

2A01-12

## BRISTOL BAY SOCKEYE SALMON SMOLT STUDIES FOR 2000



by

Drew L. Crawford

and

Frederick W. West

Regional Information Report<sup>1</sup> No. 2A01-12

Alaska Department of Fish and Game  
Division of Commercial Fisheries  
Regional Office  
333 Raspberry Road  
Anchorage, Alaska 99518-1599

July 2001

---

<sup>1</sup>Contribution 01-12 from the Anchorage regional office. The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate needs for up-to-date information, reports in this series may contain preliminary data.

**BRISTOL BAY SOCKEYE SALMON SMOLT STUDIES FOR 2000**

by

Drew L. Crawford

and

Frederick W. West

Regional Information Report<sup>1</sup> No. 2A01-12

Alaska Department of Fish and Game  
Division of Commercial Fisheries  
Regional Office  
333 Raspberry Road  
Anchorage, Alaska 99518-1599

July 2001

---

<sup>1</sup>Contribution 01-12 from the Anchorage regional office. The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate needs for up-to-date information, reports in this series may contain preliminary data.

## AUTHOR

Drew L. Crawford is a Region II Bristol Bay Research Biologist for the Alaska Department of Fish and Game, Division of Commercial Fisheries, 333 Raspberry Road, Anchorage, AK 99518-1599.

Frederick W. West is a Region II Bristol Bay Assistant Research Biologist for the Alaska Department of Fish and Game, Division of Commercial Fisheries, 333 Raspberry Road, Anchorage, AK 99518-1599.

## ACKNOWLEDGMENTS

We wish to thank the following Alaska Department of Fish and Game, Division of Commercial Fisheries personnel for contributing to the success of the Bristol Bay sockeye salmon smolt sonar studies in 2000. Ryan Bill<sup>a</sup>, Catherine Ducasse<sup>a</sup>, Brian Holder<sup>b</sup>, Andrew Johnson<sup>b</sup>, Tom Kerns<sup>ac</sup>, Susan Klock<sup>a</sup>, Susan McNeil<sup>bc</sup>, Christopher Shelden<sup>cd</sup>, Fred Tilly<sup>bce</sup>, and Fred West<sup>cd</sup> collected smolt data. Cathy Tilly and Charlette Fullinck aged the smolt scales. Dan Gray, Mark Reynolds, Slim Morstad, and Carol Klutsch provided logistical support. Lowell Fair, Dan Gray, and Suzanne Maxwell provided editorial reviews of this document. We also wish to thank Bristol Bay Science and Research Institute personnel Kyle Belleque<sup>d</sup> and Tim Enright<sup>d</sup> for collecting Ugashik River smolt data; Branch River Air Service and Peninsula Airways for logistical support; and hydroacoustic consultant, Al Menin, for providing technical assistance and expert advice to the 2000 smolt sonar projects.

<sup>a</sup> Egegik River smolt sonar project

<sup>b</sup> Kvichak River smolt sonar project

<sup>c</sup> Lead crewmember

<sup>d</sup> Ugashik River smolt sonar project

<sup>e</sup> Kvichak smolt sonar evaluation project

## PROJECT SPONSORSHIP

The Ugashik River smolt project was financed through a cooperative agreement (COOP-00-070) with the Bristol Bay Science and Research Institute, the Lake and Peninsula Borough, and the State of Alaska, Department of Fish and Game, Division of Commercial Fisheries.



## TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES .....	vii
LIST OF FIGURES .....	x
LIST OF APPENDICES .....	xii
ABSTRACT .....	xvii
INTRODUCTION .....	1
Background .....	1
METHODS .....	4
Hydroacoustic Equipment .....	4
Project Locations .....	5
Estimation of Smolt Numbers .....	6
Biomass Estimation .....	6
Estimation of River Velocities and Adjustment to Sonar Counts .....	6
Expansion of Biomass Estimates .....	7
Age, Weight, and Length Estimation .....	8
Estimation of Smolt Numbers .....	10
Smolt Fin Clips for DNA Analysis .....	10
Vertical Distribution of Smolt Passage .....	11
Climatological Data Collection .....	11
RESULTS .....	11
Kvichak River .....	11
Egegik River .....	14

**TABLE OF CONTENTS (Continued)**

	<u>Page</u>
Ugashik River .....	16
DISCUSSION .....	17
Kvichak River .....	17
Egegik River .....	19
Ugashik River .....	20
LITERATURE CITED .....	23
TABLES .....	35
FIGURES .....	73
APPENDIX .....	97

## LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Sonar counts by smolt day and array at the sockeye salmon smolt counting site on Kvichak River, 2000 .....	35
2. Sonar counts by hour and array at the sockeye salmon smolt counting site on Kvichak River, 2000.....	36
3. Daily number of sockeye salmon smolt emigrating seaward estimated with hydroacoustic equipment, Kvichak River, 2000 .....	37
4. Adjustment factors used to expand sonar counts into estimated numbers of sockeye salmon smolt, Kvichak River, 2000 .....	38
5. Mean fork length and weight of sockeye salmon smolt captured by fyke net, Kvichak River, 2000 .....	39
6. Mean fork length and estimated mean weight for age-1. and -2. sockeye salmon smolt, Kvichak River, 2000 .....	40
7. Range of sockeye salmon smolt passage from the transducers at Kvichak River sonar site, May 20 to June 8, 2000 .....	41
8. Climatological and hydrological observations made at sockeye salmon smolt counting site at 0800 and 2000 hours, Kvichak River, 2000 .....	42
9. Sonar counts by smolt day and array at the sockeye salmon smolt counting site on Egegik River, 2000 .....	43
10. Sonar counts by hour and array at the sockeye salmon smolt counting site on Egegik River, 2000.....	44
11. Daily number of sockeye salmon smolt emigrating seaward estimated with hydroacoustic equipment, Egegik River, 2000 .....	45
12. Adjustment factors used to expand sonar counts into estimated numbers of sockeye salmon smolt, Egegik River, 2000 .....	46
13. Mean fork length and weight of sockeye salmon smolt captured by fyke net, Egegik River, 2000 .....	47
14. Mean fork length and estimated mean weight for age-1. and -2. sockeye salmon smolt, Egegik River, 2000 .....	48

**LIST OF TABLES (Continued)**

<u>Table</u>	<u>Page</u>
15. Range of sockeye salmon smolt passage from the transducers at Egegik River sonar site, May 20 to June 7, 2000 .....	49
16. Climatological and hydrological observations made at sockeye salmon smolt counting site at 0800 and 2000 hours, Egegik River, 2000 .....	50
17. Sonar counts by smolt day and array at the sockeye salmon smolt counting site on Ugashik River, 2000 .....	51
18. Sonar counts by hour and array at the sockeye salmon smolt counting site on Ugashik River, 2000 .....	52
19. Daily number of sockeye salmon smolt emigrating seaward estimated with hydroacoustic equipment, Ugashik River, 2000 .....	53
20. Adjustment factors used to expand sonar counts into estimated numbers of sockeye salmon smolt, Ugashik River, 2000 .....	54
21. Mean fork length and weight of sockeye salmon smolt captured by fyke net, Ugashik River, 2000 .....	55
22. Mean fork length and estimated mean weight for age-1. and -2. sockeye salmon smolt, Ugashik River, 2000 .....	56
23. Climatological and hydrological observations made at sockeye salmon smolt counting site at 0800 and 2000 hours, Ugashik River, 2000 .....	57
24. Age composition of total migration and mean fork length and weight by age class for sockeye salmon smolt, Kvichak River, 1955-2000 .....	58
25. Water temperatures at sockeye salmon smolt counting site, Kvichak River, 1963-2000 .....	59
26. Sockeye salmon spawning escapement, total number of smolt produced by age class, percent of total smolt production by age class, and number of smolt produced per spawner for 1968-1998 brood years, Kvichak River .....	60

**LIST OF TABLES (Continued)**

<u>Table</u>	<u>Page</u>
27. Sockeye salmon spawning escapements, smolt production, adult returns, and smolt survival (number of adults produced per smolt) for 1968-1998 brood years, Kvichak River .....	61
28. Comparison of the age composition of outmigrating sockeye salmon smolt at Kvichak River with the freshwater age composition of their total adult returns by brood year, 1981-1993 .....	62
29. Age composition of total migration and mean fork length and weight by age class for sockeye salmon smolt, Egegik River, 1939-2000 .....	63
30. Water temperatures at sockeye salmon smolt counting site, Egegik River, 1981-2000 .....	64
31. Sockeye salmon spawning escapement, total number of smolt produced by age class, percent of total smolt production by age class, and number of smolt produced per spawner for 1978-1998 brood years, Egegik River .....	65
32. Sockeye salmon spawning escapements, smolt production, adult returns, and smolt survival (number of adults produced per smolt) for 1978-1998 brood years, Egegik River .....	66
33. Comparison of the age composition of outmigrating sockeye salmon smolt at Egegik River with the freshwater age composition of their total adult returns by brood year, 1981-1993 .....	67
34. Age composition of total migration and mean fork length and weight by age class for sockeye salmon smolt, Ugashik River, 1958-2000 .....	68
35. Water temperatures at sockeye salmon smolt counting site, Ugashik River, 1983-2000 ...	69
36. Sockeye salmon spawning escapement, total number of smolt produced by age class, percent of total smolt production by age class, and number of smolt produced per spawner for 1979-1998 brood years, Ugashik River .....	70
37. Sockeye salmon spawning escapements, smolt production, adult returns, and smolt survival (number of adults produced per smolt) for 1979-1998 brood years, Ugashik River .....	71

## LIST OF TABLES (Continued)

<u>Table</u>	<u>Page</u>
38. Comparison of the age composition of outmigrating sockeye salmon smolt at Ugashik River with the freshwater age composition of their total adult returns by brood year, 1981-1993 .....	72

## LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Locations of major rivers and smolt sonar counting sites in the Bristol Bay Management Area .....	73
2. River bottom profile and sonar array placement at Kvichak River smolt sonar site, 2000 .....	74
3. River bottom profile and sonar array placement at Egegik River smolt sonar site, 2000 .....	75
4. River bottom profile and sonar array placement at Ugashik River smolt sonar site, 2000 .....	76
5. Range of smolt passage from the transducers summarized by hour, Kvichak River, May 20 to June 8, 2000 .....	77
6. Kvichak River smolt sonar disabled time because of weather by smolt day and hour, May 20 to June 13, 2000 .....	78
7. Kvichak River smolt sonar disabled time because of boat traffic by smolt day and hour, May 20 to June 13, 2000 .....	79
8. Range of smolt passage from the transducers summarized by hour, Egegik River, May 20 to June 7, 2000 .....	80
9. Egegik River smolt sonar disabled time because of weather by smolt day and hour, May 20 to June 10, 2000 .....	81
10. Ugashik River smolt sonar disabled time because of weather by smolt day and hour, May 19 to June 11, 2000 .....	82

**LIST OF FIGURES (Continued)**

<u>Figure</u>	<u>Page</u>
11. Ugashik River smolt sonar disabled time because of boat or float plane traffic by smolt day and hour, May 19 to June 11, 2000 .....	83
12. Comparison of the percent of the 2000 total adjusted sonar counts by smolt day at Kvichak River smolt sonar with the 1990-1999 mean .....	84
13. Comparison of the cumulative percent of the 2000 total adjusted sonar counts by smolt day at Kvichak River smolt sonar with the 1990-1999 mean .....	85
14. Comparison of the percent of the 2000 total adjusted sonar counts by hour at Kvichak River smolt sonar with the 1990-1999 mean.....	86
15. Comparison of the age composition of outmigrating sockeye salmon smolt at Kvichak River with the freshwater age composition of the total adult returns by brood year, 1984-1993.....	87
16. Comparison of the percent of the 2000 total adjusted sonar counts by smolt day at Egegik River smolt sonar with the 1990-1999 mean .....	88
17. Comparison of the cumulative percent of the 2000 total adjusted sonar counts by smolt day at Egegik River smolt sonar with the 1990-1999 mean .....	89
18. Comparison of the percent of the 2000 total adjusted sonar counts by hour at Egegik River smolt sonar with the 1990-1999 mean.....	90
19. Comparison of the age composition of outmigrating sockeye salmon smolt at Egegik River with the freshwater age composition of the total adult returns by brood year, 1984-1993 .....	91
20. Comparison of the percent of the 2000 total adjusted sonar counts by smolt day at Ugashik River smolt sonar with the 1990-1999 mean.....	92
21. Comparison of the cumulative percent of the 2000 total adjusted sonar counts by smolt day at Ugashik River smolt sonar with the 1990-1999 mean .....	93
22. Comparison of the percent of the 2000 total adjusted sonar counts by hour at Ugashik River smolt sonar with the 1990-1999 mean.....	94
23. Comparison of the age composition of outmigrating sockeye salmon smolt at Ugashik River with the freshwater age composition of the total adult returns by brood year, 1984-1993.....	95

## LIST OF APPENDICES

	<u>Page</u>
APPENDIX A: RIVER WIDTH AND DISTANCE BETWEEN ARRAYS AT SMOLT SONAR SITES	
A.1. River width and distance between arrays at Kvichak River smolt sonar site, 1989-2000.....	97
A.2. River width and distance between arrays at Egegik River smolt sonar site, 1989-2000 .....	98
A.3. River width and distance between arrays at Ugashik River smolt sonar site, 1988-2000 .....	99
APPENDIX B: WINTER ICE-COVER DATES FOR EAST-SIDE BRISTOL BAY LAKES	
B.1. Ice-cover dates for Lake Iliamna, 1970-2000 .....	101
B.2. Ice-cover dates for Becharof Lake, 1976-2000 .....	102
B.3. Ice-over dates for Upper and Lower Ugashik Lakes, 1977-2000 .....	103
APPENDIX C: FYKE NET CATCH AT SMOLT SONAR SITES	
C.1. Kvichak River smolt fyke net catch log, 2000 .....	105
C.2. Kvichak River fyke net catches by species and smolt day, May 21 to June 10, 2000.....	107
C.3. Kvichak River fyke net catches by species and hour, May 21 to June 10, 2000 .....	108
C.4. Kvichak River fyke net estimated catch and time fished by smolt day and hour, 2000.....	109
C.5. Egegik River smolt fyke net catch log, 2000.....	110
C.6. Egegik River fyke net catches by smolt day and species, May 21 to June 10, 2000.....	112
C.7. Egegik River fyke net catches by hour and species, May 21 to June 10, 2000 .....	113
C.8. Egegik River fyke net estimated catch and time fished by smolt day and hour, 2000 .....	114
C.9. Ugashik River smolt fyke net catch log, 2000.....	115

## LIST OF APPENDICES (Continued)

Page

### APPENDIX C: FYKE NET CATCHES AT SMOLT SONAR SITES (Continued)

C.10.	Ugashik River fyke net catches by smolt day and species, May 20 to June 11, 2000 .....	117
C.11.	Ugashik River fyke net catches by hour and species, May 20 to June 11, 2000 .....	118
C.12.	Ugashik River fyke net estimated catch and time fished by smolt day and hour, 2000 .....	119

### APPENDIX D: RIVER VELOCITIES AT SMOLT SONAR SITES

D.1.	Kvichak River water velocity at the center smolt sonar array, 1987-2000 .....	121
D.2.	Average water velocity at Kvichak River smolt sonar center array, May 15 to June 15, 1988-2000.....	122
D.3.	Egegik River water velocity at the center smolt sonar array, 1984-2000 .....	123
D.4.	Average water velocity at Egegik River smolt sonar center array, May 15 to June 15, 1984-2000.....	124
D.5.	Ugashik River water velocity at the inshore smolt sonar array, 1984-2000 .....	125
D.6.	Average water velocity at Ugashik River smolt sonar inshore array, May 15 to June 15, 1983-2000 .....	126

### APPENDIX E: SMOLT COUNTER APPLICATION DATA AND OBSERVATIONS..... 127

E.1.	List of *.dat files generated by the University of Washington, Applied Physics Laboratory, smolt counter digital storage application at Kvichak River smolt sonar, May 24 to June 14, 2000.....	131
E.2.	List of *.dat files generated by the University of Washington, Applied Physics Laboratory, smolt counter digital storage application at Ugashik River smolt sonar, May 20 to June 12, 2000.....	143

## LIST OF APPENDICES (Continued)

	<u>Page</u>
APPENDIX E: SMOLT COUNTER APPLICATION DATA AND OBSERVATIONS (Continued)	
E.3. January 3, 2001 correspondence from Ed Belcher, Applied Physics Laboratory, University of Washington to Suzanne Maxwell and Drew Crawford, Alaska Department of Fish and Game entitled: Analysis of Type A and Type B errors and update of Smolt Counter Interface Software .....	155
E.4. Sample Smolt Counter Application *.dat file printout.....	161
E.5. Summary of smolt school data for Kvichak 31-May-2000 0200.dat.....	162
E.6. Summary of smolt school data for Ugashik 31-May-2000 0200.dat .....	162
E.7. Maximum counts per second and their frequency in Kvichak 31-May-2000 0200.dat .....	163
E.8. Maximum counts per second and their frequency in Ugashik 31-May-2000 0200.dat .....	163
APPENDIX F: SMOLT ESTIMATE DATA BY OUTMIGRATION YEAR	
F.1. Total smolt outmigration estimates for Kvichak River by outmigration year, 1983-2000 .....	165
F.2. Age composition of smolt outmigration estimates for Kvichak River by outmigration year, 1983-2000.....	166
F.3. Total smolt outmigration estimates for Egegik River by outmigration year, 1983-2000.....	167
F.4. Age composition of smolt outmigration estimates for Egegik River by outmigration year, 1983-2000.....	168
F.5. Total smolt outmigration estimates for Ugashik River by outmigration year, 1983-2000 .....	169
F.6. Age composition of smolt outmigration estimates for Ugashik River by outmigration year, 1983-2000.....	170

**LIST OF APPENDICES (Continued)**

	<u>Page</u>	
APPENDIX G: MEAN WATER TEMPERATURES AT SMOLT SONAR SITES		
G.1. Comparison of Kvichak River mean water temperatures at the start of the smolt sonar project and at the time of peak smolt passage, 1984-2000.....	171	
G.2. Comparison of Egegik River mean water temperatures at the start of the smolt sonar project and at the time of peak smolt passage, 1984-2000.....	172	
G.3. Comparison of Ugashik River mean water temperatures at the start of the smolt sonar project and at the time of peak smolt passage, 1984-2000.....	173	
APPENDIX H: CLIMATOLOGICAL FACTORS THAT MAY HAVE AFFECTED THE FRESHWATER SURVIVAL OF 2000 SMOLT .....		175
H.1. Average monthly air temperature for King Salmon, July 1970 to June 2000 .....	178	
H.2. Comparison of monthly air temperature to the 30-year mean at King Salmon, July 1997 to June 2000 .....	179	
H.3. Daily air temperatures (normal, mean, and extreme) for King Salmon, October 1997 to April 1998 .....	180	
H.4. Daily air temperatures (normal, mean, and extreme) for King Salmon, October 1998 to April 1999 .....	181	
H.5. Daily air temperatures (normal, mean, and extreme) for King Salmon, October 1999 to April 2000 .....	182	
H.6. Average monthly precipitation for King Salmon, July 1970 to June 2000 .....	183	
H.7. Comparison of monthly precipitation to the 30-year mean at King Salmon, July 1997 to June 2000 .....	184	
H.8. Average monthly snowfall for King Salmon, July 1970 to June 2000.....	185	
H.9. Comparison of monthly snowfall to the 30-year mean at King Salmon, July 1997 to June 2000.....	186	



## ABSTRACT

Numbers of sockeye salmon *Oncorhynchus nerka* smolt emigrating to sea from three rivers in Bristol Bay, Alaska, were estimated from sonar counts and age-weight-length samples from mid-May to mid-June in 2000. Hydroacoustic equipment was used to estimate total smolt biomass, and age-weight-length samples were used to convert biomass estimates into numbers of smolt by age group. Estimated numbers of smolt emigrating were 130,038,649 from Kvichak River, 32,465,479 from Egegik River, and 10,880,559 from Ugashik River. Age-1. smolt, the progeny of 1998 spawners, predominated at Kvichak River (82%). Age-2. smolt, the progeny of 1997 spawners, predominated at Egegik River (96%) and Ugashik River (82%). The 2000 field season was the first year of a three-year Western Alaska Disaster Grant (WADG) study (\$450 K) to evaluate the smolt sonar project on the Kvichak River.

**KEYWORDS:** smolt, sockeye salmon, *Oncorhynchus nerka*, Bristol Bay, Kvichak River, Egegik River, Ugashik River, sonar, smolt emigration estimate, outmigration timing, age-length-weight relationship

## INTRODUCTION

The Bristol Bay Management Area includes all waters east of a line from Cape Newenham to Cape Menshikof (Figure 1) and supports the largest sockeye salmon *Oncorhynchus nerka* fishery in the world. From 1980 to 1999 the commercial catch in Bristol Bay averaged 25.7 million sockeye salmon (ADF&G 2000). To effectively manage this fishery, managers need accurate abundance forecasts of returning sockeye salmon and precise estimates of optimum spawning escapement goals. Estimates of outmigrating smolt numbers are currently used as an index of production for adult salmon; this information is used to prepare preseason forecasts of adult returns and aids in setting goals for optimum numbers of spawners.

This report summarizes upward-looking smolt sonar studies conducted on the Kvichak, Egegik, and Ugashik Rivers in 2000. The objectives of these studies were to: (1) estimate numbers of outmigrating sockeye salmon smolt; (2) describe smolt migration patterns; (3) collect smolt age, weight, and length data; and (4) record climatological and hydrological parameters which might affect migratory behavior.

### *Background*

Fyke nets were used to estimate smolt numbers on Kvichak River from 1956 to 1970; on Naknek River from 1956 to 1978; on Egegik River during 1957, 1969, and 1978; on Ugashik River from 1955 to 1965, 1967 to 1970, and 1972 to 1975; and on Wood River from 1955 to 1966 (Burgner and Koo 1954; Rietze and Spangler 1958; Kerns 1961; Burgner 1962; Jaenicke 1963, 1968; Church 1963; Church and Nelson 1963; Nelson 1964, 1965a, 1965b, 1966a, 1966b, 1969; Marriott 1965; Nelson and Jaenicke 1965; Pennoyer and Seibel 1965; Pennoyer 1966; Pennoyer and Stewart 1967, 1969; Robertson 1967; Siedelman 1967, 1969; Paulus and McCurdy 1969, 1972; Van Valin 1969a, 1969b; Shroeder 1972a, 1972b, 1974a; McCurdy and Paulus 1972a, 1972b; Paulus 1972; McCurdy 1974a, 1974b; Bill 1975, 1976, 1977; Pella and Jaenicke 1978; Yuen 1978). Although fyke net sampling provided information on age, size, and relative abundance of smolt, it did not provide an accurate estimate of the total number of smolts. To improve estimates of smolt numbers, the department began experimenting with and using hydroacoustic (sonar) equipment in the 1970's.

Hydroacoustic equipment was used to estimate sockeye salmon smolt numbers on Kvichak River from 1971 through 2000; Wood River from 1975 to 1990; Naknek River from 1982 to 1986 and 1993 to 1994; Egegik River from 1982 through 2000; Ugashik River from 1983 to 1991 and 1993 to 2000; Nuyakuk River from 1983 to 1989; and Togiak River in 1988 (Russell 1972; Parker 1974a, 1974b; Krasnowski 1975; Randall 1976, 1977, 1978; Newcome 1978; Yuen 1980a, 1980b; Clark and Robertson 1980; Bucher 1980, 1981, 1982, 1983, 1984, 1986a, 1986b, 1987; Bergstrom and Yuen 1981; Yuen and Wise 1982; Eggers 1984; Eggers and Yuen 1984; Bue 1986a, 1986b; Bue and Fried 1987; Bue et al. 1988; Cross et al. 1990; Woolington et al. 1990, 1991; Crawford et

al. 1992; Crawford and Cross 1992, 1994a, 1994b, 1995a, 1995b, 1996, 1997, 1998, 1999; Crawford 2000).

Hydroacoustic equipment developed by Bendix Corporation<sup>2</sup> was tested on Kvichak River in 1969 (McCurdy and Paulus 1972b; Paulus and Parker 1974). Further testing and modification of this prototype resulted in the construction of smolt counters for use on Wood (Krasnowski 1976, 1977) and Kvichak Rivers (Randall 1977) in 1975 and 1976. Hydroacoustic equipment for counting smolt was tested on Ugashik River from 1973 to 1975 (Schroeder 1974b, 1975; Sanders 1976). Smolt studies on Naknek, Egegik, Ugashik, and Nuyakuk Rivers were limited to occasional fyke net sampling to obtain age and size data from 1975 to 1982 (Huttunen 1980; Eggers 1984; Minard 1984). An experimental two-array sonar system similar to the one used on Kvichak River was tested on Egegik River during 1981 (Bue 1982). Smolt enumeration projects using modified Bendix counters began on Naknek and Egegik Rivers in 1982 (Huttunen 1984; Bue 1984) and on Ugashik and Nuyakuk Rivers in 1983 (Fried et al. 1987; Minard and Frederickson 1987).

In 1985 and 1986, a Lowrance<sup>2</sup>, Model X-16 sonar with a 192 kHz frequency transmitter and a horizontally-mounted 8° transducer were used to determine the lateral distribution of smolt passing each of the respective sonar sites. Bue et al. (1988) reported that most smolt passing the Kvichak River sonar site stayed within a 68-m corridor that began 6.4 m from the left bank<sup>3</sup> (total river width = 100 m). Smolt passing the Egegik River sonar primarily used a 73-m corridor beginning 12.2 m from the left bank (total river width = 104 m). Ugashik River smolt used a 21-m corridor, which began 7.0 m from the left bank (total river width = 43 m). This Lowrance sonar unit was not an effective tool for collecting lateral smolt distribution data on Wood River (Cross et al. 1990; Woolington et al. 1990, 1991).

The monitoring of smolt migrations was discontinued on Naknek River in 1986 (Bue et al. 1988), on Togiak River in 1988 (Woolington et al. 1990), on Nuyakuk River in 1989 (Woolington et al. 1991), and on Wood River in 1990 (Crawford et al. 1992).

In 1990 a single narrow-beam, side-looking BioSonics<sup>2</sup> sonar unit was used from May 29 to 31 to determine the lateral limits of smolt distribution at the Kvichak River sonar site (Huttunen and Skvorc 1991); most smolt migrated between 40 and 100 m offshore from the right bank. The total river width at the site was 136 m.

The results of the 1990 study were encouraging, so in 1991 it was expanded to evaluate the feasibility of using side-looking sonar to enumerate outmigrating Kvichak River sockeye salmon smolt. Huttunen and Skvorc (1992) estimated, based on 81 h of horizontal-aspect echo-integration data collected June 2-14, that 44,972,864 smolt passed through the sonar site during the counting period. This compared well to an upward-looking Bendix<sup>2</sup> sonar estimate of 43,525,980 smolt for

---

<sup>2</sup> Use of a company's name does not constitute endorsement.

<sup>3</sup> In this report the location of projects and the placement of equipment are referenced to the right and left bank of the respective river as determined by facing downstream at the study site.

the same hours of operation. The maximum single-beam listening range for the side-looking sonar varied from 118 m to 120 m, ensonifying 88%-90% of the total 134-m river cross section. In comparison, the three array upward-looking sonar ensonifies about 7.5% of the river. The spatial distributions of smolt on a nightly basis were highly dynamic; side-looking estimates peaked at ranges from 64 m on June 12 to 118 m on June 7. Whereas the distribution of upward-looking estimates also varied between nights, the largest estimates were typically from the inshore array at 56 m from the right bank. No side-looking sonar smolt studies have been conducted since 1991.

The last year the Alaska Department of Fish and Game (ADF&G) funded the entire Ugashik smolt project was 1991; in 1992 the smolt migration on Ugashik River was not monitored (Crawford and Cross 1992). The Ugashik River smolt study was resumed to measure the freshwater production, the size and age structure of smolt from recent sockeye salmon spawning escapements, and to continue use of smolt data for preparing preseason forecasts of adult salmon returns. Cooperative agreements between ADF&G and other local private and public agencies have funded the Ugashik smolt project from 1993-2000 (e.g., City of Pilot Point and ADF&G in 1993; Lake and Peninsula Borough, and ADF&G in 1994; City of Pilot Point, Lake and Peninsula Borough, and ADF&G in 1995; Lake and Peninsula Borough, and ADF&G in 1996; City of Pilot Point, Lake and Peninsula Borough, and ADF&G in 1997 and 1998; Lake and Peninsula Borough, and ADF&G in 1999; and Bristol Bay Science and Research Institute, Lake and Peninsula Borough, and ADF&G in 2000).

In 1993, approval of a cooperative agreement between the National Park Service and ADF&G allowed for continued enumeration of sockeye salmon smolt with hydroacoustic equipment on Naknek River in 1993 and 1994. The primary reason for resuming the Naknek River smolt study was to measure freshwater production from the record sockeye salmon escapement (3.6 million fish) that entered the Naknek River drainage to spawn during the 1991 commercial fishermen strike. This study was concluded in 1994 and was summarized in Crawford and Cross (1995b).

In 1997 and 1998, returns of adult sockeye salmon to Bristol Bay were well below forecast. For the Kvichak River, the low returns of adult salmon followed three consecutive years of record high smolt abundance estimates (greater than 300 million smolt per year). Consequently a new study was initiated in the fall of 1999 with Western Alaska Disaster Grant (WADG) monies to evaluate the existing acoustic equipment and sampling design used to estimate smolt abundance on the Kvichak River and to investigate new equipment and techniques to see if it is possible to improve annual smolt outmigration estimates.

In order to provide a quick inseason comparison of Bendix smolt counter data with sonar counts from other hydroacoustic systems, ADF&G contracted the Applied Physics Laboratory at the University of Washington during the winter of 2000/2001 to design and insert a computer interface into each of three smolt counters and write software to accept and store smolt count data on a computer. This new data collection system was tested and used at Kvichak River and Ugashik River smolt sonar sites in 2000. The new computer interface and software was not used at Egegik River because of electronic problems with their smolt sonar counter.

The 2000 field season was the first year of a three-year WADG study (\$450 K) to evaluate the smolt sonar project on the Kvichak River. The objectives of this study are: (1) Clearly document

the current acoustic methodology (Bendix counter) for estimating abundance of outmigrating sockeye salmon smolt in the Kvichak River. Identify the potential sources of bias and imprecision in the current estimation method, and mechanisms by which the Bendix system may have failed in any or all of the previous 30 years. (2) Study and describe smolt behavior (e.g., fish speed, school density, and school structure) in the vicinity of the current site and evaluate the assumptions about smolt behavior that must be made to derive acoustic estimates of smolt abundance. (3) Based on (1) and (2) above, determine if the historical smolt abundance estimates are valid and, if not, whether they can be corrected. If the historical estimates can be corrected, develop the means to do so. (4) Compare sockeye salmon smolt abundance estimates among a Bendix array, a Hydroacoustic Technologies, Inc. (HTI) upward-looking multiple transducer array, and a HTI side-looking split beam transducer and recommend the best system to estimate smolt abundance on the Kvichak River. (5) Design an acoustic system that improves upon weaknesses identified in the Bendix smolt counter and deploy this complete system in May 2001. Run the new and old systems side-by-side for two complete seasons and thoroughly compare the results derived from each. Results and findings from this study will be published for the ADF&G in a separate report by hydroacoustic consultant, Don Degan of Aquacoustics, Inc.

## METHODS

For step-by-step procedures on the installation, operation, maintenance, troubleshooting, and retrieval of smolt sonar and sampling equipment; plus detailed instructions on data collection, recording, and reporting techniques see Crawford and Tilly (1995).

### *Hydroacoustic Equipment*

Bendix Corporation constructed all hydroacoustic systems used to estimate smolt numbers in Bristol Bay river systems in 2000; all projects used 1982 or 1983 model smolt counters. Transducers used to transmit and receive sound pulses at each sonar site were housed in 3.0-m long arrays set on the river bottom and connected by coaxial cable to a control unit located on shore. Three arrays were used at each sonar site except Ugashik River, where two arrays were used because of a narrow channel width. Each array had 10 upward-facing single-element International Transducer Corporation<sup>2</sup>, Model 5095 transducers that operate at a frequency of 235 kHz and a half-power beam angle of 9°. Belcher (2000a) reported that the smolt counter performs an analog version of echo integration which integrates the mean-square echo voltage over a range of interest which is proportional to fish biomass. Detected echoes from each transducer were accumulated in the smolt counter and a printer produced a hard copy of totaled counts by array at prescribed intervals, which were summed and recorded hourly on a field data collection form. A single 12-volt battery recharged by a pair of 43 watt, 2.9 amp solar panels, powered each smolt counting system.

In addition to collecting smolt counts at prescribed intervals on printer tapes, the smolt projects at Kvichak and Ugashik River also had a computer interface on their smolt counters and software to accept and store smolt counts on a computer. The computer interface records counted (e.g., [actual Bendix sonar count] \* [5 smolt/count]) at one-second intervals. Sonar counts from each array are kept separate. Belcher (2000b) outlines the details of this new data collection system.

Hydroacoustic equipment to monitor smolt outmigrations was operated on Kvichak, Egegik, and Ugashik Rivers from mid-May to mid-June. The smolt outmigrations in Kvichak, Egegik, and Ugashik Rivers generally peak during late May or early June and drop off by mid-June. All arrays at each project site were removed from the water at the end of the field season.

All smolt hydroacoustic systems used in 2000 were calibrated with a smolt simulator by Hydroacoustic Consultant, Al Menin, to record one count whenever 41.5 g of biomass passed through each transducer beam during a given period. Because most smolt migrate within the upper portion of the water column, individual arrays were calibrated independently, which allowed the operator to set the counting range as near the surface as possible. The pulse width of the smolt counter is 0.136 mS, which theoretically allows the counting range to be set within 10 cm of the surface (1/2 pulse width). The counting range was set 1-2 cm below this theoretical limit to avoid common surface disturbances caused by debris, light wind, and rain. The counting range was reduced further or the system was disabled if disturbances penetrated deeper.

Sources of false counts (e.g., boats, wind, rain, snow, debris) were noted and the hydroacoustic equipment was disabled whenever false-count conditions were detected. Known false counts were subtracted from hourly totals, and linear interpolations were used to estimate counts missed while equipment was disabled. The control unit automatically recorded and stored the length of time the system was disabled. Manual control was available for adjusting printing intervals for accumulated counts, transducer pulse rate, and the portion of the water column monitored. Transducer signal characteristics were visually monitored with an oscilloscope.

Site location and equipment changes that have been made over the years to improve our ability to enumerate annual sockeye salmon smolt outmigrations using sonar are summarized in Crawford and Cross (1996, 1997, 1998).

### ***Project Locations***

The Kvichak River counting site was located 6 km below the outlet of Lake Iliamna (Figure 1); it was moved to this location in 1989, approximately 1 km downstream from the site used during the previous 15 years (Woolington et al. 1991). The Kvichak River was approximately 133 m wide at this site. Three transducer arrays referred to as *inshore*, *center*, and *offshore*, were anchored 50 m, 70 m, and 84 m from the right bank (Figure 2).

The Egegik River counting site was located 4 km below the outlet of Becharof Lake (Figure 1); it has been operated at this location since 1982 (Eggers and Yuen 1984). Egegik River was 108 m

wide at this site. The inshore, center and offshore arrays were anchored 40 m, 55 m, and 67 m from the left bank (Figure 3).

The Ugashik River counting site was located 50 m below the outlet of Lower Ugashik Lake (Figure 1). Because this river-section is only 45 m wide, only two arrays have been used. The inshore and offshore arrays were anchored 27 m and 34 m from the right bank (Figure 4).

Appendices A.1 to A.3 summarize river widths and locations of arrays at each river from 1989-2000.

### *Estimation of Smolt Numbers*

The process of generating smolt numbers was divided into three steps: (1) estimating total fish biomass emigrating past the study site; (2) sampling the emigrating fish population to estimate species, age, weight, and length composition; and (3) converting fish biomass into numbers of smolt by age and species.

#### **Biomass Estimation**

Fish biomass was estimated using hydroacoustic equipment operated 24 h/d. The signal pulse rate or ping rate of the smolt counter was set to correspond with the river velocity.

Belcher (2000a) reported the ping rate ( $pr$ ) for the Bendix smolt sonar system was calculated as—

$$pr = \frac{(v + 0.34)}{(0.47 * h/3)} \text{ pings/s}$$

where

$v$  = river velocity, and

$h$  = height of the cross beam measurement (m).

The river velocity measured at a location referred to as the *velocity index*. The velocity index at Kvichak River was measured at the center array and the velocity index at Ugashik River was measured at the inshore array. At Egegik River, a buoyed flow meter anchored downriver of the center array was used as the velocity index.

***Estimation of River Velocities and Adjustments to Sonar Counts***. River velocities at the Kvichak and Ugashik River sites were nearly constant; thus velocities were measured once a week with a Gurley<sup>2</sup>, Model 622, flow meter and the counter was adjusted accordingly.

River velocities at the Egegik River site were influenced by tides, therefore river velocities were measured continuously by a Gurley, Model 625, flow meter anchored directly downstream of the velocity index array, and smolt counts were adjusted every 15-30 min to account for changes in river velocity. To account for differences in river velocities between the velocity index and the arrays ( $i$ ), readings were taken over each array at specified intervals (e.g., hourly at Egegik and every 7-10 days at Kvichak and Ugashik) and velocity correction factors ( $vcf_i$ ) were then calculated as:

$$vcf_i = \frac{v_i}{v_{index}},$$

where

$v_i$  = velocity over array  $i$ , and  
 $v_{index}$  = velocity over the velocity index array.

Adjustments to daily counts ( $ac_{i,z}$ ) were then made for differences in river velocity:

$$ac_{i,z} = c_{i,z}(vcf_i),$$

where  $c_{i,z}$  = counts for array  $i$  on day  $z$ .

Ideally, all sonar arrays monitored fish biomass 24 h/d, so daily counts for each array represented actual sonar counts. If an array was not monitored during an hour, counts were linearly interpolated using estimated counts from several hours before and after the missing count.

**Expansion of Biomass Estimates.** The width of river section ( $l_{i,z}$ ) monitored by array  $i$  on day  $z$  depended on array length (3.03 m), water depth over the array, and transducer signal beam width, calculated as:

$$l_{i,z} = 3.03 + 2 \left( d_{i,z} \tan \frac{bw}{2} \right),$$

where

$d_{i,z}$  = average water depth over array  $i$  on day  $z$ , and  
 $bw$  = transducer beam width in degrees ( $9^\circ$  for all transducers).

Arrays were placed perpendicular to the river current; distances from each array to a reference point on one riverbank were measured to the nearest foot (Appendix A.1, A.2, and A.3). The inshore and offshore limits of smolt passage were estimated based on past studies with side-looking hydroacoustic equipment (Bue et al. 1988; Huttunen and Skvorc 1991, 1992). However, because of changing water levels and river velocities at Kvichak River in 1998, the crew noticed schools of smolt further from the inshore bank. Since then, the inshore limit dead zone (e.g., the shallow or slack water area of the river that extends outward from the right river bank where little or no smolt passage was recorded or observed) was extended from 30' to 60' (Appendix A.1). Distances were calculated between inshore limit of smolt passage to first array ( $D_1$ ); first to second array ( $D_2$ ); second to third array ( $D_3$ ) at sites where three arrays were used; and offshore array to offshore limit of smolt passage ( $D_4$ ).

The estimated biomass of fish ( $\hat{B}_z$ ) passing the counting site on day  $z$  was calculated as follows:

$$\hat{B}_z = \frac{1}{2} D_1 \left( \frac{ac_{1,z}}{l_{1,z}} \right) + \sum_{i=2}^{na} \left[ \frac{1}{2} D_i \left( \frac{ac_{i-1,z}}{l_{i-1,z}} + \frac{ac_{i,z}}{l_{i,z}} \right) \right] + \frac{1}{2} D_{na+1} \left( \frac{ac_{na,z}}{l_{na,z}} \right),$$

where

- $D_i$  = the distance for interval  $i$ , and  
 $na$  = number of transducer arrays used.

### Age, Weight, and Length Estimation

Data on age, weight, and length of sockeye salmon smolt were obtained from samples captured in a fyke net. Smolt weight in grams and length, from tip-of-snout to fork-of-tail, in millimeters were measured; age was determined from visual observations of scales mounted on glass slides. European ages -- 1., 2., or 3. depending on the number of freshwater annuli -- were used. Parent year escapements that produced 2000 smolt occurred in 1998 for age-1. smolt, 1997 for age-2. smolt, and 1996 for age-3. smolt.

Sample size goals for Kvichak, Egegik, and Ugashik Rivers were set at a minimum of 400 smolt/d. Based on binomial proportions for the two major age groups, a sample size of 400 smolt would simultaneously estimate the percentage of each age class within 5% of the true percentage 95% of the time (Goodman 1965; Cochran 1977). When the daily goal of 400 smolt was not obtained, samples from subsequent days were combined until a total of at least 400 were reached.

Mean length of smolt differs among fyke net samples from a single day (Minard and Brandt 1986). Thus, to ensure that daily age composition estimates were representative of the population, attempts were made daily to obtain 100 smolt from each of six different fyke net catches. Because weight and age of smolt are strongly correlated to length, the time and cost of data collection was reduced

by measuring up to a maximum of 600 smolt each day for length and up to 100 of those smolt for age and weight (Bue and Eggers 1989).

Age was estimated for smolt measured only for length using an age-length key (Bue and Eggers 1989). The key used length to categorize age-1. or -2. sockeye salmon smolt by determining a discriminant length that minimized classification error. This discriminant length was chosen such that the number of age-1. smolt classified as age-2. smolt was equal to the number of age-2. smolt classified as age-1. smolt. Age-3 smolt were not included in this analysis because too few samples were collected.

Weight was estimated for smolt measured only for length using a least squares linear regression. Based on paired weight-length data obtained from smolt sampled for age, weight, and length, we estimated weights ( $W_j$ ) of age  $j$  smolt measured only for length as explained by (Ricker 1975):

$$W_j = \alpha L_j^\beta ,$$

where

$L_j$  = fork length of an age  $j$  smolt, and  
 $\alpha$  and  $\beta$  = parameters which determine the y-axis intercept and the slope of the line.

Due to the variability of age and size composition estimates among subsamples (e.g., fyke net catches) taken the same day, daily mean weight ( $\hat{W}$ ) and age proportions ( $\hat{P}_j$ ) were estimated as the mean of subsampled values:

$$\hat{W} = \frac{\sum_{k=1}^m \left( \frac{\sum w_k}{n_k} \right)}{m} ,$$

where

$m$  = number of subsamples collected during a sampling period,  
 $w_k$  = observed weights from subsample  $k$ , and  
 $n_k$  = number of observations in subsample  $k$ ; and

$$\hat{P}_j = \frac{\sum_{k=1}^m \left( \frac{n_{j,k}}{n_k} \right)}{m} ,$$

where  $n_{j,k}$  = number of observations of age  $j$  in subsample  $k$ .

## Estimation of Smolt Numbers

Numbers of smolt by age were estimated by combining biomass estimates with estimates of age and weight composition. Mean weight of smolt was used to convert estimates of biomass per count to estimates of smolt per count ( $\hat{SPC}$ ):

$$\hat{SPC} = \frac{BPC}{\hat{W}} ,$$

where  $BPC$  = biomass (g) per count.

The estimated number of smolt passing the counting site ( $\hat{N}_z$ ) each day ( $z$ ) was computed:

$$\hat{N}_z = \hat{B}_z (\hat{SPC}) .$$

The estimated contribution of age  $j$  smolt on day  $z$  ( $\hat{N}_{j,z}$ ) was estimated by:

$$\hat{N}_{j,z} = \hat{N}_z (\hat{P}_j).$$

Finally, daily estimates of smolt numbers were summed. The seasonal total of all smolt passing the sonar site ( $\hat{N}_{tot}$ ) was

$$\hat{N}_{tot} = \sum \hat{N}_z ,$$

and the estimated number of age  $j$  smolt that passed the site during the season ( $\hat{N}_{j,tot}$ ) was

$$\hat{N}_{j,tot} = \sum \hat{N}_{j,z} .$$

### *Smolt Fin Clips for DNA Analysis*

In 1999 and 2000, the Kvichak River smolt crew collected sockeye salmon smolt fin clip samples for a DNA analysis that will be conducted by the ADF&G genetics laboratory in Anchorage. Genetics lab personnel will summarize results from these analyses in a separate report.

The sampling goal for this genetics study was to obtain at least one fin clip from each smolt that was sampled for age-weight-length (AWL) data. For sockeye salmon smolt that were in good condition and able to be released alive, one pelvic fin was collected with a sharp pair of dissecting scissors. For dead smolt, the entire caudal fin was collected plus some muscle tissue at the base. Between samples, the scissors were wiped off with a paper towel to prevent contamination of subsequent samples.

All smolt fin clip samples were collected, preserved, and shipped according to procedures outlined by the ADF&G genetics lab (Sheri Wilson, ADF&G Genetics, personal communication).

### *Vertical Distribution of Smolt Passage*

Monitoring of vertical distribution of passing smolt schools was conducted with an oscilloscope during the 2 weeks of peak smolt passage. Vertical distribution of smolt was monitored for approximately 1 h during each 8-h shift. Observers recorded the top and bottom depth (in centimeters) of passing smolt schools and spread their hour of monitoring throughout their shift and among all arrays. Arrays that received the highest counts were monitored most often.

### *Climatological Data Collection*

Climatological data were recorded at each smolt sonar site. Observations of sky conditions and measurements of wind direction, wind velocity (km/h), daily precipitation (mm), air and water temperatures (°C) were recorded at 0800 and 2000 hours daily. Wind direction, wind velocity, and air temperature data were measured with a West Marine<sup>2</sup>, Model 332356, weather monitor. Precipitation data was collected with a direct-read rain gauge graduated from 0.1 mm to 15.0 mm. Water temperatures were collected with a mercury pocket thermometer graduated in 1° increments from -10°C to +110°C.

## **RESULTS**

### *Kvichak River*

On May 1, Iliamna Air Taxi reported that the ice on Lake Iliamna was rotten everywhere. There was open water in the upper end (e.g., Pedro Bay down to Porcupine Island) and open leads through the lake.

By May 3, the northern half of Lake Iliamna was completely open. Large rafts of very rotten ice remained in the southern half of the lake and were blown back-and-forth by the wind. Pieces that drifted past Igiugig at the outlet, broke up as they floated down the Kvichak River.

There was open water on most of Lake Iliamna by May 6<sup>th</sup>. There were still several large rafts of ice in the southern half of the lake between Kokhanak and Igiugig at this time, however what remained was expected to breakup or melt in place. This breakup date is 7 days earlier than the 1970-1999 average breakup date for Lake Iliamna (Appendix B.1).

ADF&G's Kvichak smolt personnel arrived in Igiugig on the afternoon of May 16; there was no ice in Lake Iliamna or Kvichak River.

Since Lake Iliamna and Kvichak River were both ice-free during the 2000 smolt season, we were able to set and fish our fyke net daily. The first fyke net set at 1845 hours on May 21 caught 240 sockeye salmon smolt in 15 min (Appendix C.1). Eighty-three percent of these smolt were age-1. See Appendices C.2 to C.4 for a complete summary of the 2000 Kvichak River fyke net catch by date, species, hour, and time fished. In addition to sockeye salmon smolt, other species captured in the fyke net were: three-spine stickleback *Gasterosteus aculeatus*, nine-spine stickleback *Pungitius pungitius*, chinook salmon smolt *Oncorhynchus tshawytscha*, pink salmon fry *Oncorhynchus gorbuscha*, lamprey (*sp.*), sculpin *Cottus sp.*, rainbow trout juveniles *Oncorhynchus mykiss* and smelt (*sp.*).

The Kvichak smolt counter (S/N 8230001) was activated at 1200 hours on May 20. The smolt passage rate during the first 48 h of sonar operation was high. Hourly passage rates ranged from 6 to 751 thousand smolt per hour and averaged 116 thousand smolt per hour.

River velocity measurements over the center index array, which was used to adjust the sonar counter firing rate, ranged from 1.1 to 1.3 m/s (3.5 to 4.4 ft/sec). The average river velocity in 2000 was 1.2 m/s (.8 ft/sec), slightly less than the recent 12-year average at the Kvichak River sonar site (Appendices D.1 and D.2). Velocity correction factors (m/s) used for the three arrays were as follows:

Smolt Days	Inshore	Center	Offshore
May 19 – May 25	0.95	1.00	1.03
May 26 - June 03	0.98	1.00	0.96
June 04 - June 13	0.98	1.00	0.96
June 14	0.97	1.00	1.02

A total of 2,982,842 sonar counts were recorded at the Kvichak River counting site from May 20 to June 13, 2000 (Table 1). This year the sonar counts were highest over the offshore sonar array (40%) followed by the center (37%) and inshore sonar arrays (23%). Daily sonar counts were highest from May 20-23 and May 27 to June 1. The peak daily sonar count of 630,772 occurred on May 21. Over the course of the entire sampling season, 27% of the total sonar counts were

obtained between 0100 hours and 0400 hours (Table 2); the peak hourly passage rate of 117,370 sonar counts per hour occurred at 1200 hours on May 21.

We also collected six 3.5" double sided high density diskettes which contained 450 \*.dat files with 6.7 Mbytes of University of Washington, Applied Physics Lab (UW/APL) smolt counter application data (Appendix E.1). Post-season processing of select \*.dat files turned up several software problems, consequently, this data set was not used to generate a smolt outmigration estimate in 2000. For more information about smolt counter application data and observations, see Appendix E.

Based on expanded sonar counts an estimated 130,038,649 sockeye salmon smolt migrated from Kvichak River in 2000 (Table 3). Age-1. smolt (1998 brood year) comprised 82% of the total smolt estimate and they were the predominant age class from May 20 to June 13. Age-2. smolt (1997 brood year) were most numerous from May 20-31 but they never comprised more than 29% of the total daily smolt estimate. The highest daily smolt counts occurred on May 21 and May 30. The smolt per count estimates based on mean smolt weights ranged from 6.0 to 7.2 with an average of 6.5 smolt per count (Table 4).

Age, weight, and length data were collected from 1,964 sockeye salmon smolt in 2000 (Table 5). All smolt sampled were age 1. or 2. Mean length was 86 mm for age-1. smolt and 103 mm for age-2. smolt. Mean weight was 5.8 g for age-1. smolt and 9.5 g for age-2. smolt. An additional 7,002 smolt were measured for length only (Table 6). The discriminating length calculated to differentiate age-1. from age-2. smolt was 95 mm.

Fin clip samples were collected from 1,997 sockeye salmon smolt at the Kvichak River smolt sonar site in 2000 for DNA analysis that will be preformed and reported by the ADF&G genetics laboratory in Anchorage.

Seventy-one range-of-passage measurements were recorded for smolt schools passing over Kvichak River sonar arrays between May 20 and June 8 (Table 7). Schools passed at an average range of 187 cm to 238 cm above the transducers. Average counting range above the transducers was 259 cm to 273 cm during the peak smolt passage. The difference in the range of smolt passage by hour over each sonar array is shown in Figure 5.

River and weather conditions were recorded at the counting site from May 20 to June 14 (Table 8). The river and weather conditions were excellent for counting smolt in 2000. There was no disabled time from lake ice in the river and few storms. The smolt counter was disabled for 21.1 h (4%) of the 600 h it operated in 2000 because of weather (Figure 6). Strong E and NE winds, wave action, and rainsqualls were the primary causes. The only smolt days with 3-or-more hours of disabled time because of weather were 6/07 (3 h), 6/11 (10 h), and 6/12 (13h). Mean water temperature during the project was 7.4°C (range 2.5°C to 9.5°C). Mean daily water temperatures during the peak of the smolt migration ranged from 6.0°C to 7.0°C.

In 2000, boat traffice caused the Kvichak River smolt sonar to be disabled for an additional 15.1 h (Figure 7). Average disabled time from boat traffice prior to the opening of the rainbow trout sport

fishing season at 0001 hours on June 8<sup>th</sup> was 0.4 h/d, but after the sport fish opening, it increased to 1.0 h/d. Most boat traffic occurred from 1100 to 2100 hours with peak passages at 1300, 1700, and 2100 hours. An additional 6.4 h of disabled time was attributed to WADG Kvichak Smolt Sonar Evaluation Study activities.

### *Egegik River*

A local pilot reported that 75% of Becharof Lake was open on April 7 and it was completely ice-free on April 12 (L. Seibert, PenAir pilot, personal communication). This was 11 d earlier than the 1975-1999 average reported break-up date for Becharof Lake of April 23 (Appendix B.2).

The first Egegik River smolt crewmembers flew to the study site on the evening of May 17. There was no ice in the lake or the river when the crew arrived. No observations of smolt or birds feeding on smolt were reported prior to the activation of the smolt counter. The crew set up the Egegik smolt counter (S/N 8240002) late in the morning on May 20, however it malfunctioned and the backup smolt counter (S/N 832003) was flown out that afternoon as a replacement. Efforts to diagnose and repair the Egegik smolt counter inseason were unsuccessful. Therefore, the backup smolt counter was used for the entire 2000 field season.

The backup smolt sonar counter was activated at Egegik River at 0001 hours on May 21. Sonar counts during the first several hours of sonar operations were as high as 206,000 counts per hour on the offshore array; thereafter, the first daily sonar count greater than 100,000 did not occur again until smolt day 5/29 (Table 9).

A fyke net installed and fished several hours nightly from May 21-22 caught only 17 sockeye salmon smolt (Appendix C.5). From May 23 on, the fyke netting routinely caught more than 100 smolt per set. For a complete summary of the 2000 Egegik River fyke net catch by date, species, hour, and time fished see Appendices C.5 to C.8. In addition to sockeye salmon smolt, the following other species were also captured in the fyke net: threespine stickleback, juvenile chinook salmon, juvenile coho salmon *Oncorhynchus kisutch*, and pink salmon fry.

River velocities at the counting site ranged from 0.4 to 0.7 m/s (1.4 to 2.3 ft/sec). The river velocities at the center array were slightly less than the 1984-1999 average of 2.1 ft/sec (Appendices D.3 and D.4). In 2000, the smolt counter ping rate was set according to the water velocities at an index buoy set downstream from the center array. Velocity correction factors (m/s) used for three arrays were:

Smolt Days	Index Buoy	Inshore	Center	Offshore
May 20 - May 27	1.00	0.67	0.97	1.07
May 28 - Jun 04	1.00	0.71	0.99	1.01
Jun 05 - Jun 10	1.00	0.73	1.00	1.06

A total of 2,627,421 sonar counts were recorded at the Egegik River counting site from May 20 to June 10, 2000 (Table 9). Sonar counts were most numerous over the center array (66%) followed by the offshore (32%) and inshore (2%) arrays. Daily sonar counts were highest from May 31 through June 2. Fifty percent of the total sonar count was recorded during this three-day period. The peak daily sonar count of 553,904 occurred on June 1. Over the course of the season, the largest hourly sonar counts were recorded from 2200 hours to 0400 hours (Table 10); 67% of all smolt counts were obtained during these times.

An estimated 32,465,479 sockeye salmon smolt migrated from Egegik River in 2000 based on expanded sonar counts (Table 11). Age-2. smolt (1997 brood year) comprised 96% of the total smolt estimate from May 20 to June 10. Age-1. smolt (1998 brood year) and age-3. smolt (1996 brood year) composed 4% and <1% of the total smolt estimate, respectively. A mean weight of 12.6 g per smolt (Table 12) resulted in an average 3.3 smolt per count adjustment factor to expand sonar counts.

Age, weight, and length data were collected from 1,758 sockeye salmon smolt in 2000 (Table 13). Age-1., -2., and -3. smolt were sampled. Mean length was 103 mm for age-1. smolt, 113 mm for age-2. smolt, and 128 mm for age-3. smolt. Mean weight was 10.1 g for age-1. smolt, 12.9 g for age-2. smolt, and 18.7 g for age-3. smolt. An additional 7,325 smolt were measured for length only (Table 14). Age-1. smolt were separated from age-2. smolt using a discriminating length of 100.8 mm.

Sixty-four range-of-passage measurements were recorded for smolt schools passing over Egegik River sonar arrays during peak smolt passages from May 20 to June 7 (Table 15). Schools passed at an average range of 159 cm to 246 cm above the transducers. The average counting range above the transducers was 331 cm to 349 cm during the peak smolt passage. The difference in the range of smolt passage by hour for each array is shown in Figure 8.

River and weather conditions were recorded at the counting site from May 20 to June 11 (Table 16). The weather was very good to excellent for counting smolt in 2000. The smolt counter was disabled because of weather for only 42.1 hours (8%) of the 516 hours it operated (Figure 9). Wave action from strong SW, E, and SW winds were the primary causes. Smolt days with 6 or more hours of disabled time because of weather were 5/26 (9 h), 6/06 (22 h), and 6/10 (10 h). Mean water temperature during the season was 5.8°C (range 2.5°C to 10.0°C). Mean daily water temperature during the peak of the smolt count on June 9 was 5.5°C.

In 2000, the Egegik River smolt sonar disabled time from boat traffic was negligible (<1 min).

## *Ugashik River*

The ice cover on Upper and Lower Ugashik Lakes broke up on April 7 (L. Seibert, PenAir pilot, personal communication). This was 16 d earlier than the 1977-1999 average reported break-up date of for these lakes (Appendix B.3).

In 2000, the first two Ugashik crewmembers arrived at the study site mid-morning on May 17 and the remaining crewmembers arrived that afternoon. As the crew assembled their arrays and tested their transducers on the afternoon of May 18 they reported seeing Arctic terns catching a few smolt at or near the sonar site.

The Ugashik smolt counter (S/N 8320004) was activated at 1200 hours on May 19. Initial sonar counts indicated little or no smolt passage at the smolt sonar site prior to May 25. The first daily sonar counts greater than 100,000 occurred on May 29.

A fyke net fished from 0033 hours to 0121 hours on May 20 (smolt day 5/19) caught 49 smolt (Appendix C.9). Complete summaries of the 2000 Ugashik River fyke net catch by date, species, hour, and time fished are presented in Appendices C.10 to C.12. Other species captured in the fyke net were: pink salmon fry and sculpin (sp).

River velocity measurements over the inshore index array ranged from 1.8 to 2.0 m/s (5.9 to 6.7 ft/sec). The average velocity in 2000 was equal to the 1983-1999 average of 1.9 m/sec (6.2 ft/sec) (Appendix D.5 and D.6). Velocity correction factors (m/s) used to adjust the sonar counter transmit rate for the two arrays were as follows:

Smolt Days	Inshore	Offshore
May 19 - May 24	1.00	0.85
May 25 - May 30	1.00	0.94
May 31 - Jun 07	1.00	0.94
Jun 08 - Jun 11	1.00	1.00

A total of 1,454,814 sonar counts were recorded at the Ugashik River sonar counting site from May 19 to June 11, 2000 (Table 17). Most counts (56%) were recorded over the inshore array. Daily sonar counts were highest from May 30 to June 2. Fifty-nine percent of the total counts were recorded on these days. The peak daily sonar count of 237,173 occurred on May 31. Over the entire sampling season, 73% of all smolt counts were recorded between 2400 hours and 0300 hours with peak passages occurring between 0100 hours and 0200 hours (Table 18).

We also collected twenty-three 3.5" double sided high-density diskettes which contained 510 \*.dat files with 7.7 Mbytes of University of Washington, Applied Physics Lab smolt counter application data (Appendix E.2). Post-season processing of select \*.dat files turned up several software problems, consequently, this data set was not used to generate a smolt outmigration estimate in

2000. For more information about smolt counter application data and observations, see Appendix E.

Based on expanded sonar counts an estimated 10,880,559 sockeye salmon smolt migrated from Ugashik River in 2000 (Table 19). Age-2. smolt (1997 brood year) comprised 82% of the total smolt estimate and they were the predominant age class through June 9. Age-1. smolt (1998 brood year) composed 18% of the total migration and they were most numerous from June 1-11. Mean weights of smolt ranged from 9.4 to 13.3 g per smolt (Table 20), resulting in an average 3.6 smolt per count adjustment factor for the expansion of sonar counts.

Age, weight, and length data were collected from 1,165 sockeye salmon smolt in 2000 (Table 21). Mean length was 95 mm for age-1. smolt and 112 mm for age-2. smolt. Mean weight was 8.4 g for age-1. smolt and 12.5 g for age-2. smolt. An additional 5,609 sockeye salmon smolt were sampled for length only (Table 22). A discriminating length of 101 mm was calculated to differentiate age-1. smolt from age-2. smolt at Ugashik River.

No range of passage measurements were recorded for smolt schools passing over Ugashik River sonar arrays in 2000. However, the average counting range above the transducers during peak passage was 277 cm to 295 cm.

River and weather conditions were recorded at the counting site from May 20 to June 12 (Table 23). Weather conditions were good for enumerating sockeye salmon smolt emigrating from Upper and Lower Ugashik Lakes in 2000. The smolt counter was disabled for 87.5 h (15%) of the 576 h it operated in 2000 because of weather (Figure 10). Snow, rainsqualls, wave action, and entrained air in the water column from strong W, E, and NE winds were the primary causes. Smolt days with 6 or more hours of disabled time because of weather were: 5/20 (15 h), 5/26(10 h), 6/06 (23 h), 6/07 (8 h), and 6/11 (8 h). Average water temperature was 5.9°C (range 3.5°C to 8.0°C). The mean water temperature during the peak of the smolt outmigration, on May 31, was 6.5°C.

During 2000, Ugashik River smolt sonar counters were also disabled for 3.2 h from boat-or-floatplane traffic (Figure 11) and an additional 2.3 h because of equipment problems or adjustments.

## DISCUSSION

### *Kvichak River*

The 2000 smolt outmigration estimate of 130,038,649 smolt is the tenth largest smolt outmigration estimate recorded at the Kvichak River sonar site (Appendices F.1 and F.2). This is 24% less than the 1983-1999 average of 172,149,518 smolt. All smolt outmigration estimates since 1994 have been composed primarily of age-1. smolt.

Comparing the percent of the total adjusted sonar count by smolt day for 2000 with the 1990-1999 mean it appears that the timing of the peak count was 6 d earlier (Figure 12). A comparison of the 2000 cumulative percent of the total adjusted sonar count by smolt day with the 1990-1999 mean shows that the timing for the front end (25%) of the smolt outmigration was 1 d earlier, the mid-point (50%) was equal to the recent 10-year average, and the later portion (75%) was 5 d earlier (Figure 13).

Historically, the proportion of age-2. smolt has been highest early in the season. This was also true in 2000, with age-2. smolt 7-29% of the fyke net catch during the last two weeks of May. Thereafter, age-2. smolt generally comprised 8-18% of the fyke net catch.

The graph of the percent of the total adjusted sonar count by hour for 2000 was similar to the graph of the 1990-1999 mean count per hour (Figure 14). However, in 2000, the 1200 to 1400 hours and 1900 to 2200 hour counts were above average.

Age-1. smolt in 2000 were 2% shorter and 1% lighter than the 1955-1999 mean (Table 24). Age-2. smolt were 4% shorter and 9% lighter than the 1955-1999 mean.

The mean water temperature in 2000 was 1.5°C warmer (NSC) than the 1963-1999 mean of 5.9°C (Table 25). The mean daily water temperature when the Kvichak River sonar project began this year was 0.5°C warmer than the recent 15-year average of 4.3°C (Appendix G.1). On May 21, the peak of the 2000 smolt passage, the mean daily water temperature was 0.4°C warmer than the 1984-1999 mean. For other climatological factors that may have affected the freshwater survival of smolt that outmigrated in 2000 see Appendix H.

The most recent brood year of sockeye salmon that spawned in the Kvichak River drainage and had all of its offspring outmigrate from freshwater spawning and rearing areas to the marine environment is brood year 1996. A comparison of total smolt outmigration estimates by age with the 1996 brood year escapement of 1,450,578 sockeye salmon showed a freshwater survival rate of approximately 140 smolt per spawner (Table 26). Since we expect no catch of age-3. smolt at Kvichak River in 2001, the freshwater survival rate for the 1997 brood year escapement of 1,503,732 sockeye salmon should remain at 103 smolt per spawner. Smolt-per-spawner estimates for 1996 and 1997 were both greater than the recent ten-year average for Kvichak River; mean production from brood years 1986-1995 was 30 smolt per spawner. The smolt per spawner estimate for 1997 is the second highest on record for any eastside Bristol Bay river and it is twice as high as any smolt per spawner estimate that we have calculated for Kvichak River before brood year 1996.

Nineteen ninety-three (1993) was the most recent brood year of sockeye salmon to have all age groups of adults return from the marine environment to the Kvichak River drainage to spawn. A comparison of smolt outmigration estimates by age with corresponding adult returns for brood years 1984-1993 (Table 27) shows an average marine survival (i.e. adult salmon returns per smolt) of 0.09 for age-1. smolt and 0.15 for age-2. smolt. For brood year 1994, the last adult sockeye salmon (e.g., ages 2.4 and 3.3) will return to the Kvichak River in 2001 as 7-year-old fish. Since 7-

year-old fish historically compose < 1% of the total sockeye salmon return to the Kvichak River, the average marine survival for brood year 1994 age-1. (0.01) and age-2. smolt (0.04) are both well below the 1984-1993 averages.

A comparison of the age composition of sockeye salmon smolt from the Kvichak River with the freshwater age composition of the total adult returns shows close comparison for brood years 1984, 1985, 1988, 1990, and 1993 (Figure 15). For example in brood year 1984, 20% of the smolt were estimated to be age-1. and 80% of the smolt were estimated to be age-2. Analysis of the freshwater age of the total adult return for the 1984 brood year showed 19% age-1. and 81% age-2. However, the freshwater age relationship between smolt and adults does not always hold true. In brood years 1986, 1987, 1989, and 1992 estimates of smolt age composition were significantly higher for age-1. smolt and lower for age-2. smolt than adult returns (Table 28). Similarly, in brood year 1991, smolt age composition showed lower percentages of age-1. and greater percentages of age-2. smolt than the age composition of the adult return.

If the fyke net catches a representative sample of outmigrating smolt and smolt survival rates by age are equal, then you would expect the freshwater age composition of the smolt to match the freshwater age composition of the total adult return from corresponding brood years. However, there is strong evidence that survival rates are higher for the larger age-2. smolt than for the smaller age-1. smolt (Table 27). Differences in freshwater age composition between smolt and their corresponding adult return can be attributed to a number of factors including: (1) differential survival rates of smolt by age; (2) errors in estimates of smolt age composition; (3) errors in estimates of adult total return age composition; and (4) inaccurate estimates of numbers of smolt by age because of not counting the early or late portions of the outmigration.

### *Egegik River*

The 2000 Egegik River smolt outmigration estimate was 39% smaller than the 1983-1999 average of 53,322,449 smolt (Appendices F.3 and F.4). Four of the last five years have had smolt outmigration estimates below the 1983-1999 average; 1996, 1997, 1999, and 2000 smolt estimates were all below average. In the last five years, age-2. smolt have been the predominant age class outmigrating from the Egegik River in 1997, 1999, and 2000.

Comparing the percent of the total adjusted sonar count by smolt day for 2000 with the 1990-1999 mean, the timing of the peak count appeared to be 7 d later than average (Figure 16). A comparison of the cumulative percent of the total adjusted sonar count by smolt day for 2000 with the 1990-1999 mean shows that the timing for the front end (25%) of the smolt outmigration was 3 d late, the mid-point (50%) was 4 d late, and the later portion (75%) was 1 d later than average (Figure 17).

The graph of the percent of the total adjusted sonar count by hour for 2000 was similar to the 1990-1999 mean (Figure 18).

Age-1. smolt in 2000 were equal in length and 4% heavier than the 1939-1999 mean (Table 29). Age-2. smolt were also 4% shorter than the historical mean and weighed 14% less; age-3. smolt were 5% shorter and weighed 12% less.

The mean water temperature in 2000 was 0.4 °C colder than the 1981-1999 average of 5.8°C (Table 30). The mean daily water temperature when the Egegik River sonar was activated was 0.6°C warmer than the 1984-1999 average (Appendix G.2). During the peak smolt passage on June 1, the mean daily water temperature was 0.2°C warmer than the 1984-1999 average. Other climatological factors that may have affected the freshwater survival of 2000 smolt are discussed in Appendix H.

In the Egegik River drainage, the most recent brood year of sockeye salmon that has spawned and outmigrated as smolt from freshwater to the marine environment is brood year 1996. A comparison of total smolt outmigration estimates by age with the 1996 brood year escapement of 1,076,460 sockeye salmon showed a freshwater survival rate of approximately 53.8 smolt per spawner (Table 31). Since we expect age-3. smolt to comprise < 3% of the total smolt outmigration at Egegik River in 2001, the freshwater survival rate for the 1997 brood year escapement of 1,103,964 sockeye salmon should remain at 29.0 smolt per spawner. The smolt-per-spawner estimate for 1996 was above and 1997 was below the recent ten-year average for Egegik River; mean production from brood years 1985-1995 was 38.2 smolt per spawner.

The most recent brood year of sockeye salmon to have all age groups of adults return from the marine environment to the Egegik River drainage to spawn was 1993. A comparison of smolt outmigration estimates by age with corresponding adult returns for brood years 1983-1993 (Table 32) shows an average marine survival (i.e., adult salmon returns per smolt) of 0.21 for age-1. smolt and 0.31 for age-2. smolt. For brood year 1994, the last adult sockeye salmon (e.g., ages 2.4 and 3.3) will return to the Egegik River in 2001 as 7-year-old fish. Seven-year-old fish historically composed < 1% of the total sockeye salmon return to the Egegik River, therefore the average marine survival for brood year 1994 age-1. smolt (0.06) will be below the 1983-1993 average and age-2. smolt (0.51) will be above the 1983-1993 average.

A comparison of the age composition of outmigrating sockeye salmon smolt at Egegik River with the freshwater age composition of the total adult returns shows similarities ( $\pm 15\%$ ) for brood years 1984, 1985, 1988, 1989, 1990 and 1991 (Figure 19, Table 33). However, as we saw at Kvichak River, the smolt to adult freshwater age relationship does vary. In brood year 1986, 1987, and 1993 smolt age composition showed a higher percentage of age-1. smolt and a lower percentage of age-2. smolt than the adult returns. One brood year, 1984, had smolt age compositions with a lower percentage of age-1. and higher percentage of age-2. smolt than the corresponding adult returns.

### *Ugashik River*

The 2000 smolt outmigration of 10,880,559 smolt is the third lowest estimate recorded at the Ugashik River smolt sonar site (Appendices F.5 and F.6). All smolt outmigrations from Ugashik

River in the last seven years have been smaller than the 1990-1999 average of 32,417,970 smolt. Three of the last five years have had smolt outmigrations composed primarily of age-1. smolt.

Comparing the percent of the total adjusted sonar count by smolt day for 2000 with the 1990-1999 mean, it appears that the timing of the peak counts was 1 d late (Figure 20). A comparison of the cumulative percent of the total adjusted sonar count by smolt day with the 1990-1999 mean shows that the timing for the front end (25%) of the smolt outmigration was 2 d later, the mid-point (50%) was equal to the average, and the later portion (75%) was 3 d earlier than average (Figure 21). Judging from the low sonar counts prior to May 25, we probably counted most of the smolt early in the outmigration. The gentle slope of the cumulative curve on the last several days of the project indicates we probably counted most smolt toward the end of the outmigration as well. The graph of the percent of the total adjusted sonar count by hour for 2000 was similar to the graph of the 1990-1999 mean count per hour (Figure 22).

The dominant age groups of adult sockeye salmon from the 2000 smolt outmigration will return in 2002 (ages 1.2 and 2.2 fish) and 2003 (ages 1.3 and 2.3 fish).

Age-1. smolt in 2000 were 4% longer than the 1958-1999 mean, but weighed 21% more (Table 34). These were the heaviest age-1. smolt we have sampled at Ugashik since 1996. Age-2. smolt were the same length and weighed 2% more than the 1958-1999 mean.

The mean water temperature in 2000 was equal to the 1983-1999 mean of 5.9 °C (Table 35). The average daily water temperature when the sonar was activated this year was 5.0 °C which is 1.0 °C warmer than the 1984-1999 average (Appendix G.3). At the peak of the 2000 smolt passage on June 1 the mean daily water temperature was 7.5 °C, 1.5°C less than the 1984-1999 average. See Appendix H for other climatological factors that may have affected the freshwater survival of smolt that outmigrated in 2000.

In the Ugashik River drainage, 1996 is the most recent brood year of sockeye salmon that has spawned and outmigrated as smolt from freshwater to the marine environment. A comparison of total smolt outmigration estimates by age with the 1996 brood year escapement of 667,518 sockeye salmon showed a freshwater survival rate of approximately 15.6 smolt per spawner (Table 36). Since we expect no catch of age-3. smolt at Ugashik River in 2001, the freshwater survival rate for the 1997 brood year escapement of 618,396 sockeye salmon should remain at 31.4 smolt per spawner. Smolt-per-spawner estimates for 1996 and 1997 were both below the recent ten-year average for Ugashik River; mean production from brood years 1985-1999 was 72.0 smolt per spawner.

The most recent brood year of sockeye salmon to have all age groups of adults return from the marine environment to the Ugashik River drainage to spawn was 1993. A comparison of smolt outmigration estimates by age with corresponding adult returns for brood years 1984-1993 (Table 37) shows an average marine survival (i.e. adult salmon returns per smolt) of 0.07 for age-1. smolt and 0.16 for age-2. smolt. For brood year 1994, the last adult sockeye salmon (e.g., ages 2.4 and 3.3) will return to the Ugashik River in 2001 as 7-year-old fish. Seven-year-old fish historically make up < 1% of the total sockeye salmon return to the Ugashik River. Therefore, the average

marine survival for age-1. smolt from brood year 1994 (0.59) will be well above the 1984-1993 average for Ugashik River and the average marine survival of age-2. smolt (0.81) is well above the 1984-1993 average.

A comparison of the age composition of outmigrating smolt at Ugashik River with the freshwater age composition of the total adult salmon return showed similarities ( $\pm 5\%$ ) for brood years 1983, 1988, and 1991 (Figure 23, Table 38). In brood year 1985, age composition estimates from outmigrating smolt showed a lower percentage of age-1. smolt and a higher percentage of age-2. smolt compared to returning adults. In brood years 1984, 1986, 1987, 1992, and 1993 smolt age composition data showed higher percentages of age-1. smolt and lower percentages of age-2. smolt compared to adult returns.

## LITERATURE CITED

- Alaska Department of Fish and Game (ADF&G). 2000. Bristol Bay Area annual management report, 1999. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A2000-xx, Anchorage.
- Belcher, E.O. 2000a. Bendix Corporation smolt counter functional description. Prepared for: Alaska Department of Fish and Game, Division of Commercial Fisheries, Sonar Project Coordinator – Suzanne Maxwell, 43961 Kalifornsky Beach Road, Suite B, Soldotna, Alaska. Prepared by: Applied Physics Laboratory, University of Washington, 1013 NE 40<sup>th</sup> Street, Seattle, Washington.
- Belcher, E.O. 2000b. Smolt counter digital storage operation manual. Prepared for: Alaska Department of Fish and Game, Division of Commercial Fisheries, Project Coordinator – Michael Link, 333 Raspberry Road, Anchorage, Alaska. Prepared by: Applied Physics Laboratory, University of Washington, 1013 NE 40<sup>th</sup> Street, Seattle, Washington.
- Belcher, E.O. 2001. Smolt counter digital storage operation manual. Prepared for: Alaska Department of Fish and Game, Division of Commercial Fisheries, Project Coordinator – Suzanne Maxwell, 43961 Kalifornsky Beach Road, Suite B, Soldotna, Alaska. Prepared by: Applied Physics Laboratory, University of Washington, 1013 NE 40<sup>th</sup> Street, Seattle, Washington.
- Bergstrom, D.J., and H.J. Yuen. 1981. 1980 Kvichak River sockeye salmon smolt studies. Pages 1-15 *in* C.P. Meacham, editor. 1980 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 63, Juneau.
- Bill, D.L. 1975. 1974 Naknek River sockeye salmon smolt studies. Pages 14-23 *in* P. Krasnowski, editor. 1974 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 20, Juneau.
- Bill, D.L. 1976. 1975 Naknek River sockeye salmon smolt studies. Pages 10-19 *in* P. Krasnowski, editor. 1975 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 25, Juneau.
- Bill, D.L. 1977. 1976 Naknek River sockeye salmon smolt studies. Pages 14-23 *in* N. Newcome, editor. 1976 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 33, Juneau.
- Bucher, W. 1980. 1979 Wood River sockeye salmon smolt studies. Pages 12-33 *in* C.P. Meacham, editor. 1979 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 46, Juneau.

## LITERATURE CITED (Continued)

- Bucher, W. 1981. 1980 Wood River sockeye salmon smolt studies. Pages 16-33 *in* C.P. Meacham, editor. 1980 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 63, Juneau.
- Bucher, W. 1982. 1981 Wood River sockeye salmon smolt studies. Pages 28-48 *in* D.C. Huttunen, editor. 1981 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 73, Juneau.
- Bucher, W. 1983. 1983 Wood River sockeye salmon smolt studies. Pages 72-96 *in* B.G. Bue, and S.M. Fried, editors. 1987. 1983 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 207, Juneau.
- Bucher, W. 1984. 1982 Wood River sockeye salmon smolt studies. Pages 47-68 *in* D.M. Eggers, and H.J. Yuen, editors. 1982 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 103, Juneau.
- Bucher, W. 1986a. 1984 Wood River sockeye salmon smolt studies. Pages 56-78 *in* B.G. Bue, editor. 1984 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 182, Juneau.
- Bucher, W. 1986b. 1985 Wood River sockeye salmon smolt studies. Pages 67-91 *in* B.G. Bue, editor. 1985 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 184, Juneau.
- Bucher, W. 1987. 1983 Wood River sockeye salmon smolt studies. Pages 72-98 *in* B.G. Bue, and S.M. Fried, editors. 1987. 1983 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 207, Juneau.
- Bue, B.G. 1982. 1981 Egegik River sockeye salmon smolt studies. Pages 15-27 *in* D.C. Huttunen, editor. 1981 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 73, Juneau.
- Bue, B.G. 1984. 1982 Egegik River sockeye salmon smolt studies. Pages 28-40 *in* D.M. Eggers, and H.J. Yuen, editors. 1982 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 103, Juneau.
- Bue, B.G. editor. 1986a. 1984 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 182, Juneau.

## LITERATURE CITED (Continued)

- Bue, B.G. editor. 1986b. 1985 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 184, Juneau.
- Bue, B.G., and D.M. Eggers. 1989. An age-length key for sockeye salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2D89-5, Anchorage.
- Bue, B.G., and S.M. Fried. 1987. Bristol Bay sockeye salmon smolt studies for 1983. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 207, Juneau.
- Bue, B.G., D.L. Bill, W.A. Bucher, S.M. Fried, H.J. Yuen, and R.E. Minard. 1988. Bristol Bay sockeye salmon smolt studies for 1986. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report 88-15, Juneau.
- Burgner, R.L. 1962. Studies of red salmon smolts from the Wood River Lakes, Alaska. Pages 251-314 *in* T.S.Y. Koo, editor. Studies of Alaska Red Salmon. University of Washington Publications in Fisheries, Seattle.
- Burgner, R.L., and S.Y. Koo. 1954. Results of the red salmon seaward migrant enumeration, Wood River Lakes, 1951-1953. University of Washington, Fisheries Research Institute, Circular 62, Seattle.
- Church, W. 1963. Red salmon smolts from the Wood River system, 1961. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 32, Juneau.
- Church, W., and M. Nelson. 1963. Abundance, size and age of red salmon smolts from the Wood River system, 1962. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 33, Juneau.
- Clark, J.H., and T.L. Robertson. 1980. 1978 Wood River sockeye salmon smolt studies. Pages 18-29 *in* C.P. Meacham, editor. 1978 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 44, Juneau.
- Cochran, W.G. 1977. Sampling Techniques. John Wiley and Sons, New York, New York.
- Crawford, D.L. 2000. Bristol Bay sockeye salmon smolt studies for 1999. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A00-18, Anchorage.

## LITERATURE CITED (Continued)

- Crawford, D.L., and B.A. Cross. 1992. Bristol Bay sockeye salmon smolt studies for 1991. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fisheries Report 92-20, Juneau.
- Crawford, D.L., and B.A. Cross. 1994a. Bristol Bay sockeye salmon smolt studies for 1992. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Technical Fisheries Report 94-19, Juneau.
- Crawford, D.L., and B.A. Cross. 1994b. Bristol Bay sockeye salmon smolt studies for 1993. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A94-14, Anchorage.
- Crawford, D.L., and B.A. Cross. 1995a. Bristol Bay sockeye salmon smolt studies for 1994. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A95-12, Anchorage.
- Crawford, D.L., and B.A. Cross. 1995b. Naknek River sockeye salmon smolt studies 1993-1994. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A95-09, Anchorage.
- Crawford, D.L., and B.A. Cross. 1996. Bristol Bay sockeye salmon smolt studies for 1995. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A96-10, Anchorage.
- Crawford, D.L., and B.A. Cross. 1997. Bristol Bay sockeye salmon smolt studies for 1996. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A97-10, Anchorage.
- Crawford, D.L., and B.A. Cross. 1998. Bristol Bay sockeye salmon smolt studies for 1997. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A98-13, Anchorage.
- Crawford, D.L., and B.A. Cross. 1999. Bristol Bay sockeye salmon smolt studies for 1998. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A99-10, Anchorage.
- Crawford, D.L., and F.C. Tilly. 1995. Bristol Bay upward-looking sonar sockeye salmon smolt enumeration project instruction manual. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A95-14, Anchorage.

## LITERATURE CITED (Continued)

- Crawford, D.L., J.D. Woolington, and B.A. Cross. 1992. Bristol Bay sockeye salmon smolt studies for 1990. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fisheries Report 91-2013, Juneau.
- Cross, B.A., B.L.Stratton, and B.G. Bue. 1990. Bristol Bay sockeye salmon smolt studies for 1987. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fisheries Report 90-05, Juneau.
- Eggers, D.M. 1984. 1982 Ugashik River sockeye salmon smolt studies. Pages 41-46 *in* D.M. Eggers, and H.J. Yuen, editors. 1982 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 103, Juneau.
- Eggers, D.M., and H.J. Yuen, editors. 1984. 1982 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 103, Juneau.
- Fried, S.M., H.J. Yuen, and B.G. Bue. 1987. 1983 Naknek, Egegik, and Ugashik rivers sockeye salmon smolt studies. Pages 36-71 *in* B.G. Bue, and S.M. Fried, editors. 1983 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 207, Juneau.
- Goodman, L. 1965. On simultaneous confidence intervals from multinomial populations. *Technometrics*. 7:247-254.
- Huttunen, D.C. 1980. 1978 Bristol Bay special sockeye salmon smolt studies. Pages 30-34 *in* C.P. Meacham, editor. 1978 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 44, Juneau.
- Huttunen, D.C. 1984. 1982 Naknek River sockeye salmon smolt studies. Pages 14-27 *in* D.G. Eggers, and H.J. Yuen, editors. 1982 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 103, Juneau.
- Huttunen, D.C., and P.A. Skvorc II, 1991. Kvichak River side-looking sonar smolt investigations, 1990. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 5J91-04, Anchorage.
- Huttunen, D.C., and P.A. Skvorc II, 1992. Kvichak River side-looking sonar abundance estimation. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 5J92-07, Anchorage.

## LITERATURE CITED (Continued)

- Jaenicke, H.W. 1963. Ugashik River smolt studies: a preliminary report of the 1962 season. United States Department of the Interior, Bureau of Commercial Fisheries, Manuscript Report 63-5, Auke Bay, Alaska.
- Jaenicke, H.W. 1968. Sockeye salmon smolt investigations on the Ugashik River, Alaska, 1958-63. Master of Science Thesis, Humbolt State College, Humbolt, California.
- Kerns, O.E. 1961. Abundance and age of Kvichak River red salmon smolts. *Fishery Bulletin* 189(61):301-320.
- Krasnowski, P. 1975. 1974 Kvichak River sockeye salmon smolt studies. Pages 1-13 *in* P. Krasnowski, editor. 1974 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 20, Juneau.
- Krasnowski, P. 1976. 1975 Wood River sockeye salmon smolt studies. Pages 29-51 *in* P. Krasnowski, editor. 1975 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 25, Juneau.
- Krasnowski, P. 1977. 1976 Wood River sockeye salmon smolt studies. Pages 24-43 *in* N. Newcome, editor. 1976 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 33, Juneau.
- Marriott, R.A. 1965. 1963 Kvichak River red salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 48, Juneau.
- McCurdy, M.L., and R.D. Paulus. 1972a. 1971 Naknek River sockeye salmon smolt studies. Pages 29-34 *in* P.A. Russell, and M.L. McCurdy, editors. 1971 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 2, Juneau.
- McCurdy, M.L., and R.D. Paulus. 1972b. 1969 Kvichak River sockeye salmon smolt studies. Pages 1-34 *in* M.L. McCurdy, editor. 1969 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 3, Juneau.
- McCurdy, M.L. 1974a. 1972 Naknek River sockeye salmon smolt studies. Pages 38-48 *in* K.P. Parker, editor. 1972 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 13, Juneau.
- McCurdy, M.L. 1974b. 1973 Naknek River sockeye salmon smolt studies. Pages 23-32 *in* K.P. Parker, editor. 1973 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 14, Juneau.

## LITERATURE CITED (Continued)

- Minard, R.E. 1984. 1982 Nushagak and Nuyakuk River sockeye salmon smolt studies. Pages 69-72 *in* D.M. Eggers, and H.J. Yuen, editors. 1982 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 103, Juneau.
- Minard, R.E., and J. Brandt. 1986. 1985 Nuyakuk River sockeye salmon smolt studies. Pages 92-106 *in* B.G. Bue, editor. 1985 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 184, Juneau.
- Minard, R.E., and M. Frederickson. 1987. 1983 Nuyakuk River sockeye salmon smolt studies. Pages 97-110 *in* B.G. Bue, and S.M. Fried, editors. 1983 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 207, Juneau.
- Morrow, J.E. 1980. The freshwater fishes of Alaska. Alaska Northwest Publishing Company, Anchorage.
- National Weather Service (NWS). 1996. 1996 Local climatological data, annual summary with comparative data, King Salmon, Alaska. National Oceanic and Atmospheric Administration, National Climatic Data Center, ISSN 0197-978.
- NWS. 1997. 1997 Local climatological data, annual summary with comparative data, King Salmon, Alaska. National Oceanic and Atmospheric Administration, National Climatic Data Center, ISSN 0197-975.
- NWS. 1998. 1998 Local climatological data, annual summary with comparative data, King Salmon, Alaska. National Oceanic and Atmospheric Administration, National Climatic Data Center, ISSN 0197-975.
- NWS. 1999. 1999 Local climatological data, annual summary with comparative data, King Salmon, Alaska. National Oceanic and Atmospheric Administration, National Climatic Data Center, ISSN 0197-975.
- NWS. 2000a. Local climatological data, monthly summary, January 2000, King Salmon, Alaska. National Oceanic and Atmospheric Administration, National Climatic Data Center, ISSN 0197-9795 (1 of 12).
- NWS. 2000b. Local climatological data, monthly summary, February 2000, King Salmon, Alaska. National Oceanic and Atmospheric Administration, National Climatic Data Center, ISSN 0197-9795 (2 of 12).

## LITERATURE CITED (Continued)

- NWS. 2000c. Local climatological data, monthly summary, March 2000, King Salmon, Alaska. National Oceanic and Atmospheric Administration, National Climatic Data Center, ISSN 0197-9795 (3 of 12).
- NWS. 2000d. Local climatological data, monthly summary, April 2000, King Salmon, Alaska. National Oceanic and Atmospheric Administration, National Climatic Data Center, ISSN 0197-9795 (4 of 12).
- NWS. 2000e. Local climatological data, monthly summary, May 2000, King Salmon, Alaska. National Oceanic and Atmospheric Administration, National Climatic Data Center, ISSN 0197-9795 (5 of 12).
- NWS. 2000f. Local climatological data, monthly summary, June 2000, King Salmon, Alaska. National Oceanic and Atmospheric Administration, National Climatic Data Center, ISSN 0197-9795 (6 of 12).
- Nelson, M.L. 1964. Abundance, size and age of red salmon smolts from the Wood River system, 1963. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 37, Juneau.
- Nelson, M.L. 1965a. Abundance, size, age and survival of red salmon smolts from the Ugashik Lakes system, Bristol Bay, 1964. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 62, Juneau.
- Nelson, M.L. 1965b. Abundance, size and age of red salmon smolts from the Wood River system, 1964. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 54, Juneau.
- Nelson, M.L. 1966a. Abundance, size, age and survival of red salmon smolts from the Ugashik Lakes system, Bristol Bay, 1965. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 85, Juneau.
- Nelson, M.L. 1966b. Abundance, size and age of red salmon smolts from the Wood River Lakes system, 1965. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 76, Juneau.
- Nelson, M.L. 1969. 1967 Ugashik River red salmon smolt studies. Pages 26-32 *in* D.M. Stewart, editor. 1967 Bristol Bay red salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 134, Juneau.

## LITERATURE CITED (Continued)

- Nelson, M.L., and H.W. Jaenicke. 1965. Abundance, size and age of red salmon smolts from the Ugashik Lakes system, Bristol Bay, 1963. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 49, Juneau.
- Newcome, N. 1978. 1977 Wood River sockeye salmon studies. Pages 24-34 in H. Yuen, editor. 1977 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 41, Juneau.
- Parker, K.P. 1974a. 1972 Kvichak River sockeye salmon smolt studies. Pages 1-37 in K.P. Parker editor. 1972 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 13, Juneau.
- Parker, K.P. 1974b. 1973 Kvichak River sockeye salmon smolt studies. Pages 1-22 in K.P. Parker, editor. 1973 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 14, Juneau.
- Paulus, R.D. 1972. 1969 Egegik River sockeye salmon smolt studies. Pages 62-65 in M.L. McCurdy, editor. 1969 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 3, Juneau.
- Paulus, R., and M. McCurdy. 1969. 1968 Kvichak River sockeye salmon (*Oncorhynchus nerka*) smolt studies. Pages 1-45 in M.L. McCurdy, editor. 1968 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 138, Juneau.
- Paulus, R.D., and M.L. McCurdy. 1972. 1970 Kvichak River sockeye salmon smolt studies. Pages 1-13 in P.A. Russell, editor. 1970 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 4, Juneau.
- Paulus, R., and K. Parker. 1974. Kvichak River sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 166, Juneau.
- Pella, J.J., and H.W. Jaenicke. 1978. Some observations on the biology and variations of populations of sockeye salmon of the Naknek and Ugashik Systems of Bristol Bay, Alaska. National Oceanic and Atmospheric Administration, Northwest Fisheries Center, Northwest and Alaska Fisheries Center Processed Report, Seattle, Washington.
- Pennoyer, S. 1966. 1965 Kvichak River red salmon (*Oncorhynchus nerka*) smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 83, Juneau.

## LITERATURE CITED (Continued)

- Pennoyer, S., and M.C. Seibel. 1965. 1964 Kvichak River red salmon (*Oncorhynchus nerka*) smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 58, Juneau.
- Pennoyer, S., and D.M. Stewart. 1967. 1966 Kvichak River red salmon (*Oncorhynchus nerka*) smolt studies. Pages 4-18 in D.M. Stewart, editor. 1966 Bristol Bay red salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 102, Juneau.
- Pennoyer, S., and D.M. Stewart. 1969. 1967 Kvichak River red salmon (*Oncorhynchus nerka*) smolt studies. Pages 4-17 in D.M. Stewart, editor. 1967 Bristol Bay red salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 134, Juneau.
- Randall, R.C. 1976. 1975 Kvichak River sockeye salmon smolt studies. Pages 1-9 in P. Krasnowski, editor. 1975 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 25, Juneau.
- Randall, R.C. 1977. 1976 Kvichak River sockeye salmon smolt studies. Pages 1-13 in N. Newcome, editor. 1976 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 33, Juneau.
- Randall, R.C. 1978. 1977 Kvichak River sockeye salmon smolt studies. Pages 1-5 in H. Yuen, editor. 1977 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 41, Juneau.
- Rietze, H.L., and P.J. Spangler. 1958. Operation report for red salmon smolt studies on the Naknek and Egegik Rivers, 1957. United States Fish and Wildlife Service, Bureau of Commercial Fisheries, Western Alaska Salmon Investigations.
- Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada No. 191, Ottawa, Canada.
- Robertson, A.D. 1967. Naknek River red salmon smolt study, 1966. Pages 34-40 in D.M. Stewart, editor. 1966 Bristol Bay red salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Information Leaflet 102, Juneau.
- Russell, P.A. 1972. 1971 Kvichak River sockeye salmon smolt studies. Pages 1-28 in P.A. Russell, and M.L. McCurdy, editors. 1971 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 2, Juneau.

## LITERATURE CITED (Continued)

- Sanders, G.H. 1976. 1975 Ugashik River sockeye salmon smolt studies. Pages 20-28 *in* P. Krasnowski, editor. 1975 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 25, Juneau.
- Schroeder, T.R. 1972a. 1969 Ugashik River sockeye salmon smolt studies. Pages 35-45 *in* M.L. McCurdy, editor. 1969 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 3, Juneau.
- Schroeder, T.R. 1972b. 1970 Ugashik River sockeye salmon smolt studies. Pages 14-23 *in* P.A. Russell, editor. 1970 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 4, Juneau.
- Schroeder, T.R. 1974a. 1972 Ugashik River sockeye salmon smolt studies. Pages 49-56 *in* K.P. Parker, editor. 1972 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 13, Juneau.
- Schroeder, T.R. 1974b. 1973 Ugashik River sockeye salmon smolt studies. Pages 33-45 *in* K.P. Parker, editor. 1973 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 14, Juneau.
- Schroeder, T.R. 1975. 1974 Ugashik River sockeye salmon smolt studies. Pages 24-37 *in* P. Krasnowski, editor. 1974 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 20, Juneau.
- Siedelman, D.L. 1967. Abundance, size and age of red salmon smolts from the Wood River Lakes system, 1966. Pages 18-33 *in* D.M. Stewart, editor. 1966 Bristol Bay red salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 102, Juneau.
- Siedelman, D.L. 1969. Abundance, size and age of sockeye salmon smolt from the Ugashik Lakes system, 1968. Pages 46-61 *in* M.L. McCurdy, editor. 1968 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet 138, Juneau.
- Van Valin, G.R. 1969a. Naknek River red salmon smolt study, 1967. Pages 33-43 *in* D.M. Stewart, editor. 1967 Bristol Bay red salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Information Leaflet 134, Juneau.
- Van Valin, G.R. 1969b. Naknek River sockeye salmon smolt study, 1968. Pages 62-77 *in* M.L. McCurdy, editor. 1968 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Information Leaflet 138, Juneau.

## LITERATURE CITED (Continued)

- Woolington, J.D., B.A. Cross, B.L. Stratton, and B.G. Bue. 1990. Bristol Bay sockeye salmon smolt studies for 1988. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fisheries Report 90-16, Juneau.
- Woolington, J.D., B.A. Cross, and B.L. Stratton. 1991. Bristol Bay sockeye salmon smolt studies for 1989. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fisheries Report 91-19, Juneau.
- Yuen, H.J. 1978. 1977 Naknek River sockeye salmon smolt studies. Pages 12-23 *in* H. Yuen, editor. 1977 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 41, Juneau.
- Yuen, H.J. 1980a. 1978 Kvichak River sockeye salmon smolt studies. Pages 1-17 *in* C.P. Meacham, editor. 1978 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 44, Juneau.
- Yuen, H.J. 1980b. 1979 Kvichak River sockeye salmon smolt studies. Pages 1-12 *in* C.P. Meacham, editor. 1979 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 46, Juneau.
- Yuen, H.J., and M. Wise. 1982. 1981 Kvichak River sockeye salmon smolt studies. Pages 2-15 *in* D.C. Huttunen, editor. 1981 Bristol Bay sockeye salmon smolt studies. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report 73, Juneau.

Table 1. Sonar counts by smolt day and array at the sockeye salmon smolt counting site on Kvichak River, 2000.

Smolt Day <sup>a</sup>	Transducer Array			Total
	Inshore	Center	Offshore	
5/20 <sup>bc</sup>	46,426	125,339	67,195	238,960
5/21 <sup>de</sup>	118,189	249,818	262,765	630,772
5/22	23,396	64,041	39,543	126,980
5/23	40,633	82,779	71,950	195,362
5/24 <sup>c</sup>	14,166	7,485	13,127	34,778
5/25	13,900	12,416	20,699	47,015
5/26	17,734	22,537	33,502	73,773
5/27	26,043	39,092	117,537	182,672
5/28	35,784	39,241	51,937	126,962
5/29	36,600	66,184	53,724	156,508
5/30	89,297	138,299	172,743	400,339
5/31	53,356	68,484	73,066	194,906
6/01	27,621	30,767	46,562	104,950
6/02	6,356	3,779	5,229	15,364
6/03	9,432	8,155	5,500	23,087
6/04	12,546	11,803	11,886	36,235
6/05	15,202	10,732	9,066	35,000
6/06 <sup>c</sup>	4,819	4,153	4,499	13,471
6/07 <sup>cf</sup>	19,101	33,511	63,691	116,303
6/08	26,932	37,182	36,706	100,820
6/09 <sup>c</sup>	8,683	6,769	3,879	19,331
6/10	16,203	11,284	11,152	38,639
6/11 <sup>c</sup>	8,913	9,868	9,949	28,730
6/12 <sup>c</sup>	6,118	8,713	9,297	24,128
6/13	5,787	5,870	6,100	17,757
Total	683,237	1,098,301	1,201,304	2,982,842
Percent	22.9	36.8	40.3	

<sup>a</sup> Smolt day began at 1200 hours and ended at 1159 hours the next calendar day.

<sup>b</sup> Sonar counter was activated at 1200 hours on May 20, 2000.

<sup>c</sup> Sonar counts interpolated for one or more arrays for the following periods:  
 1600-1659 & 1800-1859 hours (2 h) on smolt day 5/20 due to heavy rain & an equipment problem  
 1200-1359 hours (2 h) on smolt day 5/24 due to installation of other sonar evaluation equipment  
 1000-1159 hours (2 h) on smolt day 6/06 due to high wind (E 18-30)  
 1200-1459 hours (3 h) on smolt day 6/07 due to high wind (E 18-30)  
 1600-1759 hours (2 h) on smolt day 6/09 due to sonar evaluation mapping crew  
 1500-1959 & 0700-1159 hours (10 h) on smolt day 6/11 due to high winds (E 18-30 & NE 20-30) & waves  
 1200-0059 hours (13 h) on smolt day 6/12 due to high winds(NE 20-30), waves, and entrained air in the water column

<sup>d</sup> Peak daily passage estimate for 2000.

<sup>e</sup> First fyke net set at 1845-1900 hours, catch = 240 smolt.

<sup>f</sup> Rainbow trout *Oncorhynchus mykiss* sport fishing season opened at 0001 hours on June 8. Increased boat traffic after this opening produced 5.2 hours of sonar disabled time.

Table 2. Sonar counts by hour and array at the sockeye salmon smolt counting site on Kvichak River, 2000.

Sonar Operating Period	Hour	Sonar Count				Hourly Percent
		Transducer Array			Total	
		Inshore	Center	Offshore		
	1200	49,786	74,511	67,012	191,310	6.41
	1300	51,329	63,929	74,419	189,677	6.36
	1400	38,472	65,092	57,630	161,194	5.40
	1500	30,155	47,031	28,353	105,540	3.54
	1600	34,134	43,818	28,628	106,580	3.57
	1700	25,433	37,873	30,972	94,278	3.16
	1800	35,598	41,003	35,373	111,975	3.75
	1900	34,931	61,133	34,898	130,962	4.39
	2000	36,673	79,873	49,410	165,956	5.56
Smolt	2100	39,281	74,671	65,725	179,677	6.02
Days	2200	33,602	59,666	69,792	163,060	5.47
5/20	2300	<sup>b</sup> 17,399	38,026	41,687	97,112	3.26
to	2400	<sup>c</sup> 11,322	21,859	21,415	54,597	1.83
6/13	0100	<sup>c</sup> 14,422	50,835	97,033	162,290	5.44
	0200	<sup>c</sup> 32,498	58,852	201,224	292,574	9.81
	0300	<sup>c</sup> 34,712	70,865	105,082	210,659	7.06
	0400	<sup>c</sup> 53,252	53,098	30,546	136,896	4.59
	0500	<sup>c</sup> 45,195	35,318	29,731	110,244	3.70
	0600	<sup>b</sup> 11,556	23,956	32,868	68,380	2.29
	0700	8,520	15,548	22,831	46,899	1.57
	0800	8,619	18,075	18,094	44,787	1.50
	0900	6,502	15,155	15,955	37,613	1.26
	1000	12,002	22,334	19,856	54,192	1.82
	1100	17,844	25,781	22,770	66,395	2.23
Total		683,237	1,098,301	1,201,304	2,982,842	100.00

<sup>a</sup> Daylight hours unless indicated otherwise.

<sup>b</sup> Twilight hours

<sup>c</sup> Hours of darkness

Table 3. Daily number of sockeye salmon smolt emigrating seaward estimated with hydroacoustic equipment, Kvichak River, 2000.

Smolt Day <sup>a</sup>	Age 1.			Age 2.			All Ages	
	Number	Percent	Cumulative Total	Number	Percent	Cumulative Total	Daily Total	Cumulative Total
5/20	7,775,710	81.3	7,775,710	1,789,685	18.7	1,789,685	9,565,395	9,565,395
5/21	22,142,594	81.3	29,918,304	5,096,419	18.7	6,886,104	27,239,013	36,804,408
5/22	4,548,294	85.9	34,466,598	749,043	14.1	7,635,147	5,297,337	42,101,745
5/23	7,318,362	85.9	41,784,960	1,205,236	14.1	8,840,383	8,523,598	50,625,343
5/24	1,699,985	93.0	43,484,945	127,759	7.0	8,968,142	1,827,744	52,453,087
5/25	1,538,869	73.9	45,023,814	542,371	26.1	9,510,513	2,081,240	54,534,327
5/26	2,667,356	81.3	47,691,170	615,543	18.8	10,126,056	3,282,899	57,817,226
5/27	6,830,284	81.3	54,521,454	1,576,219	18.8	11,702,275	8,406,503	66,223,729
5/28	3,698,297	70.7	58,219,751	1,531,195	29.3	13,233,470	5,229,492	71,453,221
5/29	4,535,779	72.4	62,755,530	1,728,244	27.6	14,961,714	6,264,023	77,717,244
5/30	11,998,527	72.4	74,754,057	4,571,735	27.6	19,533,449	16,570,262	94,287,506
5/31	7,807,210	86.9	82,561,267	1,174,853	13.1	20,708,302	8,982,063	103,269,569
6/01	4,555,734	89.5	87,117,001	535,040	10.5	21,243,342	5,090,774	108,360,343
6/02	597,861	84.4	87,714,862	110,841	15.6	21,354,183	708,702	109,069,045
6/03	857,119	84.4	88,571,981	158,906	15.6	21,513,089	1,016,025	110,085,070
6/04	1,313,466	82.5	89,885,447	277,842	17.5	21,790,931	1,591,308	111,676,378
6/05	1,408,426	86.9	91,293,873	212,130	13.1	22,003,061	1,620,556	113,296,934
6/06	603,512	91.7	91,897,385	54,481	8.3	22,057,542	657,993	113,954,927
6/07	5,238,990	91.7	97,136,375	472,948	8.3	22,530,490	5,711,938	119,666,865
6/08	4,376,914	91.7	101,513,289	395,124	8.3	22,925,614	4,772,038	124,438,903
6/09	692,359	83.3	102,205,648	138,604	16.7	23,064,218	830,963	125,269,866
6/10	1,429,587	83.3	103,635,235	286,192	16.7	23,350,410	1,715,779	126,985,645
6/11	1,043,868	83.3	104,679,103	208,974	16.7	23,559,384	1,252,842	128,238,487
6/12	858,758	83.3	105,537,861	171,916	16.7	23,731,300	1,030,674	129,269,161
6/13	641,138	83.3	106,178,999	128,350	16.7	23,859,650	769,488	130,038,649
	106,178,999	81.7		23,859,650	18.4		130,038,649	

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 4. Adjustment factor used to expand sonar counts into estimated numbers of sockeye salmon smolt, Kvichak River, 2000.

Smolt Day <sup>a</sup>	Mean Weight of Smolt (g)	Smolt per Count
5/20	6.5	6.4
5/21	6.5	6.4
5/22	6.4	6.5
5/23	6.4	6.5
5/24	5.8	7.2
5/25	6.8	6.1
5/26	6.4	6.5
5/27	6.4	6.5
5/28	6.9	6.0
5/29	6.8	6.1
5/30	6.8	6.1
5/31	6.1	6.8
6/01	5.9	7.0
6/02	6.4	6.5
6/03	6.4	6.5
6/04	6.5	6.4
6/05	6.2	6.7
6/06	5.9	7.1
6/07	5.9	7.1
6/08	5.9	7.1
6/09	6.6	6.3
6/10	6.6	6.3
6/11	6.6	6.3
6/12	6.6	6.3
6/13	6.6	6.3

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 5. Mean fork length and weight of sockeye salmon smolt captured by fyke net, Kvichak River, 2000.

Smolt Day <sup>a</sup>	Age 1.					Age 2.				
	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size <sup>b</sup>	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size <sup>b</sup>
5/21	87	9.8	5.9	2.32	69	103	14.4	9.5	3.65	29
5/22	85	12.5	6.1	2.41	70	105	14.6	10.5	3.60	25
5/23	85	12.5	6.2	2.83	94	96	8.3	8.1	1.25	2
5/24	85	9.2	5.2	2.36	95	95	5.3	7.9	1.30	4
5/25	86	10.5	6.0	2.81	83	105	6.6	10.7	2.45	11
5/26	85	10.9	5.7	2.50	92	102	9.6	9.1	1.14	4
5/27	87	14.7	5.8	2.73	69	102	18.6	9.2	4.48	31
5/28	86	10.3	5.7	2.44	86	105	9.2	9.8	3.21	12
5/29	87	11.0	5.7	2.56	72	107	13.3	10.6	4.77	25
5/30	88	11.3	5.4	3.48	61	106	11.1	9.2	4.25	39
5/31	87	15.9	5.5	3.55	83	99	20.7	8.3	4.58	17
6/01	86	13.3	5.1	2.68	76	105	22.8	9.4	8.29	24
6/02	86	11.8	5.9	2.67	82	103	12.8	9.6	2.89	17
6/03	85	12.2	5.9	2.91	64	107	22.6	11.2	5.40	34
6/04	88	13.9	5.9	2.79	91	105	12.7	9.6	3.41	9
6/05	88	13.1	5.9	2.48	84	106	14.7	10.0	3.09	16
6/06	86	12.9	5.6	2.34	90	102	12.5	8.9	2.61	9
6/07					0					0
6/08	87	14.4	5.8	2.95	90	103	10.6	9.1	2.66	9
6/09	85	10.8	5.7	2.52	95	106	12.2	9.8	3.85	5
6/10	89	11.2	6.4	2.60	75	105	12.2	9.9	3.52	21
Total Mean	86		5.8		1,621	103		9.5		343

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

<sup>b</sup> Also collected one fin clip sample from each smolt sampled for age-weight-length (AWL) data for DNA analysis by the ADF&G genetics lab in Anchorage.

Table 6. Mean fork length and estimated mean weight for age-1. and -2. sockeye salmon smolt, Kvichak River, 2000.

Smolt Day <sup>b</sup>	Age 1. <sup>a</sup>				Age 2. <sup>a</sup>			
	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size
5/21	86	15.8	5.7	367	105	16.7	9.7	70
5/22	87	11.7	5.8	89	106	13.9	10.1	31
5/23	85	14.4	5.6	266	104	10.7	9.5	25
5/24	85	14.5	5.5	382	104	12.2	9.4	20
5/25	84	13.8	5.4	327	106	16.6	10.1	107
5/26	86	11.5	5.7	100	99	4.0	8.2	7
5/27	86	16.4	5.7	371	106	18.7	10.0	127
5/28	86	17.9	5.7	315	106	18.9	10.1	177
5/29	86	11.1	5.7	78	105	10.8	9.8	21
5/30	86	15.1	5.7	356	105	18.2	9.7	115
5/31	85	16.7	5.5	514	105	15.7	9.8	67
6/01	85	15.1	5.5	326	103	11.2	9.2	22
6/02	85	13.8	5.4	185	105	10.8	9.9	20
6/03	85	17.0	5.6	338	105	13.5	9.8	20
6/04	86	17.5	5.7	597	105	19.0	9.9	134
6/05	85	17.5	5.6	413	107	18.5	10.2	59
6/06	85	12.2	5.5	106	103	7.2	9.4	9
6/07				0				0
6/08	84	15.2	5.4	347	106	14.3	10.1	27
6/09	85	12.3	5.5	169	107	4.8	10.2	2
6/10	87	15.2	5.9	256	105	12.6	9.7	40
Total Mean	86		5.6	5,902	105		9.7	1,100

<sup>a</sup> Length-weight parameters by age group and discriminating length used to separate ages from May 21 to June 10 were:

Age 1.  $a = -9.2117$   $b = 2.4537$   $r^2 = 0.5082$   $n = 1,621$

Age 2.  $a = -10.5028$   $b = 2.7430$   $r^2 = 0.7921$   $n = 343$

Discriminating Length = 95.36 mm

<sup>b</sup> Sampling day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 7. Range of sockeye salmon smolt passage from the transducer face at Kvichak River sonar site, May 20 to June 8, 2000.

	Range of Passage from the Transducers (cm)							
	Inshore Array <sup>a</sup> Smolt Schools		Center Array <sup>b</sup> Smolt Schools		Offshore Array <sup>c</sup> Smolt Schools		All Combined Smolt Schools	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
Maximum	272	228	269	239	258	229	258	228
Mean	239	186	241	186	236	188	238	187
Minimum	183	148	179	134	169	139	183	148
n	20	20	29	29	22	22	71	71

a Average depth of inshore array on smolt day 5/21 was 273 cm.

b Average depth of center array on smolt day 5/21 was 269 cm.

c Average depth of offshore array on smolt day 5/21 was 259 cm.

Table 8. Climatological and hydrological observations made at sockeye salmon smolt counting site at 0800 and 2000 hours, Kvichak River, 2000.

Date	Cloud Cover <sup>a</sup>		Precipitation <sup>b</sup> (mm)	Wind Direction & Velocity (km/h)		Air Temperature (°C)		Water Temperature (°C)		Water Clarity <sup>c</sup>
	0800	2000		0800	2000	0800	2000	0800	2000	
5/20	3	3	1.0	na	WSW 06	na	9.0	2.5	7.0	clear
5/21	1	3	2.3	0	S 23	1.0	9.0	6.0	7.0	clear
5/22	1	3	7.6	SW 6-13	SW 0-2	10.0	na	6.0	6.0	clear
5/23	na	3	0.3	S 24	SSW 23	na	5.0	6.0	5.9	clear
5/24	2	3	0.0	0	WNW 02	0.0	8.0	4.5	7.0	clear
5/25	1	3	0.0	0	NNW 03	7.0	11.0	5.0	7.0	clear
5/26	1	3	0.0	0	NW 18	11.0	12.0	5.0	8.5	clear
5/27	1	3	0.0	0	SW 05	13.0	12.0	6.0	7.5	clear
5/28	2	3	0.0	0	NW 08	7.0	10.0	6.0	8.5	clear
5/29	1	3	0.0	0	NW 05	12.0	9.0	6.5	8.0	clear
5/30	4	4	1.8	NNE 08	na	7.0	na	6.5	6.5	clear
5/31	3	4	3.6	N 11	na	11.0	11.0	6.5	6.5	clear
6/01	4	4	n	N 08	0	8.0	11.0	6.5	6.5	clear
6/02	4	4	0.0	0	0	8.0	11.0	6.5	7.0	clear
6/03	3	4	0.0	NE 08	N 16	5.0	18.0	7.0	8.0	clear
6/04	1	1	0.0	0	NE 08	13.0	20.0	7.0	9.0	clear
6/05	1	1	0.0	S 21	SW 10	13.0	17.0	8.0	9.0	clear
6/06	4	4	1.3	0	E 10-25	na	9.0	8.0	8.5	lt brown
6/07	3	3	1.5	NE 23-34	na	na	9.0	8.0	8.5	murky
6/08	3	2	0.0	NE 13	NE 08	8.0	9.0	8.0	8.5	murky
6/09	4	2	0.5	0	E 08	na	14.0	9.0	9.5	murky
6/10	2	2	0.0	NE 15	E 24	10.0	9.0	9.0	9.5	murky
6/11	3	4	0.0	N 15	NE 24	8.0	11.0	9.0	9.0	murky
6/12	3	4	0.0	NE 31-48	E 23-40	7.0	10.0	8.0	8.5	murky
6/13	3	na	0.0	NE 24-27	na	9.5	na	9.0	na	murky
6/14	3	na	0.0	0	na	7.0	na	8.5	na	clear

<sup>a</sup> 1 = Cloud cover not more than 1/10  
 2 = Cloud cover not more than 1/2  
 3 = Cloud cover more than 1/2  
 4 = Completely overcast  
 5 = Fog

<sup>b</sup> na = not available

<sup>c</sup> Water clarity at 0800 hours

Table 9. Sonar counts by smolt day and array at the sockeye salmon smolt counting site on Egegik River, 2000.

Smolt Day <sup>a</sup>	Transducer Array			Total
	Inshore	Center	Offshore	
5/20 <sup>b</sup>	576	8,724	259,973	269,273
5/21 <sup>c</sup>	233	977	1,615	2,825
5/22	564	1,739	3,252	5,555
5/23	782	34,121	52,304	87,207
5/24	2,623	33,633	30,818	67,074
5/25	2,594	20,534	17,216	40,344
5/26 <sup>d</sup>	4,026	34,848	42,439	81,313
5/27	433	44,261	34,770	79,464
5/28	1,617	27,476	21,697	50,790
5/29	9,294	128,681	60,979	198,954
5/30	585	66,305	12,061	78,951
5/31	792	245,488	67,220	313,500
6/01 <sup>e</sup>	1,506	487,098	65,300	553,904
6/02	7,863	416,729	27,422	452,014
6/03	1,957	98,357	79,008	179,322
6/04	298	10,395	5,550	16,243
6/05 <sup>d</sup>	1,307	15,755	7,779	24,841
6/06 <sup>d</sup>	1,349	16,787	11,878	30,014
6/07	3,537	32,858	24,897	61,292
6/08	252	8,142	9,287	17,681
6/09	165	2,979	4,212	7,356
6/10 <sup>d</sup>	240	3,950	5,314	9,504
Total	42,593	1,739,837	844,991	2,627,421
Percent	1.6	66.2	32.2	

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

<sup>b</sup> Sonar counter was activated at 0001 hours on May 21.

<sup>c</sup> Fyke net fished for 1-2 h per night from this smolt day on whenever conditions permitted.

<sup>d</sup> Sonar counts interpolated for one or more arrays for the following periods:

1300-2159 hours on smolt day 5/26 from strong SW winds and white capped waves

1100-1159 hours on smolt day 6/05 due to strong E winds and rain

1200-1159 hours on smolt day 6/06 due to strong E winds and rain showers

1300-2259 hours on smolt day 6/10 due to strong SE winds

<sup>e</sup> Peak daily smolt passage for 2000.

Table 10. Sonar counts by hour and array at the sockeye salmon smolt counting site on Egegik River, 2000.

Sonar Operating Period	Hour	a	Sonar Count				Hourly Percent
			Transducer Array			Total	
			Inshore	Center	Offshore		
	1200		245	68,175	14,303	82,722	3.15
	1300		1,483	63,778	16,276	81,536	3.10
	1400		713	71,072	20,744	92,528	3.52
	1500		2,621	41,810	8,236	52,666	2.00
	1600		379	50,001	3,669	54,049	2.06
	1700		492	48,948	762	50,202	1.91
	1800		311	47,184	697	48,192	1.83
	1900		766	19,586	2,139	22,490	0.86
	2000		216	7,779	826	8,820	0.34
Smolt	2100		220	19,254	3,341	22,815	0.87
Days	2200		259	259,761	18,580	278,600	10.60
5/20	2300	b	236	62,704	54,844	117,783	4.48
to	2400	c	457	95,452	65,458	161,367	6.14
6/10	0100	c	7,869	112,219	117,536	237,623	9.04
	0200	c	15,850	156,720	294,355	466,924	17.77
	0300	c	5,111	196,141	92,697	293,948	11.19
	0400	c	1,884	126,764	46,254	174,902	6.66
	0500	c	1,556	51,917	28,335	81,808	3.11
	0600	b	481	29,920	18,150	48,551	1.85
	0700		219	16,005	1,612	17,835	0.68
	0800		327	18,648	8,126	27,100	1.03
	0900		243	86,678	5,170	92,091	3.50
	1000		543	43,577	6,936	51,055	1.94
	1100		118	45,746	15,949	61,813	2.35
Total			42,593	1,739,837	844,991	2,627,421	100.00

<sup>a</sup> Daylight hours unless indicated otherwise.

<sup>b</sup> Twilight hours

<sup>c</sup> Hours of darkness

Table 11. Daily number of sockeye salmon smolt emigrating seaward estimated with hydroacoustic equipment, Egegik River, 2000.

Smolt Day <sup>a</sup>	Age 1.			Age 2.			Age 3.			All Ages	
	Number	Percent	Cumulative Total	Number	Percent	Cumulative Total	Number	Percent	Cumulative Total	Daily Total	Cumulative Total
5/20	45,872	1.3	45,872	3,481,669	97.9	3,481,669	28,447	0.8	28,447	3,555,988	3,555,988
5/21	454	1.3	46,326	34,521	97.9	3,516,190	282	0.8	28,729	35,257	3,591,245
5/22	900	1.3	47,226	68,319	97.9	3,584,509	558	0.8	29,287	69,777	3,661,022
5/23	13,893	1.3	61,119	1,054,539	97.9	4,639,048	8,616	0.8	37,903	1,077,048	4,738,070
5/24	10,484	1.3	71,603	795,795	97.9	5,434,843	6,502	0.8	44,405	812,781	5,550,851
5/25	6,320	1.3	77,923	479,702	97.9	5,914,545	3,919	0.8	48,324	489,941	6,040,792
5/26	9,022	0.9	86,945	981,224	99.0	6,895,769	1,288	0.1	49,612	991,534	7,032,326
5/27	2,130	0.2	89,075	924,060	99.8	7,819,829	0	0.0	49,612	926,190	7,958,516
5/28	773	0.1	89,848	592,600	99.6	8,412,429	1,606	0.3	51,218	594,979	8,553,495
5/29	23,511	1.0	113,359	2,304,395	99.0	10,716,824	0	0.0	51,218	2,327,906	10,881,401
5/30	38,711	4.0	152,070	920,906	95.9	11,637,730	960	0.1	52,178	960,577	11,841,978
5/31	154,872	4.0	306,942	3,684,264	95.9	15,321,994	3,842	0.1	56,020	3,842,978	15,684,956
6/01	251,663	3.7	558,605	6,537,810	96.1	21,859,804	12,243	0.2	68,263	6,801,716	22,486,672
6/02	203,292	3.7	761,897	5,281,211	96.1	27,141,015	9,889	0.2	78,152	5,494,392	27,981,064
6/03	259,653	11.2	1,021,550	2,061,643	88.6	29,202,658	5,118	0.2	83,270	2,326,414	30,307,478
6/04	16,968	8.3	1,038,518	187,225	91.7	29,389,883	0	0.0	83,270	204,193	30,511,671
6/05	12,608	4.1	1,051,126	296,423	95.9	29,686,306	0	0.0	83,270	309,031	30,820,702
6/06	19,479	5.0	1,070,605	370,349	94.9	30,056,655	546	0.1	83,816	390,374	31,211,076
6/07	39,617	5.0	1,110,222	753,201	94.9	30,809,856	1,111	0.1	84,927	793,929	32,005,005
6/08	18,545	7.8	1,128,767	218,907	92.2	31,028,763	0	0.0	84,927	237,452	32,242,457
6/09	10,909	11.3	1,139,676	85,325	88.4	31,114,088	308	0.3	85,235	96,542	32,338,999
6/10	14,292	11.3	1,153,968	111,784	88.4	31,225,872	404	0.3	85,639	126,480	32,465,479
	1,153,968	3.5		31,225,872	96.2		85,639	0.3		32,465,479	

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 12. Adjustment factors used to expand sonar counts into estimated numbers of sockeye salmon smolt, Egegik River, 2000.

Smolt Day <sup>a</sup>	Mean Weight of Smolt (g)	Smolt per Count
5/20	13.0	3.2
5/21	13.0	3.2
5/22	13.0	3.2
5/23	13.0	3.2
5/24	13.0	3.2
5/25	13.0	3.2
5/26	13.3	3.1
5/27	13.5	3.1
5/28	13.2	3.1
5/29	13.2	3.2
5/30	12.4	3.4
5/31	12.4	3.4
6/01	12.2	3.4
6/02	12.2	3.4
6/03	11.9	3.5
6/04	12.1	3.4
6/05	12.6	3.3
6/06	12.4	3.4
6/07	12.4	3.4
6/08	11.8	3.5
6/09	12.2	3.4
6/10	12.2	3.4

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 13. Mean fork length and weight of sockeye salmon smolt captured by fyke net, Egegik River, 2000.

Smolt Day <sup>a</sup>	Age 1.					Age 2.					Age 3.				
	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size
5/22					0	117	10.4	13.4	3.77	17					0
5/23					0	117	15.9	13.3	5.41	93	124	8.9	15.9	3.19	7
5/24					0	113	17.8	12.0	5.31	98	126	2.4	16.1	1.19	2
5/25					0	118	18.6	14.3	5.95	99	142		24.1		1
5/26					0	115	15.8	13.5	5.31	86	127		18.0		1
5/27					0	116	14.7	13.9	6.01	100					0
5/28					0	114	16.8	12.7	5.45	98	124	5.4	16.2	1.96	2
5/29	99		8.6		1	116	19.8	13.7	6.68	98					0
5/30	95		7.9		1	115	15.9	13.0	5.43	98	125		16.3		1
5/31	101	7.1	9.1	1.34	7	111	21.8	12.0	6.64	93					0
6/01	102	5.3	9.8	1.59	4	110	14.3	12.0	4.94	73	118		15.0		1
6/02	112		9.0		1	110	17.8	11.8	5.46	98	133		20.5		1
6/03	101	11.2	9.8	3.55	14	111	18.4	12.6	6.21	84	126	3.0	17.5	0.59	2
6/04	102	12.7	10.3	3.95	15	109	21.1	12.7	6.89	84					0
6/05	105	4.5	12.0	2.21	7	111	20.2	13.3	7.72	93					0
6/06	110	11.8	12.3	3.74	3	112	21.6	12.8	7.09	95	126		17.7		1
6/07	103	8.8	10.2	3.28	10	108	19.7	11.5	6.33	90					0
6/08	107	7.0	11.5	2.54	11	109	24.1	11.8	8.82	89					0
6/09	104	11.2	10.9	2.48	13	113	32.0	14.2	16.50	85	144	4.2	29.0	2.56	2
Total Mean	103		10.1		87	113		12.9		1,671	128		18.7		21

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 14. Mean fork length and estimated mean weight for age-1. and -2. sockeye salmon smolt, Egegik River, 2000.

Smolt Day <sup>b</sup>	Age 1. <sup>a</sup>				Age 2. <sup>a</sup>			
	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size
5/23	0	0	0	0	118	13.1	14.5	20
5/24	96	3.5	8.6	8	112	19.5	12.6	137
5/25	99	0	9.1	4	114	27.9	13.1	630
5/26	99	1.6	9.2	7	114	27.3	13.3	559
5/27	93	3	7.9	2	115	26.1	13.4	568
5/28	100	0	9.4	1	114	28.5	13.3	546
5/29	100	0	9.4	7	114	30.2	13	575
5/30	98	1.5	9.1	4	114	21.3	13.1	202
5/31	97	5.1	8.8	30	110	28.2	12.1	507
6/01	97	3.3	8.9	8	112	24.8	12.5	298
6/02	98	2.8	9.1	27	111	27	12.1	481
6/03	97	7.1	8.8	68	110	28.5	11.9	472
6/04	98	3.8	9	44	110	29.6	12	464
6/05	97	6	8.8	20	112	29.3	12.5	439
6/06				0				0
6/07	98	6.7	8.9	34	111	29.6	12.3	495
6/08	98	5.5	8.9	40	109	31.1	11.8	402
6/09	97	4.7	8.9	21	107	18.4	11.1	139
6/10	97	5.8	8.8	9	112	20.1	12.5	57
Total Mean	98		8.9	334	112		12.6	6,991

<sup>a</sup> Length-weight parameters by age group and discriminating length used to separate ages were:

Age 1.  $a = -9.5776$   $b = 2.5655$   $r^2 = 0.6734$   $n = 87$

Age 2.  $a = -9.9769$   $b = 2.6470$   $r^2 = 0.8249$   $n = 1,671$

Discriminating Length = 100.81 mm

<sup>b</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 15. Range of sockeye salmon smolt passage from the transducers at Egegik River sonar site, May 20 to June 7, 2000.

	Range of Passage from the Transducers (cm)							
	Inshore Array <sup>a</sup> Smolt Schools		Center Array <sup>b</sup> Smolt Schools		Offshore Array <sup>c</sup> Smolt Schools		All Combined Smolt Schools	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
Maximum			303	240	339	309	303	240
Mean			246	159	293	193	246	159
Minimum			151	91	229	149	151	91
n	0	0	41	41	23	23	64	64

<sup>a</sup> The average counting range from the inshore array transducers on smolt day 6/01 was 251 cm.

<sup>b</sup> The average counting range from the center array transducers on smolt day 6/01 was 331 cm.

<sup>c</sup> The average counting range from the offshore array transducers on smolt day 6/01 was 349 cm.

Table 16. Climatological and hydrological observations made at sockeye salmon smolt counting site at 0800 and 2000 hours, Egegik River, 2000.

Date	Cloud Cover <sup>a</sup>		Precipitation (mm)	Wind Direction & Velocity (km/h)		Air Temperature <sup>b</sup> (°C)		Water Temperature (°C)		Water Clarity <sup>c</sup>
	0800	2000		0800	2000	0800	2000	0800	2000	
5/20	4	3	0.0	ENE 21	E 27	5.0	11.0	3.5	7.0	clear
5/21	3	3	1.3	S 13	SW 19	4.0	8.0	4.0	7.0	clear
5/22	3	2	0.0	SW 23	SW 29	3.0	6.0	4.0	7.0	clear
5/23	3	3	trace	SW 16	SSW 23	1.0	2.0	3.5	5.0	clear
5/24	3	2	0.0	SW 13	SW 10	3.0	8.0	3.0	5.5	clear
5/25	2	3	0.0	SW 08	SW 13	3.0	10.0	2.5	6.5	clear
5/26	2	2	0.0	S 10	W 37	1.0	12.0	2.5	7.0	clear
5/27	4	3	0.0	SW 26	W 24	5.0	7.0	5.0	7.0	clear
5/28	1	2	0.0	SW 18	SW 27	7.0	9.0	4.0	8.0	clear
5/29	4	4	0.0	0	E 26	4.0	6.0	4.0	6.0	clear
5/30	4	4	trace	NE 32	E 29	5.0	6.0	4.0	6.0	clear
5/31	2	2	0.0	E 29	E 32	6.0	8.0	4.5	8.0	clear
6/01	2	4	0.0	E 24	E 35	6.0	6.0	5.0	6.0	clear
6/02	4	3	0.0	NE 24	NE 32	9.0	9.0	4.5	7.0	clear
6/03	1	4	0.0	ENE 16	E 26	9.0	10.0	5.0	7.0	clear
6/04	1	1	0.0	ESE 08	E 13	11.0	17.0	5.0	10.0	clear
6/05	1	2	0.0	0	NW 19	11.0	13.0	5.0	9.0	clear
6/06	4	4	na	NE 32	E 48-64	6.0	na	6.0	na	clear
6/07	4	4	4.1	E 45	E 24	6.0	6.0	5.0	7.0	clear
6/08	4	3	2.3	0	0	6.0	15.0	5.0	8.0	clear
6/09	5	3	0.3	0	0	5.0	12.0	5.0	9.0	clear
6/10	3	3	0.0	0	E 48	9.0	11.0	6.0	9.0	clear
6/11	4	na	na	NW 13	na	8.0	na	6.0	na	clear

<sup>a</sup> 1 = Cloud cover not more than 1/10  
 2 = Cloud cover not more than 1/2  
 3 = Cloud cover more than 1/2  
 4 = Completely overcast  
 5 = Fog

<sup>b</sup> na = not available

<sup>c</sup> Water clarity at 0800 hours

Table 17. Sonar counts by smolt day and array at the sockeye salmon smolt counting site on Ugashik River, 2000.

Smolt Day <sup>a</sup>	Sonar Count		
	Transducer Array		Total
	Inshore	Offshore	
5/19 <sup>b</sup>	18,164	9,414	27,578
5/20 <sup>c</sup>	9,860	8,199	18,059
5/21 <sup>c</sup>	7,012	3,792	10,804
5/22 <sup>c</sup>	5,085	3,861	8,946
5/23 <sup>c</sup>	1,971	2,154	4,125
5/24	4,019	2,957	6,976
5/25 <sup>d</sup>	42,201	34,513	76,714
5/26 <sup>cd</sup>	16,302	11,882	28,184
5/27 <sup>d</sup>	11,239	5,503	16,742
5/28	4,472	3,544	8,016
5/29 <sup>c</sup>	44,369	21,519	65,888
5/30	117,136	119,364	236,500
5/31 <sup>c</sup>	130,519	106,654	237,172
6/01 <sup>c</sup>	150,230	85,319	235,549
6/02	67,073	83,524	150,597
6/03 <sup>c</sup>	25,199	12,865	38,063
6/04 <sup>c</sup>	51,780	30,512	82,291
6/05 <sup>c</sup>	41,771	18,304	60,075
6/06 <sup>ce</sup>	29,624	17,775	47,400
6/07 <sup>c</sup>	5,450	9,029	14,479
6/08	7,097	11,525	18,622
6/09	19,387	19,802	39,189
6/10	7,480	7,475	14,955
6/11 <sup>c</sup>	3,257	4,631	7,888
<b>Total</b>	<b>820,696</b>	<b>634,114</b>	<b>1,454,810</b>
<b>Percent</b>	<b>56.4</b>	<b>43.6</b>	

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

<sup>b</sup> The sonar counter was activated at 1200 hours on smolt day 5/19.

<sup>c</sup> Sonar counts interpolated for one or more arrays for the following periods:

- 2100-1159 hours on smolt day 5/20 due to heavy rain mixed w/ snow
- 1200-1259 hours on smolt day 5/21 due to heavy rain mixed w/ snow
- 1100-1159 hours on smolt day 5/22 due to snow
- 1400-1559 and 1700-1859 hours on smolt day 5/23 due to high WSW wind
- 1500-2159 hours on smolt day 5/26 due to high W wind
- 0900-1159 hours on smolt day 5/26 due to high SW wind and heavy rain
- 0400-0459 hours on smolt day 5/29 due to high E wind and wave action in river
- 1400-1459 hours on smolt day 5/31 due to plane traffic
- 1200-1359 and 1500-1659 hours on smolt day 6/01 due to high E wind and waves
- 1300-1359 and 1700-1959 hours on smolt day 6/03 due to high E wind
- 1200-1459 hours on smolt day 6/04 due to boat traffic
- 1100-1159 hours on smolt day 6/05 due to high E wind
- 1200-1259 and 1500-0959 hours on smolt day 6/06 due to high E wind and waves
- 1300-1559 and 1700-2159 hours on smolt day 6/07 due to high E and NE wind, debris, and rain
- 0400-0459 hours on smolt day 6/11 due to rain
- 0700-1159 hours on smolt day 6/11 due to high E wind and rain

<sup>d</sup> Bendix smolt counter printer relay switch failed. Calculated sonar counts from UW/APL Smolt Counter application \*.dat files for the following periods:

- 0100-0259 hours on smolt day 5/25
- 0000-0859 hours on smolt day 5/26
- 1200-2059 hours on smolt day 5/27

<sup>e</sup> Sonar counter disabled, but unable to interpolate counts for the following period:

- 1300-1459 hours on smolt day 6/06 due to high E wind and waves

Table 18. Sonar counts by hour and array at the sockeye salmon smolt counting site on Ugashik River, 2000.

Sonar Operating Period	Hour	a	Sonar Count			Hourly Percent
			Transducer Array		Total	
			Inshore	Offshore		
	1200		10,945	9,065	20,010	1.38
	1300		6,548	19,831	26,378	1.81
	1400		4,003	5,795	9,798	0.67
	1500		4,079	3,304	7,383	0.51
	1600		4,028	6,240	10,268	0.71
	1700		35,784	31,810	67,593	4.65
	1800		15,768	11,176	26,943	1.85
	1900		10,814	17,662	28,476	1.96
	2000		14,357	8,794	23,150	1.59
Smolt Days	2100		16,122	15,248	31,370	2.16
	2200		16,258	17,998	34,256	2.35
5/19 to 6/11	2300	b	14,004	19,645	33,649	2.31
	2400	c	74,992	69,376	144,368	9.92
	0100	c	193,983	112,903	306,886	21.09
	0200	c	253,905	156,283	410,188	28.20
	0300	c	108,945	85,437	194,381	13.36
	0400	c	12,907	14,168	27,075	1.86
	0500	c	1,620	2,445	4,065	0.28
	0600	b	1,366	1,565	2,930	0.20
	0700		825	1,026	1,850	0.13
	0800		2,003	3,319	5,321	0.37
	0900		2,658	5,106	7,764	0.53
	1000		5,436	8,264	13,700	0.94
	1100		9,351	7,658	17,009	1.17
Total			820,696	634,114	1,454,810	100.00

<sup>a</sup> Daylight hours unless indicated otherwise.

<sup>b</sup> Twilight hours.

<sup>c</sup> Hours of darkness.

Table 19. Daily number of sockeye salmon smolt emigrating seaward estimated with hydroacoustic equipment, Ugashik River, 2000.

Smolt Day <sup>a</sup>	Age 1.			Age 2.			All Ages	
	Number	Percent	Cumulative Total	Number	Percent	Cumulative Total	Daily Total	Cumulative Total
5/19	13,428	7.3	13,428	170,781	92.7	170,781	184,209	184,209
5/20	8,113	7.3	21,541	103,184	92.7	273,965	111,297	295,506
5/21	5,245	7.3	26,786	66,715	92.7	340,680	71,960	367,466
5/22	4,100	7.3	30,886	52,153	92.7	392,833	56,253	423,719
5/23	1,758	7.3	32,644	22,362	92.7	415,195	24,120	447,839
5/24	3,191	7.3	35,835	40,592	92.7	455,787	43,783	491,622
5/25	19,897	4.0	55,732	482,573	96.0	938,360	502,470	994,092
5/26	12,674	6.6	68,406	180,245	93.4	1,118,605	192,919	1,187,011
5/27	7,974	6.6	76,380	113,402	93.4	1,232,007	121,376	1,308,387
5/28	4,171	7.7	80,551	50,139	92.3	1,282,146	54,310	1,362,697
5/29	37,021	7.7	117,572	445,024	92.3	1,727,170	482,045	1,844,742
5/30	118,872	7.7	236,444	1,428,949	92.3	3,156,119	1,547,821	3,392,563
5/31	77,796	4.8	314,240	1,532,892	95.2	4,689,011	1,610,688	5,003,251
6/01	384,536	20.2	698,776	1,523,833	79.9	6,212,844	1,908,369	6,911,620
6/02	502,987	41.1	1,201,763	722,018	58.9	6,934,862	1,225,005	8,136,625
6/03	56,409	18.4	1,258,172	250,999	81.7	7,185,861	307,408	8,444,033
6/04	158,944	23.5	1,417,116	517,992	76.5	7,703,853	676,936	9,120,969
6/05	88,357	17.4	1,505,473	419,445	82.6	8,123,298	507,802	9,628,771
6/06	166,299	37.4	1,671,772	278,470	62.6	8,401,768	444,769	10,073,540
6/07	43,617	37.4	1,715,389	73,037	62.6	8,474,805	116,654	10,190,194
6/08	55,989	37.4	1,771,378	93,755	62.6	8,568,560	149,744	10,339,938
6/09	126,768	37.4	1,898,146	212,275	62.6	8,780,835	339,043	10,678,981
6/10	70,531	52.4	1,968,677	63,994	47.6	8,844,829	134,525	10,813,506
6/11	35,156	52.4	2,003,833	31,897	47.6	8,876,726	67,053	10,880,559
	2,003,833	18.4		8,876,726	81.6		10,880,559	

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 the next calendar day.

Table 20. Adjustment factors used to expand sonar counts into estimated numbers of sockeye salmon smolt, Ugashik River 2000.

Smolt Day <sup>a</sup>	Mean Weight of Smolt (g)	Smolt per Count
5/19	13.3	3.1
5/20	13.3	3.1
5/21	13.3	3.1
5/22	13.3	3.1
5/23	13.3	3.1
5/24	13.3	3.1
5/25	13.0	3.2
5/26	12.7	3.3
5/27	12.7	3.3
5/28	12.6	3.3
5/29	12.6	3.3
5/30	12.6	3.3
5/31	12.4	3.3
6/01	11.1	3.7
6/02	9.7	4.3
6/03	11.3	3.7
6/04	10.8	3.8
6/05	11.0	3.8
6/06	9.7	4.3
6/07	9.7	4.3
6/08	9.7	4.3
6/09	9.7	4.3
6/10	9.4	4.4
6/11	9.4	4.4

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 21. Mean fork length and weight of sockeye salmon smolt captured by fyke net, Ugashik River, 2000.

Smolt Day <sup>a</sup>	Age 1.					Age 2.				
	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size	Mean Length (mm)	Std. Error	Mean Weight (g)	Std. Error	Sample Size
5/20	96	19.0	8.9	4.63	6	115	19.0	13.7	5.82	29
5/21	85	18.0	6.2	3.28	4	114	17.1	13.9	6.26	35
5/22	106	9.6	11.9	2.58	3	115	12.4	13.9	4.14	17
5/23										
5/24						117	12.4	14.3	4.17	44
5/25	108	10.1	12.1	2.91	2	116	16.9	13.7	5.82	98
5/26	103		10.4		1	115	10.8	14.0	4.45	39
5/27	99	3.4	9.5	1.44	6	113	12.4	13.0	3.94	19
5/28	101		10.2		1	115	7.3	14.0	3.07	24
5/29						120	8.1	15.2	2.69	25
5/30	96	11.5	8.3	3.22	17	112	17.1	12.5	5.99	83
5/31	96	10.3	7.7	2.25	5	113	16.2	12.6	5.27	95
6/01	87	15.4	6.3	3.95	35	110	17.2	11.7	5.02	64
6/02	88	26.4	6.4	5.76	36	110	13.3	11.3	5.48	62
6/03	92	19.4	8.6	6.68	9	109	12.1	11.4	3.59	91
6/04	93	22.1	9.0	5.94	21	108	13.5	10.9	3.99	77
6/05	96	12.0	8.3	2.87	16	111	15.7	11.9	5.18	83
6/06										
6/07	84	15.1	5.5	3.37	23	108	3.0	9.9	0.54	2
6/08										
6/09	93	16.3	7.6	4.62	15	105	20.7	10.5	3.14	35
6/10	92	16.4	7.6	4.33	12	110	11.2	10.7	4.71	8
6/11	88	11.3	6.5	2.64	20	110	6.9	11.9	1.36	3
Total Mean	95		8.4		232	112		12.5		933

<sup>a</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 22. Mean fork length and estimated mean weight for age-1. and -2. sockeye salmon smolt, Ugashik River, 2000.

Smolt Day <sup>b</sup>	Age 1. <sup>a</sup>				Age 2. <sup>a</sup>			
	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size	Mean Length (mm)	Std. Error	Estimated Weight (g)	Sample Size
5/20	93	3.7	7.5	3	113	16.4	12.6	36
5/21	93	10.5	7.6	11	114	18.9	13.0	78
5/22	97	0.6	8.5	2	114	14.1	12.9	42
5/23				0	120	10.9	14.7	44
5/24	92	3.0	7.4	2	117	16.8	13.8	124
5/25	96	8.8	8.4	16	115	24.5	13.1	494
5/26	94	6.8	7.8	5	115	17.7	13.3	131
5/27	96	10.8	8.3	14	113	20.3	12.7	194
5/28	93	9.5	7.7	6	114	18.3	12.8	165
5/29	84	1.2	5.6	2	119	16.3	14.5	99
5/30	95	11.3	8.0	51	113	24.7	12.5	465
5/31	95	11.1	8.0	20	113	21.9	12.7	519
6/01	87	22.0	6.3	107	112	20.5	12.3	425
6/02	87	33.5	6.3	289	111	22.7	11.9	290
6/03	91	25.6	7.2	103	112	26.1	12.2	341
6/04	88	32.7	6.6	161	111	27.6	12.0	425
6/05	93	15.7	7.6	92	109	19.7	11.5	412
6/06				0				0
6/07	82	23.7	5.3	105	110	3.7	11.6	3
6/08				0				0
6/09	94	17.6	7.8	94	108	15.6	11.2	239
Total Mean	92		7.3	1,083	113		12.7	4,526

<sup>a</sup> Length-weight parameters by age group and discriminating length used to separate ages were:

Age 1.  $a = -10.8222$   $b = 2.8297$   $r^2 = 0.76$   $n = 232$

Age 2.  $a = -9.5836$   $b = 2.5601$   $r^2 = 0.69$   $n = 933$

Discriminating Length = 101.4 mm

<sup>b</sup> Sample day began at 1200 hours and ended at 1159 hours the next calendar day.

Table 23. Climatological and hydrological observations made at sockeye salmon smolt counting site at 0800 and 2000 hours, Ugashik River, 2000.

Date	Cloud Cover <sup>a</sup>		Precipitation (mm)	Wind Direction & Velocity (km/h)		Air Temperature <sup>b</sup> (°C)		Water Temperature (°C)		Water Clarity <sup>c</sup>
	0800	2000		0800	2000	0800	2000	0800	2000	
5/20	4	4	0.0	NE 05	NE 09	7.0	2.0	4.0	6.0	clear
5/21	4	4	3.0	SW 08	SW 12	1.0	-4.0	5.0	4.0	clear
5/22	3	2	trace	SW 10	W 08	3.0	3.0	4.0	4.0	clear
5/23	3	4	trace	SW 15	SW 14	1.0	2.0	4.0	4.0	clear
5/24	3	2	0.0	SW 06	0	3.0	8.0	3.0	4.0	clear
5/25	3	2	0.0	0	W 10	3.0	11.0	4.0	4.0	clear
5/26	3	2	0.0	SW 10	NW 20	3.0	11.0	4.5	4.0	clear
5/27	4	4	trace	SW 12	SW 10-15	3.0	6.0	4.2	4.0	clear
5/28	4	3	0.0	SW 10	WSW 10	4.0	8.0	3.0	4.0	clear
5/29	4	4	0.0	0	SSW 07	4.0	8.0	4.5	7.0	clear
5/30	3	3	0.0	SE 10	E 15	6.0	13.0	5.0	10.0	clear
5/31	3	3	0.0	E 06	E 14	9.0	20.0	5.0	8.0	clear
6/01	2	4	trace	E 17	E 15	9.0	9.0	7.0	8.0	clear
6/02	3	4	0.0	E 08	NE 16-20	10.0	19.0	7.0	9.0	clear
6/03	4	3	0.0	NE 13	ENE 07	9.0	13.0	7.5	8.0	clear
6/04	2	2	0.0	0	ESE 12	11.0	17.0	7.5	7.0	clear
6/05	1	2	0.0	S 06	E 09	8.0	17.0	7.5	6.0	clear
6/06	4	4	trace	0	E 35-40	9.0	8.0	5.5	6.0	murky
6/07	4	4	trace	E 20	E 25	8.0	10.0	6.0	7.0	murky
6/08	4	4	6.4	NE 06	WSW 09	8.0	9.0	6.0	7.0	clear
6/09	4	2	5.1	0	0	5.0	12.0	5.5	9.0	clear
6/10	2	2	0.8	ENE 05	0	10.0	11.0	7.0	8.0	clear
6/11	4	4	0.8	N 06-10	NE 10	8.0	10.0	7.0	8.0	clear
6/12	4	na	2.5	ENE 20	na	7.0	na	7.0	na	clear

<sup>a</sup> 1 = Cloud cover not more than 1/10  
 2 = Cloud cover not more than 1/2  
 3 = Cloud cover more than 1/2  
 4 = Completely overcast  
 5 = Fog

<sup>b</sup> na = not available

<sup>c</sup> Water clarity at 0800 hours

Table 24. Age composition of total migration and mean fork length and weight by age class for sockeye salmon smolt, Kvichak River, 1955-2000.

Year of Migration	Age 1.			Age 2.			Age 3.			Total Estimate *			
	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year		Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)
1955	1953	7	89	-	1952	93	-	-	1951	0	-	-	260,068
1956	1954	39	92	-	1953	61	116	-	1952	0	-	-	77,660
1957	1955	72	96	7.3	1954	28	120	14.4	1953	0	-	-	30,907
1958	1956	98	84	4.6	1955	2	114	-	1954	0	-	-	3,333,953
1959	1957	3	80	-	1956	97	99	7.6	1955	0	-	-	2,863,876
1960	1958	10	91	6.3	1957	90	108	10.3	1956	0	-	-	614,003
1961	1959	72	92	6.8	1958	28	117	13.1	1957	0	-	-	36,164
1962	1960	94	82	4.3	1959	6	110	9.9	1958	0	-	-	1,203,000
1963	1961	3	83	4.8	1960	97	98	7.5	1959	0	-	-	4,229,431
1964	1962	22	87	5.2	1961	78	108	9.8	1960	0	-	-	2,061,586
1965	1963	4	90	6.8	1962	96	109	11.3	1961	0	-	-	1,812,555
1966	1964	92	94	7.4	1963	8	114	12.6	1962	0	-	-	275,761
1967	1965	93	86	5.9	1964	7	118	14.2	1963	0	-	-	3,088,742
1968	1966	11	88	5.5	1965	89	104	9.2	1964	0	-	-	6,123,683
1969	1967	52	92	5.7	1966	48	109	10.6	1965	0	-	-	1,135,344
1970	1968	38	91	6.0	1967	62	110	11.0	1966	0	-	-	483,638
1971	1969	93	90	5.8	1968	7	111	11.1	1967	0	-	-	91,682,813
1972	1970	1	80	4.2	1969	99	106	10.0	1968	0	-	-	54,623,559
1973	1971	3	86	5.1	1970	97	97	8.3	1969	0	-	-	196,966,331
1974	1972	9	96	8.3	1971	79	111	13.1	1970	12	124	17.5	27,082,626
1975	1973	63	98	8.4	1972	37	122	16.4	1971	0	-	-	15,632,531
1976	1974	97	88	5.8	1973	3	121	14.2	1972	0	-	-	111,388,180
1977	1975	38	86	5.5	1974	62	106	10.1	1973	0	-	-	192,578,099
1978	1976	12	88	6.0	1975	88	97	7.8	1974	0	-	-	245,591,014
1979	1977	51	90	6.0	1976	49	109	10.3	1975	0	-	-	55,181,540
1980	1978	94	88	5.9	1977	6	110	10.7	1976	0	-	-	192,853,007
1981	1979	89	85	5.4	1978	11	108	10.2	1977	0	-	-	252,222,769
1982	1980	58	84	5.1	1979	39	103	9.1	1978	0	-	-	239,721,729
1983	1981	8	80	4.9	1980	92	98	8.5	1979	0	-	-	82,793,899
1984	1982	58	90	6.8	1981	42	104	10.0	1980	0	-	-	89,489,975
1985	1983	92	85	5.3	1982	8	102	9.2	1981	0	-	-	25,527,851
1986	1984	61	84	5.5	1983	39	107	10.4	1982	<1	102	9.1	136,733,218
1987	1985	3	82	4.5	1984	97	96	7.0	1983	<1	97	8.5	342,686,918
1988	1986	13	86	5.6	1985	87	99	8.3	1984	<1	107	9.8	100,173,692
1989	1987	95	85	5.5	1986	5	108	10.8	1985	<1	105	9.5	153,464,216
1990	1988	53	87	6.1	1987	47	105	10.5	1986	0	-	-	88,004,103
1991	1989	72	85	5.5	1988	28	105	9.9	1987	0	-	-	121,454,182
1992	1990	23	84	5.6	1989	77	100	9.3	1988	0	-	-	79,490,008
1993	1991	10	86	6.0	1990	90	97	8.2	1989	0	-	-	226,407,888
1994	1992	64	84	5.7	1991	36	102	9.5	1990	0	-	-	83,845,472
1995	1993	95	87	6.2	1992	5	103	9.8	1991	0	-	-	220,892,127
1996	1994	74	89	6.5	1993	26	110	11.3	1992	0	-	-	373,166,532
1997	1995	74	88	6.8	1994	26	105	10.6	1993	0	-	-	363,397,663
1998	1996	65	90	6.7	1995	35	112	11.9	1994	0	-	-	295,470,850
1999	1997	92	86	5.8	1996	8	108	10.3	1995	0	-	-	143,543,215
Mean			87	5.9			107	10.4			107	10.9	
2000	1998	82	86	5.8	1997	18	103	9.5	1996	0	-	-	130,038,649
% Difference from Mean			-2	-1			-4	-9					

\* Estimates of smolt numbers from 1955 to 1970 based on fyke net catches; estimates of smolt numbers from 1971 to present based on hydroacoustic techniques.

Table 25. Water temperatures at sockeye salmon smolt counting site, Kvichak River, 1963-2000.

Year	Sample Period	Water Temperature (°C)		
		Minimum	Mean	Maximum
1963	May 16 - June 14	2.2	5.5	8.9
1964	May 18 - June 14	0.0	2.6	5.6
1965	May 17 - June 11	0.0	4.4	8.9
1966	May 16 - June 26	0.0	4.7	11.1
1967	May 17 - June 20	1.1	6.9	9.4
1968	May 12 - June 12	3.3	5.4	8.3
1969	May 16 - June 18	0.3	3.9	7.8
1970	May 13 - June 07	2.8	6.8	11.1
1971	May 17 - June 20	1.1	2.4	3.3
1972	May 18 - June 18	0.6	2.9	5.0
1973	May 15 - June 14	2.9	4.9	8.9
1974	May 13 - June 09	3.0	6.2	8.0
1975	May 17 - June 15	2.0	3.8	8.0
1976	May 18 - June 19	2.0	3.9	9.5
1977	May 17 - June 14	3.0	6.4	9.5
1978	May 19 - June 09	5.0	7.6	11.0
1979	June 01 - June 10	8.0	8.6	10.0
1980	May 16 - June 18	1.5	5.5	9.0
1981	May 15 - June 09	7.0	8.2	10.0
1982	May 14 - June 15	2.5	4.9	8.5
1983	May 19 - June 14	5.2	7.9	10.5
1984	May 19 - June 11	5.5	7.9	10.0
1985	May 23 - June 20	2.0	4.6	7.0
1986	May 18 - June 12	1.0	4.6	7.0
1987	May 21 - June 13	4.5	6.7	9.0
1988	May 17 - June 17	3.0	7.1	11.0
1989	May 19 - June 16	3.0	5.8	8.8
1990	May 22 - June 15	3.5	7.3	9.5
1991	May 23 - June 17	1.0	4.8	8.5
1992	May 22 - June 14	5.0	7.8	10.0
1993	May 19 - June 12	4.0	6.6	11.0
1994	May 22 - June 16	1.5	6.1	11.0
1995	May 21 - June 14	4.0	8.1	12.5
1996	May 17 - June 13	5.0	8.1	13.0
1997	May 17 - June 13	5.0	8.8	13.0
1998	May 18 - June 13	2.0	6.2	9.5
1999	May 23 - June 17	0.0	2.9	8.0
Mean		2.8	5.9	9.2
2000	May 20 - June 14	2.5	7.4	9.5
Difference from Mean		-0.3	1.5	0.3

Table 26. Sockeye salmon spawning escapement, total number of smolt produced by age class, percent of total smolt production by age class, and number of smolt produced per spawner for 1968-1998 brood years, Kvichak River.

Brood Year	Total Spawning Escapement <sup>a</sup>	Number of Smolt Produced						Per Spawner
		Age 1.	(%) <sup>b</sup>	Age 2.	(%) <sup>b</sup>	Age 3.	(%) <sup>b</sup>	
1968				5,959,383		0		
1969	8,394,204	85,723,430	61	54,159,340	39	0	139,882,770	16.7
1970	13,935,306	464,219	<1	191,842,930	98	2,918,768	195,225,917	14.0
1971	2,387,392	5,123,400	19	21,423,246	81	0	26,546,646	11.1
1972	1,009,962	2,740,610						
1973	226,554			3,031,287		0		
1974	4,433,844	108,356,892	49	114,269,848	51	0	222,626,740	50.2
1975	13,140,450	78,308,251	27	213,364,470	73	0	291,672,721	22.2
1976	1,965,282	32,226,544	55	26,423,348	45	0	58,649,892	29.8
1977	1,341,144	28,758,191	73	10,410,467	27	0	39,168,658	29.2
1978	4,149,288	182,442,540	85	32,294,536	15	0	214,737,076	51.8
1979	11,218,434	219,928,232	71	89,300,703	29	0	309,228,935	27.6
1980	22,505,268	150,421,026	66	76,244,773	34	0	226,665,799	10.1
1981	1,754,358	6,549,125	15	37,595,987	85	0	44,145,112	25.2
1982	1,134,840	51,893,988	96	1,937,408	4	2,065	53,833,461	47.4
1983	3,569,982	23,590,443	31	53,260,693	69	123,975	76,975,111	21.6
1984	10,490,670	83,470,460	20	331,384,545	80	43,135	414,898,140	39.5
1985	7,211,046	11,178,398	11	87,004,194	89	30,345	98,212,937	13.6
1986	1,179,322	13,126,363	66	6,830,717	34	0	19,957,080	16.9
1987	6,065,880	146,603,154	78	41,434,534	22	0	188,037,688	31.0
1988	4,065,216	46,569,569	58	34,266,421	42	0	80,835,990	19.9
1989	8,317,500	87,187,761	59	61,317,308	41	0	148,505,069	17.9
1990	6,970,020	18,172,700	8	204,626,879	92	0	222,799,579	32.0
1991	4,222,788	21,781,009	42	30,207,268	58	0	51,988,277	12.3
1992	4,725,864	53,638,204	83	11,034,144	17	0	64,672,348	13.7
1993	4,025,166	209,857,983	69	96,434,554	31	0	306,292,537	76.1
1994	8,337,840	276,731,978	75	94,049,964	25	0	370,781,942	44.5
1995	10,038,720	269,347,699	72	103,481,449	28	0	372,829,148	37.1
1996	1,450,578	191,989,401	94	12,200,727	6	0	204,190,128	140.8
1997	1,503,732	131,342,488	85	23,859,650	15	<sup>c</sup>	155,202,138 <sup>c</sup>	103.2 <sup>c</sup>
1998	2,296,074	106,178,999				<sup>c</sup>		
1986-1995 Max	10,038,720	276,731,978	83	204,626,879	92	0	372,829,148	76.1
1986-1995 Avg	5,794,832	114,301,642	61	68,368,324	39	0	182,669,966	30.1
1986-1995 Min	1,179,322	13,126,363	8	6,830,717	17	0	19,957,080	12.3

<sup>a</sup> Kvichak River tower count only. Does not include aerial survey index counts from Branch River.

<sup>b</sup> Percent of total smolt production.

<sup>c</sup> Incomplete returns from brood year escapements.

Table 27. Sockeye salmon spawning escapements, smolt production, adult returns, and smolt survival (number of adults produced per smolt) for 1968-1998 brood years, Kvichak River.

Brood Year	Total Spawning Escapement <sup>a</sup>	Age 1.			Age 2.		
		Number of Smolt	Adult <sup>b</sup> Returns	Adult Returns per Smolt	Number of Smolt	Adult <sup>b</sup> Returns	Adult Returns per Smolt
1968	2,557,440	.	.	.	5,959,383	209,138	0.04
1969	8,394,204	85,723,430	449,791	0.01	54,159,340	4,824,026	0.09
1970	13,935,306	464,219	56,778	0.12	191,842,930	15,351,498	0.08
1971	2,387,392	5,123,400	337,314	0.07	21,423,246	2,489,981	0.12
1972	1,009,962	2,740,610	436,837	0.16	.	1,504,435	<sup>c</sup>
1973	226,554	.	1,606,766	<sup>c</sup>	3,031,287	818,529	0.27
1974	4,433,844	108,326,892	8,353,542	0.08	114,269,848	17,796,617	0.16
1975	13,140,450	78,308,251	6,920,452	0.09	213,364,470	31,164,576	0.15
1976	1,965,282	32,226,544	6,132,390	0.19	26,423,348	4,431,284	0.17
1977	1,341,144	28,758,191	2,912,441	0.10	10,410,467	309,369	0.03
1978	4,149,288	182,442,540	2,991,655	0.02	32,294,536	2,151,024	0.07
1979	11,218,434	219,928,232	20,621,724	0.09	89,300,703	21,516,038	0.24
1980	22,505,268	150,421,026	4,534,253	0.03	76,244,773	8,508,770	0.11
1981	1,754,358	6,549,125	1,019,361	0.16	37,595,987	1,098,376	0.03
1982	1,134,840	51,893,988	995,144	0.02	1,937,408	663,241	0.34
1983	3,569,982	23,590,443	11,612,066	0.49	53,260,693	1,773,442	0.03
1984	10,490,670	83,470,460	4,455,429	0.05	331,384,545	19,478,848	0.06
1985	7,211,046	11,178,398	2,313,349	0.21	87,004,194	15,069,258	0.17
1986	1,179,322	13,126,363	1,791,108	0.14	6,830,717	2,722,727	0.40
1987	6,065,880	146,603,154	6,706,260	0.05	41,434,534	5,229,846	0.13
1988	4,065,216	46,569,569	4,982,204	0.11	34,266,421	4,961,033	0.14
1989	8,317,500	87,187,761	3,829,838	0.04	61,317,308	22,259,220	0.36
1990	6,970,020	18,172,700	2,740,515	0.15	204,626,879	22,351,535	0.11
1991	4,222,788	21,781,009	3,927,255	0.18	30,207,268	870,852	0.03
1992	4,725,864	53,638,204	655,398	0.01	11,034,144	743,926	0.07
1993	4,025,166	209,857,983	1,750,572	0.01	96,434,554	1,180,762	0.01
1994	8,337,840	276,731,978	2,987,502	0.01	94,049,964	3,972,452 <sup>d</sup>	0.04 <sup>d</sup>
1995	10,038,720	269,347,699	9,473,554 <sup>d</sup>		103,481,449	513,662 <sup>d</sup>	
1996	1,450,578	191,989,401	362,150 <sup>d</sup>		12,200,727	0 <sup>d</sup>	
1997	1,503,732	131,342,488	0 <sup>d</sup>		23,859,650	<sup>d</sup>	
1998	2,296,074	106,178,999	<sup>d</sup>				
1984-1993 Max	10,490,670	209,857,983	6,706,260	0.21	331,384,545	22,351,535	0.40
1984-1993 Avg	5,727,347	69,158,560	3,315,193	0.09	90,454,056	9,486,801	0.15
1984-1993 Min	1,179,322	11,178,398	655,398	0.01	6,830,717	743,926	0.01

<sup>a</sup> Kvichak River tower count only. Does not include aerial survey index counts from Branch River.

<sup>b</sup> Includes estimates of adult returns through 2000.

<sup>c</sup> Insufficient smolt samples collected to perform this calculation.

<sup>d</sup> Future adult returns will increase these values.

Table 28. Comparison of the age composition of outmigrating sockeye salmon smolt at Kvichak River with the freshwater age composition of their total adult returns by brood year, 1981-1993.

Smolt Outmigration Year	Brood Years	Freshwater Age	Proportion of Total			Comments
			Smolt	Adult	Difference	
1983	1981 1980	Age 1. Age 2.	0.15 .	0.48 .	-0.33	Ice problems - (5/19-5/22), intermittent
1984	1982 1981	Age 1. Age 2.	0.96 0.85	0.60 0.52	0.36 0.33	No ice problems noted.
1985	1983 1982	Age 1. Age 2.	0.31 0.04	0.87 0.40	-0.56 -0.36	Ice problems - 5/22-6/02, 6/06 intermittent, 6/3-6/5 continuous
1986	1984 1983	Age 1. Age 2.	0.20 0.69	0.19 0.13	0.01 0.56	No ice problems noted.
1987	1985 1984	Age 1. Age 2.	0.11 0.80	0.13 0.81	-0.02 -0.01	No ice problems noted.
1988	1986 1985	Age 1. Age 2.	0.66 0.89	0.40 0.87	0.26 0.02	No ice problems noted.
1989	1987 1986	Age 1. Age 2.	0.78 0.34	0.56 0.60	0.22 -0.26	No ice problems noted.
1990	1988 1987	Age 1. Age 2.	0.58 0.22	0.50 0.44	0.08 -0.22	Ice problems prior to 5/21.
1991	1989 1988	Age 1. Age 2.	0.59 0.41	0.15 0.50	0.44 -0.09	Ice problems - 5/22-5/26 intermittent, 5/27-5/29 continuous.
1992	1990 1989	Age 1. Age 2.	0.08 0.41	0.11 0.85	-0.03 -0.44	Ice problems - 5/19-5/22 continuous, 5/24-5/26 and 5/31 intermitten
1993	1991 1990	Age 1. Age 2.	0.42 0.92	0.82 0.89	-0.40 0.03	No ice problems. River ice-free 10 d before sonar activated.
1994	1992 1991	Age 1. Age 2.	0.83 0.58	0.47 0.18	0.36 0.40	Ice problems - 5/17- 5/28 continuous.
1995	1993 1992	Age 1. Age 2.	0.69 0.17	0.60 0.53	0.09 -0.36	Ice problems - 5/17- 5/21 continuous.
1996	1994 1993	Age 1. Age 2.	. 0.31	. 0.40	. -0.09	No ice problems. River ice-free 8 d before sonar activated. Excellent Weather - 46 h disabled time

Table 29. Age composition of total migration and mean fork length and weight by age class for sockeye salmon smolt, Egegik River, 1939-2000.

Year of Migration	Age 1.				Age 2.				Age 3.				Total Estimate <sup>a</sup>
	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	
1939	1937		96		1936		105		1935				
1956	1954		101		1953		116		1952		123		
1957	1955		107		1954		120		1953		130		
1959	1957		99		1956		116		1955		123		
1960	1958		106		1957		115		1956		140		
1969	1967		99		1966		119		1965		115		
1977	1975		110	11.3	1974		116	13.3	1973				
1978	1976		104	10.1	1975		122	15.4	1974		130	18.1	
1981	1979		105	9.1	1978		122	16.6	1977		128	19.1	
1982	1980	77	104	9.2	1979	23	130	17.1	1978	0	145	23.5	63,970,160
1983	1981	12	101	9.3	1980	88	116	13.6	1979	0			18,766,889
1984	1982	35	106	10.1	1981	65	112	12.2	1980	0	134	20.2	49,667,432
1985	1983	83	106	10.4	1982	17	123	16.8	1981	0	138	24.1	66,073,548
1986	1984	32	101	9.0	1983	68	122	15.7	1982	0	140	22.6	44,197,865
1987	1985	9	107	11.6	1984	91	114	14.1	1983	0	128	18.9	49,868,710
1988	1986	74	103	10.2	1985	26	117	14.3	1984	0	136	21.2	48,961,215
1989	1987	73	99	8.9	1986	27	119	15.4	1985	0	135	21.1	99,886,786
1990	1988	7	87	6.1	1987	93	105	10.5	1986	0			56,095,226
1991	1989	5	102	10.3	1988	95	118	15.6	1987	0	140	24.4	94,095,226
1992	1990	26	104	10.2	1989	73	112	12.4	1988	1	127	17.6	23,748,278
1993	1991	35	102	9.3	1990	65	112	12.2	1989	0	138	22.1	57,960,399
1994	1992	58	104	9.6	1991	42	118	13.7	1990	0	125	14.6	94,086,989
1995	1993	13	103	9.3	1992	87	112	11.6	1991	0	126	14.9	57,385,790
1996	1994	71	106	10.5	1993	26	124	16.1	1992	3	141	21.4	31,270,793
1997	1995	45	103	9.5	1994	54	117	13.4	1993	1	135	18.4	27,050,113
1998	1996	64	105	9.0	1995	35	121	13.7	1994	1	132	16.2	78,791,125
1999	1997	9	107	9.9	1996	87	127	16.5	1995	2	140	19.2	8,592,482
Mean			103	9.7			117	14.3			133	19.9	
2000	1998	4	103	10.1	1997	96	113	12.9	1996	0	128	18.7	32,465,479
Difference from Mean			0	0.4			.4	-1.4			.5	-1.2	

<sup>a</sup> No estimate of smolt numbers for 1939-1981 fyke net catches; estimates of smolt numbers from 1982-2000 based on hydroacoustic techniques.

Table 30. Water temperatures at sockeye salmon smolt counting site, Egegik River, 1981-2000.

Year	Sample Period	Water Temp (C°)		
		Minimum	Mean	Maximum
1981	May 15 - June 08	7.0	8.2	10.0
1982	May 15 - June 16	2.5	4.9	8.5
1983	May 18 - June 10	5.2	7.9	10.5
1984	May 17 - June 11	5.5	7.9	10.0
1985	May 17 - June 12	2.0	4.6	7.0
1986	May 19 - June 12	1.0	4.6	7.0
1987	May 18 - June 13	4.5	6.7	9.0
1988	May 19 - June 14	3.0	7.1	11.0
1989	May 21 - June 10	3.0	5.8	8.8
1990	May 20 - June 11	3.5	7.3	9.5
1991	May 21 - June 12	1.0	4.8	8.5
1992	May 21 - June 12	5.0	7.8	10.0
1993	May 18 - June 09	4.0	6.6	11.0
1994	May 21 - June 10	1.5	6.1	11.0
1995	May 21 - June 13	2.0	7.0	12.5
1996	May 19 - June 13	2.0	5.8	10.5
1997	May 19 - June 10	3.5	7.9	13.0
1998	May 19 - June 11	2.5	4.9	7.0
1999	May 21 - June 14	0.0	2.2	8.0
Mean		3.1	6.2	9.6
2000	May 20 - June 11	2.5	5.8	10.0
Difference from Mean		-0.6	-0.4	0.4

Table 31. Sockeye salmon spawning escapement, total number of smolt produced by age class, percent of total smolt production composed by age class, and number of smolt produced per spawner for 1978-1998 brood years, Egegik River.

Brood Year	Total Spawning Escapement <sup>a</sup>	Number of Smolt Produced						Per Spawner	
		Age 1.	(% <sup>b</sup> )	Age 2.	(% <sup>b</sup> )	Age 3.	(% <sup>b</sup> )		Total
1978	895,698					225,522			
1979	1,032,042			14,287,075		0			
1980	1,060,860	49,457,563	75	16,524,563	25	197,429	0	66,179,555	62.4
1981	694,680	2,242,326	6	32,235,734	93	52,852	0	34,530,912	49.7
1982	1,034,628	17,234,269	60	11,434,848	40	564	0	28,669,681	27.7
1983	792,282	54,585,828	64	29,984,140	35	85,087	0	84,655,055	106.8 <sup>c</sup>
1984	1,165,345	14,016,441	24	45,386,536	76	80,931	0	59,483,908	51.0
1985	1,095,192	4,397,087	26	12,758,135	74	81,150	0	17,236,372	15.7
1986	1,151,320	36,122,149	57	27,347,612	43	0	0	63,469,761	55.1
1987	1,272,978	72,458,024	58	52,299,487	42	396,423	0	125,153,934	98.3 <sup>c</sup>
1988	1,612,680	3,795,739	4	89,162,038	96	361,128	0	93,318,905	57.9
1989	1,610,916	4,519,527	21	17,338,786	79	37,254	0	21,895,567	13.6
1990	2,191,362	6,048,364	14	37,719,609	86	19,196	0	43,787,169	20.0
1991	2,786,880	20,203,545	34	39,158,743	66	11,242	0	59,373,530	21.3
1992	1,945,332	54,909,050	52	49,962,265	47	1,067,697	1	105,939,012	54.5
1993	1,516,980	7,412,283	47	8,089,658	52	202,218	1	15,704,159	10.4
1994	1,897,932	22,113,438	58	14,630,756	39	1,119,575	3	37,863,769	20.0
1995	1,281,678	12,217,139	31	27,476,148	68	201,076	1	39,894,363	31.1
1996	1,076,460	50,195,402	87	7,616,295	13	85,639	0	57,897,336	53.8
1997	1,103,964	775,111	2	31,225,872	98			32,000,983 <sup>d</sup>	29.0 <sup>d</sup>
1998	1,110,882	1,153,968							
1986-1995 Max	2,786,880	72,458,024	58	89,162,038	96	1,119,575	3	125,153,934	98.3
1986-1995 Avg	1,726,806	23,979,926	38	36,318,510	62	341,581	1	60,640,017	38.2
1986-1995 Min	1,151,320	3,795,739	4	8,089,658	39	0	0	15,704,159	10.4

<sup>a</sup> Egegik River tower count only. Does not include aerial survey index counts from Shosky Creek or King Salmon River.

<sup>b</sup> Percent of total smolt production

<sup>c</sup> Smolt outmigration estimates for brood years with unusually high smolt per spawner ratios may be artificially low. During these years smolt may have passed undetected before, during, or after the operational dates of the smolt sonar.

<sup>d</sup> Incomplete returns from brood year escapements.

Table 32. Sockeye salmon spawning escapements, smolt production, adult returns, and smolt survival (number of adults produced per smolt) for 1978-1998 brood years, Egegik River.

Brood Year	Total Spawning Escapement <sup>a</sup>	Age 1.			Age 2.			Age 3.		
		Number of Smolt	Adult Returns <sup>b</sup>	Adult Returns per Smolt	Number of Smolt	Adult Returns <sup>b</sup>	Adult Returns per Smolt	Number of Smolt	Adult Returns <sup>b</sup>	Adult Returns per Smolt
1978	895,698		908,379			8,264,740		225,522	33,395	0.15
1979	1,032,042		1,239,273		14,287,075	4,705,018	0.33	0	0	
1980	1,060,860	49,457,563	3,035,494	0.06	16,524,563	5,519,025	0.33	197,429	7,730	0.04
1981	694,680	2,242,326	1,508,516	0.67 <sup>c</sup>	32,235,734	4,785,803	0.15	52,852	16,119	0.30
1982	1,034,628	17,234,269	2,873,325	0.17	11,434,848	3,447,534	0.30	564	12,739	
1983	792,282	54,585,828	4,520,747	0.08	30,036,716	6,086,667	0.20	85,087	37,683	0.44 <sup>c</sup>
1984	1,165,345	14,160,585	1,597,084	0.11	45,386,536	11,665,474	0.26	80,931	256,616	
1985	1,095,192	4,397,087	1,980,826	0.45 <sup>c</sup>	12,758,135	5,652,082	0.44 <sup>c</sup>	81,150	25,976	0.32
1986	1,151,320	36,122,149	5,676,245	0.16	27,347,612	8,520,337	0.31	0	120,388	
1987	1,272,978	72,458,024	5,548,894	0.08	52,299,487	20,199,111	0.39	396,423	193,309	0.49 <sup>c</sup>
1988	1,612,680	3,795,739	1,695,748	0.45	89,162,038	16,775,951	0.19	361,128	412,775	
1989	1,610,916	4,519,527	974,486	0.22	17,338,786	10,076,582	0.58 <sup>c</sup>	37,245	201,466	
1990	2,191,362	6,048,364	1,273,444	0.21	37,719,609	14,413,452	0.38	19,196	50,934	
1991	2,786,880	20,203,545	5,384,844	0.27	39,158,743	5,741,882	0.15	11,242	27,130	
1992	1,945,332	54,909,050	1,457,300	0.03	49,962,265	8,131,876	0.16	1,067,697	70,999 <sup>e</sup>	
1993	1,516,980	7,412,283	1,082,075	0.15	8,089,658	1,903,401 <sup>e</sup>	0.24	202,218	5,717 <sup>e</sup>	
1994	1,897,932	22,113,438	1,361,016 <sup>e</sup>	0.06 <sup>e</sup>	14,630,756	7,410,038 <sup>e</sup>	0.51 <sup>e</sup>	1,119,575	10,712 <sup>e</sup>	
1995	1,281,678	12,217,139	6,385,567 <sup>e</sup>		27,476,148	1,660,760 <sup>e</sup>		201,076		
1996	1,076,460	50,195,402	501,038 <sup>e</sup>		7,616,295			85,639		
1997	1,103,964	775,111			31,225,872					
1998	1,110,882	1,153,968								
1984-1993 Max	2,786,880	72,458,024	5,676,245	0.45	89,162,038	20,199,111	0.58	1,067,697	412,775	0.49
1984-1993 Avg	1,634,899	22,402,635	2,667,095	0.21	37,922,287	10,308,015	0.31	225,723	136,531	0.40
1984-1993 Min	1,095,192	3,795,739	974,486	0.03	8,089,658	1,903,401	0.15	0	5,717	0.32

<sup>a</sup> Egegik River tower count only. Does not include aerial survey index counts from Shosky Creek or King Salmon River.

<sup>b</sup> Includes estimates of adult returns through 2000.

<sup>c</sup> Smolt outmigration estimates for brood years with unusually high adult return per smolt ratios may be artificially low. During these years smolt may have passed undetected before, during, or after the operational dates of the smolt sonar.

<sup>d</sup> Insufficient Age 3. smolt sampled to perform this calculation.

<sup>e</sup> Future adult returns will increase these values.

Table 33. Comparison of the age composition of outmigrating sockeye salmon smolt at Egegik River with the freshwater age composition of their total adult returns by brood year, 1981-1993.

Smolt Outmigration Year	Brood Year	Freshwater Age	Proportion of Total		Difference	Comments
			Smolt	Adult		
1983	1981	Age 1.	0.06	0.24	-0.18	No ice problems noted.
	1980	Age 2.	.	.		
1984	1982	Age 1.	0.60	0.45	0.15	No ice problems noted.
	1981	Age 2.	0.93	0.76	0.17	
1985	1983	Age 1.	0.64	0.42	0.22	Ice present - 5/17-5/22 intermittent
	1982	Age 2.	0.40	0.54	-0.14	
1986	1984	Age 1.	0.24	0.12	0.12	Ice present - 5/19-5/25 intermittent
	1983	Age 2.	0.35	0.57	-0.22	
1987	1985	Age 1.	0.26	0.26	0.00	No ice problems noted.
	1984	Age 2.	0.76	0.86	-0.10	
1988	1986	Age 1.	0.57	0.40	0.17	No ice problems noted.
	1985	Age 2.	0.74	0.74	0.00	
1989	1987	Age 1.	0.58	0.21	0.37	No ice problems noted.
	1986	Age 2.	0.43	0.60	-0.17	
1990	1988	Age 1.	0.04	0.09	-0.05	Fair Weather - 118 h disabled time
	1987	Age 2.	0.42	0.78	-0.36	
1991	1989	Age 1.	0.21	0.09	0.12	Ice problems - 5/17-5/18 continuous.
	1988	Age 2.	0.96	0.89	0.07	
1992	1990	Age 1.	0.14	0.08	0.06	No ice problems noted.
	1989	Age 2.	0.79	0.90	-0.11	
1993	1991	Age 1.	0.34	0.48	-0.01	No ice problems noted.
	1990	Age 2.	0.86	0.92	-0.06	
1994	1992	Age 1.	0.52	0.15	0.37	Excellent Weather - no disabled time.
	1991	Age 2.	0.66	0.52	0.14	
1995	1993	Age 1.	0.47	0.36	0.11	Ice problems - 5/19-5/21 and 0100-0500 hours on 5/23; good weather thereafter
	1992	Age 2.	0.47	0.84	-0.37	
1996	1994	Age 1.	.	.	Excellent Weather - 26 h disabled time.	
	1993	Age 2.	0.52	0.64		-0.12

Table 34 Age composition of total migration and mean fork length and weight by age class for sockeye salmon smolt, Ugashik River, 1958-2000.

Year of Migration	Age 1.				Age 2.				Age 3.				Total Estimate <sup>a</sup>
	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	Brood Year	Percent of Total Estimate	Mean Length (mm)	Mean Weight (g)	
1958	1956	-	93	6.4	1955	-	112	11.7	1954	-	-	-	-
1959	1957	-	90	6.1	1956	-	120	13.5	1955	-	-	-	-
1960	1958	-	90	6.6	1957	-	104	11.0	1956	-	-	-	-
1961	1959	-	90	6.7	1958	-	112	12.2	1957	-	-	-	-
1962	1960	-	88	6.1	1959	-	112	12.3	1958	-	-	-	-
1963	1961	-	90	6.1	1960	-	104	9.6	1959	-	-	-	-
1964	1962	-	92	6.9	1961	-	118	12.7	1960	-	-	-	-
1965	1963	-	94	6.9	1962	-	114	12.5	1961	-	-	-	-
1967	1965	-	88	6.0	1964	-	113	12.2	1963	-	-	-	-
1968	1966	-	93	6.5	1965	-	113	10.7	1964	-	-	-	-
1969	1967	-	97	7.5	1966	-	121	14.5	1965	-	-	-	-
1970	1968	-	97	7.7	1967	-	125	15.9	1966	-	-	-	-
1972	1970	-	81	5.0	1969	-	112	11.2	1968	-	129	14.3	-
1973	1971	-	93	7.2	1970	-	113	11.9	1969	-	132	20.1	-
1974	1972	-	94	7.4	1971	-	119	13.6	1970	-	-	-	-
1975	1973	-	96	7.2	1972	-	116	13.0	1971	-	125	16.7	-
1982	1980	-	88	6.3	1979	-	113	13.0	1978	-	138	22.5	-
1983	1981	71	89	7.6	1980	29	111	13.2	1979	-	-	-	44,033,811
1984	1982	48	87	6.8	1981	52	102	10.3	1980	0	103	11.7	158,174,626
1985	1983	37	94	8.3	1982	63	107	11.8	1981	-	-	-	34,101,390
1986	1984	71	87	5.8	1983	29	114	10.9	1982	-	-	-	53,076,253
1987	1985	20	94	7.9	1984	80	107	11.1	1983	0	138	24.1	26,947,225
1988	1986	85	87	5.7	1985	15	109	10.8	1984	0	128	15.6	215,968,015
1989	1987	74	90	6.5	1986	26	108	10.7	1985	-	-	-	126,298,122
1990	1988	28	90	6.7	1987	72	108	11.8	1986	-	-	-	53,627,347
1991	1989	35	92	7.7	1988	65	107	11.6	1987	-	-	-	73,769,877
1992 <sup>b</sup>	1990	-	-	-	1989	-	-	-	1988	-	-	-	-
1993	1991	83	92	8.0	1990	17	109	12.5	1989	-	-	-	70,747,074
1994	1992	81	89	6.7	1991	19	109	11.2	1990	-	-	-	30,030,624
1995	1993	31	93	7.8	1992	69	106	11.1	1991	-	-	-	22,234,137
1996	1994	44	101	9.9	1993	56	114	13.5	1992	-	-	-	2,576,812
1997	1995	92	92	7.9	1994	8	109	12.1	1993	-	-	-	15,519,783
1998	1996	82	91	6.4	1995	18	110	11.1	1994	-	-	-	12,624,441
1999	1997	99	91	6.8	1996	1	125	17.5	1995	-	-	-	10,631,631
Mean			91	6.9			112	12.2			128	17.9	
2000	1998	18	95	8.4	1997	82	112	12.5	1996	-	-	-	10,880,559
% Difference from Mean			4	21			0	2					

<sup>a</sup> No estimates of smolt numbers from 1958-1982 fyke net catches; estimates of smolt numbers from 1983-1991 and 1993-present based on hydroacoustic techniques.

<sup>b</sup> Project not operated in 1992. No smolt data collected.

Table 35. Water temperatures at sockeye salmon smolt counting site, Ugashik River, 1983-2000.

Year	Sample Period	Water Temp (C°)		
		Minimum	Mean	Maximum
1983	May 23 - June 11	6.0	7.3	8.5
1984	May 20 - June 17	4.8	6.3	8.5
1985	May 17 - June 09	-1.0	4.3	7.0
1986	May 23 - June 28	2.0	5.6	7.0
1987	May 17 - June 13	4.0	5.9	9.0
1988	May 17 - June 13	3.5	6.6	10.0
1989	May 21 - June 16	3.0	5.8	8.8
1990	May 21 - June 14	3.0	5.9	8.0
1991	May 20 - June 14	4.0	5.9	8.5
1992	<sup>a</sup>			
1993	May 18 - June 11	5.0	6.5	9.0
1994	May 20 - June 13	4.5	6.5	10.0
1995	May 23 - June 12	4.0	6.2	9.0
1996	May 19 - June 13	3.0	5.6	7.5
1997	May 10 - June 13	3.5	7.1	12.0
1998	May 18 - June 13	3.5	5.5	7.5
1999	May 18 - June 13	1.0	2.6	6.0
Mean		3.4	5.9	8.5
2000	May 20 - June 12	3.0	5.9	10.0
Difference from Mean		-0.4	0.0	1.5

<sup>a</sup> Project not operated in 1992. No data collected.

Table 36. Sockeye salmon spawning escapement, total number of smolt produced by age class, percent of total smolt production composed by age class, and number of smolt produced per spawner for 1979-1998 brood years, Ugashik River.

Brood Year	Total Spawning Escapement <sup>a</sup>	Number of Smolt Produced					Total	Per Spawner
		Age 1. (% <sup>b</sup> )		Age 2. (% <sup>b</sup> )		Age 3. (% <sup>b</sup> )		
1979	1,700,904					0		
1980	3,321,384			12,736,379		26,384		
1981	1,326,762	31,297,432	27	82,656,993	73	0	113,954,425	85.9
1982	1,157,526	75,491,249	78	21,407,762	22	0	96,899,011	83.7
1983	1,000,614	12,693,628	46	15,186,101	54	1,677	27,881,406	27.9
1984	1,241,418	37,890,152	64	21,483,727	36	9,598	59,383,477	47.8
1985	998,232	5,461,821	14	33,238,739	86	0	38,700,560	38.8
1986	1,001,492	182,719,678	85	32,278,743	15	0	214,998,421	214.7
1987	668,964	94,019,379	71	38,789,387	29	0	132,808,766	198.5
1988	642,972	14,837,960	24	47,713,086	76	- <sup>c</sup>	62,551,046 <sup>d</sup>	97.3 <sup>d</sup>
1989	1,681,302	26,056,791		- <sup>c</sup>		0	<sup>d</sup>	<sup>d</sup>
1990	730,038	- <sup>c</sup>		12,415,518		0	<sup>d</sup>	<sup>d</sup>
1991	2,457,306	58,331,556	91	5,725,543	9	0	64,057,099	26.1
1992	2,173,692	24,305,081	61	15,272,807	39	0	39,577,888	18.2
1993	1,389,534	6,961,330	83	1,429,625	17	0	8,390,955	6.0
1994	1,080,858	1,147,187	49	1,199,949	51	0	2,347,136	2.2
1995	1,304,058	14,319,834	86	2,292,099	14	0	16,611,933	12.7
1996	667,518	10,332,342	99	56,184	1	0	10,388,526	15.6
1997	618,396	10,545,429	54	8,876,726	46	<sup>d</sup>	19,422,155 <sup>d</sup>	31.4 <sup>d</sup>
1998	890,508	2,003,833				<sup>d</sup>	<sup>d</sup>	<sup>d</sup>
1986-1995 Max	2,457,306	182,719,678	91	47,713,086	76		214,998,421	214.7
1986-1995 Avg	1,313,022	46,966,533	69	17,457,417	31		67,667,906	72.0
1986-1995 Min	642,972	1,147,187	24	1,199,949	9		2,347,136	2.2

<sup>a</sup> Ugashik River tower count only. Does not include aerial survey index counts from King Salmon River or Dog Salmon River.

<sup>b</sup> Percent of total smolt production.

<sup>c</sup> No smolt data collected in 1992, therefore smolt production data for the 1988 (Age 3.), 1989 (Age 2.), and 1990 (Age 1.) brood years are incomplete.

<sup>d</sup> Incomplete returns from brood year escapements.

Table 37. Sockeye salmon spawning escapements, smolt production, adult returns, and smolt survival (number of adults produced per smolt) for 1979-1998 brood years, Ugashik River.

Brood Year	Total Spawning Escapement <sup>a</sup>	Age 1.			Age 2.			Age 3.		
		Number of Smolt	Adult Returns <sup>b</sup>	Adult Returns per Smolt	Number of Smolt	Adult Returns <sup>b</sup>	Adult Returns per Smolt	Number of Smolt	Adult Returns <sup>b</sup>	Adult Returns per Smolt
1979	1,700,904		3,960,210			2,045,642			0	<sup>c</sup>
1980	3,321,384		3,503,629		12,736,379	4,262,289	0.33	26,384	2,600	0.10
1981	1,326,762	31,297,432	4,241,375	0.14	82,656,993	3,215,237	0.04	0	1,682	<sup>c</sup>
1982	1,157,526	75,491,249	1,146,491	0.02	21,407,762	1,345,244	0.06	0	0	
1983	1,000,614	12,693,628	995,579	0.08	15,186,101	957,765	0.06	1,677	957	<sup>c</sup>
1984	1,241,418	37,890,152	1,052,692	0.03	21,483,727	4,399,295	0.20	9,598	6,732	<sup>c</sup>
1985	998,232	5,461,821	1,233,686	0.23	33,238,739	1,454,422	0.04	0	0	
1986	1,001,492	182,719,678	3,001,968	0.02	32,278,743	3,639,400	0.11	0	4,459	<sup>c</sup>
1987	668,964	94,019,379	2,478,649	0.03	38,789,387	4,215,483	0.11	0	34,612	<sup>c</sup>
1988	642,972	14,837,960	1,193,721	0.08	47,713,086	4,426,031	0.09	<sup>d</sup>	29,819	<sup>c</sup>
1989	1,681,302	26,056,791	1,104,400	0.04	<sup>d</sup>	3,449,364	<sup>c</sup>	0	9,880	<sup>c</sup>
1990	730,038	<sup>d</sup>	1,057,589	<sup>c</sup>	12,415,518	3,535,693	0.28	0	1,733	<sup>c</sup>
1991	2,457,306	58,331,556	5,221,578	0.09	5,725,543	927,616	0.16	0	0	<sup>c</sup>
1992	2,173,692	24,305,081	791,283	0.03	15,272,807	1,852,943	0.12	0	1,181 <sup>e</sup>	
1993	1,389,534	6,961,330	636,575	0.09	1,429,625	446,197	0.31	0	766 <sup>e</sup>	
1994	1,080,858	1,147,187	677,851 <sup>e</sup>	0.59 <sup>c</sup>	1,199,949	976,246 <sup>e</sup>	0.81 <sup>e</sup>	0	826 <sup>e</sup>	
1995	1,304,058	14,319,834	10,391,495 <sup>e</sup>		2,292,099	184,938 <sup>e</sup>		0		
1996	667,518	10,332,342	229,888 <sup>e</sup>		56,184					
1997	618,396	10,575,429			8,876,726					
1998	890,508	2,003,833								
1984-1993 Max	2,457,306	182,719,678	5,221,578	0.23	47,713,086	4,426,031	0.31	9,598	34,612	<sup>c</sup>
1984-1993 Avg	1,298,495	50,064,861	1,777,214	0.07	23,149,686	2,834,644	0.16	1,066	8,918	<sup>c</sup>
1984-1993 Min	642,972	5,461,821	636,575	0.02	1,429,625	446,197	0.04	0	0	<sup>c</sup>

<sup>a</sup> Ugashik River tower count only. Does not include aerial survey index counts from King Salmon River or Dog Salmon River.

<sup>b</sup> Includes estimates of adult returns through 1999.

<sup>c</sup> Insufficient smolt data to complete this calculation.

<sup>d</sup> No Ugashik River smolt enumeration project conducted in 1992. Therefore smolt estimates for 1988, 1989, and 1990 brood years are incomplete because no smolt data were collected in 1992.

<sup>e</sup> Future adult returns will increase these values.

Table 38. Comparison of the age composition of outmigrating sockeye salmon smolt at Ugashik River with the freshwater age composition of their total adult returns by brood year, 1981-1993.

Smolt Outmigration Year	Brood Year	Freshwater Age	Proportion of Total			Comments
			Smolt	Adult	Difference	
1983	1981	Age 1.	0.27	0.57	-0.30	No ice or weather problems noted.
	1980	Age 2.	-	-	-	
1984	1982	Age 1.	0.78	0.46	0.32	No ice or weather problems noted.
	1981	Age 2.	0.73	0.43	0.30	
1985	1983	Age 1.	0.46	0.51	-0.05	Ice present - 5/17-5/21 intermittent
	1982	Age 2.	0.22	0.54	-0.32	
1986	1984	Age 1.	0.64	0.19	0.45	No ice or weather problems noted.
	1983	Age 2.	0.54	0.49	0.05	
1987	1985	Age 1.	0.14	0.46	-0.32	No ice or weather problems noted.
	1984	Age 2.	0.36	0.81	-0.45	
1988	1986	Age 1.	0.85	0.45	0.40	No ice or weather problems noted.
	1985	Age 2.	0.86	0.54	0.32	
1989	1987	Age 1.	0.71	0.37	0.34	No ice or weather problems noted.
	1986	Age 2.	0.15	0.55	-0.40	
1990	1988	Age 1.	0.24	0.21	0.03	Poor Weather - 199 h disabled time
	1987	Age 2.	0.29	0.63	-0.34	
1991	1989	Age 1.	<sup>a</sup>	0.24		Poor Weather - 187 h disabled time
	1988	Age 2.	0.76	0.78	-0.02	
1992	1990	Age 1.	<sup>b</sup>	0.23		No smolt data.
	1989	Age 2.	<sup>b</sup>	0.76		
1993	1991	Age 1.	0.91	0.85	0.06	Bad Weather - 264 h disabled time
	1990	Age 2.	<sup>c</sup>	0.77		
1994	1992	Age 1.	0.61	0.30	0.31	Good Weather - 42 h disabled time
	1991	Age 2.	0.09	0.15	-0.06	
1995	1993	Age 1.	0.83	0.59	0.24	Excellent Weather - 21 h disabled time
	1992	Age 2.	0.39	0.70	-0.31	
1996	1994	Age 1.	0.49	<sup>d</sup>		Fair Weather - 109 h disabled time
	1993	Age 2.	0.17	0.41	-0.24	

<sup>a</sup> Unable to calculate the proportion of Age-1. smolt for brood year 1989 because the Age-2 smolt for brood year 1989 were not counted in 1992.

<sup>b</sup> The Ugashik Smolt project was not operated in 1992; no smolt data collected that year.

<sup>c</sup> Unable to calculate the proportion of Age-2. smolt for brood year 1990 because the Age-1 smolt for brood year 1990 were not counted in 1992.

<sup>d</sup> Incomplete adult returns from brood year escapement.

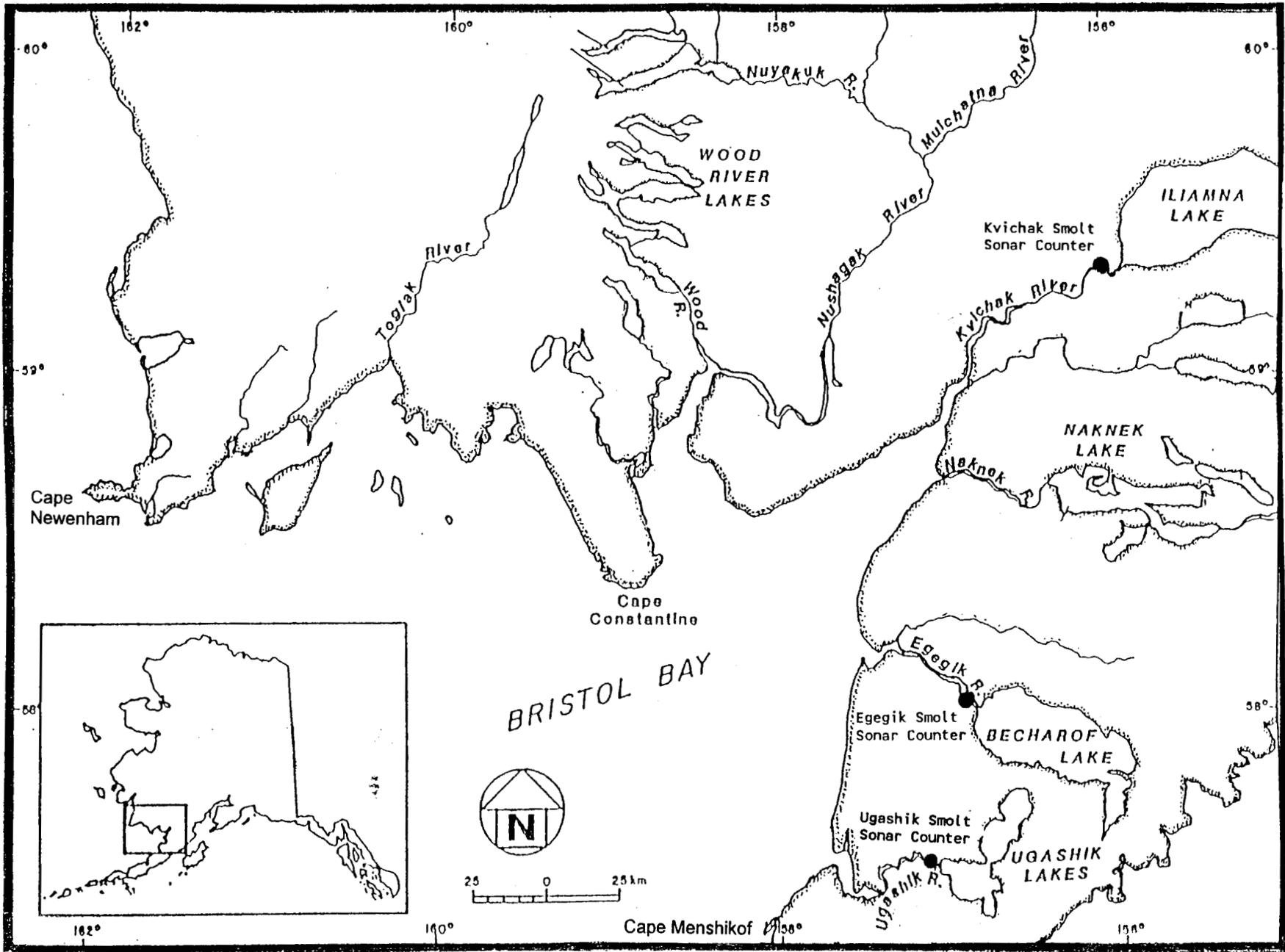


Figure 1. Locations of major rivers and smolt sonar counting sites in the Bristol Bay Management Area.

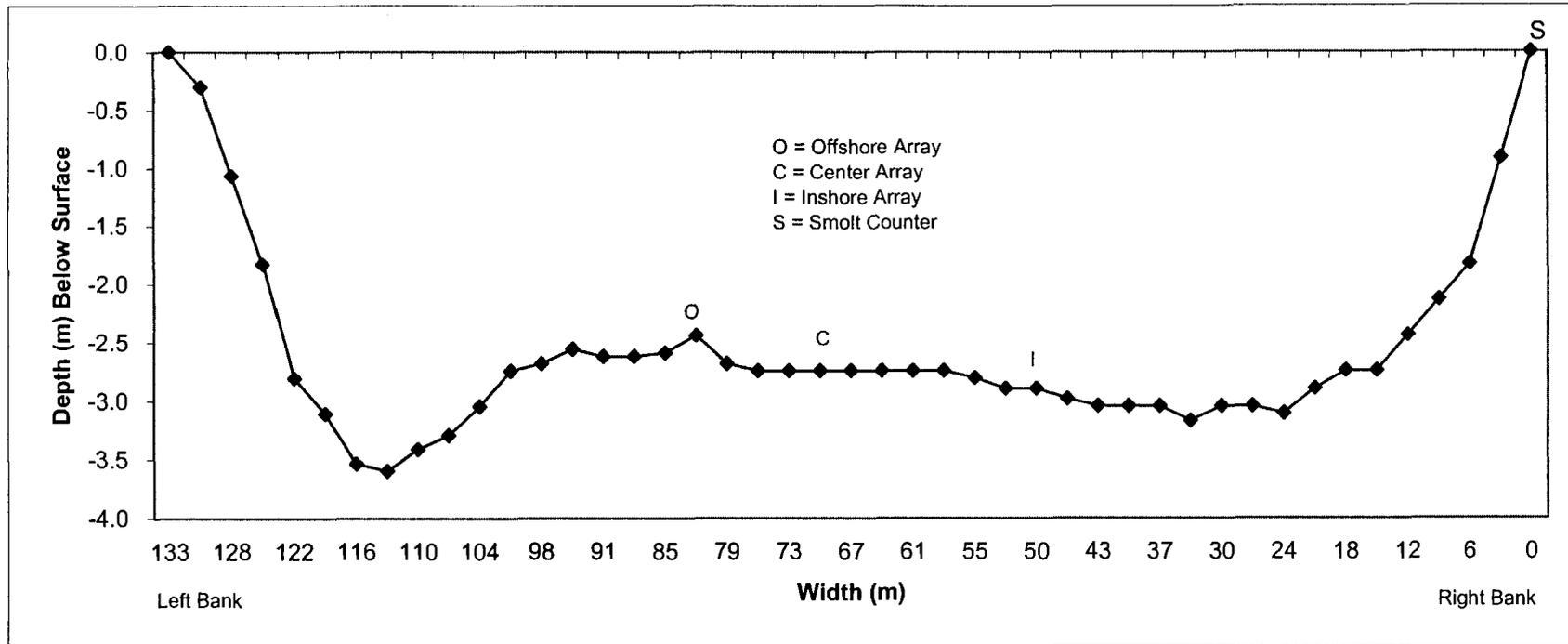


Figure 2. River bottom profile and sonar array placement at Kvichak River smolt sonar site, 2000.

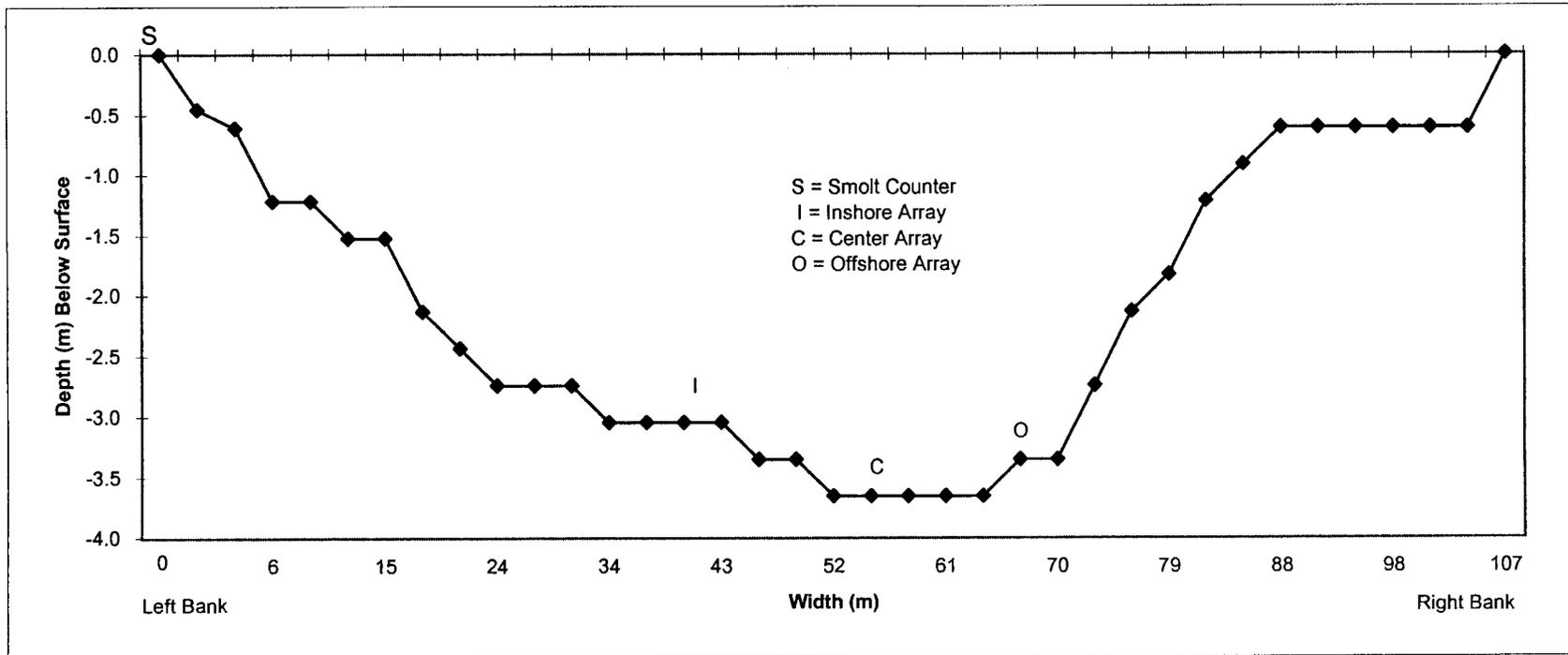


Figure 3. River bottom profile and sonar array placement at Egegik River smolt sonar site, 2000.

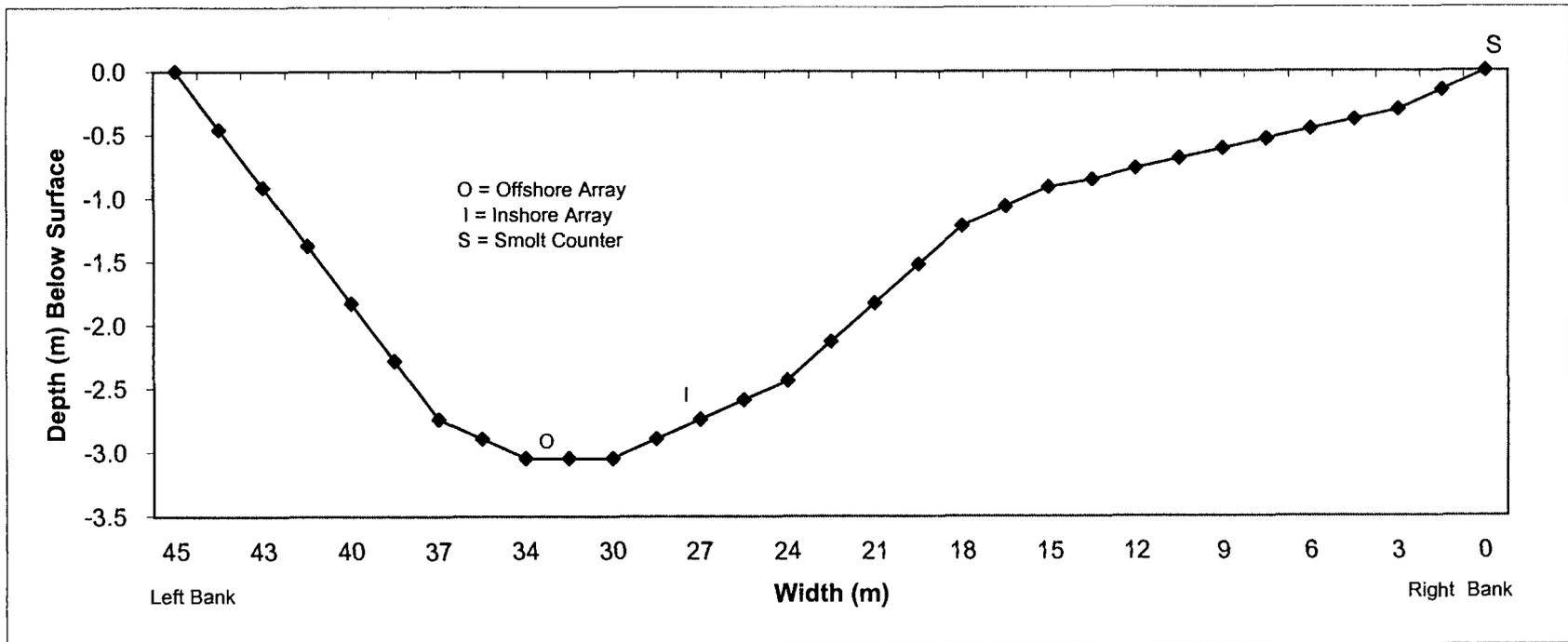


Figure 4. River bottom profile and sonar array placement at Ugashik River smolt sonar site, 2000.

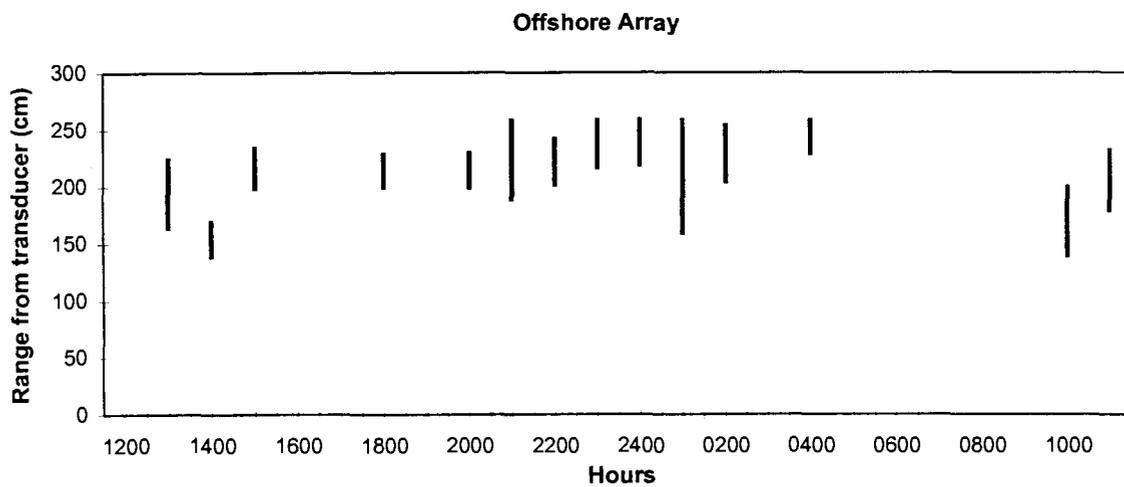
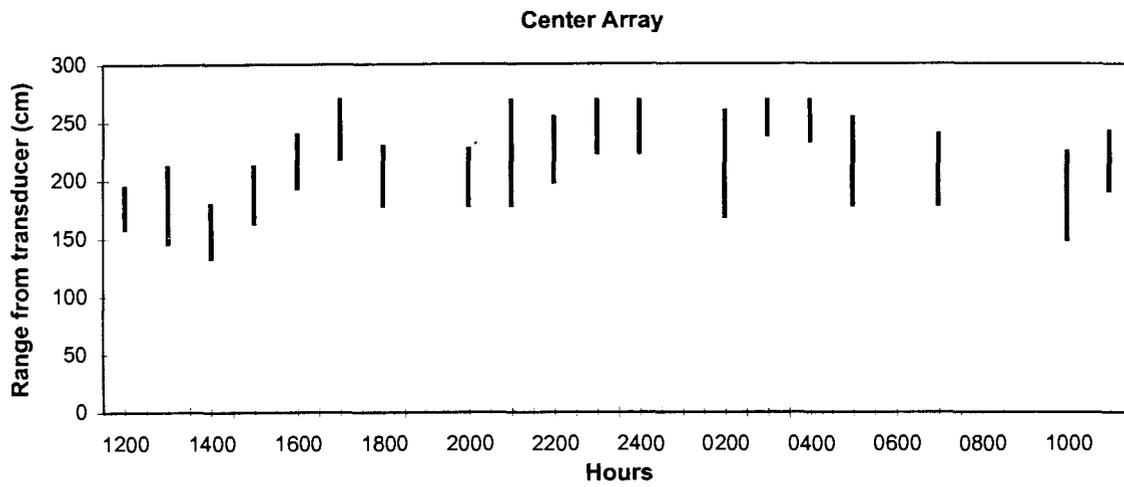
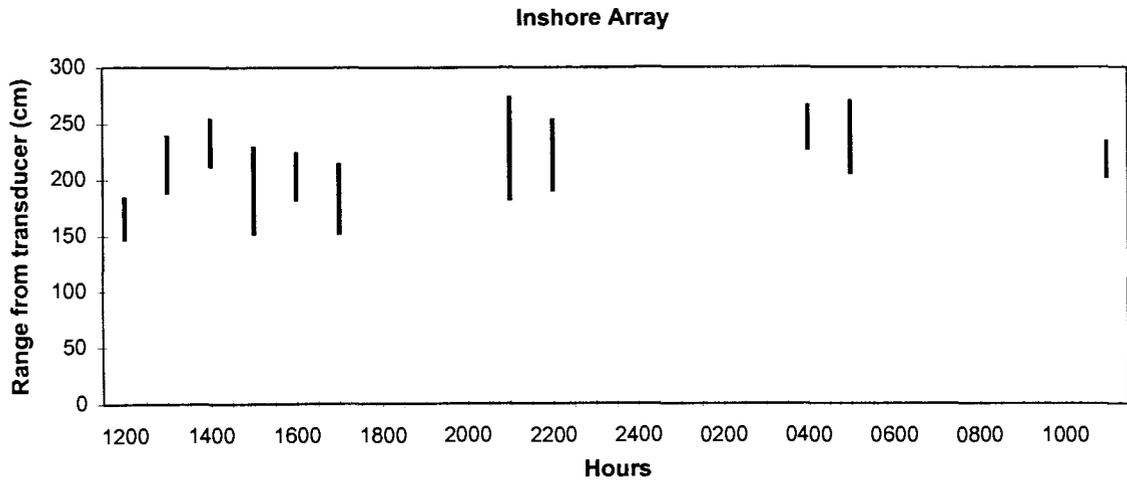


Figure 5. Range of smolt passage from the transducers summarized by hour, Kvichak River, May 20 to June 8, 2000.

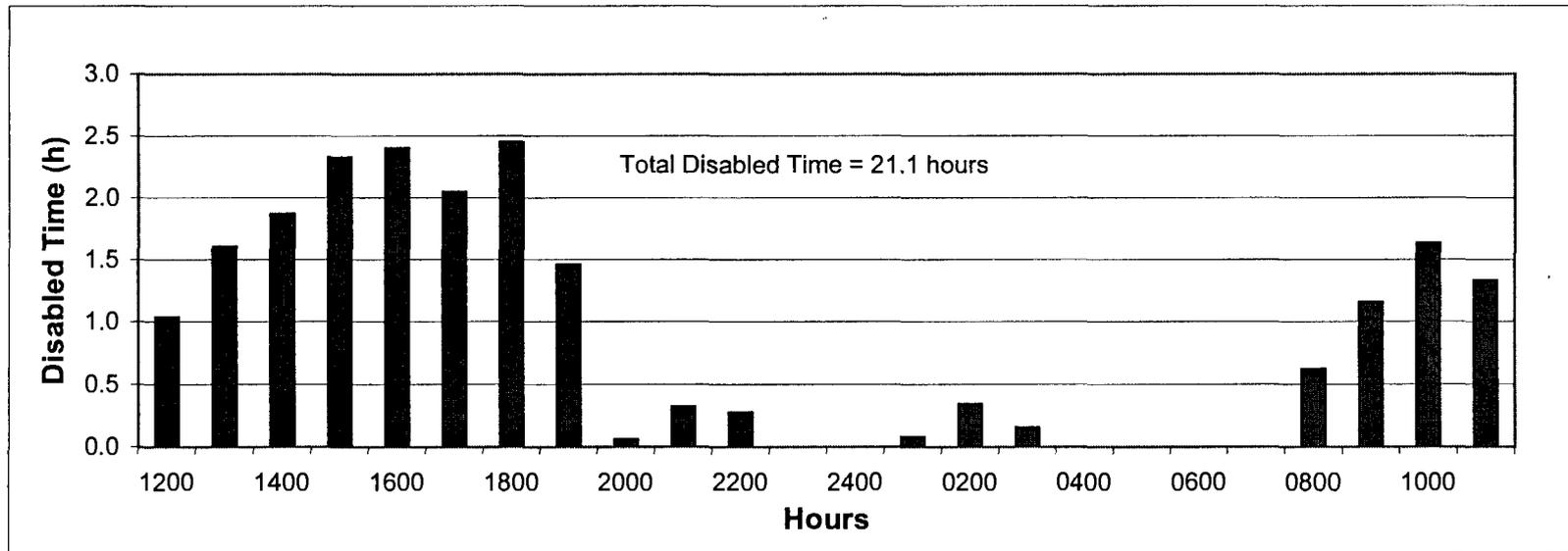
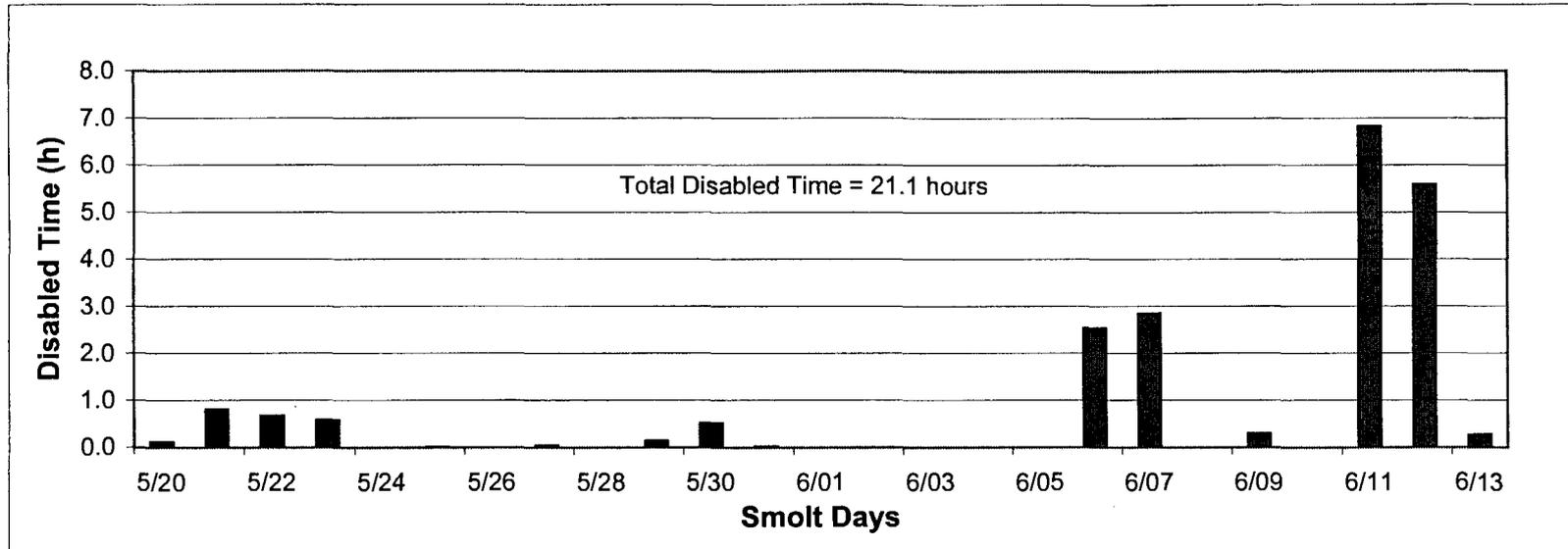


Figure 6. Kvichak River smolt sonar disabled time because of weather by smolt day and hour, May 20 to June 13, 2000.

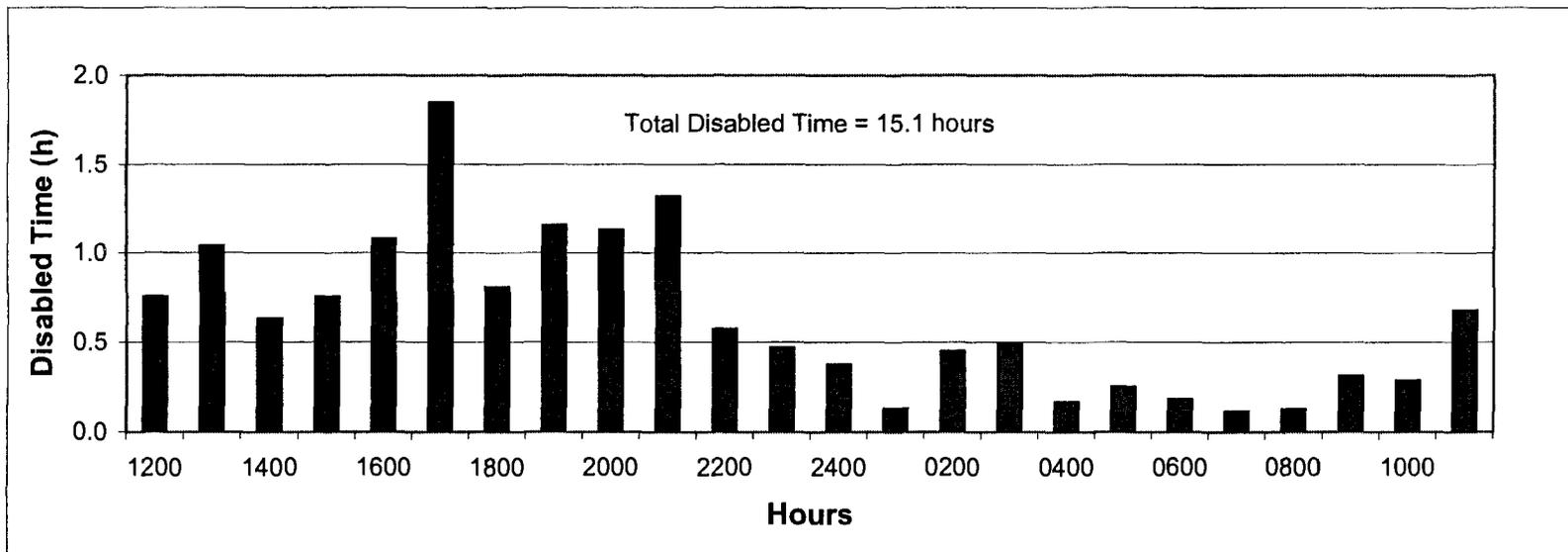
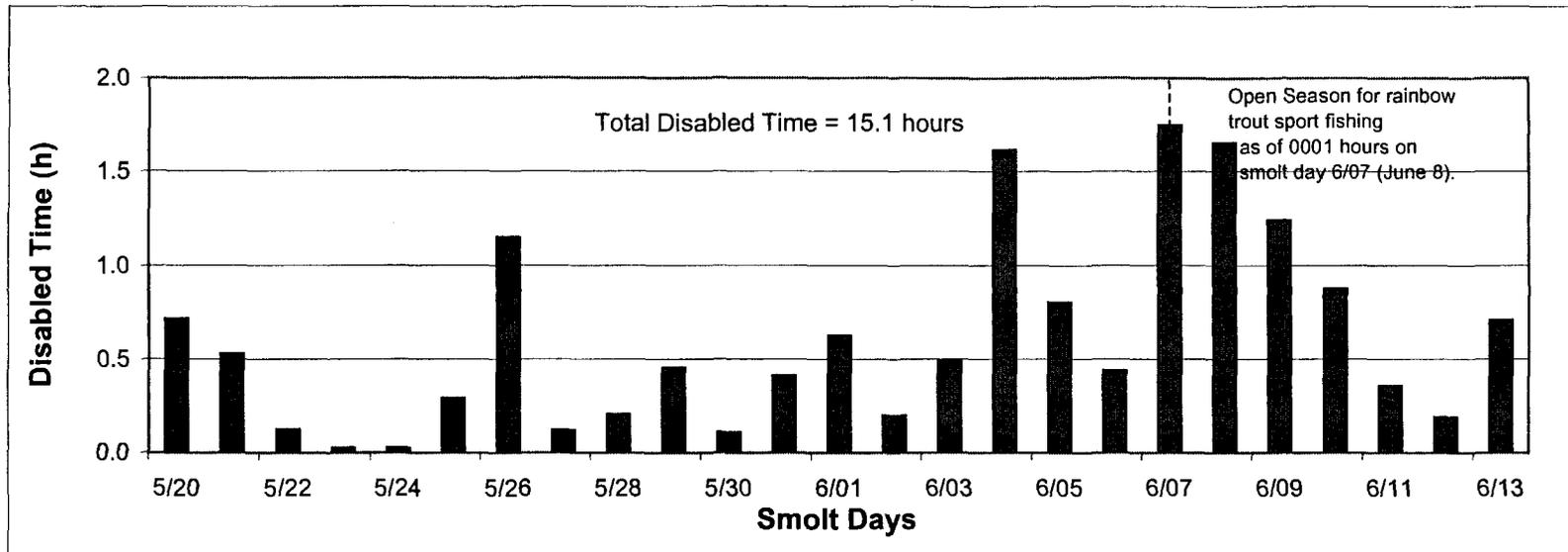


Figure 7. Kvichak River smolt sonar disabled time because of boat traffic by smolt day and hour, May 20 to June 13, 2000.

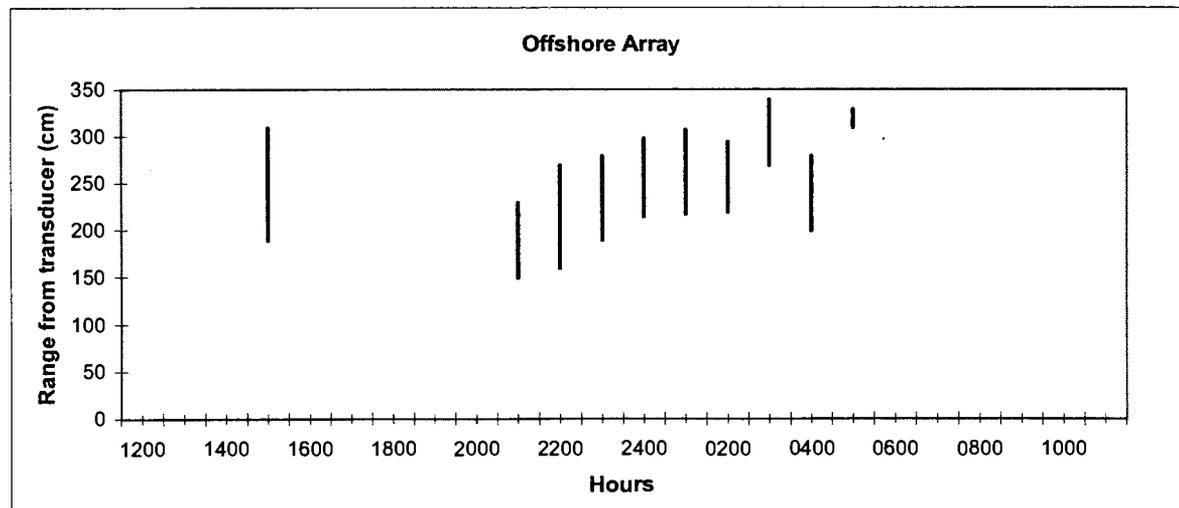
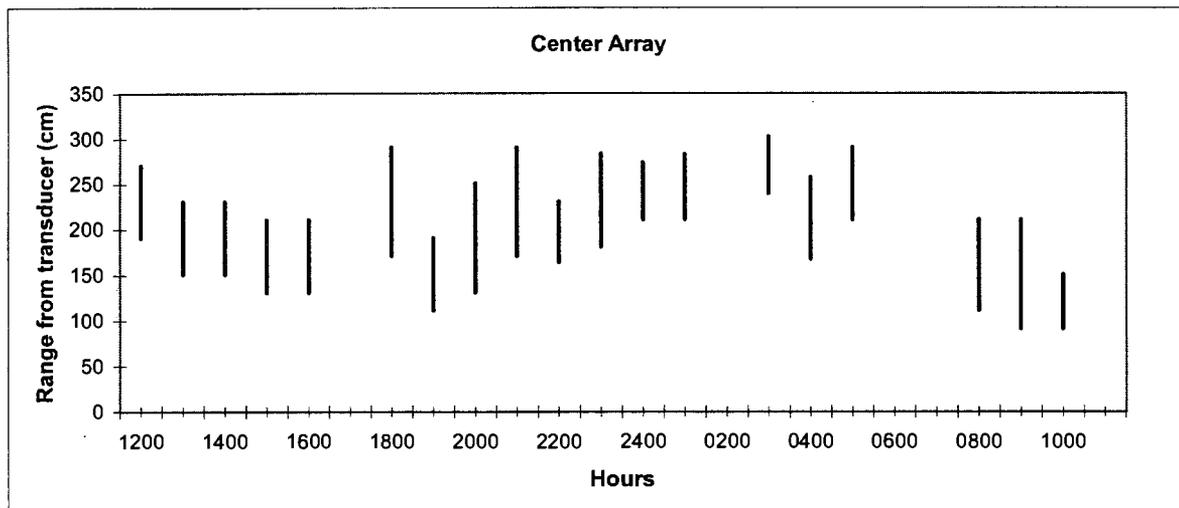
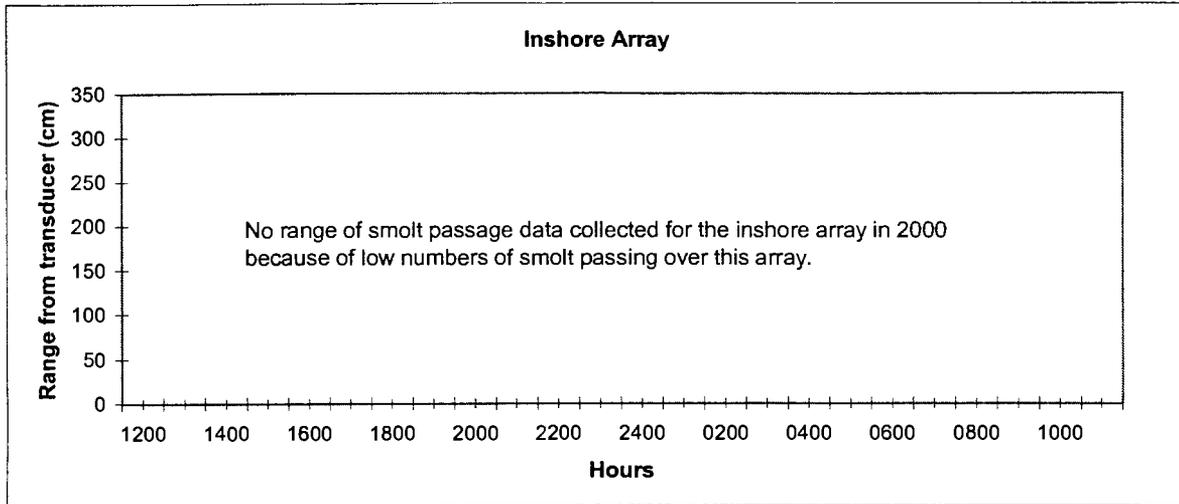


Figure 8. Range of smolt passage from the transducers summarized by hour, Egegik River, May 20 to June 7, 2000.

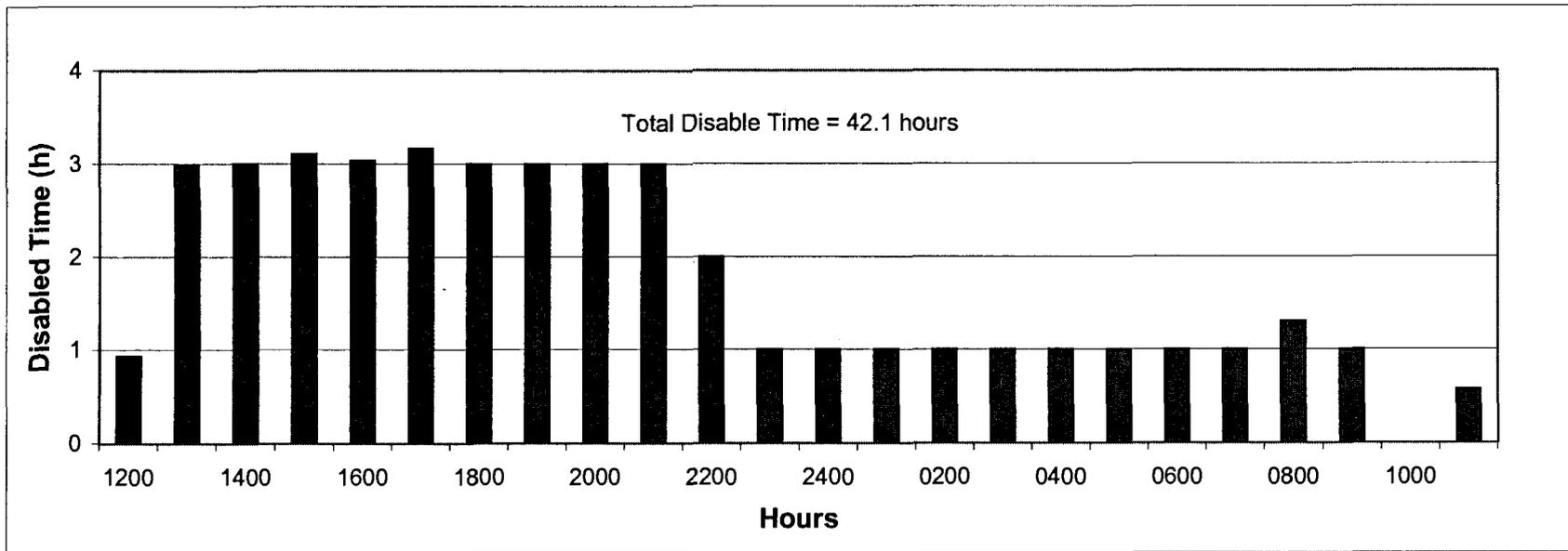
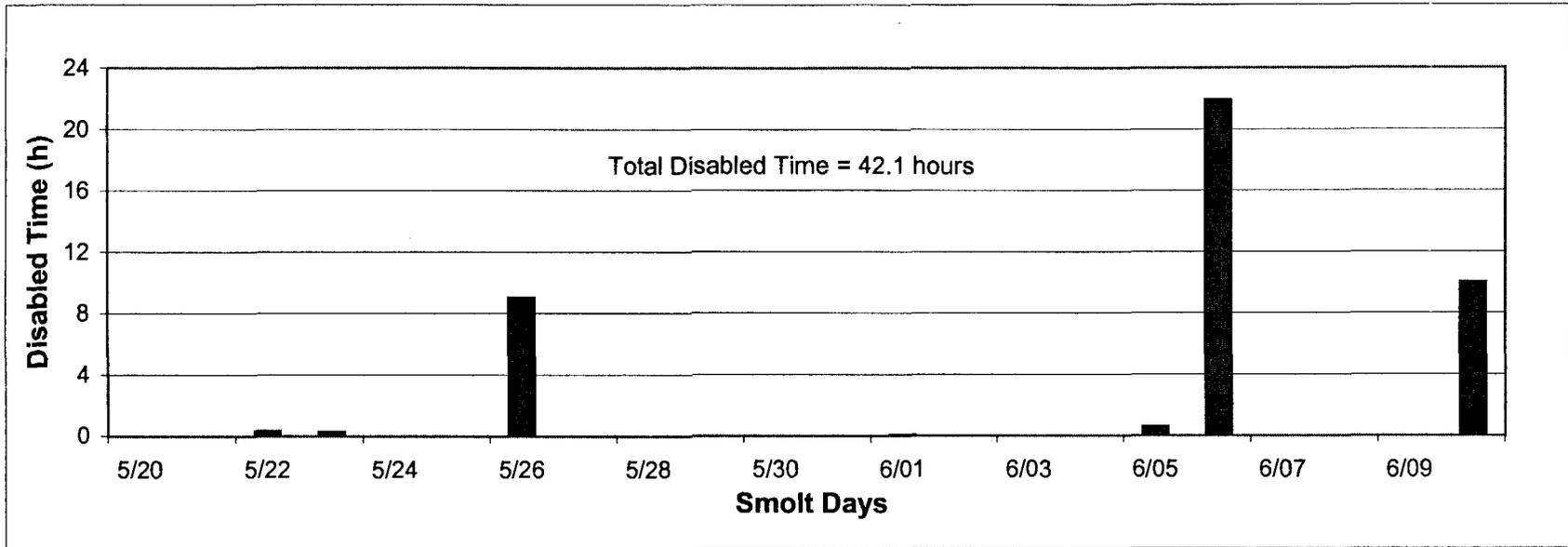


Figure 9. Egegik River smolt sonar disabled time because of weather by smolt day and hour, May 20 to June 10, 2000.

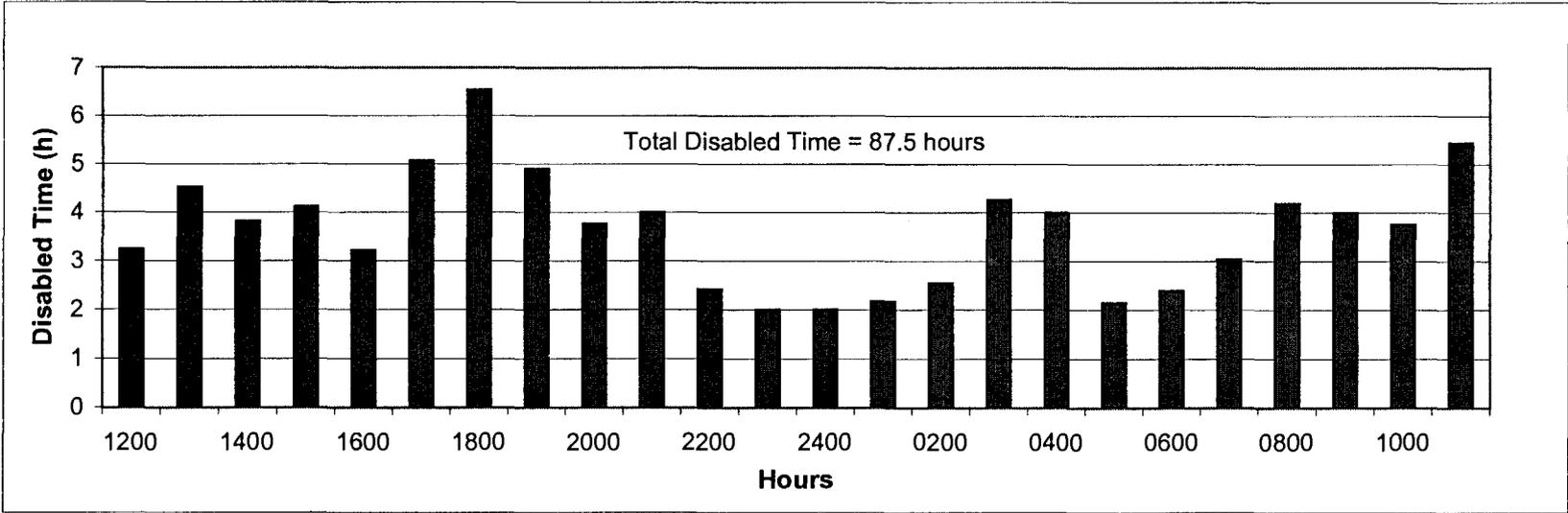
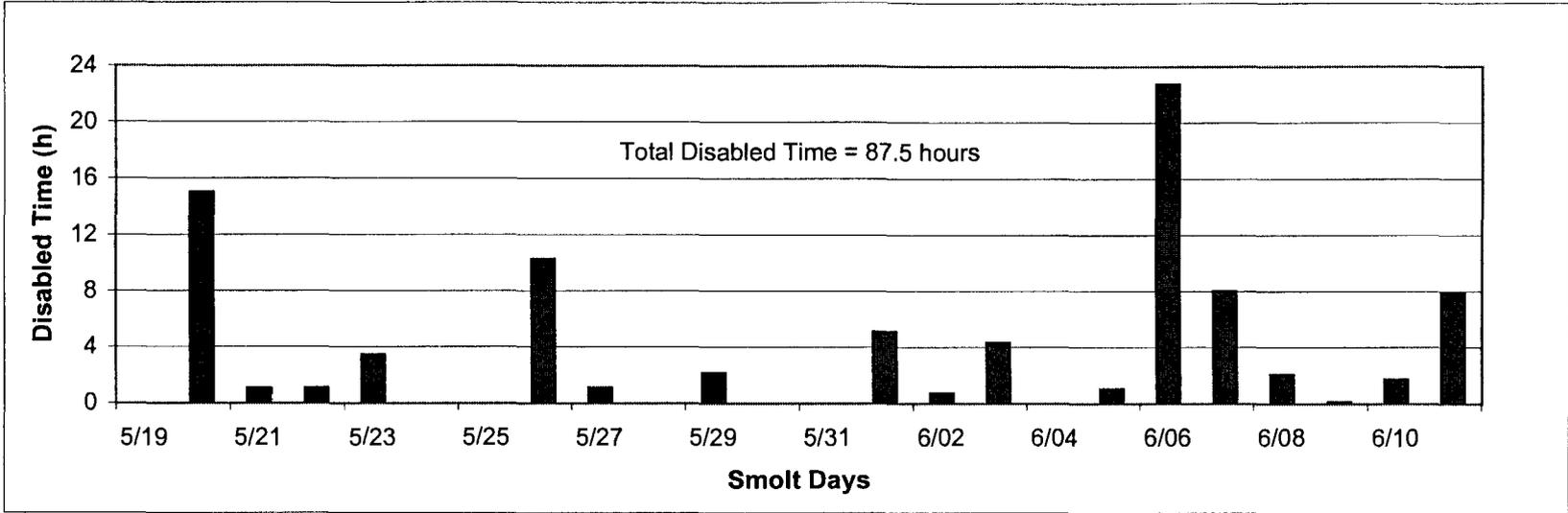


Figure 10. Ugashik River smolt sonar disabled time because of weather by smolt day and hour, May 19 to June 11, 2000.

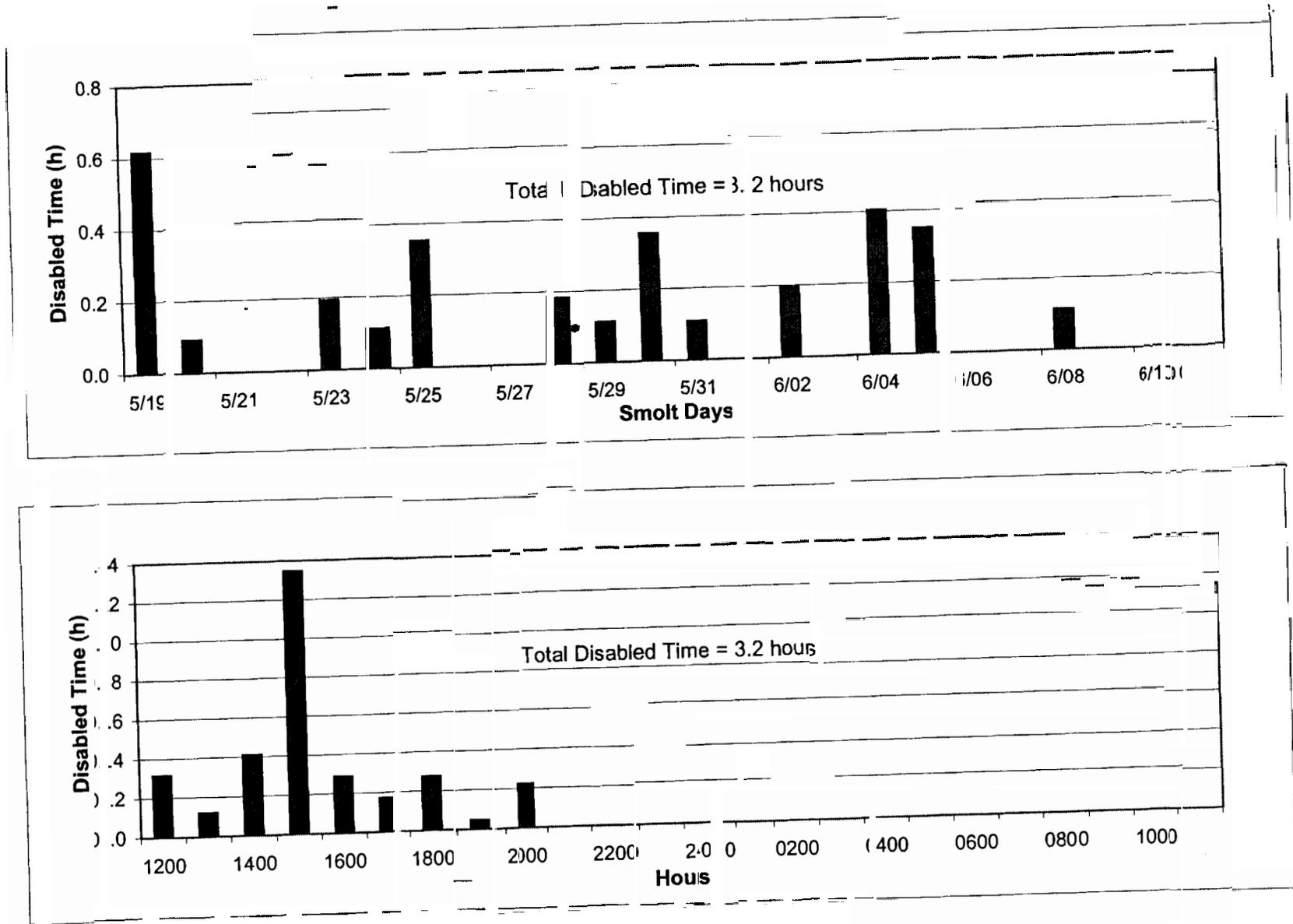


Figure 11. Ugashik River smolt sonar disabled time because of boat or float plane traffic by smolt day and hour, May 19 to June 11, 2000

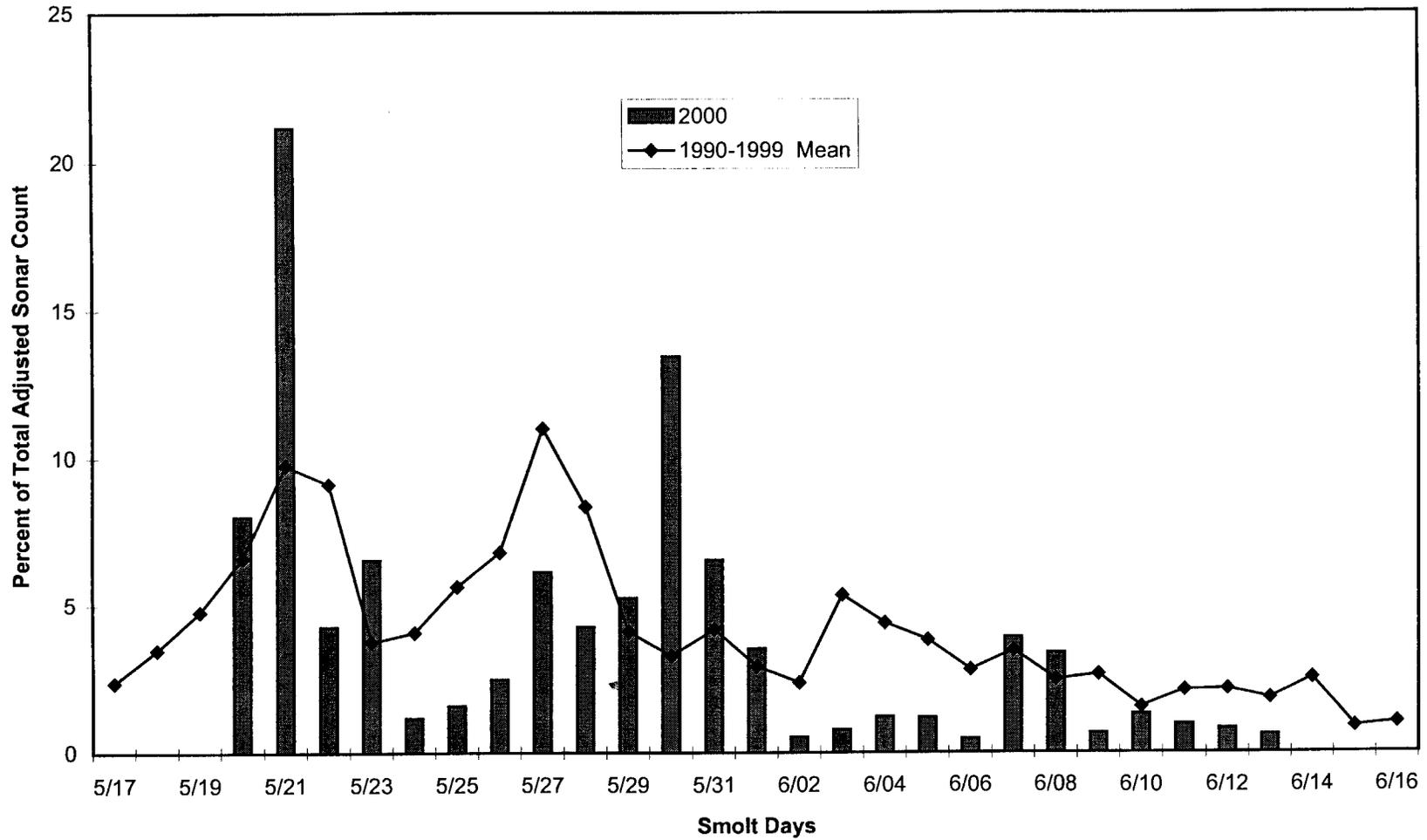


Figure 12. Comparison of the percent of the 2000 total adjusted sonar counts by smolt day at Kvichak River smolt sonar with the 1990-1999 mean.

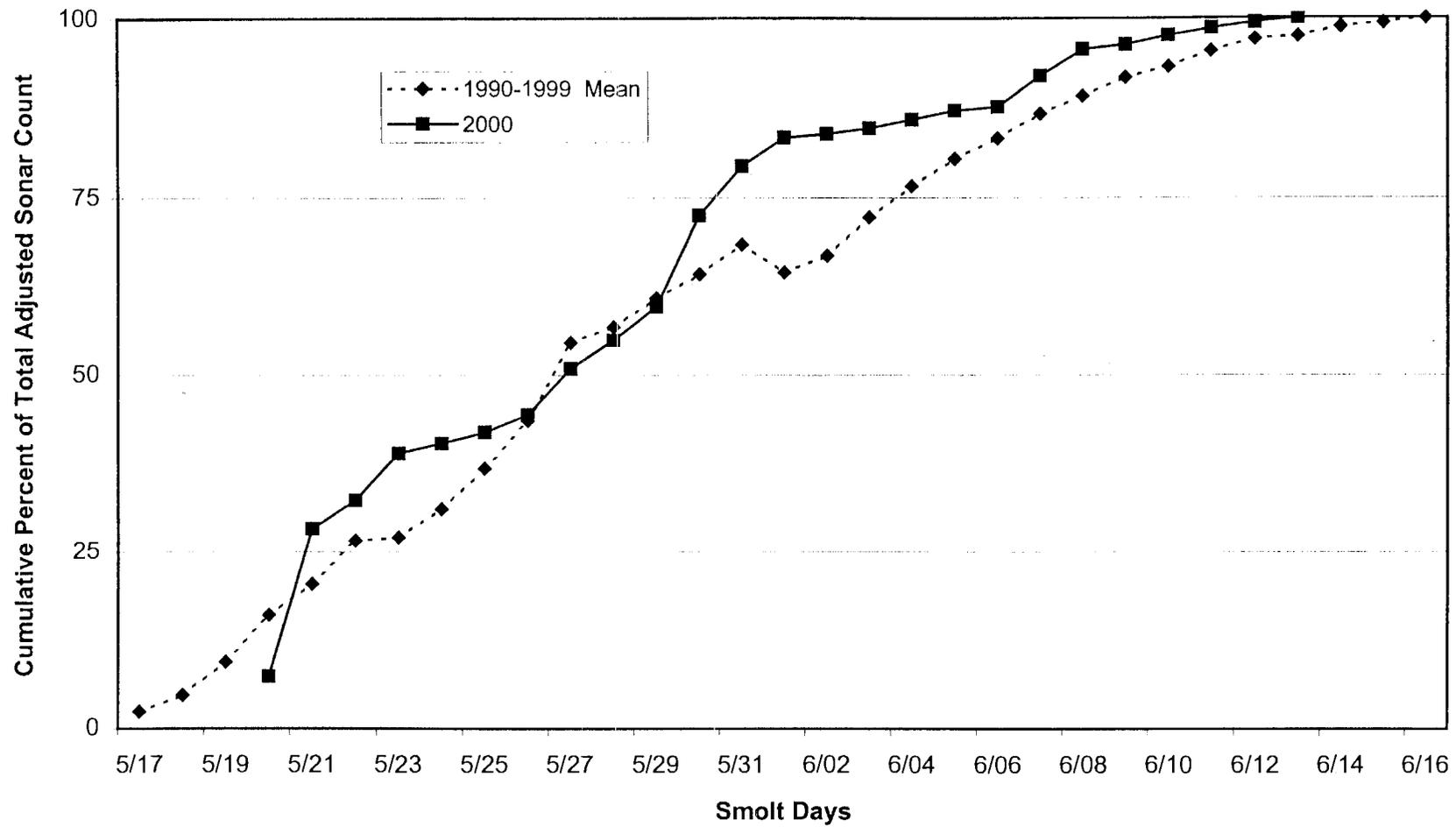


Figure 13. Comparison of the cumulative percent of the 2000 total adjusted sonar counts by smolt day at Kvichak River smolt sonar with the 1990-1999 mean.

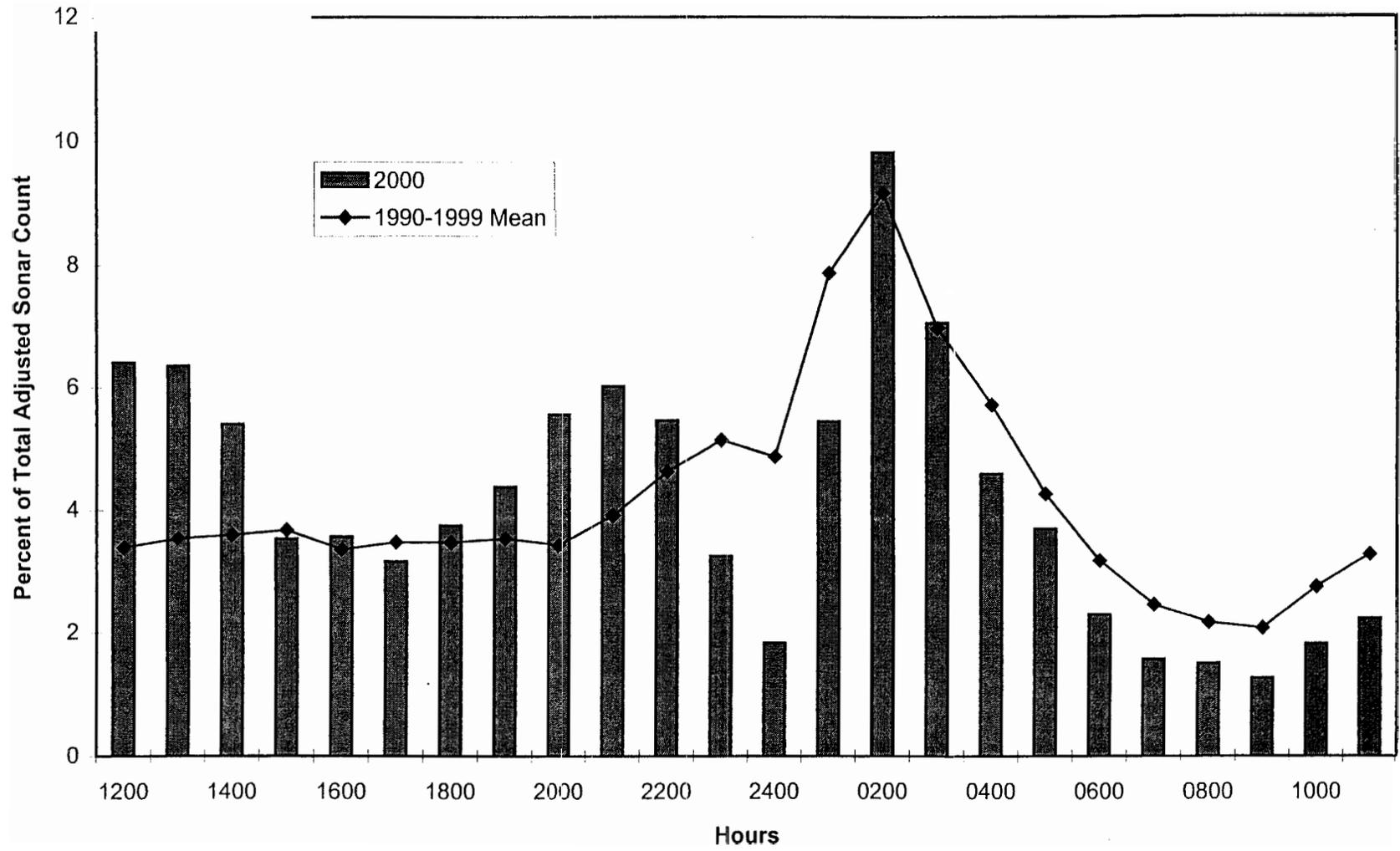


Figure 14. Comparison of the percent of the 2000 total adjusted sonar counts by hour at Kvichak River smolt sonar with the 1990-1999 mean.

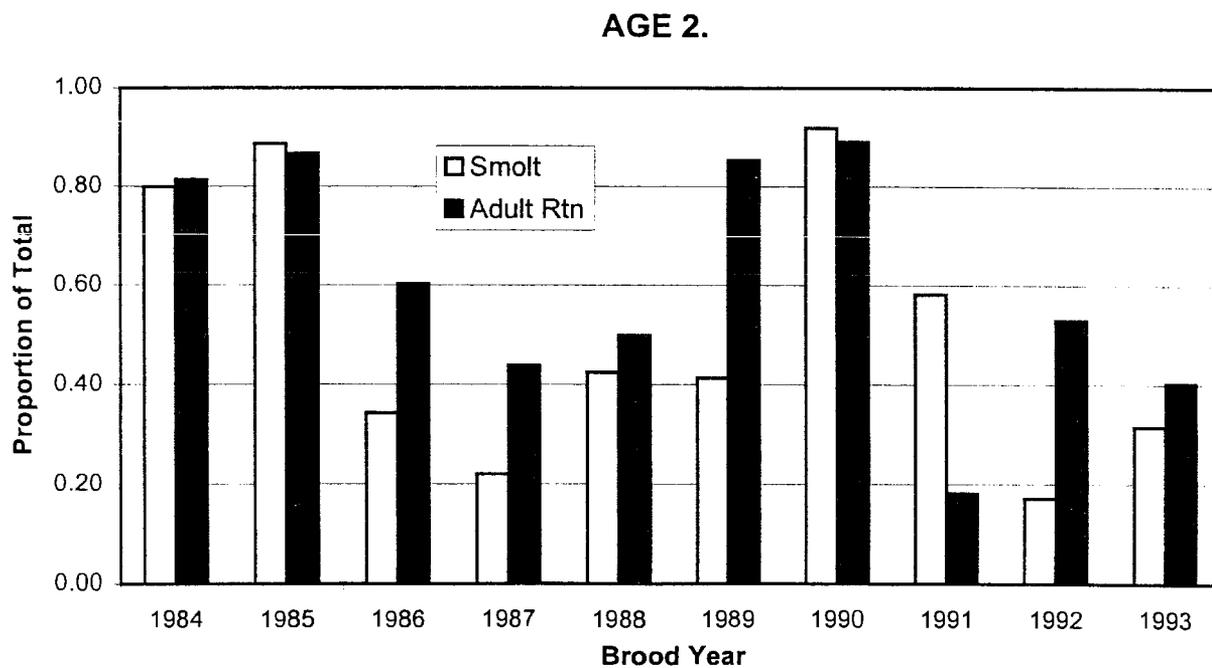
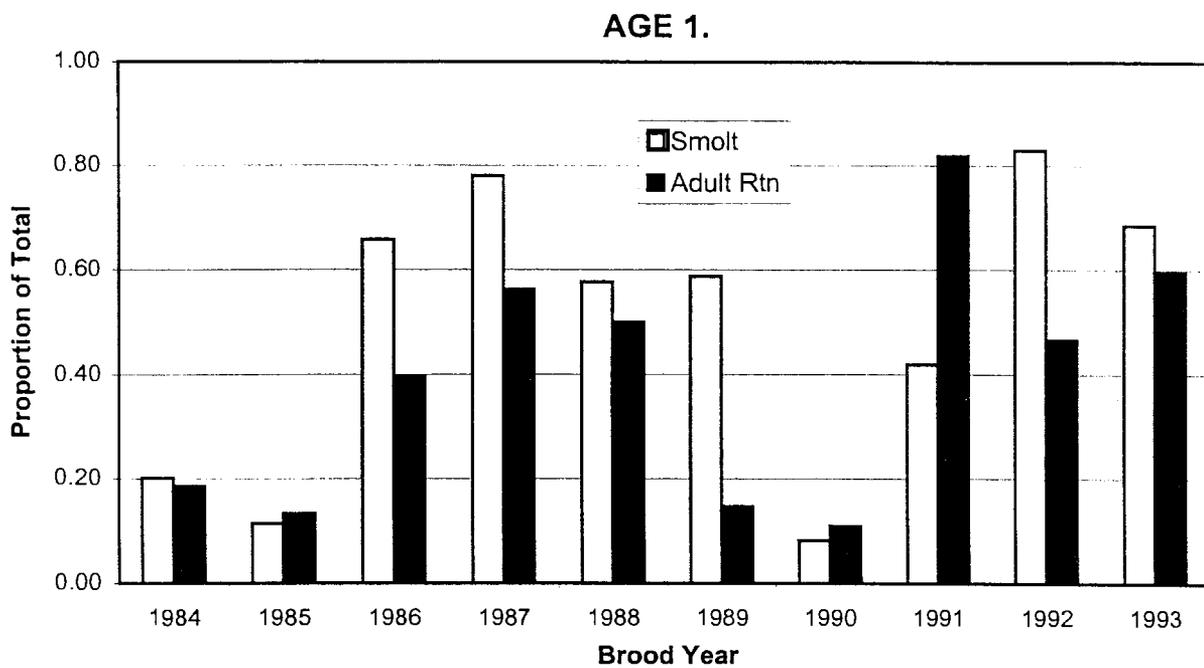


Figure 15. Comparison of the age composition of outmigrating sockeye salmon smolt at Kvichak River with the freshwater age composition of the total adult returns by brood year, 1984-1993.

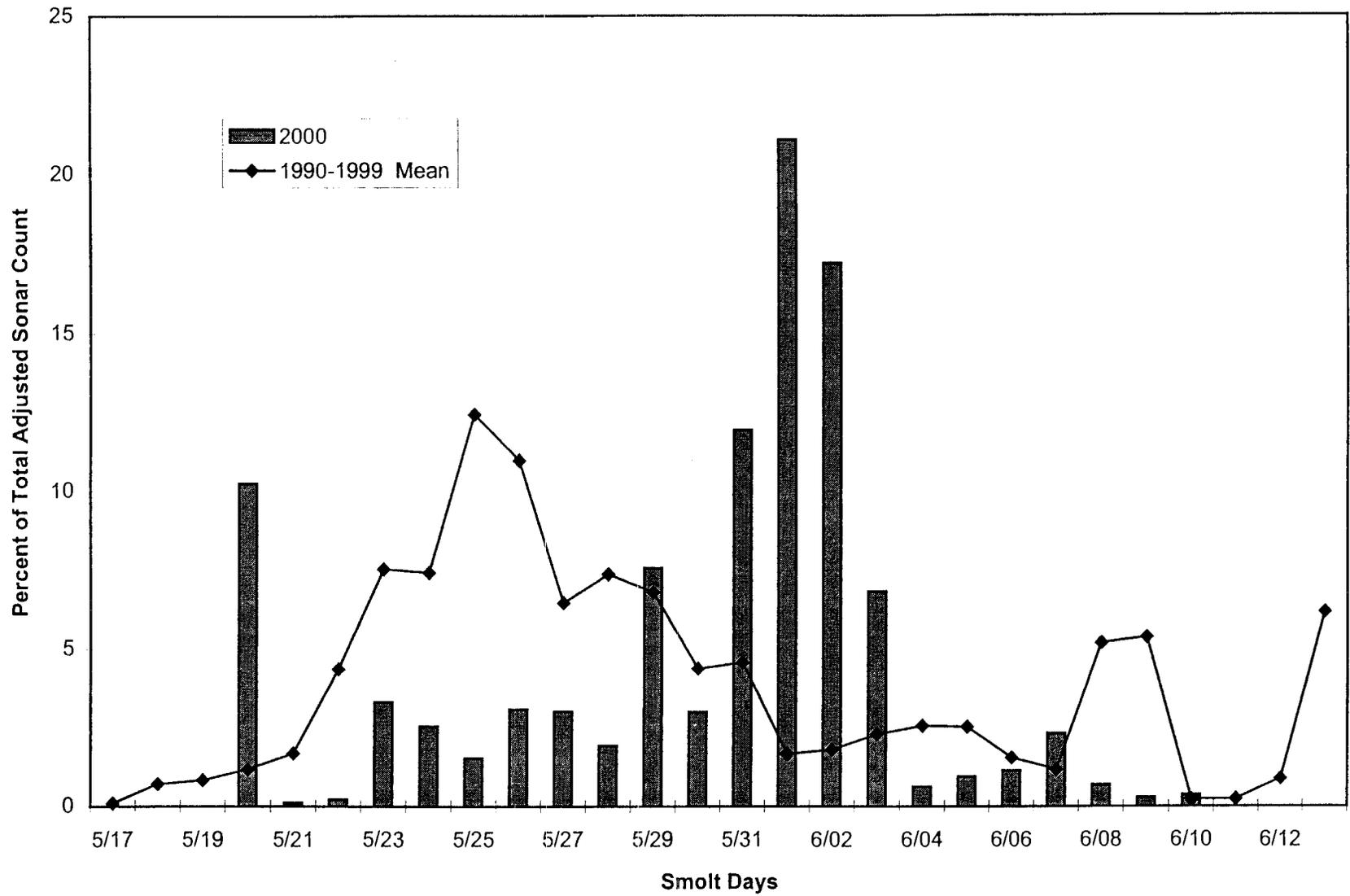


Figure 16. Comparison of the percent of the 2000 total adjusted sonar counts by smolt day at Egegik River smolt sonar with the 1990-1999 mean.

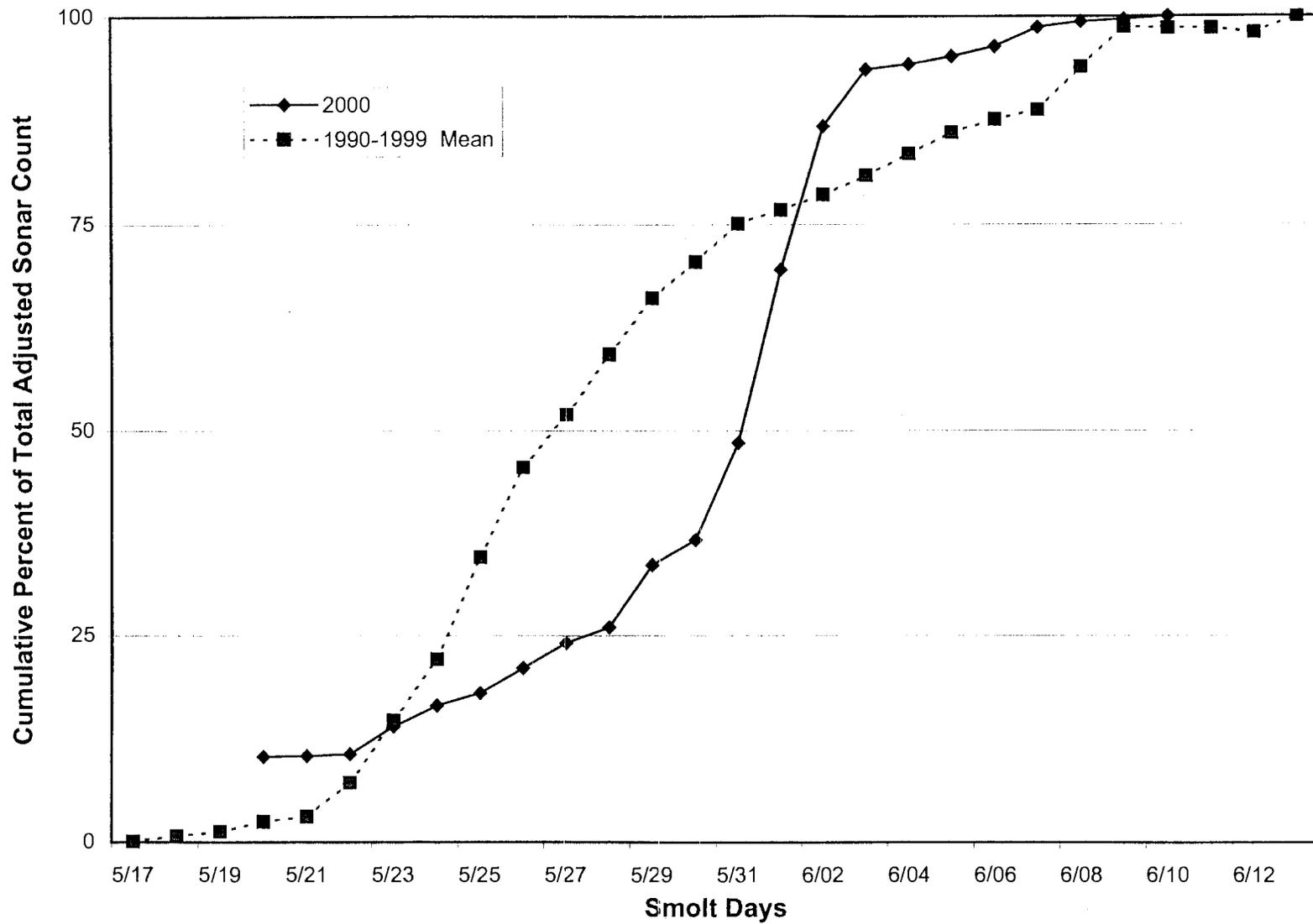


Figure 17. Comparison of the cumulative percent of the 2000 total adjusted sonar counts by smolt day at Egegik River smolt sonar with the 1990-1999 mean.

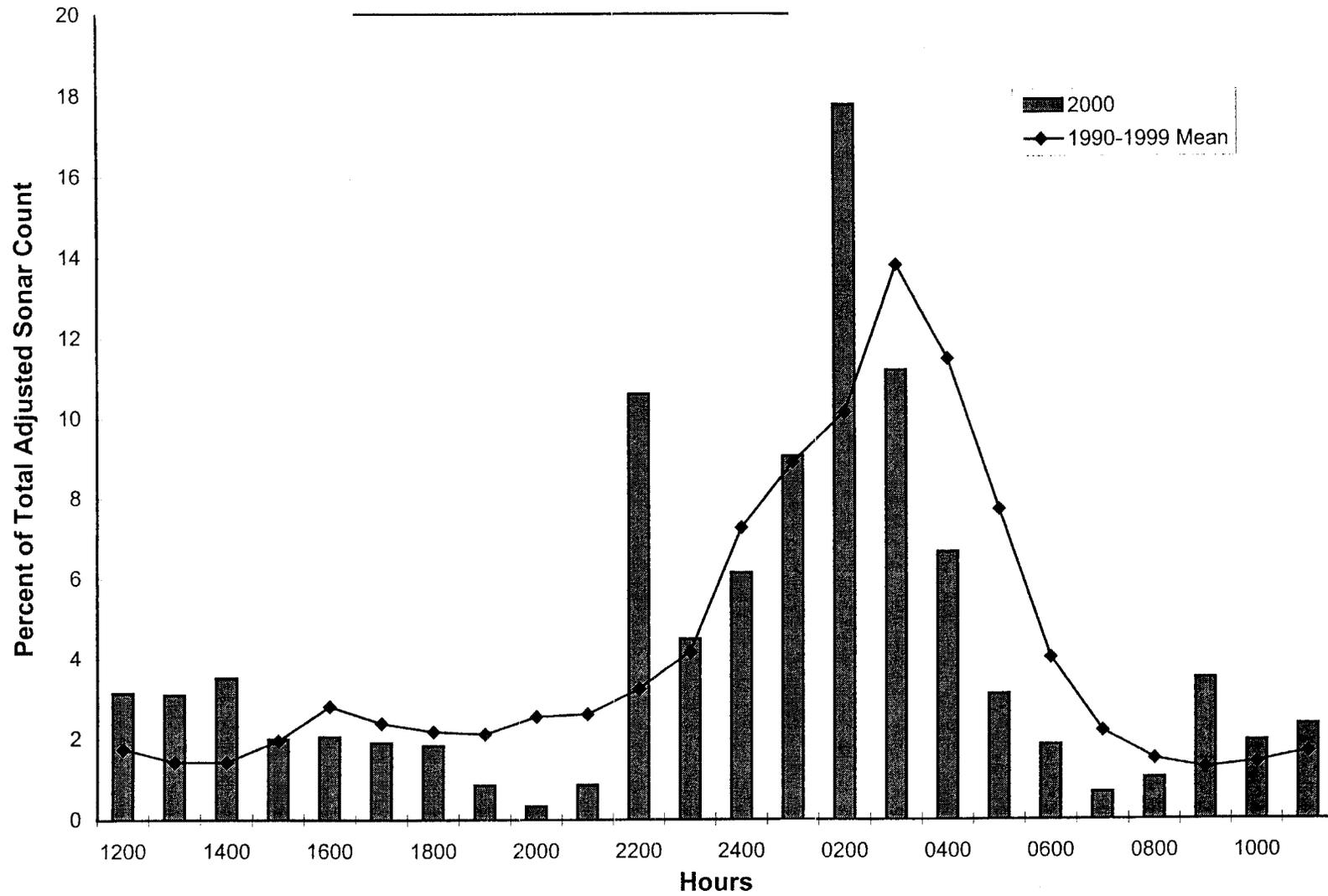


Figure 18. Comparison of the percent of the 2000 total adjusted sonar counts by hour at Egegik River smolt sonar with the 1990-1999 mean.

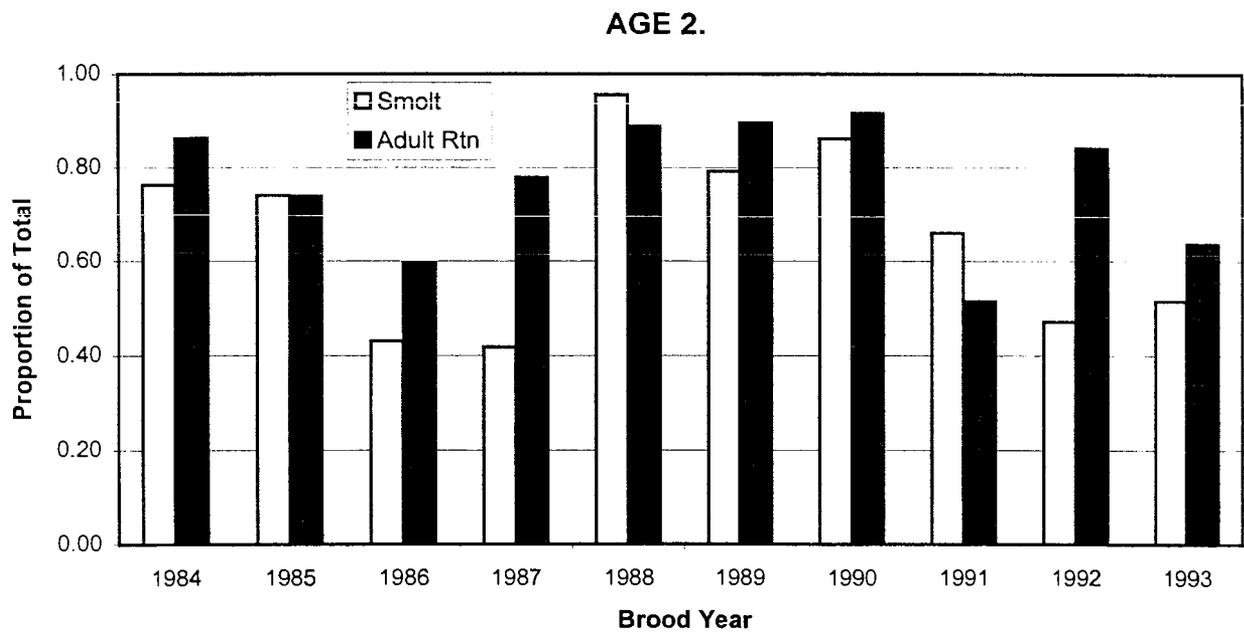
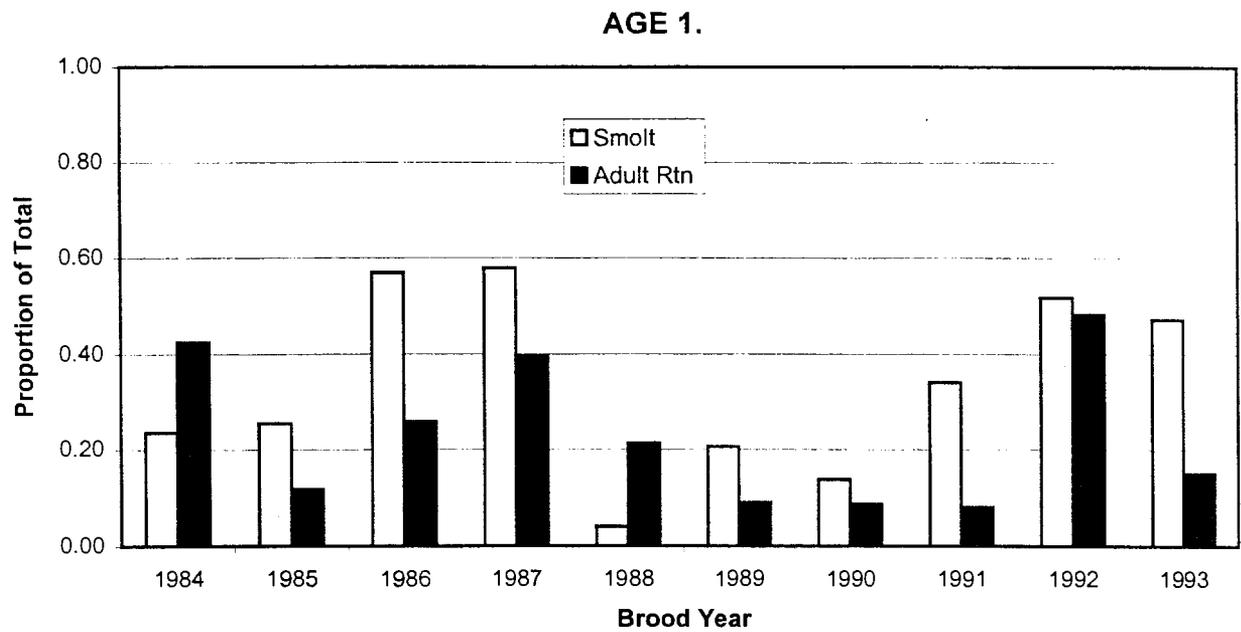


Figure 19. Comparison of the age composition of outmigrating sockeye salmon smolt at Egegik River with the freshwater age composition of the total adult returns by brood year, 1984-1993.

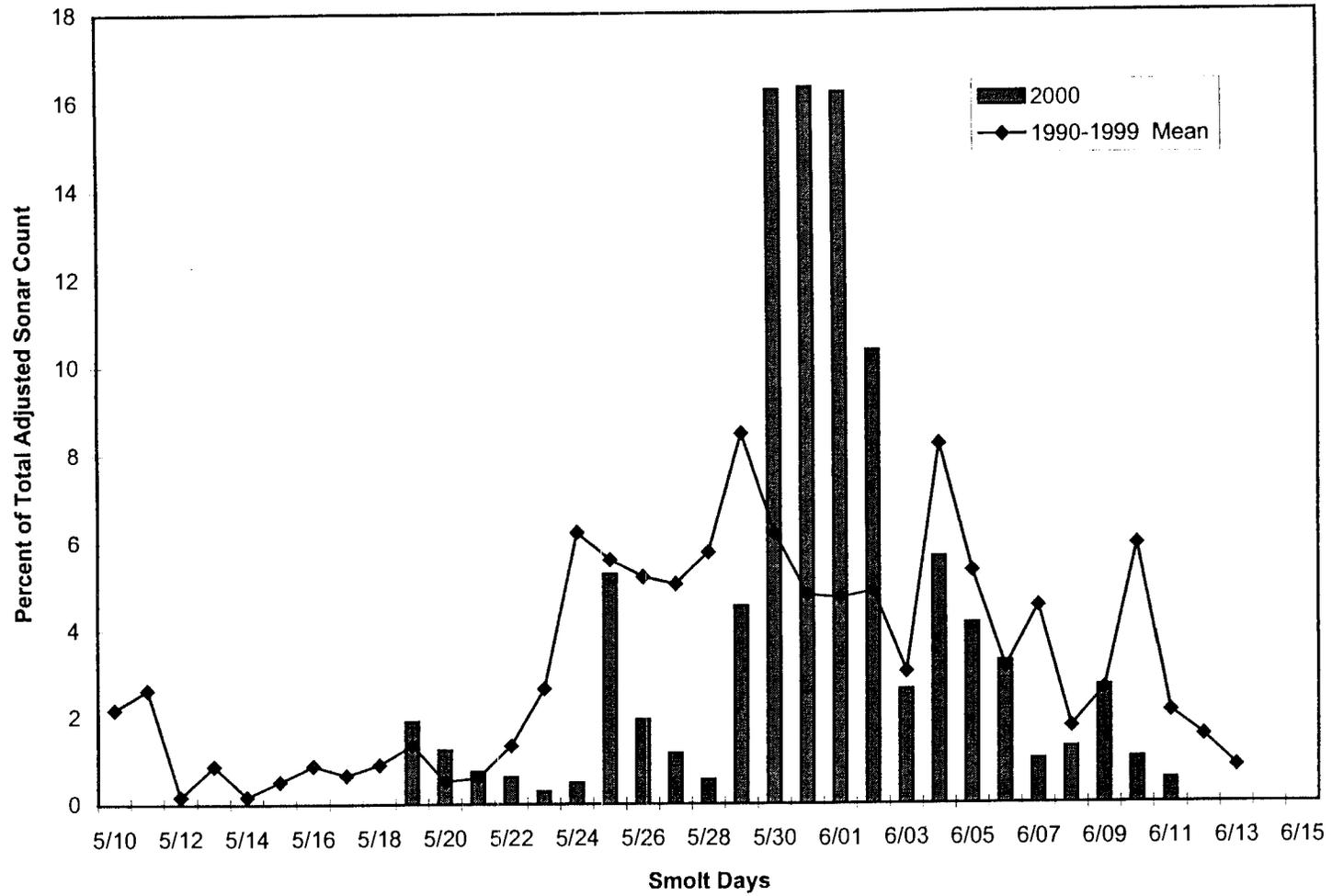


Figure 20. Comparison of the percent of the 2000 total adjusted sonar counts by smolt day at Ugashik River smolt sonar with the 1990-1999 mean.

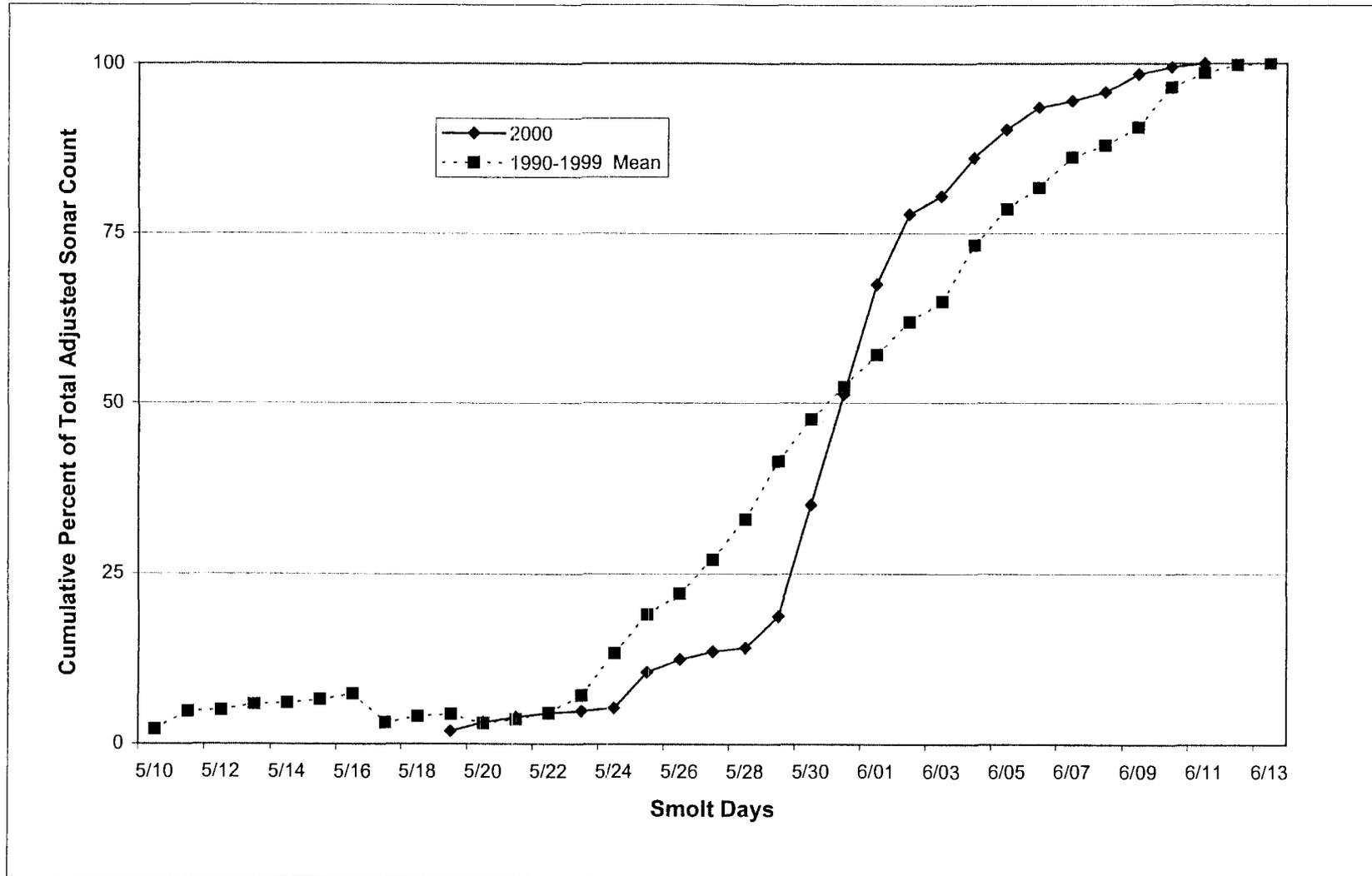


Figure 21. Comparison of the cumulative percent of the 2000 total adjusted sonar counts by smolt day at Ugashik River smolt sonar with the 1990-1999 mean.

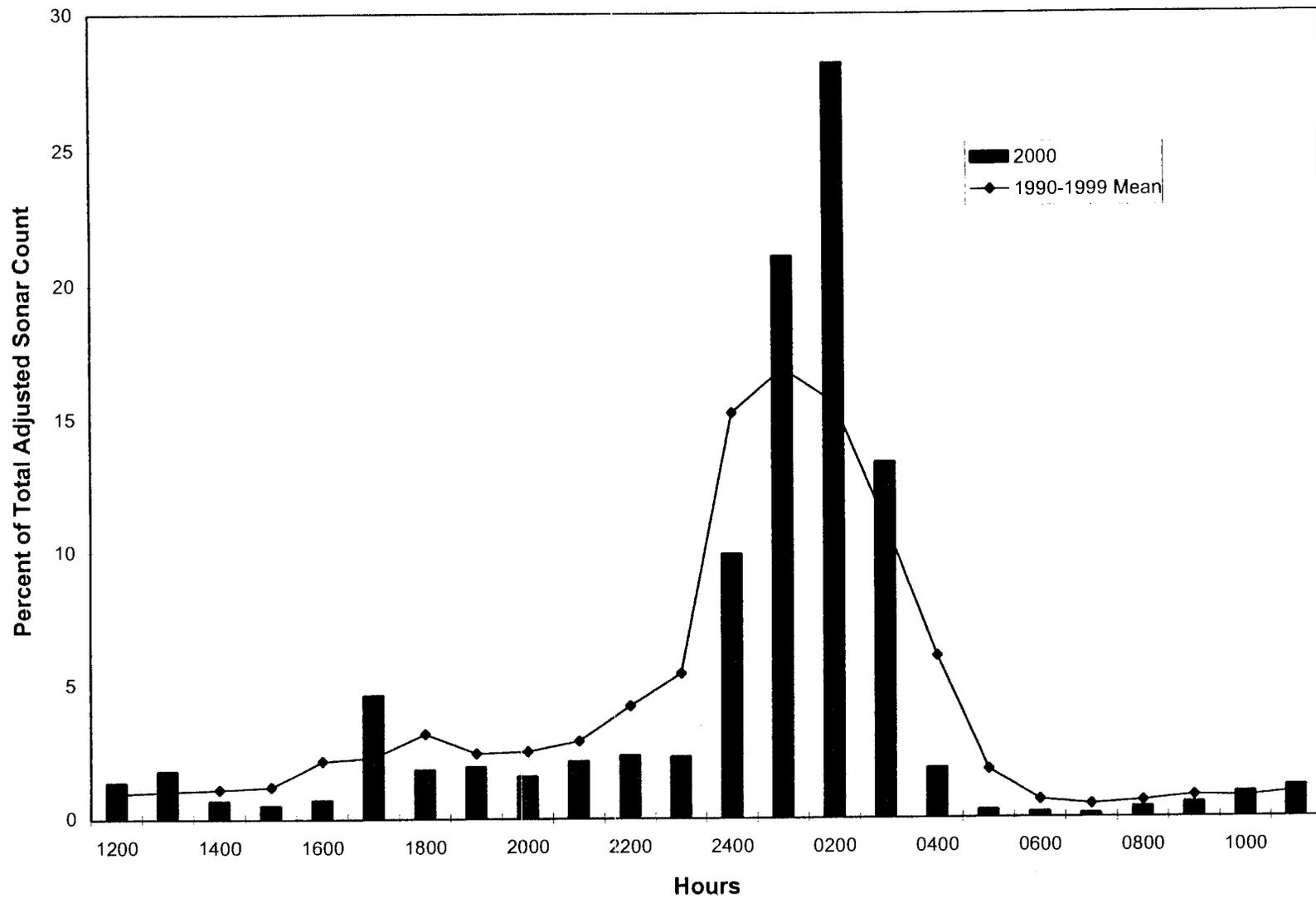


Figure 22. Comparison of the percent of the 2000 total adjusted sonar counts by hour at Ugashik River smolt sonar with the 1990-1999 mean.

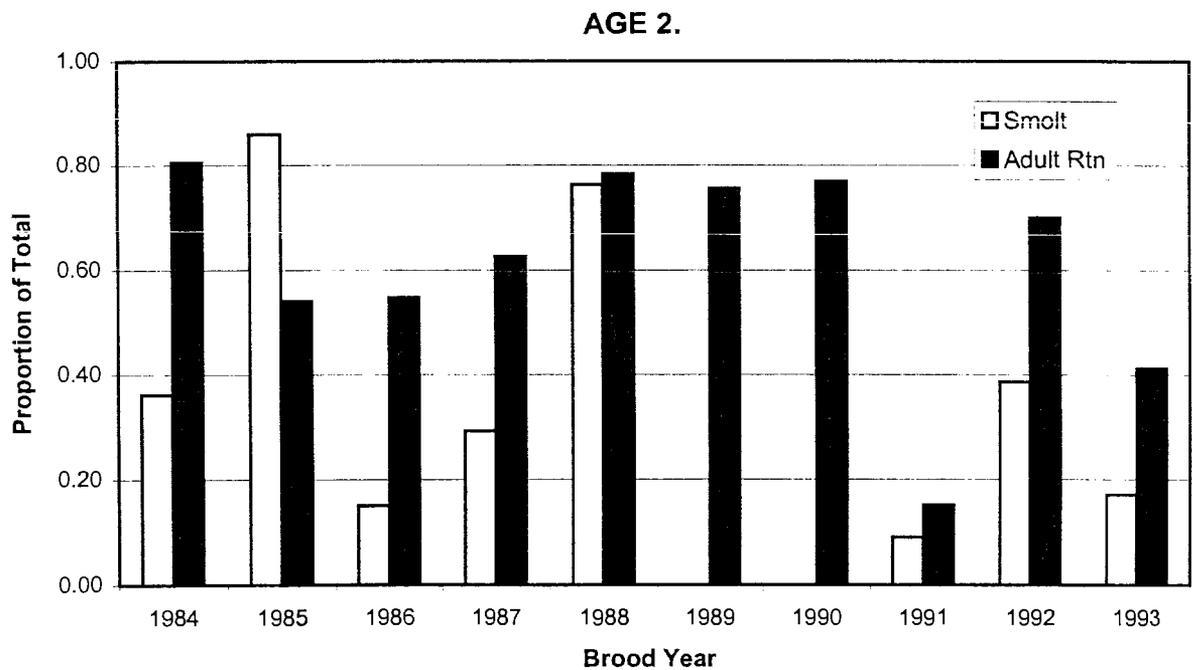
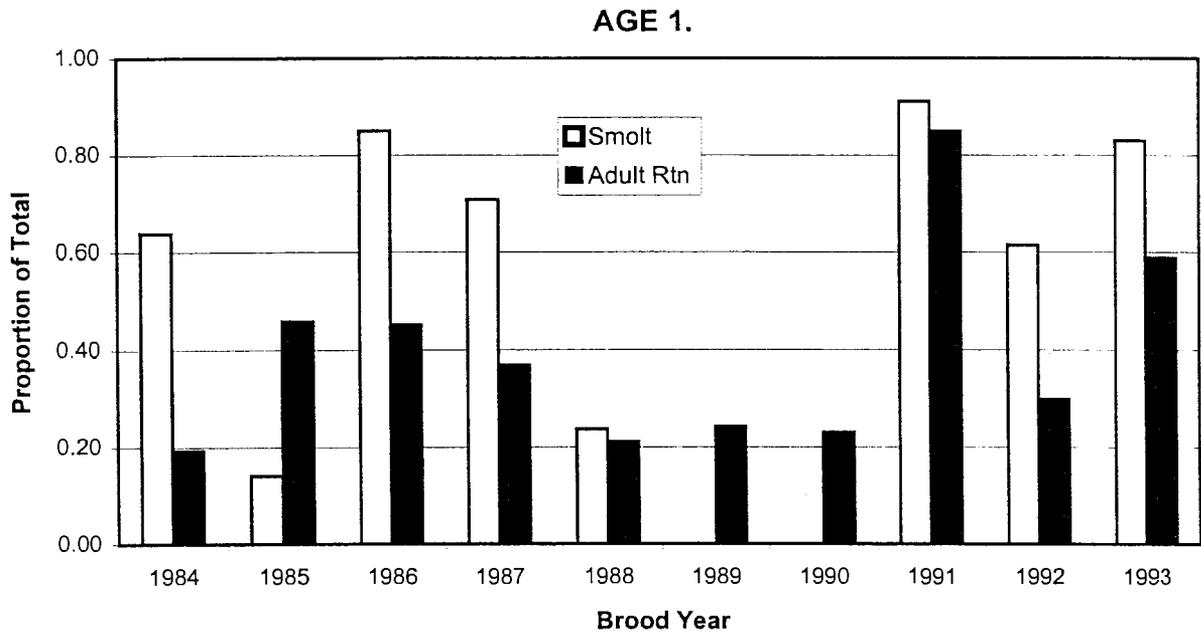


Figure 23. Comparison of the age composition of outmigrating sockeye salmon smolt at Ugashik River with the freshwater age composition of the total adult returns by brood year, 1984-1993.

## **APPENDICES**

Appendix A.1. River width and distance between arrays at Kvichak River smolt sonar site<sup>a</sup>, 1989-2000.

Year	Distance (m)						
	Left Bank Shore	Offshore Limit Dead Zone	Offshore Array	Center Array	Inshore Array	Inshore Limit Dead Zone	Right Bank Shore
1989 <sup>b</sup>	123	119	72	55	23	12	0
1990	136	128 <sup>c</sup>	96	67	42	5 <sup>c</sup>	0
1991	134	126	97	78	56	5	0
1992	129	109	85	68	49	5	0
1993	125	116	93	70	52	12	0
1994	134	125	91	70	58	12	0
1995	135	125	100 <sup>d</sup>	72	61	12	0
1996	129	120	100	85 <sup>e</sup>	52	12	0
1997	126	117	93	80	62	18	0
1998	134	125	96	69	47	15	0
1999	134	125	81	69	48	18	0
2000	133	126	84	69	50	9	0
1989-99 Max	136	128	100	85	62	18	0
1989-99 Avg	130	121	92	71	50	11	0
1989-99 Min	123	109	72	55	23	5	0

<sup>a</sup> Since 1989, the Kvichak River smolt sonar site has been located 6 km downstream from the outlet of Lake Iliamna. The current site is 1 km downstream from the 1973-1988 smolt sonar site. The Global Positioning System (GPS) coordinates for the Kvichak River smolt sonar tent are - 59°18.049'N 155°57.859'W.

<sup>b</sup> From 1989-1994 the cables for all sonar arrays were 101 m (330 ft) long.

<sup>c</sup> Source - Huttunen and Skvorc (1991)

<sup>d</sup> Offshore array cables extended to 126 m (415 ft) prior to the 1995 field season to improve array placement and safety during deployment.

<sup>e</sup> Center array cables extended to 126 m (415 ft) prior to the 1996 field season to improve array placement and safety during deployment.

Appendix A.2. River width and distance between arrays at Egegik River smolt sonar site<sup>a</sup>, 1989-2000.

Year	Distance (m)						
	Left Bank Shore	Inshore Limit Dead Zone	Inshore Array	Center Array	Offshore Array	Offshore Limit Dead Zone	Right Bank Shore
1989	0	9	40	55	67	82	104
1990	0	9	40	55	67	82	104
1991	0	9	40	55	67	85	107
1992	0	21	43	55	73	101	110
1993	0	16	43	58	70	94	116
1994	0	12	40	55	67	90	112
1995	0	9	37	53	67	93	114
1996	0	12	40	55	67	89	112
1997	0	17	40	55	67	82	107
1998	0	9	40	55	67	85	108
1999	0	12	40	55	67	91	112
2000	0	9	40	55	67	85	108
1989-99 Max	0	21	43	58	73	101	116
1989-99 Avg	0	12	40	55	68	89	109
1989-99 Min	0	9	37	53	67	82	104

<sup>a</sup> The Egegik River smolt sonar site was located 4 km downstream from the outlet of Becharof Lake, 1982-2000. The Global Positioning System (GPS) coordinates for the Egegik River smolt sonar tent are - 58°03.53' N latitude 156°53.23' W longitude

Appendix A.3. River width and distance between arrays at Ugashik River smolt sonar site<sup>a</sup>, 1988-2001.

Year	Distance (m)					Right Bank Shore
	Left Bank Shore	Offshore Limit Dead Zone <sup>b</sup>	Offshore Array	Inshore Array	Inshore Limit Dead Zone <sup>b</sup>	
1988	49	na	29	23	na	0
1989	43	34	28	23	12	0
1990	43	37	31	26	12	0
1991	43	37	30	26	12	0
1992 <sup>c</sup>						
1993	43	35	30	26	12	0
1994	43	37	32	27	12	0
1995	43	37	30	24	12	0
1996	41	35	30	26	11	0
1997	42	38	32	27	11	0
1998	44	38	33	27	14	0
1999	44	38	31	27	12	0
2000	45	38	33	28	14	0
1989-99 Max	44	38	33	27	14	0
1989-99 Avg	43	36	31	26	12	0
1989-99 Min	41	34	28	23	11	0

<sup>a</sup> The Ugashik River smolt sonar site was located 50 m downstream from the outlet of Lower Ugashik Lake, 1988-2001. The Global Positioning System (GPS) coordinates for the Ugashik River smolt sonar tent are - 57°33.89' N latitude 156°59.90' W longitude.

<sup>b</sup> na = not available

<sup>c</sup> Due to budget cuts, the smolt outmigration was not monitored on the Ugashik River in 1992.



Appendix B.1. Ice-cover dates for Lake Iliamna, 1970-2000.

Winter of	Freeze-up Date <sup>a</sup>		Break-up Date <sup>a</sup>		Total Days of Ice Cover	Comments <sup>a</sup>
	(dd-mmm)	Julian Day	(dd-mmm)	Julian Day		
1969-1970	1-Jan	1				
1970-1971	7-Jan	7	16-Jun	167	161	Long, cold winter.
1971-1972			5-Jun	157		
1972-1973			25-May	145		
1973-1974			21-May	141		
1974-1975	26-Dec	-5	4-Jun	155	161	
1975-1976			7-May	128		
1976-1977	4-Feb	35	2-May	122	88	Partially open 30-Mar
1977-1978			11-May	131		80% open 02-May
1978-1979			3-May	123		50% open 28-Apr
1979-1980			3-May	124		
1980-1981						
1981-1982	9-Jan	9	25-May	145	137	Started to reopen 10-Feb
1982-1983						
1983-1984						Still open 19-Dec
1984-1985	11-Feb	42	5-Jun	156	115	50% open 29-May
1985-1986	18-Jan	18	12-May	132	115	
1986-1987	13-Feb <sup>b</sup>	44	23-Mar	82	39	Still not frozen up by 13-Feb
1987-1988	26-Jan	26				Began re-opening 24-Feb; 75% open 01-Apr
1988-1989	13-Jan	13				50% open 20-Apr
1989-1990	9-Jan	9	22-May	142	134	
1990-1991	7-Jan	7				
1991-1992	27-Jan	27	4-May	125	98	
1992-1993	22-Jan	22	3-May	123	102	
1993-1994	16-Feb	47	5-May	125	79	Ice jammed along west shore; trickled out until 29-May
1994-1995	11-Jan <sup>b</sup>	11	22-May	142	132	Lake frozen briefly, 19-Dec, then reopened. Lake 95% open by 13-May
1995-1996	12-Jan	12	5-May	126	114	
1996-1997	23-Dec <sup>c</sup>	-8	8-May <sup>d</sup>	128	137	
1997-1998	5-Jan	5	26-Apr	117	112	
1998-1999	30-Dec	-1	28-May	148	150	
1999-2000	30-Dec	-1	6-May	126	128	
1970-1999 Min	23-Dec		23-Mar		39	
1970-1999 Avg	16-Jan		13-May		117	
1970-1999 Max	16-Feb		16-Jun		161	

<sup>a</sup> Most data is anecdotal, provided by pilots from local air charter companies (R. Russell, ADF&G retired, King Salmon, personal communication).

<sup>b</sup> Last date area was observed with open water; may have frozen over later.

<sup>c</sup> Mostly frozen 18-Dec, except several large holes.

<sup>d</sup> Lake Iliamna was still ice covered on the evening of May 6. Subsequent scutherly and westerly winds over the next several days caused the ice to break up, blow up the lake, and melt in place. By May 10 the lake was ice-free at Igiugig.

Appendix B.2. Ice-cover dates for Becharof Lake, 1976-2000.

Winter of	Freeze-up Date <sup>a</sup>		Break-up Date <sup>a</sup>		Total Days of Ice Cover	Comments <sup>a</sup>
	(dd-mmm)	Julian Day	(dd-mmm)	Julian Day		
1975-1976			6-Apr	97		
1976-1977			6-Apr	96		Island Arm still frozen. Main basin opened earlier.
1977-1978						
1978-1979						
1979-1980						
1980-1981			13-May	133		May have opened earlier.
1981-1982			20-May	140		Still open 15-Dec. May have opened earlier than 20-May.
1982-1983	18-Jan	18				50% open 31-Mar
1983-1984	16-Jan <sup>b</sup>	16	16-May	137		Still open 16-Jan
1984-1985	11-Feb	42	3-May	123	82	
1985-1986	26-Feb	57	27-Apr	117	61	Still open 30-Jan
1986-1987	12-Mar <sup>b</sup>	71				Still open 12-Mar
1987-1988	24-Mar <sup>b</sup>	84				Still open 24-Mar
1988-1989	17-Jan	17	27-Apr	117	101	
1989-1990	21-Feb	52	25-Apr	115	64	
1990-1991	4-Feb	35	1-Apr	91	57	
1991-1992	27-Jan	27	10-May	131	105	
1992-1993	23-Jan	23	31-Mar	90	68	
1993-1994	25-Feb	56	4-Apr	94	39	
1994-1995	24-Jan	24	28-Apr	118	95	Wind driven ice lense blocked lake outlet on 19-May & 20-May
1995-1996	8-Jan	8	28-Mar	88	81	
1996-1997	13-Dec <sup>c</sup>	-18	19-Apr <sup>d</sup>	109	128	
1997-1998	6-Jan	6	4-Apr	94	89	
1998-1999	5-Feb <sup>e</sup>	36	28-May	148	113	Accumulated of ice at the lake outlet caused ice problems in the river from 27-May to 18-June.
1999-2000	2-Jan	2	12-Apr	103	101	
1976-1999 Min	13-Dec		28-Mar		39	
1976-1999 Avg	1-Feb		23-Apr		86	
1976-1999 Max	24-Mar		28-May		128	

<sup>a</sup> Most data is anecdotal, provided by pilots from local air charter companies (R. Russell, ADF&G retired, King Salmon, personal communication).

<sup>b</sup> Last date area was observed with open water; may have frozen over even later.

<sup>c</sup> Mostly frozen on 13-Dec except a small section of shoreline near Whale Mt and two small sections in the NW half of the lake.

<sup>d</sup> In a 19-Apr satellite photo the lake appears to be completely ice free (1 °C), scattered patches of windblown ice remain along the NE & W end of lake.

<sup>e</sup> Estimated freeze-up date. West half of lake frozen on 08-Jan. Average temperatures in King Salmon were below -18°C (0°F) from 28-Jan to 12-Feb. The coldest days occurred from 30-Jan to 05-Feb with average daily temperatures of -29 to -34°C (-20 to -29 °F).

Appendix B.3. Ice-cover dates for Upper and Lower Ugashik Lakes, 1977-2000.

Winter of	Freeze-up Date <sup>a</sup>		Break-up Date <sup>a</sup>		Total Days of Ice Cover	Comments <sup>a</sup>
	(dd-mmm)	Julian Day	(dd-mmm)	Julian Day		
1976-1977			6-Apr	96		
1977-1978						
1978-1979						
1979-1980						
1980-1981						Still open 16-Dec
1981-1982			12-May	132		
1982-1983	18-Jan	18				Partially open 31-Mar
1983-1984	16-Jan <sup>b</sup>	16				
1984-1985	11-Feb	42	14-May	134	93	
1985-1986	26-Feb	57	9-May	129	73	
1986-1987	12-Mar <sup>b</sup>	71				
1987-1988	9-Dec	-22	24-Mar	84	107	
1988-1989	17-Jan	17	10-May	130	114	
1989-1990	21-Feb	52	25-Apr	115	64	
1990-1991	8-Jan	8				
1991-1992	27-Jan	27	4-May	125	99	
1992-1993	20-Jan	20	31-Mar	90	71	
1993-1994	16-Feb	47	8-Apr	98	52	
1994-1995	24-Jan	24	28-Apr	118	95	
1995-1996	8-Jan	8	15-Apr	106	99	
1996-1997	13-Dec <sup>c</sup>	-18	26-Apr <sup>d</sup>	116	135	
1997-1998	5-Jan	5	4-Apr	94	90	
1998-1999	22-Jan	22	19-May	139	118	
1999-2000	25-Dec	-6	7-Apr	98	104	
1977-1999 Min	9-Dec		24-Mar		52	
1977-1999 Avg	23-Jan		23-Apr		93	
1977-1999 Max	12-Mar		19-May		135	

<sup>a</sup> Most data is anecdotal, provided by pilots from local air charter companies (R. Russell, ADF&G retired, King Salmon, personal communication).

<sup>b</sup> Last date area was observed with open water; may have frozen over even later.

<sup>c</sup> Mostly frozen on 13-Dec except SW shoreline of Upper Ugashik Lake by Blue Mt and the NW shore of Lower Ugashik Lake between the outlet and the Narrows.

<sup>d</sup> Upper Ugashik Lake ice free by 24-Apr. Lower Ugashik Lake 90% open by 26-April. Lake ice flows cleared in Ugashik River about 4-May.



Appendix C.1. Kvichak River smolt fyke net catch log, 2000.

Smolt Day	Cod End No.	Time <sup>a</sup>		Total Time Fished (min)		Smolt Catch		CPUE <sup>b</sup>
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
5/21	001	1845	1900	15	15	240	240	16
5/22	002	0037	0055	18		121		7
	003	0258	0421	83		57		1
	004	0604	0730	86		84		1
	005	0731	0833	62		250		4
	006	2044	0050	246	495	600	1,112	2
	5/23	007	0052	0740	408		118	
008		1518	1946	268		109		0
009		1956	2239	163		108		1
010		2243	0056	133	972	113	448	1
5/24	011	0103	0634	331		61		0
	012	2211	2330	79		141		2
	013	2334	0058	84	494	450	652	5
5/25	014	0104	0244	100		143		1
	015	0250	0330	40		54		1
	016	2246	2331	45		135		3
	017	2335	2354	19		119		6
	018	2358	0015	17	221	107	558	6
5/26	019	0021	0132	71		62		1
	020	0458	0756	178		500		3
	021	2136	2250	74	323	95	657	1
5/27	022	0015	0121	66		47		1
	023	0125	0332	127		62		0
	024	2118	2329	131		107		1
	025	2331	0020	49	373	113	329	2
5/28	026	0025	0128	63		89		1
	027	0134	0432	178		84		0
	028	0436	0441	5		140		28
	029	0509	0529	20		65		3
	030	2016	0034	258	524	77	455	0
5/29	031	0036	0158	82		116		1
	032	0205	0310	65		73		1
	033	0315	0419	64		81		1
	034	0519	0608	49		300		6
	035	0612	0732	80		123		2
	036	1928	0358	510	850	70	763	0
5/30	037	0359	0555	116		200		2
	038	2213	2252	39		170		4
	039	2300	0016	76	231	150	520	2

Smolt Day	Cod End No.	Time <sup>a</sup>		Total Time Fished (min)		Smolt Catch		CPUE <sup>b</sup>
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
5/31	040	0019	0107	48		116		2
	041	0111	0127	16		114		7
	042	0204	0304	60		150		3
	043	0316	0412	56		91		2
	044	1921	1926	5		102		20
	045	1935	2010	35		650		19
	046	2016	2034	18		104		6
	047	2040	2103	23		260		11
	048	2240	0012	92	353	200	1,787	2
6/01	049	0017	0123	66		91		1
	050	2110	0055	225	291	111	202	0
6/02	051	0057	0454	237		156		1
	052	0455	0501	6		135		23
	053	0504	0812	188		46		0
	054	2044	0052	248	679	100	437	0
6/03	055	0054	0824	450		100		0
	056	1855	0218	443	893	87	187	0
6/04	057	0221	0509	168		196		1
	058	0512	0651	99		183		2
	059	2034	2155	81		300		4
	060	2200	2250	50		200		4
	061	2255	0019	84	482	133	1,012	2
6/05	062	0021	0026	5		145		29
	063	0028	0038	10		141		14
	064	0039	0055	16		151		9
	065	2013	2135	82		121		1
	066	2141	0027	166	279	260	818	2
6/06	067	0032	0137	65		89		1
	068	0142	0433	171		380		2
	069	0440	0529	49		450		9
	070	2254	0216	202	487	120	1,039	1
6/07	071	0221	0531	130	130	94	94	1
6/08	072	1618	1945	207		91		0
	073	2358	0114	76	283	133	224	2
6/09	074	0119	0413	174		93		1
	075	0418	0550	92		93		1
	076	0555	1138	343		54		0
	077	1833	0311	518	1,127	95	335	0
6/10	078	0316	0458	102	102	176	176	2
6/11	079	0036	0231	175		115		1
	080	0236	0710	274		125		0
	081	0715	0754	39		154		4
	082	0756	1158	242	730	2	396	0
Max					1,127	650	1,787	29
Avg					470	152	566	4
Min					15	2	94	0

<sup>a</sup> Military time - 24 hour clock (hhmm).

<sup>b</sup> CPUE = catch per unit effort

Appendix C.2. Kvichak River fyke net catches by species and smolt day, May 21 to June 10, 2000.

Smolt Day	Time Fished (h)	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Sticklebacks <sup>a</sup> (Species)	Chinook Smolt	Coho Smolt	Chum Fry	Pink Fry	Lamprey (Species)	Whitefish <sup>b</sup> (Species)	Smelt <sup>c</sup> (Species)	Rainbow Trout (juv)	Sculpin <sup>d</sup> (Species)	Northern Pike (juv)
5/21	4.4	752	49	0	0	0	0	0	0	0	0	0	0
5/22	10.9	718	170	0	0	0	0	0	0	0	0	0	0
5/23	14.9	392	160	0	0	0	0	0	0	0	0	0	0
5/24	5.1	788	0	0	0	0	0	2	0	0	0	0	0
5/25	5.5	923	0	0	0	0	0	1	0	0	0	0	0
5/26	4.5	204	50	0	0	0	0	1	0	0	0	0	0
5/27	7.4	598	21	0	0	0	0	1	0	0	0	7	0
5/28	10.0	770	0	0	0	0	0	4	0	0	0	0	0
5/29	10.4	270	0	1	0	0	0	2	0	0	0	0	0
5/30	4.9	791	30	2	0	0	2	0	0	0	0	0	0
5/31	4.0	1,348	0	0	0	0	0	0	0	0	0	0	0
6/01	10.9	448	0	0	0	0	0	2	0	0	0	0	0
6/02	11.6	200	20	2	0	0	0	1	0	0	0	2	0
6/03	11.8	468	0	6	0	0	0	0	0	0	0	0	0
6/04	4.1	1,070	1	3	0	0	0	0	0	0	0	0	0
6/05	8.9	1,300	10	1	0	0	1	1	0	0	0	1	0
6/06	6.5	214	16	8	0	0	0	1	0	0	0	2	0
6/07	0.0	0	0	0	0	0	0	0	0	0	0	0	0
6/08	14.9	464	214	2	0	0	0	0	0	3	5	0	0
6/09	10.3	271	46	0	0	0	0	0	0	0	0	0	0
6/10	11.1	396	1	0	0	0	0	0	0	0	0	0	0
Total	172.2	12,385	788	25	0	0	3	16	0	3	5	12	0
Max	14.9	1,348	214										
Avg	8.2	590	38										
Min	0.0	0	0										

<sup>a</sup> Most were threespine sticklebacks, however some ninespine sticklebacks were also caught.

<sup>b</sup> Species not identified.

<sup>c</sup> Lengths range from 73 mm to 94 mm.

<sup>d</sup> Species unknown, however slimy sculpin and coastrange sculpin both occur in freshwater lakes and streams in Bristol Bay (Morrow 1980).

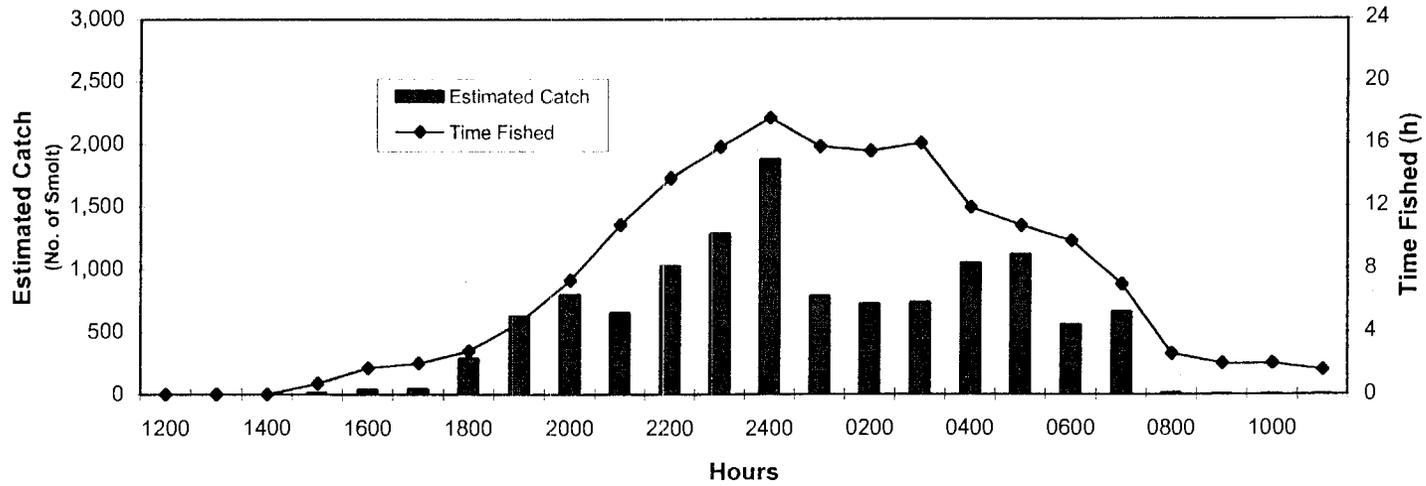
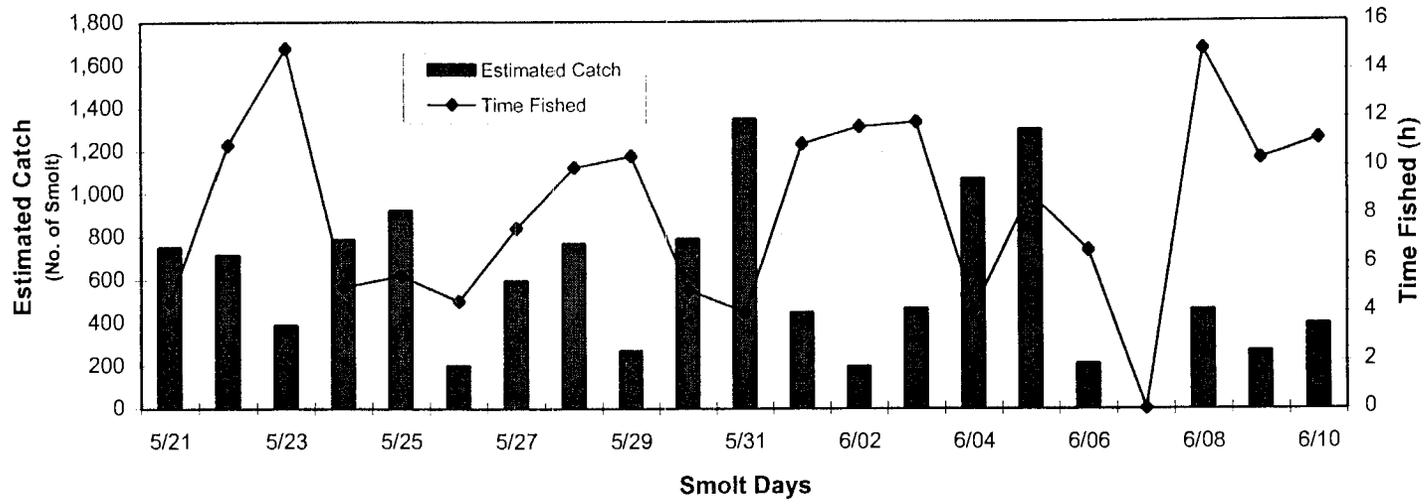
Appendix C.3. Kvichak River fyke net catches by species and hour, May 21 to June 10, 2000.

Hour <sup>a</sup>	Time Fished (h)	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Sticklebacks (Species)	Chinook Smolt	Coho Smolt	Chum Fry	Pink Fry	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin (Species)	Northern Pike (juv)
1200	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1300	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1400	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1500	0.7	18	6	0	0	0	0	0	0	0	0	0	0
1600	1.7	43	10	0	0	0	0	0	0	0	0	0	0
1700	2.0	50	10	0	0	0	0	0	0	0	0	0	0
1800	2.8	296	37	0	0	0	0	0	0	0	0	0	0
1900	4.6	631	9	1	0	0	0	0	0	0	0	0	0
2000	7.3	803	17	1	0	0	0	0	0	0	0	0	0
2100	10.8	660	33	1	0	0	0	0	0	0	0	0	0
2200	13.8	1030	35	2	0	0	0	1	0	0	0	0	0
2300 <sup>b</sup>	15.8	1287	42	4	0	0	0	1	0	0	0	0	0
2400 <sup>c</sup>	17.7	1881	103	6	0	0	0	2	0	0	4	5	0
0100 <sup>c</sup>	15.8	790	93	4	0	0	2	7	0	2	1	3	0
0200 <sup>c</sup>	15.5	726	108	3	0	0	1	3	0	0	0	1	0
0300 <sup>c</sup>	16.0	737	115	2	0	0	0	1	0	0	0	1	0
0400 <sup>c</sup>	11.9	1051	79	1	0	0	0	1	0	0	0	0	0
0500 <sup>c</sup>	10.8	1117	39	0	0	0	0	0	0	1	0	2	0
0600 <sup>b</sup>	9.8	558	20	0	0	0	0	0	0	0	0	0	0
0700	7.0	666	31	0	0	0	0	0	0	0	0	0	0
0800	2.6	17	1	0	0	0	0	0	0	0	0	0	0
0900	2.0	9	0	0	0	0	0	0	0	0	0	0	0
1000	2.0	9	0	0	0	0	0	0	0	0	0	0	0
1100	1.6	6	0	0	0	0	0	0	0	0	0	0	0
Total	172.2	12,385	788	25	0	0	3	16	0	3	5	12	0

<sup>a</sup> Daylight hours unless indicated otherwise

<sup>b</sup> Twilight hours

<sup>c</sup> Hours of darkness



Appendix C.4. Kvichak River fyke net estimated catch and time fished by smolt day and hour, 2000.

Appendix C.5. Egegik River smolt fyke net catch log, 2000.

Smolt Day	Cod End No.	Time <sup>a</sup>		Total Time Fished (min)		Smolt Catch		CPUE <sup>b</sup>
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
5/21		0006	0210	124	124	0	0	0
5/22	001	0013	0206	113	113	17	17	0
5/23	002	0014	0220	126	126	120	120	1
5/24	003	0008	0146	98		93		1
	004	0147	0200	13		90		7
	005	0201	0216	15	126	62	245	4
5/25	006	0010	0134	84		144		2
	007	0136	0146	10		125		13
	008	0148	0150	2		122		61
	009	0152	0153	1		131		131
	010	0155	0157	2		105		53
	011	0159	0202	3	102	107	734	36
5/26	012	0045	0048	3		111		37
	013	0050	0053	3		114		38
	014	0054	0057	3		115		38
	015	0059	0100	1		500		500
	016	0103	0105	2		113		57
	017	0107	0109	2	14	106	1,059	53
5/27	018	0022	0031	9		130		14
	019	0033	0041	8		200		25
	020	0044	0054	10		120		12
	021	0055	0106	11		150		14
	022	0107	0115	8		200		25
	023	0118	0122	4	50	150	950	38
5/28	024	0027	0041	14		160		11
	025	0044	0101	17		200		12
	026	0104	0112	8		140		18
	027	0115	0118	3		100		33
	028	0128	0137	9		150		17
	029	0142	0153	11	62	150	900	14
5/29	030	0043	0109	26		110		4
	031	0111	0124	13		130		10
	032	0126	0135	9		150		17
	033	0137	0148	11		150		14
	034	0151	0157	6		120		20
	035	0202	0211	9	74	110	770	12
5/30	036	0122	0139	17		110		6
	037	0142	0157	15		110		7
	038	0158	0215	17	49	100	320	6
5/31	039	0021	0043	22		500		23
	040	0046	0051	5		200		40
	041	0055	0100	5		200		40
	042	0103	0115	12		100		8
	043	0118	0122	4		110		28
	044	0128	0135	7	55	100	1,210	14

Appendix C.5. (p 2 of 2)

Smolt Day	Cod End No.	Time <sup>a</sup>		Total Time Fished (min)		Smolt Catch		CPUE <sup>b</sup>
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
6/01	045	0024	0049	25		100		4
	046	0052	0058	6		100		17
	047	0102	0121	19		100		5
	048	0122	0208	46	96	100	400	2
6/02	049	0012	0036	24		120		5
	050	0039	0053	14		120		9
	051	0057	0106	9		110		12
	052	0109	0127	18		120		7
	053	0133	0149	16		130		8
	054	0153	0205	12	93	150	750	13
6/03	055	0008	0050	42		120		3
	056	0053	0116	23		130		6
	057	0118	0139	21		100		5
	058	0140	0206	26		150		6
	059	0207	0216	9	121	100	600	11
6/04	060	0010	0103	53		120		2
	061	0104	0117	13		120		9
	062	0118	0125	7		300		43
	063	0126	0146	20		250		13
	064	0147	0157	10		135		14
	065	0158	0204	6	109	110	1,035	18
6/05	066	0010	0105	55		180		3
	067	0106	0126	20		110		6
	068	0127	0142	15		110		7
	069	0143	0201	18		100		6
	070	0202	0219	17	125	100	600	6
6/06								
6/07	071	0027	0043	16		100		6
	072	0044	0046	2		250		125
	073	0047	0124	37		100		3
	074	0126	0144	18		100		6
	075	0147	0158	11		120		11
	076	0159	0215	16	100	100	770	6
6/08	077	0015	0049	34		100		3
	078	0053	0118	25		200		8
	079	0119	0132	13		130		10
	080	0134	0152	18		100		6
	081	0155	0215	20	110	100	630	5
6/09	082	0010	0126	76		120		2
	083	0129	0210	41	117	120	240	3
6/10	084	0120	0205	45		100		2
	085	0207	0216	9	54	40	140	4
Max				126	126	500	1,210	500
Avg				21	91	134	575	23
Min				1	14	0	0	0

<sup>a</sup> Military time - 24 hour clock (hhmm).

<sup>b</sup> CPUE = catch per unit effort

Appendix C.6. Egegik River fyke net catches by smolt day and species, May 21 to June 10, 2000.

Smolt Day	Time Fished (h)	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Threespine Stickleback	Chinook Smolt	Coho Juvenile	Chum Fry	Pink Fry	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin (Species)	Northern Pike (juv)
5/21	2.1	0	0	0	0	0	10	0	0	0	0	0	0
5/22	1.9	17	0	0	0	0	0	0	0	0	0	0	0
5/23	2.1	120	0	0	0	0	0	0	0	0	0	0	0
5/24	2.1	245	0	0	0	0	0	0	0	0	0	0	0
5/25	1.7	734	0	0	0	0	0	0	0	0	0	0	0
5/26	0.2	1,059	0	0	0	0	0	0	0	0	0	0	0
5/27	0.9	924	0	0	0	0	0	0	0	0	0	0	0
5/28	1.0	900	0	0	0	0	0	0	0	0	0	0	0
5/29	1.2	770	0	0	0	0	0	0	0	0	0	0	0
5/30	0.8	320	0	0	0	0	0	0	0	0	0	0	0
5/31	0.9	1,210	0	0	0	0	0	0	0	0	0	0	0
6/01	1.6	400	0	0	0	0	0	0	0	0	0	0	0
6/02	1.6	750	0	0	2	0	0	0	0	0	0	0	0
6/03	2.0	680	0	0	1	0	0	0	0	0	0	0	0
6/04	1.8	1,035	1	0	0	0	15	0	0	0	0	0	0
6/05	2.1	600	0	0	1	0	0	0	0	0	0	0	0
6/06 <sup>a</sup>	0.0	0	0	0	0	0	0	0	0	0	0	0	0
6/07	1.7	770	0	1	0	0	0	0	0	0	0	0	0
6/08	1.8	630	0	0	0	0	0	0	0	0	0	0	0
6/09	2.0	240	0	0	0	0	0	0	0	0	0	0	0
6/10	0.9	140	0	0	0	0	0	0	0	0	0	0	0
Total	30.3	11,544	1	1	4	0	25	0	0	0	0	0	0
Max	2.1	1,210											
Avg	1.4	550											
Min	0.0	0											

<sup>a</sup> Did not fish the fyke net on smolt day 6/06 due to winds E 40-50.

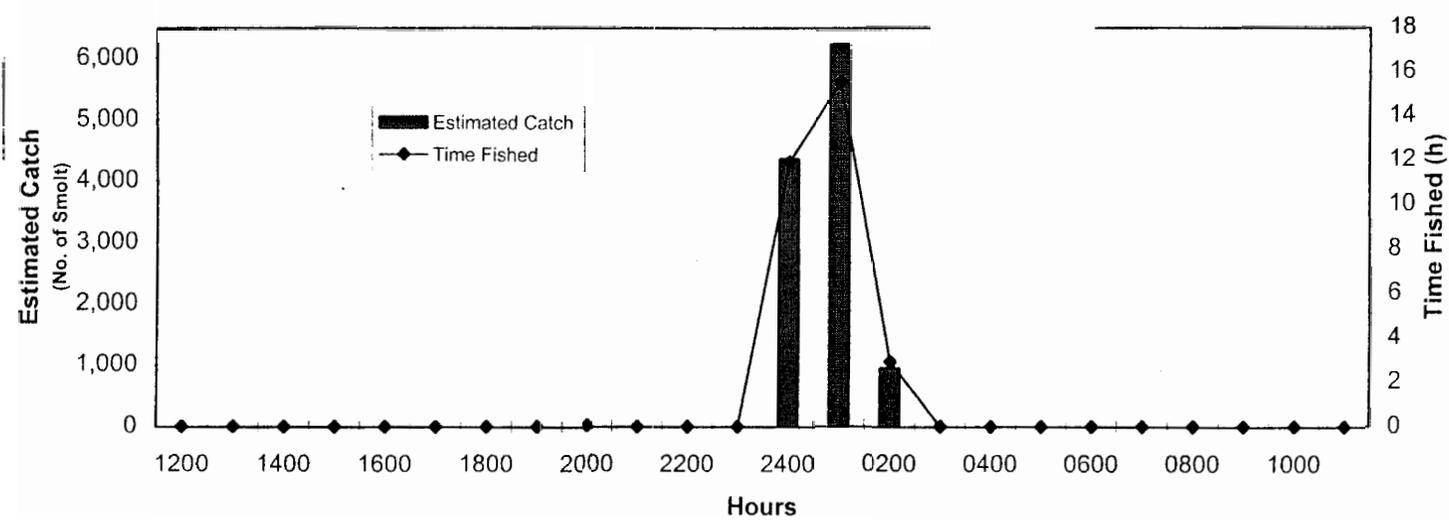
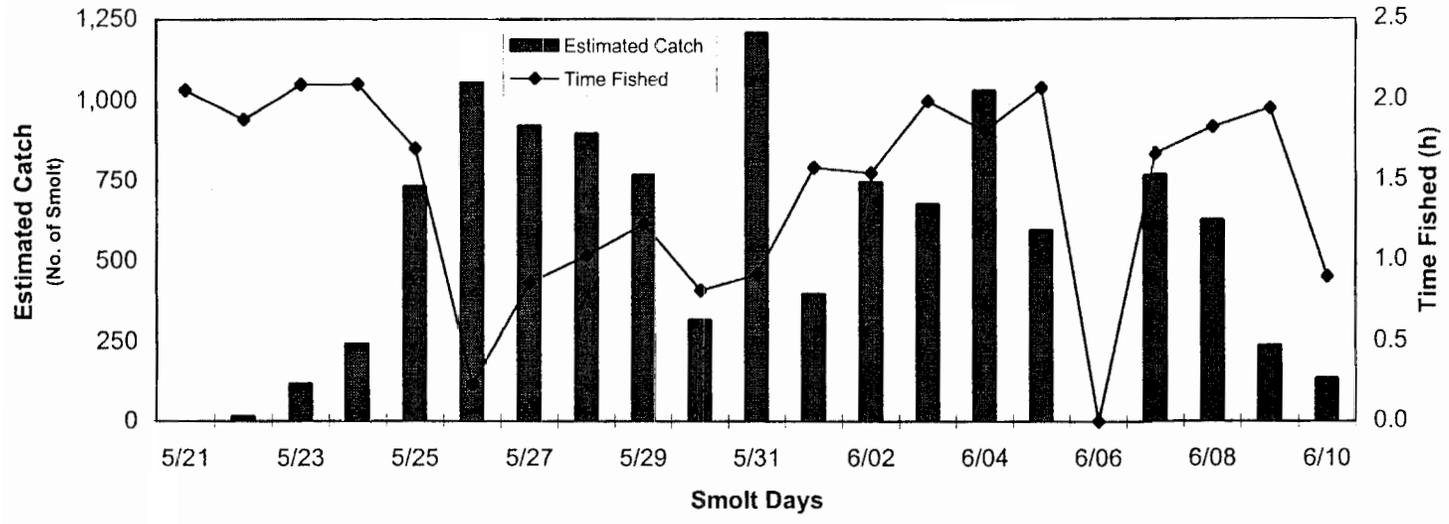
Appendix C.7. Egegik River fyke net catches by hour and species, May 21 to June 10, 2000.

Hour	Time Fished (h) <sup>a</sup>	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Threespine Stickleback	Chinook Smolt	Coho Juvenile	Chum Fry	Pink Fry	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin (Species)	Northern Pike (juv)
1200	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1300	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1400	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1500	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1600	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1700	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1800	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1900	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2100	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2200	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2300	<sup>b</sup> 0.0	0	0	0	0	0	0	0	0	0	0	0	0
2400	<sup>c</sup> 11.9	4,359	0	1	3	0	18	0	0	0	0	1	0
0100	<sup>c</sup> 15.5	6,233	1	0	1	0	6	0	0	0	0	2	0
0200	<sup>c</sup> 2.9	952	0	0	0	0	1	0	0	0	0	0	0
0300	<sup>c</sup> 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0400	<sup>c</sup> 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0500	<sup>c</sup> 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0600	<sup>b</sup> 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0700	0.0	0	0	0	0	0	0	0	0	0	0	0	0
0800	0.0	0	0	0	0	0	0	0	0	0	0	0	0
0900	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1000	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1100	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Total	30.3	11,544	1	1	4	0	25	0	0	0	0	3	0

<sup>a</sup> Daylight hours unless indicated otherwise.

<sup>b</sup> Twilight hours

<sup>c</sup> Hours of darkness



Appendix C.8. Egegik River fyke net estimated catch and time fished by smolt day and hour, 2000.

Appendix C.9. Ugashik River smolt fyke net catch log, 2000.

Smolt Day	Cod End No.	Time <sup>a</sup>		Total Time Fished (min)		Smolt Catch		CPUE <sup>b</sup>
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
5/20	001	0033	0121	48		49		1
	002	0126	0200	34	82	16	65	0
5/21	003	0028	0057	29		81		3
	004	0103	0200	57	86	48	129	1
5/22	005	0038	0117	39		55		1
	006	0122	0204	42	81	9	64	0
5/23	007	0038	0205	27	27	44	44	2
5/24	008	0044	0103	19		125		7
	009	0108	0200	52	71	45	170	1
5/25	010	0030	0035	5		101		20
	011	0044	0051	7		100		14
	012	0056	0057	1		100		100
	013	0109	0114	5		100		20
	014	0122	0134	12		100		8
	015	0140	0150	10	40	100	601	10
5/26	016	0031	0032	1		101		101
	017	0037	0054	17	18	66	167	4
5/27	018	0030	0036	6		146		24
	019	0041	0049	8		86		11
	020	0113	0133	20	34	40	272	2
5/28	021	0001	0017	16		122		8
	022	0021	0047	26		65		3
	023	0053	0115	22	64	9	196	0
5/29	024	0015	0033	18		110		6
	025	0038	0049	11	29	16	126	1
5/30	026	0015	0019	4		115		29
	027	0024	0026	2		99		50
	028	0030	0031	1		300		300
	029	0035	0036	1		500		500
	030	0041	0048	7		100		14
	031	0053	0055	2	17	150	1,264	75
5/31	032	0011	0016	5		200		40
	033	0021	0023	2		300		150
	034	0028	0029	1		400		400
	035	0034	0035	1		250		250
	036	0039	0040	1		110		110
	037	0045	0046	1	11	600	1,860	600
6/01	038	0012	0022	10		200		20
	039	0028	0035	7		300		43
	040	0040	0050	10		300		30
	041	0112	0117	5		200		40
	042	0122	0127	5		103		21
	043	0132	0138	6	43	104	1,207	17
6/02	044	0008	0018	10		140		14
	045	0024	0031	7		134		19
	046	0036	0056	20		50		3
	047	0108	0115	7		122		17
	048	0120	0126	6		102		17
	049	0131	0150	19	69	101	649	5

Smolt Day	Cod End No.	Time <sup>a</sup>		Total Time Fished (min)		Smolt Catch		CPUE <sup>b</sup>
		Set	Pulled	per Set	per Smolt Day	per Set	per Smolt Day	
6/03	050	0004	0010	6		200		33
	051	0015	0021	6		161		27
	052	0026	0050	24		103		4
	053	0055	0107	12		110		9
	054	0112	0129	17	65	128	702	8
6/04	055	0010	0014	4		103		26
	056	0019	0029	10		137		14
	057	0034	0041	7		131		19
	058	0046	0056	10		87		9
	059	0107	0110	3		101		34
	060	0115	0117	2	36	127	686	64
6/05	061	0012	0024	12		500		42
	062	0030	0034	4		130		33
	063	0039	0044	5		200		40
	064	0049	0052	3		250		83
	065	0103	0109	6		99		17
	066	0114	0117	3	33	300	1,479	100
6/06				0	0		0	
6/07	067	0022	0123	61	61	133	133	2
6/08				0	0		0	
6/09	068	0021	0037	16		300		19
	069	0042	0054	12		200		17
	070	0108	0120	12		120		10
	071	0125	0145	20	60	61	681	3
6/10	072	0019	0055	36	36	20	20	1
6/11	073	0025	0050	25	25	23	23	1
Max				61	86	600	1,860	600
Avg				13	43	144	458	51
Min				0	0	9	0	0

<sup>a</sup> Military time - 24 hour clock (hhmm).

<sup>b</sup> CPUE = catch per unit effort

Appendix C.10. Ugashik River fyke net catches by smolt day and species , May 20 to June 11, 2000.

Smolt Day	Time Fished (h)	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Sticklebacks (Species) <sup>a</sup>	Chinook Smolt	Coho Smolt	Chum Fry	Pink Fry	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin (Species)	Northern Pike (juv)
5/20	1.4	65	0	0	0	0	2	0	0	0	0	1	0
5/21	1.4	129	0	0	0	0	0	0	0	0	0	0	0
5/22	1.4	64	0	0	0	0	0	0	0	0	0	0	0
5/23	1.5	27	0	0	0	0	0	0	0	0	0	0	0
5/24	1.2	170	0	0	0	0	0	0	0	0	0	0	0
5/25	0.7	601	0	0	0	0	0	0	0	0	0	0	0
5/26	0.3	167	0	0	0	0	0	0	0	0	0	0	0
5/27	0.6	272	0	0	0	0	0	0	0	0	0	0	0
5/28	1.1	196	0	0	0	0	0	0	0	0	0	0	0
5/29	0.5	126	0	0	0	0	0	0	0	0	0	0	0
5/30	0.3	1,264	0	0	0	0	0	0	0	0	0	0	0
5/31	0.2	1,860	0	0	0	0	0	0	0	0	0	0	0
6/01	0.7	1,207	0	0	0	0	0	0	0	0	0	0	0
6/02	1.2	649	0	0	0	0	0	0	0	0	0	0	0
6/03	1.1	702	0	0	0	0	0	0	0	0	0	0	0
6/04	0.6	686	0	0	0	0	0	0	0	0	0	0	0
6/05	0.6	1,479	0	0	0	0	0	0	0	0	0	0	0
6/06	0.0	0	0	0	0	0	0	0	0	0	0	0	0
6/07	1.0	133	0	0	0	0	0	0	0	0	0	0	0
6/08	0.0	0	0	0	0	0	0	0	0	0	0	0	0
6/09	1.0	681	0	0	0	0	0	0	0	0	0	0	0
6/10	0.6	20	0	0	0	0	0	0	0	0	0	0	0
6/11	0.4	23	0	0	0	0	0	0	0	0	0	0	0
Total	17.5	10,521	0	0	0	0	2	0	0	0	0	1	0
Max	1.5	1,860											
Avg	0.8	457											
Min	0.0	0											

<sup>a</sup> Both threespine sticklebacks and ninespine sticklebacks were present.

Appendix C.11. Ugashik River fyke net catches by hour and species, May 20 to June 11, 2000.

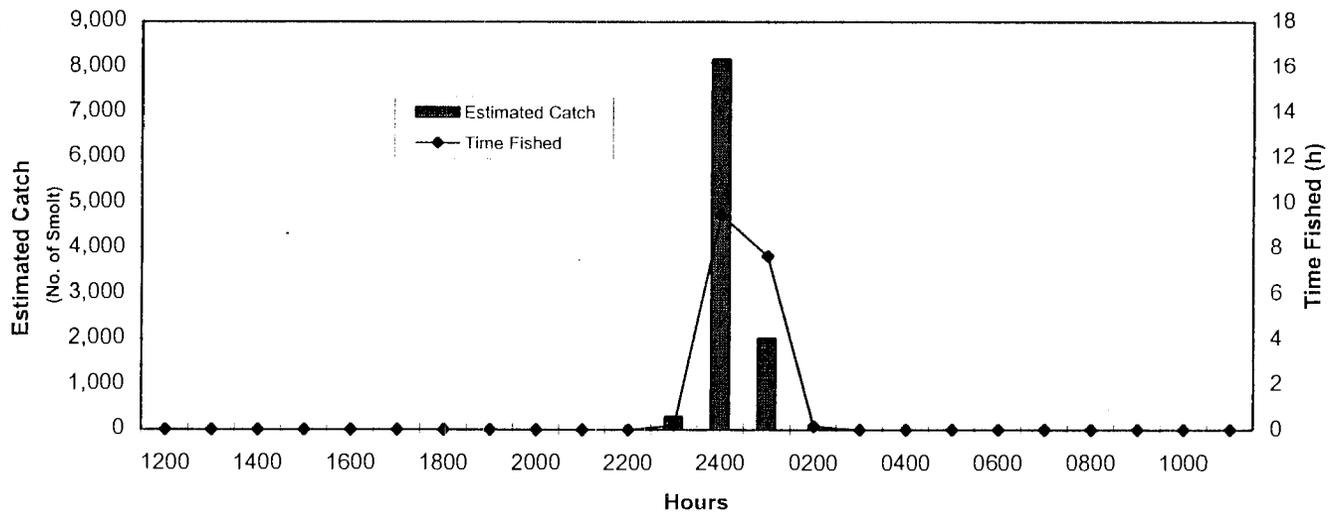
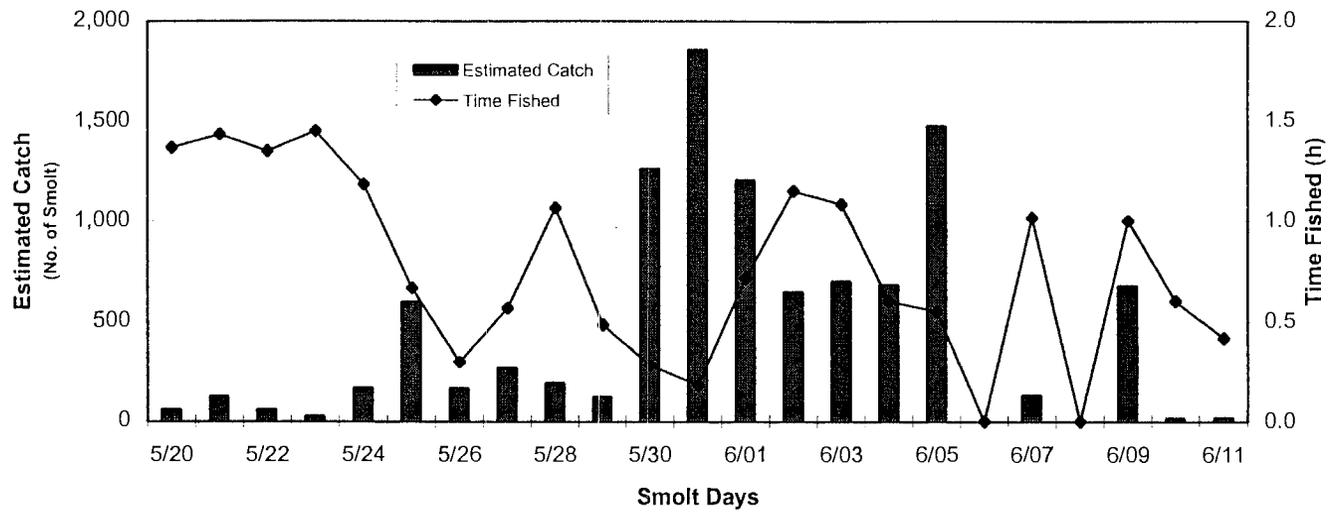
Hour	Time Fished (h)	Catch Estimate (No. of Fish)											
		Sockeye Smolt	Sticklebacks (Species) <sup>b</sup>	Chinook Smolt	Coho Smolt	Chum Fry	Pink Fry	Lamprey (Species)	Whitefish (Species)	Smelt (Species)	Rainbow Trout (juv)	Sculpin (Species)	Northern Pike (juv)
1200	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1300	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1400	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1500	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1600	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1700	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1800	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1900	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2100	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2200	0.0	0	0	0	0	0	0	0	0	0	0	0	0
2300	<sup>c</sup> 0.2	301	0	0	0	0	0	0	0	0	0	0	0
2400	<sup>d</sup> 9.5	8,189	0	0	0	0	1	0	0	0	0	1	0
0100	<sup>d</sup> 7.6	2,028	0	0	0	0	1	0	0	0	0	0	0
0200	<sup>d</sup> 0.2	3	0	0	0	0	0	0	0	0	0	0	0
0300	<sup>d</sup> 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0400	<sup>d</sup> 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0500	<sup>d</sup> 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0600	<sup>c</sup> 0.0	0	0	0	0	0	0	0	0	0	0	0	0
0700	0.0	0	0	0	0	0	0	0	0	0	0	0	0
0800	0.0	0	0	0	0	0	0	0	0	0	0	0	0
0900	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1000	0.0	0	0	0	0	0	0	0	0	0	0	0	0
1100	0.0	0	0	0	0	0	0	0	0	0	0	0	0
Total	17.5	10,521	0	0	0	0	2	0	0	0	0	1	0

<sup>a</sup> Daylight hours unless indicated otherwise.

<sup>b</sup> Both threespine sticklebacks and ninespine sticklebacks were present.

<sup>c</sup> Twilight hours

<sup>d</sup> Hours of darkness

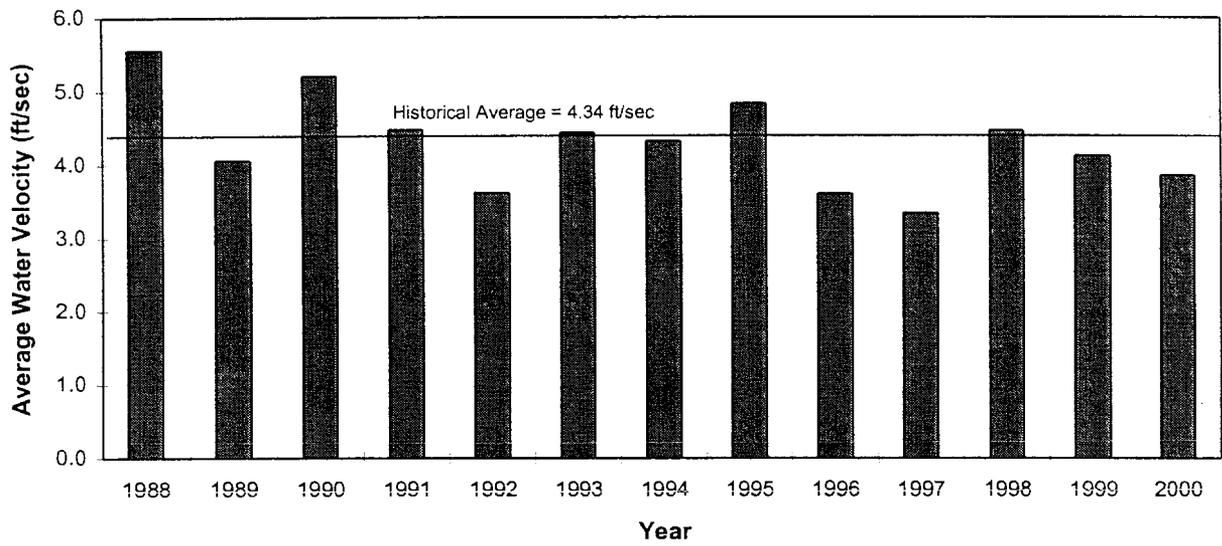


Appendix C.12. Ugashik River fyke net estimated catch and time fished by smolt day and hour, 2000.



Appendix D.1. Kvichak River water velocity at the center smolt sonar array, 1987-2000.

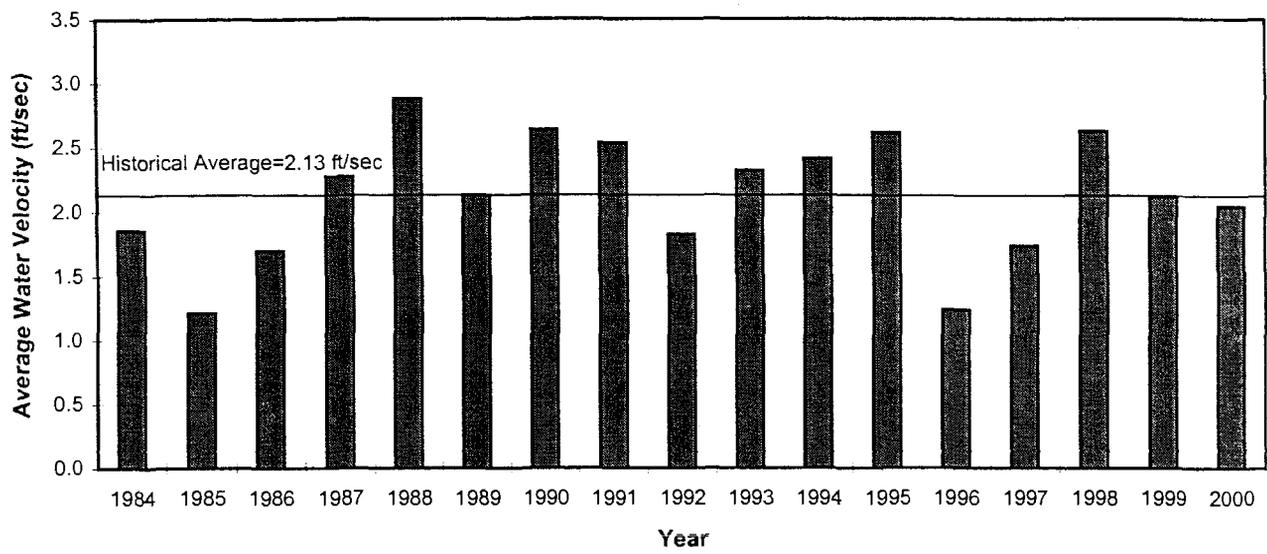
Date	Water Velocity (ft/sec)														1988-1999
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Average
5/16															
5/17											3.12	4.04			3.58
5/18							4.20			3.52					3.86
5/19			3.96											3.64	3.96
5/20															
5/21	4.96								4.82						4.89
5/22		5.38		5.01	4.27								3.57		4.56
5/23				4.99		3.43		4.27							4.23
5/24															
5/25															
5/26											3.27			3.71	3.27
5/27							4.35			3.63					3.99
5/28			3.95												3.95
5/29						3.53			4.72						4.13
5/30															
5/31		5.50			4.47							4.01			4.76
6/01															4.47
6/02				5.37											5.37
6/03											3.45		3.93		3.69
6/04								4.33		3.59				3.78	3.96
6/05															
6/06															
6/07						3.89									3.89
6/08		5.80								4.88					5.34
6/09							4.59								4.59
6/10			4.27	5.44	4.69							4.78			4.80
6/11													4.39		
6/12															
6/13							4.61	4.35		3.67	3.53	5.01			4.23
6/14														4.30	
6/15									4.90						4.90
6/16													4.60		
Max		5.80	4.27	5.44	4.69	3.89	4.61	4.35	4.90	3.67	3.53	5.01	4.60	4.30	5.80
Avg	4.96	5.56	4.06	5.20	4.48	3.62	4.44	4.32	4.83	3.60	3.34	4.46	4.12	3.86	4.34
Min		5.38	3.95	4.99	4.27	3.43	4.20	4.27	4.72	3.52	3.12	4.01	3.57	3.64	3.12



Appendix D.2. Average water velocity at Kvichak River smolt sonar center array, May 15 to June 15, 1988-2000.

Appendix D.3. Egegik River water velocity at the center smolt sonar array, 1984-2000.

Date	Water Velocity (ft/sec)																	1984-1999 Average
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
5/16																		
5/17				2.15						2.37								2.26
5/18					2.63										2.57			2.60
5/19							2.50											2.50
5/20	1.89					2.00		2.00					1.50	1.80			2.07	1.84
5/21		1.16	1.83							2.30	2.68							1.99
5/22									1.58									1.58
5/23																		
5/24									1.70			2.62			2.42	1.85		2.15
5/25					3.16								1.25	1.75				2.05
5/26			1.53	2.14			2.68											2.12
5/27											2.28							2.28
5/28						2.09				2.30							2.05	2.20
5/29								2.75										2.75
5/30																		
5/31									2.02				1.28	1.67	2.47	2.20		1.93
6/01			1.76	2.30	2.90							2.75						2.43
6/02							2.73				2.43							2.58
6/03	1.82									2.30								2.06
6/04						2.30												2.30
6/05								2.85									2.00	2.85
6/06		1.16																2.10
6/07													0.90	1.72	3.03		2.30	1.64
6/08												2.68						2.68
6/09									1.98		2.25							2.12
6/10			1.67	2.51	2.83													2.34
6/11																		
6/12												2.40						2.40
6/13		1.32																1.32
6/14																		
6/15																		
Max	1.89	1.32	1.83	2.51	3.16	2.30	2.73	2.85	2.02	2.37	2.68	2.75	1.50	1.80	3.03	2.30	2.07	3.16
Avg	1.86	1.21	1.70	2.28	2.88	2.13	2.64	2.53	1.82	2.32	2.41	2.61	1.23	1.74	2.62	2.12	2.04	2.13
Min	1.82	1.16	1.53	2.14	2.63	2.00	2.50	2.00	1.58	2.30	2.25	2.40	0.90	1.67	2.42	1.85	2.00	0.90

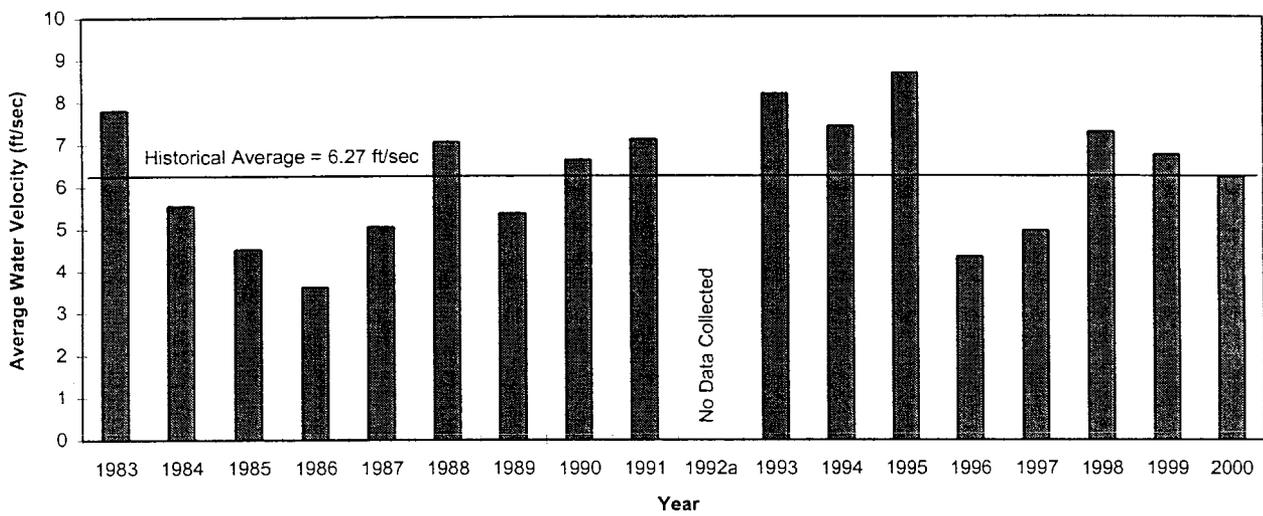


Appendix D.4. Average water velocity at Egegik River smolt sonar center array, May 15 to June 15, 1984-2000.

Appendix D.5. Ugashik River water velocity at the inshore smolt sonar array, 1983-2000.

Date	Water Velocity (ft/sec)																		1983-1999
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992 <sup>a</sup>	1993	1994	1995	1996	1997	1998	1999	2000	Average
5/05															4.99				4.99
5/06																			
5/07																			
5/08																			
5/09																			
5/10																			
5/11																			
5/12																			
5/13																			
5/14																			
5/15																			
5/16															5.13				5.13
5/17					5.17	7.15					7.84					6.30			6.62
5/18																			
5/19														3.91	5.01			6.12	4.46
5/20								6.23	5.78			7.60							6.54
5/21																			
5/22	8.00			3.16			4.13						9.48						6.19
5/23			4.10												4.86				4.48
5/24																6.49	6.12		6.31
5/25	7.63										8.34							6.12	7.99
5/26												7.78		4.52					6.15
5/27																			
5/28		5.56						6.73	7.82				8.93						7.26
5/29															4.82				4.82
5/30							4.90												4.90
5/31				3.89												7.74	6.30	5.93	5.98
6/01											8.19								8.19
6/02							5.12					7.23		4.45					5.60
6/03																			
6/04			4.93				6.17	6.84					8.72		4.88				6.31
6/05									7.70										7.70
6/06																8.59			8.59
6/07																	6.91		6.91
6/08											8.34							6.67	8.34
6/09												7.04	7.53	4.47					6.35
6/10																			
6/11				3.80														7.60	5.70
6/12							6.51	6.67											6.59
6/13																			
6/14					4.94														4.94
6/15						6.95													6.95
Max	8.00	5.56	4.93	3.89	5.17	7.15	6.51	6.84	7.82		8.34	7.78	9.48	4.52	5.13	8.59	7.60	6.67	9.48
Avg	7.82	5.56	4.51	3.62	5.06	7.05	5.37	6.62	7.10		8.18	7.41	8.67	4.34	4.95	7.28	6.73	6.21	6.27
Min	7.63	5.56	4.10	3.16	4.94	6.95	4.13	6.23	5.78		7.84	7.04	7.53	3.91	4.82	6.30	6.12	5.93	3.16

<sup>a</sup> Project not conducted in 1992 due to lack of funding. No data collected.



Appendix D.6. Average water velocity at Ugashik River smolt sonar inshore array, May 15 to June 15, 1983-2000.

## APPENDIX E. SMOLT COUNTER APPLICATION DATA AND OBSERVATIONS.

During the winter of 1999/2000, ADF&G contracted the University of Washington, Applied Physics Laboratory (UW/APL) to design and insert a computer interface into three Bendix smolt sonar counters and to write software to accept and store the data on a computer. This work was done largely to provide a real-time comparison of Bendix smolt sonar data with other hydroacoustic systems to be tested by the Western Alaska Disaster Grant - Kvichak Smolt Sonar Evaluation Project. Belcher (2000b) outlines the operating procedures for the UW/APL smolt counter digital storage system.

UW/APL smolt counter application data were collected at Bendix smolt sonar sites on Kvichak River (Appendix E.1) and Ugashik River (Appendix E.2) in 2000. No smolt counter application data was collected at Egegik River. The original Egegik smolt counter was inoperable and a backup smolt counter had to be used at this site. The backup counter was not equipped with the new computer interface.

Post-season processing of select \*.dat files turned up several software problems, which have since been diagnosed and corrected by the UW/APL (Appendix E.3). Belcher (2001) outlines the new procedures for the revised UW/APL smolt counter digital storage system.

Because of the newness of this data collection system and the problems that were encountered with it during its first year of use, \*.dat file data were not used to generate smolt outmigration estimates in 2000.

The following section lists the steps that were necessary to process and compare each Smolt Counter application \*.dat file with the Final Adjusted Bendix Counts for the same hours:

1. **Access the Smolt Counter program.**
2. From the menus listed at the top left of the screen, click on File, then click on Open
3. Insert the 3.5" diskette containing the desired \*.dat files into drive A on your computer.
4. Click on Smolt Counter
5. Click on 3 ½ Floppy (A)
6. Click on the folder that contains the desired file (e.g., May 28)
7. Click on the desired \*.dat file (e.g., Kvichak 28-May-2000 0200.dat)
8. Click on Open. This allows you to open and view the \*.dat file (Appendix E.4)
9. Print out a hard copy of the \*.dat file for your records.
10. Convert the \*.dat file to an ASCII file which has the same name but a new \*.txt file extension.
11. **Access the Microsoft Excel program.**
12. Import the desired \*.txt file into an Excel spreadsheet by – opening it and follow the steps in the Text Import Wizard. Step 1 of 3 – click Next. Step 2 of 3 – set field width (column breaks), then click Next. Step 3 of 3 – click Finish. The \*.txt file will be imported into an Excel spreadsheet.

13. The following steps are needed in order to label and identify the data and make the necessary calculations.
14. Move the cursor to cell A1 and insert two new rows at the top of the spreadsheet.
15. Type in the \*.dat file name (e.g., Kvichak 28-May-2000 0200.dat) in cell D1.
16. Type in the current date (e.g., 11/07/00) in cell D2.
17. Move the cursor to cell A4 and insert two more rows.
18. Type “Inshore” as the column header in cell A5. Right justify this text.
19. Type “Middle” as the column header in cell B5. Right justify this text.
20. Type “Offshore” as the column header in cell C5. Right justify this text.
21. Type “Status” as the column header in cell D5. Right justify this text.
22. Move the cursor to cell A3 and insert one column.
23. Increase the column width of column A from 8.43 to 18.00.
24. Type “No. of lines =” in cell A3.
25. Type the same time (e.g., 2:00:00) as the \*.dat file name in cell A6. Use military time to the nearest hour, minute, and second (e.g., hh:mm:ss).
26. Copy the time in cell A6 to cell A7. Edit this entry so that it is one second later than the time in the first cell (e.g., 2:00:01).
27. Click on A6, press the Shift key down, left click on A7. This will highlight a block containing both times entered in column A.
28. Move the cursor to the lower right corner of the highlighted block and drag the block down to the last line row of data (about 3,600 rows) to A3606. Note – the number in cell B3 will tell you how many rows of data are in the \*.dat file. This step will label the time of each row of data in the file and the top of the spreadsheet should look like this –

Kvichak 28-May-2000 0200  
10/25/00

No. of lines = 3,601

	Inshore	Middle	Offshore	Status
2:00:00	0	0	0	0
2:00:01	0	0	0	0
2:00:02	0	0	0	0
2:00:03	0	0	0	0
2:00:04	0	0	0	0
2:00:05	0	0	0	0

Sample smolt school on offshore array from 2:01:59 to 2:02:09.

2:01:57	0	0	0	0
2:01:58	0	0	0	0
2:01:59	0	0	135	0
2:02:00	0	0	610	0
2:02:01	0	0	235	0
2:02:02	0	0	160	0
2:02:03	0	0	50	0

2:02:04	0	0	10	0
2:02:05	0	0	680	0
2:02:06	0	0	725	0
2:02:07	0	0	600	0
2:02:08	0	0	335	0
2:02:09	0	0	20	0
2:02:10	0	0	0	0
2:02:11	0	0	0	0

The following calculations are performed at the bottom of the spreadsheet (A3608..E3619):

	Inshore	Middle	Offshore	Total
2:59:58	0	0	0	0
2:59:59	0	0	0	0
3:00:00	0	0	0	0

Actual *.dat file subtotals	2,195	29,270	247,225	278,690
less all counts wi/ status errors	0	0	0	0
Corrected totals	2,195	29,270	247,225	278,690

Bendix Equivalents for \*.dat file counts = (corrected total / 5 smolt/count)

	439	5,854	49,445	55,738
False Counts <sup>a</sup>	0	0	0	0
Disabled time (seconds) <sup>a</sup>	0	0	0	0

Final Adjusted \*.dat file counts = (Bendix Eqv – false counts) / (1 – (disabled t / 3,600))

	439	5,854	49,445	55,986
Final Adjusted Bendix counts <sup>a</sup>	444	5,889	49,653	55,986

<sup>a</sup> Source – Daily Sonar Log Form, Kvichak River, Smolt Day 5/27-28/2000

In the most recent changes to the smolt counter application (Appendix E.3) the automatic expansion factor of 5 smolt/count was eliminated. Therefore the \*.dat file counts will be equal to the raw Bendix sonar counts. This will eliminate a step and make post season processing of the \*.dat file data easier. At present, adjustments for false counts and disabled

time each hour will still have to be entered and calculated manually for each \*.dat file. If these steps could be automated this would facilitate post-season processing even more.

However, collecting sonar counts at the rate of one count every second and one \*.dat file every hour, provides some new insights into smolt school data. Analysis of the Kvichak 31-May-2000.dat file, the hour with the peak hourly passage rate (e.g., 364,000 smolt) for 2000 revealed that a total of 609 smolt schools passed over the Bendix sonar arrays during this hour – 150 schools on the inshore array, 130 schools on the middle array, and 329 schools on the offshore array (Appendix E.5). For this analysis, every group of smolt that passed one second or more apart were counted as a separate school. Also, all raw sonar counts in this analysis are expanded by a 5 smolt-per-count average. The average number of smolt per school that passed during this hour ranged from 300 to 600 smolt and they passed through the counting range in two seconds. The largest smolt school contained about 3,700 smolt and it took 12 seconds to pass through the counting range.

A similar analysis of Ugashik 31-May-2000 0200.dat, the file with the peak hourly passage rate (e.g., 325,000 smolt) at Ugashik River showed a total of 1,121 smolt schools passing over the Bendix sonar arrays during this hour – 566 schools on the inshore array and 555 schools on the middle array (Appendix E.6). The average number of smolt per school ranged from 400 to 500 smolt and they passed through the counting range in 2-to-3 seconds. The largest smolt school contained about 16,000 smolt and it took 38 seconds to pass through the counting range.

Another thing determined by close examination of the Kvichak River \*.dat files during hours of peak passage is that the maximum smolt count per second never exceeds 730 (Appendix E.7). This upper limit of the instantaneous count (146 Hz pulse train frequency X 5 smolt per count = 730) was verified to be accurate by hydroacoustic consultant, Al Menin. It was further explained that when this maximum count/second is reached that the pulse train continues until the capacitor is discharged, thus the smolt counter may continue to count at the 730 rate for a few seconds after the smolt school passes.

The maximum smolt count per second at Ugashik River never exceeded 725 (Appendix E.8). It is unclear at this time why this maximum count is not the same as Kvichak.

Appendix E.1. List of \*.dat files generated by the University of Washington, Applied Physics Laboratory, smolt counter digital storage application at Kvichak River smolt sonar, May 24 to June 14, 2000.

Smolt Day (m/dd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore		
5/24-5/25	1	Kvichak 24-May-2000 1711.dat	2	05:52	1,955	1,220	340	3,515	Short file, suspect counts on all arrays (I=710, M=1055, O=340, S=0) at 17:11:00 startup
	1	Kvichak 24-May-2000 1814.dat	11	45:22	335	60	295	690	Partial hour, no other irregularities detected
	1	Kvichak 24-May-2000 1900.dat	15	60:00	590	755	1,775	3,120	
	1	Kvichak 24-May-2000 2000.dat	15	60:01	5,030	1,285	1,100	7,415	
	1	Kvichak 24-May-2000 2100.dat	15	60:00	5,795	1,780	545	8,120	
	1	Kvichak 24-May-2000 2200.dat	15	60:01	4,720	2,285	2,450	9,455	
	1	Kvichak 24-May-2000 2300.dat	15	60:00	2,415	1,900	2,055	6,370	Type-A corruption with false counts (I=1105, M=320, O=160, S=77) @ 23:51:48
	1	Kvichak 25-May-2000 0000.dat	15	60:01	1,805	1,920	485	4,210	
	1	Kvichak 25-May-2000 0100.dat	15	60:00	490	1,890	16,430	18,810	
	1	Kvichak 25-May-2000 0200.dat	15	60:01	345	6,600	21,810	28,555	
	1	Kvichak 25-May-2000 0300.dat	15	60:00	12,000	4,895	6,535	23,430	
	1	Kvichak 25-May-2000 0400.dat	15	60:01	17,640	2,395	200	20,235	
	1	Kvichak 25-May-2000 0500.dat	15	60:01	6,395	2,890	3,680	12,965	
	1	Kvichak 25-May-2000 0600.dat	15	60:00	1,535	745	250	2,530	Type-A corruption with false counts (I=1105, M=320, O=160, S=77) @ 6:44:52
	1	Kvichak 25-May-2000 0700.dat	15	60:01	5	30	5	40	
	1	Kvichak 25-May-2000 0800.dat	15	60:00	3,755	2,635	3,055	9,445	Clustered counts on all 3 arrays from 08:31 to 08:36, but no status errors
	1	Kvichak 25-May-2000 0900.dat	15	60:01	17,680	5,130	2,570	25,380	Type-A corruptions with false counts (I=1105, M=320, O=160, S=77) from 9:06:05 to 9:06:23
1	Kvichak 25-May-2000 1000.dat	15	60:00	1,105	1,110	765	2,980	Type-A corruption with false counts (I=1105, M=320, O=160, S=77) @ 10:37:36	
1	Kvichak 25-May-2000 1100.dat	15	60:01	1,600	200	880	2,680		
5/25-5/26	1	Kvichak 25-May-2000 1200.dat	15	60:00	470	925	95	1,490	
	1	Kvichak 25-May-2000 1300.dat	15	60:01	1,810	715	770	3,295	
	1	Kvichak 25-May-2000 1400.dat	15	60:00	838,785	243,655	122,130	1,204,570	Type-A corruptions with false counts (I=1105, M=320, O=160, S=77) from 14:20:01 to 14:32:
	1	Kvichak 25-May-2000 1500.dat	15	60:01	2,295	135	130	2,560	
	1	Kvichak 25-May-2000 1600.dat	15	60:00	660	720	255	1,635	
	1	Kvichak 25-May-2000 1700.dat	15	60:01	335	25	60	420	
	1	Kvichak 25-May-2000 1800.dat	15	60:01	745	0	30	775	False cts from boat - need to subtract 18:59:36 to 18:59:40 cts (n=730) from inshore
	1	Kvichak 25-May-2000 1933.dat	7	26:38	880	0	35	915	Partial hour
	1	Kvichak 25-May-2000 2000.dat	15	60:01	735	0	400	1,135	
	1	Kvichak 25-May-2000 2100.dat	15	60:00	270	735	155	1,160	
	1	Kvichak 25-May-2000 2200.dat	15	60:01	3,050	1,015	140	4,205	
	1	Kvichak 25-May-2000 2300.dat	15	60:00	2,220	6,280	3,225	11,725	
	1	Kvichak 26-May-2000 0000.dat	15	60:01	1,015	1,390	370	2,775	
	1	Kvichak 26-May-2000 0100.dat	15	60:00	370	1,535	15,700	17,605	
	1	Kvichak 26-May-2000 0200.dat	15	60:01	220	11,705	51,975	63,900	
	1	Kvichak 26-May-2000 0300.dat	15	60:00	17,075	17,960	7,260	42,295	
	1	Kvichak 26-May-2000 0400.dat	15	60:01	31,160	9,420	1,210	41,790	
	1	Kvichak 26-May-2000 0500.dat	29	120:01	2,890	6,890	8,665	18,445	No false cts from 5:00:00 to 5:59:59, type-B corruption with false cts from 6:00:05 to 6:00:15 No Kvichak 26-May-2000 0600.dat. 0600 hr cnts appended to Kvichak 26-May-2000 0500.dat file
	1	Kvichak 26-May-2000 0700.dat	15	60:01	870	175	595	1,640	
	1	Kvichak 26-May-2000 0800.dat	23	94:02	illegible	illegible	illegible	1,598,495	Type-A and -B corruptions with false counts from 8:59:41 to 9:16:47. No Kvichak 26-May-2000 0900.dat. 0200 hr cnts appended to Kvichak 26-May-2000 0800.dat file
1	Kvichak 26-May-2000 1000.dat	15	60:01	3,575	5,670	3,935	13,180		
1	Kvichak 26-May-2000 1116.dat	11	43:18	2,240	940	3,195	6,375	Partial hour	

Smolt Day (m/dd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore		
5/26-5/27	1	Kvichak 26-May-2000 1200.dat	15	60:01	8,320	9,505	14,445	32,270	
	1	Kvichak 26-May-2000 1300.dat	15	60:00	6,150	4,060	1,185	11,395	
	1	Kvichak 26-May-2000 1400.dat	15	60:01	3,095	2,145	1,670	6,910	
	1	Kvichak 26-May-2000 1500.dat	21	85:41	illegible	illegible	illegible	1,783,070	No false cts from 15:00:00 to 15:59:59, type-B corruption with false cts from 16:00:05 to 16:
		Kvichak 26-May-2000 1600.dat							No Kvichak 26-May-2000 1600.dat. 0200 hr crts appended to Kvichak 26-May-2000 1500.dat file
		Kvichak 26-May-2000 1700.dat							No Kvichak 26-May-2000 1700.dat
		Kvichak 26-May-2000 1800.dat							No Kvichak 26-May-2000 1800.dat
	1	Kvichak 26-May-2000 1900.dat	18	74:21	720,110	210,110	109,435	1,039,655	Type-A corruptions with false counts from 19:48:59 to 19:59:59. Type-B corruption with false cts from 20:00:05 to
		Kvichak 26-May-2000 2000.dat							No Kvichak 26-May-2000 2000.dat
	1	Kvichak 26-May-2000 2156.dat	1	3:00	0	0	0	0	Extremely short file, no counts.
	1	Kvichak 26-May-2000 2213.dat	11	46:48	11,035	10,050	3,645	24,730	Partial hour
	1	Kvichak 26-May-2000 2300.dat	15	60:00	4,045	5,825	10,675	20,545	
	1	Kvichak 27-May-2000 0000.dat	15	60:00	690	1,510	2,115	4,315	
		Kvichak 27-May-2000 0100.dat							No Kvichak 27-May-2000 0100.dat.
		Kvichak 27-May-2000 0200.dat							No Kvichak 27-May-2000 0200.dat.
		Kvichak 27-May-2000 0300.dat							No Kvichak 27-May-2000 0300.dat.
		Kvichak 27-May-2000 0400.dat							No Kvichak 27-May-2000 0400.dat.
		Kvichak 27-May-2000 0500.dat							No Kvichak 27-May-2000 0500.dat.
		Kvichak 27-May-2000 0600.dat							No Kvichak 27-May-2000 0600.dat.
		Kvichak 27-May-2000 0700.dat							No Kvichak 27-May-2000 0700.dat.
	Kvichak 27-May-2000 0800.dat							No Kvichak 27-May-2000 0800.dat.	
	Kvichak 27-May-2000 0900.dat							No Kvichak 27-May-2000 0900.dat.	
	Kvichak 27-May-2000 1000.dat							No Kvichak 27-May-2000 1000.dat.	
1	Kvichak 27-May-2000 1127.dat	8	32:27	0	1,215	70	1,285	Partial hour	
5/27-5/28		Kvichak 27-May-2000 1200.dat							No Kvichak 27-May-2000 1200.dat.
	1	Kvichak 27-May-2000 1301.dat	14	58:55	155	740	165	1,060	Partial hour
	1	Kvichak 27-May-2000 1400.dat	39	166:10	13,690	9,000	7,825	30,515	Editors Notes: Type-A & -B corruptions. Time suspect. Should include cts from 1400 to 1646 h.
	1	Kvichak 27-May-2000 1500.dat	1	00:01	55	0	0	55	Partial hour
	1	Kvichak 27-May-2000 1507.dat	13	52:11	2,840	4,740	3,200	10,780	Partial hour
	1	Kvichak 27-May-2000 1600.dat	15	60:01	231,440	70,190	36,365	337,995	Type-A corruptions with false counts from 16:37:24 to 16:40:47.
	1	Kvichak 27-May-2000 1755.dat	2	08:05	0	30	420	450	Partial hour
	1	Kvichak 27-May-2000 1807.dat	13	52:31	6,395	5,780	4,745	16,920	Partial hour
	1	Kvichak 27-May-2000 1900.dat	15	60:01	4,745	2,640	7,995	15,380	
	1	Kvichak 27-May-2000 2000.dat	15	60:00	1,550	4,000	6,880	12,430	
	1	Kvichak 27-May-2000 2100.dat	15	60:01	7,790	12,735	12,890	33,415	
	1	Kvichak 27-May-2000 2200.dat	15	60:00	12,105	9,170	20,435	41,710	
	1	Kvichak 27-May-2000 2300.dat	15	60:01	5,600	8,220	19,180	33,000	
	1	Kvichak 28-May-2000 0000.dat	15	60:01	360	1,215	6,865	8,440	
	1	Kvichak 28-May-2000 0100.dat	15	60:00	2,260	21,970	99,285	123,515	
	1	Kvichak 28-May-2000 0200.dat	15	60:01	2,195	29,270	247,225	278,690	
	1	Kvichak 28-May-2000 0300.dat	15	60:00	10,185	20,345	62,840	93,370	
	1	Kvichak 28-May-2000 0400.dat	15	60:01	29,005	18,915	18,010	65,930	
	1	Kvichak 28-May-2000 0500.dat	15	60:00	12,045	16,780	24,285	53,110	
	1	Kvichak 28-May-2000 0600.dat	15	60:01	3,585	5,880	11,395	20,860	
1	Kvichak 28-May-2000 0700.dat	15	60:00	3,440	6,795	1,650	11,885		
1	Kvichak 28-May-2000 0800.dat	15	60:01	1,410	2,255	3,765	7,430		
1	Kvichak 28-May-2000 0900.dat	15	60:00	410	2,965	5,205	8,580		
1	Kvichak 28-May-2000 1000.dat	15	60:01	3,440	2,515	4,785	10,740		
1	Kvichak 28-May-2000 1100.dat	15	60:01	2,985	5,900	5,620	14,505		

Smolt Day (m/dd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments	
					Inshore	Middle	Offshore			
5/28-5/29	1	Kvichak 28-May-2000 1200.dat	15	60:00	1,825	3,675	4,035	9,535		
	1	Kvichak 28-May-2000 1300.dat	15	60:01	2,670	6,490	1,345	10,505		
	1	Kvichak 28-May-2000 1400.dat	15	60:00	5,895	5,310	9,385	20,590		
	1	Kvichak 28-May-2000 1500.dat	15	60:01	4,340	5,765	8,185	18,290		
	1	Kvichak 28-May-2000 1600.dat	15	60:00	510	2,525	3,570	6,605		
			Kvichak 28-May-2000 1700.dat						No Kvichak 28-May-2000 1700.dat.	
			Kvichak 28-May-2000 1800.dat						No Kvichak 28-May-2000 1800.dat.	
			Kvichak 28-May-2000 1900.dat						No Kvichak 28-May-2000 1900.dat.	
			Kvichak 28-May-2000 2000.dat						No Kvichak 28-May-2000 2000.dat.	
			Kvichak 28-May-2000 2100.dat						No Kvichak 28-May-2000 2100.dat.	
			Kvichak 28-May-2000 2200.dat						No Kvichak 28-May-2000 2200.dat.	
			Kvichak 28-May-2000 2300.dat						No Kvichak 28-May-2000 2300.dat.	
	2		Kvichak 29-May-2000 0000.dat	15	60:01	3,800	3,490	6,005	13,295	
	2		Kvichak 29-May-2000 0100.dat	15	60:00	4,200	8,600	12,800	25,600	
	2		Kvichak 29-May-2000 0200.dat	15	60:01	6,575	10,635	8,900	26,110	
	2		Kvichak 29-May-2000 0300.dat	15	60:00	8,895	15,265	15,415	39,575	
	2		Kvichak 29-May-2000 0400.dat	15	60:01	21,670	17,935	15,865	55,470	
	2		Kvichak 29-May-2000 0500.dat	15	60:00	5,240	7,340	6,355	18,935	
	2		Kvichak 29-May-2000 0600.dat	15	60:01	4,695	8,195	3,310	16,200	
	2		Kvichak 29-May-2000 0700.dat	15	60:00	3,835	6,150	4,450	14,435	
2		Kvichak 29-May-2000 0800.dat	15	60:01	2,245	10,155	10,280	22,680		
2		Kvichak 29-May-2000 0900.dat	15	60:00	4,120	11,375	18,115	33,610		
2		Kvichak 29-May-2000 1000.dat	15	60:01	4,960	19,040	19,450	43,450		
2		Kvichak 29-May-2000 1100.dat	15	60:01	9,265	8,965	12,965	31,195		
5/29-5/30	2	Kvichak 29-May-2000 1200.dat	15	60:00	11,230	16,195	12,615	40,040		
	2	Kvichak 29-May-2000 1300.dat	15	60:01	12,195	11,535	11,065	34,795		
	2	Kvichak 29-May-2000 1400.dat	15	60:00	19,295	28,045	8,595	55,935		
	2	Kvichak 29-May-2000 1500.dat	15	60:01	17,015	23,055	11,125	51,195		
	2	Kvichak 29-May-2000 1600.dat	15	60:00	17,205	21,860	9,555	48,620		
	2	Kvichak 29-May-2000 1700.dat	15	60:01	13,055	20,470	13,465	46,990		
	2	Kvichak 29-May-2000 1800.dat	15	60:00	15,735	26,985	16,820	59,540		
	2	Kvichak 29-May-2000 1900.dat	15	60:01	5,660	21,430	18,580	45,670		
	2	Kvichak 29-May-2000 2000.dat	15	60:00	13,160	28,155	26,480	67,795		
	2	Kvichak 29-May-2000 2100.dat	15	60:01	11,610	41,780	57,015	110,405		
	2	Kvichak 29-May-2000 2200.dat	15	60:01	8,160	22,165	21,075	51,400		
	2	Kvichak 29-May-2000 2300.dat	15	60:00	5,715	10,740	4,135	20,590		
			Kvichak 30-May-2000 0000.dat						No Kvichak 30-May-2000 0000.dat.	
			Kvichak 30-May-2000 0100.dat						No Kvichak 30-May-2000 0100.dat.	
			Kvichak 30-May-2000 0200.dat						No Kvichak 30-May-2000 0200.dat.	
			Kvichak 30-May-2000 0300.dat						No Kvichak 30-May-2000 0300.dat.	
	2		Kvichak 30-May-2000 0400.dat	15	60:01	15,015	7,195	3,615	25,825	
	2		Kvichak 30-May-2000 0500.dat	15	60:00	4,195	4,290	4,370	12,855	
	2		Kvichak 30-May-2000 0600.dat	15	60:01	1,200	1,410	670	3,280	
	2		Kvichak 30-May-2000 0700.dat	15	60:00	315	260	460	1,035	
2		Kvichak 30-May-2000 0800.dat	15	60:01	355	255	35	645		
2		Kvichak 30-May-2000 0900.dat	29	120:01	240	905	55	1,200	No false cts from 9:00:00 to 9:59:59. Type-B corruptions with false counts from 10:00:05 to 10:00:15	
		Kvichak 30-May-2000 1000.dat						No Kvichak 30-May-2000 1000.dat. 1000 hr cts appended to Kvichak 30-May-2000 0900.dat		
2		Kvichak 30-May-2000 1100.dat	15	60:01	1,875	1,275	370	3,520		

Smolt Day (mVdd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments	
					Inshore	Middle	Offshore			
5/30-5/31	2	Kvichak 30-May-2000 1200.dat	15	60:00	2,400	1,995	1,045	5,440		
	2	Kvichak 30-May-2000 1300.dat	15	60:01	9,570	17,375	9,515	36,460		
	2	Kvichak 30-May-2000 1400.dat	15	60:00	14,545	24,140	24,260	62,945		
	2	Kvichak 30-May-2000 1500.dat	15	60:01	211,205	23,060	20,545	254,810	Testing target strength & effective counting range below the surface, subtract inshore false ct	
	2	Kvichak 30-May-2000 1600.dat	15	60:00	20,285	24,205	30,885	75,375		
	2	Kvichak 30-May-2000 1700.dat	15	60:01	18,985	12,365	22,245	53,595		
	2	Kvichak 30-May-2000 1800.dat	15	60:00	30,875	15,735	24,485	71,095		
	2	Kvichak 30-May-2000 1900.dat	15	60:01	23,485	23,635	21,935	69,055	Smolt counter disabled due to rain for 1,056 sec	
	2	Kvichak 30-May-2000 2000.dat	15	60:00	24,020	37,955	26,115	88,090		
	2	Kvichak 30-May-2000 2100.dat	15	60:01	16,590	70,405	69,290	156,285		
	2	Kvichak 30-May-2000 2200.dat	15	60:01	42,990	51,840	30,965	125,795		
	2	Kvichak 30-May-2000 2300.dat	15	60:00	16,000	58,730	39,055	113,785		
	2	Kvichak 31-May-2000 0000.dat	15	60:01	7,145	25,365	27,465	59,975		
	2	Kvichak 31-May-2000 0100.dat	15	60:00	5,165	13,610	20,875	39,650		
	2	Kvichak 31-May-2000 0200.dat	15	60:01	44,785	54,575	206,240	305,600		
	2	Kvichak 31-May-2000 0300.dat	15	60:00	41,460	84,960	120,705	247,125		
	2	Kvichak 31-May-2000 0400.dat	15	60:01	21,365	30,720	29,595	81,680		
	2	Kvichak 31-May-2000 0500.dat	15	60:00	30,810	25,920	19,020	75,750		
	2	Kvichak 31-May-2000 0600.dat	15	60:01	11,965	8,195	19,505	39,665		
	2	Kvichak 31-May-2000 0700.dat	15	60:00	5,780	5,970	7,700	19,450		
	2	Kvichak 31-May-2000 0800.dat	15	60:01	5,440	12,705	21,085	39,230		
	2	Kvichak 31-May-2000 0900.dat	15	60:01	3,605	5,460	14,030	23,095		
	2	Kvichak 31-May-2000 1000.dat	15	60:00	3,745	8,795	14,250	26,790		
	2	Kvichak 31-May-2000 1100.dat	15	60:01	8,560	28,975	21,645	59,180		
	5/31-6/01	2	Kvichak 31-May-2000 1200.dat	15	60:00	21,155	22,885	12,545	56,585	
		2	Kvichak 31-May-2000 1300.dat	15	60:01	28,160	26,645	13,705	68,510	
2		Kvichak 31-May-2000 1400.dat	15	60:00	26,000	20,810	13,630	60,440		
2		Kvichak 31-May-2000 1500.dat	15	60:01	17,190	26,210	20,090	63,490		
2		Kvichak 31-May-2000 1600.dat	15	60:00	83,920	30,170	16,390	130,480		
2		Kvichak 31-May-2000 1700.dat	15	60:01	44,110	27,595	21,615	93,320		
2		Kvichak 31-May-2000 1800.dat	15	60:00	26,805	12,995	23,280	63,080		
2		Kvichak 31-May-2000 1900.dat	15	60:01	21,990	23,270	22,055	67,315		
2		Kvichak 31-May-2000 2000.dat	15	60:01	25,180	30,355	22,190	77,725		
2		Kvichak 31-May-2000 2100.dat	15	60:00	7,785	47,815	25,055	80,655		
2		Kvichak 31-May-2000 2200.dat	15	60:01	6,825	14,770	30,295	51,890		
2		Kvichak 31-May-2000 2300.dat	15	60:00	4,135	11,470	17,340	32,945		
2		Kvichak 01-June-2000 0000.dat	15	60:01	450	1,590	2,795	4,835		
2		Kvichak 01-June-2000 0100.dat	15	60:00	685	1,540	26,215	28,440		
2		Kvichak 01-June-2000 0200.dat	15	60:01	2,790	13,130	102,410	118,330		
2		Kvichak 01-June-2000 0300.dat	15	60:00	8,545	32,940	62,645	104,130		
2		Kvichak 01-June-2000 0400.dat	15	60:01	10,595	28,850	14,725	54,170		
2		Kvichak 01-June-2000 0500.dat	15	60:00	2,360	6,835	7,680	16,875		
2		Kvichak 01-June-2000 0600.dat	15	60:01	1,255	1,350	600	3,205		
2		Kvichak 01-June-2000 0700.dat	15	60:00	1,925	1,900	420	4,245		
2		Kvichak 01-June-2000 0800.dat	15	60:01	1,425	1,130	245	2,800		
2		Kvichak 01-June-2000 0900.dat	15	60:01	15	620	320	955		
2		Kvichak 01-June-2000 1000.dat	15	60:00	825	810	1,510	3,145		
2		Kvichak 01-June-2000 1100.dat	15	60:01	3,935	1,160	1,450	6,545		

Smolt Day (m/dd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments	
					Inshore	Middle	Offshore			
6/01-6/02	2	Kvichak 01-June-2000 1200.dat	15	60:00	10,145	5,655	3,325	19,125		
	2	Kvichak 01-June-2000 1300.dat	15	60:01	4,280	26,345	22,350	52,975		
	2	Kvichak 01-June-2000 1400.dat	15	60:00	6,650	4,765	4,615	16,030		
	2	Kvichak 01-June-2000 1500.dat	15	60:01	7,480	6,300	3,350	17,130		
	2	Kvichak 01-June-2000 1600.dat	15	60:00	18,585	10,790	4,935	34,310		
	2	Kvichak 01-June-2000 1700.dat	15	60:01	8,310	10,525	5,155	23,990		
	2	Kvichak 01-June-2000 1800.dat	15	60:00	5,095	4,950	12,790	22,835		
	2	Kvichak 01-June-2000 1900.dat	15	60:01	6,960	17,000	23,170	47,130		
	2	Kvichak 01-June-2000 2000.dat	15	60:01	5,015	3,630	11,250	20,095		
	2	Kvichak 01-June-2000 2100.dat	15	60:00	36,650	7,095	3,625	47,370		
	2	Kvichak 01-June-2000 2200.dat	15	60:01	3,905	14,560	10,645	29,110		
	2	Kvichak 01-June-2000 2300.dat	15	60:00	4,415	9,715	11,480	25,610		
	3	Kvichak 02-June-2000 0000.dat	15	60:01	3,835	2,870	4,735	11,440		
	3	Kvichak 02-June-2000 0103.dat	15	56:39	1,605	3,935	18,145	23,685		
	3	Kvichak 02-June-2000 0200.dat	15	60:01	3,360	14,590	65,485	83,435		
	3	Kvichak 02-June-2000 0300.dat	15	60:00	4,870	18,695	39,030	62,595		
	3	Kvichak 02-June-2000 0400.dat	15	60:01	8,230	14,450	11,955	34,635		
	3	Kvichak 02-June-2000 0500.dat	15	60:01	4,445	4,105	4,560	13,110		
	3	Kvichak 02-June-2000 0600.dat	15	60:00	890	1,280	155	2,325		
	3	Kvichak 02-June-2000 0700.dat	15	60:01	0	345	45	390		
	3	Kvichak 02-June-2000 0800.dat	15	60:00	665	1,035	175	1,875		
	3	Kvichak 02-June-2000 0900.dat	15	60:01	20	905	0	925		
	3	Kvichak 02-June-2000 1000.dat	15	60:00	35	90	325	450		
	3	Kvichak 02-June-2000 1100.dat	15	60:01	100	10	1,015	1,125		
	6/02-6/03	3	Kvichak 02-June-2000 1200.dat	15	60:00	1,050	130	0	1,180	
		3	Kvichak 02-June-2000 1300.dat	15	60:01	490	785	35	1,310	
		3	Kvichak 02-June-2000 1400.dat	15	60:00	285	390	1,980	2,655	
3		Kvichak 02-June-2000 1500.dat	15	60:01	135	820	590	1,545		
3		Kvichak 02-June-2000 1600.dat	15	60:00	16,435	720	995	18,150		
3		Kvichak 02-June-2000 1700.dat	15	60:01	2,365	450	820	3,635		
3		Kvichak 02-June-2000 1800.dat	1	2:02	0	0	530	530		
3		Kvichak 02-June-2000 1928.dat	8	31:49	2,100	960	1,070	4,130		
3		Kvichak 02-June-2000 2000.dat	15	60:01	600	800	2,180	3,580		
3		Kvichak 02-June-2000 2100.dat	15	60:00	780	620	1,590	2,990		
3		Kvichak 02-June-2000 2200.dat	15	60:01	2,290	2,560	1,935	6,785		
3		Kvichak 02-June-2000 2300.dat	15	60:00	1,340	2,180	1,325	4,845		
3		Kvichak 03-June-2000 0000.dat	15	60:01	285	915	290	1,490		
3		Kvichak 03-June-2000 0100.dat	15	60:00	65	820	1,350	2,235		
3		Kvichak 03-June-2000 0200.dat	15	60:01	200	2,580	6,820	9,600		
3		Kvichak 03-June-2000 0300.dat	29	120:01	2,035	2,975	2,045	7,055	No false cts from 3:00:00 to 3:59:59 Type-B corruptions with false counts from 4:00:05 to 4:00:15 No Kvichak 03-June-2000 0400.dat. 0400 hr cts appended to Kvichak 03-June-2000 0300.dat	
3		Kvichak 03-June-2000 0400.dat	15	60:01	450	155	10	615		
3		Kvichak 03-June-2000 0600.dat	15	60:00	10	5	50	65		
3		Kvichak 03-June-2000 0700.dat	15	60:01	1,105	600	515	2,220		
3		Kvichak 03-June-2000 0800.dat	15	60:00	1,855	65	0	1,920		
3	Kvichak 03-June-2000 0900.dat	15	60:01	0	290	245	535			
3	Kvichak 03-June-2000 1000.dat	15	60:00	1,710	105	455	2,270			
3	Kvichak 03-June-2000 1100.dat	15	60:01	265	395	1,665	2,325			

Smolt Day (m/dd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments	
					Inshore	Middle	Offshore			
6/03-6/04	3	Kvichak 03-June-2000 1200.dat	15	60:00	160	760	0	920		
	3	Kvichak 03-June-2000 1300.dat	15	60:01	10	595	915	1,520		
	3	Kvichak 03-June-2000 1400.dat	15	60:00	1,290	365	415	2,070		
	3	Kvichak 03-June-2000 1500.dat	15	60:01	5,645	2,010	1,215	8,870		
	3	Kvichak 03-June-2000 1600.dat	15	60:01	8,170	1,290	360	9,820		
	3	Kvichak 03-June-2000 1700.dat	15	60:00	1,810	1,295	200	3,305		
	3	Kvichak 03-June-2000 1800.dat	15	60:01	4,460	1,255	450	6,165		
	3	Kvichak 03-June-2000 1900.dat	15	60:00	460	950	760	2,170		
	3	Kvichak 03-June-2000 2000.dat	15	60:01	2,990	27,960	12,765	43,715		
	3	Kvichak 03-June-2000 2100.dat	15	60:00	2,775	2,980	2,360	8,115		
	3	Kvichak 03-June-2000 2200.dat	15	60:01	1,195	1,060	1,270	3,525		
	3	Kvichak 03-June-2000 2300.dat	15	60:00	1,690	730	840	3,260		
	3	Kvichak 04-June-2000 0000.dat	15	60:01	1,185	2,530	455	4,170		
	3	Kvichak 04-June-2000 0100.dat	15	60:00	1,080	590	50	1,720		
	3	Kvichak 04-June-2000 0200.dat	15	60:01	450	1,900	4,995	7,345		
	3	Kvichak 04-June-2000 0300.dat	15	60:01	4,605	2,110	860	7,575		
	3	Kvichak 04-June-2000 0400.dat	15	60:00	6,715	9,885	2,665	19,265		
	3	Kvichak 04-June-2000 0500.dat	15	60:01	3,720	4,650	3,115	11,485		
	3	Kvichak 04-June-2000 0600.dat	15	60:00	2,500	3,540	1,650	7,690		
	3	Kvichak 04-June-2000 0700.dat	15	60:01	1,315	1,165	2,245	4,725		
	3	Kvichak 04-June-2000 0800.dat	15	60:00	4,405	1,755	985	7,145		
	3	Kvichak 04-June-2000 0900.dat	15	60:01	600	670	680	1,950		
	3	Kvichak 04-June-2000 1000.dat	15	60:00	100	10	815	925		
	3	Kvichak 04-June-2000 1100.dat	15	60:01	520	285	55	860		
	6/04-6/05	3	Kvichak 04-June-2000 1200.dat	15	60:00	230	775	570	1,575	
		3	Kvichak 04-June-2000 1300.dat	15	60:01	65	120	70	255	
		3	Kvichak 04-June-2000 1400.dat	15	60:01	560	650	755	1,965	
3		Kvichak 04-June-2000 1500.dat	15	60:00	35	275	160	470		
3		Kvichak 04-June-2000 1600.dat	15	60:01	855	805	1,290	2,950		
3		Kvichak 04-June-2000 1700.dat	15	60:00	9,255	1,460	580	11,295		
3		Kvichak 04-June-2000 1800.dat	15	60:01	7,385	500	415	8,300		
3		Kvichak 04-June-2000 1900.dat	15	60:00	275	650	870	1,795		
3		Kvichak 04-June-2000 2000.dat	15	60:01	2,300	2,360	2,500	7,160		
3		Kvichak 04-June-2000 2100.dat	15	60:00	2,485	420	1,275	4,180		
3		Kvichak 04-June-2000 2200.dat	15	60:01	4,015	7,600	8,005	19,620		
3		Kvichak 04-June-2000 2300.dat	15	60:00	2,915	6,085	10,180	19,180		
3		Kvichak 05-June-2000 0000.dat	15	60:01	3,945	5,985	5,925	15,855		
3		Kvichak 05-June-2000 0100.dat	15	60:00	2,740	2,640	1,600	6,980		
3		Kvichak 05-June-2000 0200.dat	15	60:01	2,100	1,305	755	4,160		
3		Kvichak 05-June-2000 0300.dat	15	60:01	11,350	2,070	665	14,085		
3		Kvichak 05-June-2000 0400.dat	15	60:00	7,965	7,115	3,770	18,850		
3		Kvichak 05-June-2000 0500.dat	15	60:01	4,680	7,885	4,675	17,240		
3		Kvichak 05-June-2000 0600.dat	15	60:00	2,045	2,780	1,890	6,715		
3		Kvichak 05-June-2000 0700.dat	15	60:01	145	140	440	725		
3	Kvichak 05-June-2000 0800.dat	15	60:00	85	60	660	805			
3	Kvichak 05-June-2000 0900.dat	15	60:01	155	240	5	400			
3	Kvichak 05-June-2000 1000.dat	15	60:00	320	885	870	2,075			
3	Kvichak 05-June-2000 1100.dat	15	60:01	2,180	2,530	3,400	8,110			

Smolt Day (m/dd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore		
6/05-6/06	3	Kvichak 05-June-2000 1200.dat	15	60:00	8,125	685	1,195	10,005	
	3	Kvichak 05-June-2000 1300.dat	15	60:01	1,165	3,490	0	4,655	
	3	Kvichak 05-June-2000 1400.dat	15	60:01	2,305	2,625	2,420	7,350	
	3	Kvichak 05-June-2000 1500.dat	15	60:00	3,120	2,445	305	5,870	
	3	Kvichak 05-June-2000 1600.dat	15	60:01	303,735	92,195	45,925	441,855	Type-A corruptions (I=1105, M=320, O=160, S=77) with false counts from 16:50:17 to 16:54:4
	3	Kvichak 05-June-2000 1700.dat	15	60:00	3,170	1,245	3,410	7,825	
	3	Kvichak 05-June-2000 1800.dat	15	60:01	420	970	2,855	4,245	
	3	Kvichak 05-June-2000 1900.dat	15	60:00	4,240	710	475	5,425	
	3	Kvichak 05-June-2000 2000.dat	15	60:01	6,320	1,305	165	7,790	
	3	Kvichak 05-June-2000 2100.dat	15	60:00	685	4,875	5,145	10,705	
	3	Kvichak 05-June-2000 2200.dat	15	60:01	2,325	3,085	2,430	7,840	
	3	Kvichak 05-June-2000 2300.dat	15	60:00	5,200	3,880	2,295	11,375	
	4	Kvichak 06-June-2000 0000.dat	15	60:01	1,640	3,190	2,615	7,445	
	4	Kvichak 06-June-2000 0100.dat	19	120:01	5,245	2,590	8,330	16,165	No false cts from 1:00:00 to 1:59:59. Type-B corruptions with false counts from 2:00:05 to 2:00:15. No Kvichak 06-June-2000 0200.dat. 0200 hr cts appended to Kvichak 06-June-2000 0100.dat
	4	Kvichak 06-June-2000 0200.dat							
	4	Kvichak 06-June-2000 0300.dat	15	60:01	2,140	3,960	6,025	12,125	
	4	Kvichak 06-June-2000 0400.dat	15	60:00	19,530	11,725	3,325	34,580	
	4	Kvichak 06-June-2000 0500.dat	15	60:01	2,080	2,970	2,190	7,240	
	4	Kvichak 06-June-2000 0600.dat	15	60:00	195	105	35	335	
	4	Kvichak 06-June-2000 0700.dat	15	60:01	1,250	1,925	475	3,650	
	4	Kvichak 06-June-2000 0800.dat	15	60:00	65	100	0	165	
	4	Kvichak 06-June-2000 0900.dat	15	60:01	90	185	0	275	
	4	Kvichak 06-June-2000 1000.dat	29	120:01	413,505	119,795	60,440	593,740	No false cts from 10:00:00 to 10:59:59. Type-B corruptions with false counts from 11:00:05 to 11:00:15. No Kvichak 06-June-2000 1100.dat. 1100 hr cts appended to Kvichak 06-June-2000 0100.dat
	4	Kvichak 06-June-2000 1100.dat							
6/06-6/07	4	Kvichak 06-June-2000 1200.dat	15	60:00	12,665	1,420	970	15,055	
	4	Kvichak 06-June-2000 1300.dat	15	60:01	105	105	0	210	
	4	Kvichak 06-June-2000 1400.dat	15	60:01	515	65	305	885	
	4	Kvichak 06-June-2000 1500.dat	15	60:00	1,730	175	55	1,960	
	4	Kvichak 06-June-2000 1600.dat	15	60:01	900	185	15	1,100	
	4	Kvichak 06-June-2000 1700.dat	15	60:00	700	480	230	1,410	
	4	Kvichak 06-June-2000 1800.dat	15	60:01	1,080	610	135	1,825	
	4	Kvichak 06-June-2000 1900.dat	15	60:00	345	295	105	745	
	4	Kvichak 06-June-2000 2000.dat	15	60:01	1,030	630	765	2,425	
	4	Kvichak 06-June-2000 2100.dat	15	60:00	1,885	540	975	3,400	
	4	Kvichak 06-June-2000 2200.dat	15	60:01	385	630	1,625	2,640	
	4	Kvichak 06-June-2000 2300.dat	15	60:00	1,470	435	840	2,745	
	4	Kvichak 07-June-2000 0000.dat	15	60:01	3,630	2,435	400	6,465	
	4	Kvichak 07-June-2000 0100.dat	15	60:01	5,020	2,015	1,760	8,795	
	4	Kvichak 07-June-2000 0200.dat	15	60:00	1,000	3,120	4,365	8,485	
	4	Kvichak 07-June-2000 0300.dat	15	60:01	1,805	2,540	2,275	6,620	
	4	Kvichak 07-June-2000 0400.dat	15	60:00	370	845	270	1,485	
	4	Kvichak 07-June-2000 0500.dat	15	60:01	1,285	580	345	2,210	
	4	Kvichak 07-June-2000 0600.dat	15	60:00	750	1,155	495	2,400	
	4	Kvichak 07-June-2000 0700.dat	15	60:01	18,460	6,295	3,990	28,745	
	4	Kvichak 07-June-2000 0800.dat	15	60:00	1,830	980	1,090	3,900	
	4	Kvichak 07-June-2000 0900.dat	15	60:01	4,665	2,765	2,775	10,205	
	4	Kvichak 07-June-2000 1000.dat	15	60:00	0	0	0	0	0 Smolt counter disabled - no counts recorded in this *.dat file.
	4	Kvichak 07-June-2000 1100.dat	15	60:01	0	0	0	0	0 Smolt counter disabled - no counts recorded in this *.dat file.

Smolt Day (m/dd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore		
6/07-6/08	4	Kvichak 07-June-2000 1200.dat	15	60:01	0	0	0	0	Smolt counter disabled - no counts recorded in this *.dat file.
	4	Kvichak 07-June-2000 1300.dat	15	60:00	0	0	0	0	Smolt counter disabled - no counts recorded in this *.dat file.
	4	Kvichak 07-June-2000 1400.dat	15	60:01	70,820	20,625	10,280	101,725	
	4	Kvichak 07-June-2000 1500.dat	15	60:00	335	2,525	165	3,025	
	4	Kvichak 07-June-2000 1600.dat	15	60:01	14,355	16,905	8,055	39,315	
	4	Kvichak 07-June-2000 1700.dat	15	60:00	370	7,860	5,730	13,960	
	4	Kvichak 07-June-2000 1800.dat	15	60:01	365	870	605	1,840	
	4	Kvichak 07-June-2000 1900.dat	15	60:00	1,070	1,055	830	2,955	
	4	Kvichak 07-June-2000 2000.dat	15	60:01	3,920	320	150	4,390	
	4	Kvichak 07-June-2000 2100.dat	15	60:00	1,330	3,205	3,010	7,545	
	4	Kvichak 07-June-2000 2200.dat	15	60:01	1,225	595	3,505	5,325	
	4	Kvichak 07-June-2000 2300.dat							No Kvichak 07-June-2000 2300.dat file
	4	Kvichak 08-June-2000 0000.dat	1	00:01	0	0	0	0	
	4	Kvichak 08-June-2000 0100.dat	15	60:01	2,070	4,300	5,820	12,190	
	4	Kvichak 08-June-2000 0200.dat	15	60:00	4,420	12,580	19,305	36,305	
	4	Kvichak 08-June-2000 0300.dat	15	60:01	2,110	8,880	15,515	26,505	
	4	Kvichak 08-June-2000 0400.dat	15	60:00	5,575	7,705	13,795	27,075	
	4	Kvichak 08-June-2000 0500.dat	15	60:01	17,240	13,840	27,825	58,905	
	4	Kvichak 08-June-2000 0600.dat	15	60:00	8,850	34,870	88,780	132,500	
	4	Kvichak 08-June-2000 0700.dat	15	60:01	6,765	15,740	72,945	95,450	
4	Kvichak 08-June-2000 0800.dat	15	60:00	8,780	21,735	20,635	51,150		
4	Kvichak 08-June-2000 0900.dat	15	60:01	10,595	10,225	12,225	33,045		
4	Kvichak 08-June-2000 1000.dat	15	60:00	6,950	8,905	6,475	22,330		
4	Kvichak 08-June-2000 1100.dat	15	60:01	8,375	8,330	13,265	29,970		
6/08-6/09	4	Kvichak 08-June-2000 1200.dat	15	60:01	11,445	6,080	8,960	26,485	
	4	Kvichak 08-June-2000 1300.dat	15	60:00	6,370	8,765	14,325	29,460	
	4	Kvichak 08-June-2000 1400.dat	15	60:01	9,165	12,330	19,155	40,650	
	4	Kvichak 08-June-2000 1500.dat	15	60:00	9,535	4,965	7,275	21,775	
	4	Kvichak 08-June-2000 1600.dat	15	60:01	20,900	6,375	30,020	57,295	
	4	Kvichak 08-June-2000 1700.dat	15	60:00	6,760	13,005	12,175	31,940	
	4	Kvichak 08-June-2000 1800.dat	15	60:01	9,905	9,470	9,445	28,820	
	4	Kvichak 08-June-2000 1900.dat	15	60:00	9,335	13,535	11,465	34,335	
	4	Kvichak 08-June-2000 2000.dat	15	60:01	4,800	7,685	8,630	21,115	
	4	Kvichak 08-June-2000 2100.dat	15	60:00	33,080	7,635	1,495	42,210	
	4	Kvichak 08-June-2000 2200.dat	15	60:01	2,930	4,005	5,620	12,555	
	4	Kvichak 08-June-2000 2300.dat	15	60:01	7,855	6,715	7,640	22,210	
	4	Kvichak 09-June-2000 0000.dat	15	60:00	3,365	3,840	1,515	8,720	
	4	Kvichak 09-June-2000 0100.dat	15	60:01	1,940	4,440	2,055	8,435	
	4	Kvichak 09-June-2000 0200.dat	15	60:00	550	9,925	14,240	24,715	
	4	Kvichak 09-June-2000 0300.dat	15	60:01	3,830	9,480	4,165	17,475	
	4	Kvichak 09-June-2000 0400.dat	15	60:00	9,195	18,475	6,630	34,300	
	4	Kvichak 09-June-2000 0500.dat	15	60:01	6,950	8,930	6,425	22,305	
	4	Kvichak 09-June-2000 0600.dat	15	60:00	2,775	3,045	3,200	9,020	
	4	Kvichak 09-June-2000 0700.dat	15	60:01	1,805	1,910	520	4,235	
4	Kvichak 09-June-2000 0800.dat	15	60:00	25	1,220	710	1,955		
4	Kvichak 09-June-2000 0900.dat	15	60:01	775	2,115	1,275	4,165		
4	Kvichak 09-June-2000 1000.dat	15	60:00	475	865	2,055	3,395		
4	Kvichak 09-June-2000 1100.dat	15	60:01	1,605	240	125	1,970		

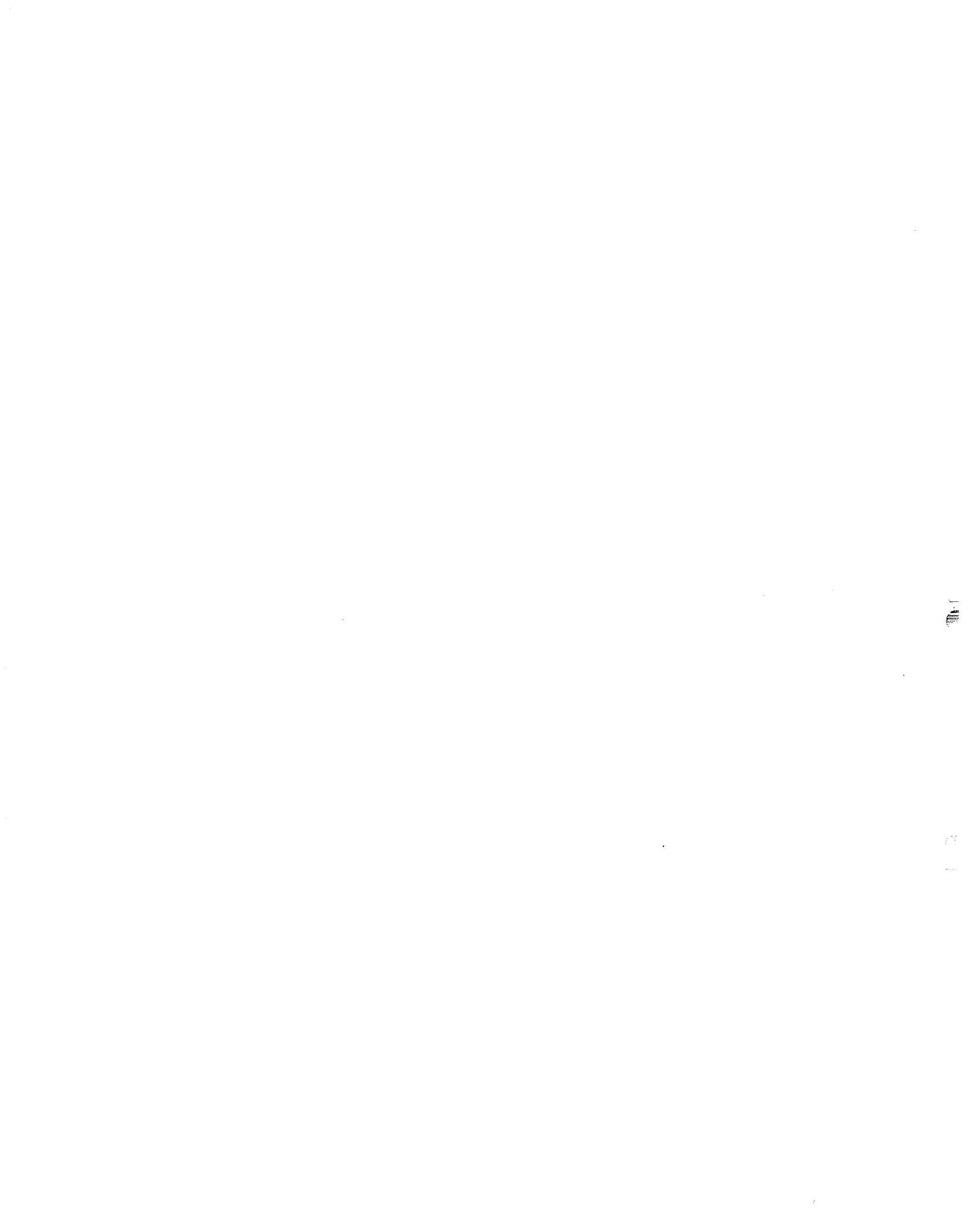
Smolt Day (m/dd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore		
6/09-6/10	4	Kvichak 09-June-2000 1200.dat	15	60:01	265	95	2,160	2,520	
	4	Kvichak 09-June-2000 1300.dat	15	60:00	640	5	515	1,160	
	4	Kvichak 09-June-2000 1400.dat	15	60:01	1,965	1,925	430	4,320	
	4	Kvichak 09-June-2000 1500.dat	15	60:00	2,190	1,425	255	3,870	
	4	Kvichak 09-June-2000 1600.dat	15	60:01	21,340	0	15	21,355	
	4	Kvichak 09-June-2000 1700.dat	15	60:00	1,020	475	0	1,495	
	4	Kvichak 09-June-2000 1800.dat	15	60:01	2,665	1,360	1,165	5,190	
	4	Kvichak 09-June-2000 1900.dat	15	60:00	15,725	24,855	210	40,790	
	4	Kvichak 09-June-2000 2000.dat	15	60:01	810	2,760	320	3,890	
	4	Kvichak 09-June-2000 2100.dat	15	60:00	335	55	115	505	
	4	Kvichak 09-June-2000 2200.dat	15	60:01	935	260	555	1,750	
			Kvichak 09-June-2000 2300.dat						No Kvichak 09-June-2000 2300.dat file
	5	Kvichak 10-June-2000 0000.dat	15	60:00	1,695	1,620	200	3,515	
	5	Kvichak 10-June-2000 0100.dat	28	116:33	5,615	1,230	165	7,010	No false cts from 1:00:00 to 1:59:59. Type-B corruptions with false counts from 2:00:05 to 2:00:15
			Kvichak 10-June-2000 0200.dat						No Kvichak 10-June-2000 0200.dat. 0200 hr cts appended to Kvichak 10-June-2000 0100.d
	5	Kvichak 10-June-2000 0300.dat	15	60:01	4,300	925	305	5,530	
	5	Kvichak 10-June-2000 0400.dat	15	60:00	8,385	5,750	1,860	15,995	
	5	Kvichak 10-June-2000 0500.dat	15	60:01	2,610	1,295	375	4,280	
	5	Kvichak 10-June-2000 0600.dat	15	60:01	1,065	35	25	1,125	
	5	Kvichak 10-June-2000 0700.dat	15	60:00	1,190	1,110	1,815	4,115	
	5	Kvichak 10-June-2000 0800.dat	15	60:01	5	35	0	40	
	5	Kvichak 10-June-2000 0900.dat	15	60:00	95	760	310	1,165	
	5	Kvichak 10-June-2000 1000.dat	15	60:01	120	335	260	715	
5	Kvichak 10-June-2000 1100.dat	15	60:00	150	920	3,605	4,675		
6/10-6/11	5	Kvichak 10-June-2000 1200.dat	15	60:01	1,440	430	225	2,095	
	5	Kvichak 10-June-2000 1300.dat	15	60:00	845	135	940	1,920	
	5	Kvichak 10-June-2000 1400.dat	15	60:01	2,120	815	965	3,900	
	5	Kvichak 10-June-2000 1500.dat	15	60:00	690	545	1,565	2,800	
	5	Kvichak 10-June-2000 1600.dat	15	60:01	3,245	1,480	785	5,510	
	5	Kvichak 10-June-2000 1700.dat	15	60:01	695	2,280	1,610	4,585	
	5	Kvichak 10-June-2000 1800.dat	15	60:00	266,865	76,680	38,955	382,500	
	5	Kvichak 10-June-2000 1900.dat	15	60:01	3,390	1,825	2,225	7,440	
	5	Kvichak 10-June-2000 2000.dat	15	60:00	2,290	620	945	3,855	
	5	Kvichak 10-June-2000 2100.dat	15	60:01	580	690	1,570	2,840	
	5	Kvichak 10-June-2000 2200.dat	15	60:00	1,330	1,720	1,190	4,240	
	5	Kvichak 10-June-2000 2300.dat	29	120:01	31,870	15,770	45,505	93,145	No false cts from 23:00:00 to 23:59:59. Type-B corruptions with false counts from 00:00:05 to 00:00:15
			Kvichak 11-June-2000 0000.dat						No Kvichak 11-June-2000 0000.dat 0000 hr cts appended to Kvichak 10-June-2000 2300.da
	5	Kvichak 11-June-2000 0100.dat	15	60:01	1,085	1,000	540	2,625	
	5	Kvichak 11-June-2000 0200.dat	15	60:00	6,620	8,715	3,925	19,260	
	5	Kvichak 11-June-2000 0300.dat	15	60:01	5,810	3,975	1,380	11,165	
	5	Kvichak 11-June-2000 0400.dat	15	60:00	9,780	3,695	1,860	15,335	
	5	Kvichak 11-June-2000 0500.dat	15	60:01	9,330	3,605	2,075	15,010	
	5	Kvichak 11-June-2000 0600.dat	15	60:01	3,910	3,390	2,715	10,015	
	5	Kvichak 11-June-2000 0700.dat	15	60:00	9,200	2,185	5,560	16,945	
	5	Kvichak 11-June-2000 0800.dat	15	60:01	3,830	6,110	11,105	21,045	
	5	Kvichak 11-June-2000 0900.dat	15	60:00	2,550	4,195	2,365	9,110	
	5	Kvichak 11-June-2000 1000.dat	15	60:01	5,180	1,510	5,025	11,715	
5	Kvichak 11-June-2000 1100.dat	15	60:00	5,835	2,660	4,580	13,075		

Smolt Day (m/dd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments	
					Inshore	Middle	Offshore			
6/11-6/12	5	Kvichak 11-June-2000 1200.dat	15	60:01	2,625	1,980	3,310	7,915		
	5	Kvichak 11-June-2000 1300.dat	15	60:00	3,225	3,380	4,205	10,810		
	5	Kvichak 11-June-2000 1400.dat	15	60:01	2,595	3,940	3,205	9,740		
	5	Kvichak 11-June-2000 1500.dat	15	60:00	600	290	1,500	2,390		
	5	Kvichak 11-June-2000 1600.dat	15	60:01	0	0	0	0		
			Kvichak 11-June-2000 1700.dat						No Kvichak 11-June-2000 1700.dat	
			Kvichak 11-June-2000 1800.dat						No Kvichak 11-June-2000 1800.dat	
			Kvichak 11-June-2000 1900.dat						No Kvichak 11-June-2000 1900.dat	
			Kvichak 11-June-2000 2000.dat						No Kvichak 11-June-2000 2000.dat	
			Kvichak 11-June-2000 2100.dat						No Kvichak 11-June-2000 2100.dat	
			Kvichak 11-June-2000 2200.dat						No Kvichak 11-June-2000 2200.dat	
			Kvichak 11-June-2000 2300.dat						No Kvichak 11-June-2000 2300.dat	
	5		Kvichak 12-June-2000 0000.dat	15	60:02	150	380	1,725	2,255	
	5		Kvichak 12-June-2000 0100.dat	15	60:00	6,950	4,890	3,100	14,940	
	5		Kvichak 12-June-2000 0200.dat	15	60:01	1,315	3,700	1,985	7,000	
	5		Kvichak 12-June-2000 0300.dat	15	60:01	1,445	480	875	2,800	
	5		Kvichak 12-June-2000 0400.dat	15	60:00	20	95	0	115	
	5		Kvichak 12-June-2000 0500.dat	15	60:01	10	20	60	90	
	5		Kvichak 12-June-2000 0600.dat	15	60:00	95	830	135	1,060	
	5		Kvichak 12-June-2000 0700.dat	15	60:01	9,790	2,575	3,695	16,060	
5		Kvichak 12-June-2000 0800.dat	15	60:00	265	570	1,095	1,930		
5		Kvichak 12-June-2000 0900.dat	15	60:01	0	0	0	0		
5		Kvichak 12-June-2000 1000.dat	15	60:00	510	310	110	930		
5		Kvichak 12-June-2000 1100.dat	15	60:01	1,420	205	1,305	2,930		
6/12-6/13	5	Kvichak 12-June-2000 1200.dat	15	60:00	1,800	445	2,105	4,350		
	5	Kvichak 12-June-2000 1300.dat	15	60:01	675	510	1,665	2,850		
	5	Kvichak 12-June-2000 1400.dat	15	60:01	235	0	175	410		
	5	Kvichak 12-June-2000 1500.dat	15	60:00	35	0	0	35		
	5	Kvichak 12-June-2000 1600.dat	15	60:01	135,060	39,055	19,555	193,670		
	5	Kvichak 12-June-2000 1700.dat	15	60:00	0	0	0	0		
	5	Kvichak 12-June-2000 1800.dat	15	60:01	235	30	0	265		
	5	Kvichak 12-June-2000 1900.dat	15	60:00	135	175	365	675		
	5	Kvichak 12-June-2000 2000.dat	15	60:01	65	680	310	1,055		
	5	Kvichak 12-June-2000 2100.dat	15	60:00	40	535	130	705		
	5	Kvichak 12-June-2000 2200.dat	15	60:01	145	0	35	180		
	5	Kvichak 12-June-2000 2300.dat	15	60:00	5	0	50	55		
	6		Kvichak 13-June-2000 0000.dat	15	60:01	20	30	70	120	
	6		Kvichak 13-June-2000 0100.dat	15	60:01	1,440	650	1,375	3,465	
	6		Kvichak 13-June-2000 0200.dat	15	60:00	475	1,255	880	2,610	
	6		Kvichak 13-June-2000 0300.dat	15	60:01	520	15	40	575	
	6		Kvichak 13-June-2000 0400.dat	15	60:00	5,595	1,830	1,210	8,635	
	6		Kvichak 13-June-2000 0500.dat	15	60:01	1,755	485	1,540	3,780	
	6		Kvichak 13-June-2000 0600.dat	15	60:00	930	4,700	2,025	7,655	
	6		Kvichak 13-June-2000 0700.dat	15	60:01	235	8,865	2,155	11,255	
6		Kvichak 13-June-2000 0800.dat	15	60:00	2,725	1,095	1,885	5,705		
6		Kvichak 13-June-2000 0900.dat	15	60:01	45	3,715	5,085	8,845		
6		Kvichak 13-June-2000 1000.dat	15	60:00	595	3,800	6,175	10,570		
6		Kvichak 13-June-2000 1100.dat	15	60:01	173,610	54,515	28,845	256,970		

Smolt Day (m/dd-mdd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore		
6/13-6/14	6	Kvichak 13-June-2000 1200.dat	15	60:00	710	2,405	4,170	7,285	
	6	Kvichak 13-June-2000 1300.dat	1	00:01	0	0	0	0	
	6	Kvichak 13-June-2000 1400.dat	15	60:01	1,020	1,985	3,945	6,950	
	6	Kvichak 13-June-2000 1500.dat	15	60:00	8,870	5,360	3,590	17,820	
	6	Kvichak 13-June-2000 1600.dat	15	60:01	5,195	2,680	1,345	9,220	
	6	Kvichak 13-June-2000 1700.dat	15	60:00	2,250	1,350	1,400	5,000	
	6	Kvichak 13-June-2000 1800.dat	15	60:01	25	110	465	600	
	6	Kvichak 13-June-2000 1900.dat	15	60:00	1,100	190	1,030	2,320	
	6	Kvichak 13-June-2000 2000.dat	15	60:01	170	755	0	925	
	6	Kvichak 13-June-2000 2100.dat	15	60:00	1,050	55	150	1,255	
	6	Kvichak 13-June-2000 2200.dat	15	60:01	1,160	690	200	2,050	
	6	Kvichak 13-June-2000 2300.dat	15	60:00	183,505	53,135	26,560	263,200	
	6	Kvichak 14-June-2000 0000.dat	15	60:01	3,315	980	510	4,805	
	6	Kvichak 14-June-2000 0100.dat	15	60:00	360	360	490	1,210	
	6	Kvichak 14-June-2000 0200.dat	15	60:01	285	290	60	635	
	6	Kvichak 14-June-2000 0300.dat	15	60:01	1,740	1,180	465	3,385	
	6	Kvichak 14-June-2000 0400.dat	15	60:00	2,315	5,690	2,755	10,760	
		Kvichak 14-June-2000 0500.dat							No Kvichak 14-June-2000 0500.dat file.
		Kvichak 14-June-2000 0600.dat							No Kvichak 14-June-2000 0600.dat file.
		Kvichak 14-June-2000 0700.dat							No Kvichak 14-June-2000 0700.dat file.
		Kvichak 14-June-2000 0800.dat							No Kvichak 14-June-2000 0800.dat file.
		Kvichak 14-June-2000 0900.dat							No Kvichak 14-June-2000 0900.dat file.
		Kvichak 14-June-2000 1000.dat							No Kvichak 14-June-2000 1000.dat file.
		Kvichak 14-June-2000 1100.dat							No Kvichak 14-June-2000 1100.dat file.

\* The total counts for the smolt counter \*.dat file have not been adjusted for false cts and disabled time in this table.

<sup>b</sup> The total counts for the Bendix have been adjusted for false counts and disabled time as indicated on the Daily Sonar Log Form.



Appendix E.2. List of \*.dat files generated by the University of Washington, Applied Physics Laboratory, smolt counter digital storage application at Ugashik River smolt sonar, May 20 to June 12, 2000.

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments	
					Inshore	Middle	Offshore*			
5/20-5/21	1	Ugashik 20-May-2000 1800.dat	15	60:01	0	85	0	85	Bendix counter - down 20 m, wind NE 8-10, zero cts on both arrays this hr	
	1	Ugashik 20-May-2000 1900.dat	15	60:00	705	35	0	740	Bendix counter - down 20 m, wind NE 8-10, zero cts on both arrays this hr	
	1	Ugashik 20-May-2000 2000.dat	15	60:01	10	1,060	0	1,070	Bendix counter - down 20 m, wind NE 9, inshore=0, center=156 this hr	
	1	Ugashik 20-May-2000 2100.dat	15	60:00	1,335	1,530	400	2,865	Type-A corruption with false counts (I=1025, M=320, O=400)	
	1	Ugashik 20-May-2000 2200.dat	15	60:01	375	750	0	1,125	Bendix counter - disabled for this entire hour, heavy rain mixed w/ snow	
	1	Ugashik 20-May-2000 2300.dat	15	60:00	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)	
	1	Ugashik 21-May-2000 0000.dat	15	60:01	0	0	0	0	Bendix counter - disabled for this entire hour, heavy rain mixed w/ snow	
	1	Ugashik 21-May-2000 0100.dat	15	60:00	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)	
	1	Ugashik 21-May-2000 0200.dat	15	60:01	0	0	0	0	Bendix counter - disabled for this entire hour, heavy rain mixed w/ snow	
	1	Ugashik 21-May-2000 0300.dat	29	120:01	490	580	0	1,070	Type-B corruption, false counts from 4:00:05 to 4:00:23 discounted.	
			Ugashik 21-May-2000 0400.dat			0	0	0	0	No Ugashik 21-May-2000 0400.dat, 0400 hr cnts appended to Ugashik 21-May-2000 0300.dat file
	1	Ugashik 21-May-2000 0500.dat	15	60:01	0	0	0	0	Bendix counter - disabled for this entire hour, heavy rain mixed w/ snow	
	1	Ugashik 21-May-2000 0600.dat	15	60:00	0	0	0	0	Bendix counter - disabled for this entire hour, heavy rain mixed w/ snow	
	1	Ugashik 21-May-2000 0700.dat	15	60:01	0	0	0	0	Bendix counter - disabled for this entire hour, heavy rain mixed w/ snow	
	1	Ugashik 21-May-2000 0800.dat	15	60:00	0	0	0	0	Bendix counter - disabled for this entire hour, heavy rain mixed w/ snow	
	1	Ugashik 21-May-2000 0900.dat	15	60:01	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)	
	1	Ugashik 21-May-2000 1000.dat	15	60:00	0	0	0	0	Bendix counter - disabled for this entire hour, heavy rain mixed w/ snow	
	1	Ugashik 21-May-2000 1100.dat	15	60:01	0	0	0	0	Bendix counter - disabled for this entire hour, heavy rain mixed w/ snow	
	5/21-5/22	2	Ugashik 21-May-2000 1200.dat	15	60:00	0	0	0	0	Bendix counter - disabled for this entire hour, heavy rain mixed w/ snow
		2	Ugashik 21-May-2000 1300.dat	15	60:01	1,045	0	0	1,045	
2		Ugashik 21-May-2000 1400.dat	29	120:01	0	145	0	145	Type-B corruption, false counts from 15:00:05 to 15:00:23 discounted.	
			Ugashik 21-May-2000 1500.dat			170	400	0	570	No Ugashik 21-May-2000 1500.dat file. Counter did not record 1500 hour counts.
2		Ugashik 21-May-2000 1600.dat	15	60:01	80	215	0	295		
2		Ugashik 21-May-2000 1700.dat	15	60:00	245	1,905	0	2,150		
2		Ugashik 21-May-2000 1800.dat	15	60:01	555	165	0	720		
2		Ugashik 21-May-2000 1900.dat	15	60:00	475	400	0	875		
2		Ugashik 21-May-2000 2000.dat	15	60:01	155	415	0	570		
2		Ugashik 21-May-2000 2100.dat	15	60:00	465	420	0	885		
2		Ugashik 21-May-2000 2200.dat	15	60:01	1,270	615	0	1,885		
2		Ugashik 21-May-2000 2300.dat	15	60:00	780	735	0	1,515		
2		Ugashik 22-May-2000 0000.dat	15	60:01	13,480	4,295	0	17,775		
2		Ugashik 22-May-2000 0100.dat	15	60:00	10,580	2,720	0	13,300		
2		Ugashik 22-May-2000 0200.dat	15	60:01	2,730	1,065	0	3,795		
2		Ugashik 22-May-2000 0300.dat	15	60:01	1,110	175	0	1,285		
2		Ugashik 22-May-2000 0400.dat	15	60:00	705	1,080	0	1,785		
2		Ugashik 22-May-2000 0500.dat	15	60:01	75	1,275	0	1,350		
2		Ugashik 22-May-2000 0600.dat	15	60:00	50	50	0	100		
2		Ugashik 22-May-2000 0700.dat	15	60:01	1,090	405	400	1,895	Type-A corruption with false counts (I=1025, M=320, O=400)	
2	Ugashik 22-May-2000 0800.dat	15	60:00	195	320	0	515			
2	Ugashik 22-May-2000 0900.dat	15	60:01	1,380	740	400	2,520	Type-A corruption with false counts (I=1025, M=320, O=400)		
2	Ugashik 22-May-2000 1000.dat	15	60:00	355	1,190	0	1,545			
2	Ugashik 22-May-2000 1100.dat	15	60:01	245	1,165	0	1,410			

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore*		
5/22-5/23	3	Ugashik 22-May-2000 1200.dat	15	60:00	150	305	0	455	
	3	Ugashik 22-May-2000 1300.dat	15	60:01	1,275	945	400	2,620	Type-A corruption with false counts (I=1025, M=320, O=400)
	3	Ugashik 22-May-2000 1400.dat	15	60:01	1,595	770	400	2,765	Type-A corruption with false counts (I=1025, M=320, O=400)
	3	Ugashik 22-May-2000 1500.dat	15	60:00	1,575	755	400	2,730	Type-A corruption with false counts (I=1025, M=320, O=400)
	3	Ugashik 22-May-2000 1600.dat	15	60:01	12,765	3,995	4,800	21,560	Type-A corruptions (n=12) with false counts (I=1025, M=320, O=400)
	3	Ugashik 22-May-2000 1700.dat	15	60:00	1,905	730	400	3,035	Type-A corruption with false counts (I=1025, M=320, O=400)
	3	Ugashik 22-May-2000 1800.dat	15	60:01	1,900	660	400	2,960	Type-A corruption with false counts (I=1025, M=320, O=400)
	3	Ugashik 22-May-2000 1900.dat	15	60:00	550	525	0	1,075	
	3	Ugashik 22-May-2000 2000.dat	15	60:01	195	545	0	740	
	3	Ugashik 22-May-2000 2200.dat	15	60:00	350	155	0	505	
	3	Ugashik 22-May-2000 2200.dat	15	60:01	90	370	0	460	
	3	Ugashik 22-May-2000 2300.dat	15	60:00	15	955	200	1,170	Unexplained false counts on offshore array
	3	Ugashik 23-May-2000 0000.dat	15	60:01	3,140	3,525	0	6,665	
	3	Ugashik 23-May-2000 0100.dat	15	60:00	5,420	3,490	0	8,910	
	3	Ugashik 23-May-2000 0200.dat	15	60:01	5,295	3,300	0	8,595	
	3	Ugashik 23-May-2000 0300.dat	15	60:01	8,960	3,645	1,200	13,805	Type-A corruptions (n=3) with false counts (I=1025, M=320, O=400)
	3	Ugashik 23-May-2000 0400.dat	15	60:00	850	45	0	895	
	3	Ugashik 23-May-2000 0500.dat	15	60:01	40	0	0	40	
	3	Ugashik 23-May-2000 0600.dat	15	60:00	510	420	0	930	
		Ugashik 23-May-2000 0700.dat					0	0	No Ugashik 23-May-2000 0700.dat file. No 0700 hour count, battery problem.
		Ugashik 23-May-2000 0800.dat					0	0	No Ugashik 23-May-2000 0800.dat file. No 0800 hour count, battery problem.
		Ugashik 23-May-2000 0900.dat					0	0	No Ugashik 23-May-2000 0900.dat file. No 0900 hour count, battery problem.
		Ugashik 23-May-2000 1000.dat					0	0	No Ugashik 23-May-2000 1000.dat file. No 1000 hour count, battery problem.
		Ugashik 23-May-2000 1100.dat					0	0	No Ugashik 23-May-2000 1100.dat file. No 1100 hour count, battery problem.
5/23-5/24	4	Ugashik 23-May-2000 1246.dat	4	13:20	65	695	0	760	No Ugashik 23-May-2000 1200.dat file. No 1200 hour count, battery problem.
	4	Ugashik 23-May-2000 1300.dat	15	60:01	2,285	2,450	400	5,135	Type-A corruption with false counts (I=1025, M=320, O=400)
	4	Ugashik 23-May-2000 1400.dat	15	60:00	295	570	0	865	Smolt counter disabled, WSW 15-20, Bendix cts interpolated for this hour
	4	Ugashik 23-May-2000 1500.dat	15	60:01	0	0	0	0	Smolt counter disabled, WSW 15-20, Bendix cts interpolated for this hour
	4	Ugashik 23-May-2000 1600.dat	15	60:01	1,555	2,320	400	4,275	Type-A corruption with false counts (I=1025, M=320, O=400)
	4	Ugashik 23-May-2000 1700.dat	15	60:00	170	115	0	285	
	4	Ugashik 23-May-2000 1800.dat	15	60:01	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)
	4	Ugashik 23-May-2000 1900.dat	15	60:00	400	605	0	1,005	
	4	Ugashik 23-May-2000 2000.dat	15	60:01	385	120	0	505	
	4	Ugashik 23-May-2000 2100.dat	15	60:00	320	30	0	350	
	4	Ugashik 23-May-2000 2200.dat	15	60:01	1,030	555	400	1,985	Type-A corruption with false counts (I=1025, M=320, O=400)
	4	Ugashik 23-May-2000 2300.dat	15	60:00	35	295	0	330	
	4	Ugashik 24-May-2000 0000.dat	15	60:01	3,580	355	0	3,935	
	4	Ugashik 24-May-2000 0100.dat	15	60:00	30	390	0	420	
	4	Ugashik 24-May-2000 0200.dat	15	60:01	865	425	0	1,290	
	4	Ugashik 24-May-2000 0300.dat	29	120:01	510	75	0	585	Type-B corruption with false counts from 4:00:05 to 4:00:23 and Type-A corruptions (n=2)
		Ugashik 24-May-2000 0400.dat			2,090	650	800	3,540	No Ugashik 24-May-2000 0400.dat. 0400 hr cmts appended to Ugashik 24-May-2000 0300.dat file
	4	Ugashik 24-May-2000 0500.dat	15	60:01	40	105	0	145	
	4	Ugashik 24-May-2000 0600.dat	15	60:00	0	0	0	0	
	4	Ugashik 24-May-2000 0700.dat	15	60:01	505	25	0	530	
	4	Ugashik 24-May-2000 0800.dat	15	60:00	180	625	0	805	
	4	Ugashik 24-May-2000 0900.dat	15	60:01	60	420	0	480	
	4	Ugashik 24-May-2000 1000.dat	15	60:00	125	735	0	860	
	4	Ugashik 24-May-2000 1100.dat	15	60:01	110	250	0	360	

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore*		
5/24-5/25	5	Ugashik 24-May-2000 1200.dat	15	60:00	50	860	120	1,030	Unexplained false counts on offshore array
	5	Ugashik 24-May-2000 1300.dat	15	60:01	1,260	270	0	1,530	
	5	Ugashik 24-May-2000 1400.dat	15	60:00	1,960	110	10,445	12,515	Crew Comment: VHF handheld radio caused false counts on offshore array
	5	Ugashik 24-May-2000 1500.dat	15	60:01	1,165	1,995	0	3,160	
	5	Ugashik 24-May-2000 1600.dat	15	60:01	360	350	0	710	
	5	Ugashik 24-May-2000 1700.dat	15	60:00	5,805	370	0	6,175	
	5	Ugashik 24-May-2000 1800.dat	15	60:01	105	60	0	165	
	5	Ugashik 24-May-2000 1900.dat	15	60:00	165	645	0	810	
	5	Ugashik 24-May-2000 2000.dat	15	60:01	15	1,170	0	1,185	
	5	Ugashik 24-May-2000 2100.dat	15	60:00	710	605	0	1,315	
	5	Ugashik 24-May-2000 2200.dat	15	60:01	55	30	0	85	
	5	Ugashik 24-May-2000 2300.dat	15	60:00	275	245	0	520	
	5	Ugashik 25-May-2000 0000.dat	15	60:01	4,535	2,960	135	7,630	Unexplained false counts on offshore array
	5	Ugashik 25-May-2000 0100.dat	15	60:00	7,850	3,320	0	11,170	
	5	Ugashik 25-May-2000 0200.dat	15	60:01	1,475	465	0	1,940	
	5	Ugashik 25-May-2000 0300.dat	15	60:01	455	670	0	1,125	
	5	Ugashik 25-May-2000 0400.dat	15	60:00	1,135	355	400	1,890	Type-A corruption with false counts (I=1025, M=320, O=400)
	5	Ugashik 25-May-2000 0500.dat	15	60:01	110	655	0	765	
	5	Ugashik 25-May-2000 0600.dat	15	60:00	1,430	320	400	2,150	Type-A corruption with false counts (I=1025, M=320, O=400)
	5	Ugashik 25-May-2000 0700.dat	15	60:01	0	60	0	60	
5	Ugashik 25-May-2000 0800.dat	15	60:00	1,565	1,125	400	3,090	Type-A corruption with false counts (I=1025, M=320, O=400)	
5	Ugashik 25-May-2000 0900.dat	15	60:01	55	1,235	0	1,290		
5	Ugashik 25-May-2000 1000.dat	15	60:00	75	110	0	185		
5	Ugashik 25-May-2000 1100.dat	15	60:01	30	275	0	305		
5/25-5/26	6	Ugashik 25-May-2000 1200.dat	15	60:00	25	45	0	70	
	6	Ugashik 25-May-2000 1300.dat	15	60:01	35	275	0	310	
	6	Ugashik 25-May-2000 1400.dat	15	60:01	0	285	0	285	
	6	Ugashik 25-May-2000 1500.dat	15	60:00	50	1,210	0	1,260	
	6	Ugashik 25-May-2000 1600.dat	15	60:01	1,020	1,590	0	2,610	
	6	Ugashik 25-May-2000 1700.dat	15	60:00	2,040	740	400	3,180	Type-A corruption with false counts (I=1025, M=320, O=400)
	6	Ugashik 25-May-2000 1800.dat	15	60:01	1,145	85	0	1,230	
	6	Ugashik 25-May-2000 1900.dat	15	60:00	1,080	370	400	1,850	Type-A corruption with false counts (I=1025, M=320, O=400)
	6	Ugashik 25-May-2000 2000.dat	15	60:01	660	130	0	790	
	6	Ugashik 25-May-2000 2100.dat	15	60:00	4,140	435	400	4,975	Type-A corruption with false counts (I=1025, M=320, O=400)
	6	Ugashik 25-May-2000 2200.dat	15	60:01	260	235	0	495	
	6	Ugashik 25-May-2000 2300.dat	15	60:00	5,345	1,185	0	6,530	
	6	Ugashik 26-May-2000 0000.dat	15	60:01	34,235	43,855	0	78,090	
	6	Ugashik 26-May-2000 0100.dat	15	60:00	49,110	57,880	400	107,390	Type-A corruption with false counts (I=1025, M=320, O=400)
	6	Ugashik 26-May-2000 0200.dat	15	60:01	73,530	31,630	0	105,160	
	6	Ugashik 26-May-2000 0300.dat	15	60:01	34,880	18,285	400	53,565	Type-A corruption with false counts (I=1025, M=320, O=400)
	6	Ugashik 26-May-2000 0400.dat	15	60:00	1,500	1,340	0	2,840	
	6	Ugashik 26-May-2000 0500.dat	15	60:01	30	1,555	0	1,585	
	6	Ugashik 26-May-2000 0600.dat	15	60:00	35	0	0	35	
	6	Ugashik 26-May-2000 0700.dat	15	60:01	1,125	1,195	400	2,720	Type-A corruption with false counts (I=1025, M=320, O=400)
6	Ugashik 26-May-2000 0800.dat	15	60:00	2,645	595	0	3,240		
6	Ugashik 26-May-2000 0900.dat	15	60:01	1,245	2,185	400	3,830	Type-A corruption with false counts (I=1025, M=320, O=400)	
6	Ugashik 26-May-2000 1000.dat	15	60:00	2,025	4,820	0	6,845		
6	Ugashik 26-May-2000 1100.dat	15	60:01	2,525	4,310	400	7,235	Type-A corruption with false counts (I=1025, M=320, O=400)	

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore*		
5/26-5/27	7	Ugashik 26-May-2000 1200.dat	15	60:00	2,500	3,105	0	5,605	
	7	Ugashik 26-May-2000 1300.dat	15	60:01	20	1,475	55	1,550	Unexplained false counts on offshore array
	7	Ugashik 26-May-2000 1400.dat	15	60:01	230	15,485	0	15,715	WNW 15-20, gusting 25, dwn 0.25
	7	Ugashik 26-May-2000 1500.dat	15	60:00	6,235	16,865	0	23,100	Smolt counter disabled, WSW 15-20, Bendix cts interpolated for this hour
	7	Ugashik 26-May-2000 1600.dat	15	60:01	0	0	0	0	Smolt counter disabled, WSW 15-20, Bendix cts interpolated for this hour
	7	Ugashik 26-May-2000 1700.dat	15	60:00	0	0	0	0	Smolt counter disabled, WSW 15-20, Bendix cts interpolated for this hour
	7	Ugashik 26-May-2000 1800.dat	15	60:01	0	0	0	0	Smolt counter disabled, WSW 15-20, Bendix cts interpolated for this hour
	7	Ugashik 26-May-2000 1900.dat	15	60:00	0	0	0	0	Smolt counter disabled, WSW 15-20, Bendix cts interpolated for this hour
	7	Ugashik 26-May-2000 2000.dat	15	60:01	0	0	0	0	Smolt counter disabled, WSW 15-20, Bendix cts interpolated for this hour
	7	Ugashik 26-May-2000 2100.dat	15	60:00	0	0	0	0	Smolt counter disabled, WSW 15-20, Bendix cts interpolated for this hour
	7	Ugashik 26-May-2000 2200.dat	15	60:01	130	245	0	375	Smolt counter partially disabled, SW 10-15
	7	Ugashik 26-May-2000 2300.dat	15	60:00	845	1,180	0	2,025	
	7	Ugashik 27-May-2000 0000.dat	15	60:01	15,200	6,280	400	21,880	Type-A corruption with false counts (I=1025, M=320, O=400)
	7	Ugashik 27-May-2000 0100.dat	29	120:01	28,635	8,805	0	37,440	Type-B corruption with false counts from 2:00:06 to 2:00:15 and Type-A corruption (n=1)
	7	Ugashik 27-May-2000 0200.dat			14,665	3,325	400	18,390	No Ugashik 27-May-2000 0200.dat. 0200 hr cnts appended to Ugashik 27-May-2000 0100.dat file
	7	Ugashik 27-May-2000 0300.dat	15	60:01	12,080	3,100	0	15,180	
	7	Ugashik 27-May-2000 0400.dat	15	60:00	2,405	485	0	2,890	
	7	Ugashik 27-May-2000 0500.dat	15	60:01	15	1,200	0	1,215	
	7	Ugashik 27-May-2000 0600.dat	15	60:00	1,410	3,180	400	4,990	Type-A corruption with false counts (I=1025, M=320, O=400)
	7	Ugashik 27-May-2000 0700.dat	15	60:01	160	90	0	250	
7	Ugashik 27-May-2000 0800.dat	15	60:00	1,080	520	400	2,000	Type-A corruption with false counts (I=1025, M=320, O=400)	
7	Ugashik 27-May-2000 0900.dat	15	60:01	0	0	0	0	Smolt counter disabled, SW 15-20 w/ heavy rain, Bendix cts interpolated	
7	Ugashik 27-May-2000 1000.dat	15	60:00	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)	
7	Ugashik 27-May-2000 1100.dat	15	60:01	680	660	0	1,340	Smolt counter disabled, SW 15-20 w/ heavy rain, Bendix cts interpolated	
5/27-5/28	8	Ugashik 27-May-2000 1200.dat	15	60:00	265	525	0	790	
	8	Ugashik 27-May-2000 1300.dat	15	60:01	865	50	0	915	
	8	Ugashik 27-May-2000 1400.dat	15	60:01	1,900	145	0	2,045	
	8	Ugashik 27-May-2000 1500.dat	15	60:00	195	340	0	535	
	8	Ugashik 27-May-2000 1600.dat	15	60:01	315	1,335	0	1,650	
	8	Ugashik 27-May-2000 1700.dat	15	60:00	1,520	1,020	0	2,540	
	8	Ugashik 27-May-2000 1800.dat	15	60:01	70	15	0	85	Smolt counter mostly disabled, WSW 15-20, Bendix cts interpolated
	8	Ugashik 27-May-2000 1900.dat	15	60:00	55	25	0	80	Smolt counter mostly disabled, WSW 15-20, Bendix cts interpolated
	8	Ugashik 27-May-2000 2047.dat	3	12:05	1,105	430	400	1,935	Type-A corruption with false counts (I=1025, M=320, O=400)
	8	Ugashik 27-May-2000 2100.dat	15	60:00	3,015	2,075	0	5,090	
	8	Ugashik 27-May-2000 2200.dat	15	60:01	3,445	1,310	0	4,755	
	8	Ugashik 27-May-2000 2300.dat	15	60:01	465	3,940	0	4,405	
	8	Ugashik 28-May-2000 0000.dat	15	60:00	31,005	6,885	0	37,890	
	8	Ugashik 28-May-2000 0100.dat	15	60:01	6,275	2,360	0	8,635	
	8	Ugashik 28-May-2000 0200.dat	15	60:00	4,340	1,055	400	5,795	Type-A corruption with false counts (I=1025, M=320, O=400)
	8	Ugashik 28-May-2000 0300.dat	15	60:01	1,490	970	0	2,460	
	8	Ugashik 28-May-2000 0400.dat	15	60:00	175	30	0	205	
	8	Ugashik 28-May-2000 0500.dat	15	60:01	210	715	0	925	
	8	Ugashik 28-May-2000 0600.dat	15	60:00	15	795	0	810	
	8	Ugashik 28-May-2000 0700.dat	15	60:01	175	1,035	0	1,210	
8	Ugashik 28-May-2000 0800.dat	15	60:00	45	700	0	745		
8	Ugashik 28-May-2000 0900.dat	15	60:01	535	270	0	805		
8	Ugashik 28-May-2000 1000.dat	15	60:00	1,265	1,550	400	3,215	Type-A corruption with false counts (I=1025, M=320, O=400)	
8	Ugashik 28-May-2000 1100.dat	15	60:01	420	1,070	0	1,490		

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore*		
5/28-5/29	9	Ugashik 28-May-2000 1200.dat	15	60:00	930	260	0	1,190	
	9	Ugashik 28-May-2000 1300.dat	15	60:00	215	1,740	0	1,955	
	9	Ugashik 28-May-2000 1400.dat	3	10:01	150	35	0	185	Partial hourly count - no explanation in Sonar Adjustment Log, T. Enright on duty
		Ugashik 28-May-2000 1500.dat							No Ugashik 28-May-2000 1500.dat
	9	Ugashik 28-May-2000 1626.dat	8	33:41	1,275	395	400	2,070	Type-A corruption with false counts (I=1025, M=320, O=400)
	9	Ugashik 28-May-2000 1700.dat	15	60:00	335	1,960	0	2,295	
	9	Ugashik 28-May-2000 1800.dat	15	60:01	20	65	0	85	
	9	Ugashik 28-May-2000 1900.dat	15	60:00	105	690	680	1,475	Unexplained false count on offshore array.
	9	Ugashik 28-May-2000 2000.dat	15	60:01	3,055	600	400	4,055	Type-A corruption with false counts (I=1025, M=320, O=400)
	9	Ugashik 28-May-2000 2100.dat	15	60:00	1,595	555	0	2,150	
	9	Ugashik 28-May-2000 2200.dat	15	60:01	685	45	0	730	
	9	Ugashik 28-May-2000 2300.dat	15	60:00	730	725	0	1,455	
	9	Ugashik 29-May-2000 0000.dat	15	60:01	3,385	4,290	0	7,675	
	9	Ugashik 29-May-2000 0100.dat	15	60:00	7,545	1,735	0	9,280	
	9	Ugashik 29-May-2000 0200.dat	15	60:01	1,590	450	0	2,040	
	9	Ugashik 29-May-2000 0300.dat	15	60:01	840	1,040	0	1,880	
	9	Ugashik 29-May-2000 0400.dat	15	60:00	175	30	0	205	
	9	Ugashik 29-May-2000 0500.dat	15	60:01	0	700	0	700	
	9	Ugashik 29-May-2000 0600.dat	15	60:00	485	0	0	485	
	9	Ugashik 29-May-2000 0700.dat	15	60:01	5	0	0	5	
9	Ugashik 29-May-2000 0800.dat	15	60:00	15	35	0	50		
9	Ugashik 29-May-2000 0900.dat	15	60:01	1,525	335	400	2,260	Type-A corruption with false counts (I=1025, M=320, O=400)	
9	Ugashik 29-May-2000 1000.dat	15	60:00	15	470	0	485		
9	Ugashik 29-May-2000 1100.dat	15	60:01	1,025	330	400	1,755	Type-A corruption with false counts (I=1025, M=320, O=400)	
5/29-5/30	10	Ugashik 29-May-2000 1200.dat	15	60:00	160	15	0	175	
	10	Ugashik 29-May-2000 1300.dat	15	60:01	195	10	0	205	
	10	Ugashik 29-May-2000 1400.dat	15	60:01	110	0	70	180	Unexplained false count on offshore array.
	10	Ugashik 29-May-2000 1500.dat	15	60:00	0	25	0	25	
	10	Ugashik 29-May-2000 1600.dat	15	60:01	1,155	1,075	0	2,230	Smolt counter Briefly Disabled - Boat traffic
	10	Ugashik 29-May-2000 1700.dat	15	60:00	1,030	0	0	1,030	
	10	Ugashik 29-May-2000 1800.dat	15	60:01	4,770	5	0	4,775	
	10	Ugashik 29-May-2000 1900.dat	15	60:00	15,530	8,670	0	24,200	
	10	Ugashik 29-May-2000 2000.dat	15	60:01	18,355	11,740	0	30,095	
	10	Ugashik 29-May-2000 2100.dat	15	60:00	7,980	2,015	0	9,995	
	10	Ugashik 29-May-2000 2200.dat	15	60:01	14,095	16,615	0	30,710	
	10	Ugashik 29-May-2000 2300.dat	15	60:00	2,775	3,520	0	6,295	
	10	Ugashik 30-May-2000 0000.dat	15	60:01	15,065	14,750	0	29,815	
	10	Ugashik 30-May-2000 0100.dat	15	60:00	25,340	13,020	0	38,360	Smolt Counter Partially disabled - E 10 wind increasing
	10	Ugashik 30-May-2000 0200.dat	15	60:01	41,770	21,715	0	63,485	
	10	Ugashik 30-May-2000 0300.dat	15	60:01	4,060	1,455	0	5,515	Smolt Counter Mostly disabled - E 15+, wave action
	10	Ugashik 30-May-2000 0400.dat	15	60:00	0	0	0	0	Smolt counter disabled, E 10-15, waves braking in river, Bendix cts interpolated
	10	Ugashik 30-May-2000 0500.dat	15	60:01	890	2,875	0	3,765	Smolt Counter Partially disabled - E 10, some wave action
	10	Ugashik 30-May-2000 0600.dat	15	60:00	2,515	315	0	2,830	
	10	Ugashik 30-May-2000 0700.dat	15	60:01	1,075	495	400	1,970	Type-A corruption with false counts (I=1025, M=320, O=400)
10	Ugashik 30-May-2000 0800.dat	15	60:00	20	10	0	30		
10	Ugashik 30-May-2000 0900.dat	15	60:01	1,435	2,295	890	4,620	Unexplained false count on offshore array.	
10	Ugashik 30-May-2000 1000.dat	15	60:00	6,285	5,360	0	11,645		
10	Ugashik 30-May-2000 1100.dat	15	60:01	5,030	4,040	0	9,070		

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore*		
5/30-5/31	11	Ugashik 30-May-2000 1200.dat	15	60:00	6,055	3,065	0	9,120	
	11	Ugashik 30-May-2000 1300.dat	15	60:01	3,760	1,320	0	5,080	
	11	Ugashik 30-May-2000 1400.dat	15	60:01	3,050	955	0	4,005	
	11	Ugashik 30-May-2000 1500.dat	15	60:00	2,800	520	0	3,320	
	11	Ugashik 30-May-2000 1600.dat	15	60:01	5,730	1,725	0	7,455	
	11	Ugashik 30-May-2000 1700.dat	15	60:00	7,325	5,930	0	13,255	
	11	Ugashik 30-May-2000 1800.dat	15	60:01	9,250	4,245	0	13,495	
	11	Ugashik 30-May-2000 1900.dat	15	60:00	14,965	13,065	0	28,030	
	11	Ugashik 30-May-2000 2000.dat	15	60:01	7,715	9,685	0	17,400	
	11	Ugashik 30-May-2000 2100.dat	15	60:00	5,495	15,095	0	20,590	
	11	Ugashik 30-May-2000 2200.dat	15	60:01	20,385	28,465	0	48,850	
	11	Ugashik 30-May-2000 2300.dat	15	60:00	1,485	130	0	1,615	
	11	Ugashik 31-May-2000 0000.dat	15	60:01	6,320	3,310	0	9,630	
	11	Ugashik 31-May-2000 0100.dat	15	60:00	107,170	85,485	0	192,655	
	11	Ugashik 31-May-2000 0200.dat	15	60:01	217,575	272,150	0	489,725	
	11	Ugashik 31-May-2000 0300.dat	15	60:01	142,575	117,335	0	259,910	
	11	Ugashik 31-May-2000 0400.dat	15	60:00	11,300	9,655	0	20,955	
	11	Ugashik 31-May-2000 0500.dat	15	60:01	2,800	375	0	3,175	
	11	Ugashik 31-May-2000 0600.dat	15	60:00	25	870	0	895	
	11	Ugashik 31-May-2000 0700.dat	15	60:01	300	510	0	810	
11	Ugashik 31-May-2000 0800.dat	15	60:00	1,100	5,090	0	6,190		
11	Ugashik 31-May-2000 0900.dat	15	60:01	4,710	10,805	400	15,915	Type-A corruption with false counts (I=1025, M=320, O=400)	
11	Ugashik 31-May-2000 1000.dat	15	60:00	730	3,775	0	4,505		
11	Ugashik 31-May-2000 1100.dat	15	60:01	3,940	330	400	4,670	Type-A corruption with false counts (I=1025, M=320, O=400)	
5/31-6/01	12	Ugashik 31-May-2000 1200.dat	15	60:00	1,900	50	0	1,950	
	12	Ugashik 31-May-2000 1300.dat	15	60:01	2,085	1,465	400	3,950	Type-A corruption with false counts (I=1025, M=320, O=400)
	12	Ugashik 31-May-2000 1400.dat	15	60:01	22,865	16,475	10	39,350	Unexplained false count on offshore array.
	12	Ugashik 31-May-2000 1500.dat	15	60:00	3,070	2,450	575	6,095	Type-A corruption with false counts (I=1025, M=320, O=400), plus unexplained false offshore
	12	Ugashik 31-May-2000 1600.dat	15	60:01	80	1,510	0	1,590	Smolt counter mostly disabled - Velocity reading, ENE 15-20
	12	Ugashik 31-May-2000 1700.dat	15	60:00	138,125	126,580	400	265,105	Type-A corruption with false counts (I=1025, M=320, O=400)
	12	Ugashik 31-May-2000 1800.dat	15	60:01	30,970	15,510	400	46,880	Type-A corruption with false counts (I=1025, M=320, O=400)
	12	Ugashik 31-May-2000 1900.dat	15	60:00	1,170	5,175	400	6,745	Type-A corruption with false counts (I=1025, M=320, O=400)
	12	Ugashik 31-May-2000 2000.dat	15	60:01	17,665	3,775	670	22,110	Unexplained false count on offshore array.
	12	Ugashik 31-May-2000 2100.dat	15	60:00	16,680	30,535	0	47,215	
	12	Ugashik 31-May-2000 2200.dat	15	60:01	17,890	26,785	0	44,675	
	12	Ugashik 31-May-2000 2300.dat	15	60:00	12,555	39,695	0	52,250	
	12	Ugashik 01-June-2000 0000.dat	15	60:01	48,035	99,080	0	147,115	
	12	Ugashik 01-June-2000 0100.dat	15	60:00	238,335	77,875	0	316,210	
	12	Ugashik 01-June-2000 0200.dat	15	60:01	95,785	34,825	0	131,610	
	12	Ugashik 01-June-2000 0300.dat	15	60:01	10,615	33,070	400	44,085	Type-A corruption with false counts (I=1025, M=320, O=400)
	12	Ugashik 01-June-2000 0400.dat	15	60:00	3,095	19,865	0	22,960	
	12	Ugashik 01-June-2000 0500.dat	15	60:01	205	640	0	845	
	12	Ugashik 01-June-2000 0600.dat	15	60:00	490	90	0	580	
	12	Ugashik 01-June-2000 0700.dat	15	60:01	1,575	415	400	2,390	Type-A corruption with false counts (I=1025, M=320, O=400)
12	Ugashik 01-June-2000 0800.dat	15	60:00	1,170	835	400	2,405	Type-A corruption with false counts (I=1025, M=320, O=400)	
12	Ugashik 01-June-2000 0900.dat	15	60:01	135	730	0	865		
12	Ugashik 01-June-2000 1000.dat	15	60:00	1,480	585	400	2,465	Type-A corruption with false counts (I=1025, M=320, O=400)	
12	Ugashik 01-June-2000 1100.dat	15	60:01	4,675	2,195	0	6,870		

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore <sup>a</sup>		
6/01-6/02	13	Ugashik 01-June-2000 1200.dat	15	60:01	1,295	605	400	2,300	Type-A corruption with false counts (I=1025, M=320, O=400)
	13	Ugashik 01-June-2000 1300.dat	15	60:00	0	0	0	0	Smolt counter disabled - E 20-25+, bdx cts interpolated
	13	Ugashik 01-June-2000 1400.dat	15	60:01	2,525	530	400	3,455	Type-A corruption with false counts (I=1025, M=320, O=400)
	13	Ugashik 01-June-2000 1500.dat	15	60:00	3,485	755	0	4,240	Smolt counter disabled - E 15-20, white caps at mouth, bdx cts interpolated
	13	Ugashik 01-June-2000 1600.dat	15	60:01	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)
	13	Ugashik 01-June-2000 1700.dat	15	60:00	6,540	4,665	0	11,205	Smolt counter partially disabled - E 20
	13	Ugashik 01-June-2000 1800.dat	15	60:01	4,570	2,850	0	7,420	
	13	Ugashik 01-June-2000 1900.dat	15	60:00	3,570	1,900	0	5,470	
	13	Ugashik 01-June-2000 2000.dat	15	60:01	8,885	245	0	9,130	Smolt counter partially disabled - E 17, waves breaking in river
	13	Ugashik 01-June-2000 2100.dat	15	60:00	4,450	340	0	4,790	
	13	Ugashik 01-June-2000 2200.dat	15	60:01	250	55	0	305	
	13	Ugashik 01-June-2000 2300.dat	15	60:00	225	815	0	1,040	
	13	Ugashik 02-June-2000 0000.dat	15	60:01	29,505	30,840	0	60,345	
	13	Ugashik 02-June-2000 0100.dat	15	60:01	147,150	87,735	0	234,885	
	13	Ugashik 02-June-2000 0200.dat	15	60:00	336,120	129,345	0	465,465	
	13	Ugashik 02-June-2000 0300.dat	15	60:01	161,985	118,090	400	280,475	Type-A corruption with false counts (I=1025, M=320, O=400)
	13	Ugashik 02-June-2000 0400.dat	15	60:00	9,790	10,465	400	20,655	Type-A corruption with false counts (I=1025, M=320, O=400)
	13	Ugashik 02-June-2000 0500.dat	15	60:01	965	125	0	1,090	
	13	Ugashik 02-June-2000 0600.dat	15	60:00	60	0	0	60	
	13	Ugashik 02-June-2000 0700.dat	15	60:01	90	0	0	90	
	13	Ugashik 02-June-2000 0800.dat	15	60:00	925	270	0	1,195	
	13	Ugashik 02-June-2000 0900.dat	15	60:01	2,665	2,395	0	5,060	
	13	Ugashik 02-June-2000 1000.dat	15	60:00	2,805	0	0	2,805	
	13	Ugashik 02-June-2000 1100.dat	15	60:01	4,900	5,930	0	10,830	
6/02-6/03	14	Ugashik 02-June-2000 1200.dat	15	60:01	3,530	3,620	0	7,150	
	14	Ugashik 02-June-2000 1300.dat	15	60:00	5,865	59,990	0	65,855	
	14	Ugashik 02-June-2000 1400.dat	15	60:01	2,735	2,450	0	5,185	
	14	Ugashik 02-June-2000 1500.dat	15	60:00	1,940	1,665	0	3,605	
	14	Ugashik 02-June-2000 1600.dat	15	60:01	1,000	4,200	0	5,200	
	14	Ugashik 02-June-2000 1700.dat	15	60:00	1,685	1,510	0	3,195	
	14	Ugashik 02-June-2000 1800.dat	15	60:01	7,760	2,815	0	10,575	Smolt counter partially disabled - Boat traffic
	14	Ugashik 02-June-2000 1900.dat	15	60:00	4,445	315	0	4,760	
	14	Ugashik 02-June-2000 2000.dat	15	60:01	445	815	0	1,260	
	14	Ugashik 02-June-2000 2100.dat	15	60:00	3,575	1,905	400	5,880	Type-A corruption with false counts (I=1025, M=320, O=400)
	14	Ugashik 02-June-2000 2200.dat	15	60:01	5,180	3,815	0	8,995	
	14	Ugashik 02-June-2000 2300.dat	15	60:00	2,870	5,730	0	8,600	
	14	Ugashik 03-June-2000 0000.dat	15	00:01	0	0	0	0	Software only recorded for 1 second,
	14	Ugashik 03-June-2000 0100.dat	15	60:01	42,445	56,125	400	98,970	Type-A corruption with false counts (I=1025, M=320, O=400)
	14	Ugashik 03-June-2000 0200.dat	15	60:00	208,470	188,485	0	396,955	
	14	Ugashik 03-June-2000 0300.dat	15	60:01	30,105	58,480	400	88,985	Type-A corruption with false counts (I=1025, M=320, O=400)
	14	Ugashik 03-June-2000 0400.dat	15	60:00	6,675	7,915	0	14,590	
	14	Ugashik 03-June-2000 0500.dat	15	60:01	515	460	0	975	
	14	Ugashik 03-June-2000 0600.dat	15	60:00	170	195	0	365	
	14	Ugashik 03-June-2000 0700.dat	15	60:01	2,675	450	400	3,525	Type-A corruption with false counts (I=1025, M=320, O=400)
	14	Ugashik 03-June-2000 0800.dat	15	60:00	200	235	0	435	
	14	Ugashik 03-June-2000 0900.dat	15	60:01	2,500	1,270	585	4,355	Type-A corruption with false counts (I=1025, M=320, O=400)
	14	Ugashik 03-June-2000 1000.dat	15	60:00	2,875	1,795	0	4,670	
	14	Ugashik 03-June-2000 1100.dat	15	60:01	1,885	635	400	2,920	Type-A corruption with false counts (I=1025, M=320, O=400)

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments	
					Inshore	Middle	Offshore*			
6/03-6/04	15	Ugashik 03-June-2000 1200.dat	15	60:01	7,970	11,745	0	19,715	Smolt counter partially disabled - E 15-18, dwn .25	
	15	Ugashik 03-June-2000 1300.dat	15	60:00	0	0	0	0	Smolt counter disabled - E 20-25+, unable to tell true counts, bdx cts interpolated	
	15	Ugashik 03-June-2000 1400.dat	15	60:01	285	380	0	665	Smolt counter briefly disabled, E 10 -15	
	15	Ugashik 03-June-2000 1500.dat	15	60:00	2,455	390	0	2,845		
	15	Ugashik 03-June-2000 1600.dat	15	60:01	1,275	3,325	0	4,600	Smolt counter briefly disabled, E 10 -15	
	15	Ugashik 03-June-2000 1700.dat	15	60:00	260	100	0	360	Smolt counter disabled - E 20-25+, bdx cts interpolated	
	15	Ugashik 03-June-2000 1800.dat	15	60:01	0	0	0	0	Smolt counter disabled - E 20-25+, bdx cts interpolated	
	15	Ugashik 03-June-2000 1900.dat	15	60:00	0	0	0	0	Smolt counter disabled - ENE 1, wind diminishing, bdx cts interpolated	
	15	Ugashik 03-June-2000 2000.dat	15	60:01	1,935	675	400	3,010	Type-A corruption with false counts (I=1025, M=320, O=400)	
	15	Ugashik 03-June-2000 2100.dat	15	60:00	1,120	1,495	0	2,615		
	15	Ugashik 03-June-2000 2200.dat	15	60:01	6,335	605	400	7,340	Type-A corruption with false counts (I=1025, M=320, O=400)	
	15	Ugashik 03-June-2000 2300.dat	15	60:01	1,350	190	0	1,540		
	15	Ugashik 04-June-2000 0000.dat	15	60:00	14,230	5,285	400	19,915	Type-A corruption with false counts (I=1025, M=320, O=400)	
	15	Ugashik 04-June-2000 0100.dat	15	60:01	29,755	12,115	0	41,870		
	15	Ugashik 04-June-2000 0200.dat	15	60:00	24,195	3,885	0	28,080		
	15	Ugashik 04-June-2000 0300.dat	15	60:01	13,435	2,230	0	15,665		
	15	Ugashik 04-June-2000 0400.dat	15	60:00	2,625	1,640	0	4,265		
	15	Ugashik 04-June-2000 0500.dat	15	60:01	20	30	0	50		
	15	Ugashik 04-June-2000 0600.dat	15	60:00	1,050	585	400	2,035	Type-A corruption with false counts (I=1025, M=320, O=400)	
	15	Ugashik 04-June-2000 0700.dat	15	60:01	5	360	0	365		
15	Ugashik 04-June-2000 0800.dat	15	60:00	1,680	350	400	2,430	Type-A corruption with false counts (I=1025, M=320, O=400)		
15	Ugashik 04-June-2000 0900.dat	15	60:01	160	5	0	165			
15	Ugashik 04-June-2000 1000.dat	15	60:01	1,120	325	400	1,845	Type-A corruption with false counts (I=1025, M=320, O=400)		
15	Ugashik 04-June-2000 1100.dat	15	60:00	0	70	0	70			
6/04-6/05	16	Ugashik 04-June-2000 1200.dat	15	60:01	3,565	280	0	3,845	Smolt counter not disabled - boat traffic, bdx cts interpolated	
	16	Ugashik 04-June-2000 1300.dat	15	60:00	7,950	16,305	0	24,255	Smolt counter not disabled - boat traffic, bdx cts interpolated	
	16	Ugashik 04-June-2000 1400.dat	15	60:01	1,545	350	400	2,295	Type-A corruption with false counts (I=1025, M=320, O=400)	
	16	Ugashik 04-June-2000 1500.dat	15	60:00	219,995	68,480	85,600	374,075	Type-A corruptions (n=214) with false counts (I=1025, M=320, O=400); corresponded w/ boat traffic	
	16	Ugashik 04-June-2000 1600.dat	15	60:01	1,465	345	400	2,210	Type-A corruption with false counts (I=1025, M=320, O=400)	
	16	Ugashik 04-June-2000 1700.dat	15	60:00	45	830	0	875		
	16	Ugashik 04-June-2000 1800.dat	15	60:01	8,625	6,700	400	15,725	Type-A corruption with false counts (I=1025, M=320, O=400)	
	16	Ugashik 04-June-2000 1900.dat	15	60:00	3,435	2,760	0	6,195		
	16	Ugashik 04-June-2000 2000.dat	15	60:01	3,530	4,875	0	8,405		
	16	Ugashik 04-June-2000 2100.dat	29	120:01	7,950	4,290	0	12,240	Type-B corruption, false counts from 22:00:05 to 22:00:23 discounted.	
			Ugashik 04-June-2000 2200.dat			7,195	1,140	0	8,335	No Ugashik4-Jun-2000 2200.dat. 2200 hr cnts appended to Ugashik 4-Jun-2000 2100.dat file
	16	Ugashik 04-June-2000 2300.dat	15	60:01	17,280	21,885	400	39,565	Type-A corruption with false counts (I=1025, M=320, O=400)	
	16	Ugashik 05-June-2000 0000.dat	15	60:00	8,785	18,285	0	27,070		
	16	Ugashik 05-June-2000 0100.dat	15	60:01	79,715	53,470	400	133,585	Type-A corruption with false counts (I=1025, M=320, O=400)	
	16	Ugashik 05-June-2000 0200.dat	15	60:00	105,485	29,360	20	134,865	Unexplained false count on offshore array.	
	16	Ugashik 05-June-2000 0300.dat	15	60:01	13,695	3,615	0	17,310		
	16	Ugashik 05-June-2000 0400.dat	15	60:00	75	380	0	455		
	16	Ugashik 05-June-2000 0500.dat	15	60:01	0	115	0	115		
	16	Ugashik 05-June-2000 0600.dat	15	60:00	0	355	0	355		
	16	Ugashik 05-June-2000 0700.dat	15	60:01	1,055	905	400	2,360	Type-A corruption with false counts (I=1025, M=320, O=400)	
16	Ugashik 05-June-2000 0800.dat	15	60:00	420	130	0	550			
16	Ugashik 05-June-2000 0900.dat	15	60:01	0	935	675	1,610	Unexplained false count on offshore array.		
16	Ugashik 05-June-2000 1000.dat	15	60:01	40	545	0	585			
16	Ugashik 05-June-2000 1100.dat	15	60:00	2,505	2,195	400	5,100	Type-A corruption with false counts (I=1025, M=320, O=400)		

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments	
					Inshore	Middle	Offshore <sup>a</sup>			
6/05-6/06	17	Ugashik 05-June-2000 1200.dat	15	60:01	3,065	925	0	3,990	Smolt counter partially disabled - boat traffic, W 9	
	17	Ugashik 05-June-2000 1300.dat	15	60:00	395	620	0	1,015	Smolt counter briefly disabled - boat traffic, W 10-15	
	17	Ugashik 05-June-2000 1400.dat	15	60:01	1,225	1,120	0	2,345	Smolt counter briefly disabled - boat traffic, W 10-15	
	17	Ugashik 05-June-2000 1500.dat	15	60:00	2,105	520	400	3,025	Type-A corruption with false counts (I=1025, M=320, O=400)	
	17	Ugashik 05-June-2000 1600.dat	15	60:01	1,505	325	0	1,830		
	17	Ugashik 05-June-2000 1700.dat	15	60:00	2,780	850	0	3,630	Smolt counter briefly disabled - boat traffic, W 6-10	
	17	Ugashik 05-June-2000 1800.dat	15	60:01	25	125	0	150		
	17	Ugashik 05-June-2000 1900.dat	15	60:00	2,375	3,770	0	6,145		
	17	Ugashik 05-June-2000 2000.dat	15	60:01	0	2,895	0	2,895	Smolt counter briefly disabled - boat traffic, W 7	
	17	Ugashik 05-June-2000 2100.dat	15	60:01	9,010	3,420	0	12,430		
	17	Ugashik 05-June-2000 2200.dat	15	60:00	990	4,165	0	5,155		
	17	Ugashik 05-June-2000 2300.dat	15	60:01	4,605	12,050	0	16,655		
	17	Ugashik 06-June-2000 0000.dat	15	60:00	66,885	31,775	400	99,060	Type-A corruption with false counts (I=1025, M=320, O=400)	
	17	Ugashik 06-June-2000 0100.dat	15	60:01	61,420	18,750	0	80,170		
	17	Ugashik 06-June-2000 0200.dat	15	60:00	15,510	7,235	400	23,145	Type-A corruption with false counts (I=1025, M=320, O=400)	
	17	Ugashik 06-June-2000 0300.dat	15	60:01	23,700	7,545	0	31,245		
	17	Ugashik 06-June-2000 0400.dat	15	60:00	2,970	1,155	400	4,525	Type-A corruption with false counts (I=1025, M=320, O=400)	
	17	Ugashik 06-June-2000 0500.dat	15	60:01	5	105	0	110		
	17	Ugashik 06-June-2000 0600.dat	15	60:00	5	25	0	30		
	17	Ugashik 06-June-2000 0700.dat	15	60:01	35	85	0	120		
	17	Ugashik 06-June-2000 0800.dat	15	60:00	5	5	0	10		
	17	Ugashik 06-June-2000 0900.dat	15	60:01	400	0	0	400		
	17	Ugashik 06-June-2000 1000.dat	15	60:01	1,215	295	0	1,510		
	17	Ugashik 06-June-2000 1100.dat	15	60:00	0	0	0	0	Smolt counter disabled - E 20, bdx cts interpolated	
	6/06-6/07	18	Ugashik 06-June-2000 1200.dat	17		0	0	0	0	Smolt counter disabled - E 25-35+, breakers, bdx cts interpolated
			Ugashik 06-June-2000 1300.dat			0	0	0	0	Smolt counter disabled - E 25-35+, breakers, unable to interpolate
			Ugashik 06-June-2000 1400.dat			0	0	0	0	Smolt counter disabled - E 25-35+, breakers, unable to interpolate
		Ugashik 06-June-2000 1500.dat			0	0	0	0	Smolt counter disabled - E 25-35+, breakers, bdx cts interpolated	
		Ugashik 06-June-2000 1600.dat			0	0	0	0	Smolt counter disabled - E 35-40 w/gusts, waves in river, bdx cts interpolated	
		Ugashik 06-June-2000 1700.dat			0	0	0	0	Smolt counter disabled - E 35-40 w/gusts, waves in river, bdx cts interpolated	
		Ugashik 06-June-2000 1800.dat			0	0	0	0	Smolt counter disabled - E 35-40 w/gusts, waves in river, bdx cts interpolated	
		Ugashik 06-June-2000 1900.dat			0	0	0	0	Smolt counter disabled - E 35-40 w/gusts, waves in river, bdx cts interpolated	
		Ugashik 06-June-2000 2000.dat			0	0	0	0	Smolt counter disabled - E 35-40 w/gusts, waves in river, bdx cts interpolated	
		Ugashik 06-June-2000 2100.dat			0	0	0	0	Smolt counter disabled - E 35-40 w/gusts, waves in river, bdx cts interpolated	
		Ugashik 06-June-2000 2200.dat			0	0	0	0	Smolt counter disabled - E 35-40 w/gusts, waves in river, bdx cts interpolated	
		Ugashik 06-June-2000 2300.dat			0	0	0	0	Smolt counter disabled - E 40-60 w/gusts, breakers, bdx cts interpolated	
		Ugashik 07-June-2000 0000.dat			0	0	0	0	Smolt counter disabled - E 35-45 w gusts,fyke net not set, bdx cts interpolated	
		Ugashik 07-June-2000 0100.dat			0	0	0	0	Smolt counter disabled - E 35-45w gusts, bdx cts interpolated	
		Ugashik 07-June-2000 0200.dat			0	0	0	0	Smolt counter disabled - E 35-45w gusts, bdx cts interpolated	
		Ugashik 07-June-2000 0300.dat			0	0	0	0	Smolt counter disabled - E 20-30,wind subsiding, bdx cts interpolated	
		Ugashik 07-June-2000 0400.dat			0	0	0	0	Smolt counter disabled - E 20-30,wind subsiding, bdx cts interpolated	
		Ugashik 07-June-2000 0500.dat			0	0	0	0	Smolt counter disabled - E 15-20, bdx cts interpolated	
		Ugashik 07-June-2000 0600.dat			0	0	0	0	Smolt counter disabled - E 15-20, bdx cts interpolated	
		Ugashik 07-June-2000 0700.dat			0	0	0	0	Smolt counter disabled - ENE 15-20, bdx cts interpolated	
		Ugashik 07-June-2000 0800.dat			0	0	0	0	Smolt counter disabled - ENE 15-20, bdx cts interpolated	
		Ugashik 07-June-2000 0900.dat			0	0	0	0	Smolt counter disabled - ENE 15-20, bdx cts interpolated	
		Ugashik 07-June-2000 1000.dat			0	0	0	0	Smolt counter mostly disabled - E 18-20, still lots of air present	
		Ugashik 07-June-2000 1100.dat			0	0	0	0	E 20, dwn .20 may have some debris false counts	

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore*		
6/07-6/08	19	Ugashik 07-June-2000 1232.dat	7	27:25	4,265	2,415	0	6,680	E 20-25, debris in water
	19	Ugashik 07-June-2000 1300.dat	15	60:00	0	0	0	0	Smolt counter disabled - E 20-25, debris and lt rain, bdx cts interpolated
	19	Ugashik 07-June-2000 1400.dat	15	60:01	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)
	19	Ugashik 07-June-2000 1500.dat	15	60:01	1,065	505	0	1,670	Smolt counter disabled - E 15-20, debris and lt rain, bdx cts interpolated
	19	Ugashik 07-June-2000 1600.dat	15	60:00	3,480	2,170	0	5,650	Smolt counter partially disabled - E 20-25
	19	Ugashik 07-June-2000 1700.dat	15	60:01	9,940	2,300	0	12,740	Smolt counter disabled - E 20-25, bdx cts interpolated
	19	Ugashik 07-June-2000 1800.dat	15	60:00	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)
	19	Ugashik 07-June-2000 1900.dat	15	60:01	0	0	0	0	Smolt counter disabled - ENE 10, heavy rain, bdx cts interpolated
	19	Ugashik 07-June-2000 2000.dat	15	60:00	0	0	0	0	Smolt counter disabled - ENE 10, heavy rain, bdx cts interpolated
	19	Ugashik 07-June-2000 2100.dat	15	60:01	0	0	0	0	Smolt counter disabled - ENE 10, heavy rain, bdx cts interpolated
	19	Ugashik 07-June-2000 2200.dat	15	60:00	750	2,005	0	2,755	Smolt counter partially disabled - ENE 10, lt rain
	19	Ugashik 07-June-2000 2300.dat	15	60:01	55	1,300	0	1,355	
	19	Ugashik 08-June-2000 0000.dat	15	60:00	580	850	0	1,430	
	19	Ugashik 08-June-2000 0100.dat	15	60:01	1,035	1,655	0	2,690	
	19	Ugashik 08-June-2000 0200.dat	15	60:01	790	2,260	0	3,050	Smolt counter briefly disabled - NE 5-10, lt rain
	19	Ugashik 08-June-2000 0300.dat	15	60:00	15	10	0	25	Smolt counter mostly disabled - rain
	19	Ugashik 08-June-2000 0400.dat	15	60:01	0	510	0	510	
	19	Ugashik 08-June-2000 0500.dat	15	60:00	1,055	470	400	1,925	Type-A corruption with false counts (I=1025, M=320, O=400)
	19	Ugashik 08-June-2000 0600.dat	15	60:01	15	60	0	75	
	19	Ugashik 08-June-2000 0700.dat	15	60:00	10	115	0	125	
19	Ugashik 08-June-2000 0800.dat	15	60:01	660	55	0	715		
19	Ugashik 08-June-2000 0900.dat	15	60:00	1,050	710	400	2,160	Type-A corruption with false counts (I=1025, M=320, O=400)	
19	Ugashik 08-June-2000 1000.dat	15	60:01	0	0	315	315	Unexplained false count on offshore array	
19	Ugashik 08-June-2000 1100.dat	15	60:00	1,025	705	410	2,140	Type-A corruption with false counts (I=1025, M=320, O=400) plus unexplained false offshore	
6/08-6/09	20	Ugashik 08-June-2000 1200.dat	15	60:01	4,135	1,335	1,600	7,070	Type-A corruption with false counts (I=1025, M=320, O=400)
	20	Ugashik 08-June-2000 1300.dat	15	60:00	160	630	0	790	Smolt counter mostly disabled - plane traffic, ESE 5
	20	Ugashik 08-June-2000 1400.dat	15	60:01	170	1,175	0	1,345	
	20	Ugashik 08-June-2000 1500.dat	15	60:01	25	60	0	85	Smolt counter briefly disabled - boat traffic, check array position
	20	Ugashik 08-June-2000 1600.dat	15	60:00	5	50	0	55	Smolt counter partially disabled - Velocity reading
	20	Ugashik 08-June-2000 1700.dat	15	60:01	255	455	0	710	Smolt counter partially disabled - SW 5, heavy rain
	20	Ugashik 08-June-2000 1800.dat	15	60:00	270	1,440	0	1,710	Smolt counter mostly disabled - SW 5, heavy rain
	20	Ugashik 08-June-2000 1900.dat	15	60:01	1,565	17,135	400	19,100	Type-A corruption with false counts (I=1025, M=320, O=400)
	20	Ugashik 08-June-2000 2000.dat	15	60:00	1,195	175	0	1,370	Smolt counter partially disabled - WSW 9, heavy rain
	20	Ugashik 08-June-2000 2100.dat	15	60:01	2,845	4,375	0	7,220	
	20	Ugashik 08-June-2000 2200.dat	15	60:00	1,375	810	400	2,585	Type-A corruption with false counts (I=1025, M=320, O=400)
	20	Ugashik 08-June-2000 2300.dat	15	60:01	980	615	0	1,595	
	20	Ugashik 09-June-2000 0000.dat	15	60:00	6,840	2,340	0	9,180	
	20	Ugashik 09-June-2000 0100.dat	15	60:01	15,490	3,440	400	19,330	Type-A corruption with false counts (I=1025, M=320, O=400)
	20	Ugashik 09-June-2000 0200.dat	15	60:01	1,710	2,500	0	4,210	
	20	Ugashik 09-June-2000 0300.dat	15	60:00	435	185	0	620	
	20	Ugashik 09-June-2000 0400.dat	15	60:01	35	125	390	550	Unexplained false count on offshore array
	20	Ugashik 09-June-2000 0500.dat	15	60:00	530	215	0	745	
	20	Ugashik 09-June-2000 0600.dat	15	60:01	1,055	715	400	2,170	Type-A corruption with false counts (I=1025, M=320, O=400)
	20	Ugashik 09-June-2000 0700.dat	15	60:00	95	890	0	985	
20	Ugashik 09-June-2000 0800.dat	15	60:01	20	645	0	665		
20	Ugashik 09-June-2000 0900.dat	15	60:00	15	55	185	255	Unexplained false count on offshore array	
20	Ugashik 09-June-2000 1000.dat	15	60:01	1,060	870	400	2,330	Type-A corruption with false counts (I=1025, M=320, O=400)	
20	Ugashik 09-June-2000 1100.dat	15	60:00	1,520	225	0	1,745		

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore*		
6/09-6/10	21	Ugashik 09-June-2000 1200.dat	15	60:01	1,045	360	400	1,805	Type-A corruption with false counts (I=1025, M=320, O=400)
	21	Ugashik 09-June-2000 1300.dat	15	60:00	3,680	2,835	0	6,515	
	21	Ugashik 09-June-2000 1400.dat	15	60:01	300	1,220	0	1,520	
	21	Ugashik 09-June-2000 1500.dat	15	60:01	1,295	1,470	0	2,765	
	21	Ugashik 09-June-2000 1600.dat	15	60:00	0	2,145	0	2,145	
	21	Ugashik 09-June-2000 1700.dat	15	60:01	1,450	180	0	1,630	
	21	Ugashik 09-June-2000 1800.dat	15	60:00	520	385	0	905	
	21	Ugashik 09-June-2000 1900.dat	15	60:01	95	440	0	535	Smolt counter briefly disabled - NE 10, rain
	21	Ugashik 09-June-2000 2000.dat	15	60:00	1,975	420	400	2,795	Type-A corruption with false counts (I=1025, M=320, O=400)
	21	Ugashik 09-June-2000 2100.dat	15	60:01	1,475	1,045	400	2,920	Type-A corruption with false counts (I=1025, M=320, O=400)
	21	Ugashik 09-June-2000 2200.dat	15	60:00	15	220	0	235	
	21	Ugashik 09-June-2000 2300.dat	15	60:01	3,590	2,430	400	6,420	Type-A corruption with false counts (I=1025, M=320, O=400)
	21	Ugashik 10-June-2000 0000.dat	15	60:00	9,375	19,905	0	29,280	
	21	Ugashik 10-June-2000 0100.dat	15	60:01	20,970	21,575	0	42,545	
	21	Ugashik 10-June-2000 0200.dat	15	60:01	31,825	23,795	0	55,620	
	21	Ugashik 10-June-2000 0300.dat	15	60:00	20,330	17,845	240	38,415	Unexplained false count on offshore array
	21	Ugashik 10-June-2000 0400.dat	15	60:01	1,830	845	400	3,075	Type-A corruption with false counts (I=1025, M=320, O=400)
	21	Ugashik 10-June-2000 0500.dat	15	60:00	105	90	0	195	
	21	Ugashik 10-June-2000 0600.dat	15	60:01	175	190	0	365	
	21	Ugashik 10-June-2000 0700.dat	15	60:00	95	105	0	200	
	21	Ugashik 10-June-2000 0800.dat	15	60:01	1,165	845	400	2,410	Type-A corruption with false counts (I=1025, M=320, O=400)
21	Ugashik 10-June-2000 0900.dat	15	60:00	60	1,235	0	1,295		
21	Ugashik 10-June-2000 1000.dat	15	60:01	425	720	0	1,145		
21	Ugashik 10-June-2000 1100.dat	15	60:00	3,590	2,840	0	6,430		
6/10-6/11	22	Ugashik 10-June-2000 1200.dat	15	60:01	2,570	240	0	2,810	
	22	Ugashik 10-June-2000 1300.dat	15	60:00	1,095	385	0	1,480	Smolt counter partially disabled - E 20-25
	22	Ugashik 10-June-2000 1400.dat	15	60:01	70	15	0	85	Smolt counter mostly disabled - E 20-25
	22	Ugashik 10-June-2000 1500.dat	15	60:01	150	45	0	195	Smolt counter partially disabled - E 20-25
	22	Ugashik 10-June-2000 1600.dat	15	60:00	3,400	1,080	400	4,880	Type-A corruption with false counts (I=1025, M=320, O=400)
	22	Ugashik 10-June-2000 1700.dat	15	60:01	790	315	0	1,105	
	22	Ugashik 10-June-2000 1800.dat	15	60:00	435	1,615	0	2,050	
	22	Ugashik 10-June-2000 1900.dat	15	60:01	0	210	0	210	
	22	Ugashik 10-June-2000 2000.dat	15	60:00	55	915	0	970	
	22	Ugashik 10-June-2000 2100.dat	15	60:01	10	400	0	410	
	22	Ugashik 10-June-2000 2200.dat	15	60:00	140	520	0	660	
	22	Ugashik 10-June-2000 2300.dat	15	60:01	0	0	0	0	
	22	Ugashik 11-June-2000 0000.dat	15	60:00	265	1,725	0	1,990	
	22	Ugashik 11-June-2000 0100.dat	15	60:01	5,975	7,140	0	13,115	
	22	Ugashik 11-June-2000 0200.dat	15	60:01	18,650	16,370	0	35,020	
	22	Ugashik 11-June-2000 0300.dat	15	60:00	2,270	4,370	0	6,640	
	22	Ugashik 11-June-2000 0400.dat	15	60:01	140	655	0	795	
	22	Ugashik 11-June-2000 0500.dat	15	60:00	75	140	0	215	
	22	Ugashik 11-June-2000 0600.dat	15	60:01	190	785	0	975	
	22	Ugashik 11-June-2000 0700.dat	15	60:00	10	65	0	75	
	22	Ugashik 11-June-2000 0800.dat	15	60:01	775	800	505	2,080	Unexplained false count on offshore array
	22	Ugashik 11-June-2000 0900.dat	15	60:00	15	235	0	250	
22	Ugashik 11-June-2000 1000.dat	15	60:01	10	0	0	10		
22	Ugashik 11-June-2000 1100.dat	29	120:01	1,700	665	400	2,765	Type-A and -B corruptions, false counts from 12:00:05 to 12:00:15 discounted.	

Smolt Day (m/dd-m/dd)	Diskette Number	Files Names (location, date, and time)	File Size (KB)	Recording Time (min:sec)	Total Count by Array			Total Count (all arrays)	Comments
					Inshore	Middle	Offshore <sup>a</sup>		
6/11-6/12		Ugashik 11-June-2000 1200.dat			0	240	0	240	No Ugashik 11-Jun-2000 1200.dat. 1200 hr crts appended to Ugashik 11-Jun-2000 1100.dat file
	23	Ugashik 11-June-2000 1300.dat	15	60:01	10	95	0	105	Smolt counter briefly disabled - Heavy rain, E 7
	23	Ugashik 11-June-2000 1400.dat	15	60:00	760	330	0	1,090	
	23	Ugashik 11-June-2000 1500.dat	15	60:01	585	445	0	1,030	
	23	Ugashik 11-June-2000 1600.dat	15	60:00	1,245	2,205	0	3,450	
	23	Ugashik 11-June-2000 1700.dat	15	60:01	1,485	255	0	1,740	
	23	Ugashik 11-June-2000 1800.dat	15	60:00	355	1,165	0	1,520	
	23	Ugashik 11-June-2000 1900.dat	15	60:01	45	175	0	220	
	23	Ugashik 11-June-2000 2000.dat	15	60:00	1,065	675	400	2,140	Type-A corruption with false counts (I=1025, M=320, O=400)
	23	Ugashik 11-June-2000 2100.dat	15	60:01	20	645	0	665	
	23	Ugashik 11-June-2000 2200.dat	15	60:00	415	260	0	675	
	23	Ugashik 11-June-2000 2300.dat	15	60:01	600	325	0	925	
	23	Ugashik 12-June-2000 0000.dat	15	60:01	2,770	1,305	400	4,475	Type-A corruption with false counts (I=1025, M=320, O=400)
	23	Ugashik 12-June-2000 0100.dat	15	60:00	1,665	5,000	0	6,665	
	23	Ugashik 12-June-2000 0200.dat	15	60:01	1,875	1,680	400	3,955	Type-A corruption with false counts (I=1025, M=320, O=400)
	23	Ugashik 12-June-2000 0300.dat	15	60:00	25	445	0	470	Smolt counter mostly disabled - NNE 12
	23	Ugashik 12-June-2000 0400.dat	15	60:01	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)
	23	Ugashik 12-June-2000 0500.dat	15	60:00	1,015	185	0	1,200	Smolt counter briefly disabled - NE 10-15, lt rain
	23	Ugashik 12-June-2000 0600.dat	15	60:01	380	265	0	645	Smolt counter partially disabled - NE 16, lt rain
	23	Ugashik 12-June-2000 0700.dat	15	60:00	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)
	23	Ugashik 12-June-2000 0800.dat	15	60:01	0	0	0	0	Smolt counter disabled - E 20-25, rain, bdx cts interpolated
	23	Ugashik 12-June-2000 0900.dat	15	60:00	1,025	320	400	1,745	Type-A corruption with false counts (I=1025, M=320, O=400)
	23	Ugashik 12-June-2000 1000.dat	15	60:01	0	0	0	0	Smolt counter disabled - E 20-25, rain, bdx cts interpolated
	23	Ugashik 12-June-2000 1100.dat	15	60:01	0	0	0	0	Smolt counter disabled - E 20-25, rain, bdx cts interpolated

<sup>a</sup> Due to the narrow wide of the Ugashik River at the smolt sonar site, only two arrays of transducers are used. Counts are collected on the inshore and middle arrays only. Therefore, all offshore array counts in this data set are false.

Appendix E.3. January 3, 2001 correspondence from Ed Belcher, Applied Physics Laboratory, University of Washington to Suzanne Maxwell and Drew Crawford, Alaska Department of Fish and Game entitled: Analysis of Type A and Type B errors and update of Smolt Counter Interface Software.

3 January 2001

To: Suzanne Maxwell and Drew Crawford  
From: Ed Belcher, Applied Physics Laboratory, University of Washington  
Subj: Analysis of Type A and Type B errors and update of Smolt Counter Interface Software

**Analysis of topside software used in May-June 00 data collection**  
Drew Crawford reported two types of errors in the field. Type A (incorrect data entries that almost always had a status code value of 77) and Type B (files that were longer than one hour and had spurious data near the beginning of the second hour).

Three laptop computers were sent to APL-UW. Two of them were used in the field during the May-June 00 collection. The third was not used because the third smolt counter with interface was not functioning.

We connected the two laptops used in the field to a smolt counter interface that was activated by a pulse generator. We were able to duplicate the data errors seen in the field. Bill Hanot then altered the software to eliminate erroneous data from being recorded. The modified software was tested using the same methods that generated errors in the original software. The modified software (Version 2.0) passed the tests. It should provide error-free files in May-June 01 and beyond.

First we outline the errors we saw when using the original software in each of the two computers used in the field in 2000.

**1) Host Latitude Cpi AK Prop # 11-39152**

Problem areas:

*a) Suspend*

If the computer is put into "suspend," it will stop queries to the counter interface and will generate code 77 data when taken out of suspend.

*b) Mouse at top of Smolt counter window*

If one places the mouse arrow on the top window bar of the smolt counter window and then holds down the left button, the clock at the top left of window will not update. When the button is released, the clock quickly updates and code 77 data are written. Short hold (clicks) cause no harm. If holds are 1 sec or longer then clock stops and bad data can be written. If the mouse arrow is anywhere but on the top bar, it does not cause harm to hold down the mouse button.

*c) Clock stopped but no bad data writes*

Moving an Explorer window back and forth with mouse arrow caused no data to write but it did stop the posting of clock updates to the window.

*d) Conversion*

Conversion of all \*.dat files to \*.txt files causes Code 77 errors on current file (if recording on current file while converting past files).

*e) File length*

When left alone, the computer made and stored 18 consecutive one-hour files with correct counts and correct code. All files were either 3600 or 3601 seconds long. When we approached 10:00am, I put the mouse arrow on the smolt counter window bar and held down the left button. The application clock stopped as time passed through the top of the hour. A new file was NOT formed. The old file continued and ended when the computer was left alone at 11:00am. The two-hour file did have false data in it at the beginning of the second hour. Its status code line had 116, 117, 114, 116, 103, 105, 51, 99, 48, 57, 116, etc. Bill Hanot suspects this was caused because the extra long file was unexpected and was writing in memory space allocated to another application. The other application wrote over the data in the smolt counter file.

**No problems:**

a) When using the mouse on applications outside of smolt counter.

For example, holding the mouse down to scroll in Wordpad did not cause a problem.

b) Dragging files in Explorer to copy on disk and the copying on disk did not cause bad data to be written in current file. It did cause some slowing of posting clock times.

c) Using Wordpad to look at 18 text files did not cause a problem. I loaded files, scrolled files up and down the window.

d) Closing the top.

The Latitude Cpi does not go to sleep when the top is closed. It keeps sending update requests to the counter and continues to receive the data properly. The data are plotted properly and filed properly with the top closed.

**2) Inspiron 7000 AK 10101129**

Ways to get bad data:

a) *Holding left button down with arrow on top of smolt counter window bar* causes the application clock to stop and code 77 data to be written to the file being recorded. Holding the mouse button down when arrow is in application but not on top bar does not cause a problem. Resizing the window sometimes causes bad data to be written.

b) *Conversion of \*.dat files to \*.txt files* causes the clock updates to stop and Code 77 data to be written.

c) *Closing the lid put the computer in some sort of sleep mode that turns off the RS232 link to the counter. We hooked up a scope to the link and closed the lid. The data traffic stopped. When the lid was opened, the computer went through a 'wake up' sequence that generated Code 77 data. Thus the data are not generated when computer is asleep but as it awakens.*

d) *Resizing the smolt counter window can cause bad data.*

e) *Ways to get longer than one-hour files*

Hold down mouse button with arrow on smolt counter window bar as the clock goes through a "top of the hour." This means if the smolt counter 1-second checks of the clock are interrupted by other computer activity, the check will miss the top of the hour and not make a new file until the next top of the hour. When left alone, the computer begins a new file each hour.

No problems were seen when:

- a) I used Wordpad to look at 20 previously recorded one-hour files while recording. No bad data were recorded and the clock updated very regularly.
- b) The 20 files had no errors and were between 3600 and 3601 seconds long when the computer was not used for other activities.
- c) Data transfer from disk to floppy using Explorer did not cause any bad data to be written.

**3) Latitude CS      This computer did not collect data with the old software and was not tested with old software.**

### **Analysis of updated NEW Smolt Counter Software (Version 2.0 dated December 18, 2000)**

The new software was tested on the Inspiron 7000 and the Latitude Cpi. Both computers gave the results described below:

- a) **Recorded counts are now machine counts**, NOT multiplied by 5.
- b) **New files are written with a time stamp** in first column. For example if a file were started at 14:35:24, the text file would look like:

35:24	1	0	0	0
35:25	2	1	0	0
35:26	2	1	0	0
35:27	0	0	0	0

.  
. .  
.

If someone is working on the computer and keeps interrupts from initiating data queries to the smolt counter, the timestamps will show the discontinuities:

35:27	0	10	0	0
35:28	0	10	0	0
35:32	0	40	0	0
35:33	0	10	0	0
35:34	0	10	0	0

In the above case, the hardware counter is getting a constant 10 counts/s in the center array. The interrupts were inhibited for four seconds. The counter interface in the smolt counter hardware continues to accumulate the counts. When it is finally asked the count after 4 seconds, it reports 40. The sum of the counts remains correct even though the responses did not come each second. Rejecting all other responses within the same second eliminates spurious data (Code 77 data).

c) **The updated software starts a new file each hour** (within a few seconds) no matter how much time other applications are taking. The computer checks for the "top of the hour" and checks if the file has more than 3600 entries (the number of seconds in one hour). When the number of lines exceed 3600, a new file is made no matter what time it is.

d) **The updated software does not write spurious data into the files.**

Spurious data occurs when the pent-up interrupts are let loose and interrogate the RS232 link as fast as the computer allows. The new software checks the frequency of responses. It does not take more than one response per second. Fortunately, the response to the first pent-up interrupt is correct, the remaining responses are gibberish. The software ignores them. The result is that files may have multi-second spaces between responses but the hardware in the counter continues to accumulate properly so the total count will be correct. See above for examples of counter files when the counter is going at a constant 10 counts/s.

e) **The new software is still able to convert files from the May-June-00 data.**

The older data files do not have time stamps. When converted the files have a line counter in the first column. For example:

0000	1	0	0	0
0001	2	1	0	0
0002	2	1	0	0
0003	0	0	0	0

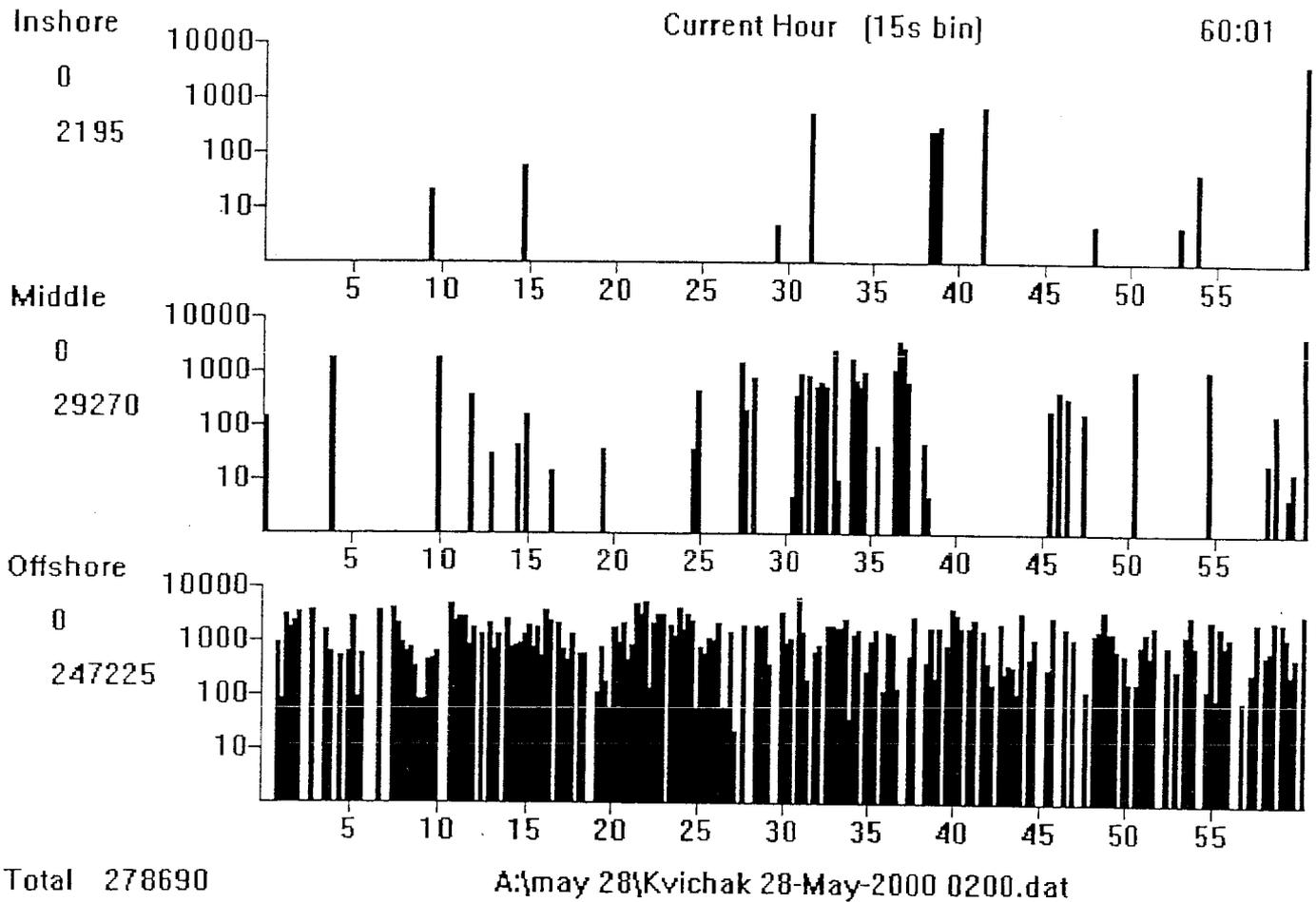
The numbers are consecutive and do not have gaps when interrupts are prevented by other computer activity.

**f) The older \*.dat files are around 15kB long. The new \*.dat files are 22kB long because of the timestamps.**

In summary, the new software was checked to make sure it did the following:

- 1) Changes to a new file each hour no matter what other activity was going on in the computer.
- 2) Eliminates spurious data resulting from a barrage of pent-up interrupts to the RS232 port.
- 3) Can copy \*.dat files to a floppy, can covert \*.dat files to \*.txt files, can change folders and operate on old files stored elsewhere on the disk, without losing good data or writing bad data.
- 4) Can cope with high activity while recording. Inquiries to the smolt counter may be interrupted while other activity takes precedence. The smolt counter interface can accumulate counts from each of the three arrays until they reach 255 (the largest value that can be written in a byte). The max rate for the Bendix counter is 146/s. Our suggestion is to let the computer just count when the smolts are coming in great numbers, but when the smolt counts are only 40/sec or less per channel, you can tie up the computer for 6 seconds with out losing data. That would be hard to do. You would need to be willful, like holding the mouse down when the pointer is at the top of smolt counter window for 6 seconds before you lose data. Interrupting the computer count can be noted by watching the posted timestamp on the upper right hand corner of the smolt counter window. When it freezes, the inquiries may be inhibited.

**The new software will not work if the computers are put in "Suspend" or if the Inspiron 7000's top is closed. In both cases, queries to the counter interface are stopped and data will be lost after a few seconds.**



Appendix E.4. Sample Smolt Counter Application \*.dat file printout.

Appendix E.5. Summary of smolt school data for Kvichak 31-May-2000 0200.dat.

Inshore Array			Middle Array			Offshore Array		
No. of Schools	No. of Smolt per School	Passage Time (sec)	No. of Schools	No. of Smolt per School	Passage Time (sec)	No. of Schools	No. of Smolt per School	Passage Time (sec)
150			130			329		
Max	1,940	7	Max	2,675	6	Max	3,685	12
Avg	297	2	Avg	420	2	Avg	627	2
Min	5	1	Min	5	1	Min	5	1

Appendix E.6. Summary of smolt school data for Ugashik 31-May-2000 0200.dat.

Inshore Array			Middle Array		
No. of Schools	No. of Smolt per School	Passage Time (sec)	No. of Schools	No. of Smolt per School	Passage Time (sec)
566			555		
Max	8,365	24	Max	15,985	38
Avg	382	2	Avg	491	3
Min	5	1	Min	5	1

Appendix E.7. Maximum counts per second and their frequency  
in Kvichak 31-May-2000 0200.dat.

	Array		
	Inshore	Middle	Offshore
Max Count / sec	725	725	730
DCOUNT (725)	5	8	54
DCOUNT (730)	0	0	3

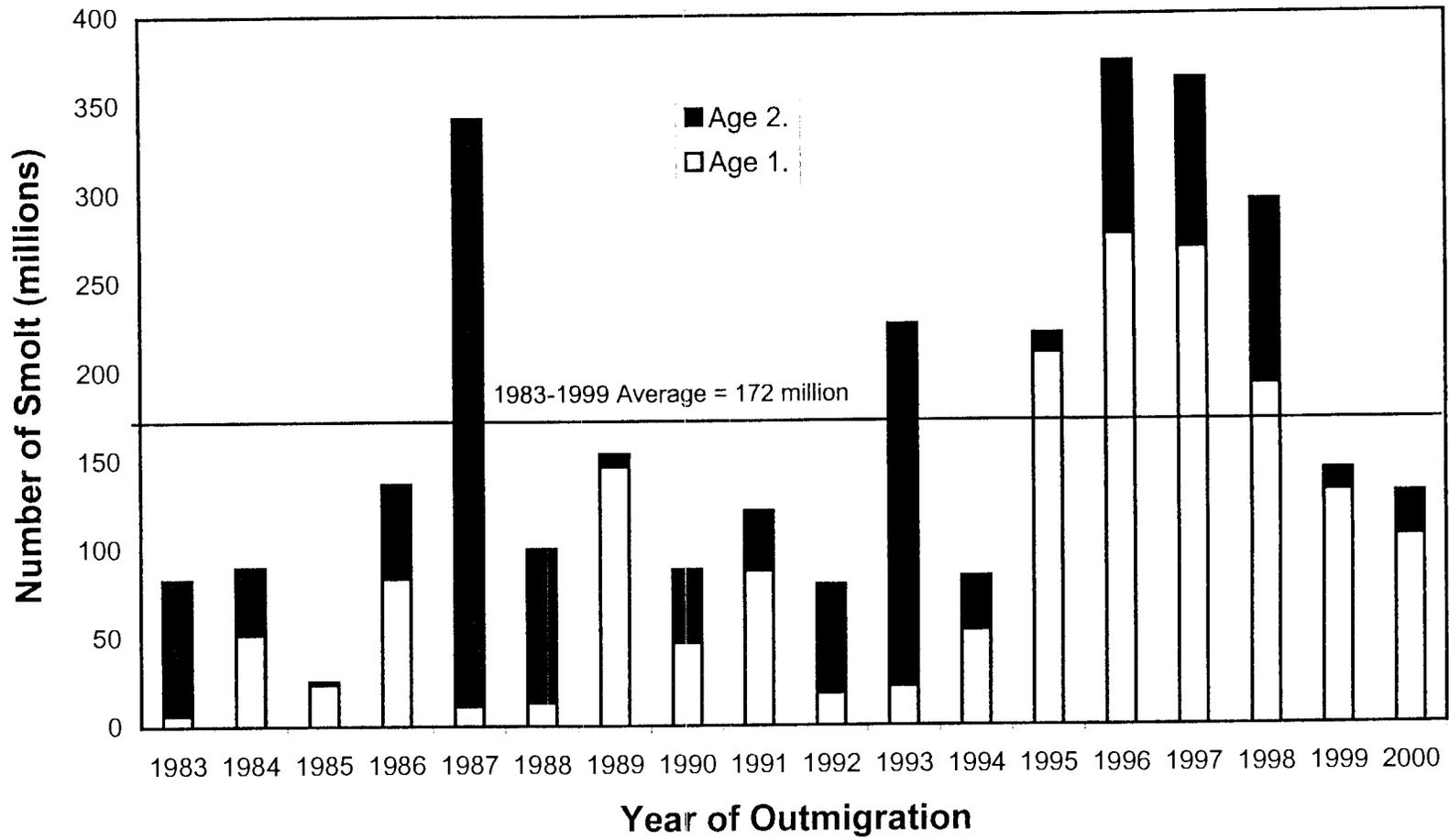
Appendix E.8. Maximum counts per second and their frequency  
in Ugashik 31-May-2000 0200.dat.

	Array	
	Inshore	Middle
Max Count / sec	725	725
DCOUNT (725)	15	45
DCOUNT (730)	0	0



Appendix F.1. Total smolt outmigration estimates for Kvichak River by outmigration year, 1983-2000.

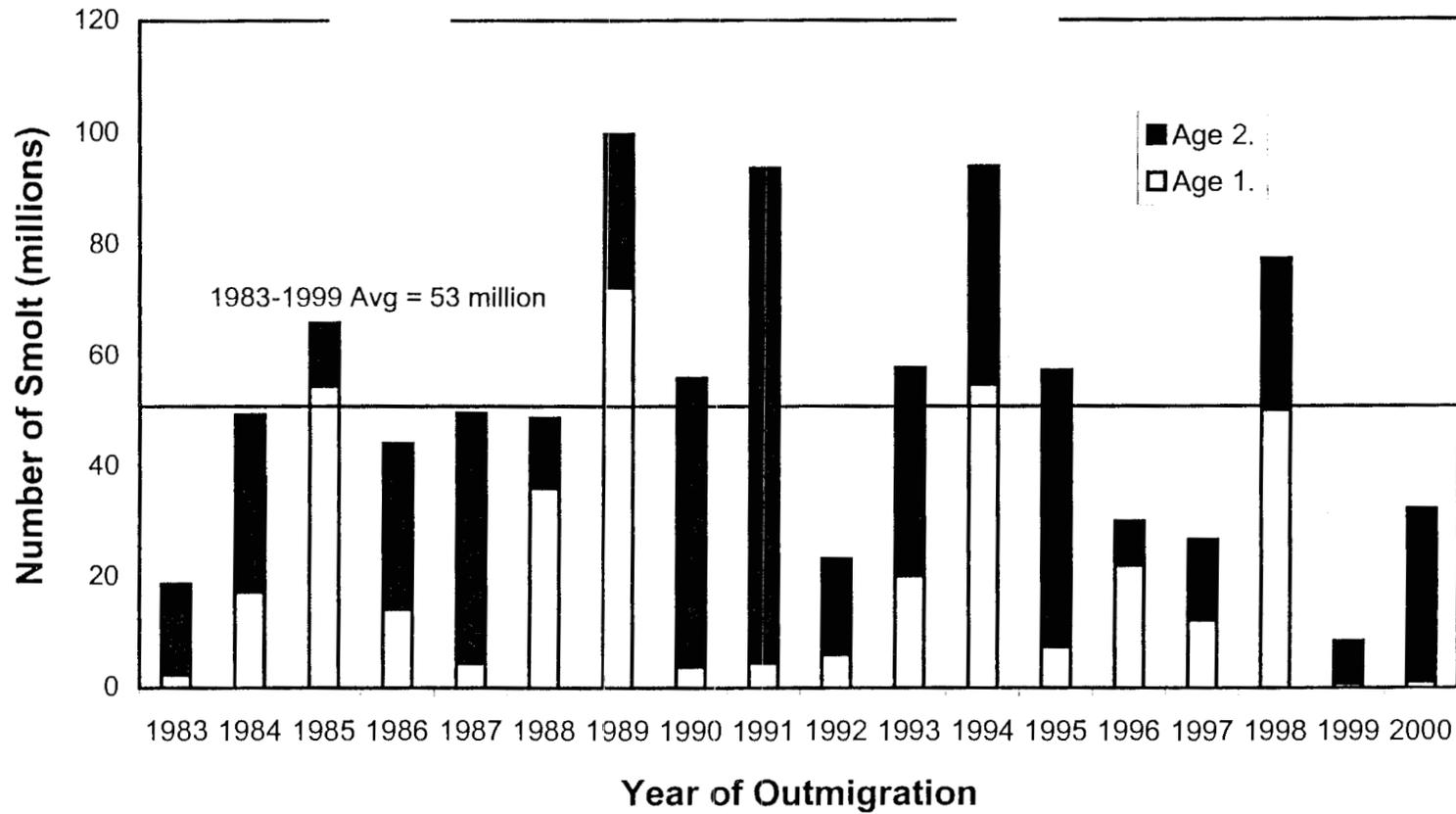
Year of Outmigration	Breakup	Operating Dates	Total Days Operated	Cumulative Percent by Date			Peak Daily		Total Smolt Estimate	Comments
				10%	50%	90%	Date	Smolt Estimate		
1983		5/19-6/13	26	5/23	5/26	6/05	5/24	14,258,463	82,793,899	Ice Problems - 5/19-5/22 intermittent
1984		5/18-6/10	24	5/21	5/27	6/05	5/27	13,184,162	89,489,975	
1985		5/22-6/19	29	6/06	6/10	6/17	6/09	6,059,204	25,527,851	Ice Problems - 5/22-6/02, 6/06 intermittent, 6/03-6/05 continuous
1986		5/21-6/12	23	5/28	6/05	6/06	6/06	58,591,781	136,733,218	
1987	3/23	5/21-6/13	24	5/24	5/28	6/09	5/28	45,657,674	342,686,918	
1988		5/22-6/16	26	5/23	6/01	6/13	6/01	15,490,767	100,173,692	
1989		5/19-6/15	28	5/29	6/03	6/10	6/03	26,318,761	153,464,216	New Site Location - 1 km downstream from 1974-1988 site
1990		5/21-6/14	25	5/22	5/25	6/10	5/27	11,721,914	88,004,103	Ice Problems - prior to 5/21
1991		5/22-6/16	26	5/30	5/28	6/10	6/04	19,885,424	121,454,182	Ice Problems - 5/22-5/26 intermittent, 5/27-5/29 continuous
1992	5/04	5/23-6/13	22	5/25	5/22	6/03	5/28	18,838,144	79,490,008	Ice Problems - 5/19-5/22 continuous, 5/24-5/26, 5/31 intermittent
1993	5/03	5/18-6/11	25	5/19	5/24	5/31	5/31	44,155,479	226,407,888	
1994		5/28-6/15	19	5/31	6/05	6/11	6/05	11,705,421	83,845,472	Ice Problems - 5/17-5/28 continuous
1995		5/21-6/13	24	5/21	5/25	6/03	5/22	40,060,740	220,892,127	Ice Problems - 5/17-5/21 continuous
1996	5/05	5/18-6/12	26	5/24	5/28	5/31	5/28	78,544,749	373,166,532	
1997		5/17-6/12	27	5/19	5/24	6/01	5/22	44,778,344	363,397,663	
1998	4/26	5/17-6/12	27	5/20	5/25	6/01	5/21	46,937,701	295,470,850	
1999		6/01-6/16	16	6/04	6/08	6/14	6/04	18,566,414	143,543,215	Ice Problems - 5/17-5/31 continuous threat from frozen lake
1983-99 Max			29	6/06	6/10	6/17	6/09	78,544,749	373,166,532	
1983-99 Avg			25	5/25	5/29	6/06	5/29	30,279,714	172,149,518	
1983-99 Min			16	5/19	5/22	5/31	5/21	6,059,204	25,527,851	
2000		5/20-6/13	25	5/21	5/27	6/07	5/21	27,239,013	130,038,649	



Appendix F.2. Age composition of smolt outmigration estimates for Kvichak River by outmigration year, 1983-2000.

Appendix F.3. Total smolt outmigration estimates for Egegik River by outmigration year, 1983-2000.

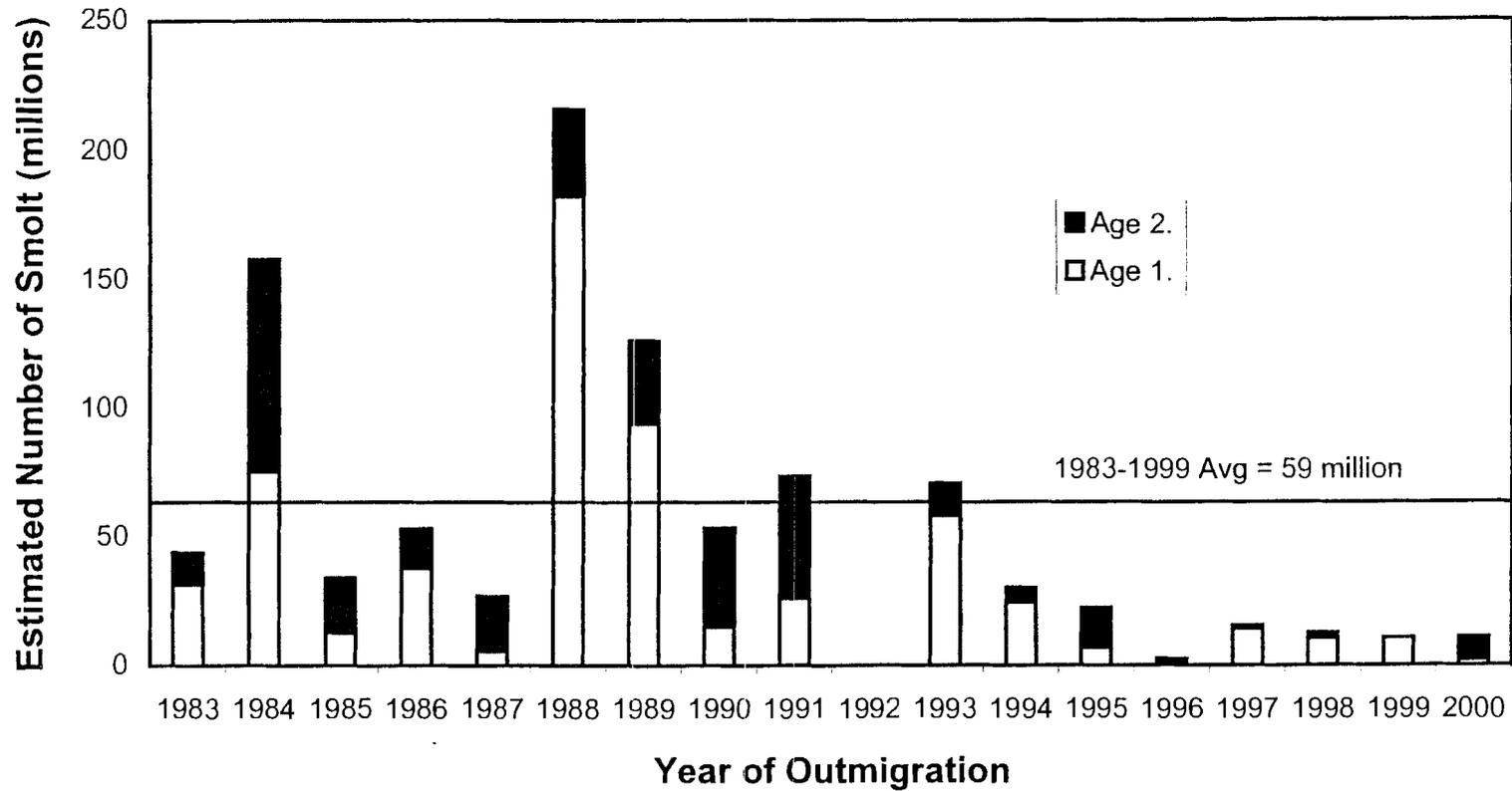
Year of Outmigration	Operating Dates	Total Days Operated	Cumulative Percent by Date			Peak Daily		Total Smolt Estimate	Comments
			10%	50%	90%	Date	Smolt Estimate		
1983	5/17-6/10	25	5/21	5/27	5/31	5/29	5,377,393	18,766,889	
1984	5/19-6/10	23	5/26	5/26	5/30	5/26	23,006,014	49,667,432	
1985	5/19-6/11	24	5/27	5/29	6/01	5/27	24,392,451	66,073,548	Ice Present - 5/17-5/22 intermittent
1986	5/18-6/11	25	5/27	5/29	6/03	5/29	10,079,789	44,197,865	Ice Present - 5/19-5/25 intermittent
1987	5/19-6/13	26	5/21	5/24	6/08	5/22	9,088,350	49,868,710	
1988	5/18-6/13	27	5/23	5/26	6/05	5/24	9,963,520	48,961,215	
1989	5/20-6/09	21	5/25	5/27	5/31	5/27	21,494,695	99,886,786	
1990	5/19-6/11	24	5/23	5/25	5/29	5/25	17,366,276	56,095,226	Fair Weather - 118 h disabled time
1991	5/21-6/11	22	5/25	5/28	6/07	6/04	17,890,595	94,077,988	Ice Problems - 5/17-5/18 continuous
1992	5/22-6/11	21	5/26	5/27	6/02	5/26	7,935,493	23,748,278	
1993	5/17-6/08	23	5/20	5/24	5/27	5/25	11,674,298	57,960,399	
1994	5/21-6/09	20	5/24	5/31	6/05	5/31	14,215,785	94,086,989	
1995	5/21-6/12	23	5/22	5/23	5/29	5/23	19,428,442	57,385,790	Ice Problems - 5/19-5/21 continuous
1996	5/19-6/12	25	5/24	5/25	5/29	5/24	10,043,411	31,270,793	
1997	5/18-6/09	23	5/24	5/28	5/31	5/29	4,881,168	27,050,113	Excellent Weather - 1 hr disabled time
1998	5/18-6/10	24	5/26	5/29	6/04	5/29	17,439,907	78,791,125	Good Weather - 67 hr disabled time
1999	5/21-6/13	24	5/23	6/09	6/09	6/09	3,703,824	8,592,482	Ice Problems - 5/27-6/06 intermittent, 6/07-6/13 continuous
1983-99 Max		27	5/27	6/09	6/09	6/09	24,392,451	99,886,786	
1983-99 Avg		24	5/23	5/27	6/01	5/27	13,410,671	53,322,449	
1983-99 Min		20	5/20	5/23	5/27	5/22	3,703,824	8,592,482	
2000	5/20-6/10	22	5/21	6/01	6/03	6/01	6,801,716	32,465,479	Excellent Weather - 42 hr disabled time



Appendix F.4. Age composition of smolt outmigration estimates for Egegik River by outmigration year, 1983-2000.

Appendix F.5. Total smolt outmigration estimates for Ugashik River by outmigration year, 1983-2000.

Year of Outmigration	Operating Dates	Total Day Operated	Cumulative Percent by Date			Peak Daily		Total Smolt Estimate	Comments
			10%	50%	90%	Date	Smolt Estimate		
1983	5/21-6/16	27	5/26	6/01	6/13	6/07	5,355,409	44,033,811	
1984	5/22-6/16	26	5/24	6/01	6/08	6/01	26,771,956	158,174,626	
1985	5/22-6/17	27	5/24	6/05	6/11	6/04	5,498,113	34,101,390	Intermittent ice floes - 5/17-5/21
1986	5/21-6/13	24	5/30	6/02	6/10	5/30	9,142,549	53,076,253	
1987	5/17-6/13	28	5/21	6/03	6/06	6/03	4,944,521	26,947,225	
1988	5/17-6/13	28	5/28	6/06	6/10	6/07	55,816,902	215,968,015	
1989	5/22-6/15	25	5/25	5/31	6/09	5/25	22,376,115	126,298,122	
1990	5/20-6/13	25	5/26	5/30	6/07	5/29	13,459,723	53,627,347	Poor Weather - 199 h disabled time
1991	5/20-6/13	25	5/25	6/02	6/06	6/02	11,905,863	73,769,877	Poor Weather - 187 h disabled time
1992		0							
1993	5/17-6/11	26	5/26	5/30	6/06	5/26	12,360,357	70,747,074	Bad Weather - 264 h disabled time
1994	5/20-6/12	24	5/28	6/04	6/07	6/04	6,914,049	30,030,624	Excellent Weather - 44 h disabled time
1995	5/22-6/12	22	5/24	5/26	6/01	5/25	4,355,545	22,234,137	Excellent Weather - 21 h disabled time
1996	5/19-6/11	24	5/25	5/30	6/04	6/04	627,517	2,576,812	Fair Weather - 105 h disabled time
1997	5/10-6/12	34	5/18	5/24	5/30	5/24	4,065,127	15,519,783	Excellent Weather - 31 h disabled time
1998	5/17-6/12	27	5/27	6/05	6/11	6/05	2,058,183	12,624,441	Fair Weather - 148 h disabled time
1999	5/17-6/12	27	5/29	6/10	6/11	6/10	4,171,058	10,631,631	Intermittent to heavy ice floes - 5/18-5/23; Good Weather - 62 h disabled ti
1990-99 Max		34	5/29	6/10	6/11	6/10	13,459,723	73,769,877	
1990-99 Avg		23	5/25	5/31	6/05	5/31	6,657,491	32,417,970	
1990-99 Min		0	5/18	5/24	5/30	5/24	627,517	2,576,812	
2000	5/19-6/11	24	5/25	5/31	6/05	6/01	1,908,369	10,880,559	Good Weather - 88 h disabled time



Appendix F.6. Age composition of smolt outmigration estimates for Ugashik River by outmigration year, 1983-2000.

Appendix G.1. Comparison of Kvichak River mean water temperatures at the start of the smolt sonar project and at the time of peak smolt passage, 1984-2000.

Year	Sonar Startup			Peak Smolt Passage	
	Smolt Day	Mean Water Temperature °C		Smolt Day	Mean Water Temperature °C
1984	18-May	5.5	<sup>a</sup>	27-May	6.8
1985	22-May	3.8	<sup>b</sup>	9-Jun	5.8
1986	21-May	4.5		6-Jun	7.0
1987	21-May	4.5		28-May	5.9
1988	22-May	3.8		1-Jun	5.7
1989	19-May	4.0		3-Jun	6.0
1990	21-May	3.5	<sup>c</sup>	27-May	5.8
1991	22-May	2.0		4-Jun	4.8
1992	23-May	6.3		28-May	7.5
1993	18-May	4.5	<sup>d</sup>	31-May	7.8
1994	28-May	4.0		5-Jun	6.0
1995	21-May	6.0		22-May	6.0
1996	18-May	7.0		28-May	7.5
1997	17-May	5.5		22-May	7.0
1998	18-May	3.0		25-May	4.4
1999	1-Jun	0.5		4-Jun	2.5
Max		7.0			7.8
Avg		4.3			6.1
Min		0.5			2.5
2000	20-May	4.8		21-May	6.5

<sup>a</sup> Water temperature recorded May 19, 1984.

<sup>b</sup> Water temperature recorded May 23, 1985.

<sup>c</sup> Water temperature recorded May 22, 1990.

<sup>d</sup> Water temperature recorded May 19, 1993.

Appendix G.2. Comparison of Egegik River mean water temperatures at the start of the smolt sonar project and at the time of peak smolt passage, 1984-2000.

Year	Sonar Startup		Peak Smolt Passage	
	Smolt Day	Mean Water Temperature °C	Smolt Day	Mean Water Temperature °C
1984	19-May	7.0	26-May	7.5
1985	19-May	2.5	27-May	4.0
1986	18-May	3.0	29-May	4.7
1987	19-May	5.5	22-May	4.0
1988	18-May	4.9	24-May	5.8
1989	20-May	3.5	27-May	4.2
1990	19-May	3.5	25-May	3.8
1991	21-May	7.0	4-Jun	8.0
1992	22-May	7.0	26-May	6.8
1993	17-May	6.5	25-May	6.5
1994	21-May	4.0	31-May	5.8
1995	21-May	4.3	23-May	5.0
1996	19-May	4.8	24-May	5.3
1997	19-May	4.0	29-May	7.5
1998	18-May	4.5	29-May	5.3
1999	21-May	2.5	9-Jun	0.5
Max		7.0		8.0
Avg		4.7		5.3
Min		2.5		0.5
2000	20-May	5.3	1-Jun	5.5

<sup>a</sup> Water temperature recorded May 19, 1986.

<sup>b</sup> Water temperature recorded May 19, 1988.

<sup>c</sup> Water temperature recorded May 21, 1989.

<sup>d</sup> Water temperature recorded May 20, 1990.

<sup>e</sup> Water temperature recorded May 23, 1992.

<sup>f</sup> Water temperature recorded May 18, 1993.

<sup>g</sup> Water temperature recorded May 22, 1995.

Appendix G.3. Comparison of Ugashik River mean water temperatures at the start of the smolt sonar project and at the time of peak smolt passage, 1984-2000.

Year	Sonar Startup		Peak Smolt Passage	
	Smolt Day	Mean Water Temperature °C	Smolt Day	Mean Water Temperature °C
1984	22-May	4.8	1-Jun	6.5
1985	22-May	1.5	4-Jun	5.3
1986	21-May	4.0	30-May	5.0
1987	17-May	5.5	3-Jun	6.3
1988	17-May	3.5	7-Jun	7.3
1989	22-May	4.0	25-May	4.0
1990	20-May	3.0	29-May	6.3
1991	20-May	4.0	2-Jun	5.5
1992 <sup>a</sup>				
1993	17-May	6.0	26-May	7.0
1994	20-May	5.0	4-Jun	7.0
1995	22-May	4.5	25-May	5.0
1996	19-May	4.0	4-Jun	7.0
1997	10-May	5.0	24-May	6.5
1998	17-May	3.5	5-Jun	6.0
1999	26-May	1.5	10-Jun	5.0
Max		6.0		7.3
Avg		4.0		6.0
Min		1.5		4.0
2000	19-May	5.0	1-Jun	7.5

<sup>a</sup> Project not conducted. No data collected.



## APPENDIX H. CLIMATOLOGICAL FACTORS THAT MAY HAVE AFFECTED THE FRESHWATER SURVIVAL OF 2000 SMOLT

The freshwater survival of salmon eggs, fry, and smolt from the 1997 and 1998 brood years may have been affected by several climatic factors outlined below; however, we have no direct information indicating the magnitude or direction of the effect.

### *Air Temperature*

According to air temperature data collected by the National Weather Service (1997; 1998; 1999; 2000a,b,c,d,e,f) the overall annual temperatures for King Salmon and vicinity from July through June in 1997-1998 was 1.4 °F warmer, in 1998-1999 was -2.5 °F colder, and in 1999-2000 was 0.5 °F warmer than the 30-year mean (Appendix H.1).

Average monthly temperatures for the same time periods are shown in (Appendix H.2). Some colder months which may have impacted salmon eggs, fry, and smolt in the Kvichak, Egegik, and Ugashik River drainage were October and December 1997 (5.4 °F and 9.4 °F below average), January, August, and December 1998 (2.6 °F, 2.6 °F, and 7.8 °F below average) and January, February, March, May, October, November, and December 1999 (4.4 °F, 11.2 °F, 9.6 °F, 3.3 °F, 4.5 °F, 4.3 °F, 15.0 °F below average), and January 2000 (11.4 °F below average). The remaining months were at or above the 30-year mean temperatures, which would have been favorable for the development and survival of juvenile salmon.

Air temperatures during the winter of 1997-1998 were milder than the prior year. Between October 1997 and April 1998 there were 130 d with average daily air temperatures less than or equal to 32 °F and 16 d with average daily temperatures less than 0 °F (Appendix H.3). This milder weather, especially in March and April, may have created more favorable rearing conditions for salmon eggs and fry from the 1997 brood year. The winter of 1997-1998 had 82 d with average daily air temperatures greater than 32 °F. Below normal temperatures predominated from mid-October to early November (14 d), late November to early December (6 d), and mid-December to mid-January (22 d).

During the winter of 1998-1999, air temperatures were more severe than 1997-1998. Between October 1998 and April 1999 there were 142 d with average daily air temperatures less than or equal to 32 °F and 45 d with average daily temperatures less than 0 °F (Appendix H.4). The winter of 1998-1999 had only 70 d with average daily air temperatures greater than 32 °F which may have slowed development of salmon eggs and fry from the 1998 brood year. Below normal temperatures predominated from late November to mid-December (18 d), late December to early January (10 d), mid-January to mid-February (22 d) and late February to mid-March (19d).

During the winter of 1999-2000, air temperatures were less severe than 1997-1998. Between October 1999 and April 2000 there were 137 d with average daily air temperatures less than or

equal to 32 °F and 31 d with average daily temperatures less than 0 °F (Appendix H.5). The winter of 1999-2000 had 76 d with average daily air temperatures greater than 32 °F which may have benefited fry and smolt from the 1998 brood year as well as salmon eggs and fry from the 1999 brood year. Below normal temperatures predominated from late October to mid-January (67 d), late January to early February (5 d), and late March to early April (7d).

### *Precipitation*

Precipitation data collected by the National Weather Service (1997; 1998; 1999; 2000a,b,c,d,e,f) for King Salmon and vicinity from July through June in 1997-1998, 1998-1999 and 1999-2000 were 0.4 in less, 1.0 in more, and 1.0 in less, than the 30-year mean annual precipitation of 19.4 in (Appendix H.6).

Average monthly precipitation during the 1997-1998 season were greater than or equal to the 30-year mean in 6 out of 12 months (Appendix H.7). The months in which precipitation probably had the greatest impact upon freshwater survival of sockeye salmon in east side Bristol Bay river systems were August, September, May, and June. The average monthly precipitations for these months were 25%, 32%, 133%, and 37% greater than the 30-year means. The increase in precipitation may have caused some flooding, although we have no direct information that significant flooding occurred.

Average monthly precipitations during the 1998-1999 season fluctuated above and below the 30-year mean (Appendix H.7). The average monthly precipitations for August, September, and October were 3.59 in, 3.28 in, and 3.96 in; 21%, 22%, and 88% greater than the 30-year mean. This increased precipitation in the fall may have caused some flooding which could decrease freshwater survival of eggs from the 1998 brood year due to scouring and siltation of salmon redds. The months in which low precipitation may have impacted freshwater survival of sockeye salmon in east side Bristol Bay river systems were December, January, March, and April. The precipitation for these months was 40%, 53%, 58%, and 36% less than the 30-year mean. It is unknown how this increase followed by decreases in precipitation may have effected the age-1. (1998 brood year) and age-2. (1997 brood year) fry.

Average monthly precipitations during the 1999-2000 season were less than the 30-year mean in all 12 months (Appendix H.7). The months in which precipitation probably did not impact the freshwater survival of sockeye salmon in east side Bristol Bay river systems were August through October, December through February, and June. The average monthly precipitations for the remaining 5 months were below the 30-year mean. Low water levels may have reduced access to and availability of suitable adult salmon spawning habitat and juvenile rearing habitat. Lower than usual precipitation in the spring may also have dewatered some smaller tributaries and prevented fry from entering rearing areas in the lakes.

## *Snowfall*

Snowfall data collected for King Salmon and vicinity by the National Weather Service (1997; 1998, 1999, 2000a,b,c,d,e,f) from July through June in 1997-1998, 1998-1999, and 1999-2000 were 4.2 in more, 8.3 in more, and 9.2 in more than the 30-year mean annual snowfall of 46.7 in. (Appendix H.8).

During the winter of 1997-1998 most of the snow fell early with above normal snowfalls in November (10.4 in), December (13.1 in), and January (17.3 in) (Appendix H.9). The monthly snowfall for the remainder of the winter was below normal, however the insulating qualities of the early snowfall may have protected developing eggs (1997 brood year) and rearing age-1. and -2. fry (1996 and 1995 brood years) from exposure to severe temperatures.

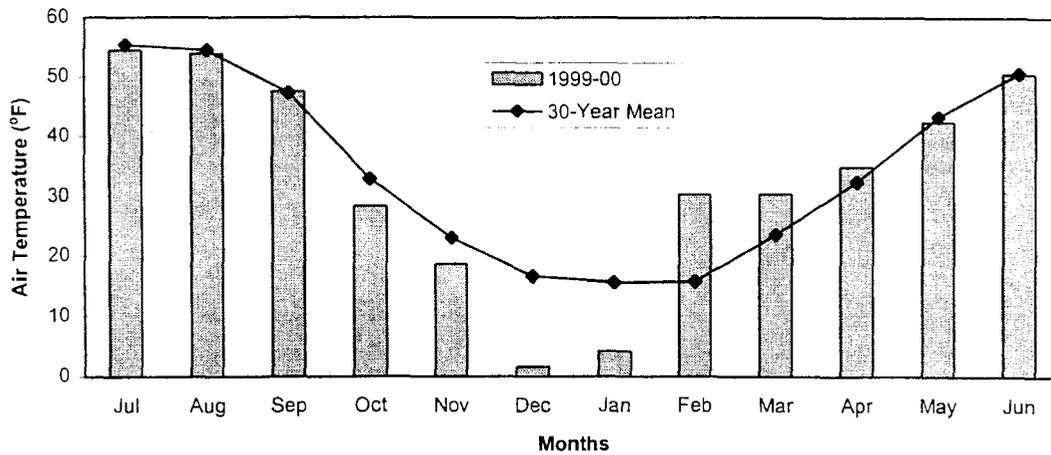
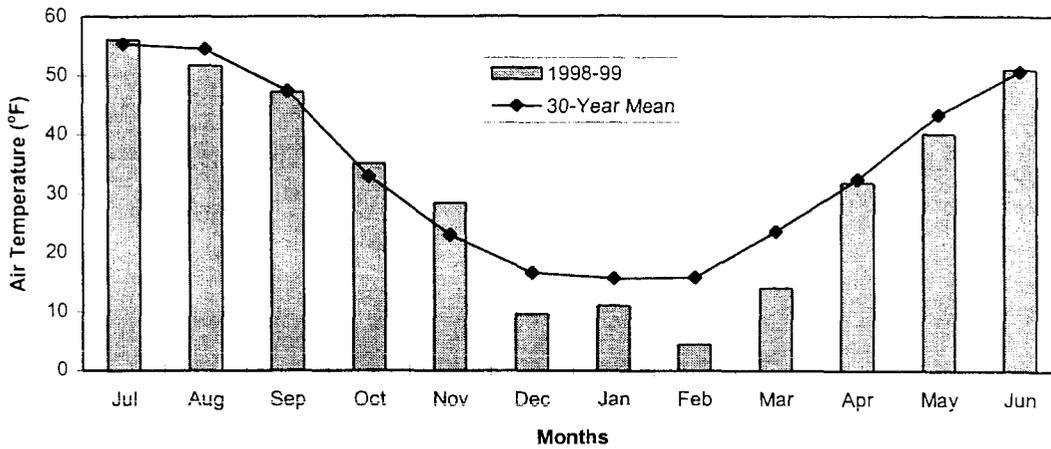
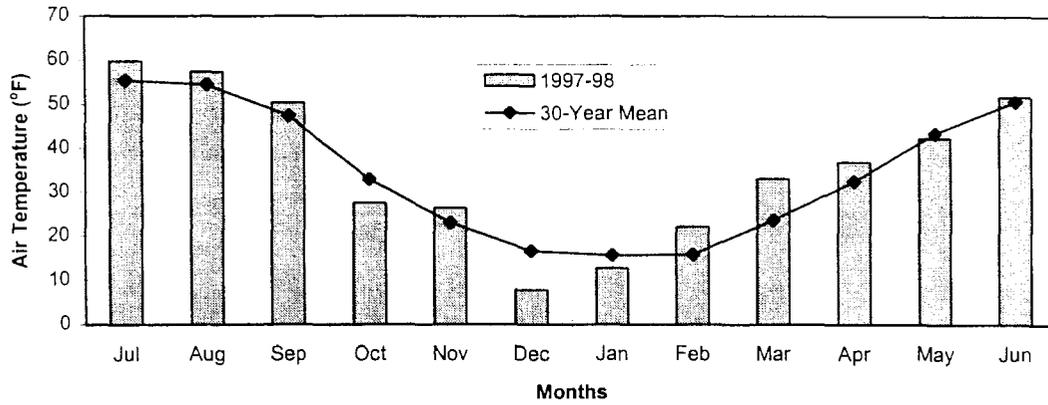
Overall, snowfall during the winter of 1998-1999 season was above normal (Appendix H.9). The total monthly snowfalls for October, February, and April were 206%, 198%, and 230% respectively, above the 30-year mean. The warm spell that occurred in late October and early November melted most if not all of the October snow. Snowfalls in November, December, January, and March were below normal. It is unknown how the lack of insulating snow in the early half of the winter may have affected the incubating salmon eggs (1998 brood year) and rearing fry in east side Bristol Bay streams and lakes.

Average monthly snowfalls during the winter of 1999-2000 were above normal (Appendix H.9). The average monthly snowfalls during October and November were slightly less than normal, but were probably adequate to provide an insulating layer to protect developing salmon eggs and emerging fry (1999 brood year) from sharp changes in temperature. The insulating effects of the above average snowfall in December and January may have cancelled out the negative effects of the below normal temperatures (Appendix H.2).

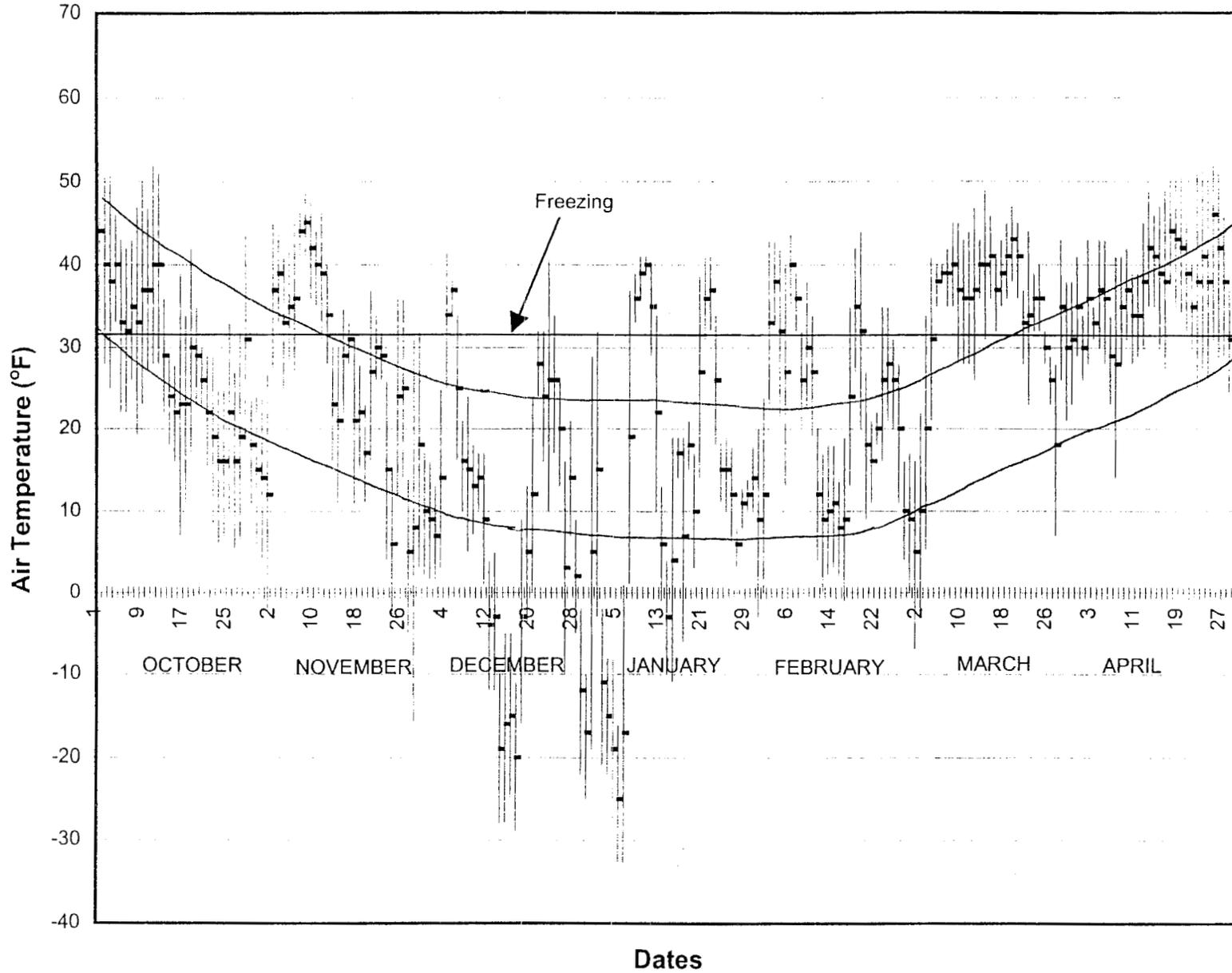
Appendix H.1. Average monthly air temperature for King Salmon, July 1970 to June 2000.

Smolt Year	Air Temperature (°F) <sup>a</sup>												Average Annual
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
1970-71	52.7	51.7	44.8	29.3	29.3	11.6	-2.6	12.2	7.8	26.8	37.7	47.3	29.1
1971-72	54.5	54.9	46.8	34.3	21.6	18.6	6.7	6.2	1.8	2.1	40.9	46.6	27.9
1972-73	55.2	54.4	45.5	36.0	25.4	16.2	1.8	19.5	19.3	35.9	42.9	51.4	33.6
1973-74	55.6	54.6	47.2	34.1	24.7	17.9	9.5	0.4	23.2	35.6	45.5	51.2	33.3
1974-75	55.4	57.0	50.6	33.4	20.1	8.0	4.7	3.9	14.5	25.0	39.4	47.1	29.9
1975-76	54.7	53.6	47.1	32.4	12.7	10.2	12.3	7.3	15.3	29.5	39.5	46.9	30.1
1976-77	53.2	53.1	45.3	31.5	24.2	19.3	34.4	30.1	18.8	25.7	39.5	50.5	35.5
1977-78	54.3	56.8	47.0	31.7	14.1	10.6	28.6	24.8	25.6	37.5	45.2	49.5	35.5
1978-79	54.2	57.1	47.7	36.5	30.0	28.0	30.1	6.2	30.3	39.6	47.3	52.0	38.3
1979-80	57.8	56.0	50.0	39.4	29.4	4.5	9.0	20.7	27.6	36.4	41.7	48.9	35.1
1980-81	55.1	51.1	47.0	35.2	26.3	5.3	29.8	21.9	34.4	35.8	46.8	50.3	36.6
1981-82	55.1	54.8	44.9	33.2	23.4	13.3	17.0	12.8	23.9	25.5	40.3	48.9	32.8
1982-83	51.5	52.3	46.2	28.1	26.1	24.0	11.9	18.7	33.2	36.5	46.6	53.8	35.7
1983-84	57.4	54.1	45.5	28.8	30.1	27.2	17.4	-2.1	36.3	29.2	43.0	52.3	34.9
1984-85	53.7	53.5	48.0	30.1	22.5	24.7	32.6	10.6	22.6	20.8	39.9	47.4	33.9
1985-86	54.3	52.4	47.4	26.7	25.1	34.2	16.9	22.1	21.5	28.1	42.1	49.9	35.1
1986-87	53.7	52.2	48.8	36.1	26.3	30.6	21.1	24.3	29.8	32.3	42.8	49.3	37.3
1987-88	55.9	57.0	45.4	37.5	16.5	9.4	25.6	26.6	24.8	31.1	44.5	52.8	35.6
1988-89	56.8	53.5	45.8	30.9	13.9	20.8	-2.9	28.8	23.6	36.1	42.0	51.6	33.4
1989-90	56.3	57.1	51.7	36.7	18.1	19.5	16.8	-1.8	25.4	39.3	45.8	51.4	34.7
1990-91	56.0	55.9	47.5	31.5	17.3	20.4	17.5	14.2	25.7	36.4	44.5	50.4	34.8
1991-92	55.2	53.7	50.7	37.2	23.1	15.1	17.7	3.1	22.0	32.4	42.7	52.6	33.8
1992-93	55.6	53.9	41.0	31.7	23.5	19.2	15.0	22.7	31.1	41.0	48.3	53.1	36.3
1993-94	57.9	56.0	48.6	38.1	29.6	24.6	21.2	14.3	19.5	36.0	45.4	51.7	36.9
1994-95	55.7	55.9	48.6	29.9	19.3	14.3	19.5	23.1	17.4	40.3	46.4	53.2	35.3
1995-96	57.3	54.8	52.5	35.1	18.4	25.0	15.2	14.0	33.1	34.9	46.5	52.0	36.6
1996-97	55.3	52.9	43.6	29.4	25.6	6.3	12.8	30.3	20.8	37.7	47.8	54.0	34.7
1997-98	59.8	57.4	50.4	27.6	26.4	7.8	12.7	22.1	33.1	36.9	42.3	51.7	35.7
1998-99	56.1	51.7	47.2	35.1	28.4	9.6	11.0	4.4	14.0	31.8	40.1	51.0	31.7
1999-00	54.5	53.9	47.6	28.4	18.7	1.6	4.2	30.3	30.4	34.9	42.5	50.6	33.1
Max	59.8	57.4	52.5	39.4	30.1	34.2	34.4	30.3	36.3	41.0	48.3	54.0	38.3
30-Year Mean	55.4	54.4	47.3	32.9	23.0	16.6	15.6	15.7	23.6	32.4	43.3	50.6	34.2
Min	51.5	51.1	41.0	26.7	12.7	1.6	-2.9	-2.1	1.8	2.1	37.7	46.6	27.9

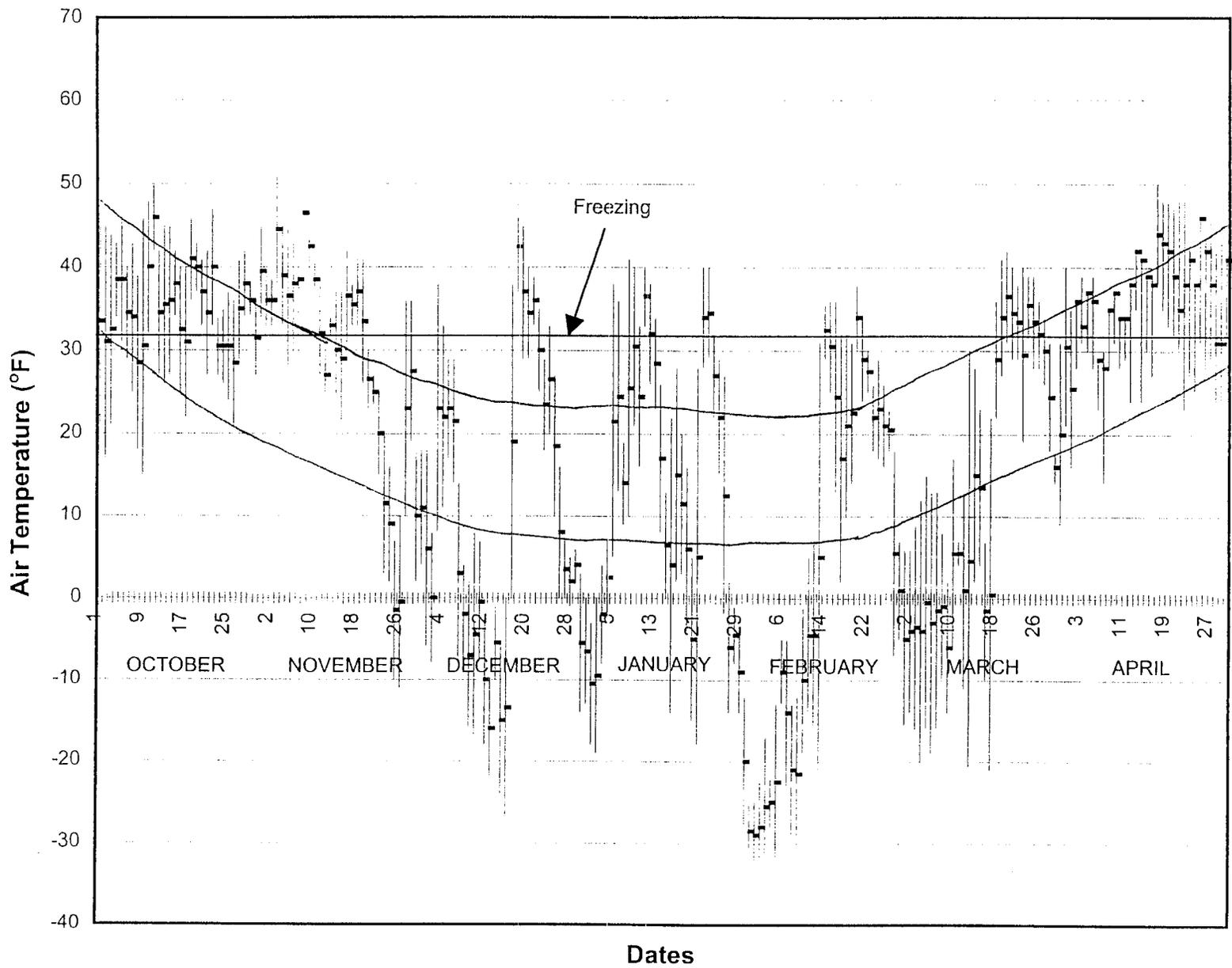
<sup>a</sup> Source - National Weather Service (1997; 1998; 1999; 2000a,b,c,d,e,f)



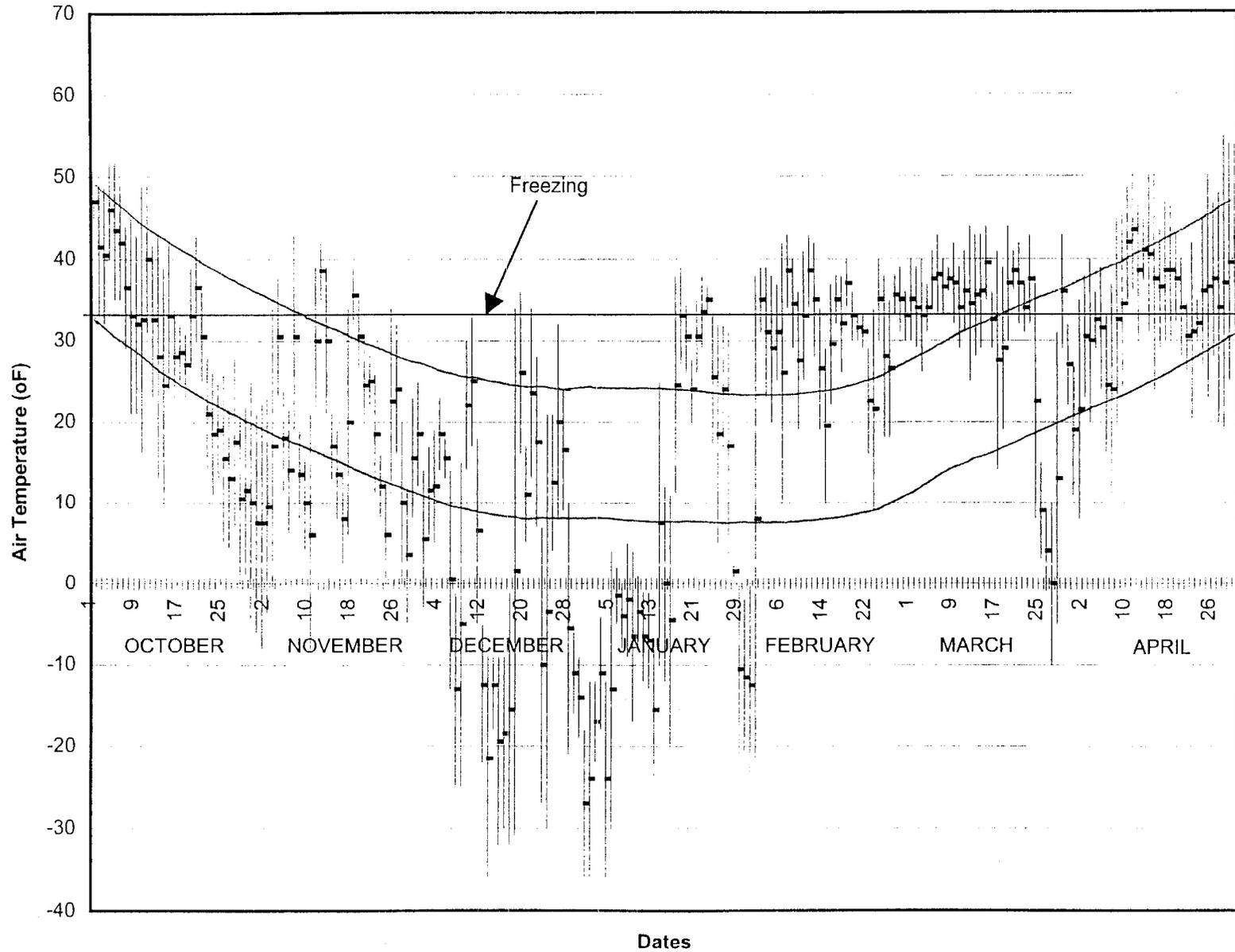
Appendix H.2. Comparison of monthly air temperature to the 30-year mean at King Salmon, July 1997 to June 2000.



Appendix H.3. Daily air temperatures (normal, mean and extreme) for King Salmon, October 1997 to April 1998.



Appendix H.4. Daily air temperatures (normal, mean and extreme) for King Salmon, October 1998 to April 1999.

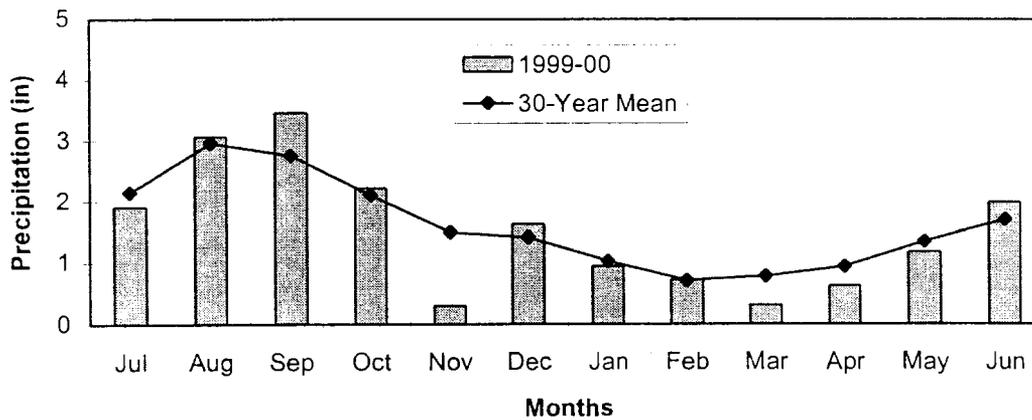
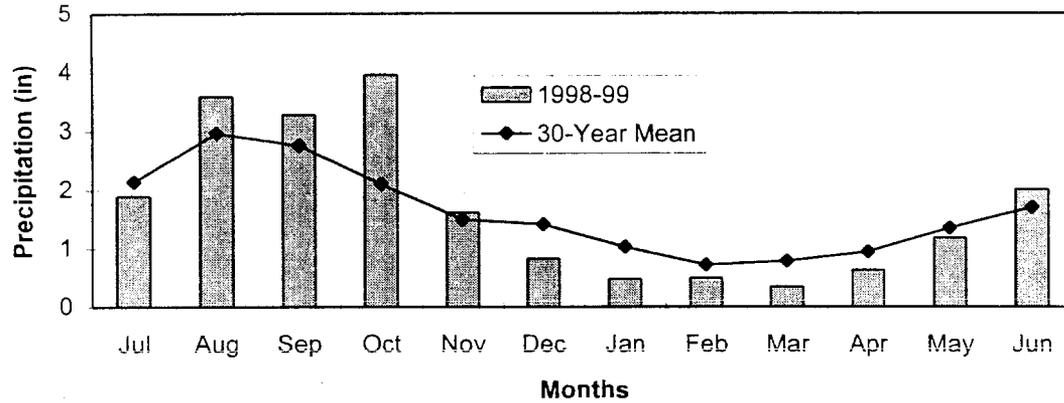
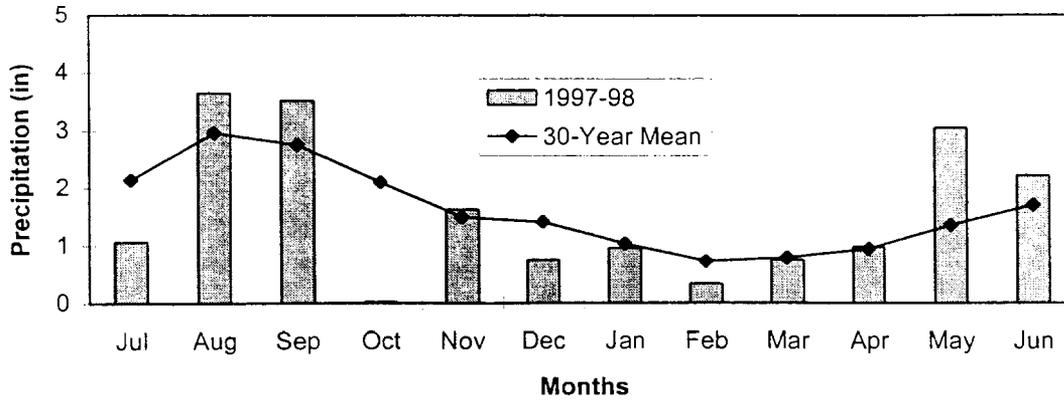


Appendix H.5. Daily air temperatures (normal, mean and extreme) for King Salmon, October 1999 to April 2000.

Appendix H.6. Average monthly precipitation for King Salmon, July 1970 to June 2000.

Smolt Year	Precipitation (in) <sup>a</sup>												Total Annual
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
1970-71	2.87	4.31	1.59	2.24	0.79	1.33	0.45	1.62	0.27	0.84	1.43	1.48	19.22
1971-72	3.25	4.30	3.40	2.72	1.13	3.42	1.30	0.21	0.17	1.37	1.29	1.62	24.18
1972-73	1.08	1.95	2.95	2.57	1.35	0.59	0.62	0.11	1.25	0.43	1.83	1.48	16.21
1973-74	2.43	3.80	1.41	1.52	0.97	1.10	0.86	0.55	1.27	1.18	0.57	2.40	18.06
1974-75	2.01	3.19	1.56	2.90	1.20	1.23	2.14	0.76	0.93	2.65	0.86	2.69	22.12
1975-76	0.74	1.05	3.90	2.10	0.46	1.38	1.24	0.97	0.78	0.58	1.47	1.34	16.01
1976-77	2.60	1.71	2.64	0.81	2.06	1.77	0.85	1.35	1.99	1.68	1.72	0.99	20.17
1977-78	1.60	3.16	2.58	3.29	0.58	1.04	0.70	0.28	0.26	0.58	0.98	2.81	17.86
1978-79	1.66	2.03	1.87	2.84	1.77	3.65	1.00	0.29	0.39	1.20	0.46	1.80	18.96
1979-80	2.24	2.50	0.91	2.71	2.89	1.09	1.46	0.83	1.51	0.42	1.61	2.19	20.36
1980-81	2.97	2.36	2.00	2.46	1.19	0.49	1.76	2.26	1.83	0.49	0.73	2.27	20.81
1981-82	2.17	3.93	1.82	1.59	1.31	0.59	1.48	0.15	1.37	1.20	1.55	3.04	20.20
1982-83	1.98	1.99	5.14	1.41	0.83	1.37	0.42	0.25	0.22	2.22	1.37	1.20	18.40
1983-84	1.53	2.33	2.36	2.82	0.98	0.48	1.17	0.55	0.44	0.43	1.08	1.59	15.76
1984-85	1.30	2.41	0.89	0.57	1.00	1.79	0.95	0.73	1.27	0.34	1.16	1.23	13.64
1985-86	1.31	3.24	2.64	2.29	3.35	1.58	1.33	0.19	0.24	0.98	1.01	0.93	19.09
1986-87	2.44	3.22	4.03	2.50	1.91	0.65	2.38	0.54	0.55	0.81	1.74	1.49	22.26
1987-88	1.94	2.73	2.99	2.47	2.75	1.07	0.56	0.75	0.74	1.02	2.95	1.11	21.08
1988-89	2.73	2.88	2.17	1.68	1.52	1.60	0.84	0.93	0.19	0.99	2.32	1.10	18.95
1989-90	3.04	3.15	5.90	2.86	1.58	1.31	1.44	1.61	1.71	0.89	1.52	1.22	26.23
1990-91	5.08	2.02	2.75	2.38	2.10	3.26	0.55	0.58	1.56	0.86	1.24	1.63	24.01
1991-92	1.02	1.79	2.10	1.99	1.34	1.26	0.79	0.92	1.40	0.19	0.74	2.53	16.07
1992-93	3.02	4.73	1.35	1.11	1.45	1.77	1.48	0.35	0.26	0.50	0.70	0.50	17.22
1993-94	1.01	3.21	4.53	1.98	3.00	2.15	1.35	1.22	0.91	1.35	1.74	1.71	24.16
1994-95	3.77	3.17	3.46	2.41	2.98	2.28	0.35	0.49	0.17	1.51	1.44	0.81	22.84
1995-96	2.27	4.73	2.74	1.46	0.13	0.14	0.70	0.75	0.38	0.87	0.84	2.41	17.42
1996-97	1.27	2.61	2.60	1.06	0.62	0.64	0.25	0.72	0.13	0.38	0.67	1.14	12.09
1997-98	1.07	3.65	3.52	0.03	1.63	0.75	0.95	0.34	0.75	0.98	3.05	2.22	18.94
1998-99	1.90	3.59	3.28	3.96	1.62	0.83	0.48	0.50	0.35	0.63	1.18	2.01	20.33
1999-00	1.91	3.07	3.46	2.22	0.31	1.63	0.95	0.73	0.32	0.63	1.18	1.99	18.40
Max	5.08	4.73	5.90	3.96	3.35	3.65	2.38	2.26	1.99	2.65	3.05	3.04	26.23
30-Year Mean	2.14	2.96	2.75	2.10	1.49	1.41	1.03	0.72	0.79	0.94	1.35	1.70	19.37
Min	0.74	1.05	0.89	0.03	0.13	0.14	0.25	0.11	0.13	0.19	0.46	0.50	12.09

<sup>a</sup> Source - National Weather Service (1997; 1998; 1999; 2000a,b,c,d,e,f)



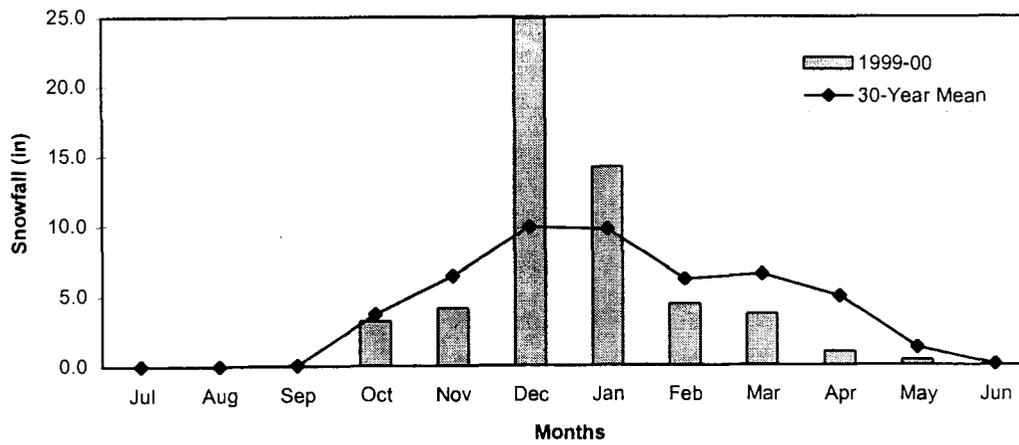
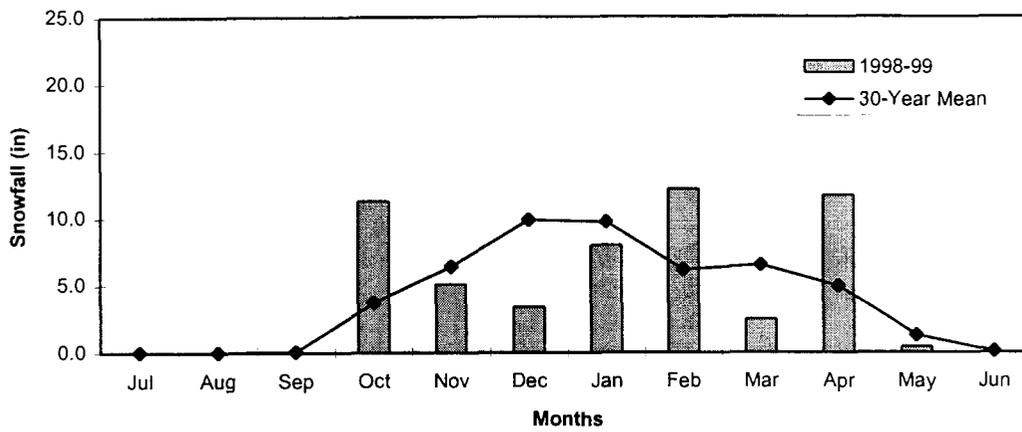
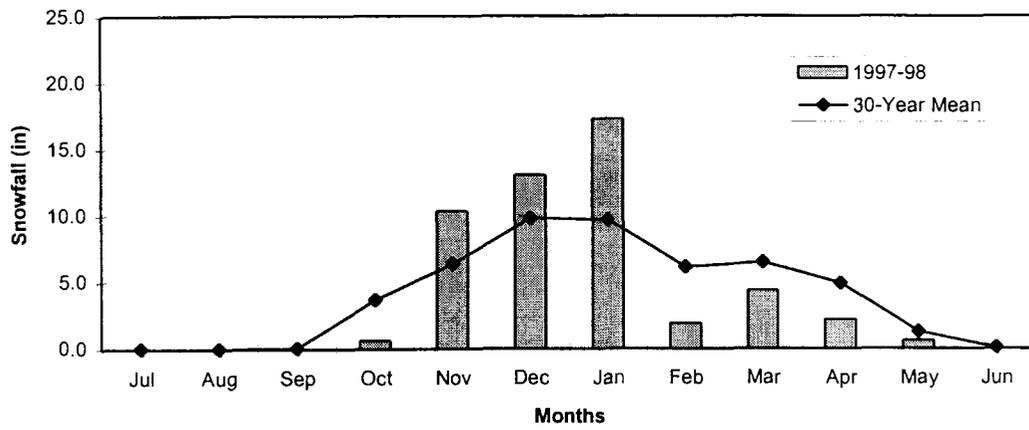
Appendix H.7. Comparison of monthly precipitation to the 30-year mean at King Salmon, July 1997 to June 2000.

Appendix H.8. Average monthly snowfall for King Salmon, July 1970 to June 2000.

Smolt Year	Snowfall (in) <sup>a,b</sup>												Total Annual
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
1970-71	0.0	0.0	T	8.3	1.4	8.6	4.3	15.2	1.6	8.9	2.5	T	50.8
1971-72	0.0	0.0	0.0	7.9	3.9	15.1	11.7	2.1	1.9	8.7	0.1	1.3	52.7
1972-73	0.0	0.0	T	0.8	8.0	2.1	3.0	0.8	8.1	2.2	0.6	0.0	25.6
1973-74	0.0	0.0	T	2.0	2.1	12.7	11.9	5.3	4.6	5.1	T	0.0	43.7
1974-75	0.0	0.0	0.0	T	4.3	10.9	19.1	6.3	8.7	14.3	2.9	0.0	66.5
1975-76	0.0	0.0	0.0	0.8	3.9	13.9	12.0	3.2	6.7	6.2	3.2	0.0	49.9
1976-77	0.0	0.0	0.0	2.0	10.9	11.0	2.1	11.9	20.0	4.6	T	0.0	62.5
1977-78	0.0	0.0	T	4.3	5.3	4.5	3.9	3.7	2.2	0.6	T	0.0	24.5
1978-79	0.0	0.0	0.0	1.0	2.2	14.1	4.4	0.2	1.1	T	T	0.0	23.0
1979-80	0.0	0.0	0.0	T	8.5	9.7	11.5	11.1	9.0	T	0.8	0.0	50.6
1980-81	0.0	0.0	0.0	0.3	6.1	6.8	10.5	11.3	15.8	0.6	T	T	51.4
1981-82	0.0	0.0	0.5	0.3	4.8	5.9	5.7	T	8.3	8.3	T	0.0	33.8
1982-83	0.0	0.0	0.0	2.8	2.0	2.9	4.0	2.0	T	6.0	0.1	0.0	19.8
1983-84	0.0	0.0	T	9.9	2.3	2.8	8.4	5.5	T	4.0	0.3	0.0	33.2
1984-85	0.0	0.0	0.0	3.4	7.3	3.8	3.7	6.4	8.9	3.4	6.1	0.0	43.0
1985-86	0.0	0.0	0.0	2.5	9.3	3.6	13.5	1.8	2.5	9.8	1.3	0.0	44.3
1986-87	0.0	0.0	0.0	2.3	2.5	4.8	24.7	2.7	2.7	9.4	T	0.0	49.1
1987-88	0.0	0.0	T	0.1	13.2	8.9	3.3	10.1	9.4	4.4	1.2	0.0	50.6
1988-89	0.0	0.0	T	3.4	12.7	9.2	14.9	3.7	5.1	1.5	2.1	0.0	52.6
1989-90	0.0	0.0	T	0.4	12.3	12.4	14.9	20.3	13.5	3.4	0.2	0.0	77.4
1990-91	0.0	0.0	T	15.7	6.7	18.9	3.1	4.3	14.0	2.8	0.0	0.0	65.5
1991-92	0.0	0.0	0.0	T	9.0	9.4	7.2	8.6	8.7	0.5	T	T	43.4
1992-93	0.0	0.0	T	0.9	7.9	8.0	30.6	5.5	5.2	1.8	T	T	59.9
1993-94	0.0	0.0	0.1	2.0	5.1	28.4	11.0	3.2	7.7	5.6	0.2	0.1	63.4
1994-95	0.0	0.0	0.0	8.4	17.9	16.0	5.9	2.0	2.0	0.4	0.1	0.1	52.8
1995-96	0.0	0.0	0.0	2.1	2.4	1.5	2.9	7.3	1.7	5.7	1.9	0.3	25.8
1996-97	0.0	0.0	0.3	2.6	0.1	8.5	3.7	5.2	2.3	T	T	0.0	22.7
1997-98	0.0	0.0	0.0	0.6	10.4	13.1	17.3	1.9	4.4	2.2	0.6	0.0	50.5
1998-99	0.0	T	T	11.3	5.1	3.4	8.0	12.2	2.5	11.7	0.4	T	54.6
1999-00	0.0	0.0	0.0	3.2	4.1	24.9	14.2	4.4	3.7	1.0	0.4	0.0	55.9
Max	0.0	0.0	0.5	15.7	17.9	28.4	30.6	20.3	20.0	14.3	6.1	1.3	77.4
30-Year Mean	0.0	0.0	0.0	3.7	6.4	9.9	9.7	6.1	6.5	4.9	1.3	0.1	46.7
Min	0.0	0.0	0.0	0.1	0.1	1.5	2.1	0.2	1.1	0.4	0.0	0.0	19.8

<sup>a</sup> Source - National Weather Service (1997; 1998; 1999; 2000a,b,c,d,e,f)

<sup>b</sup> T = trace



Appendix H.9. Comparison of monthly snowfall to the 30-year mean at King Salmon, July 1997 to June 2000.

The Alaska Department of Fish and Game administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility, or if you desire further information please write to ADF&G, P.O. Box 25526, Juneau, AK 99802-5526; U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington, VA 22203 or O.E.O., U.S. Department of the Interior, Washington DC 20240.

For information on alternative formats for this and other department publications, please contact the department ADA Coordinator at (voice) 907-465-6077, (TDD) 907-465-3646, or (FAX) 907-465-6078.