thus, it seems implausible that the 2005 emigration was earlier than our sampling effort. However, the Alagnak River was ice free at the start of sampling so it is possible that some sockeye smolts emigrated before sampling began.

Sockeye smolt catch and CPUE appeared to decrease in early June (Table 2 and Figure 3), suggesting that the emigration was ending. However, the Alagnak River was relatively cool throughout the sampling season (6 to 7.5°C) and was consistently about 3-4°C colder than the Nonvianuk River. Thus, it is possible that the Alagnak smolt emigration may have been delayed because of cold water temperatures. Without any historical data, we have no idea whether this is normal. The presence of smolts observed at the adult escapement tower (located near the river mouth) as late as mid-July suggests that late run timing is a possibility in this system. There is considerable distance between the smolt sampling location and the river mouth, and little is known regarding smolt travel time between these areas.

There may be two reasons for the high Nonvianuk River smolt catch. The bulk of the 2003 adult return may have spawned in areas that used Nonvianuk Lake as their juvenile rearing habitat, or juvenile survival in Nonvianuk Lake was much greater than in Alagnak Lake. The Nonvianuk system appears to be quality rearing habitat as evidenced by the larger and more numerous fish emigrating from this system compared to the others, particularly the relatively heavy age-2 smolt.

Over the course of the 2005 sockeye smolt outmigration, we successfully characterized the emigrating smolt runs on the Kvichak, Alagnak, and Nonvianuk rivers. Smolt sampling on the Kvichak River ran smoothly largely because we were able to follow established methods from the historical smolt monitoring program. Conversely, sampling smolts in the Alagnak watershed was greatly complicated by our lack of prior knowledge of this system. Site accessibility (i.e. no float plane access throughout much of the river) and difficult river passage conditions (i.e. impassable rapids on the Alagnak River and shallow water on the Nonvianuk River) affected our ability to sample smolts effectively. If future smolt monitoring is conducted on this system, it would be valuable to investigate other sampling locations.

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office of the U.S. National Park Service, who assisted me with obtaining the permit (KATM-2005-SCI-0004) necessary to base our Alagnak project in Katmai National Park. Mike Daigneault and Matt Nemeth provided helpful comments on drafts of this report, and Julie-Ann Huddleston assisted with document preparation.

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Table 1. Total sockeye salmon smolt catch, length frequency (LF), and age, weight and length (AWL) sample sizes by river, 2005.

River	LF Sample	AWL Sample	Total Catch
Kvichak	4,190	943	6,349
Alagnak	418	269	696
Nonvianuk	3,160	521	3,683
Total	7,768	1,733	10,728

Table 2. Daily sockeye salmon smolt catch, effort, and CPUE (fish/min) by river, 2005.

	Effort (min)			Sockeye smolt			CPUE		
	Alagnak	Kvichak	Nonvianuk	Alagnak	Kvichak	Nonvianuk	Alagnak	Kvichak	Nonvianuk
18-May		123			4			0.03	
19-May		115			0			0.00	
20-May		439			575			1.31	
21-May		71			783			11.03	
22-May		111			946			8.52	
23-May		175			781			4.46	
24-May		189	198		643	0		3.40	0.00
25-May	175	104	80	0	732	2	0.00	7.04	0.03
26-May	65	157	112	0	978	271	0.00	6.23	2.42
27-May	295	358	215	7	35	342	0.02	0.10	1.59
28-May	120	344	65	0	431	18	0.00	1.25	0.28
29-May	200	321	32	27	401	0	0.14	1.25	0.00
30-May	240	237	302	12	4	2	0.05	0.02	0.01
31-May	344	282	376	28	3	8	0.08	0.01	0.02
1-Jun	309	288	420	4	2	0	0.01	0.01	0.00
2-Jun	198	278	50	16	0	727	0.08	0.00	14.54
3-Jun	340	301	24	251	1	690	0.74	0.00	28.75
4-Jun	431	293	328	127	0	50	0.29	0.00	0.15
5-Jun	467	317	30	51	0	488	0.11	0.00	16.27
6-Jun	490	293	23	74	3	627	0.15	0.01	27.26
7-Jun	450	284	30	89	10	75	0.20	0.04	2.50
8-Jun	185		28	10		383	0.05		13.68
9-Jun		319			17			0.05	
10-Jun		302			0			0.00	
11-Jun		311			0			0.00	

Table 3. Cumulative percent of sockeye salmon smolt outmigration on Kvichak River, by year. Historical percent passage based on sonar estimates of fish abundance (Crawford, 2001); 2005 percent based on fyke net CPUE.

Year of Outmigration	Operating Dates	Total Days Operated	Cumulative % by Date		
			10%	50%	90%
1983	5/19-6/13	26	23-May	26-May	5-Jun
1984	5/18-6/10	24	21-May	27-May	5-Jun
1985	5/22-6/19	29	6-Jun	10-Jun	17-Jun
1986	5/21-6/12	23	28-May	5-Jun	6-Jun
1987	5/21-6/13	24	24-May	28-May	9-Jun
1988	5/22-6/16	26	23-May	1-Jun	13-Jun
1989	5/19-6/15	28	29-May	3-Jun	10-Jun
1990	5/21-6/14	25	22-May	25-May	10-Jun
1991	5/22-6/16	26	30-May	28-May	10-Jun
1992	5/23-6/13	22	25-May	22-May	3-Jun
1993	5/18-6/11	25	19-May	24-May	31-May
1994	5/28-6/15	19	31-May	5-Jun	11-Jun
1995	5/21-6/13	24	21-May	25-May	3-Jun
1996	5/18-6/12	26	24-May	28-May	31-May
1997	5/17-6/12	27	19-May	24-May	1-Jun
1998	5/17-6/12	27	20-May	25-May	1-Jun
1999	6/01-6/16	16	4-Jun	8-Jun	14-Jun
2000	5/20-6/13	25	21-May	27-May	7-Jun
2005	5/18-6/11	24	20-May	24-May	28-May
Min(83-00)			19-May	22-May	31-May
Avg(83-00)			25-May	29-May	6-Jun
Max (83-00)			4-Jun	8-Jun	14-Jun

Table 4. Average daily fyke net CPUE (sockeye salmon smolt/min) observed on the Kvichak River, 1996-2001 and 2005 (Crawford and Cross 1997; Crawford and Cross 1998; Crawford and Cross 1999; Crawford 2000; Crawford 2001; Crawford and West 2001).

Year	Average Daily CPUE	Std Dev
1996	2.4	4.47
1997	3.9	4.80
1998	27.1	117.66
1999	3.6	6.51
2000	2.2	3.29
2001	7.6	12.99
2005	1.9	3.20

Table 5. The measured (scale analysis), estimated (discriminatory length criteria), and combined age composition of emigrating sockeye salmon smolts by river, 2005.

		Age-1		Age-2	
	Method	N	%	N	%
Kvichak	Measured	926	98.62	13	1.38
	Estimated	4,176	99.67	14	0.33
	Combined	5,102	99.47	27	0.53
Alagnak	Measured	263	100	0	0
	Estimated	418	100	0	0
	Combined	681	100	0	0
Nonvianuk	Measured	518	99.42	3	0.58
	Estimated	3,151	99.72	9	0.28
	Combined	3,669	99.67	12	0.33

Table 6. Kvichak sockeye salmon smolt age composition (%) from 1994 to 2001 compared to 2005 (Crawford 2001).

	Age Composition (%)	
Year	Age-1	Age-2
1994	64	36
1995	95	5
1996	74	26
1997	74	26
1998	65	35
1999	92	8
2000	82	18
2001	71	29
2005	99.5	0.5

Table 7. Parameters used to estimate age- and river-specific weights of sockeye salmon smolt based on measured lengths, 2005.

	Kvichak		Nonvianuk		Alagnak
Parameter	Age-1	Age-2	Age-1	Age-2	Age-1
α	7.76E-04	7.10E-04	6.41E-05	1.19E-03	3.96E-05
β	1.99	2.04	2.56	1.97	2.63

Table 8. Comparison of age-specific average length and weight for 2005 Kvichak sockeye salmon smolt and Kvichak smolt historical (1955-2000) record (Crawford 2001).

		Historical		2005	
		Mean	Std Dev	Mean	Std Dev
Fork Length (mm)	Age-1	87	4.13	88	5.29
	Age-2	107	6.72	112	4.63
Weight (g)	Age-1	5.9	0.91	5.9	0.71
	Age-2	10.4	1.99	11	0.92

Figure 1. Sockeye salmon smolt fyke net sampling locations on the Kvichak (A), Alagnak (B) and the Nonvianuk (C) Rivers, 2005.

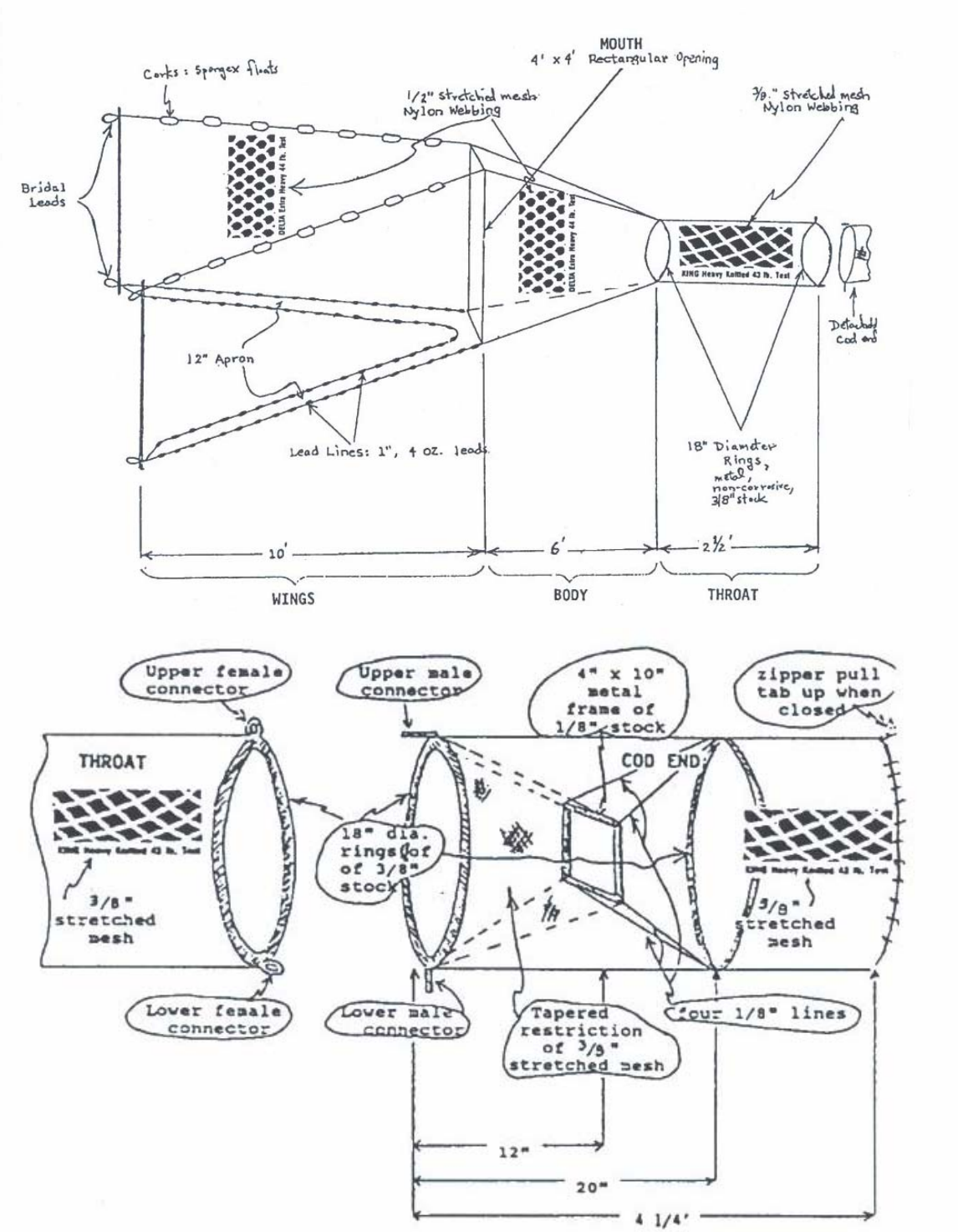

Figure 2. Diagram of fyke net used for sockeye salmon smolt emigration sampling on the Kvichak, Alagnak, and Nonvianuk Rivers, 2005.

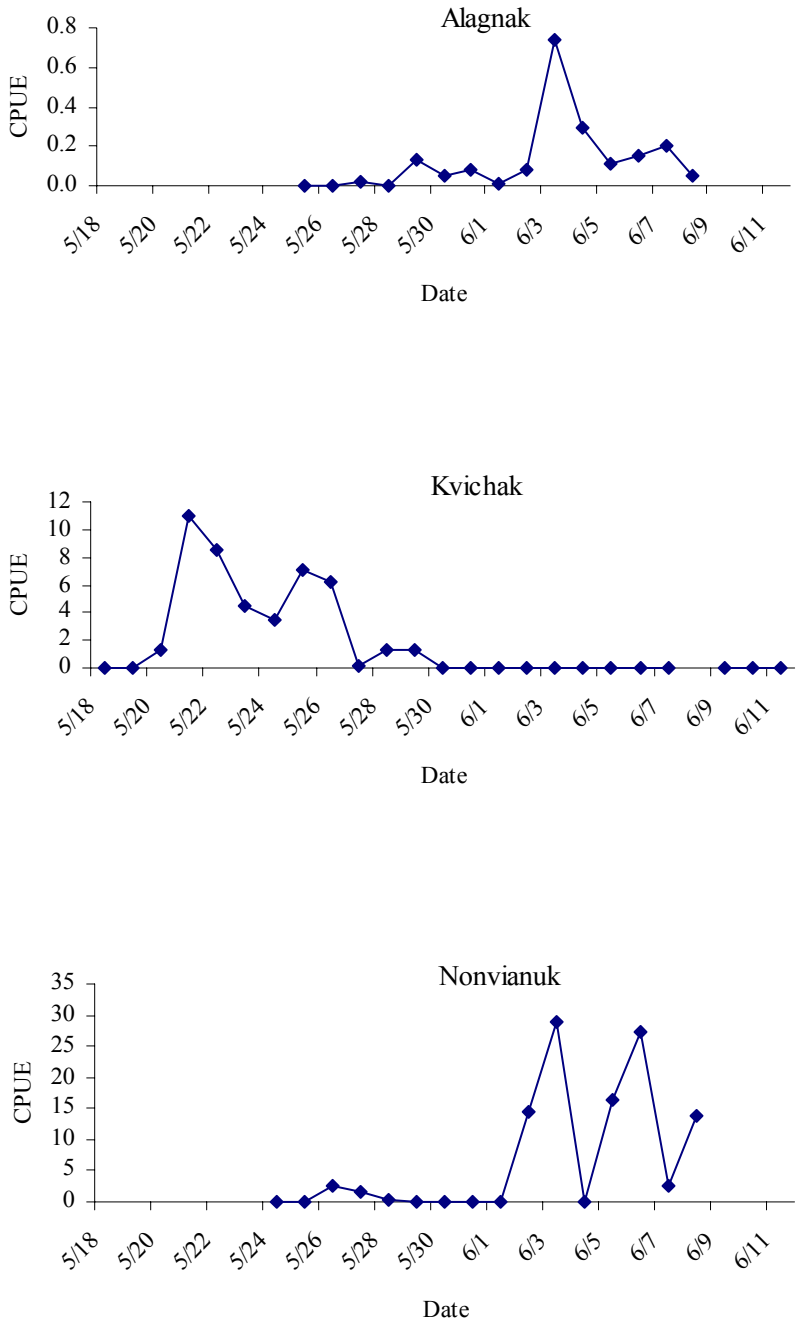

Figure 3. Sockeye salmon smolt catch per unit effort (CPUE; fish/min) for the Alagnak, Kvichak, and Nonvianuk rivers, 2005.

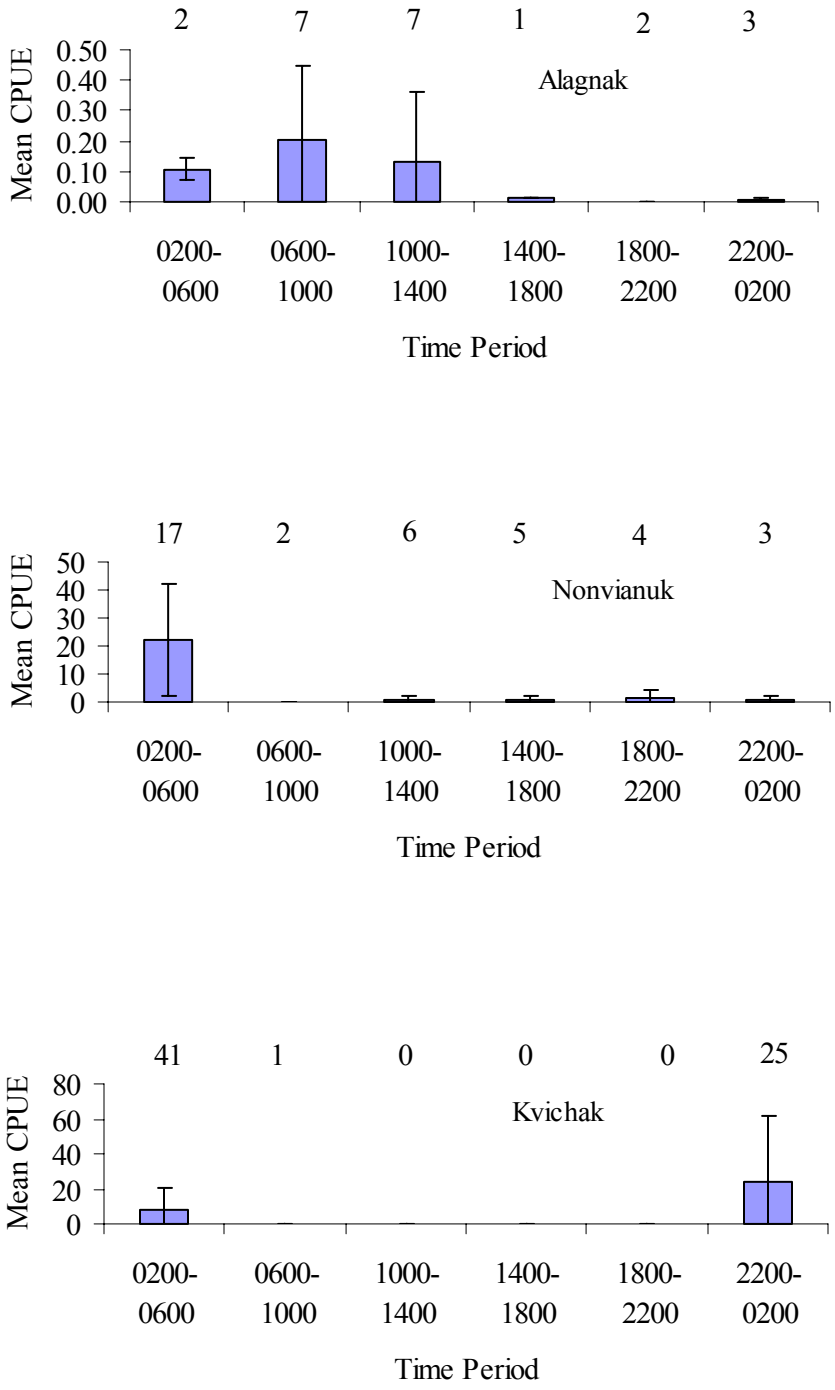

Figure 4. Average sockeye salmon smolt CPUE by time period for the Alagnak, Kvichak, and Nonvianuk rivers, 2005. Whiskers reflect one standard deviation. Total number of sampling events is shown across the top of each chart.

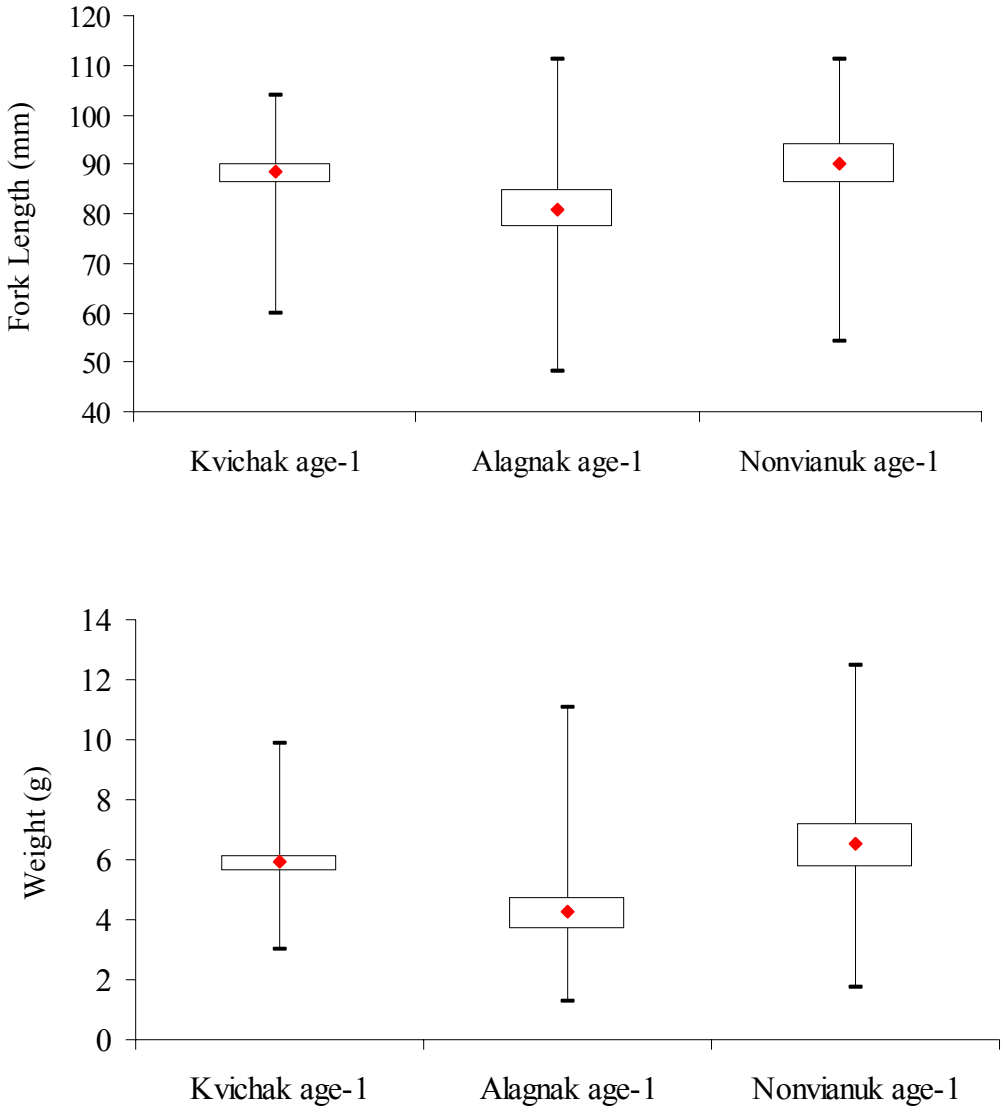

Figure 5. Length and weight distributions for age-1 sockeye salmon smolt by river, 2005. The point represents the median value, the box represents the limits of the 1st and 3rd quartiles, and the whiskers show the minimum and maximum values.

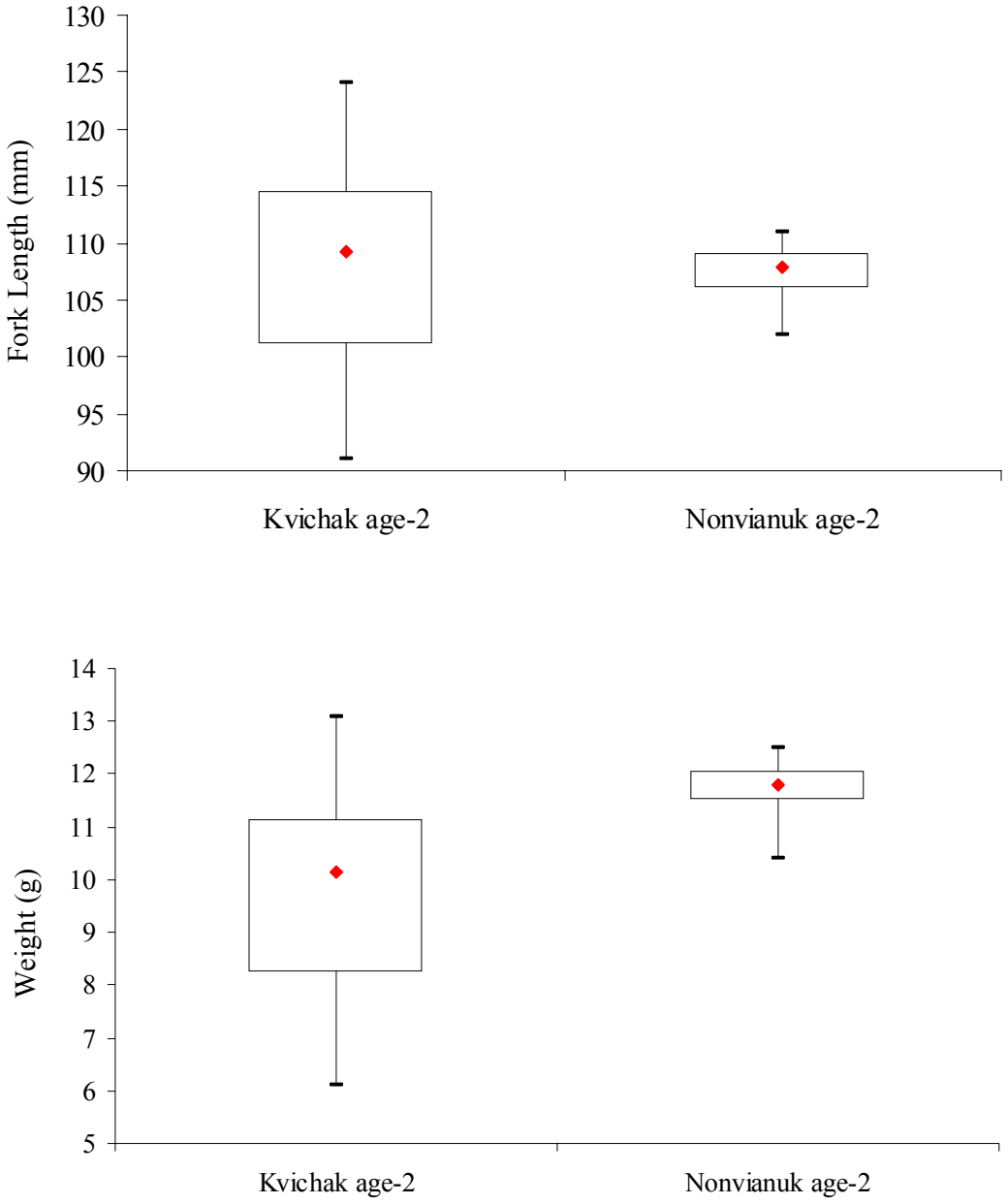

Figure 6. Length and weight distributions for age-2 sockeye salmon smolt by river, 2005. Age-2 smolts were not caught in the Alagnak. The point represents the median value, the box represents the limits of the 1st and 3rd quartiles, and the whiskers show the minimum and maximum values.

Appendix A. Lead fisheries technician's report: Alagnak and Nonvianuk rivers.

Alagnak (Branch) River Smolt, 2005 by Fred Tilly (Alaska Department of Fish and Game)

This spring smolt sampling was carried out for the first time on the Alagnak River. Samples were collected with fyke nets from May 24 through June 8, 2005 on both the Alagnak and Nonvianuk forks of the river. A temporary camp was set up just below the forks and sampling was conducted short distance upstream from the confluence in each fork.

Site Considerations and Methods:
Both of the forks and the main river in this area are very fast flowing. Gurley meter readings were not obtained but the current was markedly faster than that on the Kvichak River downstream of Igiugig where the smolt project is conducted there and water velocity is generally around 1.5m/s. The surface in all areas of the main flow is disturbed by constant wave action typical of rapids, the waves being from 5-15cm high.

Two fyke nets with wing openings of 3m and 1.2m^2 openings were used. The fyke net site used on the Alagnak fork was about 600m above the confluence just around the first bend and over toward the right bank (facing downstream) side. The river here is about 60m wide. A maximum depth was not determined. The water was far too fast for the fyke net in most of the river and a site about 15m out from the right bank was used. Anchor placement was also a problem as the bottom is composed of a hard cobble of medium-sized 1-5kg stones and offered little purchase for an anchor. A tree on the bank and a larger boulder were used to support the anchors and we had only one incidence of anchor dragging. The site was certainly not located in the area likely used by most of the smolt but it did catch fish and a large school entered the net on one occasion. Water depth at the net was 1.2m. Spotlighting was tried on 5/27 starting at 2359 to determine if smolt were passing in the main channel but none were seen. Visibility was limited by the surface wave action and the motor was used as it was too fast to anchor.

The fyke net site used on the Nonvianuk fork was about 100m upstream of the confluence. The river there is about 50m wide, and averages only 1 to 1.2 m in depth. The net site was in a depth of about 1.2m and about 25m out from the right bank. It was in one of the two main channels, an area likely used by many of the migrating smolt. A boulder near shore on the right bank was used to anchor one side and an anchor (later two anchors in tandem) was used on the offshore side looped around a large rock. The bottom was not conducive to firm anchoring and anchors had to be re-set every two or three days with resultant disruption of sampling. Smolt catches were good at this site in the early morning hours when smolt were running.

Spotlighting on the Nonvianuk was done on 5/27 at 2350 for 5 minutes and numerous pinks were seen. On 5/29 spotlighting was used from 0417-0450. No net was set as the anchors had dragged and we were waiting for more rope to reach better anchor rocks. Only pinks were seen and visibility was difficult due to surface wave action. The technique, which holds promise for estimating run strength at night quickly and easily, is of limited usefulness on this area of the Alagnak due to fast water velocity and resultant wave action.

Sample timing:
The nets were fished at various times of day and night. On the Nonvianuk the most reliable time for catching large numbers of smolt was found to be 0300 to 0500 and samples were collected mainly in that time period starting on 6/2.

An optimal time for catching large numbers of smolt was not established on the Alagnak fork due to the low passage rate on that river. The one large catch recorded occurred in the 0900 hour. The net was usually fished for several hours starting at about the same time as the setting of the Nonvianuk net.

Weather conditions:
This spring was warm, following a generally warm winter season. Both lakes were ice free and there was no ice in the rivers by mid May. Insects were out early, with some mosquitoes and black flies present by mid May, which is unusually early.

Results:
Fyke net fishing effort and catch are summarized in the fyke fet logs, attached. A good number of samples were collected from the Nonvianuk fork. These fish were very healthy looking and the weights for given sizes was very good. See AWL sample data. Scales not yet read at this writing. On the Nonvianuk 521 AWL samples were collected and length information was collected on 3,160 additional sockeye salmon smolt. Many more smolt were caught on the Nonvianuk fork than were processed as samples often contained 500 to 1,000 smolt and only about 200 were used in a sample.

On the Alagnak fork a steady very light trickle of samples was collected. A total of 269 AWL samples were collected as well as lengths on an additional 418 sockeye salmon smolt. Nearly all smolt caught on the Alagnak fork were processed as samples. The fish were small and thin. Weights for fish of given lengths were noticeably lower than for those from the Nonvianuk.

Pink fry were extremely numerous migrating down the Nonvianuk fork throughout the time of the project. Catches estimated at over 20,000 in less than an hour of fishing time occurred on 6/2 and 6/5 in the early morning hours and pink daily timing seemed to coincide with that for sockeye. Much smaller numbers of chum fry were also caught as well as a few king salmon smolt.

On the Alagnak fork a few pinks and chums were always included in the catches with only 2 king smolt caught during the project.

Bird activity as an indicator:
There was considerable fishing from our arrival at the site on 5/21 until the end of the project on June 8 by Bonaparte gulls as well as a few terns and the larger Mew gulls. The birds were feeding primarily on pink salmon fry. On several occasions we did observe gulls catching sockeye smolt. On some days later in the project the catching of sockeye by birds on the Alagnak fork indicated that numbers of smolt were probably passing on that fork in the main current while our net off to the side was catching hardly anything.

Water temperature:
Water temperatures were taken at each fyke net site 6 inches below the surface at various times of day through the project. See water temp. recording log. From May 27 to June 8 the Alagnak temperature varied from 5.5 to 8 °C while that on the Nonvianuk varied between 9.5 and 11.5 °C. There was always about a 3.5 °C difference in the temperature of the two forks at any given time.

Relative water depth:
The main river seemed to have come up recently as we drove the boats upriver on 5/21. Numerous logs and debris floating down was a sure sign of this. After the start of the project the level on the Nonvianuk came up about 5 inches while that on the Alagnak fork came up only about 1 inch by June 2. After that the water levels dropped somewhat with the Alagnak loosing its 1 inch gain and the Nonvianuk dropping 3 inches from its peak.

Discussion:
The most clearly demonstrated result of the sampling of the two forks was the difference in condition of the smolt. The thinner, smaller smolt that made up the passage on the Alagnak fork during this period may not be representative of the population of migrants that moved down that river this spring.

Though our Alagnak net location was not in the main channel we did hit one sizeable school on 6/3 and it seems reasonable to assume that we missed the main run on that fork due mainly to timing rather than a poor net location. If that were the case the scattering of small fish that we caught could represent stragglers at the end of the run or odd fish that came out before the main run started. Very small smolt have been observed in the samples taken on the Kvichak in past years near the end of that run.

The question seems to be – Were we too late or too early on the Alagnak fork? The cooler water temperatures and the fact that I have observed very large schools of smolt migrating down and hitting the surface during the day from Branch River Lodge while the tower crew was there on about June 21 argue for a later smolt run on the Alagnak. The generally warm spring suggests that an earlier than usual run could have taken place.

The run on the Nonvianuk seemed to be just getting started around June 2. On 5/31, fishing until midnight yielded hardly any smolt. Our May fishing times were during the day and evening so it may be that smolt on this fork come out in short pulses and pass the sample site in the early morning hours.

This is an exceptionally challenging area of water in which to fish for smolt with fyke nets. The cobble bottom and the speed of the current are the main problems. Finding solid purchase with an anchor is extremely difficult and the strain on the nets due to high water velocity is extreme in the main current areas. I do not think it is possible to fish a fyke net at all in the main channel of the Alagnak fork near the site we used or anywhere upstream to the falls. The Nonvianuk was workable and could be done much more effectively with a cross-river cable rather than anchors.

Recommendations:

The fishing of both forks from a single base camp has proven to be difficult if not impossible with fyke net gear due to the fast water on the Alagnak fork. To adequately sample smolt on both forks it may be necessary to do the sampling near each of the lake outlets.

We used Nonvianuk Lake as our supply drop-off point this year and noted good fyke net locations within 0.8 km of the outlet. This would provide a close location for meeting planes and eliminate the need to frequently negotiate the shallow and fast stretch down to the forks. There are Park Service cabins there that are not used until the opening of fishing season around June 8 as well as established camp sites. The problem there would be the high number of sport fishermen that use the area after the opening. There may be a similar situation at the outlet of Kukaklek Lake. It would need to be scouted in advance.

If this project is done again new fyke nets will need to be purchased. The 50 year old net (That is actually probably a fairly close estimate of its age.) was finally thrown out at the end of this season. The one we kept is also getting old and is not in great shape. The net used on the Kvichak should be used as a model as the type of mesh is ideal for fast water being composed of thin but strong strands that generate less water resistance. The remaining fyke net is stored at Branch River Lodge as of July 1, 2005.

Appendix B. Lead fisheries technician's report: Kvichak River.

Kvichak Smolt 2005 Report
Susan Klock, ADF&G
Zack Babb (BBSRI), Courtney Pierce, (BBNA)

Project dates & Logistics
The smolt project was organized differently this year having been given to BBSRI (Bristol Bay Science and Research Institute). This year the smolt project consisted of fyke net sampling. No sonar was used. The Kvichak crew began work on May 15 by staging gear in King Salmon. On May 16, the 2 person Kvichak crew was joined by the 2 person Alagnak smolt crew (Fred Tilly and Ralph Reddell) and flew to Igiugig using two C-185 charters at 11am and 12:30 and one person taking the Monday mail plane. The remainder of May 16 and all of May 17 was used to set up camp, put the boats in the water, erect the weatherport, and set the fyke net anchors. Note that although the fyke net operation can be run by 2 people, it is necessary to have at least 3 people for setup and breakdown due to the weight of equipment involved. Fyke netting began the evening of May 18 and concluded the morning of June 11. The crew began work at 2330 and finished between 0700 and 0900 depending on number of smolt caught. On June 3, Courtney Pierce arrived and on June 5, Zack Babb departed. On June 12, the Alagnak smolt crew flew to Igiugig to assist with camp breakdown and repair equipment. The entire 4 person crew flew back to King Salmon the same day at 1500 using a Cherokee charter from Pen Air.

Fyke netting
The fyke net was set about 6km downstream of the 2004 site on a bend in the river where a gravel bar lies on the inshore side of the net. Fred Tilly called this site the old index site. Due to rising water level, on 6/4 the fyke net was moved upriver to approximately the second site used in 2004 in a straight stretch of river above the bend. The weatherport was set on the gravel bar for convenient access to the fyke net.

The first week was very cloudy with lots of rain but calm at night and good fyke netting conditions, culminating in a lengthy wind storm for 4 days 5/27-30 sending a lot of debris downriver. Most of the fyke net catches were recorded in this first 10 day period including 6 nights of 600 or more samples. Conditions were good for another week with more sun and no rain including 3 hot sunny days until the arrival of the second large storm with very strong winds 6/8-10 and more debris, however very few smolt were caught after 5/29. Few smolt were seen at the boat landing all season. Also of note, Dan Salmon reported on 6/1 seeing a large mass of smolt in the Newhalen River.

Water Temperature
The Kvichak River was full of icebergs when the crew arrived on 5/16. Villagers reported there had been ice for several days due to wind from a certain direction (which does not occur every year) but the ice had cleared by the morning of 5/17. One villager reported seeing a lot of smolt going out with the ice for several days.

The water temperature upon arrival at the boat landing was 7, fairly warm for the start of the smolt project. It rose to a peak of 12 on 6/5 before dropping significantly down to 6.5 on 6/9 after the second storm and finished at 8.5.

Water Level

Water was higher this year than previous years. Contrary to what the 2004 smolt report states, the water level in 2004 was at least 11cm higher than 2003, based on visual observation by the sonar crew at the sonar weatherport. Visual observation this year at the sonar site estimates the water level to be approximately 8cm above 2004. A water gauge was installed at the weatherport and readings taken daily in the morning. During the smolt run, the river rose 18cm, unlike the previous two years where the water level remained constant.

Spotlighting

Continuing the spotlighting procedure as started by Fred Tilly in 2004, spotlighting was done nightly using a 400,000 candle power spotlight powered by a 12V battery. An anchor was set so that the spotlight boat sat parallel to the fyke net boat across the river in the deeper faster current. Spotlighting was done randomly (no fixed time intervals) and schools of smolt were recorded as to approximate size. Of interest, in peak periods, such as the first days when the net was catching a lot of smolt, 5/20-25, not many schools were seen in the spotlight indicating more smolt were on the net side of the river. After the first storm, from 6/2 on, spotlighting typically showed one school per minute or less, and fyke net catches were very poor. Smolt passage in schools per minute increased the last 3 nights which may have coincided with the cooler water temperature. Random spotlighting was done in the area between the fyke net boat and the spotlight boat without seeing many schools of smolt. The spotlight anchor was not moved when the fyke net was moved on 6/4. Random spotlighting was also done from the bow of the fyke net boat to confirm no smolt were on that side of the river when the net was not catching smolt. Random spotlighting was done on 6/11 between the fyke net and the sandbar to locate where the smolt where passing. The smolt passage as seen in the spotlight was estimated to be 70 feet offshore of the fyke net and 11.5m off the sandbar. It is not possible to set the fyke net in this main passage area due to limitations on how deep the net and how swift the current is.

Supplies needed for 2006:

20 AA batteries (headlights, walkie-talkies)
8 C batteries (headlight)
Cigarette plug with battery clips (unless new one bought for Kvichak tower in 2005)
2x3m blue tarp or visqueen
duct tape & packing tape
5 #2 pencils
Aquarium type dipnet
Timer if more accurate spotlighting times are desired
2 carabiners

Appendix C. Climate and stream observation data, Kvichak River, 2005.

	Sky[a]		Precipitation (mm)[b]			Wind (Dir-Vel)		Air Temp (c)		Water Temp (c)	Water Color[c]
Date	8AM	8PM	8AM	8PM	Total (24hr)	8AM	8PM	8AM	8PM	8AM	8AM
17-May	5	NR	0	0	0	calm	calm	NR	NR	7	1
19-May	5	2	0	0	0	NW5	NR	8	16	7.5	1
20-May	3	4	0	0	0.5	NW9	NR	6	15	8	1
21-May	4	4	INT	INT	9.5	SW5	SW8	9	NR	9	1
22-May	NR	NR	INT	0	15.2	NR	NR	NR	NR	NR	1
23-May	4	3	INT	0	2	W5	SW8	8	11	9	1
24-May	4	4	0	0	0	calm	NR	10	NR	9	1
25-May	3	1	0	0	0.5	calm	NE15	10	16	8	1
26-May	1	4	0	0	0	E10	E10	8	10	8	1
27-May	3	3	0	0	0	E25	E25	9	10	8	1
28-May	4	3	0	0	0	E25	NE15	10	13	8	5
29-May	2	3	0	0	0	calm	SE30	8	12	8	1
30-May	4	3	0	0	0	NE35	SE20	10	16	8	1
31-May	4	4	0	INT	8.5	calm	SE5	10	NR	8	1
1-Jun	2	3	TR	0	2	calm	NW8	8	NR	9	1
2-Jun	1	3	0	0	0	calm	NW10	10	13	11	1
3-Jun	1	3	0	0	0.5	calm	NW3	2	19	11	1
4-Jun	1	3	0	0	0	NE4	W5	7	19	11	1
5-Jun	1	1	0	0	0	calm	W5	10	22	12	1
6-Jun	1	3	0	0	0	NW3	NW20	7	15	11	1
7-Jun	4	4	0	0	0.5	E25	NR	8	12	9	5

a: Sky codes: 1=cloud cover<10%, 2=cloud cover<50%, 3=cloud cover>50%, 4=100% overcast, 5=Fog or thick haze

b: Precipitation Codes: INT=intermittent, TR=trace

c: Water Color codes: 1=clear, 2=light Brown, 3=brown, 4=dark brown, 5=murky or glacial

note: NR=no report. All observations are general and were made in the area of the confluence of these two rivers except water temperature, which was measured upstream of the confluence, at the locations of the fyke nets.

Appendix C. Climate and stream observation data, Kvichak River, 2005.

	Sky[a]		Precipitation (mm)[b]			Wind (Dir-Vel)		Air Temp (c)		Water Temp (c)	Water Color[c]
Date	8AM	8PM	8AM	8PM	Total (24hr)	8AM	8PM	8AM	8PM	8AM	8AM
8-Jun	4	3	0	0	0	ENE30	E10	8	13	8	1
9-Jun	4	3	INT	0	0.7	NE10	NE5	6	12	6.5	1
10-Jun	3	3	0	TR	TR	NE10	NE3	8	15	8	1
11-Jun	4	2	INT	0	NR	N3	NR	7	15	8.5	1

a: Sky codes: 1=cloud cover<10%, 2=cloud cover<50%, 3=cloud cover>50%, 4=100% overcast, 5=Fog or thick haze

b: Precipitation Codes: INT=intermittent, TR=trace

c: Water Color codes: 1=clear, 2=light Brown, 3=brown, 4=dark brown, 5=murky or glacial

note: NR=no report. All observations are general and were made in the area of the confluence of these two rivers except water temperature, which was measured upstream of the confluence, at the locations of the fyke nets.

Appendix D. Climate and stream observation data, Alagnak watershed, 2005.

Date	Sky[a]		Precipitation (mm)[b]			Wind (Dir-Vel)		Air Temp (°C)		Water Temp (°C)			Water Color[c]	
	8AM	8PM	8AM	8PM	Total (24hr)	8AM	8PM	8AM	8PM	Time	Alagnak	Nonvianuk	8AM	8PM
24-May	1	4	INT	INT	TR	NR	SE3	NR	NR	NR	NR	NR	1	1
25-May	1	1	0	0	0	E10	E20	NR	13	NR	NR	NR	1	1
26-May	1	3	0	0	0	E10	E20	NR	13	NR	NR	NR	1	1
27-May	4	4	0	0	0	E12	E20	NR	NR	14:00	7	11	1	1
28-May	4	4	0	0	0	E25	E20	NR	NR	12:00	6	9.5	1	1
29-May	4	4	0	0	0	E5	E25	NR	NR	5:00	6	9.5	1	1
30-May	4	4	INT	INT	TR	E15	E25	NR	NR	8:00	6	9	1	1
31-May	4	4	INT	INT	TR	E10	E25	NR	NR	9:00	6.5	10	1	1
1-Jun	4	4	0	INT	TR	NE7	NE20	NR	NR	11:00	7.5	10.5	1	1
2-Jun	1	3	0	INT	TR	W3	W15	NR	NR	NR	NR	NR	1	1
3-Jun	1	2	0	0	0	W3	W15	NR	NR	4:00	6	8	1	1
4-Jun	1	1	0	0	0	W5	W8	NR	NR	5:00	7	10	1	1
5-Jun	1	NR	0	0	0	calm	NR	NR	NR	5:00	7	10	1	NR

a: Sky codes: 1=cloud cover<10%, 2=cloud cover<50%, 3=cloud cover>50%, 4=100% overcast, 5=Fog or thick haze
b: Precipitation Codes: INT=intermittent, TR=trace
c: Water Color codes: 1=clear, 2=light Brown, 3=brown, 4=dark brown, 5=murky or glacial
note: NR=no report. All observations are general and were made in the area of the confluence of these two rivers except water temperature, which was measured upstream of the confluence, at the locations of the fyke nets.

Appendix E. Fyke-net effort and catch data for individual sampling events on the Alagnak, Nonvianuk and Kvichak Rivers, 2005.

Date	River	Set Midpoint	Set Time	Pull Time	Time (min)	Total Catch	CPUE
25-May	Alagnak	18:47	17:20	20:15	175	0	0.00
26-May	Alagnak	21:09	20:37	21:42	65	0	0.00
27-May	Alagnak	10:27	10:05	10:50	45	3	0.07
27-May	Alagnak	11:25	10:50	12:00	70	3	0.04
27-May	Alagnak	12:26	12:00	12:53	53	0	0.00
27-May	Alagnak	22:55	21:52	23:59	127	1	0.01
28-May	Alagnak	13:10	12:10	14:10	120	0	0.00
29-May	Alagnak	5:52	4:12	7:32	200	27	0.14
30-May	Alagnak	9:47	8:10	11:25	195	12	0.06
30-May	Alagnak	22:57	22:35	23:20	45	0	0.00
31-May	Alagnak	10:39	9:15	12:03	168	26	0.15
31-May	Alagnak	22:28	21:00	23:56	176	2	0.01
1-Jun	Alagnak	12:02	10:05	14:00	235	3	0.01
1-Jun	Alagnak	16:38	16:01	17:15	74	1	0.01
2-Jun	Alagnak	5:56	4:17	7:35	198	16	0.08
3-Jun	Alagnak	6:55	4:05	9:45	340	251	0.74
4-Jun	Alagnak	7:25	4:58	9:53	295	39	0.13
4-Jun	Alagnak	11:02	9:54	12:10	136	88	0.65
5-Jun	Alagnak	8:56	5:03	12:50	467	51	0.11
6-Jun	Alagnak	8:40	4:35	12:45	490	74	0.15
7-Jun	Alagnak	7:35	3:50	11:20	450	89	0.20
8-Jun	Alagnak	6:47	5:15	8:20	185	10	0.05
24-May	Nonvianuk	17:43	17:27	18:00	33	0	0.00
24-May	Nonvianuk	19:22	18:00	20:45	165	0	0.00
25-May	Nonvianuk	12:40	12:00	13:20	80	2	0.03
26-May	Nonvianuk	13:15	13:00	13:30	30	122	4.07
26-May	Nonvianuk	14:19	13:57	14:42	45	149	3.31
26-May	Nonvianuk	15:01	14:43	15:20	37	0	0.00
27-May	Nonvianuk	13:32	12:30	14:35	125	23	0.18
27-May	Nonvianuk	21:55	21:40	22:10	30	167	5.57
27-May	Nonvianuk	22:40	22:10	23:10	60	152	2.53
28-May	Nonvianuk	12:07	11:35	12:40	65	18	0.28
29-May	Nonvianuk	15:31	15:15	15:47	32	0	0.00

Appendix E. Fyke-net effort and catch data for individual sampling events on the Alagnak, Nonvianuk and Kvichak Rivers, 2005.

Date	River	Set Midpoint	Set Time	Pull Time	Time (min)	Total Catch	CPUE
30-May	Nonvianuk	9:31	7:58	11:05	187	0	0.00
30-May	Nonvianuk	22:47	21:50	23:45	115	2	0.02
31-May	Nonvianuk	10:24	9:00	11:48	168	2	0.01
31-May	Nonvianuk	22:15	20:31	23:59	208	6	0.03
1-Jun	Nonvianuk	11:42	9:45	13:40	235	0	0.00
1-Jun	Nonvianuk	15:27	13:55	17:00	185	0	0.00
2-Jun	Nonvianuk	4:15	4:01	4:30	29	253	8.72
2-Jun	Nonvianuk	4:40	4:31	4:49	18	222	12.33
2-Jun	Nonvianuk	4:51	4:50	4:53	3	252	84.00
3-Jun	Nonvianuk	4:04	3:58	4:10	12	201	16.75
3-Jun	Nonvianuk	4:13	4:11	4:16	5	251	50.20
3-Jun	Nonvianuk	4:20	4:17	4:24	7	238	34.00
4-Jun	Nonvianuk	5:55	4:46	7:04	138	50	0.36
4-Jun	Nonvianuk	8:22	7:05	9:40	155	0	0.00
4-Jun	Nonvianuk	18:57	18:40	19:15	35	0	0.00
5-Jun	Nonvianuk	4:16	4:13	4:20	7	121	17.29
5-Jun	Nonvianuk	4:26	4:21	4:31	10	173	17.30
5-Jun	Nonvianuk	4:38	4:32	4:45	13	194	14.92
6-Jun	Nonvianuk	3:55	3:50	4:00	10	252	25.20
6-Jun	Nonvianuk	4:03	4:01	4:06	5	137	27.40
6-Jun	Nonvianuk	4:11	4:07	4:15	8	238	29.75
7-Jun	Nonvianuk	4:22	4:10	4:35	25	75	3.00
7-Jun	Nonvianuk	20:42	20:40	20:45	5	0	0.00
8-Jun	Nonvianuk	4:40	4:35	4:45	10	187	18.70
8-Jun	Nonvianuk	4:50	4:46	4:55	9	132	14.67
8-Jun	Nonvianuk	5:00	4:56	5:05	9	64	7.11
18-May	Kvichak	1:29	0:28	2:31	123	4	0.03
19-May	Kvichak	1:32	0:35	2:30	115	0	0.00
20-May	Kvichak	1:00	0:23	1:37	74	110	1.49
20-May	Kvichak	2:02	1:40	2:24	44	150	3.41
20-May	Kvichak	2:34	2:20	2:48	28	90	3.21
20-May	Kvichak	3:00	2:51	3:09	18	111	6.17
20-May	Kvichak	3:56	3:15	4:38	83	112	1.35
20-May	Kvichak	6:18	4:42	7:54	192	2	0.01
21-May	Kvichak	0:46	0:20	1:13	53	150	2.83
21-May	Kvichak	1:20	1:13	1:27	14	131	9.36

Appendix E. Fyke-net effort and catch data for individual sampling events on the Alagnak, Nonvianuk and Kvichak Rivers, 2005.

Date	River	Set Midpoint	Set Time	Pull Time	Time (min)	Total Catch	CPUE
21-May	Kvichak	1:28	1:27	1:29	2	300	150.00
21-May	Kvichak	1:27	1:27	1:28	1	103	103.00
21-May	Kvichak	1:27	1:27	1:28	1	99	99.00
22-May	Kvichak	1:30	1:27	1:34	7	200	28.57
22-May	Kvichak	0:52	0:20	1:25	65	138	2.12
22-May	Kvichak	1:34	1:28	1:41	13	200	15.38
22-May	Kvichak	1:50	1:43	1:57	14	135	9.64
22-May	Kvichak	2:00	1:59	2:01	2	123	61.50
22-May	Kvichak	2:07	2:02	2:12	10	150	15.00
23-May	Kvichak	2:18	2:15	2:22	7	200	28.57
23-May	Kvichak	1:28	0:24	2:33	129	120	0.93
23-May	Kvichak	2:38	2:36	2:40	4	98	24.50
23-May	Kvichak	2:49	2:43	2:55	12	150	12.50
23-May	Kvichak	3:01	2:58	3:05	7	103	14.71
23-May	Kvichak	3:16	3:08	3:24	16	110	6.88
24-May	Kvichak	3:29	3:27	3:32	5	120	24.00
24-May	Kvichak	1:26	0:15	2:38	143	88	0.62
24-May	Kvichak	2:46	2:41	2:51	10	120	12.00
24-May	Kvichak	2:57	2:53	3:02	9	102	11.33
24-May	Kvichak	3:08	3:04	3:12	8	109	13.63
24-May	Kvichak	3:21	3:14	3:28	14	104	7.43
25-May	Kvichak	3:42	3:31	3:54	23	120	5.22
25-May	Kvichak	0:52	0:21	1:24	63	101	1.60
25-May	Kvichak	1:29	1:27	1:32	5	160	32.00
25-May	Kvichak	1:36	1:35	1:37	2	105	52.50
25-May	Kvichak	1:44	1:41	1:48	7	150	21.43
25-May	Kvichak	1:53	1:51	1:55	4	96	24.00
26-May	Kvichak	2:01	1:58	2:05	7	200	28.57
26-May	Kvichak	0:49	0:12	1:27	75	108	1.44
26-May	Kvichak	1:40	1:29	1:52	23	120	5.22
26-May	Kvichak	2:03	1:54	2:12	18	120	6.67
26-May	Kvichak	2:19	2:15	2:23	8	130	16.25
26-May	Kvichak	2:32	2:25	2:40	15	150	10.00
26-May	Kvichak	2:49	2:44	2:55	11	150	13.64
27-May	Kvichak	3:20	0:21	6:19	358	35	0.10
28-May	Kvichak	0:49	0:12	1:26	74	111	1.50

Appendix E. Fyke-net effort and catch data for individual sampling events on the Alagnak, Nonvianuk and Kvichak rivers, 2005.

Date	River	Set Midpoint	Set Time	Pull Time	Time (min)	Total Catch	CPUE
28-May	Kvichak	1:39	1:28	1:51	23	130	5.65
28-May	Kvichak	2:03	1:53	2:14	21	107	5.10
28-May	Kvichak	2:45	2:16	3:14	58	76	1.31
28-May	Kvichak	4:04	3:16	4:52	96	7	0.07
28-May	Kvichak	5:31	4:55	6:07	72	0	0.00
29-May	Kvichak	1:08	0:33	1:43	70	200	2.86
29-May	Kvichak	1:50	1:46	1:55	9	150	16.67
29-May	Kvichak	2:46	1:58	3:35	97	51	0.53
29-May	Kvichak	4:50	3:38	6:03	145	0	0.00
30-May	Kvichak	2:14	0:16	4:13	237	4	0.02
31-May	Kvichak	2:39	0:18	5:00	282	3	0.01
1-Jun	Kvichak	2:40	0:16	5:04	288	2	0.01
2-Jun	Kvichak	2:47	0:28	5:06	278	0	0.00
3-Jun	Kvichak	2:42	0:12	5:13	301	1	0.00
4-Jun	Kvichak	2:44	0:18	5:11	293	0	0.00
5-Jun	Kvichak	2:55	0:17	5:34	317	0	0.00
6-Jun	Kvichak	2:46	0:20	5:13	293	3	0.01
7-Jun	Kvichak	2:45	0:23	5:07	284	10	0.04
9-Jun	Kvichak	2:56	0:17	5:36	319	17	0.05
10-Jun	Kvichak	2:46	0:15	5:17	302	0	0.00
11-Jun	Kvichak	2:42	0:07	5:18	311	0	0.00